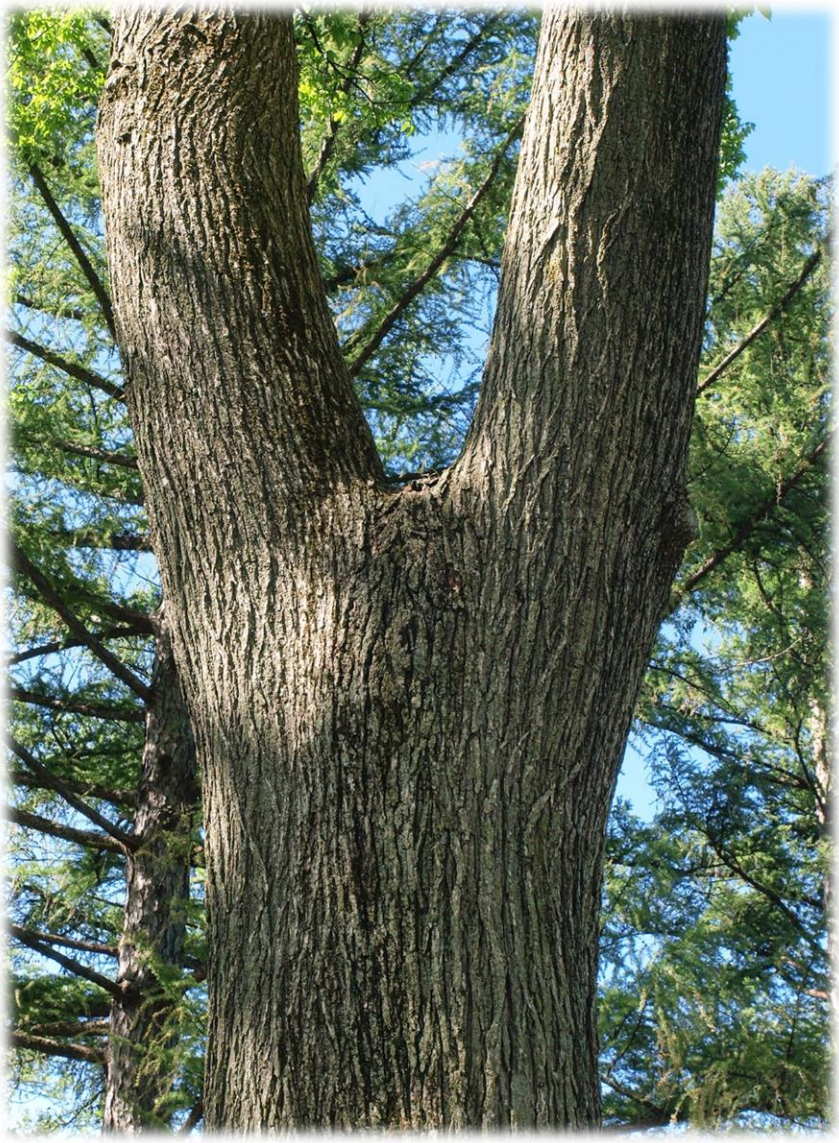


***Ulmus americana* – American Elm**

Morton Arboretum, Illinois

THE ULMACEAE – ELMS

By Susan McDougall

When Frederick Law Olmsted designed Central Park in New York City, he could not have foreseen how the wide grass paths and the stone walls might play an important role in the future of the American Elms that were part of his vision. First planted in the 1860s, the spacing and isolation of many of those trees would contribute to their survival. In other parks around the country, close-packed elms were not so fortunate.

The Elms – *Ulmus*

There it was, in dollars and cents - the value of a tree. Printed out in black on a small green poster, the number was so precise I reasoned it must be scientific. The sign was wrapped with a thin string around the broad trunk of an American Elm. Here was a healthy specimen of a species that has stared extinction in the face, driven to the edge by the attack of a foreign invader. As I looked at the sign, I could appreciate the efforts of the arboretum to place a monetary value on trees that were present on the continent long before humans. In our society, dollar figures are something everyone can understand.

Value of an *Ulmus americana* (American Elm)

MORTON ARBORETUM, LISLE, IL

But somehow, at least in the case of the American Elm, the small sign with its handwritten numbers seemed to diminish the presence of the ridged gray bark, the widely-spread branches, and the toothy leaves, waving in the breeze. The sheer immensity of an aging tree. Would it survive if the fungus, carried by its beetle vectors, managed to make its way here? What could save it? What use is a sign in a world where diseases, worms, and bugs cross boundaries like migratory birds on the wing?

