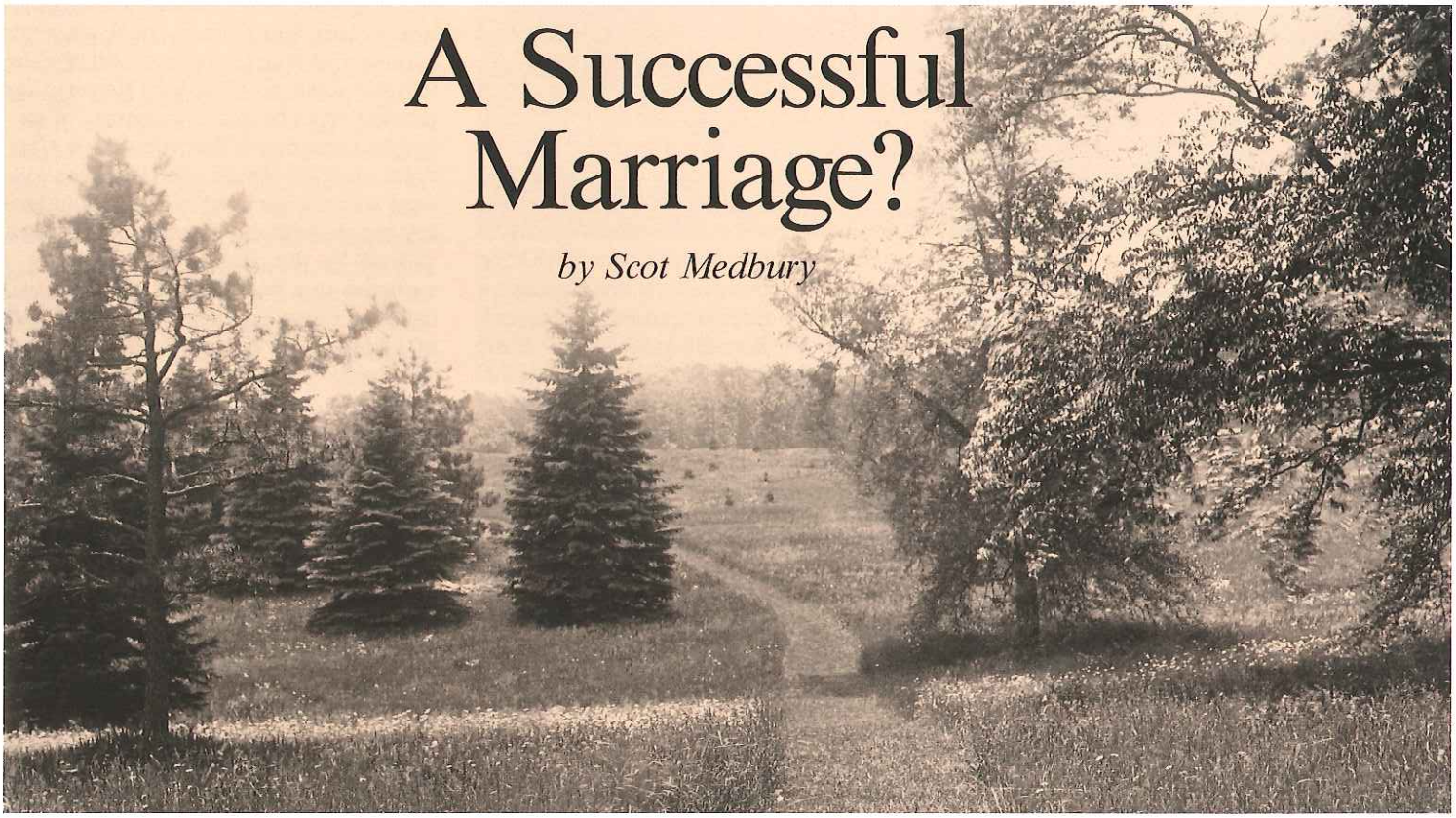
Taxonomy and Garden Design

A Successful Marriage?

by Scot Medbury



A view of Arnold Arboretum's conifer collection in 1903.

