(45) The Retention Pond was constructed in 1999 to receive run-off from the newly-built Recreation Center and associated parking lots. This area was once a construction dumpsite, and many truckloads of concrete had to be hauled out before excavation could begin. A geosynthetic membrane lines the bottom of the pond, ensuring that it will never dry out, and a weir on the west end allows water to slowly drain into the Cannon River following major rainfall events. The pond was intentionally shaped like a natural oxbow, and the area around it was planted into native prairie plants.

(46) Kettle Hole Marsh is situated in a geological feature known as a kettle. A kettle is formed when a large block of glacial ice is left behind by a retreating glacier. Glacial meltwater deposits sediments around the block of ice, which then leaves a water-filled depression when it melts. Kettle Hole Marsh has no inlet or outlet streams and drains a very small area. It contains a unique community of marsh plants found nowhere else in the Arb and is a great place to hear Wood Frogs, Leopard Frogs, and Chorus Frogs singing during April and early May. Jean Hoff analyzed pollen cores from the marsh for a geology comps project in 1978 and found an increase in grass pollen around 750 years ago, indicating that the marsh may have been an open pond prior to that time. In the past century, Kettle Hole Marsh has been threatened by sedimentation from agricultural land to the south. Once the 2008 prairie is established on this land, sedimentation should be reduced to natural levels.

(47) Cole Wetland: This marsh was formed as sediment carried by an ephemeral stream (which flows beneath the bridge on the paved path) spread out into Spring Creek, creating a shallow, slow-flowing area. Cole Wetland was restored into native wetland species in 1995 with a generous grant from the family of Richard S. Cole. Marsh marigolds and other wetland specialist plants can be seen blooming here in the spring. In recent years, this area has suffered from an invasion of non-native Reed-canary Grass (*Phalaris arundinacea*), which has choked out many of the native plants.

Carleton College Cowling Arboretum

An Interpretive Guide

Author's Note:

The Cowling Arboretum has figured prominently into my four years at Carleton. I have worked on the Arb crew cutting buckthorn, collecting prairie seed, and maintaining the trails. I have counted grassland birds and monitored the effect of experimental cattle grazing on prairie legumes. I have spent countless hours on -20º nights or 100º days, in blizzards and in thunderstorms, wandering the trail system in search of birds and blooms but ultimately in search of something more – a profound, almost spiritual, sense of place, of connection with all of nature, past and present. It is for this reason that I have sought the extremes – the wall cloud of a May thunderstorm, the bite of a late November wind, the utter silence and crisp air of winter's coldest night.

As my senior year drew to a close, I found myself wanting to give something back to the Arb, so I created this guide as an ENTS capstone project. It is organized into two sections: History and Habitats. Points of interest are marked in the field with numbered signs that correspond to the numbers in this booklet. An index to the numbers can be found on page 4.

I urge readers to view this guide not simply as a source of information but as a prod to the imagination. Imagine this land beneath a tropical ocean or beneath a mile of glacial ice. Imagine the prairies with bison and grizzly bears. Try to envision the Carleton farm, complete with cattle, swine, and horses. Picture Lilac Hill as it once was, abloom with 90 lilac varieties from around the globe. Most importantly, see yourself as a part of this evolving landscape, and you may begin to feel a sense of place, a sense of connection with nature so treasured by writers such as Muir, Abbey, and Thoreau. There is much to see in the Arb if we slow down, take off our headphones, and simply observe.

~Markael Luterra
June 4, 2007

(41) The Cannon River flows from Sakatah Lake, southwest of Faribault, to its mouth at the Mississippi river near Red Wing. The Straight River, a major tributary, begins near Owatonna and joins the Cannon at Faribault. Average flow at Northfield is about 500 cubic feet per second (cfs), though flows of greater than 5,000 cfs can occur during major floods. The river carries relatively high levels of dissolved nutrients and chemical pollutants from agricultural and municipal runoff, and efforts to clean up the river will require major changes in agricultural techniques.

(42) Spring Creek flows from just southeast of Northfield through Lyman Lakes and into the Cannon River near the south end of the Lower Arb. Like the Cannon River, Spring Creek carries high levels of dissolved nutrients that lead to abundant algal growth in Lyman Lakes. As its name suggests, Spring Creek is fed by natural springs and never runs dry, even in extreme drought.

(43) Oxbow Pond is a natural pond in the floodplain below Best Woods. It can be seen from the trail here in winter months. An oxbow pond, named for its curved shape, is produced when a river cuts off a meander in its course, leaving an abandoned, curved section of river that becomes a pond. Oxbow pond is the only Arb pond surrounded by woodland, and it is a good place to hear Wood Frogs singing in early April.

(44) Turtle Pond is an artificial wetland created in 1990. At that time the City of Northfield needed to bury a new sewer line beneath this area and agreed to excavate the pond as compensation for damage to the Arb. The pond and island were designed to provide habitat for the threatened Wood Turtle (*Clemmys insculpta*), which has been seen and studied in this area. The unmaintained trail along the river was once a major trail but was closed to minimize disturbance of turtle habitat. Look for evidence of beaver (*Castor canadensis*) cutting in this area.

Trees of the pine plantations:

(38) Red Pine (*Pinus resinosa*)

Red Pine is a tall pine with long (4-6”) needles and reddish-gray bark. The needles are produced in pairs, easily distinguishing this species from white pine which has needles in groups of five. The bark tends to be more gray-brown near the base of the trunk and more red near the top. This species is sometimes called the Norway Pine, though it is native to the U.S. and not Norway.

(39) White Pine (*Pinus strobus*)

White Pine is a majestic pine that can reach grand proportions in its native habitat. The largest white pine, in Great Smoky Mountains National Park, is 187.5 feet tall, making it the tallest tree in eastern North America. The largest trees are nearly 500 years old. The white pines in the Arb are much less impressive, being only slightly over 50 years old, but they are nonetheless beautiful trees. The slender needles, 2-5” in length, are produced in bundles of five, giving the tree a soft appearance. White pine bark is gray to gray-brown and deeply furrowed on older trees.

(40) Jack Pine (*Pinus banksiana*)

Jack Pine is a relatively short-lived, pioneer species adapted to rapid regeneration after forest fire in its native habitat. It is a shorter, smaller tree than red and white pine, seldom growing more than 60 feet tall. Jack pine produces short (3/4-2”) needles in clusters of two and has dark gray-brown, scaly bark. As an adaptation to fire, jack pines produce “serotinous cones” that are sealed shut by solid resin. Heat from a forest fire melts the resin and opens the cones, producing a rain of jack pine seeds that quickly germinate and regenerate the forest.

Water and Wetlands

The Arb contains two streams, three ponds, and two marshes, all of which have different histories and support different assemblages of plant and animal life.

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red-brown heartwood that can be used for firewood or lumber. The compound leaves resemble black walnut but have a characteristic shiny upper surface. The bark of mature trees has a distinctive tight crosshatch pattern.

Pine Plantations

The pine plantations located near the north end of the Lower Arb represent a unique, non-native community. The pines (red pine, white pine, and jack pine) are not native to this part of Minnesota, but are native to the coniferous forests found in the northern half of the state.

The pines were planted in the late 1940s and early 1950s by D. Blake Stewart and his grounds crew under the supervision of Dr. Harvey Stork. At the time of planting, this land was managed as part of the Carleton Farm and not included in the Arboretum. The soil beneath the pines is sandy and produced poor yields when planted into row crops. Stork and Stewsie needed to find a use for this marginal land and eventually decided to plant pines, citing erosion control, cover for wildlife, and potential economic returns from Christmas tree sales as important benefits.

Fifty years later, less than half of the pines remain. Large areas were cleared in 2001 and have since been designated as prairie or forest restoration areas. No plans exist to cut the remaining pines, however, and a dense stand of young pines has recently recruited into the 1991 forest restoration.

While the pines are not native to the Northfield area, many of the animals that breed in or migrate through the Arb spend part of their lives in pine forests and are thus capable of utilizing the habitat. Student naturalists frequently find owl and crow pellets beneath the pines, and pheasants, wild turkeys, and deer frequent the area during the winter. Red squirrels eat pine buds in early spring, leaving the ground beneath littered with small green twigs, or "nips."

largest tree of any type, in the Arb. Given that it stands in an area once inundated by the Waterford mill dam, it must have attained this size in 90 years or less. Young cottonwoods have silvery-white bark, while the bark of mature trees is gray-brown and deeply furrowed. The triangular, serrate-margined leaves resemble those of aspen and make a similar rustling sound in the wind. Cottonwood seeds are buried within a mass of soft white "cotton." When the seed ripens in June, this cotton is released in quantities sufficient to whiten the ground along riverbanks and lakeshores.

