The ARNOLD ARBORETUM of HARVARD UNIVERSITY

Annual Report 1982-1983

To the President of the University:

In an era of increasing shortage of food and wood, and in which the biological diversity necessary for the development of new crops, and the maintenance of old, is rapidly being eroded, what will Harvard's contribution be to the amelioration of these problems? Should this University concern itself with such issues, or should we leave them to the land grant colleges? Fifty years ago, the Bussey Institution was recognized worldwide for the research it supported in plant physiology; research which, though often of immediate application, addressed questions of fundamental long-term importance to agriculture and forestry. Now that Harvard plant science is organized into two departments, differing in the level of biological organization at which the research is conducted, how well prepared are we to reassert leadership in the botanical issues of our times? And particularly, in the context of this theme, what part should the affiliated botanical institutions, such as the Arnold Arboretum, play in Harvard plant sciences?

Major theoretical advances in plant science are being made at the molecular and cellular level. In particular, increased understanding of the chemical nature of the gene is providing the means to comprehend evolutionary processes, while the techniques of tissue culture and cell hybridization, together with advances in electron microscopy are permitting rapid advances in our knowledge of the fine structure of cells, the function of their various organelles, and the partitioning of the chemical processes within them. Plant tissue is particularly amenable to manipulation for such research, notably in its capacity for replication through tissue culture.

The potential importance of tissue culture and genetic engineering techniques in agriculture and forestry are not difficult to see; neither are the significance of the technical advances in cellular and molecular biology for the evolutionist, though rather little of this research is being conducted in our Department of Organismic and Evolutionary Biology. What, though, is the role of institutions such as the Arnold Arboretum in relation to these new sciences?

The biological collections are libraries for inquiring into biological diversity at and above the level of the species. Unlike libraries, the classification and filing of biological collections is

the starting point of a discipline in its own right, systematics. I have discussed the role of systematics in biological scholarship in my Report for 1981. Here I wish to emphasize that, though the primary task of the systematist is to describe the patterns of biological diversity, the results are meaningless unless communicated to other disciplines. Clearly, the systematist must himself effect this communication, by identifying those patterns from which generalizations appear most likely to be generated. The systematist has therefore to command a broad knowledge of biology.

It is the affiliated institutions, and particularly those with collections, which distinguish Harvard biology from that in other universities. We must frankly ask whether, at the present stage of scientific advancement, they are an impediment or an advantage. High sounding statements about the importance of systematics notwithstanding, does that discipline, and the collections upon which it relies, have anything to contribute to the new mechanistic approaches to evolutionary biology, to genetics, and to cell biology? This question is acritical one at Harvard. We will never be able to muster the vast faculty and resources in experimental plant sciences of some of the state universities. Worse perhaps, our collections incur substantial and inescapable expense and must be regarded as a serious drain if they are not of value.

With Harvard biology now further divided into separate departments, Cellular and Developmental, and Organismic and Evolutionary, the affiliated institutions have been associated with the latter. This is presumably on account of the areas of scholarship these institutions have recently represented, but in the case of the Arnold Arboretum this allocation would not have been so obvious had the division occurred in the thirties. It is doubtful, though, whether any current member of our Department of Cellular and Developmental Biology sees the need for collaboration with systematic biologists in his research. This is partially a reflection of appointment policy, but also of the current state of our science. Developmental biology, including developmental genetics which seek to explain how genetic instructions for tissue differentiation are transmitted and implemented, have lagged. We are likely to see substantial advances in developmental biology, through molecular genetics, in the coming years though and it is these advances which will permit molecular, cellular and organismic, including systematic biologists to collaborate more closely again.

Currently, no developmental biologists are working with plant material at Harvard. I am convinced that itis up to the affiliated institutions to make preparations for bridging the gap. Indeed, I believe that success in this task would secure an unassailable place for Harvard biology in the future. Increasingly biological advances are being achieved through team work rather than through the outstanding creativity of independent individuals. This runs counter to Harvard's tradition of maintaining thin but outstanding representation in a broad range of fields. At least in the fields of molecular genetics and developmental biology, the affiliated institutions have the opportunity to overcome this problem through appointments which bridge between systematics and the new fields.

Dr. John Einset, who will join the staff of the Arnold Arboretum in July 1983, represents such a bridging appointment. His research addresses the mechanisms of hormonal control of cell differentiation, but he is pursuing it in part through comparative studies using material from the living collections at Jamaica Plain. Dr. Einset has been assigned to the Department of Organismic and Evolutionary Biology, but he could almost equally well have been placed in Cellular and Developmental Biology. In point of fact, no search would have been conducted in the field he represents had the Arnold Arboretum not existed; for his interests lie in what, but for it, would be a no-man's-land between the two departments.

A field of great current interest to cell physiologists, as well as to evolutionary biologists, ecologists and agronomists, is fungal physiology. Here, important advances are being made in our understanding of the biochemical physiology of fungal infection in higher plants, and also in that of the symbiosis between the roots of higher plants and the mycorrhizal fungi on which many rely as meditators of nutrient uptake from the soil. Both of these are particularly intricate "examples of symbiotic interactions between fungi and plants, sometimes highly specific, which have resulted from natural selection. Their underlying processes and mechanisms are becoming amenable to experimental investigation.