I grew up in the Pacific Northwest where the nearest naturally-occurring native elm was five hundred miles distant in western Montana. Except for the Bigleaf Maple in our front yard, a stout tree made for climbing and observing cars and walkers from the branches, and the Douglas-firs in the woods behind our home, I knew little about trees. Only later would I learn about the distant American Elm and the disease that was decimating young and old trees in forests and cities alike. The elm was a popular tree for street-sides and parks, a 100-footer with lovely arching branches that provided welcome shade. What town or city would not want one?

What I did not know was that Dutch Elm Disease had been present in North America since the 1920s and that the damage was severe; so permanent that today it is estimated—generously — that only about 25 percent of the population remains. Gone are the giant city trees, the trees in back yards, the trees of

parks and trail sides. Forests are laid bare, and, saddest of all, when limbs do sprout from infected trunks, as they often manage to do, they are doomed. The pathogen is deadly.

As a child, my husband David, too, was unaware of the dying of the elms. He grew up in north-eastern Wisconsin, a state where elms were common. In the back yard of his home two large elm trees thrived, giants as leafy trees go, so tall that they lacked branches for climbing. But they provided shade on a hot Wisconsin summer's day, arching snow-covered branches in the winter and, like other fine trees, had their admirers.

We visited David's home a few years ago. It was in an excellent location, across from a lovely river, close to parks and open land, a fine place for a young child. We drove around, noting the "hill" in the backyard (I proffered my Northwestern scoff at this), and noted changes and similarities from the past.

The elm trees were gone. We do not know if they were taken down by a new owner who did not want big trees or if they died from Dutch Elm Disease. I rather preferred the former. At least death would have been quick.

By the time we returned to Wisconsin, I knew that the disease can be a fast or a slow killer. Starting from the top branches, where leaves die earlier than the usual autumnal drop, the fungal invasion moves inexorably downward, consuming, and eventually coming to the roots, which rot and die. A tragic and, from a human perspective, agonizing end for a magnificent tree. By the 1970s the Wisconsin elms, as with their relatives to the east, were dying.

Now, wherever we travel, whether in the West where elms are planted, or east of the Rockies where they are native, we feel very fortunate when we find healthy trees. We are grateful that studies and mapping of remaining stands are available, and that progress is being made on combatting the deadly disease. With some cause to take heart, we must acknowledge that the damage is great, the future in the hands of experts and dedicated amateurs alike.

Yet not knowing what the future might hold for the native elms, I contemplated creating my own sign of the value of these trees that make forest and town alike so beautiful. Environmental monetary value had already been determined; "priceless" seemed too obvious, so all I could think of was the tree itself, and the unheralded significance of its loss.

THE ULMACEAE

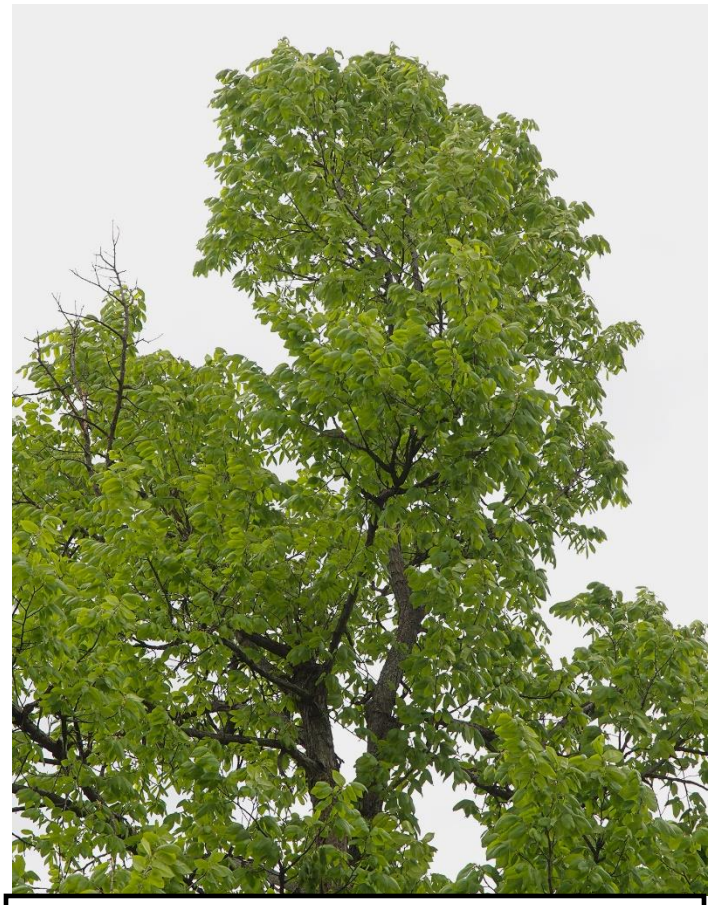
Primarily a family of the northern temperate regions, with a few members scattered elsewhere, most members of the Ulmaceae are trees, some more than 115 tall, although most are typically shorter. Often important timber trees, at one time the family included as many as 19 genera; botanical research has whittled the family to eight, with a paltry two in North America. And one *Planera* — consists of a single species worldwide, while the other, *Ulmus* — the elms — is represented by six natives and four established exotics. Where have the other genera gone? In the New World, three have been unceremoniously moved to another family, the Cannabaceae, formerly composed only of herbaceous species that, as the name implies, includes marijuana.