(35) Silver Maple (*Acer saccharinum*)

Sometimes known as soft maple, this fast-growing maple has relatively weak branches that are often broken in windstorms. Like the related sugar maple, it produces sweet sap, but its sugar concentration is lower and a great deal of sap is required to make syrup from this species. The leaves can be distinguished from sugar maple by their whitish ("silver") undersides and their doubly lobed margins. Copious quantities of winged seeds are produced in June and spin to the ground like tiny helicopters.

(36) Willow (*Salix amygdaloides* and *Salix nigra*)

All willow species prefer wet soil, and the willows in the Arb are no exception. Large willows can be found immediately adjacent to the Cannon River and Spring Creek, often leaning out over the river. Older trees tend to rot out inside, eventually toppling but remaining alive at the base. Willows have deeply furrowed bark, short, stout trunks that often branch near the base, and narrow, serrate-margined, lance-shaped leaves.

(37) Green Ash (*Fraxinus pennsylvanica*)

One of the most abundant trees in the Arb and on campus, green ash grows well in floodplain and upland forests alike. It is nevertheless much more prevalent on the floodplain, so I have chosen to list it as a floodplain forest tree. The majority of the young trees in Earth Day Field are this species, and seven large (~3 foot diameter) green ash trees can be found on the floodplain near the iron bridge. Green ash grows rapidly but produces solid,

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Overview

The Carleton College Cowling Arboretum (hereafter the Carleton Arboretum or simply the Arb) comprises 880 acres of land extending two miles northeast from campus along the Cannon River and almost a mile east along Wall Street. It contains a great variety of habitats, including restored prairie, oak savanna, upland forest, floodplain forest, pine plantations, and wetlands. The Arb is divided by State Highway 19 into the Upper (southern) and Lower (northern) Arb. The Upper Arb contains more trails, allows bike use, and is generally managed with a focus on recreational opportunities, while the much larger Lower Arb contains a lower trail density, does not allow bikes, and is managed for conservation, education, and research.

HISTORY OF THE ARBORETUM

Geology

The story of the Carleton Arboretum begins around 500 million years ago, when the land that is now the Arb was submerged beneath a shallow equatorial sea. This sea, which covered the region during Cambrian, Ordovician, and Devonian periods, some 550-430 million years ago, left behind alternating layers of sandstone, limestone, and dolomite more than a thousand feet thick. After the seas retreated, these rock layers began to erode, gradually exposing older rocks.

Two bedrock layers are exposed in the Arb: the Shakopee formation and St. Peter Sandstone. **(1)** The Shakopee formation is 126 feet thick around Northfield, and only the upper part is exposed along Spring Creek and the Cannon River. This rock is primarily dolomite, chemically $CaMg(CO_3)_2$, formed by precipitation of calcium and magnesium carbonates from mineral-rich seawater during the Ordovician period. The Shakopee dolomite does not contain nearly as many fossils as other carbonate layers in the region, but it is possible to find evidence of early marine life. The rock contains fossilized gastropods (a type of mollusk), as well as fossilized stromatolites. Stromatolites are mineralized seafloor mounds formed by photosynthetic cyanobacteria; these unusual forms can still be found today, virtually unchanged in appearance 500 million years later. The nearest exposure of fossilized stromatolites occurs along the railroad tracks across the Cannon River.

(2) On top of the Shakopee formation rests the St. Peter sandstone, known as the "Ivory Soap" of sandstones for its 99.44% purity. White to yellow in color, this "stone" is composed entirely of well-rounded quartz grains of similar size with virtually no cementing material. As a result, it is more reminiscent of sand than stone, and outcrops appear as sandy spots easily mistaken for sandbars – except that sandbars usually aren't on hillsides. The fine sand on the trail next to Olin Farm House is derived from St. Peter sandstone close to the surface.

When the seas retreated, they left behind a nearly feature-

species. These species grow rapidly and can achieve very large diameters in a century or less. As the floodplain is frequently inundated during the bloom period of upland forest flowers, these flowers are much less abundant in the floodplain. Wood Nettle (*Laportea canadensis*), which possesses stinging hairs that cause itching upon skin contact, is the dominant understory plant in most places.

Very little of the floodplain forest in the Arb can be considered mature. One possible remnant can be found just before the iron bridge at the end of the Lower Arb. Part of this area was an island during settlement times, and some very large green ash trees are present here. Another area with large trees lies to the west of the trail to the old Waterford Mill. This area was inundated until the mill dam was destroyed in 1916, so these large trees are no more than 90 years old.

Most of the Arb floodplain was cultivated as farmland until recently. The first field to be abandoned was the Earth Day Field, just past the sewage treatment plant, which was taken out of cultivation in 1970. This area bears no resemblance to a field today, as it is covered by a dense stand of green ash and other trees. The field past Waterford Mill was removed from cultivation in 1982, and the field surrounding the retention pond and Turtle Pond was abandoned in 1990. Trees are beginning to grow in these areas, but these fields have developed a thick covering of nonnative Reed-canary Grass (*Phalaris arundinacea*), which slows seedling establishment. In addition, beaver (*Castor canadensis*) frequently cut seedlings in these fields. Given the abundance of seed-producing floodplain trees lining the abandoned fields, no tree seedlings have been planted in these areas.

Trees of the Floodplain:

(34) Eastern Cottonwood (*Populus deltoides*)

Eastern Cottonwood is a widespread tree ranging from Saskatchewan east to New York and South to Texas. It is the largest tree native to this area, sometimes achieving a trunk diameter of seven feet or greater and a height of 100 feet. The tree I chose to represent this species is the largest cottonwood, and the

species, the list describes abundance, seasons during which sightings are most likely, and in some cases information about locations of previous sightings.

For the casual visitor, a few species of birds will stand out as most visible and abundant. These include the bright red Northern Cardinal, with its loud "what-cheer" song given in spring and summer, and the ubiquitous Black-capped Chickadee. In summer months, watch for the American Redstart, a distinct black-and-orange warbler that favors the low canopy where it is easily sighted. Downy, Hairy, and Red-bellied Woodpeckers are present year round. Woodpeckers can be recognized by their trunk-hugging posture and the drumming sounds produced as they bore into dead trees in search of insects.

Of the forest mammals, the squirrels are most obvious. In addition to the Gray Squirrels so common on campus, the Arb contains the smaller, white-bellied Red Squirrel and the larger, reddish-orange Fox Squirrel. If you are lucky, you might spot the small, striped Eastern Chipmunk. Other mammalian denizens of the forest are largely nocturnal and seldom seen. These include foxes (Red Fox and Gray Fox), coyotes, Striped Skunks, and weasels (of both the Short-tailed and Long-tailed variety).

Floodplain Forest

The level, low-lying land along the Cannon River is floodplain, a geological feature produced over long periods of time by sediment deposition during major floods. Approximately once every two years, the river overtops its banks and spreads out across the floodplain. Aside from this periodic flooding, the floodplain differs from uplands in having a deep layer of fertile, moist soil that supports rapid tree growth. While prairies covered much of the surrounding upland, the floodplain was probably mostly forested in presettlement times. The rapid growth of trees on this land allowed forest to develop in just a few years without fire, and once established this forest was relatively resistant to incursion by prairie conflagrations.

Floodplain forest shares a number of tree species with upland forest, but is characterized by a different mix of dominant

less flat landscape which was slowly eroded over the next 400 million years. To continue the story of the Arb landscape, we must fast-forward to the end of the last Ice Age. Northfield was covered by glacial ice at least four separate times, but the surface geology reflects the most recent glaciation, the Wisconsinian, which reached its maximum extent and began to retreat 14,000 years ago. The eastern edge of this glaciation lies about a mile to the east of the Arb. The rolling landscape of the prairie restorations and surrounding areas is characteristic of a moraine – formed as glacial till (unsorted silt, sand, and gravel) carried forward by the glacial advance is deposited as the ice melts. Flatter areas such as the Carleton campus and the area around Best Woods are outwash terraces, deposited by sediment-rich glacial meltwater. As the glacier retreated, huge volumes of water carved a channel over 100 feet deep that follows the course of Spring Creek and the Cannon River through the Arb; this channel was filled with sediment over time and has only recently been mapped by a seismic survey. The final gift of the retreating glacier was a one- to two-foot thick layer of loess – fine windblown sediment – that covers the entire Arb with the exception of the floodplain. The retreating glacier left behind bare ground vulnerable to wind erosion, and prevailing west winds deposited loess across the region.