Grouping plants together by type is a familiar practice in North American gardens where small, separate collections of maples, oaks or other genera are common features. The application of taxonomic theme to the layout of an entire garden is a more unusual occurrence, however, although such arrangements were the vogue of 19th-century botanical gardens and arboreta. The plant collections in these gardens were frequently grouped into families or genera and then planted out along a winding pathway so that visitors encountered specimens in a taxonomic sequence.

The educational benefits of such a unifying display theme are tantalizing. Growing related plants together, in effect, organizes a collection into a living encyclopedia, allowing for comparison of the characteristics of species within a genus or genera within a family. By lining out related taxa in an evolutionary progression, the more complicated sequential taxonomic arrangement reveals the ancestral affinities of modern floras. Good examples of this display theme are the "order beds" of herbaceous plants at gardens like Kew and Cambridge, which have long provided botany students with a compact synopsis of the plant kingdom arranged in taxonomic sequence.

Despite all these educational advantages, the sequential taxonomic arrangement is one of our most dubious inheritances from the past. Significant horticultural and design-related problems result from the application of taxonomy to the layout of a garden, especially when the concept is applied to a plant collection that strives to be comprehensive in scope. The arboretum projects of the Olmsted landscape architectural firms illustrate some of these problems and also exhibit how changes in plant taxonomy were expressed in the landscape.

Historical Background

The historical antecedents for arranging plant collections taxonomically include the first European botanical garden, the Orto Botanica, founded in Pisa in 1543. The plants in this garden were grouped according to the classification systems used in the popular herbals of the period, systems that were adapted from the work of the 1st-century Greek herbalist Dioscorides. As the science of botany advanced during the Renaissance, the practice of storing herbarium collections in a taxonomic order likely contributed to the practice of arranging living collections in a similar fashion.

Following the publication of Linnaeus' comprehensive classification system in 1753, botanical taxonomy changed radically—and taxonomic gardens quickly followed suit. William Aiton used the Linnaean system in laying out the original nine-acre botanical garden at Kew in 1760, as did the Reverend Erasmus Darwin when designing his private garden near London.

In 1759, the French botanist Bernard deJussieu became dissatisfied with the Linnaean system while laying out a taxonomic garden at Versailles. De Jussieu began moving plants around in pots in an attempt to express his own system of classification, one that was expanded upon and published by his nephew Antoine Laurent de Jussieu in 1789. This classification eventually became the basis for taxonomic gardens in France and elsewhere in Europe.

Following de Jussieu's study, three successive systems of classification have been principally employed in the layout of sequentially-ordered taxonomic plant collections. In chronological order, these classification systems were: (1) the system of the Swiss botanist Augustin Pyramus de Candolle, which largely superseded the Linnaean system by 1840; (2) the system of George Bentham and Joseph Dalton Hooker, published in England between 1862-83; and (3) the post-Darwinian system of Adolph Engler and Karl Prantl, published in Germany between 1887-1915.

In order to appreciate the progression of plant families in taxonomic gardens, it is first necessary to understand the placement of the gymnosperms and subdivisions of the angiosperms (e.g., monocots and dicots) within each of these classification systems. The sequence of dicot families is especially important, for although both de Candolle and Bentham and Hooker began with the polypetalous (many-petalled) buttercups and magnolias, Engler and Prantl's dicot sequence commenced with the willows and birches, whose apetalous (petal-less) flowers they considered to be more primitive.

The sequence of families in de Candolle's and Bentham and Hooker's systems was not intended to show evolutionary progression, however, being dictated instead by the necessity of following a sequence in a book. Most plant classification systems appearing after the work of Charles Darwin and Alfred Russell Wallace have been predicated on an understanding of descent and evolution and, therefore, have tried to establish ancestral relationships among plants. In the first phylogenetic systems, such as Engler and Prantl's, plant families were placed in a sequence beginning with the most primitive plants and ending with the most advanced. Today, taxonomists have largely abandoned linear sequences as expressions of evolutionary progression and have devised phylogenetic trees to show ancestral affinities among plants.

