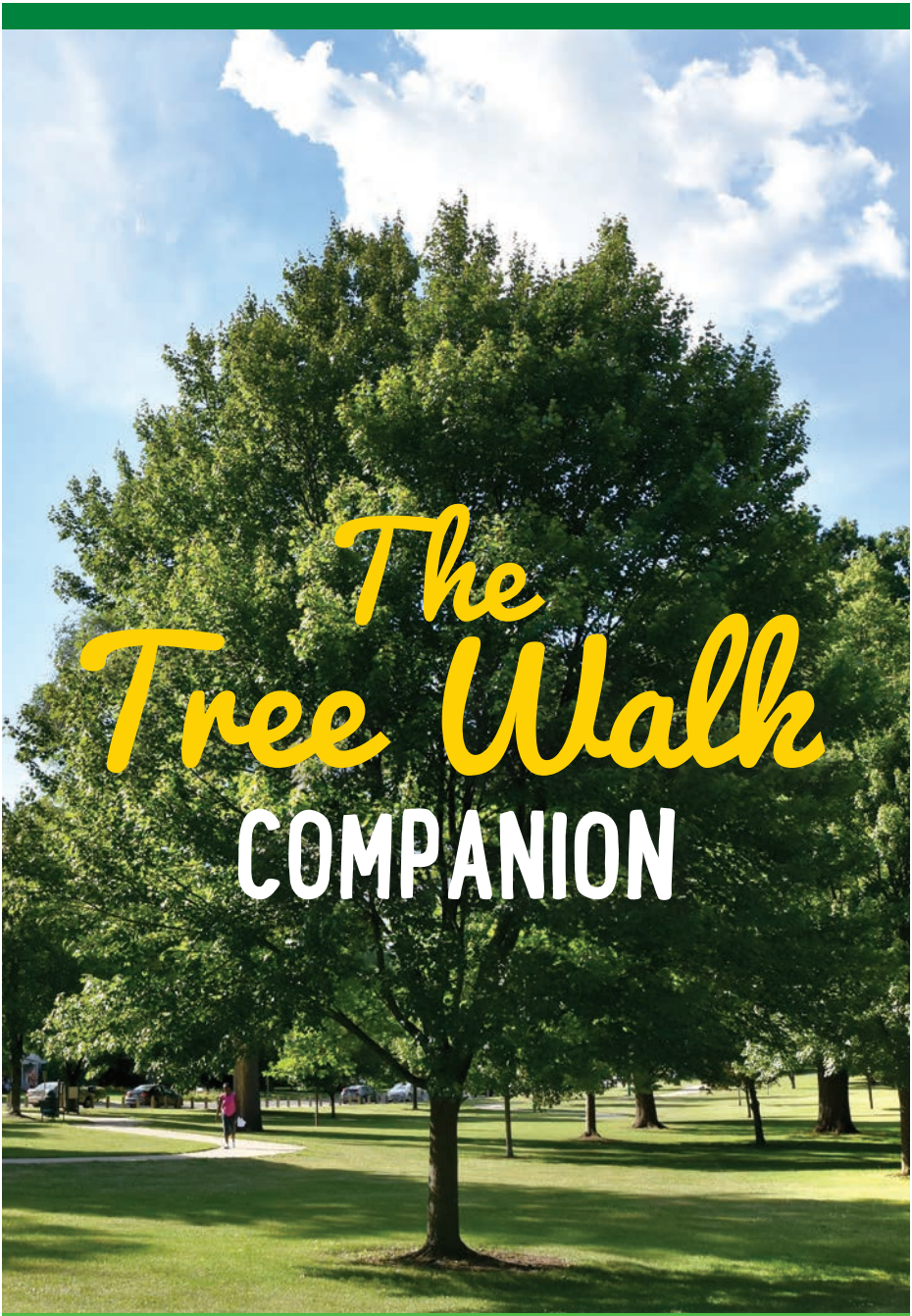


The Tree Walk COMPANION

CHAMPAIGN PARK DISTRICT

Text and illustrations: Jean Burridge, ISA Certified Arborist

champaignparks.org

The Hessel Park Tree Walk has 36 different species of trees.

Each has travelled a different route to this place. Every one has unique allies, foes, and environmental challenges. This has made them what they are.

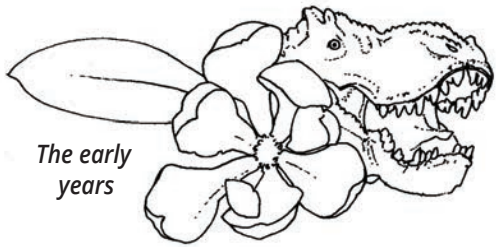
The following pages tell some of their stories.

1	Magnolia	Ancient Flowers
2	American Sweetgum	Birdfeeder
3	Silver Maple	Quicksilver
4	Kentucky Coffeetree	The Fixer
5	Scarlet Oak	Flying Oak
6	Northern Red Oak	Oak versus Squirrel
7	American Linden	Bee Tree
8	Shadbush	Timekeeper
9	Black Tupelo	Wayfarer's Inn
10	Douglas Fir	House Tree
11	Hackberry	Arbor Day
12	Littleleaf Linden	Pollarding
13	White Spruce	Farthest North
14	Bur Oak	Charge of Red Bison
15	London Planetree	Britain's Coal Age
16	Tuliptree	Cooling Tower
17	River Birch	First Responder
18	Eastern White Pine	Tall Ships
19	Swamp White Oak	Urbs in Horto
20	White Oak	Acorn Wars
21	Norway Maple	Around the World
22	Green Ash	Emerald Ash Borer
23	White Ash	No Tree is an Island
24	Sugar Maple	Sweet Spring
25	Ginkgo	Jurassic Park Tree
26	Chinese Chestnut	Chestnut Blight
27	Northern Catalpa	Keeping Them Sweet
28	Shingle Oak	Marcescence
29	Yellow Buckeye	Shady Grove
30	European Beech	First Book
31	Eastern Redbud	Forest Edge
32	Red Maple	Lower the Colors
33	Pin Oak	Cycle of Life
34	Baldcypress	Roots
35	Yellowwood	Flowers of the Forest
36	Eastern Cottonwood	River Tree

1 SAUCER MAGNOLIA

Magnolia X soulangiana

ANCIENT FLOWERS

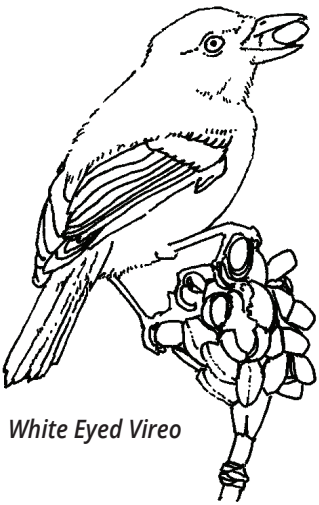


The early years

When you look at a Magnolia, you are seeing a tree that has changed very little since it first arose in the upper Cretaceous period, 95 million years ago. The Cretaceous was the last great age of dinosaurs. Magnolias shared the forest with Tyrannosaurs, Ankylosaurs and Triceratops. We all know how this ended. A deadly comet/intense volcanic activity, mass extinction. Magnolias made it, but the Age of Dinosaurs was over.

Magnolias are among the most primitive of the Angiosperms, the flowering plants, which first appear in the fossil record during the Cretaceous. What do botanists mean when they say that a flower is primitive? Anatomically, a flower is a modified branch, with four whorls: female tip, male anthers, petals, basal sepals.

In Magnolia flowers, the base of the flower is a leafy bract, not a sepal. They have simple, radially symmetrical flowers, with numerous, undifferentiated flower parts, many of which are eaten by their pollinators. Flowering plants co-evolved with bees; these ancient flowering plants employ beetles, an older (295 million years ago, Permian) group. The beetles wander around the flowers, chewing as they go, transferring the pollen that falls on them. Magnolia flowers are characterized by tough, beetle-resistant carpels (female portion of flower) which protect the developing seeds.



White Eyed Vireo

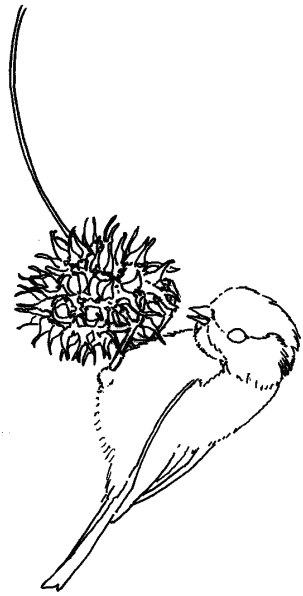
The ripened fruit of a magnolia tree (not this tree — Saucer Magnolias are sterile) is a cone-like *aggregation of follicles*, with *arillate* (flesh-covered) seeds. The arils are red when ripe, and very attractive to birds — the last surviving dinosaurs.