The geologic story of the Arb does not end with the last glacier because the floodplain of the Cannon River continues to change with each passing flood. When the river floods, it carries high sediment loads which are deposited by slow-moving water spilling out of the river banks. This "overbank deposition" has over time created the wide, flat floodplain. The river channel meanders through the floodplain in an ever-changing pattern as the river erodes the outer edges of bends and deposits sediment along the inner margins. Occasionally, the river cuts off a portion of its channel, leaving behind an oxbow lake such as the one on the floodplain below Best Woods.

Postglacial Ecology

When the glacier retreated, it left behind a barren land-

scape. It is uncertain exactly how quickly vegetation colonized the area, but based on modern studies of glacial retreat the transition was probably quite rapid. Nitrogen fixing legumes and alders were probably the first species to colonize, and other pioneer species joined the community as nitrogen accumulated in the soil. During this time period, mastodons, giant ground sloths, and saber-toothed cats probably visited the area; these animals became extinct around 13,500 years ago as Native Americans spread across the continent. At some point, pine and spruce became dominant, and a boreal forest community became established.

It is possible to obtain an accurate record of the vegetation history of an area by examining pollen preserved in lake sediments. Thanks in part to pollen analyses conducted by Dr. Phil Camill of the biology department and Dr. Charles Umbanhowar '85, the vegetation history of the Arb can be traced back to 12,500 BP (before the present). Between 12,500 and 10,000 BP, pine and spruce forest dominated. This forest was similar in composition to the boreal forest now found in far northern Minnesota and Canada. As the climate warmed, this community moved northward, eventually leaving the area. From 10,000 to 9,000 BP, the region was covered in a forest of elm and ironwood. Around 9,000 BP, the climate became warmer and drier, and prairie dominated from 8,000-4,250 BP. Tree pollen is still present in this period, suggesting that forest persisted in areas protected from prairie fire. Around 4,250 BP, bur oak (*Quercus macrocarpa*) pollen increases sharply. It appears that a reduction in fire frequency, perhaps coincident with a climatic shift, allowed the fire-tolerant oaks to spread into the prairies, producing a vast patchwork of oak woodland, oak savanna, and open prairie. Around 700 BP, a further reduction in fire frequency allowed fire-intolerant trees to spread, producing the "big woods" forest dominated by sugar maple, basswood, and red oak. It is uncertain whether the big woods ever extended into the Arb. The Public Land Survey, conducted in the 1850s, found open prairie in the area now occupied by campus and extending south and east. The uplands of the Lower Arb were oak savanna, with widely scattered oaks dotting a prairie landscape. Big woods-type forest was found across the Cannon River, a natural firebreak.

ras (circular seeds) which give rise to an equally impressive number of seedlings. Most of the mature Siberian elms have been removed from the Arb, but Myles and the Arb crew continue to do battle with thousands of seedlings. Siberian elm can be differentiated from American elm by its smaller leaves, which give the tree a somewhat feathery appearance.

(32) European Buckthorn (*Rhamnus cathartica*)

The most-disliked and most abundant invasive plant in the Arb, European Buckthorn forms dense, monospecific stands beneath open-canopied forests. These stands are self-perpetuating, as the dense shade beneath them prevents native trees and shrubs from recruiting. Typically considered a shrub, buckthorn may reach over 20 feet in height and 10 inches in diameter at the base. It produces abundant berries which are consumed by birds. The berries have a laxative effect, ensuring that the seeds are rapidly and widely dispersed. While buckthorn will invade young restorations and open forests, it is less able to invade mature, dense-canopied forests such as Best Woods. Almost half of the Arb crew's time is devoted to buckthorn removal, and Arb Manager Myles Bakke can frequently be seen wearing his "Die Buckthorn Scum" t-shirt. Despite ongoing removal efforts, many areas of the Arb remain covered by dense buckthorn. Complete removal of this species may be an eventual possibility but remains a very long-term goal at present.

(33) Honeysuckle (*Lonicera* spp.)

The lesser of two "evil" invasive shrubs, honeysuckle invades forests with open canopies, forming dense clusters of branches. Honeysuckle produces fragrant flowers in May and does not typically grow as dense as buckthorn. Even so, efforts are underway to remove this plant from the Arb.

Over the course of a year, upwards of 75 species of birds can be seen in the upland and floodplain forests of the Arb. A full list of these species is beyond the scope of this guide. I urge visitors who are interested in birds to examine the online list of Arb birds, http://apps.carleton.edu/campus/arb/fauna/birds/. For each

seldom larger than a foot in diameter, often resemble sinewy muscles and are covered with finely fissured scaly bark. Hophornbeams can be surprisingly old – a tree one foot in diameter may have lived a century or more. Slow growth produces the extremely dense, hard wood that gives rise the other common name for this species – ironwood. Ironwood yields the most heat per volume of wood of any native hardwood and is thus prized by woodcutters. The pendant fruits mature in late summer and resemble hops in appearance. These "hops" do not add flavor to beer and can cause intense itching upon skin contact. This tree is uncommon in the Arb – several can be found in Best Woods and along Spring Creek in the Upper Arb.

(29) Alternate-leaf Dogwood (*Cornus alternifolia*)

A common understory tree, alternate-leaf dogwood is best recognized by its leaves. It is the only native tree to possess unlobed simple leaves with completely smooth margins. Additionally, the vein pattern is very distinctive, with side veins curving back toward the midvein along the length of the leaf. This species produces tiny blue-black, inedible berries in late summer.

(30) Bitternut Hickory (*Carya cordiformis*)

A somewhat common tree in big woods forests, this species is extremely uncommon in the Arb. The labeled tree is one of only several mature hickories found near Best Woods. This tree is easily confused with black walnut, but can be distinguished by its bark, which is nearly smooth but covered with a thin crosshatch of scaly ridges. Hickory nuts were planted in some of the forest restorations, and a careful eye can now find a good number of hickory seedlings. The nuts, produced in autumn, contain a bitter, inedible seed.

Invasive Species

(31) Siberian Elm (*Ulmus siberica*)

Introduced from Siberia, this species of elm became a popular shade tree due to its resistance to Dutch Elm Disease. Like all elms, it produces a huge number of wind-dispersed sama-

The Last 200 Years

The Arb Before Carleton Ownership

We have little knowledge of the Native American communities that inhabited the Northfield area, but it is known that a major trading path passed through the Lower Arb and crossed the Cannon River in the vicinity of the Waterford mill site. As the pioneers moved westward, this path became a military road. It was abandoned in 1856 when the first bridge was built across the river in the young town of Northfield.

Carleton was founded in 1866, but it would be more than 50 years before the college purchased the land now known as the Arboretum. In the intervening period, part of the area across Highway 19 became a city dump littered with animal carcasses and Model Ts, and a hobo camp sprang up along the river.

(3) The Waterford Mill and associated dam was constructed in 1873 and commenced operation in 1874. It was a grist mill, functioning primarily to grind locally-grown wheat into flour. Several other businesses appeared along the river and railroad track, including a cooper's shop that produced flour barrels, a wagon-building company, and a lime kiln that heated local limestone to produce lime oxide, a valuable treatment for acid soil. As transportation improved and larger mills were constructed in the Twin Cities, the small mills along the Cannon River began to close. Waterford Mill ceased operation in 1905, and the main portion of the dam went out in 1916. The current trail to the old mill site follows the earthen wing dam which served to prevent the river from flowing around the mill through the floodplain.

The Early Years: Cowling, Stork, and Stewsie (1920-1955)

The first murmurs of interest in an Arboretum date back to 1894, but land acquisition did not begin in earnest until the 1920s under President Donald Cowling. It is not completely clear why Cowling possessed the foresight to purchase nearly 800 acres of land at a time when college funds were scarce and support among

students, faculty, and trustees was lacking. Cowling may have been looking to purchase land to allow for future expansions of campus. Farmland acquisition was clearly part of the motivation, as the Carleton Farm, started in 1914, was expanding during the 1920s. But perhaps the most important driving force behind the purchase of this land was the ambitious plan of Dr. Harvey Stork to create a landscape arboretum on a grand scale.