Fossilized remains of elms are typically represented by leaves and pollen, although some wood has been found; results of studies indicate a family origin perhaps as long as 60 million years ago, about the time of the demise of the dinosaurs. This makes the family older than the Walnut Family (Juglandaceae) but

younger than the Pea Family (Fabaceae). Elms are closely related to roses, although the similarities are not obvious.

The most widespread elm and the one most devastated by disease, is *Ulmus Americana*, the American Elm. This species is present throughout much of southern Canada, from Saskatchewan to the Maritime provinces, south to central Florida, and west to Montana. One elm species grows in southern Texas, but none is native in the far West.

Some elms are quite limited in range, as with *Ulmus serotina* (September Elm). Others are introduced species, so common that they are listed in authoritative sources and field guides alike. If you are walking on a city sidewalk in San Francisco or New York City, it would not be unusual to encounter *Ulmus parvifolia*, the widely planted Chinese Elm. In the past, the American Elm would have shaded the streets of America's cities. With their densely-covered leafy branches and thick straight trunks, elms were much loved and as with many seemingly permanent things, undoubtedly taken for granted. Now, in forest and town, the giant trees are gone, reduced to rotting wood, dead branches, and brown leaves -- struck down by a fungus and its beetle host against which they seemed defenseless.



***Ulmus thomasii* (Rock Elm) – a widely distributed species**

MORTON ARBORETUM, LISLE, IL

Yet in the twenty-first century, some old trees persist, often isolated, but occasionally as resistant forest survivors surrounded by dying neighbors. Such trees provide hope, for while science may lag in understanding the reasons that some survive, organizations such as The Nature Conservancy provide opportunities for growing resistant trees. Knowledgeable people search for these trees, take cuttings and collect pollen, while volunteers commit thousands of hours to propagating the offspring. Commercial development of elm cultivars is a growing business that at the very least promotes hardy relatives. Loss may lead to a future for elms throughout the world.

But before we look more seriously at the disease that has spelled death for millions of elms, and the specifics of family members, let us investigate how to identify an elm. The secret may lie in the leaves! And sometimes a sign or two in an arboretum or a garden helps as well.

How to Recognize an Elm – genus *Ulmus*

Forget the bark

The bark of an old American Elm is a wonderful thing to see, particularly as the trees are so very rare. Unfortunately, with its deep ridges, fissures, occasional scaly surface, and its gray or sometimes reddish color, the bark tends to resemble that of other species, even the distantly related conifers. The bark does not promote easy identification. Beneath the variable bark a straight trunk supports a crown of heavy branches. When they are young, with elms seem to reach for the sky; with age they curve over into a broad form covered thousands of bright green leaves. Small wonder that elms have been historically planted in public and private places alike.

The single *Planera* species in the Ulmaceae is a southern tree of wet habitats, so in more northern regions the question really becomes one of distinguishing an elm (*Ulmus*) from other leafy trees.