2 AMERICAN SWEETGUM

Liquidambar styraciflua

BIRDFEEDER

Sweetgum is a beautiful native tree, with star-shaped leaves that turn a dazzling array of colors in autumn. What's not to like? Many people will instantly reply, "The fruit!" Sweetgum fruit is an *aggregation* (aggravation?) *of capsules* that open to release winged seeds. The fruits accumulate under the trees, and can make walking beneath them quite unpleasant. Many animals also avoid stepping on the little spike balls — some gardeners rake them up into a defensive perimeter around vulnerable plants.



Carolina Chickadee demonstrates technique — some seeds eaten, some launched into flight.

Birdwatchers — and birds — know the value of these intricate orbs. Sweetgum fruit operate on the same principle as finch birdfeeders that dispense individual seeds from a slot in a plastic tube. Those birdfeeders work because birds have been exploiting Sweetgum fruit for much longer than humans have been manufacturing bird feeders. Goldfinches love Sweetgum seeds, as do sparrows, doves, and other seed-eating birds.

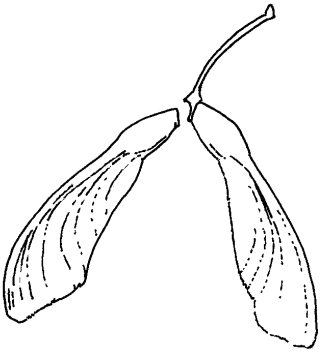
Chickadees extract seeds from the fruit while it is on the tree, and cache them in tree bark crevices. Carolina wrens rob chickadee bark stashes. Towhees are ground foragers, and work over fallen fruit. Juncos join towhees at the Thanksgiving feast spread beneath each tree.

3 SILVER MAPLE

Acer saccharinum

QUICKSILVER

A breeze ruffles the old Maple's foliage. The tree appears lighter, as the leaves lift in the wind. The lower surfaces are pale — silver, you might say.



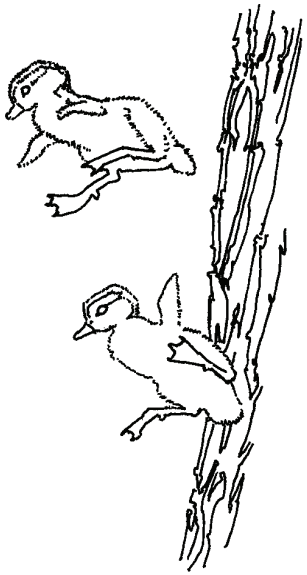
Samaras

Silver Maples are riverside trees on a tight schedule. They are the first maple to flower in late winter, and the familiar double *samara* (winged seed) ripens within three weeks of pollination.

It takes a strong spring wind to break them loose and set them whirling away from their parent tree. This increases the length of their flight. Lucky seeds drop onto damp, open soil. Unlucky seeds are eaten by a variety of hungry animals.

Those that aren't eaten start to grow. Seeds germinate quickly — no time to waste. The little trees are established before the canopy has closed for the summer. They can begin to set seed themselves when eleven years old. Silver Maple grows fast enough to be a candidate for biofuel.

Trees that grow rapidly often have weak wood, and are vulnerable to storms and decay. This has not gone unnoticed, or unappreciated. Wood Ducks find safe harbor for their nests in the resulting cavities. The Silver Maple's seeds have long flown by the time the ducklings venture forth from their tree.



Fledgling Wood Ducks

4 KENTUCKY COFFEETREE

Gymnocladus dioicus

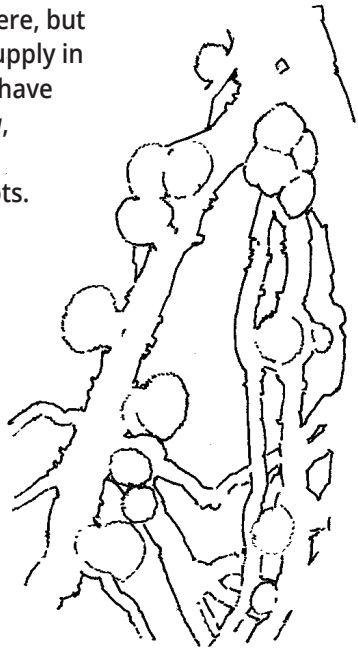
THE FIXER

It doesn't look like a soybean. But the Kentucky Coffeetree, like the soybean, is a member of the pea family (*Fabaceae*, formerly *Leguminosae*). Being a tree is a survival strategy, not a family business, and members of many different plant families have developed woody stems, and grown tall in pursuit of sunlight.

Coffeetrees and soybeans share distinctive pea flowers, and fruit that is a *legume*, a capsule that opens on two sides. Like most members of this family, they can fix nitrogen.

Nitrogen is an essential element for plant growth. It is present in each peptide in every protein molecule in all of the tree's cells. Nitrogen is in every nucleotide of the tree's genetic code. Nitrogen is essential to the tree's existence.

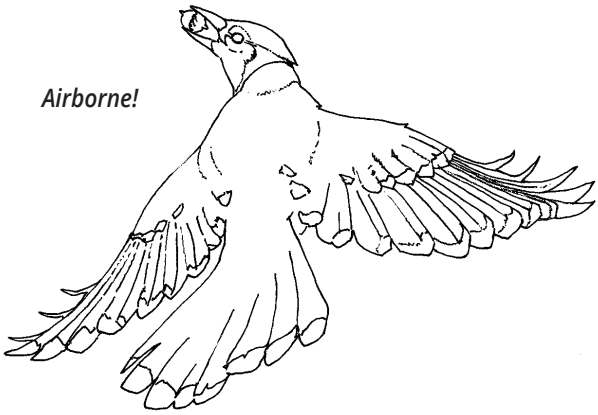
Nitrogen is abundant in the atmosphere, but unreactive. It is in chronically short supply in forests. Many plants in the Fabaceae have a symbiotic relationship with *Rhizobia*, nitrogen fixing bacteria. The bacteria infect the outer layer of the tree's roots. The tree grows nodules that enclose the bacteria, and the nitrogen compounds that they exude. The bacteria are protected, nourished with sugars, and Coffeetree and *Rhizobia* prosper together.



Rhizobia nodules

5 SCARLET OAK

Quercus coccinea



Airborne!

FLYING OAK

How can an oak fly? On the wings of an acorn-eating bird. (Think of that next time you book a flight…) The mobile stage of a tree is its seed, and oaks have a long-standing relationship with jays. In Illinois, Blue Jays gather and store acorns in the fall, and they don't always polish them all off by winter's end. Most of the acorns feed Blue Jays, but a few survive to grow into trees. Jays are acorn specialists. They have a *gular pouch*, an enlarged area of their throat, which they use to carry acorns.

This all matters because it allows oak forests to move. They retreated before advancing glaciers, and pushed north as the ice melted. Thanks to the "air lift service" that these birds provide, oaks can travel fast when they need to. Jays will fly a mile or more with their acorns, before hiding them in the ground. Each Blue Jay moves thousands of acorns each year. Jays are believed to have been a factor in the northern migration of the oak forest, after each glacial retreat.

6 RED OAK

Quercus rubra

OAK VERSUS SQUIRREL

Most oak trees are planted by squirrels. They have a long-standing, mutualistic relationship with nut-bearing trees. Squirrels harvest, assess and bury acorns in fall, and eat them all winter. Red Oak acorns do not germinate without *vernalization*, a period of cold temperatures in moist conditions. They must survive, planted and uneaten, until spring.

Squirrels eat weevil-infested acorns immediately; they will not keep. Acorns are buried to conceal them — they are moved if the squirrel thinks that a potential thief (such as another squirrel — takes one to know one) has spotted the cache. Between their excellent noses, and their excellent memories, almost every acorn has been eaten by spring. How do oaks survive this assault?

Oaks, along with other nut-bearing trees, save up for *mast* years. In most years, few acorns are produced — just enough to keep a small contingent of squirrels on retainer. In a mast year, all of the trees in a region flood their predators with more nuts than they can eat. It is not known what determines whether a year will be a mast year: spring weather, hormonal communication between trees, and time since the last mast year may all factor into it. The squirrels eat well, and bury all they can, but some of the massive granary sprouts in the spring.

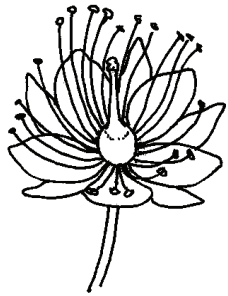
With luck, some will survive to feed future squirrels.