ISTVAN RACZ-ZSOLT DEBRECZY

Arnold's conifer collection in 1991.

The Derby Arboretum

It was to the de Candollean system that the English author and garden designer John Claudius Loudon looked when laying out the Derby Arboretum in England in 1840, the most influential of the taxonomically arranged British gardens. Early in his career, Loudon had become intrigued by the novel marriage of science and landscape beauty that a taxonomic garden presented. In 1803, he seized upon the system of de Jussieu as the organizing structure for a large arboretum and flower garden at Scotland's Scone Palace. In 1811, he recommended a similar "living museum" for the city of London, with plantations arranged by the Linnaean system in one area and by the system of de Jussieu in another. Neither the Scone Palace nor the London garden materialized as envisioned. But with the taxonomic design for Derby, Loudon at last brought the arboretum into a new era, where it joined the natural history museum and the zoological garden as an archetypal embodiment of the Victorian fascination with the natural world.

The Derby Arboretum was designed to be viewed in a prescribed sequence. This concept drew on the tradition of such emblematic landscapes as Stourhead whose classical temples, as they were revealed sequentially to the viewer, were intended to inspire various sentiments typical of the Romantic Movement. At Derby, however, a new paradigm was evoked, that of science. The paths were designed to follow, in sequence, the "natural order" of the plant collections.

The main walk at Derby was on a central axis which brought visitors to a seating area in the middle of the park. The tree collection was planted along a secondary walk that took a serpentine course around the park's perimeter, allowing visitors to enter the park, experience the entire collection and then leave by the same gate without retracing their steps. Loudon employed the "gardenesque" style (which he created and advocated) when planting the arboretum, displaying the trees singly with sufficient room for each specimen to develop without touching others. Despite such foresighted planning, the arboretum was intended to be torn up and replanted every few decades, in order to remove outsized trees and to permit the addition of new taxa.

The Derby Arboretum greatly impressed both the American landscape architect Frederick Law Olmsted, Sr., and his friend and mentor, Andrew Jackson Downing, America's first native-born professional landscape designer. Both men, when given the opportunity to design public parks, included taxonomic arboreta in their proposals, drawing heavily on Loudon's writings and his seminal design for the Derby Arboretum.

North American Examples

North America's first botanical gardens were planted without particular attention to taxonomic or other thematic arrangements. The continent's first proposal for a taxonomically arranged garden appears to have been in 1839, for Nova Scotia's Halifax Public Garden, followed closely by a design by Downing for a Derby-like arboretum in Boston's Public Garden, probably in 1841. But it was Olmsted and Calvert Vaux's inclusion of a taxonomic arboretum in their 1858 "Greensward" plan for New York's Central Park that become the most significant early proposal, since it inaugurated eighty years of involvement in taxonomic arboretum design by the Olmsted firms.

As with the Derby Arboretum, the 40-acre Central Park Arboretum was designed to be a self-contained and sequential experience. Also like Derby, the de Candollean system was followed on the plan. Since the Derby Arboretum had been criticized by Downing for its "peculiarity of design," in reference to the use of "scattered single trees and shrubs," Olmsted and Vaux's planting plans for the Central Park Arboretum avoided the aesthetic shortcomings of such spotty, gardenesque planting by displaying tree species both as specimens and *en masse*.

Olmsted and Vaux not only attempted to make the taxonomic arrangement appear picturesque but also tried to place families where they would grow best. Thus, they attempted to reconcile one of the major problems of taxonomic arrangements: Strict adherence to taxonomic groups and a fixed, linear sequence of families may locate plants on unsuitable sites, where they will not flourish.

