

Chronicling the Living Collections: the Arboretum's Plant Records

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The plant records office's high-tech functions are at the center of the Arboretum's newly integrated computer operation

The Arnold Arboretum's plant-records system has evolved over the 116 years of the Arboretum's history, and although it has undergone many changes, it has retained its integrity as a curatorial record, the oldest continuously maintained system of its kind in North America.

The Development of the Records System

Jackson Dawson, the Arboretum's first plant propagator, kept a series of journals in which he recorded plants added to the living collections using a numbering system quite different from the year-coded system that we use today. It is unclear in what year these journals were begun, although they may have been intended to accompany the maps generated from Codman's 1887 survey. The earliest entries follow the Bentham and Hooker sequence that had been established for the collections and show no chronological progression, suggesting that the journals started as an inventory of plants already present in the collections. The numbering system used, in which each new taxon added to the collection was assigned a base number from which the numbers assigned to subsequent accessions of the same taxon were derived, likewise suggests inventory numbers rather than accession numbers as we know them in today's system. Source information was recorded in these journals and/or in a card file, suggesting the existence of a parallel record system that recorded all material

received but was not at the time considered worthy of being kept once the information pertinent to the living collections had been transferred to the journals and cards.

As new material was added, it was necessary to check the existing records in order to determine whether the taxon was (or had been) already represented. If so, a sequential suffix number was added to the established base number. For example, the first recorded accession of *Magnolia acuminata*, seed received in 1874, was assigned the number 35. The next, a plant received in 1877, received the number 35-1; and plants received in 1879, 35-2. Incoming materials of taxa not already represented were assigned new base numbers.

When the identification of an accession was changed, its number was also changed in order to reflect the new taxon to which it was assigned. As the collection grew, so did the quantity of accessions representing the same taxon, and the use of the same base number for genetically unrelated accessions invited error and misinterpretation. It became clear that the system required a change, so a large proportion of the collection was renumbered: the first incoming accession of a taxon retained its number, but later accessions of the same taxon were assigned new numbers. Vegetative repropagations of material already in the collection continued to follow the suffix system, each bearing a number derived from either the original or the new base number assigned to the accession from which it

had been propagated. Although the system remained cumbersome, it was no longer necessary for numbers to change with new identifications, nor did the assignment of a number to a new accession require a thorough check of both current and dead records.

In 1916, when William Judd assumed the post of plant propagator, he initiated a new system, assigning a year-coded number that consisted of a sequential number with an appended year code (for example, *Fraxinus quadrangulata*, 52-16, was the fifty-second accession received in 1916), an accession number in the current sense, to each accession received. In the same year the greenhouse produced its first accession book, quite distinct from the earlier inventorylike journals. A chronological listing of all plant materials received, regardless of whether they were added to the living collections, the accession books now serve as our primary reference in tracing the histories of our plants.

As plants were added to the collections, however, they were assigned numbers in accordance with the older system and entered into the journals; both numbers appear on the records of material received during this period, although the inventory number has been the one used in curation of the collection. By 1934 it was apparent that the system was overly cumbersome. Base numbers had reached well over 22,000, and even in its new form, the suffix system was generating complications. Since that year the accession number assigned at the greenhouse has as a rule been retained throughout the recorded history of the resulting plants.

Still, until the mid-1970's, it was common practice for material that did not fit the standard accession pattern to be assigned an inventory number. Plants resulting from the hybridizing work of Karl Sax during the 1950's, representatives of the Arboretum's spontaneous flora deemed worthy of curation, and individuals selected from their accession lots either because the accession lot was found to include more than one taxon or for introduction as cultivars (for example, *Hamamelis* 'Arnold Promise', selected in 1963



Jackson Dawson, 1841–1916, the first superintendent of the Arnold Arboretum, had been passionately interested in seeds since childhood. During the American Civil War, some of his wounds were supposedly received while he was searching for plants and seeds. A distinguished plant propagator, he was noted for “seemingly impossible” accomplishments in grafting, seed germination, and plant culture, as well as for hybridizing the Farquhar, W C Egan, Dawson, Lady Duncan, and Sargent roses. Photograph from the Archives of the Arnold Arboretum.

from accession 1173-28 and assigned number 23167) were among the exceptions to the system.

