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Volume 25

Reign of Titans: The Rise and Fall of Conifers in the Ancient World

By Bo Kelley, MBG Arborist; photos by Taylor Herndon

If viewed through the right lens of time, the face of Planet Earth would change like the seasons. Entire continents would drift, unite, and divide from one another like clouds through the sky. Mountains would rise from the sea, soaring into the heavens as jagged beasts, only to erode and return to the earth once more. Life itself would change in an instant, evolving and adapting to the ever-changing power of natural selection. This scale of time is mysterious, if not mystical, to the human mind. For us, the Rocky Mountains have always been where they are now, Europe will always be to the east, and Antarctica is an icy wasteland in the south, unknown except by the most intrepid. If we expand upon our own view, perhaps widening the lens and considered time on a grander scale, we may begin to appreciate the beauty found in the transience of all life on this planet.

This is the story of conifers, the once powerful group of trees who, in their time, ruled every corner of the planet with utter surety. They formed the first great terrestrial forests, harboring and nurturing countless forms of life by providing an immeasurable number of niches. Within this forest ecosystem, all life embarked on an evolutionary journey together.

Even today, endless tracts of forest habitat may be comprised primarily of conifers, all existing in places of the world too harsh, hostile, and inhospitable for others. A single group of trees consisting of a mere 1% of all tree

species currently on the planet, surely laid the foundation for the angiosperms that followed.

Follow the link **here** to read a little bit more on how conifers evolved and eventually became the most dominant trees on the planet, only to be replaced by angiosperms.

Withstanding Time

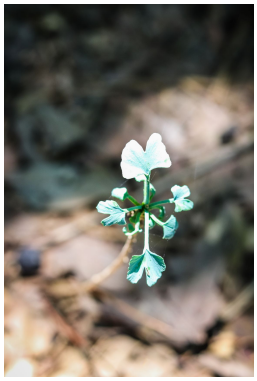
By Taylor Herndon, MBG Events Coordinator; photos by Taylor Herndon

Enduring, persistent, resilient; *Ginkgo biloba*, the tree that time forgot. With its fan-shaped leaves, pollen-bearing and seed producing organs, rancid-smelling seeds, and no living relatives, this tree is a botanical oddity. Like cycads, Ginkgos are the only other seed plants with motile sperm within their pollen tubes, a truly archaic characteristic. Ginkgos are the only genus of Ginkgophyta that have not gone extinct, while other members of the Ginkgo lineage have come and gone. A Ginkgophyte is a group of gymnosperms (non-flowering plants) that are particularly interesting to paleobotanists because they are considered the 'missing link' between ferns and angiosperms (flowering plants). Fossilized Ginkgo leaves have been discovered in every continent and have dated back a little over 200 million years to the late Triassic Period and into the Jurassic Period.