It is important to remember that membership in a botanical genus or family implies little or nothing about a particular species' ecological preferences or cultural requirements. For instance, species within the same genus may originate in such widely dissimilar habitats as bog and desert, as occurs within the genus *Pinus*.

Given this formidable problem, Olmsted and Vaux did their best to bring each family "into a position corresponding to its natural habitats," in some locations winding the paths to achieve this. Nevertheless, their design seems preoccupied with preserving the "botanical sequence," rather than concerned with the ecological preferences and performance of individual species.

ISTVAN RACZ-ZSOLT DEBRECZY

Arnold's Tilia *collection in 1913.*

Though his 1858 plan for the Central Park arboretum never came to fruition, 15 years later Olmsted was presented with an even greater opportunity, this time in Boston. The result was the famous Arnold Arboretum, North America's quintessential taxonomic plant collection. Arnold has developed out of the collaboration and foresight of a variety of institutions and individuals, among them Charles Sprague Sargent, its first director and, with Olmsted, co-designer.

Olmsted and Sargent chose Bentham and Hooker's classification as the taxonomic guide for their planting plan, setting out the trees in groups of genera. Every species to be included was planned for in advance, which created problems later when unanticipated species and cultivars were acquired. As with the de Candollean system, Bentham and Hooker's classification began with the magnolias and their relatives, which were assembled at the entrance to the 130-acre arboretum. The rest of the collection then followed in taxonomic sequence, though this time it was to be viewed from a winding carriage road instead of a pedestrian path, a sensible innovation given the large size of the property.

The Bentham and Hooker sequence was followed quite closely in Olmsted and Sargent's plan. Only one major genus, *Salix*, appears to have been placed out of sequence and that was due to ecological necessity. The moisture-loving willows were planted in wet ground near the arboretum entrance, far from their proper place at the end of the dicot sequence. Bentham and Hooker placed the conifers after the dicotyledons; consequently,

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Arnold's Tilia *collection in 1991.*

Olmsted wound the dicot sequence to terminate at an existing stand of native hemlocks. Nearby, he created a pinetum for cultivated conifers.

Unlike the plan for Central Park, where families containing mostly shrubs were interspersed in proper sequence among the tree families, Sargent insisted at Arnold that the shrubs be segregated into a separate fruticetum (from the Latin *frutex*, meaning shrub), also arranged in a progressional sequence according to Bentham and Hooker.

In a few cases, strict adherence to the taxonomic scheme resulted in poor performance among various groups of plants. For example, by the 1930s it was apparent that the magnolias planted near the entrance would never show their best because of the late heavy frosts in that location. Similarly, the taxonomic sequence relegated the flowering cherries to the coldest spot in the arboretum.

The Arnold Arboretum likely had an enormous impact on the development of other American gardens that followed, including the New York Botanical Garden and the Brooklyn Botanical Garden, where parts of the permanent collections were laid out taxonomically. Olmsted maintained a profound interest in the creation of arboreta throughout the remainder of his career, producing arboretum plans for Stanford University, the city of Rochester, New York, and other institutions. Olmsted's last commission, the Biltmore estate in North Carolina, included an ambitious proposal for what would have been the world's greatest collection of trees and shrubs, arranged taxonomically along a sinuous nine-mile drive. The collections policy for the Biltmore arboretum was the broadest imaginable: every woody plant from the world around that might be hardy, cultivars included, was to be acquired and planted, whether it was currently in cultivation or not. Such comprehensiveness ultimately proved to be the arboretum's undoing. Because the layout of the collection was determined by the Bentham and Hooker sequence, it was necessary to know in advance how many hardy trees and shrub species would be represented in each genus, so that adequate space could be allocated in the proper sequential location. Due to an incomplete knowledge of temperate floras (especially of Asiatic regions) and widespread synonymy in the nursery trade, compilation of such a master planting list was a daunting task in 1894, as it would be even today. This impasse was largely responsible for the collapse of the arboretum project at the turn of the century.