7 AMERICAN LINDEN

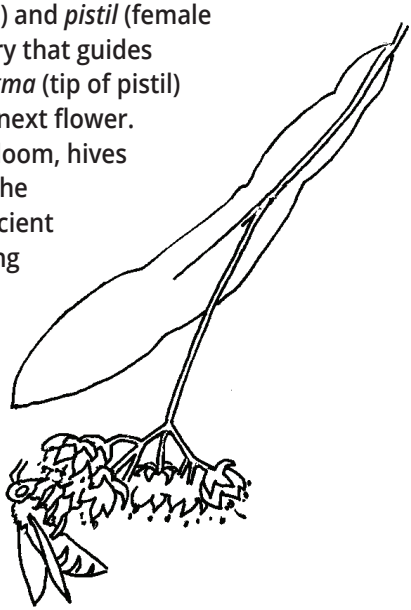
Tilia americana

BEE TREE

This tree, American Linden, is a pollinator garden several stories tall. American Linden, Basswood, is also known as Bee Tree, and for good reason. The flowers are very fragrant, with a citrus aroma that gives rise to another common name for Linden, Lime Tree. The fragrance is a lure, and the bees fly in. Lindens flower in early summer, and on a sunny day, you can hear them humming with a myriad of visiting bees.



Compare the flower with that of the primitive Magnolia. The Linden flower has fewer, more distinct parts. It is protected by a tough *calyx* (basal flower whorl) not barely modified leafy bracts. It has five distinct *petals,* and the *anthers* (for pollen) and *pistil* (female center) are backed up by a nectary that guides pollinators past the receptive *stigma* (tip of pistil) for a hit of sugar. Then on to the next flower. When these trees all come into bloom, hives of bees will devote their days to the Linden's flowers, ensuring an efficient transfer of genetic material among the trees. Linden honey is the result. It is a pale, almost mint-flavored honey, which sells for a premium – if you can find it.



8 SHADBUSH

Amelanchier species

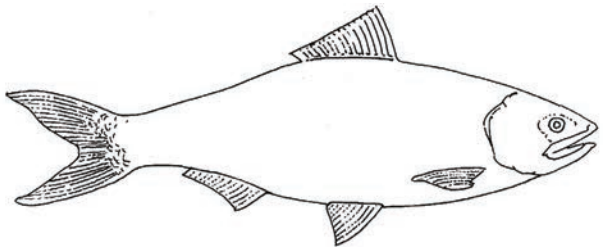
TIMEKEEPER

Before digital or printed calendars, people kept tabs on the year's schedule of work by observing *phenological* calendars – the annual recurrence of natural phenomena, such as the flowering of a species of tree. The common names of *Amelanchier* species — Shadbush, Serviceberry, Juneberry — remind us of these uses. Shadbush is well suited to this role. It flowers abundantly, and the flowers are fleeting – a precision timepiece. The flowers of Shadbush marked the return of shad, an *anadromous* fish, from the Atlantic to the rivers of the eastern coast, where it lays its eggs.

Shad arrived in the eastern rivers at the end of winter, when people were running low on food. They were a vital resource, and the flowers of the Shadbush must have been a sign, not just of spring, but of hope.

With climate change, these old associations are unraveling. Plant calendars are most sensitive to day length. Shad are temperature dependent, spawning when the water is warm enough. They were heavily exploited during the 19th century; recovery efforts are ongoing

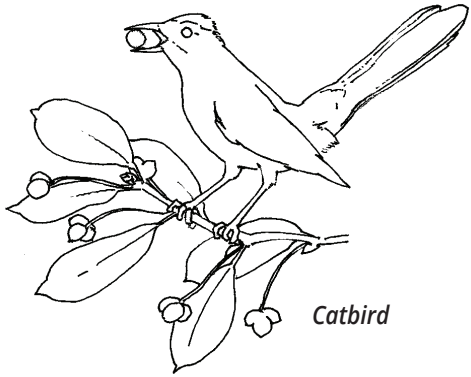
Shadbush still keeps time along the banks of the Potomac.



American Shad, *Alosa sapidissima*

9 BLACK GUM (BLACK TUPELO)

Nyssa sylvatica



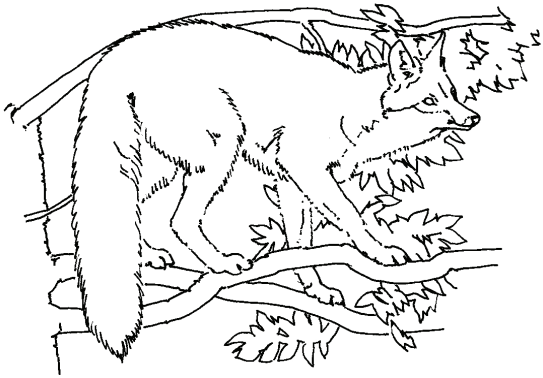
Catbird

WAYFARER'S INN

Autumn is the season of the great southward migration. Birds that raised their young on the bounty of northern summers head south to escape winter's dearth. Some birds winter on the Gulf Coast, others fly all the way to South America. To fuel this tremendous effort, they need to find food along the way.

Black Tupelo fruit is an important food source for many birds. Tupelos have brilliant fall foliage, which colors early. That color may be a high-contrast signal to birds, which have excellent color vision, that the fruit is ripe. *Fruit flagging* — coloring early and giving up weeks of photosynthesis — is costly. Dispersal by birds that are on the move may be worth it to the tree.

Migratory birds don't have a monopoly on this resource. Whitetail deer, turkeys and other fruit eating animals enjoy Tupelo fruit. Foxes gladly partake, and the arboreal Gray Fox will climb the tree to get to it.

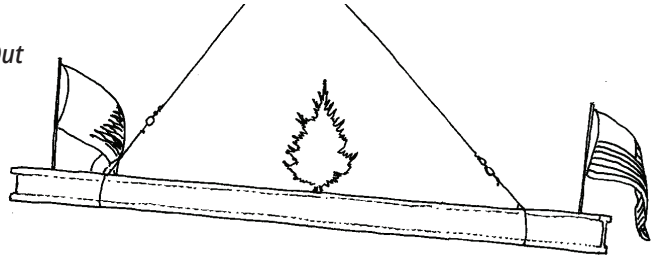


Gray Fox, aloft!

10 DOUGLASFIR

Pseudotsuga menziesii

Topping Out



HOUSE TREE

This Douglasfir is a specimen tree, planted for its beauty. Most are grown for timber. Douglasfir is one of the most valuable lumber species. It is a mainstay of the construction industry, and is present in almost every wooden structure built in the United States.

People use a lot of tree products: construction lumber, shipping pallets, copier paper. Much of this comes from tree plantations, a useful, but ecologically simplified forest, in which trees are grown as a crop for harvest. Douglasfir is often grown in plantations.

Genetically elite seedling trees are selected for fast, straight growth and pest/pathogen resistance. They will need these traits in a uniform stand — a big target for insects and fungi. They are planted on cleared ground in same-age stands, and may be treated with fertilizer, pesticides and herbicides. Stands are thinned to reduce competition. When economically mature, and growth is slowing, the remaining trees are cut. New seedlings are planted.

Plantations produce more pulp or timber per acre than natural forests. They are monocultures, often of exotic species. They are ecologically impoverished, poorer in biodiversity than the natural forests that they replace.

The ceremony of *Topping Out* a new building, by attaching an evergreen branch or a living tree to the last beam when it is placed, is quite ancient. It honors both the trees that were sacrificed for lumber, and the skill and courage of the builders. When you walk through the door of your home this evening, spare a thought for the Douglasfir that keeps it straight and true.

11 HACKBERRY

Celtis occidentalis

ARBOR DAY

The first Arbor Day was celebrated in Nebraska on April 10th, 1872. Nebraskans planted a million trees that day. Nebraska's climate is harsh, with hot summers, very cold winters, and less rainfall than the forested east. It takes a tough tree to grow in Nebraska, and the Hackberry is such a tree.

Hackberry is found well into Manitoba, and south to Oklahoma. It will grow where yearly temperatures vary by 140 degrees Fahrenheit. Established trees need only 14 inches of rainfall in a year. Kansas Hackberries kept growing during the great drought of 1934; only Bur Oak and Eastern Redcedar did better in that dire year.

Hackberries are thriving in another harsh environment — cities. In 2020, the Society of Municipal Arborists named Hackberry as the Urban Tree of the Year.

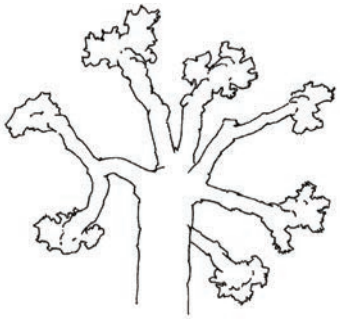
Ready to plant!