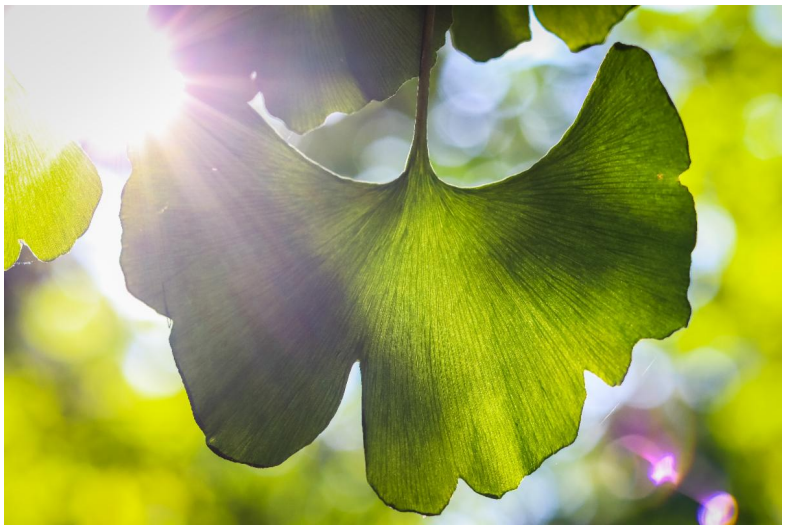
The oldest surviving kind of tree has essentially been unchanged for over 200 million years, outliving all other types of animals and plants. Ginkgos have witnessed the extinction of dinosaurs, the transformation of reptiles to mammals, and now the impacts of modern humans. During the Triassic Period, and into the Jurassic Period, the continents were still one supercontinent known as Pangea. The climate generally consisted of hot summers and cold winters in the interior of the continent. The weather was often very moderate away from the equator, which provided the perfect environment for Ginkgophyta. At least two species thrived during this time. The maximum diversity for Ginkgophyta occurred during the Cretaceous period (144 million years ago) where it reached five or six species in the Northern Hemisphere. By the Paleocene period (65 million years ago), only a single species in the genus Ginkgo remained, *Ginkgo adiantoides*; virtually indistinguishable from today's *Ginkgo biloba*. Because of the tropical environment, Ginkgos were found in northern regions at that time, but as Pangea began to separate and the world's climate began to go into disarray during the Oligocene period (33 million years ago), Ginkgos started losing their hold in certain parts of the world. They retreated from their homes in the Artic, and had more of a southern distribution, and prospered in what is now Asia, Europe and North America. Ginkgos disappeared from the fossil records altogether in North America around seven million years ago and disappeared from Europe 2.5 million years ago. The Pleistocene (less than 2 million years ago) has no known fossils of Ginkgos anywhere on Earth. Did the great Ice Ages finally extinguish the resilient Ginkgo species? *Ginkgo biloba* managed

to survive in parts of China, in protected valleys, waiting to be rediscovered by modern people.

The attention, or lack thereof, we give to mother nature tends to be for our own selfish needs which often leads to multiple repercussions for everything involved. Human dominance has negatively impacted many species, but Ginkgos have flourished alongside humankind. Without the attention of people, Ginkgos would have gone extinct, or at best, the species would have been reduced to a few individuals. The ginkgo has been a symbol of vitality, resilience, and longevity in Chinese and Japanese Buddhism, Confucianism, and Shintoism. It is believed that even the trees can be in a state of spiritual liberation and reach nirvana. The Ginkgo was viewed as a relic and has proved useful enough to gain respect. Ginkgos began their renewal. They found their way to Europe with the help of the Dutch trading colony of Deshima that resided in southern Japan. Ginkgos spread quickly to North America as well as everywhere else because it was viewed as a horticultural novelty. In a hundred years, Ginkgos successfully returned to places where they had been extinguished millions of years ago. The Ginkgo's beauty and usefulness has earned the tree great recognition throughout the world.



When the days start getting shorter and have a bit of a chill in the air, the leaves of the Ginkgo begin to change, and among the towering trees a brilliant yellow stands out. As it enters a deep slumber to endure the following season, only a bright yellow carpet remains at its base, waiting to return to the earth. This true beauty is the reason Ginkgos line busy streets and sidewalks and inhabit sacred temples and shrines. While beautiful yet vulnerable, *Ginkgo biloba* is persistent and resilient. Tolerance of pollution, resistance to disease, and the ability to withstand the extremes of Mother Nature, Ginkgos have now found peace among people and plants alike while offering up its medicinal properties. The Ginkgo has found its way into the pharmacy because of the herbal remedies its seeds and leaves provide. Ginkgo extract has been one of the most popular approaches to combat poor circulation in the brain. It has proven to help improve mood in early stages of Alzheimer's and help relieve memory loss. As if *Ginkgo biloba* is thanking humankind for saving it from its inevitable demise, it has been a source of a multibillion-dollar pharmaceutical industry and continues to help the human race.



“But in a world where so much of the landscape has been altered by human activity, more important is that the connection of local people with this marvelous tree is deep. To them, and indeed to anyone with empathy for nature, this great plant is a testament both to its tenacity and also to its lasting power” (Crane, 2013, p. 78).

The Rise of Angiosperms

By Linnea West, MBG Tree Team; photos by Taylor Herndon

Q.- What do you have in common with Brachiosaurus and Triceratops?
A. - The appreciation of a magnolia flower gracing your dining table.