The Farlow Herbarium provides an outstanding systematic resource for such endeavors, while the importance of mycorrhiza among woody plants places the living collections of the Arnold Arboretum in a favorable position. Again, though the field is indisputably important, neither department would place it in the center of their current interests.

Excepting that future appointments in these fields are desirable, should appointees be funded directly by the Faculty of Arts and Sciences, or by individual affiliated institutions? In my view, the source of funding is immaterial. What is essential, though, is that new appointees are formally associated with one of the affiliated institutions, for without such association, it is doubtful whether the integrating role of these institutions in Harvard biology can be fulfilled. This is a problem particular to plant sciences, with its many separate institutions and past history of fragmentation. In zoology, the existence of but a single affiliated institution encourages all faculty, whatever the nature of their appointments, to interact intellectually. Though great progress has been achieved, particularly this year, in integrating the policies and functions of the collections-based botanical institutions, the geographical dispersal of these institutions alone would impede further intellectual integration unless faculty representing a wider field of scholarship are formally associated with them.

In the event, I have to report that the financial position of the Arnold Arboretum continues to deteriorate at such a rate that its potential to contribute to the strengthening of Harvard biology is now seriously compromised. Without consideration of the effect of recent inflation on the general endowment income of the Arboretum, as on that of other Harvard institutions, the annual increase from the Martha Dana Mercer Fund (which is not managed by the University) has fallen short, when compared with our other endowment, by an annual rate of $120,000.00 over the last three years. Following government policy, the level of curatorial

support for the Harvard botanical collections from the National Science Foundation is also being reduced by one-third. Notwithstanding the budget reorganization reported in my 1981 Report, hoped for savings as a consequence of our administrative coordination of our Cambridge operations with those of other affiliated institutions under a Director of Administration, a further increase this year in annual giving and, in the coming year, the moving of our two projects to generate earned income into net profit, we continue to lose staff and must in future maintain level funding for the library, herbaria and most aspects of living collections curation. By the end of the coming fiscal year, it will not therefore be possible both to maintain the collections at a level adequate for their continued use for scholarly work, and also maintain a balanced budget. By then we will likely have nine staff positions open, five of which from the living collections staff, but without financial means to fill them.

During the year under review, Rousmaniere Management Associates completed a five-year financial projection for the Arnold Arboretum which made it clear that this Institute cannot survive even at present levels without a capital fund drive, and that this drive must be planned as soon as possible if their projections are to remain valid.

The Arnold Arboretum launched its capital fund drive in 1928, under the direction of Oakes Ames. In support of it, he argued: "additional funds are needed, not only for the upkeep and development of the existing collection but for making possible an increase in the research staff and to enable the Arboretum through its personnel and resources to take an influential part in the scientific work of the botanical institutions and departments". I have understood my mandate to be directed towards those very goals. I too find myself unable to complete that mandate without restoration of our institutional endowment. I am convinced that there is now sufficient understanding and sympathy among the Friends of the Arnold Arboretum of our role, both within Harvard and worldwide, for their support in achieving the goal which we share with our colleagues in Harvard botany.

ADMINISTRATION

This year has again witnessed several significant improvements. The appointment of Professor Donald Pfister as Director of the Harvard University Herbaria represents a substantial step towards the coordination of policy for the Herbaria, and its implementation. The appointment of Professor Peter Stevens, who supervises the combined herbaria of the Gray and Arnold Arboretum, to tenure permits development of a consistent long-term policy for these collections for the first time in several decades. It is fortunate that this coincides also with the re-organization of the administration of the combined herbaria and libraries under a new Director of Administration for the affiliated institutions within the Department of Organismic and Evolutionary Biology, Dr. Jay Taft.

Continued curatorial funding for the Harvard Herbaria for the coming three years has been achieved, though at a reduced level, from the National Science Foundation, with Dr. Pfister as Principal Investigator. Further, a second curatorial grant for the living collections of

the Arboretum has been awarded, also tenable, for three years, to verify the identity of the collections; the Director is Principal Investigator.

The Arnold Arboretum ignores the public at its peril. Occupying two hundred and sixty-five acres of public land, the living collections have experienced problems of security almost since their inception. Police surveillance has been inadequate, and fence and gate maintenance has so deteriorated that several of the antique gates hang off their hinges and deter visitation.

This year, thanks to excellent collaboration with Boston Parks Commissioner Robert McCoy, Police Chief Joseph Jordan, Public Safety Committee Chairman Councilor Maura Hennigan and a public advocacy group, the Arboretum Committee, substantial improvements have been made. Police surveillance has been stepped up. Boston Park Rangers, on horseback and similar in purpose to the park keepers advocated by Frederick Law Olmsted a century ago, have been detailed to the Arnold Arboretum for the duration of the visitor season. They have increased security dramatically and, in marked contrast to the previous year, I have no serious incidents to report. Though the Department of Parks and Recreation provided the principal funding, members of the Arboretum Committee, as well as Friends of the Arnold Arboretum raised a substantial contribution, while the Department of Government and Community Affairs of the University provided a useful donation. Also, the Browne Fund Committee recommended its Commission appropriate $35,000.00 as partial funding for the restoration of the gates. In collaboration with the Parks Department, canisters have this year been installed at five points within the Arboretum to solicit voluntary donations towards city responsibilities on the grounds, including road, fence and gate maintenance, and security.