A card file maintained at the greenhouse contains the information available upon accession of new material (name, date of receipt, immediate source, original source if known, quantity, type of material, locale of collection if collected from a wild population, and any additional information concerning growth habit, flower color, or other characteristics of the material being accessioned). This information is copied into the annual accession book. In addition, the greenhouse file is annotated with the methods used in propagating the accession (if seed, whether it

was stratified; if cuttings, whether hormones were used to induce rooting, and so on). This file provides information used by our propagation staff in determining the most effective means of propagation for additional incoming material (or of repropagation for material already in the collections), and in responding to inquiries from the public or other professionals.

A second card file, maintained by the plant records office, chronicles the living collections. This file, containing the accession information already recorded in the greenhouse files and the accession book, lists individual plants representing the accession lot and their locations on the grounds; it is annotated with information regarding the status of these plants each time a staff member checks on them.

It is the responsibility of the plant-records-office staff to perform regular field-checks in the collection to determine that all plants are properly mapped, recorded, and labeled (a full discussion of mapping procedures and our map system can be found in the article by Ethan Johnson in this issue). We conduct these field-checks map by map, with a full remapping cycle of the grounds requiring approximately ten years, and volunteers and seasonal interns have played a major role. In addition, other staff members working with the living collections report to the plant records office any discrepancies that they encounter between records information, maps, and plants on the grounds. In the course of their work, verification-project personnel have checked the collections in a pattern very different from the one traditionally followed by records-office field-checks. Timing their collecting activities to coincide with flowering or fruiting seasons and working with related groups at diverse locations on the grounds, they have been able to identify problems that had not been apparent during traditional field-checking. The information gleaned from records-office map checks, the verification project, and other staff members, together with any nomenclature updates or additional information obtained through

library references or correspondence, is used to update the maps, the card file, and a computerized record maintained out-of-house.

The Arboretum and the Plant Sciences Data Center

Since 1972 the Arnold Arboretum has been one of many North American gardens providing collection information to the American Horticultural Society's Plant Sciences Data Center (PSDC), located in Alexandria, Virginia, and designed to function as a central databank. Initial input to the system was performed by staff of what was then known as the Plant Records Center from copies of our living-collections card file. Much of the data entered was incomplete or incorrectly interpreted during input, resulting in errors and omissions that continue to confuse and confound those who work with the printouts generated from these records, despite the number of corrections made to them in subsequent years.

We update the PSDC records twice yearly with information concerning plants added during each of the Arboretum's planting seasons and with changes in status for existing material, which we type on standard forms and mail to PSDC for entry to their computer system. We note all additions, changes, and deletions on the current printout maintained in the plant records office, and each year when a new printout is received from PSDC, we check item by item to ascertain that all information has been properly recorded.

The format for entries in the PSDC database requires that much of the information that we have maintained in our card file over the years be abbreviated or ignored entirely, since the system uses a flat-file structure and fixed-length fields. Despite the limitations imposed and the additional work necessitated for the plant records office, use of the database has provided us with a needed check on the accuracy of the card file and has served as a method of sharing our inventory information with other gardens through the PSDC's microfiche listing of the holdings of all gardens in the system. An additional benefit



Display and record labels provide different types of information. The display labels are for the public and now list common and Latin names, plant family, and the species' geographic range. The trunk display labels (scotch pine) are nailed to the trunk, while hanging display labels (black poplar) are suspended from a branch. Older display labels provided less information. The record labels (one shown with wire attachment) are used by the staff and list curatorial information applicable to that specific accession. Photograph courtesy of Rác and Debreczy.

has been that, unlike the card file, the printout generated by PSDC is available in multiple copies and can be provided to numerous staff members for reference use. The standard printout (PSDC's General Information Listing) is arranged in alphabetical order by taxon, but special-use printouts have been generated in various formats, including listings by map location, year of receipt, and family. Listings of particular genera have been provided for use in research studies.

Other Plant-Records-Office Functions

When plants appear on a seasonal planting list for addition to the collection, plant-records staff trace their lineage to determine whether they meet collections standards, verify their nomenclature through literature search, check the records to ascertain whether the taxon is already represented by the three wild-collected accessions mandated by collections policy for each naturally occurring taxon,

make recommendations concerning whether the accession should be added to the collections and whether existing plants not meeting our standards or in poor condition should be removed as the new plants are added, and assign each individual a letter designation that differentiates it from others of the same accession lot. Embossed zinc record labels are produced for each plant and attached to it while it is still in the nursery. A record card and a PSDC entry form are completed for each, leaving only the map location to be filled in once it is determined. As planting progresses, individuals are added to the maps and their records are annotated with planting locations coded to the map system.