Come back in time with me 150 million years to ancient earth on the landmass of Laurasia, the northern half of the former supercontinent Pangaea…

It is late in the Jurassic Period. The climate is becoming more temperate after the tectonic shifts, rapid warming, and volcanic eruptions of the Permian which resulted in extinction of 90% of species on earth.

Now, throughout the globe, plants and animals are adapting, evolving, and creating new forms.

An evolutionary leap on the landmass of Laurasia leads to seeds protected within the structure of a flower (angiosperm). Not only does this flower-fruit covering keep seeds from drying out, but by providing fleshy food for animals and especially birds, the plant can be spread across long distances.

What was this earliest flower?

Scientists now believe it was a progenitor to our Magnolia. Delicate flower parts do not preserve well as fossils the way bones and chitin do. However, using the limited fossil evidence we do have, coupled with reverse-tracing the known evolutionary progression of flower structure of 800 descendant species, botanists surmise that this first flower was similar to the Magnolia of today. This projected First Flower shares characteristics with other early-lineage flowering plants in the *Magnoliaceae* and *Nymphaea* (Water Lily family): the bud is enclosed in a bract rather

than sepals and the perianth parts are undifferentiated ‘tepals’, rather than distinct petals and sepals.

Ancient Magnolia flowers, developed before most bee species, were pollinated by beetles, as they still are today. Heavy, cloyingly sweet fragrance was an enticement to beetles, the cup shape easy to crawl around in, and Magnolia’s thick, waxy petals and leaves are resistant to the powerful mandibles of beetles. As you gaze at beetles eating and spreading pollen in the sweet cavern of a Southern Magnolia blossom today, think about this same ritual being repeated for the past 150 million years...

The reproductive parts of these early angiosperms were in a series of circles. The center contains the female pistils, surrounded by concentric rings of the male anthers, and around these are rings of petals in multiples of 3. This hermaphroditic flower structure gave these new plants amazing reproductive abilities! They could self-fertilize and reproduce on their own, or when other plants of their species were nearby, they could cross-pollinate and evolve to become stronger. Insects rapidly evolved in tandem with these new food opportunities.

The advent of angiosperms and their rapid diversification and spread over the planet provided abundant food for plant-eating dinosaurs, increasing their populations. In so doing, this increased the food supply for meat-eating dinosaurs. Angiosperms, with their ability to protect seeds within a fruit covering, prolonged the viability of seeds through drought and temperature fluctuations, and increased the geographic spread through animals, water, and wind. Today, there are over 360,000 angiosperm species worldwide.

Modern day *Magnolia*, named for the French botanist, Pierre Magnol, is a large genus of 210 species. Magnolias can be found in eastern North America, south and southeast Asia, Central America, the West Indies, and South America.

They are spreading, evergreen or deciduous trees and shrubs with large, fragrant, bowl or star shaped blossoms in white, pink, purple, yellow or green. Blooms often appear before the leaves in spring. In fall, the cone-like fruit is an aggregate of follicles. All Magnolias have an undifferentiated perianth with 9-15 tepals in 3 or more whorls.

Walk our beautiful Botanic Garden grounds and see these native North American magnolias:
Magnolia grandiflora, Southern Magnolia
Magnolia virginiana, Sweetbay Magnolia
Magnolia acuminata, Cucumbertree Magnolia
Magnolia macrophylla subsp. *ashei*, Bigleaf Ashe Magnolia
Magnolia tripetala, Umbrella Magnolia
And their Asian sisters:

Magnolia xsoulangeana, Saucer Magnolia
Magnolia stellata, Star Magnolia

Join us on a Prehistoric Tree Tour this autumn as we examine the evolutionary wonders of Conifers, Ginkgos, and Angiosperms from the Age of Dinosaurs.

Sources: Tectonic-driven climate change and the diversification of angiosperms- Anne-Claire Chabouteau, Pierre Sepulchre, Yannick Donnadieu, Alain Franc, PNAS September 30, 2014; Triassic Period Facts: Climate, Animals & Plants, Mary Bagley, LiveScience Feb. 2014; Beetle Pollination-USDA, US Forest Service; Mario Vallejo-Marin, The Conversation US Aug 2017 ; Nature Communications Evolution of Flowers; www.nationalgeographic.com/science/prehistoric-world

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