RESEARCH AND INSTRUCTION

This year saw the publication of Professor Peter Ashton's comprehensive treatment of the tree family *Dipterocarpaceae* for the tropical regions of the Far East, in Flora Malesiana, Leiden. The rain forests of the Far East currently supply almost three-quarters of the hardwoods entering international trade. Of this, dipterocarp timber, and particularly the Phillipine mahoganies, comprise the great majority. But to the biologist these lofty trees, of which there are almost 400 species in the Far East alone, pose intriguing problems: how do so many, similar and apparently closely related, species maintain their numbers imbalance in the forest communities, and how have they arisen? How is cross-pollination successfully achieved among scattered trees, each of which present millions of flowers over a few days and at intervals of from 3 to 8 years? In his monograph, Ashton synthesizes knowledge on these and other aspects of dipterocarp biology and economy, much of which has resulted from his own work and that of his colleagues.

In January, Ashton participated with several U.S. scientists, including Dr. John Constable of the Massachusetts General Hospital and Professor Mark Leighton of the Department of Anthropology, in a symposium at Ho Chi Minh City, formerly Saigon, Vietnam, convened to review evidence of the effects of the military defoliation program in that country ten years after

its cessation. Ashton, who participated in a working group on inland forests, was able with Leighton to visit one of the most intensively sprayed areas, of seasonal evergreen dipterocarp forest forty kilometers northeast of Ho Chi Minh City; and also a dry dipterocarp savanna woodland north of the Dalat road, to assess damage on the ground. They discovered that subsequent fire has further degraded the more severely damaged forests, to such an extent that the direct effect of defoliant spraying is no longer discernible. Less effected areas were regenerating in a manner not substantially different from a forest that has been clear cut for timber.

With Professors Thomas Givnish, Kenneth Sebens, and Otto Solbrig, Ashton participated in teaching biology to 50, Tropical Ecology in the Fall semester and, with Professor Barry Tomlinson, ran a freshmen seminar series in the spring on tropical forest biology. During this year, Ashton presented papers at meetings of the American Institute of Biological Sciences Convention at Pennsylvania State University and at the (U.K.) Systematics Association at Reading. He gave seminars at New York and Brooklyn Botanical Gardens, at Dartmouth College, the University of North Carolina, Tufts University and Yale. He undertook reviews of the Bailey Hortorium at Cornell University, and the botanical gardens at the University of North Carolina, Chapel Hill. In Spring 1983, Ashton was elected a Fellow of the American Academy of Arts and Sciences. Steven Rogstad, a third year graduate student under Ashton's supervision, left in the spring to spend a year in the Far East in order to complete field studies in the biosystematics of four species of Polyalthia (Anonaceae). For this, he was awarded a grant for doctoral research from the National Science Foundation. Paul Rich, also in his third year and jointly supervised with Professor Givnish, is developing a study of mechanical properties of tree-shapes, as manifested by palms, in Costa Rica. Gordon Congdon, who is in his second year, has been developing plans for his thesis research, which will compare silvicultural aspects of dipterocarp phenology in the seasonal and aseasonal tropics of the Far East. Congdon has been awarded a Fulbright Scholarship to pursue his field work. Alex Moad, who is in his first year, is interested in the autecology of tree species which regenerate in openings within the rain forest canopy.

This year Professor Peter Stevens was awarded tenure. Stevens has been awarded a grant from the National Science Foundation for research towards a monograph of Mesua, *Clusiaceae*, a genus of tropical Asian understorey trees. He has concentrated this year, though, on epistemological studies of early 19th century systematics. These are bringing to light errors in the reasoning upon which evolutionary theory, based on botanical systematics, has rested. A paper on this work has been completed. Another, entitled "Pattern and Process: Phylogenetic Construction in Botany," has been submitted. Stevens, with former students Paul Groff and Michael Donoghue, is also pursuing an analysis of the morphology and dynamics of branching among woody plants.

Together with Professor W. H. Wagner, Jr., of the University of Michigan, Stevens organized a symposium, at the 1982 convention of the American Institute of Biological Sciences at Pennsylvania State University, entitled "Modern Cladistics and Systematic Botany." He gave

two papers at the convention, and also spoke at the Philadelphia Academy of Sciences and at Lehman College, New York.

Dr. Stevens taught Biology 148, Systematic Botany, again in the Fall. He served on the seminar committee of the Department of Organismic and Evolutionary Biology, and continued to run the Systematics and Biogeography discussion group. He supervises graduate students Elizabeth Taylor, who is currently in South America investigating species of the tree genus *Sterculia*; and Anna Weizmann, who is carrying out preliminary studies in the genus Freziera (*Theaceae*) to evaluate its suitability as a thesis project. With Professor Wood, he supervises Brent Mischler; and, with Professor R.E. Schultes, Jeffrey Hart who is completing a thesis on systematic and evolutionary studies in Lepechinia, *Lamiaceae*, an Andean shrub.