***Ulmus americana* (American Elm) with a buttressed trunk**

GRANT PARK, CHICAGO

***Ulmus pumila* (Siberian Elm) flowers**

GINGKO STATE PARK, WA

Rather than from bark or form, elm trees are separated from other families and from one another as well by their flower structure and by their fruits. The flowers are bisexual and lack petals but are often configured in many-flowered inflorescences, which can be long. Each small flower is on a drooping stalk, sometimes a distinguishing feature. Flowers of some species open in spring, others in autumn and winter. The fruits are more helpful, as many species have wing-like samaras, but it is the leaves that are the most distinctive.

Elms have “simple” leaves meaning they aren’t divided or feathery, like an ash or a pea, but are arranged singly along the branch. Unfortunately, this feature is not sufficient to distinguish them from many trees, such as beeches, oaks, and maples. Elm leaves are alternate on the branch, which is just like it sounds – not lined up opposite one another. In most species the leaves have toothed edges, are often doubly-toothed (unfortunately not unique to the elms), and they lack lobes (separating them from many oaks, but not from the alders or the beeches -- to mention just a couple.) However, an interesting feature of elm leaves is that they are asymmetric at the base, with one side reduced in size and the other more curved, giving the appearance of predation by an herbivore or an insect when the leaf was young. Perhaps the form enables a good twist to the leaf, laying them flat in a noonday sun.

The asymmetric leaves of *Ulmus thomasii* (Rock Elm)

MORTON ARBORETUM, LISLE, IL

A photo of *Ulmus thomasii* (Rock Elm, a Midwestern species) leaves demonstrates this feature.

Another helpful feature of the elms is that the branches tend to be “corky”. The aptly named *Ulmus alata* (Winged Elm) displays this feature; even the young ones (there is a small tree in our garden) have winged branches.

American Elm is particularly attractive in autumn, with golden-yellow leaves provide contrast against the dark bark, and a thick trunk that you sense is designed for a future of strength and size.

Although it may not be particularly easy to identify an elm, the experience of knowing you are in the presence of an old tree, perhaps planted a century ago by a farmer or an arborist, makes the effort worthwhile. In a world so fast paced as to render the tree watcher dizzy, elms can give us a link to a sometimes forgotten past.

The corky bark on the twigs of *Ulmus alata* (Winged Elm)

North American Elms - *Planera* and *Ulmus*

The Planertree – *Planera*

Lancelike leaves with large teeth on *Planera aquatica* (Planertree)

ICHETUCKNEE SPRINGS STATE PARK, FL

Florida tree book in hand and a list of herbarium specimens in a pocket, we watched the swimmers and boaters navigate a channel of slow-flowing brown/blue water with the confidence of those born in the region. We stuck to the trail on this muggy spring day, pulling our hats over our ears, at home with the trees if not with the environment. We were at Ichetucknee Springs State Park, a quiet 2,200-acre reserve in north-central Florida, east of the Panhandle. The previous day had been spent on the Gulf Coast, where familiar salt water and open spaces made for a more comfortable outing, but this was different. Impenetrable thickets, hanging branches, and warming air hinted at the possibility of encountering trees new to us. It was a place of water, and it was the right one. Here the leafy trees ruled; adapted to the warmth and moisture of the Florida landscape, they were robust and brilliantly green. Grateful for the well-kept, meandering paths, we would add nine tree species to our personal list. Near the river, at the base of a small hill, the Planertree would be the last new tree we saw that day.

Named for the eighteenth-century German botanist Johann Jacob Planer (1743-1789) and known also as the Water-elm, as both the common and scientific name imply the Planertree (*Planera aquatica*) is a tree of wet habitats. Small, often with a low-branched trunk, this species bears nutlike fruits with wart like projections. Produced in small clusters in the axils of the leaves the yellowish flowers lack petals. The only member of its genus and native only in North America — although fossils have been located in Europe — the trees have brittle wood, scaly bark, and somewhat oblong, stiff single-toothed, nearly symmetric leaves with prominent veins. The wood is known as “false sandalwood” and, although weak, it has an appealing fragrance and is used for making cabinets and other furniture.

Planera is also subject to Dutch Elm Disease, although isolation protects many.

The Elms – *Ulmus*

Two large trees planted at the edge of a broad lawn imparted a quiet contrast on an island which eschews automobiles but is denied silence by the rumbling of horse-drawn carriages and the bustle of rented bicycles. I had wanted to visit Mackinac Island for a long time. And, after a short, smooth ferry ride, here we were on a day when even the low-slung clouds that threatened to release their moisture at any time did not thwart the happy tourists. Horse-drawn carriages moved surprisingly fast, and the speedy bicycles posed as much challenge to the walker as a slow car! We were having a good time, especially when we saw the trees. We couldn't miss them. Tall, with broad straight trunks, these were giants in a landscape of low shrubs and flowery borders, squat buildings, long fences, and miniature horses. Even the fort buildings on the hill above seemed small. Could these be surviving American Elms? Were they far enough from the mainland to escape the ravages of disease?

