

**Title:** The Morris Arboretum *Quercus* Collection: Unearthing the Michaux Quercetum

**Author:** Jessamine Finch  
*The Hay Honey Farm Endowed Natural Lands Intern*

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**Abstract:**

The genus *Quercus* (oaks), considered by some the most important hardwood genus, plays a significant role in the Morris Arboretum living collection. A recognized NAPCC joint collection (North American Plant Collections Consortium), the strength of the oak collection lies in its great age and species diversity. The Michaux Quercetum is a distinct collection of oaks within the greater *Quercus* collection, resulting from a large-scale collection of North American oaks in the 1950s. Review of the species diversity, richness, and age structure of the oak collection brings to light a few simple recommendations for the maintenance and enhancement of the nationally recognized collection. The proper maintenance of unique collections projects such as the Michaux Quercetum, combined with oak collection locally and abroad and an increased planting of native oaks, will ensure the high quality of the oak collection at Morris Arboretum in the future.

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## INTRODUCTION

Oaks are not the tallest trees, or the largest, or the longest lived, but they have diversified, allowing them to thrive across the globe in vastly divergent habitats. Unlike many trees, the oak genus contains both deciduous and evergreen species. The evergreen oaks evolved for warm climates, while deciduous species evolved for climates with a distinct cold season (Logan, 2006). The oak genus is divided into two sub-genera, the red and the white. The white oaks evolved first and can be differentiated by the smooth, rounded tips of the lobes of their leaves. White oak acorns are fertilized and mature in one season. Red oaks, on the other hand, evolved later in response to a cooling climate. Leaves of red oaks have spiny tips and the acorns take two seasons to mature (Logan, 2006). Accidental crossing or hybridization among oaks is quite common and has caused some controversy within the genus. Some botanists will consider a subject to be a distinct species, while others may label it a hybrid, causing the size of this group to fluctuate according to your \* q p gōræ (Miller, 1985). Considering that, there are about 600 species of oak worldwide and 60 in the United States (Mabberley, 1987).

In many cultures, the oak tree (*Quercus*) has come to symbolize power, protection, strength, stability, and ultimately, life (Nadkarni, 2008). From ancient Norse and Celtic people, to the Greeks, Druids, and Native Americans of California, the oak was sacred, both in its symbolism and function (Nadkarni, 2008). In 2004, the oak was selected as the national tree of the United States in an online election hosted by the National Arbor Day Foundation (Nadkarni, 2008). A press release explained the justification behind this selection:

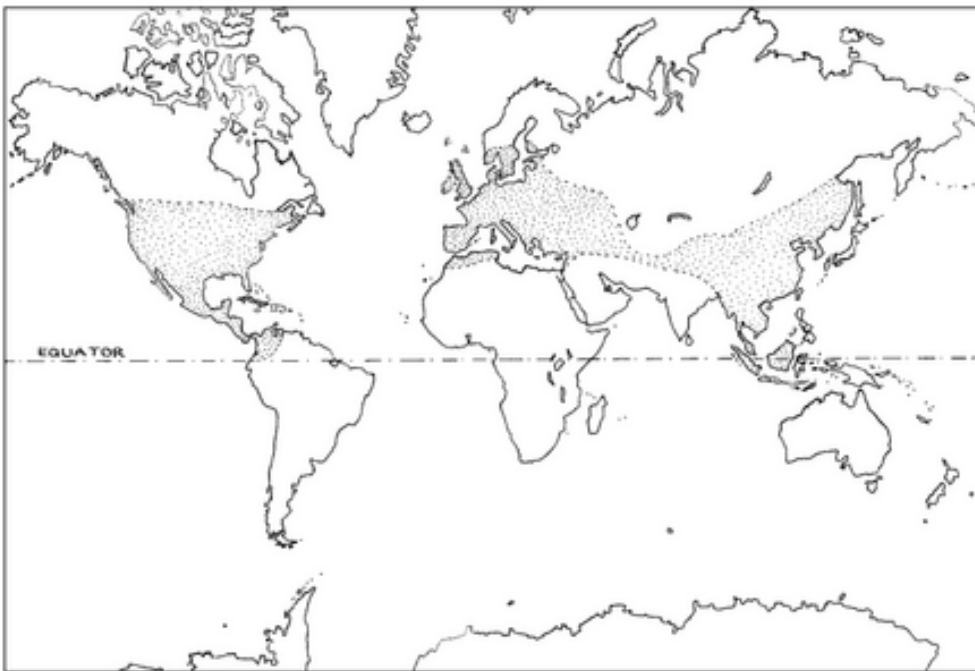
*With more than 60 species growing in the United States, making oaks a part of our landscape throughout the country, oaks have also been part of many important events in our history. From the oak leaf used by the Ford Oak as a marker in crossing a river near Homer, Illinois, to Andrew Jackson taking the White House as a symbol of victory, oaks have played a significant role in our nation's history. In the annals of military history, oaks were used as a symbol of strength and courage. The oak leaf was used by the British as a symbol of their army during the Battle of New Orleans. In the annals of military history, oaks were used as a symbol of strength and courage. The oak leaf was used by the British as a symbol of their army during the Battle of New Orleans. In the annals of military history, oaks were used as a symbol of strength and courage. The oak leaf was used by the British as a symbol of their army during the Battle of New Orleans.*