12 LITTLELEAF LINDEN

Tilia cordata

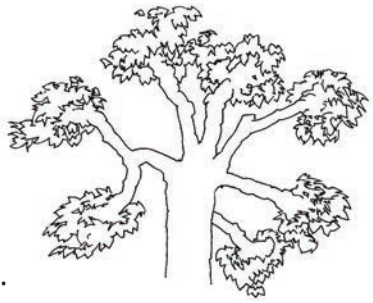
POLLARDING

In the before-times — before chainsaws — people often grew their wood to size. Cutting down and milling big trees with hand tools is hard work! Many trees in European forests were *pollarded*. Pollarding is an ancient form of pruning that develops and maintains a *meristematic* (regenerative) *callus* (undifferentiated tissue) that will re-sprout indefinitely. The sprouts are harvested for poles, or stove-wood at intervals. Pollarded trees can also serve as unusual garden specimens.



Late winter, after pruning

Lindens often annoy landscapers by sprouting from the base of the tree. They were (and are) ideal candidates for pollarding. If you have travelled in Europe, you may have seen pollarded trees. They are rare in the United States.



Spring

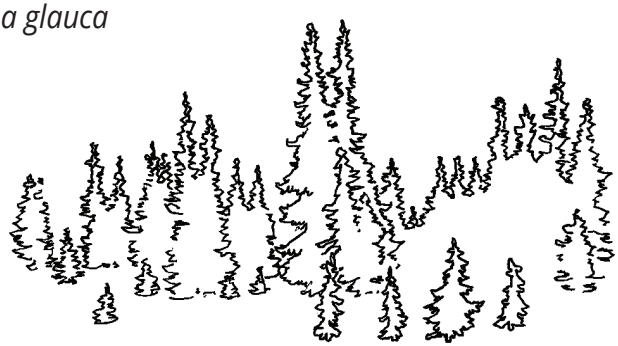
Pollarded trees have a trunk and scaffold branches. This puts the tender new shoots out of reach of foraging animals.

To pollard a tree, the young tree is *topped* — major limbs are cut short, and the stubs allowed to grow bunches of replacement shoots. These shoots are carefully removed the following winter, cutting them off at the base, without injuring the callus, which will produce new shoots. A pollarded tree is dependent on regular pruning, as the shoots are poorly attached, and crowded together.

Late autumn

13 WHITE SPRUCE

Picea glauca



FURTHEST NORTH

Imagine that you are travelling north. Cross the Illinois state line into Wisconsin. Halfway across Wisconsin, you begin to see them. Continue across the border into Canada. You have left the eastern deciduous forest, and entered the *boreal* forest, dominated by conifers. Keep going, along the western edge of Hudson Bay, until you reach the northern edge of the northern forest. The northernmost tree is a White Spruce.

White Spruce will grow where winter temperatures drop to 65 degrees below zero Fahrenheit. Spruce forests were the first to reestablish in the wake of the retreating glaciers. This tree has mastered cold. How does it manage this?

Leaves (needles) are small, waxy, and persistent. The tree doesn't have to budget replacing them every year, which is good in a short growing season. They don't desiccate in winter, when soil moisture is locked in ice. They don't freeze in late cold snaps. Drooping branches shed snow, and catch low-angled sunlight.

Flowers are basic, almost indistinguishable from new shoots when they start to open. They are wind pollinated, not dependent on warmth for insects. As White Spruce often grows in pure stands, insect guidance is not needed.

The tree prepares for winter by *hardening*, expelling water from its cells. The concentrated residue within the cell is frost-resistant. The intracellular water is so pure that ice crystals cannot form. The tree can super-chill without consequence.

There is reason why Christmas trees are conifers. They are emissaries from the land of winter.

14 BUR OAK

Quercus macrocarpa

THE CHARGE OF RED BISON

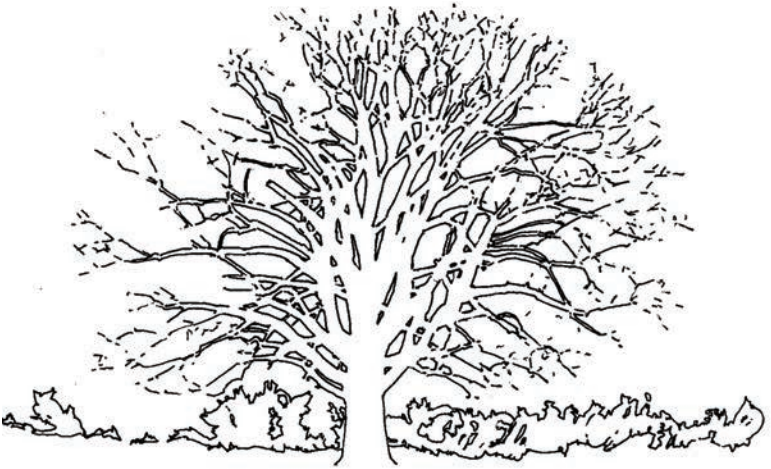
In autumn, as the sun sinks and the tall grasses ripen, the life of the prairie retreats underground. *Red Bison* — prairie fire, age old defender of the great meadows, begins to stir.

Fire defines prairie ecosystems. It kills hopeful tree seedlings, and anything else that dares to rise up above the earth when it passes. One tree withstands its charge — the Bur Oak.

Even as an acorn, Bur Oak is massive, sending down a big root that can re-sprout, if burned as a seedling. Branches are light, for their caliper. A cross section reveals a thick layer of corky bark, which insulates the vital vascular tissues. Each twig is heat-resistant. The trunk is massive, armored in ridged bark that will shrug off most fires.

Bur Oaks are found farther out in the prairie than other trees, forming the *oak openings*, groves of well-spaced trees that are the vanguard of the eastern deciduous forest.

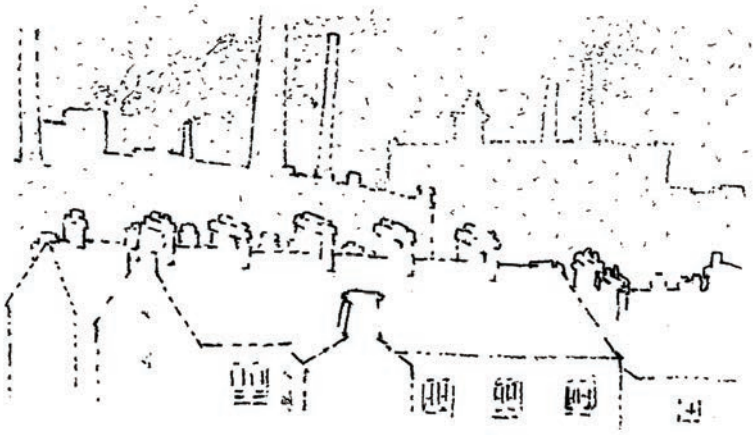
These groves attracted people. Towns such as Villa Grove were founded in Bur Oak openings. Urbana was once the Big Grove.



Fire!

15 LONDON PLANETREE

Platanus x acerifolia



BRITAIN'S COAL AGE

Nineteenth century cities packed their citizens in close proximity to massive new industries. There was no zoning. Steel mills and rail yards were next to dwellings, and everyone burned coal for warmth. You can see the results of this on old museum specimens — even the birds are covered with soot!

Black grime coated every surface, and the pines that once graced cities could no longer survive there. The Missouri Botanical Garden's Shaw Nature Reserve was established outside of Saint Louis to protect the collections from urban air pollution.

The London Planetree is the urban tree of this era. It is an English, 17th century hybrid between the American Sycamore and the Oriental Planetree. It would not have existed without the trade in exotic plant species that improved transportation made possible. Unlike the evergreen pines, London Planetree sheds its leaves every year, and even sloughs off some of its bark during summer growth. It not only tolerates pollution, but it removes some of it from the atmosphere.

Changing laws and new agricultural technologies forced rural people into cities. London Planetrees accompanied them, and made their lives a little better.

16 TULIPTREE

Liriodendron tulipifera

COOLING TOWER

Big shade trees make city summers much more pleasant. They pull heat-trapping CO2 out of the atmosphere, and absorb a number of atmospheric pollutants. They calm strong winds, and soak up rain, reducing flooding in big storms. But the most obvious benefit is cooling. A neighborhood with many trees can be as much as 10 degrees cooler than one with few trees. How do they do this?

Tree leaves absorb sunlight, to fuel photosynthesis. Each solar array (leaf) blocks sunlight. This keeps the area shaded by the tree from absorbing, and re-releasing, heat. Trees store much less heat than concrete. They are full of water, which changes temperature more slowly than pavement or houses.

Trees move water from the soil up into their leaves by *transpiration*. This process is driven by evaporation from the *stomata*, small openings on the underside of the leaf. Loss of water from the leaves creates a pressure gradient — water moves from high to low pressure.