***Ulmus americana* (American Elm)**
MACKINAC ISLAND, MI

One of six native species in North America, and the most widely distributed, *Ulmus americana* (American Elm) grows throughout the East and South, as far west as Montana. A large tree with a single, often buttressed trunk and ascending branches, here is classic form that undoubtedly contributed to the elm's popularity as a cultivated tree. American Elm leaves are dark green above, pale below, with coarse teeth, and an asymmetric form at the base. The trees we saw fit the description, better than any other possible elm. We smiled at such good fortune.

Eating the Elms

Unlike the outer bark and wood, which are indigestible to humans, the inner bark of many deciduous trees, including the elms, is edible. Flour could be made from ground, dried bark, and processed into a kind of bread ("bark bread"). If available, wheat and other flours were added in various proportions. Particularly popular in Scandinavia in the past, and enjoying a new popularity today, bark bread tended to be grayish in color and a bit bitter, but the availability of the bark of elm bark and other species as well helped to stave off famine in difficult times. The bark could also be cut into strips and boiled: this was done in Norway during the famine of 1812, brought on in part by the Napoleonic Wars in which

(and not for the first time) Norway was subjected to blockades by hostile nations. Norwegians had suffered depredation, plague, and famine periodically for hundreds of years; survival could depend on familiarity with the forest tees.

Across the globe prior to the twentieth century, Native Americans, to their good fortune, had disease-free native elm trees to exploit and many tribes collected both the bark and protein-rich seeds. American Elm inner bark was the main ingredient for a coffee-like drink by the Cheyenne, while the bark of *Ulmus rubra* (Slippery Elm) was rendered with fat and used as a flavoring.

Moving forward to the 20th century, Slippery Elm apparently found its way to the venerable American game of baseball — pitchers chewed elm tablets to enhance the performance of a spitball.

According to some sources, the seeds of *Ulmus pumila* (Siberian Elm) are delectable when eaten green and fresh, or cooked as a vegetable. When the samaras mature they are roasted, and are very good with potatoes. Unfortunately, Siberian Elm has proved to be an invasive species in certain parts of North America.

It is unlikely that in the future elm bark and seeds will compete with apples and oranges, but the growing interest in a variety of nutritious foods would seem to indicate that such products will remain on the market.

Medical Benefits

Native Americans used Slippery Elm for a variety of ailments. The Catawba made a decoction of the bark for dysentery and as a laxative and created a poultice for sores and wounds. A decoction was also employed by the Iroquois for sore throat; the Meskwaki used bark to ease childbirth.

***Ulmus rubra* (Slippery Elm)**

BIG MUDDY NATIONAL FISH AND WILDLIFE REFUGE, MO

As with many other natural products, many of the uses of elm for illness, wounds, as a soothing agent, and more have found a market today. Compounds derived from the tree, particularly the bark, are of interest to scientists, practitioners of alternative medicines, and entrepreneurs alike.

Not surprisingly, you can buy elm bark powder on the Web. Typically, the powder comes from Slippery Elm; mixed with water into a sort of gel, the ingestion of this tough product supposedly helps stomach problems, inflammation of the upper airway, and psoriasis. It is not immediately apparent what these various ailments have in common, and like many other resurrected natural cures, the advertising combined with the

testimonials makes you wonder how you ever lived without it. Perhaps I am a little skeptical about the use of bark for widely-varying ailments, although it is not surprising that the elm can provide both nutrition and a source of comfort.

Certainly, Slippery Elm fits that category. Named for the viscous liquid that is produced when the inner bark is chewed, Native Americans and early European settlers alike made use of this natural product. Elm bark contains both mucilage and tannins; the mucilage is carbohydrate-rich and is the source of the gel. This alone helps to give relief to coughing and soreness. And the gel is long-lasting, possibly providing ongoing comfort.