Harvey Stork joined the Carleton Faculty as a professor of botany and natural history in 1920 and nearly immediately began to push for the creation of an arboretum. He envisioned a landscape arboretum modeled after the famous Arnold Arboretum at Harvard. At this time, the University of Minnesota did not yet have an arboretum, and Stork enlisted the support of botanists in St. Paul who hoped to use the Carleton Arboretum for plant breeding experiments. Stork wanted the Carleton Arboretum to be a true *arboretum* (Latin: collection of trees), with 3,000 varieties of introduced trees and shrubs. He hoped to use this collection to breed new, hardy strains of ornamental plants that could grow in the harsh Minnesota climate. Stork achieved part of his dream with the purchase of land in the 1920s, but he never received sufficient funding to plant 3,000 varieties. At its peak, the Arb boasted 400 varieties of trees and shrubs.

While Stork wrote that "the primary purpose of the College in administering the Arboretum is to develop a demonstration and testing ground for materials of landscape gardening," he was also a skilled naturalist with a deep knowledge and appreciation of the native flora and fauna. In 1930, he constructed a 3.5-mile nature trail. This trail proceeded from the vicinity of athletic fields north of West Gym to the old Waterford mill site along the west bank of the Cannon, and returned along the wooded bluffs on the east bank, crossing the river twice on suspension bridges. From 1930 until 1941, Stork placed 35-70 numbered signs along the trail during the spring months and published a weekly self-guided tour. At its peak, upwards of 300 people took the tour each week.

A student Natural History Club resurrected the weekly trail guides in 1955. The suspension bridge near Waterford was destroyed by flooding in the 1940s, cutting the loop in half and

cies which can also be pioneers, basswood seedlings compete poorly with pioneer species. Basswood is most abundant in mature upland forests but can also be found growing on the floodplain. One of the tallest of the hardwoods, basswood trees can reach heights of nearly 100 feet. The bark is shallowly furrowed, with longer vertical furrows than ash or elm. Its leaves are the largest of any native hardwood, somewhat rounded and up to six inches across. Basswood produces extremely fragrant blooms during the first week of July. The flowers are pollinated by bees, and many Minnesota beekeepers sell basswood honey.

(26) Sugar Maple (*Acer saccharum*)

Perhaps the most common species in many big woods remnants, this species is mysteriously absent from mature forests in the Arb. A large maple in the Arb, especially on the floodplain, is much more likely to be silver maple (*Acer saccharinum*). Many sugar maples have been planted into the forest restorations, but it will be another 25-50 years before any of these begin to resemble the tall, majestic trees found in Nerstrand State Park and elsewhere in the big woods. Sugar maples are best identified by their leaves – the characteristic maple leaf shape found on the Canadian flag. As the name suggests, this species is the source of the sweet sap that is boiled down to make maple syrup.

(27) Hackberry (*Celtis occidentalis*)

Hackberry trees are easily recognized by their bark, which is covered by corky warts and ridges. These trees are present throughout the Arb forests but are nowhere particularly common. Numerous hackberry trees can be found around campus; a particularly large and beautiful tree once grew behind Nutting House but was removed when it began to rot inside. The "berry" in hackberry refers to the fruit, a dry, red-purple, inedible berry that matures in autumn.

(28) Eastern Hophornbeam (*Ostrya virginiana*)

Eastern hophornbeam is a very slow-growing understory tree found in mature forests. The leaves resemble elm leaves but are more finely serrate and soft/fuzzy to the touch. The trunks,

Shade-tolerant Trees

(23) American Elm (*Ulmus americana*)

The great American elm defies classification. It can be found growing in upland forests and floodplain forests. Its shade tolerance is intermediate – it can compete with pioneer species in open areas but can also persist in mature forests. It produces an abundance of wind-dispersed "samaras" – circular seeds – in late spring. Once the most common shade tree in Minnesota cities, American elms have fared poorly since the introduction of Dutch Elm Disease in the 1960s. Several large elms survive on campus thanks to routine injections of fungicides. The disease tends to kill large trees and spare small ones, so elms survive but have been almost eliminated from the forest canopy. Many small- to medium-sized elms can be found in all of the Arb forests. They can be identified by their rough, serrate-margined simple leaves and bark with broad, forking, scaly ridges. A closely related species, Slippery Elm (*Ulmus rubra*) can be found in Best Woods and other mature forests. It has slightly more scaly bark and red heartwood, but is otherwise difficult to differentiate from American elms.

(24) Red Oak (*Quercus rubra*)

One of the most common trees in Arb forests, red oak is also easy to identify. Sharp points on the leaves clearly distinguish it from the congeneric bur oak. The leaves are rich in lignin and decompose more slowly than the leaves of other forest species. Its acorns are eaten and dispersed by both red and gray squirrels. Like most oaks, it has hard, reddish wood that is prized for firewood and lumber alike. This species is the only large native tree that holds some leaves through the winter, making it particularly easy to identify during that season. It can be found in all upland forests in the Arb and is particularly abundant in the young, planted forest restorations.

(25) Basswood (*Tilia americana*)

Along with sugar maple, basswood is a characteristic tree of big woods forest. Unlike elm and red oak, shade-tolerant spe-

shortening the nature trail to an out-and-back on the west bank of the river. The club continued to publish trail guides for several years after Stork's retirement in 1955, even publishing some issues in the fall, but the last self-guided tour was published May 26, 1957.

While Stork provided most of the ideas for the Arboretum, D. Blake Stewart, or "Stewsie," put Stork's plans into practice. Stewsie came to Carleton in 1920 as Superintendent of Grounds and remained in that position for over 50 years. Stewsie frequently traveled to areas of forest about to be cleared and transplanted woodland wildflowers into Stork's "plant introduction garden" along Spring Creek. At one point the Arb contained Yellow Ladies' Slippers from northern Minnesota and Snow Trilliums from Indiana, among many other native and introduced species. Stewsie planted equally large numbers of trees, both as restorations of native forest and as introductions of new species. At the time of his retirement, Stewsie claimed to have planted 200,000 deciduous trees, 75,000 coniferous trees, and over 200,000 wildflowers into the Arb. Most of Stewsie's introduced plants ultimately failed to survive in this climate. Some, such as the ginkgo tree near the Highway 19 bridge over Spring Creek and the Siberian Squill along the creek in the Upper Arb, survive to this day but have not spread. A few introduced species, including two species of honeysuckle, Siberian Elm, and Amur Maple, thrived and reproduced prolifically, eventually becoming a nuisance and prompting removal efforts.

The Carleton Farm (1914-1964)

In the first half of the 20th century, farming was even more important to the economy of southern Minnesota than it is today, and a much larger proportion of the population was employed in some aspect of crop and livestock production. Like all Midwestern colleges of that time, Carleton was expected to understand the business of farming and to remain at the forefront of agricultural advances. To achieve these objectives, the Carleton Farm was formed in 1914. Following Cowling's land purchases in the 1920s, the Arboretum covered 360 acres, and the farm covered

310 acres. The Arboretum contained wilder lands along the Cannon River and wooded areas along the bluffs, while the farm managed the upland areas to the south and east.

The Carleton Farm cultivated row crops and raised riding horses, hogs, and dairy cattle. Eight miles of bridle trail were maintained in the farm and Arboretum land, and the area now occupied by Hillside Prairie was once a horse pasture. The Carleton Farm was most famous for its herd of 140 Holstein dairy cows, which was at one time ranked among the best dairy herds in the state. However, as Carleton became more centrally focused on the liberal arts and acquired a geographically diverse student population, interest in agriculture declined, and the Carleton Farm ceased operation in 1964.

The Dark Ages (1955-1973)

Following Stork's retirement and the end of the Carleton Farm, management and maintenance of the Arb came to a standstill. The major trails of the Arb had always been open to vehicles, but an increase in the number of cars following World War II brought more drive-through visitors than ever. In the absence of oversight, the Arb became a favorite party spot of local teenagers and Carleton students alike, and trash began to accumulate. The nature trail fell into disuse, and buckthorn began to invade wooded areas. When the farm operation ended, arable land was leased to local farmers. Finally, in 1969, the Arb trails were closed to vehicles, and two truckloads of beer bottles and cans were hauled out.