The plant records office is also responsible for display labeling in the collections. In fact, it is only within the past two decades that the responsibility for maintaining the records has been with this office, and within the past one that the files have been housed here. Previously it was the horticulturist who held prime responsibility for the records system, and what we now know as the plant records office was concerned primarily with mapping and labeling duties. Display labels were produced in-house until 1985, many of them by a member of the grounds staff during the winter season. The process by which labels were made was time consuming, involving applying automotive primer and top coats on a custom-cut sheet-metal plate, setting rubber type and printing display information on the label, and using a final protective coat of automotive varnish or polyurethane. Display labels are now produced out-of-house using the metalphoto process, in which a photographic negative is printed on sensitized aluminum. These labels are more durable than the earlier painted ones, since the image and the metal are fused in a manner that resists the cracking, chipping, and rusting that plagued the older labels.

In January of 1949, Donald Wyman completed a listing of all taxa then represented in the Arboretum's collections, with their common names and natural range, to be used as a reference in preparation of display labels. This enumeration has been expanded and

Mindful of the Past, Considerate of the Future

The Arnold Arboretum maintains substantial archives of documents, photographs, and objects to record its history and the development of its collections. Of special significance to the verification project has been material pertaining to E. H. Wilson. Wilson, active at the turn of the century, was the primary plant collector responsible for the diversity of Asian species found in our living collections. A recent grant from the Institute of Museum Services, supervised by S. Connor, has made this material far more accessible to the curatorial staff. We are now able to determine all the living accessions that trace to a Wilson collection, regardless of their

current accession numbers, read his newly transcribed field books for wild-source information that had not originally been recorded in the plant records office (his hand-written books are nearly indecipherable), and find the associated photographs linked to these plants and expeditions. Undoubtedly, some of the materials deposited in the archives were not considered terribly important at the time, but fortunately they were saved; this has allowed us to unravel and better understand part of Wilson's work. Archives are a quintessential element for the curation of collections that span generations and changing institutional priorities.

updated over the years by the records-office staff; since 1979, we have also used it to record family, author, and the reference used to document the nomenclature, as one facet of an attempt to centralize the information required for the effective curation of the collections but previously scattered through files maintained in various offices or available only through library research.

The Role of the Plant Records Office in Verification

In 1979 the Arboretum applied to the National Science Foundation for funding that would enable us to begin a comprehensive verification of the collections and establish an in-house computer system for plant records. This application was funded, and work began with the documentation of all nomenclature in use in the collections. The Living Collections Committee had established a policy regarding nomenclature (see *Arnoldia*, Volume 39, Number 6, 1979, for a discussion of this policy with regard to infraspecific taxa), and a person was hired to review the collection records and perform a literature search to verify the validity of each name, under the

supervision of the plant records office. Some names had already been researched in the course of normal curation; others required extensive library work; still others proved impossible to document. We purchased an Onyx computer (the smallest computer then available that would accommodate so large a database) and two terminals, installed them in the plant records office and at the greenhouse, and established a connection between them using modems. After development of a database format using the *Logix* database system, input from the existing records began. Repeated failures of the Onyx hardware, however, forced the abandonment of the computer just as data entry was completed. Although the Arboretum bought Digital Rainbow personal computers soon thereafter for a number of applications including the recording of accession information and the maintenance of nursery inventories, they were not suitable for the full plant-records database. It was not until July of 1986 that the generosity of an anonymous donor permitted us to purchase and install a new computer system, and we made a new start on internal computerization (refer to the article by Kerry S. Walter

in this issue). The present verification project was designed as a continuation of the original grant project, and a usable database had been anticipated in planning for it.