While many people give testimony to the use of elm bark for therapeutic effects, limited scientific inquiries have taken a look at its efficacy. One study of 24 graduate students, half of them taking a placebo and the other a slippery elm tea, indicated some "soothing" with the elm-infused drink. Not enough to be considered statistically significant, the perceived reaction was also non-quantitative, making conclusions more uncertain. Another study of 31 patients with various abdominal complaints included a formulation with more than one natural product, such as oat bran, licorice root, etc. Unfortunately, the supposed relief of various ailments was compromised by the presence of the elm in both formulations.

Slippery Elm bark has also been used in the treatment of breast cancer. Such use dates back to the 1920s when "Essiac" was made available (Essiac is derived from the developer's name, Rene Caisse). Today, a similar product with more additives is available. One study of 510 women reported little improvement, making the use of the bark not only questionable but potentially dangerous if more effective treatments are ignored.

Elm remains in the "alternative medicine" category, simply meaning that rigorous studies and recommendations are lacking. The problem is that marketing implies acceptance; one survey of Amazon online revealed 3,000 products containing slippery elm. What is lacking is sufficient scientific human subject research into slippery elm bark. One review paper indicates that there are 430 published studies, but only four of them involved human clinical trials.

It is interesting however that Slippery Elm is approved by the FDA as a demulcent (a soothing, protective agent), even though clinical trials are lacking, and the four that have been undertaken lack rigor. Why, then is it an approved "medicine"? The answer is that elm was grandfathered in as an "old drug."

At best, the use of the bark is innocuous or perhaps even helpful for certain afflictions — at the very least, it seems to be soothing and perhaps efficacious for bowel and stomach ailments. But the real concern, at least to my mind, is that such use may obscure symptoms that are indicative of something more serious transpiring in the body. The enormous growth in the availability of products such as elm bark does not validate its use. Testimonials do not constitute proof.

Working the Wood and Other Uses

Tough and disease resistant, elm wood has been historically used for utilitarian furniture and other practical items such as wagon wheel hubs and crates; the color is considered particularly rich for fine items. The wood is also made into pulp and paper. In North America, the lumber industry makes use of three species — American Elm, Rock Elm, and Slippery Elm.

For many Native American tribes, while Slippery Elm bark was an important medicine, elm trees were also utilized for physical protection and useful household items as well. Forked trees served as structural skeletons for earth lodges; these were often large homes used for family groups. Bark could be worked into a variety of practical products such as baskets, fish nets, and snowshoe frames.

Dutch Elm Disease (DED) – Loss of the Giants

In the midst of the Irish Sea, the Isle of Man is home to a large population of English Elm (*Ulmus procera*) that appear to have escaped the ravages of Dutch Elm Disease. The leaders and citizens of this independent protectorate of Great Britain have instigated the Open Elm Project, a protocol of watching for the disease, felling diseased trees, burning dead wood, and other measures. Out of a population of 250,000 elms, fewer than 2,000 have been removed and thus the project appears to be a success. Unfortunately, such attempts to control the deadly disease have been tried before. A close look at local conditions indicates that it may not be direct human intervention, important as that could be, that is slowing the disease. At least one study suggests it's the weather.

At 54 degrees of latitude, and 20 miles from the nearest tip of an English peninsula, the island enjoys a cool climate. The temperature rarely reaches 70 degrees in the summer, and the winters are cold and windy. So windy that the island's insects stay hunkered down, including the beetles. And it is the beetles that are the vectors of the deadly DED.

Named for the country home to its discoverers, Dutch Elm Disease is a wilting disease caused by *Ophiostoma*, a large genus of fungi. Although best known for its role in DED, in association with various bark beetles, *Ophiostoma* species also attack other tree families, including the Pine Family (Pinaceae). Their infestation across the globe may in part be attributed to the movement of untreated logs and wood products from continent to continent.

In the case of DED, the original geographical source of a species named *Ophiostoma ulmi* was attributed to logs from Asia, although the specific region is not known. Today, the mutant *novo-ulmi*, an even more virulent species, is the main invader of Ulmaceae species. These are fungi with an asexual reproductive process; the spores of this system are transported in the tree's water-conducting vessels; they reproduce and germinate, spreading the disease by means of the tree's own life-giving system.

Adding insult to injury, the fungus can also feed on dead elm tissue. In this case, the fungal mycelium grows in the bark and in tunnels created by beetles. It is these beetles that carry spores to other trees. As if this isn't enough, *Ophiostoma* can also reproduce sexually, the propagules of this mating are also disseminated by beetles.