A New Vision (1973-present)

A new vision for the Carleton Arboretum began to emerge in 1973 as part of a Land Use Planning seminar led by Dr. Ed Buchwald, professor of geology. Support for Stork's vision of a museum of trees and shrubs had faded, and the emerging fields of ecology and conservation biology were beginning to demonstrate the need to protect and restore native ecosystems. A second seminar, led by Dr. Gary Wagenbach of the biology department

squirrels and people with enough patience and strength to collect and crack the nuts. This species relies on squirrels to bury the nuts in open areas, where some are forgotten and allowed to sprout. A relatively fast-growing tree, it is also long-lived. While it cannot regenerate in shade, it can persist in dense forest as a mature tree, and many can be found in Best Woods. The hard, deep-brown wood is prized for furniture. Black walnut has large compound leaves and crosshatch-patterned bark which changes to a knobby texture as the tree matures. The leaves emit an acrid "walnutty" smell when crushed.

(21) Black Cherry (*Prunus serotina*)

Black cherry trees produce small, edible-but-bitter cherries in late summer. This species depends on birds to disperse its seeds into open areas where it grows rapidly. The reddish wood is often used in woodworking. Mature black cherries are best recognized by their unique scaly bark. The simple leaves are finely serrate and more elongate than elm or hackberry leaves. Black cherries are relatively common in young forests and on the edges of mature forests in the Arb.

(22) Quaking Aspen (*Populus tremuloides*)

Quaking aspen is an adaptable, widespread pioneer species found from Alaska to Maine and throughout the Rocky Mountains. Its name comes from the rustling sound made by the leaves in even the slightest breeze. Aspens are not particularly common in the Arb, but can be found in the 1992 successional field, in parts of Best Woods, and near the Umbanhowar Oak Opening. Aspens are fast-growing, shade-intolerant, and short-lived, and are thus typically replaced by more shade-tolerant species which can grow beneath the aspen canopy. Clusters of aspens are typically clones produced as underground shoots grow away from a central tree and emerge from the ground to form new trees.

Wild Ginger (*Asarum canadense*)
Wood Anemone (*Anemone quinquefolia*)
Common Blue Violet (*Viola sororia*)
False Rue Anemone (*Enemion biternatum*)
Early Meadow Rue (*Thalictrum dioicum*)
Large Bellwort (*Uvularia grandiflora*)

Late-April to late May
Jack-in-the-pulpit (*Arisaema triphyllum*)
Bent Trillium (*Trillium flexipes*)
Wild Geranium (*Geranium maculatum*)
Blue Phlox (*Phlox divaricata*)
Dame's Rocket (*Hesperis matronalis*) – nonnative species
Yellow Forest Violet (*Viola pubescens*)
Red Baneberry (*Actaea rubra*)

Upland forests in the Arb contain 10-15 species of native trees. Several tree species are shade-intolerant, unable to regenerate in mature forest, while the remaining species are shade tolerant, able to regenerate in dense shade and characteristic of mature forest. Young forests are characterized by an abundance of "pioneer" fast-growing, shade-intolerant species, while mature forests are dominated by shade-tolerant trees.

Shade-intolerant Trees

(19) Boxelder (*Acer negundo*)

A member of the maple family, this fast-growing, short-lived pioneer tree is usually the first tree to appear when an old field is abandoned. Boxelders line the edges of most Arb forests but are uncommon in the center of the woodlands. Boxelders have compound leaves, and each leaflet has a coarse sawtooth margin that is distinctive for this species. In spring, this tree produces prodigious quantities of wind-dispersed winged seeds.

(20) Black Walnut (*Juglans nigra*)

The only walnut native to this area, black walnut produces edible hard-shelled nuts that are a favorite food of red and gray

in 1977, formulated a new statement of purpose for the Arb. The Carleton Arboretum, it said, "should be developed as a multi-use preservational/educational/recreational area, serving primarily the Carleton community, but also open to the public. To that end, it should be managed as a mosaic, protecting fragile plant community and animal habitats while allowing recreational use in other areas. The educational potential of the Arb, both for formal courses and individual study, must be developed." In 1978, the position of Arboretum director was established, and Buchwald was hired to oversee the execution of the new plan.

Restoration proceeded slowly at first. Floodplain fields were taken out of cultivation in 1970, 1982, and 1990, and some tree seedlings were planted in these areas. Alumni Field in the Upper Arb was abandoned in 1986, and tree planting was initiated soon after. Small patches of Hillside Prairie were planted during most years from 1978 until 1990. Postage Stamp Prairie, the largest remnant of original prairie in the Arb (but nonetheless aptly named for its small size), was cleared of invading brush, and a cycle of spring burning was implemented.

In 1991, Dr. Mark McKone, professor of biology, took over the Arb director position, and Myles Bakke was hired into the newly-created position of Arb manager. McKone and Bakke began efforts to restore nearly 300 acres of land that had once been a part of the Carleton Farm but was now leased to local farmers. Large fields at the north end of the Arb were taken out of production in 1991, 1992, 1993, 1994, and 1997 as forest restorations. Some of these areas were planted with tree nuts and seedlings, while those adjacent to Best Woods were left unplanted to study the natural process of forest succession. Major prairie restorations began in 1995 and will be completed in 2008. Bakke and his student crew collected seeds of 80-90 plant species from Carleton's McKnight Prairie and other local prairie remnants for planting in the restorations.

In addition to prairie and forest restorations, McKone and Bakke implemented an invasive species eradication program. Buckthorn, honeysuckle, and Siberian elm are cut and the stumps treated with herbicide to prevent regrowth. In some of the areas surrounding the prairie restorations with the worst buckthorn

problems, both buckthorn and other trees are removed, and prairie seeds are planted beneath the remaining bur oaks to restore an oak savanna community.

Historical points of interest

(4) Monument Hill: The monument marks the location of the first church service in Northfield. The surrounding area was cleared in 2005 so that the site could be used for outdoor weddings and ceremonies.

(5) Horse Barn Site: This weed patch marks the site of the Carleton horse barn. "During the early 1940s the College bought the Ovestrud farm of forty acres – including a house and dairy barn – and another five acres from the Laura Baker School, both parcels lying east and south of Bell Field. By converting the barn into a stable with twenty spacious stalls and constructing practice and competitive rings – replete with jumps and hurdles – the college crew provided excellent horseback-riding facilities for Carleton women." (From *In Search of Fulfillment: Episodes in the Life of D. Blake Stewart*, by Merrill E. Jarchow).

The equestrian program ended with the Carleton Farm in the 1960s. The barn stood empty for many years and was beginning to collapse when it was destroyed by fire in 2005.

(6) Women's League Cabin Site: "For a number of years, women students had been asking for a cabin, 'far enough away from the campus for independence but close enough to reach on a bicycle.' In 1938 on land recently purchased from a neighboring farmer, Stewsie, carpenter Ed Lee, and others, by rebuilding a 'shack' located there, furnished Carleton coeds with the hide-away they had been seeking. This Stewart-designed structure continues to sere students faithfully in the 1970s." (From *In Search of Fulfillment: Episodes in the Life of D. Blake Stewart*, by Merrill E. Jarchow).

cession in the presence and absence of deer browsing. Trees within the exclosures initially were taller, but 16 years later the entire area is covered by tall young trees – proof that while deer can delay succession, they do not prevent it entirely.

Often, young trees in restorations die with no apparent aboveground damage. This can usually be traced to two native grassland rodents: meadow voles and pocket gophers. Meadow voles kill young trees by consuming bark from the base, while pocket gophers kill trees by consuming roots. Together, these two species can cause significant mortality in young forest restorations. As trees mature, they become less vulnerable to these rodents. Once enough shade develops to prevent grass growth, meadow voles and pocket gophers leave in search of grassier abodes.

Despite these difficulties, forest restoration in the Arb has been ultimately successful. The best examples can be found in the 1991, 1993, and 1994 restorations, in which nearly all trees are tall enough to escape deer browse and sufficient shade has developed to begin to reduce grass cover beneath the trees. As these trees mature, the understory will transition from grasses and weeds to a characteristic community of forest understory plants.

Many of these plants grow and bloom in April and early May, before the trees leaf out and filter the sunlight reaching the forest floor. These "spring ephemerals" are easy to identify but easy to miss, as they bloom for only a few days or weeks each year. For help with identification, check out the Arboretum website:
http://apps.carleton.edu/campus/arb/seasonal/spring_wildflowers/
http://apps.carleton.edu/campus/arb/seasonal/may_wildflowers/

Late March to early April
Siberian Squill (*Scilla siberica*) – nonnative species

Mid-April to early May
Acute-leaved Hepatica (*Hepatica acutiloba*)
White Trout Lily (*Erythronium albidum*)
Bloodroot (*Sanguinaria canadensis*)
Dutchman's Breeches (*Dicentra cucullaria*)

seum" (see history section of this guide), he also had an appreciation for native communities. Stork's sugar maple and basswood seedlings have now grown into a mature forest with an open understory.