The history of human--oak connection is rich with stories of progress, exploration, prosperity, war, and an evolving world. I will begin my paper by reviewing some of the roles oaks have played in human society over time in order to position the *Quercus* collection of the Morris Arboretum within its greater context, providing a crucial backdrop with which to interpret, maintain, and plan for the future of, our collection.

## THE HUMAN--OAK CONNECTION

Y k n n k c o " D t { c p v " N q i c p ø u " d q q m . " ð Q c m < " V j g " H t c  
 fascinating read for those interested in the natural history and folklore surrounding oaks. He  
 began his investigation with a rather keen observation, namely, that the world oak distribution is  
 ð e q v g t o k p q w u " y k v j " v j g " n q e Asia, Europe and North America ð ü g v v n g  
 (see Figure 1). He does not postulate that oaks trees were a condition for these civilizations,  
 instead, he simply draws c v v g p v k q p " v q " v j g " h c e v " v j c v " ð y j g t g " v  
 e w n v w t g u " v j c v " u j c r g f " v j g " o q f g t p " y q t n f . " v j g t g "

Figure1. Worldwide Distribution of Oaks (Nora Logan)



The poet Hesiod praised the generosity of the oak. " h q t " j g " e n c k o g f - " k v " ð {  
 acorns, honey, and galls-- y j k n g " q v j g t " v t (Logan, 2006). Archaeological d w v " q p g 0 ð  
 evidence of grinding tools before wild wheat was cut for human consumption supports the stories  
 by Hesiod, Ovid, Lucretius, and Pliny, among others, which spoke to the role acorns played in  
 diets of the Arcadians, an ancient, pastoral people who lived on the edge of the Mediterranean.  
 The evidence of oaks as a major food source can also be found in human language, such as the  
 old Tunisian word for oak that o g c p u " ð - d j g t ' k p Mahy Natives American tribes  
 such as the Ojibway, Menomenee, Iroquois, and Apache were also balanocultures, derived from  
 the Greek *balanos* \* ð c e q t p ö acorn-eating cultures. Acorns are still enjoyed today in  
 traditional Korean, Chinese, and Turkish meals (Logan, 2006). In his book, Logan experiments  
 with cooking and eating acorn products (flour and jelly) acquired from a local Korean market.  
 Although not particularly flavorful, he found these creations to be exceptionally filling, a  
 significant characteristic that has become almost completely irrelevant in the world of  
 overabundance in which many of us currently reside. K p u r k t g f " d { " N q i c p ø u " e w n k

also purchased acorn flour from a nearby Korean market, and with the help of fellow intern, Jamie Berlin, crafted delicious acorn molasses cookies to share at my project presentation (for recipe see Appendix 1).

When Bloomfield Farm Horticulturist Louise Clarke returned from her work exchange at Windsor Great Park last summer, she spoke to me of the ancient oaks she had encountered during her time in England. They were magnificent, decaying beasts, gnarled and wounded, that made our America oaks look like mere children by comparison. Prior to the publishing of *Natural History of the Oaks of Windsor* had been threatened by the expansion of highway A332, but the local community had fought to protect the trees and succeeded in blocking the road from being widened. Champion oaks are celebrated and protected throughout the United States as well. One example of these locally, and sometimes nationally, famous oaks is the Wye Oak of Maryland. Purchased by the state in 1939, the surrounding 30 acres was converted into a state park in its honor. The Wye Oak inspired Fred W. Besley, the first Maryland State Forester, to found the Big Tree Champion Program in 1925; as a result, the American Forestry Association named the Wye Oak one of the first National Champion Trees in 1940. When the Wye Oak tragically failed in a storm back in 2002, it was more than 460 years old, and the largest white oak tree in the United States, measuring 96 feet tall with a trunk diameter at breast height of 31 feet 10 inches (Logan, 2006).