More than one species of beetle transmits the spores of the pathogen. There is the European elm bark beetle as well as a native North American species, *Hylurgopinus rufipes*. (We did not have to import our own vector.) The beetles feed on healthy trees, carrying fungus spores as they move from one tree to another. Eggs are laid in the bark of dead or weakened trees and in fallen logs. When the larvae mature and tunnel through the bark, they fly to another tree, carrying the spores with them. Chewing on fresh wood reintroduces the pathogen to the conducting vessels of the new host. Employing toxins in their

attack, the thread-like mycelium kills cells kills the host's cells. The xylem — the tree's water-conducting vessels — are blocked by debris and large cells, and soon the deprived leaves begin to wilt.

The disease can also be spread by root grafts between trees; this is a process in which neighboring trees are interconnected by fusion of their roots. Such a joining may enhance nutrient and water exchange and contribute to stability. Unfortunately, this adaptation enables fungal movement from one tree to another and is an important contributor to their loss, particularly those that are closely grown. Destroyed from within, its branches laid bare by the death of the leaves that are vital to the photosynthetic process, a tree can die within a year.

Marie Beatrice Schwarz

Born in the Dutch East Indies (now Indonesia) in 1898, and later moving to the Netherlands where she pursued a doctorate in phytopathology, Dr. Schwarz is best known for her identification of the fungus responsible for Dutch elm disease in 1922. Much of her research was done in Indonesia, where she and her husband were interned in prisoner camps in 1942 following the invasion of the Japanese army. Her husband would die in camp, but she and her sons returned to the Netherlands where she continued her studies. Dr. Schwarz died in 1969 at the age of 71.

In 1921, the pathogen arrived in North America on European elm logs that were imported for use as veneer. The European beetle was already on the continent. Not recognized at first, the disease was identified in Ohio in 1930 by Christine Johanna Buisman, a woman of Dutch descent. Since its unheralded arrival on the shores of North America, it is estimated that as many as 100,000,000 elm trees, although some sources place it at less than that number with most agreeing that up to 75 percent of all elms have succumbed. Unfortunately, even the loss of so many trees did not spell the end of DED. The destruction is not complete and perhaps will never be. The fungus and its beetle vectors still thrive, passed from one hapless tree to another.

Planted close together as windbreaks, and alongside city streets, proximity alone promoted the easy spread of the fungus, not only by beetles, but also by the root grafts between the trees. What might have been a source of strength and nourishment turned into a conduit for disease and ultimate death. Entire communities of the tree disappeared. It is easy to find photos of street borders once shaded by the great arching branches of American Elm, now reduced to brown, uninterrupted patches of grass and stumps. Occasionally saplings may escape, only to become infected as they mature.

Devastating in North America, across the sea in England, the disease essentially wiped out the stately English Elm (*Ulmus procera*), a species that, despite the common name, was probably brought to the British Isles by the Romans, perhaps just as a single tree. Planted in cities, as wind breaks, in hedgerows, English Elm was perhaps the most commonly encountered landscape tree in England until 1927. In that year the less destructive species of the fungus caused the loss of many trees, but the episode ended around 1940. Then in 1967, a load of Rock Elm (*Ulmus thomasii*) logs imported from North America were infected with a more virulent form, leading to the death of 25 million trees. By 2006 DED had reached Scotland, where there is no indication the epidemic will die out.

The old elms of England are gone and only a few individuals bring the past into the present. A stand of approximately 17,000 trees, located on the southeast coast near Brighton, is now under attack. As

recently as January 24, 2019, a report indicated that five trees had been removed during the week, adding to the 2,000 removed in the previous year.

In the early years of the disease in North America, different measures were attempted to control the spread. Many jurisdictions went after the beetle, spraying trees with copious amounts of DDT. Descending clouds of pesticide-loaded spray best described the scene in the battlefield of disease versus well-intentioned humans, but such measures were destined to fail. After all, the beetles are under the bark as well as on top of it. They are small, and they fly.

Fungal control depends on continual vigilance and ongoing injections of fungicides. This is considered a preferred method in many Canadian communities and in the United States as well. Healthy trees are injected in the attempt to prevent spreading. Many municipalities, employ public awareness programs and quickly remove dead and dying trees, burning the decayed trunk to kill spores and beetles alike. The continuance of these programs relies on the involvement, and the resources, of local jurisdictions, always a matter of concern.