Beginning in 1986, a number of agricultural fields have been abandoned and designated for forest restoration. In most of these areas, young trees were hand-planted to jump-start the process. Two fields abandoned in 1991 and 1992 are immediately adjacent to Best Woods; these fields were left unplanted in order to study the natural process of forest succession in land adjacent to a mature forest.

Restoration of forest is both easier and more difficult than prairie restoration. It is easier because most of the tree species are already present in the Arb and because any area will eventually become forest given enough time in the absence of fire. It is, however, made difficult by three factors: invasive species, deer, and rodents.

The Arb contains one aggressive nonnative tree, Siberian elm, and two aggressive nonnative shrubs, buckthorn and honeysuckle. While these species do not easily invade dense, mature forests such as Best Woods, they can overwhelm young forests or older forests with an open canopy. Arb Manager Myles Bakke and his student crew attack all three of these species with chain saws, brush cutters, and herbicides in order to allow native forest to regenerate.

White-tailed deer (*Odocoileus virginianus*) are native to this area, but their populations are currently much higher than in presettlement times largely due to the elimination of wolves, a key predator. Deer consume grass, leaves, and berries in the summer months but switch to a diet of twigs in the winter. The Arb may contain upwards of 40 deer, and these animals can delay forest succession by repeatedly consuming the growing tips of young trees. For this reason, most of the trees that are hand-planted are also given plastic sleeves to protect them until they are taller than the heads of deer. In addition, local bow hunters are allowed into the Arb each December to hunt deer in an attempt to reduce the population. In the 1991 field, three chain-link exclosures were constructed to compare the process of forest suc-

The cabin was poorly maintained in the 1980s and became a favorite party spot. After a safety inspection revealed that major renovations would be required to meet building standards, the structure was torn down in the early 1990s.

(7) Lilac Hill: In 1935, A. M. Brand of Faribault quit the lilac-selling business and donated his remaining stock – some 1500 lilacs of over 90 varieties – to Carleton. These lilacs perfumed the campus each May for over 70 years. Most of the bushes have now died, and buckthorn and other trees have invaded the area. Efforts are currently underway to remove the buckthorn and dead lilacs, but as of this writing it is uncertain what is to become of Lilac Hill.

(8) Bridge Abutments: A suspension bridge here carried a footpath across the river from 1930 until its age-necessitated removal in 1987. From 1930 until 1957, the nature trail with its numbered stops proceeded across this bridge. The bridge was not replaced for several reasons. It provided access to a small portion of land that contained few recreational and research opportunities not available elsewhere in the Arb, and it provided unlighted access to the Arb from town, leading to student safety concerns.

(9) Cattle Underpass: The Carleton Farm (1914-1964) once covered the area on both sides of Hwy 19, and this underpass was constructed so that dairy cattle could be safely and easily moved across the road.

(10) Waterford Bridge: Built in 1909, the Waterford Bridge is one of the oldest bridges still in use in the area. As of this writing, it has a four ton weight limit, and plans are in place to construct a new bridge to carry Canada Avenue across the river. Due to its historic value, the old bridge will be left in place and will remain open to pedestrian traffic for as long as it remains structurally sound.

ARB COMMUNITIES

Prairie

The word "prairie," derived from the French "praierie" (meadow), describes a native grassland community that once covered all of the Great Plains, from Iowa and Minnesota west to Colorado and Wyoming. Dry western prairies are dominated by short grasses and drought-tolerant plants, while the wetter Minnesota prairies are dominated by taller grasses and a different array of plants. The community also varies at a local scale, with a drought-tolerant shortgrass community found on sandy hilltops, a tallgrass community found on level areas, and a water-loving community found in marshes and along watercourses.

To the uneducated eye, a prairie can appear as a field of grass, but this unassuming appearance hides a remarkable diversity of plants. Native tallgrass prairies found in this area before settlement contained upwards of 100 species of plants. When wet, mesic, and dry habitats are considered together, the total rises above 200. Most of these plants are "forbs" (flowering herbs), a generic term for any flowering plant that is not a grass or a sedge.

The area around Northfield receives more than enough precipitation to support forest, as is evidenced by the forest vegetation originally found west and south of the Arb. The entire area would have been covered by forest in the absence of the fires that swept through the prairies, killing all trees except for the fire-tolerant bur oaks. Set by Native Americans or by lightning, these fires burned all aboveground vegetation several times per decade. Fire is as essential to prairie as precipitation; in the absence of fire a forest is soon established.

While much of the area occupied by the Carleton campus and the Upper Arb was originally prairie, nearly all of the prairie sod was plowed by pioneer farmers. Where the land was too steep to farm, prairie transitioned to forest following the cessation of fire. The Arb contains only one tiny patch of original prairie, Postage Stamp Prairie in the Upper Arb. The other 100+ acres of prairie in the Arb have been restored in perhaps the most exten-

1200 A.D. a change in climate or reduction in fire frequency allowed fire-intolerant hardwoods to spread from small protected refuges and cover a large region. Before this time, the area was dominantly covered by oak savanna.

Following settlement of the area, the demand for firewood, construction timber, and farmland spelled the end of the big woods. It was not annihilated to the same degree as prairie, however, because it does not require fire to be maintained. Scattered fragments survived in woodlots and along rivers. Remnants of this forest can now be found near Northfield in Nerstrand Big Woods State Park and the Cannon River Wilderness Park.

It is unclear whether big woods forest existed in the Arb prior to settlement. Aerial photos from the 1930s reveal that much of the Arb's upland forest is quite young. **(48)** The oldest large area of upland forest is Best Woods in the Lower Arb. This may be original forest but several factors suggest otherwise. 1) The Public Land Survey, conducted in the 1850s, generally found forest on the west side of the cannon and prairie/oak savanna on the east side. 2) Best Woods does not contain any sugar maples, a signature species of big woods forest. 3) Large black walnut (*Juglans nigra*) trees can be found in the center of Best Woods. Black walnut is a pioneer tree species that cannot regenerate in shade, suggesting that the area now occupied by Best Woods was more open ~100-150 years ago when these trees sprouted. Taken together, these factors suggest that Best Woods is not original forest, though some big woods-type forest may have existed along the steep riverbank prior to settlement.

Whether or not big woods forest was ever present in the Arb, the decision has been made to restore a large portion of the Arb to this vegetation community. This includes Alumni Field and surrounding areas in the Upper Arb and all of the land outside of the floodplain and north of the prairie/oak savanna in the Lower Arb. Some areas, such as Best Woods and Stork Forest, are at or very close to maturity, while most of the forest is much younger.

(49) The first forest restoration undertaken in the Arb was Stork Forest, planted by Professor Harvey Stork in the 1930s and 40s. While Stork was primarily interested in creating a "tree mu-

houses such as the ones near marker #16 substitute for tree cavities. They are placed in pairs to accommodate both bluebirds and tree swallows. Both species are highly territorial toward others of their kind but are willing to accept other species as close neighbors.

Oak Savanna Points of Interest

(17) Umbanhowar Oak Opening: A few hundred feet into these oak woods is a small meadow containing native prairie and oak savanna species. Many of these bur oaks are over 100 years old. When the oaks were young, this area was oak savanna, with grasses and prairie plants beneath scattered oaks. In the last century, buckthorn and small trees have grown up beneath the oaks, leaving only this small meadow. Charles Umbanhowar, Jr. '85, now a biology professor at St. Olaf, worked on clearing brush from this area during his time at Carleton. Since that time, the Arb crew has cut buckthorn every few years to prevent re-establishment. Future plans for this area call for removing non-bur oak trees and restoring savanna by planting prairie beneath the remaining oaks

(18) Wright Savanna: Essentially an expansion of Postage Stamp Prairie, this area was cleared and restored in 1992 with a grant given in the name of longtime Vice President of the College Frank Wright and his wife, Louise. The large bur oak is old enough that it probably stood in oak savanna in its youth. With the buckthorn and other brush removed and the prairie restored, this area is once again oak savanna.