Olmsted Brothers Projects

As successors to the senior Olmsted's practice, the Olmsted Brothers firm continued a tradition of making taxonomic plans for arboreta and influenced other landscape architects to do the same. The firm was commissioned to generate plans for the Missouri Botanical Garden, the Holden Arboretum in Ohio, the original Rancho Santa Ana Botanic Garden in southern California, and the University of Pennsylvania's Morris Arboretum. All of these designs went unexecuted or no longer exist.

The Missouri Botanical Garden project is notable in that it roughly coincided with the publication of Engler and Prantl's classification system. William Trelease, the garden's first director, decided to apply both the Bentham and Hooker and the Engler and Prantl systems when engaging the Olmsteds to lay out two new geographic collection areas, choosing the former for its familiarity among botanists and the latter because it illustrated descendance affinities among plants. The two new gardens—an American collection and a larger garden devoted to the "Universal flora"—were to contain mere synopses of their respective floras. In this way, the designers avoided the horticultural problems that have plagued other taxonomically arranged gardens because representative species from a particular family or genus could be selected based upon their horticultural compatibility. In addition, the designers did not have to wrestle with the planning issues arising from a comprehensive collections policy, such as those that confounded the Biltmore project.

In 1936, the Olmsted Brothers produced the firm's last taxonomic arboretum plan for the University of Washington Arboretum in Seattle. The Engler and Prantl system was exclusively applied here to a collection intended from the outset to be comprehensive in scope. Following Engler and Prantl, the taxonomic sequence began with Ginko biloba, the most primitive hardy gymnosperm, followed next by the conifers, the woody monocots, and finally by the dicots. The dicot sequence was initiated not by the magnolias as before, but with apetalous families like Salicaceae and Betulaceae.

Despite the aesthetic and intellectual appeal of their strikingly rendered plan on paper, the Olmsted's last arboretum design revealed a sharp decline in conceptual quality. The firm seems to have been copying aspects of the Arnold Arboretum plan merely out of custom, without reexamining the theoretical basis for arranging plants in a taxonomic sequence. Incredibly, the critical interrelationship between the botanical sequence

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and the pedestrian circulation was omitted, thereby stripping the design of the educational elements that justify the use of a taxonomic sequence in the first place. Fortunately, the University of Washington Arboretum has since developed independently of the Olmsted plan for it, with greater sensitivity given to the physical characteristics of the site and the cultural requirements of the plants.

Disadvantages

With few exceptions, North American botanical gardens founded after the 1930s have eschewed sequential taxonomic arrangements in favor of geographic, ecological or strictly aesthetic themes (or combinations thereof). Gardens continue to present small phylogenetic displays, such as the Prehistoric Glen at Honolulu's Foster Botanical Garden or the Plant Families Garden at the North Carolina Botanical Garden, but the comprehensive application of taxonomy to garden design is virtually forgotten today.

The approach works reasonably well with herbaceous perennials, but woody plants lend themselves less successfully to a sequential taxonomic treatment. The flowers are often out of reach, the plants are spaced further apart and bloom times are much less synchronized than are summer-flowering herbaceous plants—all of which make comparisons of floral characters difficult.

New developments in taxonomy also pose problems for sequentially arranged taxonomic collections of woody plants. While a herbaceous garden can be torn out and replanted following a new taxonomic system, such a drastic approach is impractical in a mature arboretum. Woody collections arranged to an obsolete classification system are anachronisms, worth maintaining for their historical interest but lacking in some of the educational values that originally led to the use of a taxonomic sequence.

The most serious drawback to a taxonomic arrangement, however, deals with horticultural issues. The point has already been made that taxonomic groups above the species level often contain plants from widely dissimilar habitats. The varying degrees of sun and shade tolerance, as well as the differing nutritional and moisture requirements found among groups of related species, point to the problems encountered when these plants are grown together under similar conditions. Many plants will simply die when placed in the wrong spot. Others will struggle for years in a sickly or stunted condition and con-