Unfortunately, despite physical controls and community involvement, as important as these measures are, Dutch Elm Disease shows little sign of disappearing from the planet. Research has barely opened the door to understanding the disease: for example, although the life cycle of the beetle and pathogen is known, the relationship between them is not fully studied. Another research question is the resistance of some elm trees to the disease. Selections of healthy trees for propagation are one weapon in the battle for the survival of the elms, but the reasons for the resistance of select individuals is elusive; so many factors are involved. It is known that elm trees are most susceptible to disease in spring. This is the time of maximum growth, a period of allocation of resources to photosynthesis, wood production, and flowering that demands all the resources a tree can muster; there is little left to fight a pathogen. When this time of active growth draws to a close, resistance appears to increase. Thus, in areas such as southern Italy where blossoming of elms occurs early, probably before the beetle larvae mature, DED is less prevalent. What this means in a time of global warming is unclear, as it is of course possible that the cycles of beetle maturation and pathogen, which readily mutates, may shift as well.

Although resistance is not fully understood, much hope lies in disease resistant trees and the cultivation of selections and hybrids. Isolation may work in the short term, but the warming climate counters the benefits of cold and separation. The truth is, many elm species, as we know them in their unaltered state, may not survive, or in the best scenario be reduced to small, isolated populations, perhaps protected and kept from public view. More emphasis on developing cultivars will assuredly continue but may in the long run be counterproductive in terms of the continuance of native elms.

The future of *Ulmus* species probably does depend on the efforts of those committed to propagating trees that appear to be resistant. Today you can buy such trees, named as varieties of species such as the American Elm. Hybrids and cultivars have been introduced that are resistant; even the venerable Morton Arboretum is involved with the introduction of cultivars (hence the “Commendation” tree — *Ulmus* ‘Morton Stalwart’). Imagination can take full flight in naming these altered trees. There is ‘Emerald Sunshine’, ‘Frontier’, ‘Jefferson’, ‘Lewis & Clark’, ‘Patriot’, ‘Pioneer’, ‘Triumph’— the list goes on and on. There is no pretense that these are anything but introductions, most of them smaller than the original species. Of course, there are also the exotic elms from other countries.

With so many named variations, communities can be more particular about what they select. Lists are available of desirable alternate forms for specific locations. Do you want shorter, more narrow trees than the American Elm, perhaps for lining a city street or accenting an urban lawn? A nursery can provide advice and trees for sale. Some cultivars are more resistant than others, as limited studies indicate, and the long-term prognosis may or may not be good. Insufficient time has elapsed since the introduction of so many, and the rapidity of the spread of the disease is still not completely understood. In the meantime, the selections seem OK, and perhaps they increase public awareness of the disease.

But it is easier to put concern for the future aside, and DED is so pervasive that nothing seems immune. Crossing the Rockies, the disease popped up in Boise, Idaho in 1968. Portland was embraced by 1976, and Bellevue, Washington, by 1994. In Canada, DED is found near the Alberta/Saskatchewan border, and throughout most of the southeastern part of the country. In 2018, the Urban Forestry Department in Portland, Oregon, with the help of thousands of volunteers, surveyed the city's trees. DED was already known to be present in Portland's elms, and although fungicides were applied to over 100 healthy trees, removal remains the only option for infected trees. They cannot survive, and as a society we cannot seem to stop the infection. The managers in Portland seem to recognize that reality. Already the city is home to small disease-resistant cultivars. Perhaps this approach is something that defines our future, and we should simply move on.

Priceless old American Elm

But I can't move on, not completely, and my hope lies in the belief that the native elms won't all die, that their resistance, whether understood by science or not, will guarantee a future for these ancient trees. And in that future, it is my dream that my grandchildren and their children will come upon a stately old American Elm, surrounded by thriving offspring. These native trees won't be situated alongside a city street or in a city park – such trees will have been removed from sight long before. Free of the tunnels of voracious beetles, the secret trees might thrive in an isolated woodland, or near an old farm, in a place where wind and rain and cold offer some protection. Maybe an old one will have been protected by distance from other elms in an arboretum, as at Hoyt Arboretum in Portland, where such a beautiful tree thrives.

Wherever they are, these will be the survivors, selected by forces we may never understand. We will not know if they have done battle with the pathogen and its beetle, or if perhaps they are simply the lucky ones, distanced from invasion by location, time, and their own unique cellular structure. Away from their cultivated relatives, these solitary trees live on, their fixed place on Earth known to those few who will pay homage to their triumph over age and disease.