Dr. N. Prakash, a Mercer Fellow, completed his embryological studies at the Arnold Arboretum and returned to Australia in July 1982. In September, Bullard Fellows Professor C.V.S. and N. Gunatilleke came to the Arboretum on a one-year sabbatical leave from the University of Peradeniya, Sri Lanka. They have been conducting studies of the reproductive biology of species of *Cornus* and *Lonicera* in the living collections, with the aim of gaining fluency in contemporary techniques for research into the mating system of trees. They intend eventually to investigate the reproductive biology and breeding systems of certain endemic trees in Sri Lanka which have potential in the village economy. They are working in collaboration with Dr. Ashton, Dr. Barry Tomlinson of Harvard Forest, and Dr. K.S. Bawa of the University of Massachusetts. Biogeographical studies of the flora of Sri Lanka, which have been carried out by Dr. C.V.S. Gunatilleke, with Ashton, have also been completed.

Dr. Stephen Spongberg continues his taxonomic researches into the difficult genus *Sorbus*, *Rosaceae*, in Asia and a preliminary synthesis has been completed. With Dr. David Boufford, Spongberg assisted in organizing the 29th Annual Systematics Symposium, held in Missouri Botanical Garden, on the now well-known biogeographical relationships between Eastern Asia and Eastern North America, first analyzed in detail by Asa Gray. With Dr. Bruce Bartholomew of the California Academy of Sciences, Spongberg presented a paper on the ecological biogeography of the dawn redwood, *Metasequoia glyptostroboides*. With Dr. Boufford, Spongberg contributed an historical review of research into the subject of the symposium for the published proceedings.

Four systematic botanists from the People's Republic of China, who came to work at the Arnold Arboretum as Mercer Fellows in 1982 and whose work I discussed in my preceding Annual Report, continued their stay into this year. Professor Chong Cheng, Assistant Director at Wuhan Institute of Botany, Academia Sinica, and Professor Tsun-Shen Ying of the Institute of Botany, Academia Sinica, Beijing, returned to China 30th September 1982. Professor Cheng completed studies in Staphylea (*Staphyleaceae*) with Dr. Spongberg, Professor Ying on Diphyllea in association with Dr. Boufford. Professor Chao-Luan Li, from Chengdu Institute of Botany, Academia Sinica, continues his comparative studies within *Prunus* subgenus *Laurocerasus* in association with Dr. Spongberg. Professor Ko-ling Chu, who is working with Drs. Ashton and

Shiu-Ying Hu, is completing a manuscript in which he will report his studies on a previously unknown taxon, in *Chenopodiaceae*, which he has discovered in western China. Dr. Spongberg, with Dr. Boufford, assisted in organizing a 6-week field visit to the southeastern states by a group of seven Chinese botanists, including Professors Cheng, Ying and Li, during the autumn of 1982.

Our North American researches have been substantially advanced. Professor Carroll E. Wood's *Generic Flora of the Southeastern United States*, in its second year of a three-year grant from the National Science Foundation, saw the publication of ten more families. A further three, to be published in July 1983, will bring the total now completed to one hundred. Four indexes to these hundred papers have been prepared, and are in press. Nine of these papers comprised one issue of the *Journal of the Arnold Arboretum*, edited by Drs. Wood and N.G. Miller, which was dedicated to Dr. George R. Cooley in recognition of his gifts to Harvard University which first made this flora possible. Dr. Wood completed work on *Burmanniaceae* and *Menyanthaceae*; he is currently working on *Haloragaceae* and *Leguminosae* sub-family *Faboideae*.

Dr. Norman G. Miller, who has served as co-principal investigator, resigned from the staff to become Chief Scientist, Biological Survey, at the New York State Museum and Science Service, as of mid-September. Dr. Miller continues there as a collaborator. Dr. Richard Weaver, Horticultural Taxonomist, whose treatment with Dr. Wood of the *Gentianaceae* was published in the *Journal* this year, also resigned from our staff.

Dr. George K. Rogers continues as post-doctoral research fellow on the Generic Flora. During this year his treatments of *Casuarinaceae* and *Bataceae* were published. Also, his manuscripts on five further families are awaiting publication. On Dr. Miller's departure, Dr. Ihsan Al-Shehbaz has been appointed to the project of post-doctoral fellow. He hopes to prepare a treatment for the complex mustard family, *Brassicaceae*.

In addition, Dr. Carl S. Keener, of Pennsylvania State University, spent a six-month sabbatical at the Harvard University Herbaria, preparing a treatment of the genera of *Ranunculaceae*; Dr. Christopher S. Campbell, of the University of Maine, has been collaborating on a treatment of the sub-families and tribes of grasses, *Poaceae*.

This year Dr. Wood taught his course Biology 103, Taxonomy of Seed-Bearing Plants, which continues to command high regard among participants, in the Spring. In the Fall, he contributed Biology 18, Taxonomy of Seed-Bearing Plants. Elizabeth A. Kellogg completed her thesis under Dr. Wood's supervision. She was awarded her degree in June. In her thesis, entitled "A Biosystematic Study of the *Poa secunda* complex," Kellogg concluded that the complex breeding systems found in this group, in which the regularity of meiosis and percentage of apomixes varies even among single genotypes occupying a variety of habitats, as well as between plants and populations, is too complex to alone explain the equally complex patterns of morphological variation within the group as a whole.