Evaporation, changing from a liquid to a gas, is a *phase change*, which requires energy. Heat from the surrounding air provides the energy, and a temperature drop is the result. Perspiration cools an athlete in the same way.

People exercising under trees can let the trees sweat for them!

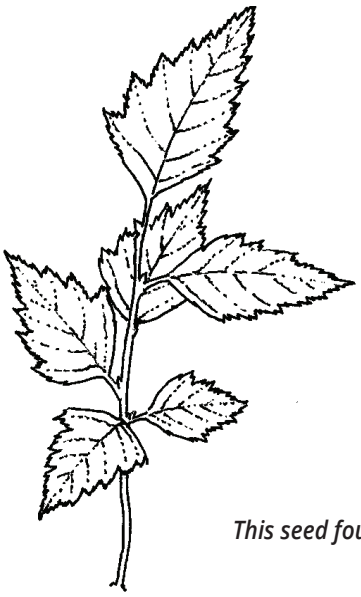
17 RIVER BIRCH

Betula nigra

FIRST RESPONDER

Birches are among the first trees to colonize devastated land. River Birches flower early, in April, and are wind pollinated. They do not have to wait until insects warm up and get to work. They set seed every year, which ripens in late spring. After a fire or washout, tiny, winged, windblown seeds arrive at the beginning of the growing season. They germinate immediately, grow fast, and prepare to hang on. They are river bank trees, and can tolerate several months of flooding.

Birch need to find and hold open ground. They require full sun. Seedlings cannot wait in the shady understory for an old tree to die. All Birch are pioneer species, starting new forests, or replacing those that have been destroyed.



This seed found open ground

Coal mining clears forests, and can leave a legacy of acidified soil. River Birch exploit this. Their competition has been removed, and it can't grow back. These tough trees can tolerate sites that have been polluted by coal mines, reforesting stream bottoms with a pH of 2.0, as acidic as vinegar.

18 EASTERN WHITE PINE

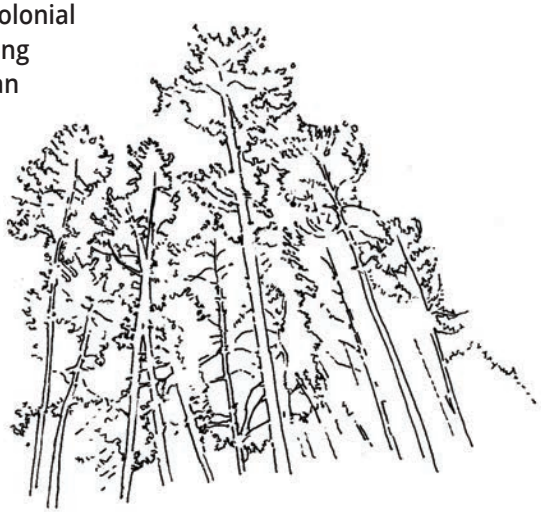
Pinus strobus

TALL SHIPS

Tree trunks withstand gale force winds while attached to the earth. Perhaps a wind-tossed tree inspired the inventor of the first mast? Sailing ships convert air movement into forward motion. The ship's mast takes the force of the wind and transfers it to a vessel that could weigh hundreds of tons.

Europeans first made it to North America on wooden sailing ships. The ability to reliably project armed force over long distances was the basis of European expansion in the early modern period. Industrialization had already destroyed much of the European forest, restricting ship-building. The explorers and colonists who encountered the Eastern White Pine forests of New England saw them as, potentially, vast armadas. They immediately started to fell the pines, and sell them to British shipyards. Lumber was one of the first American exports.

Eastern White Pines were strategic. The largest pines, trees that were 24 inches or more in diameter measured at one foot above the ground, were, legally, off limits, They were reserved for the Royal Navy and marked with a broad arrow blaze. Loggers felled them anyway, and had them milled to a "legal" 23.5 inches. The dispute between the British government and colonial timber interests was among the causes of the American War of Independence. Less than 0.5% of old growth Eastern White Pine survives.



Mature Eastern White Pines

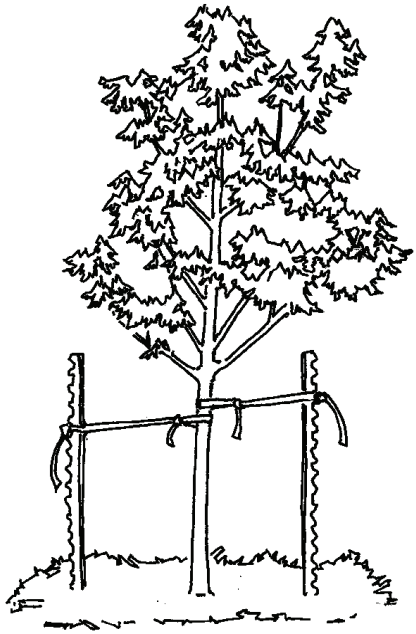
19 SWAMP WHITE OAK

Quercus bicolor

URBS IN HORTO

City in a Garden. It's the motto of Chicago, and the goal of city planners and arborists everywhere. A valued ally has been the Swamp White Oak, urban tree of the 21st century.

What makes a good city tree? Cities are notably distinct from the forests that trees evolved to live in. The soil is disturbed, compacted, and largely covered with buildings and pavement. Planting sites are exposed, but may be shaded by structures. The plants and animals of the forest have largely been replaced by humans, who demand an orderly environment. Attorneys view tall wooden objects with suspicion.



Newly planted oak

Swamp White Oaks, as the name suggests, are pre-adapted to saturated, oxygen-poor soil, flooding and drought. They have strong wood, so aren't readily damaged by storms. The wood resists decay, keeping the trees structurally sound. Oaks tolerate pruning — essential for building and vehicle clearance. As white oaks, they have some resistance to the vascular diseases that plague oaks. Tree nurseries can grow and transplant them. They aren't too messy. They are handsome trees.

The Society of Municipal Arborists named Swamp White Oak as the 1998 Urban Tree of the Year — one of the first trees to be selected. There is no place more urban than New York, New York. Swamp White Oaks were chosen for the Memorial Plaza at the World Trade Center site in New York.

20 WHITE OAK

Quercus alba

ACORN WARS

White Oak is a long lived, dominant tree throughout its range — most of the eastern United States. It outlasts its competition, expanding into the canopy space ceded by shorter-lived trees. A White Oak tree can produce vast crops of acorns into its third century of life. These acorns face long odds.

Acorns are vital to the inhabitants of the forest, from black bears prepping for hibernation, to deer and wild turkeys. A host of smaller animals: bobwhite quail, jays, various rodents, and seed-devouring weevils also consume acorns.

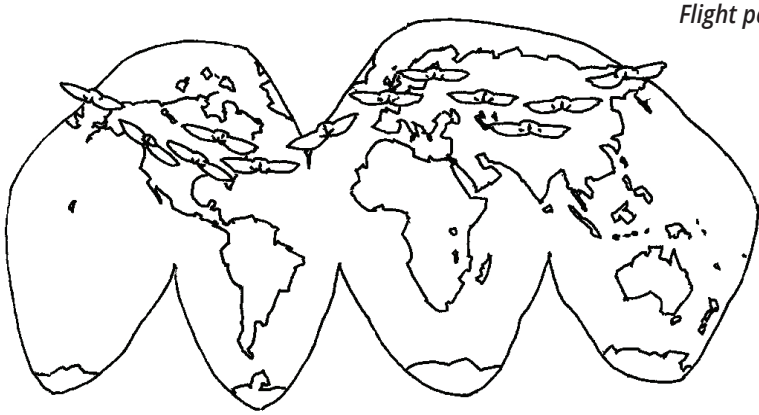
White Oak acorns sprout immediately, evading the store-and-eat-later strategy of squirrels. Squirrels will kill the acorns by biting out the embryo. They then store the dead acorns for later use. Acorns are laced with *tannins*, bitter and somewhat toxic defense chemicals. Tannins are concentrated around the seed embryo. If acorns are abundant, squirrels will often bite off the top of an acorn, eating the less toxic storage tissues and sparing the life of the seed. In lean years, they eat the whole thing.

White Oak seedlings are usually the result of *mast* years, when the oaks flood their predators with an abundance of acorns. These seedlings still face many challenges, but they have made it through to spring.

Decisions, decisions...

21 NORWAY MAPLE

Acer platanoides



AROUND THE WORLD

Maples first appear in the fossil record in the Cretaceous, about 100 million years ago, in what is now Alaska. The genus may have arisen in China; Asia is a *center of diversity* (the area where the greatest genetic variation exists) for maples. Maples are now circumpolar, their distribution pruned by Pleistocene glaciers.

Norway Maples are, as the name suggests, of European and west Asian origin. They were first introduced to the American colonies by John Bartram in 1756. Norway Maple has been planted across the United States, and is a common shade tree in suburban yards.