The wood of oaks was once valued for many tasks necessary for human life, including first boardwalks allowing travel through wetlands to the unparalleled dominance of oak-built ships and the tanning of leather, oak products have played a key role in human society. In the age of wooden ships, oak was the first choice for shipbuilding as it was strong, comparatively light, watertight, bendable, and most importantly, workable. Used in both Viking longships and renowned American Naval ships such as the USS *Constitution* (1794), it is without a doubt that oaks are responsible for some of the most significant ships ever built (Logan, 2006). Besides ships, oaks have been used to create many laborious masterpieces, such as the revolutionary 660-ton oak roof of Westminster Hall constructed for Richard II between A.D.1393 and 1397 (Logan, 2006). Although somewhat less grand, the chemical properties of oak bark were essential to the tanning leather, which prevented the animal skin from rotting and made it supple and quite waterproof (Logan, 2006).

Another practical application of oaks unique chemistry was the gallo-tannic acid derived from oak galls. These galls differed from earlier inks as they sunk quickly into the paper and oxidized, binding to the very fabric of the page, while the latter bound to the surface of the page and were easily smudged or erased. Although present in many oak galls, the highest concentrations of gall-tannic acids can be found in the galls of small scrub oak abundant in Turkey, and so named *Quercus tinctoria*, the ink oak. The oak gall ink was clear, produced a sharper line than other inks, and was virtually permanent. For these reasons it became the popular choice for government documents,

architectural f t c y k p i u . " c t v k u v ø u " c i s g a n d f l o g t l a s t i n g i d o c u m e n t s . p f " c p { " q  
 Some famous examples include, the U.S. Constitution, the Declaration of Independence, Thomas  
 L g h h g t u q p ø u " g n g x c v k q p u " q h " O q p v k e g n n q " c p f " v j g "  
 Leonardo da Vinci, the music of Bach, and the drawings of Rembrandt and van Gogh.

Unfortunately, this ink was not actually as permanent as it seemed at the time, and recently many  
 historic texts written in oak gall ink have been lost as the ink steadily degrades the cellulose on  
 which it was written (Logan, 2006). Recently, visual artist Susan Deakin from the UK produced  
 c " y q t m " e c n n g f " õ E q p v g o r n c v k q p " F t c y k p i . " 6 5 3 " { g c  
 431 year old English oak (*Quercus robur*), each annual growth ring painstakingly drawn in oak-  
 gall ink (see Fig. 2).

Figure2 Susan Deakin, "Contemplation Drawing, 431 Years"



Oaks produce many useful products desired by humans, and so to ensure sustainable  
 harvesting, forest management techniques were instated, in some places resulting in the first  
 õ h q t g u v " n c y 0 ö " Q p g " o c p c i g o g p v " v g e t h e d e h e s a s w o f g " K " h q w p  
 southwestern Spain, which combined agriculture, the production of firewood and charcoal, acorn  
 harvesting, cork production, and the rearing of livestock efficiently on one tract of land. A  
*dehesa* looks like a park, yet produces more per acre than any system of modern agriculture.  
 However, the *dehesa* only produces small quantities of many things. The principal trees are  
 evergreen oaks, *Quercus ilex* and *Q. suber*. The trees are surrounded by grasses and planted with  
 grape, chickpeas, broad beans, and wheat in the sunny openings. The acorn mast fed pigs, sheep  
 grazed the grasses, selective pruning provided firewood, and opportunistic agriculture provided  
 fruits, vegetables, and legumes (Logan, 2006). To me, *dehesas*, typically communally owned and  
 operated, perfectly encapsulate the guiding principle of permaculture, a popular reemerging trend  
 today that aims to create a highly efficient and productive system through stacking functions,  
 mixed-use space, and closed-loop nutrient cycling.