Brent Mischler, who works with Professors Stevens and Wood on the moss genus *Tortula*, will submit his thesis in the coming year. He has been concentrating on systematic studies of variation patterns in the peristome teeth which surround the mouth of the sporangium, using the scanning electron microscope. Previously unknown, these patterns are providing a valuable tool in the delineation of the genus, and of species groups within it.

In August 1982, the 1981 Greenman Award, made annually by the alumni of the Missouri Botanical Garden for the paper judged best in vascular plant or bryophyte systematics based on a doctoral dissertation published in the previous year, was presented to a former student of Professor Wood, Dr. Walter S. Judd. The work of his thesis, entitled "A Monograph of Lyonia (*Ericaceae*)," was published in three papers in vol. 62 of the *Journal of the Arnold Arboretum*.

Professor R.A. Howard continues work towards the fourth volume of his *Flora of the Lesser Antilles*, which contains dicotyledonous families. His editorial phytographical research on the unpublished manuscripts of the eighteenth century botanist of St. Vincent, Alexander Anderson, is being supported by the Stanley Smith Horticultural Trust and by a gift from Dr. George R. Cooley. Edited manuscripts on the geography and history of the island, and on the history of the St. Vincent Botanical Garden which is the oldest in the new world, have been published. Interpretations of an unpublished hortus, which includes the earliest record of plant introduction and cultivation in tropical America, continues. Dr. Howard is also preparing a short biography of the Rev. Lansdown Guilding, a naturalist who resided in St. Vincent in the early nineteenth century. Dr. Howard spent one month at British institutions in connection with these studies.

Revisionary research continues in *Icacinaceae* and *Polygonaceae* for the Floras of Venezuela and Nicaragua, and for Flora Mesoamericana. Dr. Howard continues also to cooperate with French botanists at L'Office Nationalde Foret in Guadeloupe in the preparation of a Dendrologie des Petites Antilles." During the year Dr. Howard presented seminars at the New York and Fairchild Botanical Gardens.

Professor Howard taught his course in Biology 209, The Phylogeny of Flowering Plants, which included field classes at the Fairchild Tropical Garden, Miami, in the Fall semester; and contributed to Professor Schultes' course, Biology 104, Plants and Human Affairs, in the Spring.

Dr. B. G. Schubert, Senior Lecturer, continues her revisionary research into *Desmodium*, *Begonia*, and *Dioscorea*. Several papers are nearing completion. In July 1982, she participated at the III Congreso Latinamericano and II Nacional (Peruano) de Botanica at Lima, where she was named an honorary vice president. While there, she was able to work at the Museo Javier Pradoat Universidad Nacional Mayor de San Marcos. In August, Dr. Schubert visited Mexico at the invitation of Instituto Nacional de Investigaciones Sobre Recursos Bioticos, Xalapa, where she worked with colleagues on treatments of *Dioscorea* and *Begonia* for the Flora of Vera Cruz. She later visited Universidad Nacional Autonoma de Mexico, where she collaborated on a

treatment of *Desmodium* for a book on the Leguminosae of Oaxaca and another on Dioscorea for Flora Mesoamericana. She was able to undertake a field trip in Oaxaca with her colleagues at that University.

PUBLICATIONS

Ms. Elizabeth Schmidt, Managing Editor of the *Journal*, now serves as Publications Officer for the Arboretum.

The Arnold Arboretum publishes a scientific periodical, the *Journal of the Arnold Arboretum*, which accepts papers in systematic botany and plant ecology; and a horticultural magazine, *Arnoldia*. For two years we have pursued a policy of bringing the Publication Department into financial balance. Eileen Dunne became editor of the Magazine in July 1982. Thanks to redefinition of policy, including reduction of the number of issues coupled with increase in design and printing quality, the Magazine came within $5,000.00 of achieving balance in the year under review. This year savings have been achieved also in the publication costs of the *Journal*, in part through transfer to a new printer, Allen Press. Following discussions, a substantial increase in the subscription price has been agreed to for the coming year, and a campaign to increase circulation is planned.

CURATION

The Herbaria

Two curatorial assistants, Martha Tack and Howard Farkas, resigned and have not been replaced on account of lower curatorial funding levels from the National Science Foundation. The current curatorial staff of the combined Arnold Arboretum and Gray Herbaria in Cambridge consists now of a manager, a senior curatorial assistant, a curatorial assistant, and two preparators; and, in Jamaica Plain, a curatorial associate and one full-time, one part-time preparator.

This staff is quite inadequate to meet the needs of one of the nation's largest vascular plant herbaria. The level of curatorial activity has on this account, though partially also on account of illness, been lower overall than in the previous year. At the same time, increase in research activity has led to an increase in the number of specimens accessioned by the Arnold Arboretum, to close that pertaining a decade ago. Also, the number of specimens requested on exchange has increased and is now at its highest level since the sixties. Inadequate curatorial staffing will now begin to seriously impede our research therefore.