Home At Last.

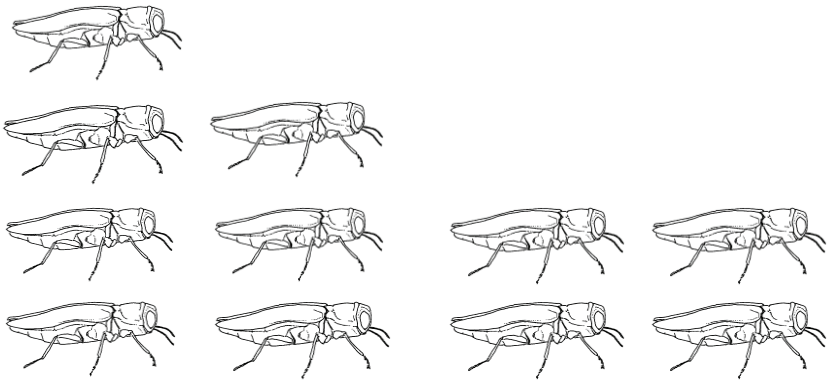
Or not....

Maple seeds can fly, and when they fly into an adjoining woodland, they will grow. Norway Maple has disrupted American forests, shading out understory plants, and starving native insects and birds. It is an invasive species. It is illegal to sell Norway Maples in some parts of New England, where they are crowding out the iconic, valuable Sugar Maples.

Too late. The Norway Maple keeps moving on. It is not reported in Alaska — yet — but is established in neighboring British Columbia.

22 GREEN ASH

Fraxinus pennsylvanica



EMERALD ASH BORER

Our country has grown and prospered through trade. There have also been casualties. These include the Ash trees of North America.

Ash (genus *Fraxinus*) are native to Europe, Asia and North America. From a common origin (in North America 44 Million Years Ago, their evolutionary paths diverged and new species arose. Each species has coevolved with its own association of pests and pathogens. Among these are flat-headed borers, beetles that target weakened, stressed trees. The larvae devour the outer *xylem*, water conducting tissue, vascular cambium, which generates the tree's *vascular system*, and nutritious *phloem*, the inner bark layer that moves sugars from the leaves through the tree. Loss of conductive tissue kills the tree.

Several life stages of these borers live in wood, and can travel long distances in untreated wooden pallets. When Emerald Ash Borers, *Agrilus planipennis,* an Asian species, found themselves in Michigan, they were surrounded by trees with no inherited resistance to them. They didn't just finish off dying trees — they killed every Ash tree that they infested.

This Green Ash tree survives because it is injected annually with insecticide. Most of the Ash trees in Illinois have died.

23 WHITE ASH

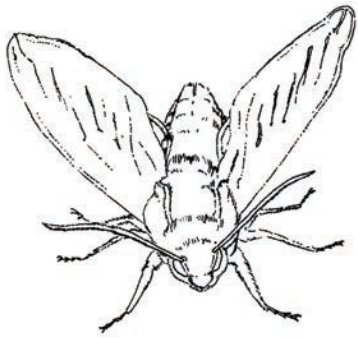
Fraxinus americana

NO TREE IS AN ISLAND

As you look at the trees of Hessel Park, dotted about the greensward, they may seem self-contained. This urban forest is the result of a series of human decisions, not forest succession. Yet each tree is connected: to the earth, air, sun, and the creatures that rely upon it.

The White Ash is threatened with extinction by the introduced Emerald Ash Borer. Collateral damage will include those animals that depended on the tree. These range from the spectacular — the Great Ash Sphinx Moth, to the obscure — the Ash Flower Gall Mite.

The Great Ash Sphinx Moth, *Sphinx chersis*, eats ash leaves. Lots of leaves. They grow to be very large (almost 5") caterpillars, pupate in burrows in the soil, and emerge as powerful, fast-moving moths that can be mistaken for hummingbirds. Sphinx moths are insect analogs of hummingbirds, feeding on nectar from tubular flowers.



Great Ash Sphinx Moth

The Ash Flower Gall Mite, E*riophyes fraxinifora,* is a microscopic mite that makes its home in male ash flowers. Feeding by the adult mite deforms the flowers into galls, where the mites lay their eggs. The young mites are embowered in protective, edible flower tissue. An idyllic life — as long as there are ash flowers.

Ash Flower Gall

24 SUGAR MAPLE

Acer saccharum

SWEET SPRING

In late winter, Sugar Maples hit reset. The carbohydrates that they stored during previous growing seasons are converted into sugar. This draws water from the soil into the root system by osmosis. Water and sugar combine into sweet (2.5% sugar) sap. The trees vascular system now has a positive pressure, and the tree will "bleed" sap if wounded in late winter. This is when the trees are tapped to make maple syrup.

Squirrels will eat tree buds in late winter and spring, and welcome sugary maple sap. They will often nip off buds and twigs to encourage flow.

When humans tap Sugar Maples, squirrels have been known to bite the plastic tubing that is used to collect the sap, and divert the flow to themselves.

A migratory woodpecker, the Yellow-Bellied Sapsucker, shares a taste for this annual bounty. These birds exploit pines and magnolias, but favor Sugar Maples. Sapsuckers drill rows of shallow holes in the tree's bark, returning to eat the exuded sap, and any insects that were attracted to it. They keep the wounds open to maintain flow, and attempt to drive off freeloaders, such as warblers — and, of course, squirrels!

Yellow-Bellied Sapsucker, tapping a Sugar Maple

25 GINKGO

Ginkgo biloba

JURASSIC PARK TREE

The title was irresistible, but "Jurassic Park Tree" doesn't do Ginkgoes justice. Ginkgoes first appear in the Permian (late Paleozoic), with the earliest known fossil dated to 270 million years ago. When the first dinosaurs appeared, Ginkgoes were there to greet them.

Ginkgoes survived the *Permian-Triassic Extinction* (about 251 million years ago), unlike 90% of known species. They were at their peak during the Jurassic (Stegosaurus), and made it through the K-T extinction 66 million years ago, that took down the dinosaurs. Only one species of this once diverse phylum (Ginkgophyta) survives, *Ginkgo biloba.*

Ginkgoes retain a number of primitive features. They are wind pollinated. Male pollen germinates into swimming sperm when it arrives at an ovule. The leaves are simple fans of bifurcating veins. The notoriously smelly "fruit", borne on female trees, is not a true fruit, but an *arillate* seed. The aril, a fleshy coating, likely evolved as a lure, enticing an animal to eat, transport, and disperse the seed. This animal is not present in Hessel Park. Seeds accumulate under the tree.

The Ginkgo's absent seed-disperser may have been a dinosaur. Something went wrong for the trees after the K-T extinction that ended the age of dinosaurs. The tree's range has been collapsing since the dinosaurs vanished. With the loss of mobility, it would have been hard for the species to rebound from local setbacks. Ginkgoes are now native to a few valleys in China. Without human intervention, they would be found nowhere else.

R. I. P.?

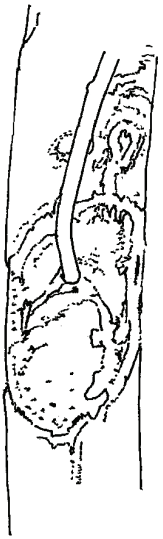
26 CHINESE CHESTNUT

Castanea mollisima

CHESTNUT BLIGHT

Chinese Chestnut did not arrive in the United States unaccompanied. Some imported nursery stock was infected with *Chestnut Blight, Cryphonectria parasitica,* a fungal pathogen native to China. Chinese Chestnuts are quite resistant to the disease. This is not the case for American Chestnuts, *Castanea dentata*, which once comprised as much as 50% of the eastern deciduous forest. No longer.

Blight enters trees through wounds, and infects the inner bark and cambium, girdling and killing branches, and ultimately the tree. Billions of trees may have been killed. Some trees still survive as root systems that will send up shoots. These are soon girdled by the fungus, which can also infect oaks, though it is not lethal to them.



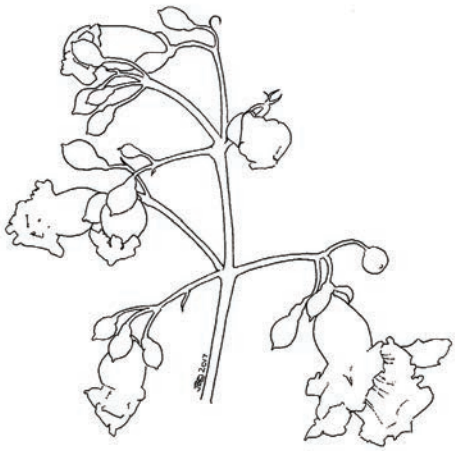
Infected shoot

Several approaches to saving the American Chestnut have been tried. Quarantine failed to limit the spread of the pathogen. Fungicide treatments were too labor-intensive. Cutting down trees (to contain the fungus) probably spread the disease, and may have destroyed disease-resistant trees. Hybridizing Chinese and American Chestnuts, then backcrossing to American Chestnut has not yielded a truly blight-resistant tree. *Hypovirulence* uses a fungal virus to weaken the pathogen. Successful in Europe, it has not been effective in the Eastern United States.