The unavailability of computerized records for the verification project necessitated changes in the way the project proceeded. The project personnel worked with printouts obtained from the Plant Sciences Data Center, which provided far less information than would have been immediately available through the computerized database and necessitated much cross-checking to the plant-records card file. Notations made to the working printout (concerning, for example, missing or dead plants, plants that did not appear on the printout but were present on the grounds, plants in poor condition, plants needing replacement labels, and plants whose map locations needed adjustment), as well as identity determinations resulting from the project, had to be communicated to the records-office staff for updates to the records, instead of being immediately incorporated into the database. This increased the amount of labor on the parts of both verification-project and records-office staff, since notations had to be made in several formats to various systems, especially as computerization progressed and updates to the database were required. Further duplication of effort became necessary when the nomenclature guidelines established for the earlier grant project were discarded, and name changes that had been processed during that project had to be processed again, but in reverse.

***BG-BASE*: a Long-Awaited Transformation in Record Keeping**

For many years there was a weak connection between the herbarium and the living collections. Although voucher specimens of plants in the collections had been made since the Arboretum's earliest days, it is only in recent years that they have been consistently identified by accession number. Taxonomists on the Arboretum staff have traditionally conducted a continuing review of both herbarium specimens and living material, annotating the

living-collections records as well as herbarium vouchers with changes in nomenclature. When visiting taxonomists annotated vouchers, however, the inclusion of their determinations in the records of the living plants was not guaranteed; often it was not until a staff taxonomist discovered these herbarium annotations in the course of his own work that living-collections annotations were made. Likewise, changes in the living-collections records based on horticultural rather than taxonomic review were rarely reflected in the herbarium. Although nomenclature in the living collections was updated as monographs, checklists, and manuals were published, such systematic annotations were seldom undertaken in the herbarium collections or in the records of accessions no longer represented by living material. Number changes in the living-collections records were not related to existing herbarium specimens, making the task of matching early specimens to the collections records or to living material of the same lineage increasingly difficult.

In designing our second computerized database, we were fortunate to have the personnel for the verification project already present. This enabled us to obtain input from the verification-project taxonomist in our efforts to link the herbarium with the collection records. Our previous experience with database design also proved beneficial in our cooperation with Kerry Walter in the design of *BG-BASE*, since some of the problems inherent in the development of a plant-records database had been addressed in the earlier attempt.

Entry of information to *BG-BASE* began very early in the system's development because of its design as interrelated modules. The first entries made were to the *FAMILIES* file, then to *GENERA*, *PSOURCES* (plant sources), and *NAMES* (taxa), and finally to *ACCESSIONS* and *PLANTS* (individuals representative of each accession lot). Data entry was an involved process, necessitating repeated passes through the existing records (one for the sources from which our plants had come, another for the taxa included in the

collections, a third for accession information, and a final one for individual plant locations and field notes). Had the database been fully developed prior to the beginning of data input, these functions might have been incorporated into a single pass through the files, but the completion of data entry would have been significantly delayed, and the modification of problem areas in the database would not have been the evolutionary process that it was. In working with each module of the system independently of the others, we were able to identify problems before subsequent modules compounded them, rendering them more difficult to revise; our weekly meetings provided a forum for discussing alternatives and additions to the design. Serving as the testing ground for the database proved to be a challenging and exciting experience for all involved.

The plant-records card file and PSDC records have been maintained throughout the process of computerization, serving their original functions while the database was growing and now providing a check on the accuracy of the information in the database. Soon the card file will be replaced by one generated from the computerized records, a "hard copy" reference to the collection much easier to interpret than the old hand-annotated cards. The greenhouse card file, as well as the annual accession book and a number of reports for curatorial purposes, will likewise be computer generated. We will save countless hours at the typewriter copying information from one place and one format

to another (thus eliminating the possibility of errors in the process), yet our curatorial information will be more comprehensive than ever before. We have started to computerize the Arboretum's photographic archives, allowing reference to yet another of the resources that will aid in the curation of the collections and increase their value for research and public education. The map system, currently in the early stages of computerization, will be integrated with the database, enabling maps to be updated automatically when changes are made to the records and opening a range of possibilities for special-purpose maps generated from a selected subset of the full collection. Plans for future expansion of the system include public access to the database through a terminal at the reception area and graphic-display capabilities to increase the value of the database to the public.

When I joined the staff of the Arnold Arboretum in 1976, we all looked on the days of Charles Sprague Sargent as the Arboretum's "Golden Age." We now find ourselves at the dawn of a new Golden Age, with a comprehensively verified collection, access to which is enhanced by a computerized system linking departments and interests to make the collection usable in ways that Professor Sargent could never have imagined.

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