Upland Forest

Prior to settlement, much of the land to the west and south of the Arb was occupied by "big woods" – hardwood forest dominated by sugar maple (*Acer saccharum*) and basswood (*Tilia americana*). This forest stretched northwest to southeast in a band from around St. Cloud to Mankato and Faribault. Pollen records reveal this forest to be relatively young; sometime around

sive prairie restoration effort in the state.

The first attempt at prairie restoration in the Arb began with the following 1977 ad in the NNB: "Hey man, wanna go south, get some sun, and smuggle some grass?" The "smuggled grass" consisted of squares of prairie sod rescued from a construction site south of town. The experiment failed miserably, as the sodcutters failed to harvest enough of the deep roots of prairie plants to ensure their survival. Between 1978 and 1990, small plots were planted each year on Hillside Prairie, but restoration did not begin in earnest until 1995.

Under the guidance of Arb Director Mark McKone and Arb Manager Myles Bakke, ever larger areas have been planted into prairie each year since 1995. Only local genotypes are used – all seeds are collected from McKnight Prairie (a Carleton-owned remnant prairie seven miles northeast of campus), other local prairie remnants, or from earlier restorations in the Arb. Bakke and the Arb crew collect seeds from over 80 species of plants throughout the summer, and a small area of McKnight prairie is combined to obtain seeds of common grasses and goldenrods. Following fall tillage, the prairie seed mixture is machine-planted, and Bakke hand-sows some rare species in appropriate microhabitats. McKone conducts semiannual vegetation surveys on the restorations and has published several papers describing the process of succession that occurs as various species of plants reach maturity at different stages.

Arb prairies are dominated by three species of grass: Big Bluestem (*Andropogon gerardii*), Indiangrass *(Sorghastrum nutans*), and Switchgrass *(Panicum virgatum*). These grasses utilize the C_4 photosynthetic pathway and grow fastest during the hot summer months of July and August. Forbs bloom throughout the spring, summer, and fall, and are most easily noticed when in flower. Common flowering plants are listed below by month of peak bloom.

April
Prairie Smoke (*Geum triflorum*)
Pussytoes (*Antennaria plantaginifolia*)

May
Golden Alexanders (*Zizia* spp.)
Penstemon (*Penstemon grandiflorus*)
Prairie Phlox (*Phlox pilosa*)
Alumroot (*Heuchera richardsonii*)
Blue-eyed Grass (*Sisyrinchium campestre*)

June
Wild Rose (*Rosa* spp.)
Prairie False Indigo (*Baptisia leucantha*)
Leadplant (*Amorpha canescens*)
Tick Trefoil (*Desmodium canadense*)
Yarrow (*Achillea millefolium*)
Larkspur (*Delphinium virescens*)
Coreopsis (*Coreopsis palmata*)
Spiderwort (*Tradescantia ohiensis*)
Death Camas (*Zigadenus elegans*)

July
Bergamot (*Monarda fistulosa*)
Rattlesnake Master (*Eryngium yuccifolium*)
Compass Plant (*Silphium laciniatum*)
Butterfly Milkweed (*Asclepias tuberosa*)
Mountain Mint (*Pycnanthemum virginianum*)
Culver's Root (*Veronicastrum virginicum*)
Black-eyed Susan (*Rudbeckia serotina*)
Partridge Pea (*Chamaecrista fasciculata*)
Prairie Clover (*Dalea* spp.)
Bush Clover (*Lespedeza* spp.)
Tall Cinquefoil (*Potentilla arguta*)

August
Vervain (*Verbena* spp.)
Prairie Coneflower (*Ratibida pinnata*)

(15) Bur oaks, *Quercus macrocarpa*, are large, fire-tolerant trees of open spaces. While mature trees are impervious to ground-level fire, young trees are more susceptible. Thus, oak savannas occurred in areas where fire-free intervals were occasionally long enough to allow young trees to become established. Bur oaks are the longest-lived trees native to this area – the largest examples on campus and in the Arb are well over 200 years old, and trees may survive for over 300 years. While dense forest can sprout beneath bur oaks in the absence of fire, this species does not regenerate in forest because the seedlings cannot tolerate shade. Bur oaks are thus found in open savanna habitats or in forests that were previously more open.

Following settlement of this area, many of the oaks were cut down, and removal of fire from the landscape allowed fire-intolerant tree species to sprout beneath the remaining savanna oaks. Many of the original trees survive, surrounded by equally tall but much younger cherry, elm, hackberry, ash, and boxelder trees. An ambitious oak savanna restoration is underway along the northern boundary of the prairie restorations in the lower Arb. Arb manager Myles Bakke and his student crew are removing the buckthorn and younger trees from these areas, leaving widely-scattered 100- to 200-year old bur oaks. Prairie is then planted beneath the oaks to recreate an oak savanna landscape. In addition, several small bur oaks have been planted into the prairie restorations.

In a broad sense, oak savanna can be envisioned as prairie with scattered trees. It contains most of the same species of forbs and grasses found in prairies along with some forest understory plants in shadier areas. Relatively few plant species are oak savanna specialists, perhaps because of the temporal instability of this habitat – savannas grew, receded, and disappeared over time with changes in climate and fire frequency.

(16) Several bird species are dependent on savanna habitat. These include the eastern bluebird and the tree swallow, both of which prefer prairie landscapes but need tree cavities in which to nest. Bluebirds declined precipitously with the destruction of oak savannas, but have recently made a dramatic recovery thanks to widespread construction of artificial nesting cavities. Bird-

writing, the boundaries between the restorations are clear, as year-to-year successional changes can be quite dramatic in the first five years. In a few years the boundaries will become less apparent as all four restorations reach a stable (or at least less-rapidly-changing) vegetation community.

(12) Hillside Prairie: Planted between 1978 and 1990, Hillside Prairie is the oldest patch of restored prairie in the Carleton Arboretum. In the days of the Carleton Farm, this area was used as a horse pasture.

(13) Postage Stamp Prairie/Okada Wildflower Garden: Postage Stamp Prairie is the only patch of original prairie in the Arb. It is named for its small size—not much larger than a postage stamp. The prairie has recently been expanded through restoration efforts. The Okada Wildflower Garden, a small patch of restored prairie along the trail, was donated in honor of May Okada, a longtime college employee, by her daughter Kimi.

(14) Marc von Trapp Memorial: Marc von Trapp, class of 2000, worked on the Arboretum crew and was enrolled in ecology when his life was tragically cut short. The benches and memorial were donated by his family and dedicated on his graduation date. This small grove of oaks was once part of a treeline that divided agricultural fields. When the treeline was removed, the fire-tolerant oaks were left standing to create a small patch of oak savanna on the prairie.

Oak Savanna

At the time of settlement, most of the Lower Arb above the floodplain was covered by a landscape of prairie and scattered bur oak trees. Like the prairie, this savanna was maintained by fire but was characterized by a slightly lower fire frequency. A band of savanna typically separated prairie from forest. In the Northfield area, this band was quite narrow, while to the north the band became much wider, encompassing much of the land now occupied by the Twin Cities.

Goldenrod (*Solidago* spp.)
Blazing Star (*Liatris* spp.)
St. John's Wort (*Hypericum punctatum*)
Prairie Sage (*Artemisia ludoviciana*)