Fungal diseases are widespread in plants, and many species have evolved good resistance. The latest effort to protect American Chestnut uses CRISPR gene-editing technology to insert a gene from wheat into the chestnut genome. The added gene produces oxalic oxidase, an enzyme found in many plants. This enzyme neutralizes the oxalic acid that the fungus uses to kill the tree's bark. Trees with two copies of the edited gene have excellent resistance to blight. The GMO trees await approval from the USDA-APHIS, USEPA and the FDA.

27 NORTHERN CATALPA

Catalpa speciosa



KEEPING THEM SWEET

Northern Catalpa flowers in early summer, after most trees have finished for the year. This facilitates pollination, because the flowers are most often pollinated by bumblebees. Only queen bees overwinter, and the first brood emerges in early summer.

Catalpas have *panicles* (a branching cluster of flowers that open from base to tip) of showy white flowers with gold and purple stripes. The tubular *corolla* (whorl of petals) has an extended lip for bumblebees and carpenter bees to land on. The high-contrast lines lead to a generous nectary. Unpollinated flowers have yellow guides. After pollination, the yellow fuzzy stripes turn orange, and nectar is not produced. As the bee advances into the flower tube, it contacts the *stigma* (receptive female surface) the dangling *anthers* (shedding pollen) and then, the nectary.

The Catalpa's leaves also have nectaries. They are triggered by leaf damage, such as that caused by leaf-devouring insects. The nectar is attractive to ants, which protect the tree, and its nectar, from herbivores.

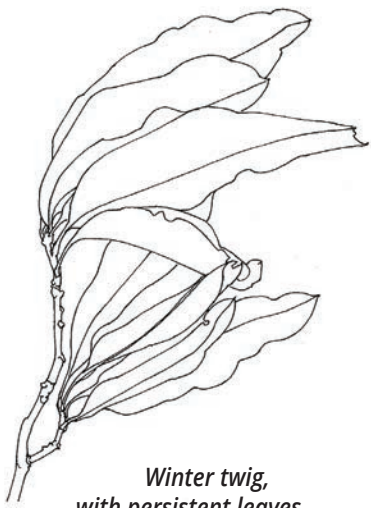
Flower showing nectar guides

28 SHINGLE OAK

Quercus imbricaria

MARCESCENCE

Shingle Oak leaves resemble those of the evergreen Live Oak. But its unlobed leaves are not evergreen, they are *marcescent* — they die in fall, but are not shed until the tree prepares to leaf out in spring. This is a common trait in the *Fagaceae*, the family to which oaks, beech and chestnuts belong.



Winter twig, with persistent leaves

In fully deciduous trees, an abscission layer forms at the base of the leaf; when it is destroyed by enzymes, or otherwise triggered, the leaf falls. In marcescent oaks, a *lignified* (lignin is a woody polymer) area forms at the base of the leaf. The leaf dies, but doesn't drop. The dead leaves persist all winter, and are shed just before the tree leafs out in the spring.

A tree may have both deciduous and marcescent leaves. In some oaks, marcescence is a juvenile characteristic which the tree outgrows. Bur Oaks shed their leaves promptly; leaf drop seems adaptive for trees in fire-prone landscapes. In Shingle Oaks, which often grow close to water, leaf retention is a lifelong trait.

No one is sure why oaks retain their dead leaves. They may collect snow, for added moisture as the growing season starts. They may be applying a well-timed layer of mulch in spring. Oaks have spent much of their history in warm climates. Leaf retention may be an evolutionary relic of their southern, evergreen past.

29 YELLOW BUCKEYE

Aesculus flava

SHADY GROVE

One of our Yellow Buckeyes in Hessel Park is an Illinois Champion Tree. Its measurements are: DBH (Diameter at Breast Height—4.5 ft. above the ground) 32.8", Circumference 8.58 ft, Height 61 ft. Spread 37 ft., for a total of 173.2 points. It was nominated by the Illini Foresters, and was most recently measured in 2020. Looking good for a tree that is far from home!

Yellow Buckeye is a tree of the *cove forests* of the Appalachian Mountains. Cove forests shelter in the low, semi-enclosed areas between mountain ridges, like coves along a coast. Appalachian forests are among the most diverse in the United States, harboring both southern species, and relict populations of northern species pushed south by glaciation. The cold-tolerant species are found at higher altitudes on the mountain slopes.

Yellow Buckeye is a *climax forest species*. Forest succession begins with pioneer trees that tolerate the sun, temperature swings and drying wind of exposed sites. This forest is infiltrated by shade-tolerant species that grow up through the pioneer trees, eventually replacing them. This is the climax forest. If not disturbed — by fire, insect infestation or logging — it will persist on the site.

Some old growth cove forests survive in the Great Smoky Mountains. A 100,000 acre stand is in Smoky Mountains National Park.

30 EUROPEAN BEECH

Fagus sylvatica

FIRST BOOK

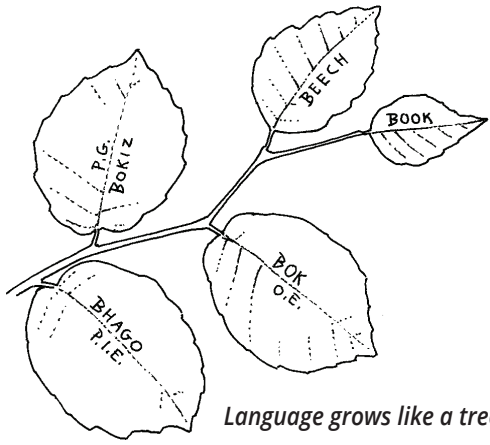
Writing made thought permanent, and books made writing portable. The history of books likely begins with the European Beech. These trees have sustained humans for thousands of years. The crop of Beech *mast* (nuts) has fed both people and their animals. These trees nourished our minds as well. The first books may have been fashioned from Beech bark or wood. The evidence for this is linguistic.

The English word for book may come from the earlier word for Beech. Many *etymologists*, experts on the origin of words, derive the modern "book" from Old English (OE) "bok", from Proto-Germanic (PG) "bokiz", which means "beech". The German word for book, "buch" is similarly derived. (Book and beech were distinct words in Old English, beech was "boecae" by the 9th century, in King Alfred's library).

This may go all the way back to Proto-Indo-European (PIE), a reconstructed prehistoric language that would have been spoken during the Neolithic. It is believed to be the source of the group of related languages now spoken in both Europe and the Indian subcontinent.

The Proto-Indo-European (PIE) root word for Beech tree, is "bhago". This is cognate with *Fagus*, the Latin word for Beech, and the scientific name of the genus.

As you read this on your phone, remember the oldest means of transporting the written word. It persists in many languages to this day.



Language grows like a tree

31 EASTERN REDBUD

Cercis canadensis

FOREST EDGE

Eastern Redbud is a small tree of the Eastern United States. It is found as an understory tree, and at the edges of forests. This is an unstable habitat — how is the tree adapted to its circumstances?

Redbuds are tolerant of a range of soil pH, and of nutritional deficiencies — they can grow where many trees cannot. They have an accelerated life cycle — they can set seed eight years after germination.

They belong to the *Fabaceae* (Pea family). Their flowers are *perfect*, having both male and female parts, and are usually pollinated by bees. They set heavy annual crops of pods.

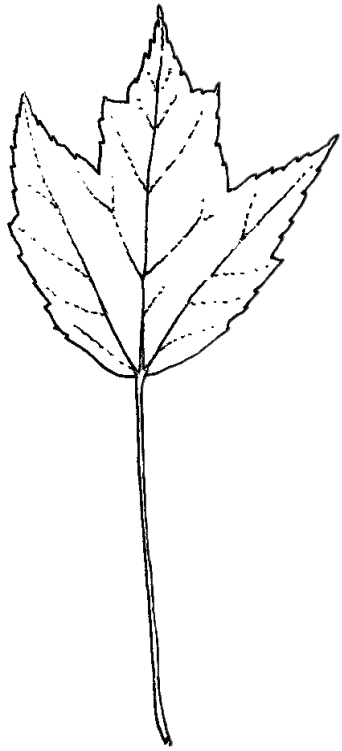
Seeds are dispersed by animals and wind, and can remain dormant for some years. Seedlings are quite shade tolerant — they can wait for damage to another tree that will flood them with sunlight.