Currently, specimens mounted over the past three years, which were left unincorporated until the herbaria had been moved into the new space provided by the building extension, are now being inserted. By the end of the year two-fifths were completed.

Faculty took an active part in curation during the year. Dr. Stevens continues to act as supervisor of the combined herbaria and, with Dr. Ashton, pre-identifies incoming Far Eastern material. Dr. Howard identifies all incoming material from the West Indies, and inspects material from elsewhere in the neotropics. Dr. Howard also prepared the 6,000 specimens in J. A. Shafer's Cuban and Puerto Rican collection, a gift from the Carnegie Institution of Pittsburgh, for division, insertion, and exchange. This required an exhaustive search through Shafer's field books, kept at the New York Botanical Garden. Dr. Ashton, assisted by volunteers, Helen and Lillian Hagopian, is in the process of completing the verification of the extensive dipterocarp holdings in the herbaria. In addition, specialists on the staff continue to annotate and identify collections sent from other herbaria for that purpose.

At Jamaica Plain, refurnishing the drying room has been completed. Some 7,000 specimens, collected as part of the program for the verification of the living collections and the strengthening of their records, have been readied for incorporation or distribution or exchange. A volunteer, Mrs. Melville Chapin, has initiated a program for preparing herbarium specimens foody plant seedlings, for ontogenetic and systematic study.

Annual Statistics for the Arnold Arboretum Herbaria

Accessions

Specimens received during the year:	By exchange	7,285	
	As gifts	4,653	
	In exchange for identification	1,125	
Total accessions (all to the Cambridge herbarium)		13,063	
Provenance of accessions:	America north of Mexico	890	
	Rest of continental America	2,055	
Subtotal			2,945
	Temperate Asia	5,374	
	India	100	
	Western Malesia	2,159	
	Eastern Malesia	481	
Subtotal			8,114
	Polynesia	90	
	Australia	194	
	Africa	9	
	Europe	1,711	

Processing

Number of sheets	Through mounting	9,587	
	Through direct incorporation	128	
Total number of sheets incorporated		9,715	
Number of sheets removed		1	
Number of sheets repaired		626	
Number of specimens annotated by staff		5,165*	
Number of type specimens pulled from general collection		971*	

Inventory, June 30, 1983

Number of sheets in herbaria:	Cambridge	1,133,237
	Jamaica Plain	168,893
Combined total		1,302,130

Service

Number of sheets sent out:	On loan to specialists		22,646*
	On exchange		4,426
	As gifts		81
Number of specimens received on loan:	For staff	5,640*	
	For students	2,940*	
	For visitors	263*	
Total received on loan			8,843*
Number of loaned specimens returned			20,032*
Number of orchid specimens placed on indefinite deposit in the Oakes Ames Orchid Herbarium			22

* Asterisked figures refer to the combined holdings of the Arnold Arboretum and Gray Herbarium.

During their field work with the Chinese party in the southeastern states, Drs. Boufford and Spongberg were able to collect specimens for the Herbaria. Dr. Boufford, a research assistant at the Cambridge Herbarium under the National Science Foundation tutorial grant, has for the past two years made extensive collections of the New England flora for exchange, especially to institutions in East Asia.

Libraries

Activity in the library is summarized in the table. There has been a decrease in book accessions which were level funded from the previous year.

The libraries continue as centralized units of the Harvard College Libraries/Faculty of Arts and Sciences Cataloguing Support Service. The Cambridge libraries receive cataloguing through this service for 403 titles, of which 27 are periodicals.

The Librarian, Ms. Barbara Callahan, met with her colleagues in the other botanical libraries under the chairmanship of the Director of the Herbaria, Professor Donald Pfister, to establish closer coordination. Archives and cataloguing projects were areas where standardization and coordination were seen to be advantageous. During the year, the librarian has been determining the feasibility and logistics of upgrading the cataloguing of the entire collection. A sample of our holdings were matched against the titles of the On-Line Computer Library Center (OCLC) data base, to determine if New York and Missouri Botanical Gardens, who are recipients of a federal grant to put their combined lists on OCLC, had already catalogued them. Only one half of our sample was on-line, and the librarian is on this account searching for grant support to provide this standard cataloguing for our library.

The shelving of the monograph collection was completed by the end of the year, as also was the relabeling of the folio collections with acid-free materials. At Jamaica Plain, Assistant Librarian and Horticultural Research Archivist Ms. Sheila Geary completed the transfer of the library there to a single floor of the Hunnewell Building. The major part of the monograph collection, all foreign journals there, the slide and photograph collections including lantern slides and glass plate negatives are now all housed on the third floor at the back of the building, where temperature fluctuations are much reduced from their former location.