The pre-Christian religion of Druidism worshipped the spirits of trees. The oak was the  
 sacred tree of this intellectual and powerful Celtic class, and they venerated mistletoe, which  
 grew on its branches. Each tribe possessed a sacred meeting place enclosed by trees. This is

where their local deity was believed to reside, and the destruction of these sacred groves was viewed with the same horror that the bombing of a mosque or burning of a church would incite within us today. After the Roman conquests, Druids were suppressed and practice carried on in secret in caves and forests. By the seventh century, many Druidic practices had almost completely died out, although the Christian church had managed to absorb many of its practices. Eleven centuries later, Druidism saw a huge revival in England, with such notable Britons as William Blake and Winston Churchill initiated into the Druidic orders. Modern day Druids are especially concerned with issues of the environment, including the distribution of information on global climate change (Nadkarni, 2008).

The peak of oak-derived products has since past, and once the most important hardwood species, oak lumber is now reserved for truck floors and middle-market cabinets (Logan, 2006). Virtually every part of the oak tree, from the wood to the bark to the acorns and galls, was at one point a valuable commodity to humans. Today a small contingent still take advantage of the many uses of the oak, but the vast majority of the population see them merely as a street tree, or a symbol of fall, or just another tree in the forest. The history of the human--oak connection is incredibly complex, engaging, and inspiring. However, the importance of oaks is more than just their practical uses, their landscape and ecological value is remarkable in and of itself and further cause to protect, plant, and maintain this incredible group.

### **HISTORY OF MICHAUX QUERCETUM**

Francois Andre Michaux (1770-1855) was a noted French botanist and early plant explorer commissioned by the French government to inventory trees of eastern North America

\* 3 : 2 4 + 0 " J k u " g z r n q t c v k q p k u g q k v m g 'g f g' ik 'p c' n d g u 't h w d m k u  
*Amerique septentrionale* " k p " 3 : 3 210 stu. This piece was illustrated by the French  
artist Pierre Joseph Redoute and detailed the possible commercial and artistic uses of North  
American trees. His travels and publications established Michaux as an early student of  
American forest trees, with a special focus on oaks (APS, 2013). Elected to the American  
Philosophical Society " n c v g " k p " n k h g . " w r q p " O k u d j o t h e n z ø u " f g c v  
õ v q " d g " w u g f " h q t " h w t v j g t k p i " v j g " r t q i (The u u " q h " h q  
Michaux Fund of the American Philosophical Society acted in part to fund the Michaux  
Quercetum project, and hence it bears his name. The word quercetum is Latin derived, meaning  
õ c p " q c m " i t q x g ö " q t " õ c p " q c m " h q t g u v 0 ö " "

Figure 3. Oak illustration by Pierre Joseph Redouté from *Histoire des arbres forestiers de*

The majority of the Michaux Quercetum is located on a total of 5 acres of the Bloomfield Farm property of the Morris Arboretum of the University of Pennsylvania. This project originated as a collaboration between the Morris Arboretum and the Northeastern Forest Experiment Station of the Forest Service, U.S. Department of Agriculture, financed in part by the Michaux Fund of the American Philosophical Society. The purpose of the project was to create a living collection of all climatically amenable species and varieties of oak (Schramm, 1954). The establishment of such an authenticated collection of oak species, both native and exotic, would provide germplasm for breeding and extensive tests of exotic species (Schramm, 1954). The establishment of such an authenticated collection of oak species, both native and exotic, would provide germplasm for breeding and extensive tests of exotic species (Schramm, 1954). Oaks are known as a highly complex and taxonomically confounded genus due to their intricate evolution processes and ease and frequency of hybridization. At the time the Quercetum was founded, approximately 80 species of oaks, in addition to 20 varieties and several hundred presumed natural hybrids, had been described in the United States (Schramm, 1954). It was believed that given a facility such as the Michaux Quercetum, studies could be undertaken to delineate and establish the validity of our native species. Such studies would provide crucial information on the existing variation within oak species, as well as the existence and distribution of oak races. Finally, this project would serve as preliminary hardiness tests for exotic species from all temperate oak-inhabited parts of the northern hemisphere (Schramm, 1954).

For each species selected for inclusion in the project, 100 seeds (acorn) were collected from individual native trees with a known geographic location in wild natural stands. The collection of seed was accompanied by a herbarium specimen prepared from the same tree from which the acorns came. In the case of species with wide distributions occupying more than one climate zone, separate seed and herbarium collections were obtained from two individual trees of a species when possible. For the purposes of this project, natural hybrids were not included as less while at the same time enlarging the collection. Acorns were planted immediately upon arrival.