Mature Redbuds are much less tolerant of shade. They are too short to win a place in the canopy. If the forest grows over them, they may succumb. In any case, the trees are not long lived. Their seedlings have scattered, tracking the light at the edge of the forest.

32 RED MAPLE

Acer rubrum

LOWERING THE COLORS



Red Maples show red through much of the year, with red winter buds, red flowers and immature fruit. In many trees there is a grand finale - spectacular red fall foliage.

As the days shorten, deciduous trees prepare to shed their leaves. The *chlorophyll* that powers photosynthesis breaks down, and is not replaced. *Carotenoids*, which are yellow, secondary photosynthetic pigments, become visible as chlorophyll disappears. The vascular system starts to shut down, prior to leaf drop.

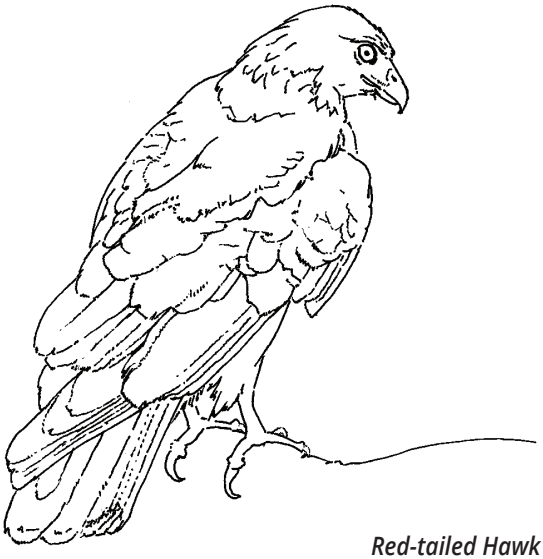
The leaf is still photosynthesizing, and sugars move slowly into the body of the tree. *Anthocyanins* protect the leaf from damage by bright sunlight, until all of the nutrients can be retrieved. Anthocyanins are red (in an acidic environment). They are synthesized in autumn, as needed. Leaves exposed to direct sunlight will produce more of this pigment.

Cold sunny days are best for fall color — the cold slows sugar movement, and sun incites anthocyanin production.

All good things must come to an end. The leaf has shut down, and its nutrients have been offloaded. An *abscission* layer forms at the base of the petiole, separating it from the tree. A gust of wind sets it free, to whirl to the earth. Red buds await the spring.

33 PIN OAK

Quercus palustris



Red-tailed Hawk

CYCLE OF LIFE

Trees are mortal. Some die abruptly, in a fire, or when cut down. Many trees *decline* slowly, as a result of age or stress. An initial problem, such as drought or storm damage, weakens the tree. This makes it vulnerable to pests or pathogens. The tree grows poorly. Leaves may be small, and fall early. It uses its reserves of starch to stay alive. It may produce large *distress crops* of fruit, putting a final effort into offspring that may escape its fate. Secondary pests, harmless to a healthy tree, move in.

The tree starts to die. Trees die from the edges toward the center. A failing tree may become *stag-headed,* with dead branches emerging from the leafy lower crown like the antlers from a deer's head.

Birds will often alight on these branches for an unobstructed view of their surroundings. In Hessel Park, a bare upper branch may sport a Red-tailed Hawk. Hawks are our apex predators — in more ways than one. Red-tailed Hawks often prey on acorn-eating rodents, such as squirrels. They are guardians of the next generation of oaks.

34 BALDCYPRESS

Taxodium distichum

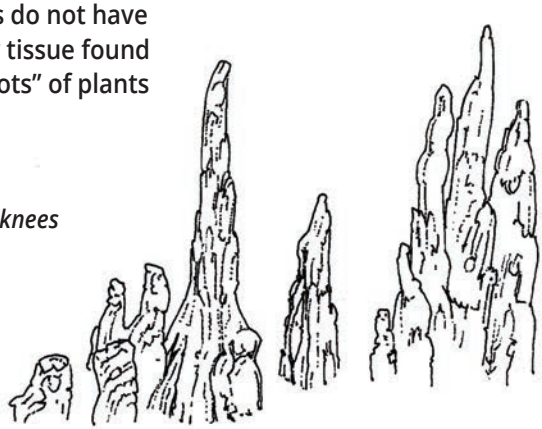
ROOTS

Baldcypress is a deciduous conifer, shedding its feather-like *branchlets* every fall, and re-sprouting in spring — hence 'bald' in winter. This tree is native to the Coastal Plain Forest, which, despite its name, reaches into the southern tip of Illinois. A very long-lived tree, some are known to be over 1500 years old.

Baldcypress is adapted to life along slow moving water. Its round, soccer-ball shaped cones are buoyant, and can float for long distances before striking land.

Trees don't have circulatory systems. They have no way to move oxygen from their leaves to their roots. Most trees will die if their roots are submerged for long periods. Baldcypress roots may be more tolerant of less efficient *anaerobic* (oxygen-free) respiration. They may also metabolize the large starch stores in their oversize root system. Flooding eliminates competition, but swamp-dwelling Baldcypress grow more slowly than trees in unsaturated soil.

Swamp grown trees develop a buttressed trunk and a massive root system, with distinctive knees. This probably helps to stabilize the tree in the soft, tenuous silts on which it grows. The knees form only in trees growing in wet conditions. They may provide added space for nutrient storage. Some authorities believe that they may be *pneumatophores,* specialized roots that support air exchange for the submerged root system. How this exchange would work is not clear. Cypress knees do not have *aerenchyma,* spongy tissue found in the "breathing roots" of plants such as mangroves.



Cypress knees

35 YELLOWWOOD

Cladrastis kentukea

FLOWERS OF THE FOREST

Yellowwood (genus *Cladrastis*) evolved in North America in the Eocene, about 40 million years ago. There are now several species of Yellowwoods in Asia, but only one survives in North America.

Yellowwood is rare throughout its range, and its range is limited. Seedlings do not flower for many years after they germinate, and tend to flower only every second or third year. Weak branches/ poor branch structure make the trees vulnerable to storm damage. A member of the pea family (Fabaceae) it does not fix nitrogen. This may limit its ability to compete with other trees.

Glaciation may be a factor in Yellowwood's distribution in the wild. It is found in the Appalachians, the Ozarks, and rarely, as far north as Indiana. Ice sheets repeatedly expanded across North America, fragmenting successive forests. Some trees recovered their ranges, and those of less assertive trees as well.

Fortunately these beautiful trees grow well in many areas where they are not found in the wild — including city parks.

36 EASTERN COTTONWOOD

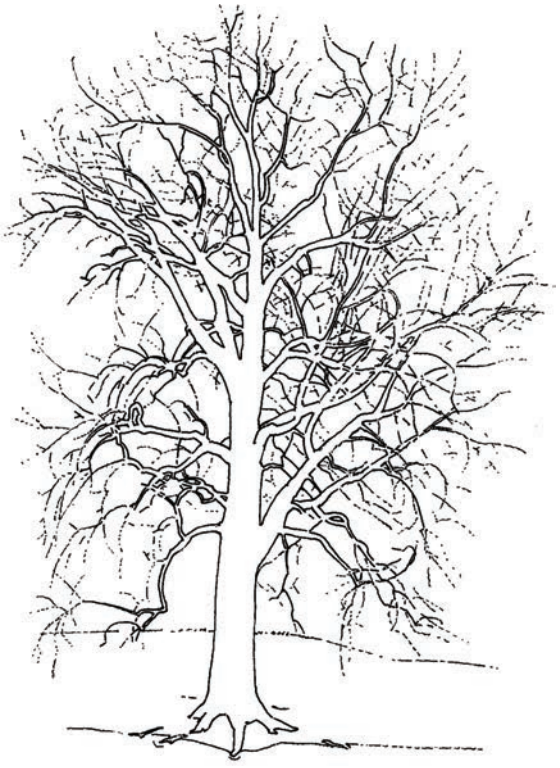
Populus deltoides

RIVER TREE

Rivers symbolize change — and transience. Heraclitus said, "You cannot step twice in the same river." Cottonwood is a true riverbank tree, seldom found far from water. It grows fast — the record is held by one that grew 100 feet tall in nine years.

This is possible in a habitat with an endless supply of water, and a good deal of sun — no shade from the river. The seeds ripen in early summer. They are tiny, with "cotton" parachutes that will ride long distances on the wind, and float like kapok in the water. The seeds germinate as soon as they strike land. No time to waste. The river may change its bed, or wash them away.

As you would expect, the wood isn't very strong, and the branches break off readily in storms. This reduces the load on the trunk and roots, and may save the tree from being uprooted. If the fallen branch lodges in a favorable location, it may grow new, *adventitious roots* (roots that don't emerge from existing roots) and start over again.



Cottonwoods are not long lived trees. Life along the ever-shifting river is uncertain. This tree seizes the day.

NOTES

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