Annual Statistics for Arnold Arboretum Libraries

Accessions

Monographs:	purchased	107	
	acquired through gifts or exchange	253	
New continuation volumes (e.g. journals):	purchased	8	
	acquired through gift or exchange	7	
Volumes added:	Subtotal for Cambridge	521	
	Subtotal for Jamaica Plain	130	
Total volumes and pamphlets added:		651	
Microfilms added		6	
Microfiche added		0	

Processing

Titles: catalogued		350	
Titles: recatalogued		18	
Total, titles catalogued and recatalogued		368	
Volumes bound:	monographs	715	
	serials	291	
Total volumes bound			1,006

Inventory, June 30, 1983

Total number of volumes and pamphlets in the Arnold Arboretum libraries at Cambridge and Jamaica Plain	89,239	
Total, microfilm reels	227	
Total, microfiches	10,867	
Number of continuation titles: on order	575	
received through gift or exchange	372	
Total, continuation titles received		947

Service

Total volumes circulated within Harvard	4,493
Photocopies supplied in lieu of interlibrary loans	5,537
Interlibrary loans received from outside Harvard	56
Number of reference requests serviced	691

Mrs. Silvia Denney-Brown, a volunteer, spent this year checking and annotating our negative and photograph files. Thanks to her work, negatives and prints are now cross-referable, which will aid us also in the conservation of our nitrate negatives. Over 5,000 negatives, representing all our holdings but for 55out-sized glass plates, have now, after several years work by volunteers, been placed in plastic acid-free envelopes.

Mrs. Carin Dohlman has taken charge of a group of volunteers who are re-organizing our extensive archives in Jamaica Plain.

The librarian was re-appointed as member of the Harvard University Preservation Committee. She serves as chairperson of the sub-committee on lending of rare books within the Harvard library system, and is a member of the sub-committee on permanent durable paper guidelines for the Office of the University Publisher. She continues to participate in the group concerned with the adequacy of ecology literature coverage at the University. Ms. Callahan volunteered to organize and conserve the Wasson Ethnomycological Library, donated to the Botanical Museum in 1982.

Living Collections

Under a grant from the National Science Foundation, which ended in February 1983, Ms. Patricia Dalton, Research Assistant, has been able to document the nomenclature of approximately 85% of the taxa in the living collections including almost all wild collected material; to classify inconsistencies in the record, and to transcribe the records into a standardized format. These standardized records have been entered into an ONYX computer equipped with an extra disc drive. The UNIX operating system and Logix relational data base software are identical and complimentary to that used at the combined herbaria. At present, the data have been entered on magnetic tape, as problems have arisen with the functioning of the core disc drive.

The Arnold Arboretum has now been awarded a second grant towards the curation of the living collections, tenable for three years. This will enable us to proceed to the second and final stage of the restoration of the records, in which the identity of the entire living collections will be verified, and herbarium reference vouchers prepared. The latter program was initiated last year by volunteers, and alluded to in my Report for 1982. This year, volunteer Dr. Richard

Warren has started a pilot verification project, in which he plans to check the identity of the gymnosperm collection, which represents one-seventh of our entire living collection. Previously assisting Ms. Dalton in the nomenclature, Dr. Warren has already established an exhaustive reference base, and his field and herbarium studies enabled us to update the records for several groups, notably the junipers.

Current mapping and record maintenance, under the responsibility of Ms. Jennifer Hicks, has fallen behind, partially owing to computer problems and partially to the need for field checking and relabeling of many areas undergoing restoration or change. With the assistance of intern Ricardo Austrich, four maps were eventually checked, revised, and redrawn, and a further twelve checked and revised.

Seven botanical gardens and university departments sought advice this year concerning the methodology of establishing systematic living collection records.

Among several areas of the living collections that have undergone renovation during the year, the *Forsythea* and *Buxus* collections were reviewed, and repropagated where necessary. Work on the *Rosaceae* collection, to replace the old shrub collection, continued. Assisted by two work study students, supervisor Gary Koller drafted a plan for the plantings, and developed an accession list for the proposed synoptic collection.

Plans for more cost-effective grounds management were implemented this year on a trial basis. In keeping with Olmsted's original intentions, selected sections have been allowed to revert to tall meadow grass and oldfield wildflowers, through which mown grass paths are cut. This has been successful overall but has increased the summer fire hazard. Cutting of all grass in early July appears necessary. The new regime of lower grass maintenance is coupled with increased maintenance of the areas abutting the grass paths. The restoration of oak and willow paths, beginning in previous years continues; grading and planting have been completed on the latter.

Mrs. Julie McGeoch, a volunteer, has coordinated program to obtain living material of all endangered woody plants at the Arnold Arboretum, so that they will be available for research on their reproduction and propagation.

Seed of woody plants not represented in the living collections were obtained by Dr. Spongberg during his expedition to the coastal plain of the Carolinas and Georgia.