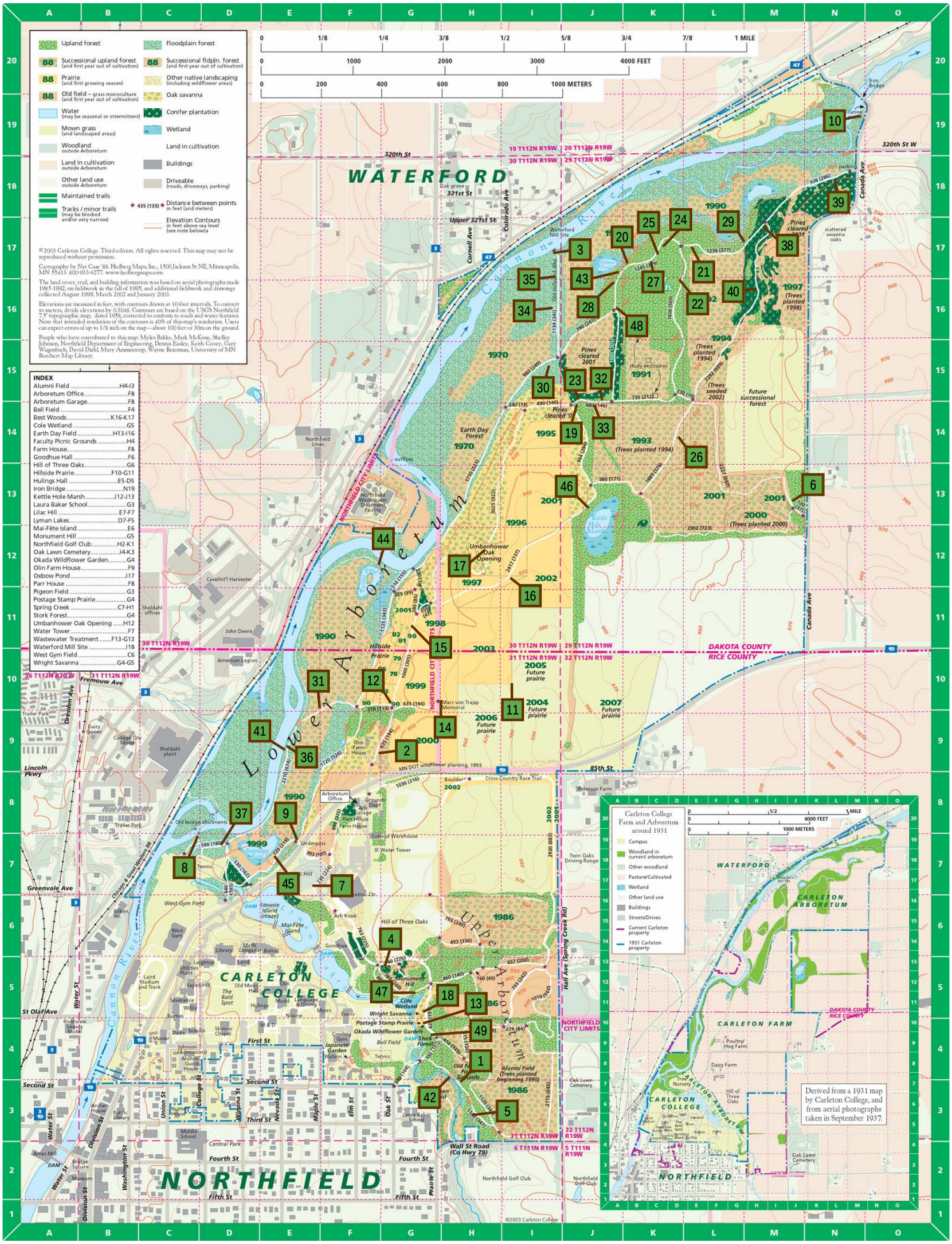
September
Asters (*Aster* spp.)
Gentians (*Gentiana* spp.)

The prairie restorations support a diverse community of grassland specialist birds in the summer months. All of these birds are more easily heard than seen, though a careful eye can spot them singing from fenceposts or tall stalks. Sedge wrens are the most common, with 23 individuals counted on the restorations in 2005. Other frequently encountered species include grasshopper sparrows, clay-colored sparrows, and dickcissels. Every year since 2005, at least one singing Henslow's sparrow has been found in the restorations. The Henslow's sparrow is a species of special concern in Minnesota that requires large areas of contiguous grassland for breeding. This year (2007), a pair of meadowlarks has appeared in the Arb prairie, announcing their presence with their beautiful flutelike song.

Mammalian inhabitants of the prairie are almost never seen, but most leave signs that reveal their presence. Tiny short-tailed shrews consume mainly insects, while meadow voles hoard and eat seeds. Thirteen-lined ground squirrels are omnivorous, eating insects, seeds, and young plants and living in shallow burrows. Pocket gophers spend their entire lives below ground, subsisting on a diet of roots. Badgers are carnivores that rely on their legendary digging ability to catch ground squirrels and pocket gophers. Large (4-5" diameter) holes surrounded by piles of dirt are a sure sign that a badger has been active in the area.

Prairie Points of Interest

(11) Four Corners: This point marks the corner of four prairie restorations: 2003 to the northwest, 2004 to the southeast, 2005 to the northeast, and 2006 to the southwest. At the time of this


Upland forest
Successional upland forest (and first year out of cultivation)
Prairie (and first growing season)
Old field – grass monoculture (and first year out of cultivation)
Water (may be seasonal or intermittent)
Mown grass (and landscaped areas)
Woodland outside Arboretum
Land in cultivation outside Arboretum
Other land use outside Arboretum
Maintained trails
Tracks / minor trails (may be blocked and/or very narrow)
Floodplain forest
Successional fldpln. forest (and first year out of cultivation)
Other native landscaping (including wildflower areas)
Oak savanna
Conifer plantation
Wetland
Land in cultivation
Buildings
Driveable (roads, driveways, parking)
Distance between points in feet (and meters)
Elevation Contours in feet above sea level (see note below)a
0 1/8 1/4 3/8 1/2 5/8 3/4 7/8 1 MILE
0 1000 2000 3000 4000 FEET
0 200 400 600 800 1000 METERS
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Cartography by Nat Case '88. Hedberg Maps, Inc., 1500 Jackson St NE, Minneapolis, MN 55413. 800-933-6277. www.hedbergmaps.com.
The land cover, trail, and building information was based on aerial photographs made 1985-1992, on fieldwork in the fall of 1995, and additional fieldwork and drawings collected August 1999, March 2002 and January 2003.
Elevations are measured in feet, with contours drawn at 10-foot intervals. To convert to meters, divide elevations by 0.3048. Contours are based on the USGS Northfield 7.5' topographic map, dated 1958, corrected to conform to roads and water features. Note that intended resolution of the contours is 40ft of this map's resolution. Users can expect errors of up to 1/8 inch on the map—about 100 feet or 30m on the ground.
People who have contributed to this map: Myles Bakke, Mark McKone, Shelley Johnson, Northfield Department of Engineering, Dennis Easley, Keith Covey, Gary Wagenbach, David Dahl, Mary Ammentorp, Wayne Bezerman, University of MN Borchert Map Library.
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Derived from a 1931 map by Carleton College, and from aerial photographs taken in September 1937.

Literature Cited

Camill, P., C. E. Umbanhowar Jr., R. Teed, C. E. Geiss, J. Aldinger, L. Dvorak, J. Kenning, J. Limmer, and K. Walkup. 2003. Late-glacial and Holocene climatic effects on fire and vegetation dynamics at the prairie-forest ecotone in south-central Minnesota. Journal of Ecology 91: 822-836.

Carleton College. 1978. A Century of Constant Change. Carleton Voice 43: 2-7 (Special Arboretum Feature).

Grimm, E. C. 1983. Chronology and dynamics of vegetation change in the prairie-woodland region of southern Minnesota, USA. New Phytologist 93: 311-350.

Haag, B. 1981. The Arb: new intruders confront themselves. Carletonian 15 May 1981: 1,11

Hoff, J. 1978. An investigation of the vegetative history of Kettle Hole Marsh by means of pollen analysis. Geology Integrative Exercise.

Jarchow, Merrill E. 1974. In search of fulfillment: episodes in the life of D. Blake Stewart. St. Paul: North Central Pub. Co.

Little, E. L. 1996. National Audubon Society Field Guide to North American Trees, Eastern Region. New York: Alfred A. Knopf

Martin, P.S. 2005. Twilight of the mammoths: ice-age extinctions and the rewilding of America. Berkeley: University of California Press.

Oden, T. Personal Interview, May 2007.

Savina, M. Personal Interview, April 2007.

Schalch, L. H. 1984. A determination of the eastern-most extent of the Des Moines Lobe near Northfield, Minnesota. Geology Integrative Exercise

Stork, H. E. 1933. The Carleton College Nature Trail. The Minnesota Conservationist (November 1933: 8+)

Stork, H. E. 1950. Relation of Farm and Arboretum. Report to Bruce Pollock in Carleton Archives.

Swanson, D. K. 1979. Glacial geology of eastern Rice County, Minnesota. Geology Integrative Exercise.

Umbanhowar, C. E. Jr., P. Camill, C. E. Geiss, and R. Teed. 2006. Asymmetric vegetation responses to mid-Holocene aridity at the prairie-forest ecotone in south-central Minnesota. Quaternary Research 66: 53-66.

Vick, T. D., C. A. Cowan, and D. J. Packer. 1981. Geophysical survey of buried bedrock topography associated with the Cannon river system around Northfield, Minnesota. Northfield, MN: Carleton College Geology Dept.

Ward, R. 1984. The Evolving Arb. Carletonian 12 Oct. 1984: 7