Annual Statistics for the Arnold Arboretum Living Collections

Accessions

New accessions received into the nursery	1,907
Taxa represented in new nursery accessions	771

Processing

Plants accessioned into the permanent collections	760
Plants in the permanent collections repropagated prior to removal	722
Plants deaccessioned: missing or removed	460
Deaccessioned plants from which wood specimens were collected	80
Accessions representing taxa new to the permanent collections	310
Taxa occurring in nature represented in new accessions	238
Cultivars represented in new accessions	34
Total number of taxa represented in new accessions	272
Accessions readied for verification through collection of herbarium vouchers	1,459
Label replacements in permanent collections:	
Record Labels	1,550
Display Labels	575
Total	2,125

Inventory: June 30, 1983

Total number of woody plant individuals and massed single taxa groups, in the permanent living collections	14,882
Number of species represented	2,583
Number of infraspecific taxa found in nature	1,152
Number of entities named as cultivars, including spontaneous forms	2,480
Total number of woody taxa in the Arnold Arboretum	6,215

Service

Taxa propagated for staff research	157
Taxa distributed to other educational and research institutions	356
Taxa distributed to private and commercial recipients	536

Total number of taxa distributed	892
Total number of shipments distributed	156

Also, Mr. Robert Nicholson, Assistant Propagator on the Grounds Staff, made an expedition to the upper crests of the Atlas and Rif Mountains of Morocco, where he obtained 50 seed and 150 herbarium collections.

The lower of the two laboratories in the greenhouse headhouse, formerly used as storage space, has during the year been furnished and equipped for plant physiological and chemosystematic research, in part thanks to an anonymous donation. This laboratory will be occupied by Professor John Einset when he arrives on July 1983. Einset will pursue work on the biochemical physiology of woody plant growth and development on a comparative basis. Later, it is hoped that funds will be found for a postdoctoral fellow to pursue chemosystematic research there as well.

Mr. Zhih-Ming Zhang, a horticulturist at the National Botanical Gardens, Academia Sinica, Beijing, has been seconded for a year by the government of the People's Republic of China, in order to study our collections and to learn plant introduction procedures and propagation techniques.

Patrick Willoughby, Assistant Superintendent at Jamaica Plain, returned in September 1982 from a one year scholarship to the United Kingdom, given by the Garden Club of America. At that time, Thomas Kinahan, Assistant Supervisor at the Case Estates, transferred to the University Department of Buildings and Grounds. Willoughby subsequently acted as Assistant Superintendent at the Case Estates and, at the end of the year, was confirmed as Assistant Managing Horticulturist there.

The Case Estates Nurseries are currently in excellent condition, largely through careful application of general and pre-emergent herbicides, and other management policies brought in by Willoughby. Lands Sakes, the Weston-based non-profit organization who hold a contract to grow fruit and vegetables on Case Estates land as earned income for the Arboretum, opened a further five acres this year. The area under cultivation by them was nearly ten acres at the end of the 1982 growing season. A further five acres will be opened in 1983, when their operation should begin to show a profit.

PUBLIC PROGRAMS

The Arboretum was again awarded a grant, at the maximum level, from the Institute of Museum Services to subsidize its public programs. Increased emphasis on publicity has allowed these programs to continue to rapidly expand under Ms. Kathleen Nixon, Public Relations Coordinator.

Membership now stands at 2,933, an increase of more than 10% over the previous year. Class registration doubled for the third year running, and this year reached 2,211. This is the most that can be achieved with present staff levels. (See the table below.) Particularly successful was a symposium, offered by our horticultural staff to members and professional horticulturists, on tree care. Courses were provided for the summer intern program as usual, and also for the Boston Park Rangers who have been providing interpretive information on the grounds during the summer.

Course and Information Statistics

Classes		1981	1982	1983
Number of registrants:	Spring	432	600	833
	Fall	496	817	

Information requests	1981-1982	1982-1983
Plant identification	30	81
Cultural	519	342
Propagation	26	45
Library	3	13
Acquisition sources	39	72
Pests, problems, weeds	?	138
Poison calls	225	306
Miscellaneous	159	203
Total:	1,000	1,200

Among seven exhibitions which were presented at the Hunnewell Building “The Art of the Olmsted Landscape,” an elaboration of an exhibit first assembled at the Metropolitan Museum of Art, New York, merits special mention.

The Arnold Arboretum participated in the New England Flower Show, and in a three-day event at Faneuil Hall as part of Museum Goers Month. This year two plant giveaways and sales, in Fall 1982 and on Arbor day in late April 1983, were organized for members and the public.

The Arboretum Committee, an independent neighborhood group formed in 1982 to gain political and financial support for the Boston Park Rangers and for public programs at the Arboretum, has increased its activities.

Summary Of Volunteer Assignments

Assignments	Number of Volunteers
Public Programs:	
Education	5
Membership	3
Public relations	12
Tours	11
Gift Shop – weekend reception	11
Publications	
Arnoldia	3
Living Collections:	
Propagation	9
Specimen Collecting	5
Verification	1
Mapping and Labeling	2
Conservation	1
Case Estates Gardening	6
Herbaria:	
Cambridge	2
Jamaica Plain	2
Wood Collection	1
Libraries:	
Cataloguing	2
Archives	2
Slide Collection	7
Staff Research:	5

It organized a door-to-door solicitation for funds, a sale and a party in aid of the Rangers, and a cleanup of the roadsides adjacent to the Arboretum perimeter. A gift of $3,000.00 towards the Park Ranger Program from the Harvard Department of Government and Community Affairs was particularly appreciated.

The number of volunteers at the Arboretum was maintained at approximately the same level as in the previous year; and provided invaluable service in almost every aspect of the institution's activities.

Peter Shaw Ashton, Director