WATTIEZA - THE WORLD'S OLDEST GIANT CLADOXYLOPSID TREE AND THE FIRST FORESTS DURING DEVONIAN TIMES

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INTRODUCTION

In recent decades new data have been obtained regarding the earliest trees, and their ecology in early forest ecosystems. The evolution of trees of modern size growing together in forests, fundamentally changed terrestrial ecosystems. The oldest trees were often thought to be of the latest Devonian age (about 372–390 Ma) as indicated by the widespread occurrence of Archaeopteris (Progymnospermopsida), however, Middle Devonian fossil tree stumps, rooted and still in life position, from the Gilboa fossil locality (New York), were discovered by a fossil hunter named Lockwood between 1852 and 1854. More stumps were discovered in the 1870s from the same Gilboa locality when workers were blasting in a quarry to obtain rock to repair roads damaged by a major flood. The stumps, later named Eospermatopteris, were widely cited as evidence of the Earth's 'oldest forest'.

However, Eospermatopteris affinities and significance have proved to be enigmatic because the aerial portion of the plant was unknown until 16 years ago when a second source of material came to light from a quarry about 16 km from the uppermost Eospermatopteris stump site. The second group of fossils, described by Stein et al. (2007), preserved nearly complete Eospermatopteris plants. The slender trunk was topped with at least eight branches that spread out from the apex like outstretched fingers. The plant did not have flattened leaves instead, the branches were covered in whorls of forked branchlets. Similar branches to those discovered at the second site in New York had been found in Middle and Late Devonian rocks in Belgium and Venezuela. They were described as a cladoxylopsid named *Wattieza*.

The first complete fossil of the world's oldest tree, a primitive Devonian plant resembling a modern palm has been uncovered by paleontologists in Schoharie County, upstate New York. The eight-meter long fossil of the species Wattieza has enabled scientists to reconstruct entirely the ancient tree for the first time and solves an old palaeobotanical mystery. As previously mentioned, the genus *Wattieza* described from Belgium and

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Venezuela (Berry, 2000), showed a similar construction of branch systems, including probable basal abscission surfaces and speckled texture, but bears more complex appendages, some with recurved tips bearing sporangia. However, the trunk remained unknown until the discovery in New York, published by Stein et al. (2007).

Back in June 2004, paleontologists L. Van Aller and F. Mannolini of the New York State Museum in Albany found the fossilized crown of a massive tree in a small sandstone quarry in Gilboa, New York. The following year, they dug out a trunk of the same species, extracting it fragment by fragment and reassembling it like a puzzle of an eight-meter-long fossilized tree. The finding solved a more than 150 years mystery: A fossilized "forest" of stumps, discovered at a site just 16 km away in the mid-1800s, that had perplexed generations of botanists ever since. Without the upper sections of the trees, experts were unable in the past to accurately identify the species.

The spectacular specimens from Schoharie County, New York, showed an intact crown belonging to the cladoxylopsid *Wattieza* and its attachment to the Eospermatopteris trunk and base. This evidence allows the reconstruction of a tall tree-fern-like plant with a trunk bearing large branches in longitudinal ranks. The branches were probably abscised as frond-like modules. Lower portions of the trunk show longitudinal carbonaceous strands typical of Eospermatopteris, and a flat bottom with many small anchoring roots.

The union of *Wattieza* branches with a trunk and base identical to those of Eospermatopteris provides the first direct evidence of general body form including attachment for both genera, and allows new insight into the enigmatic Gilboa trees (Figure 1). This evidence also provides the first reasonably complete picture of the size and architecture of large cladoxylopsids. Evidence from the specimens combined indicates that the height of the tree may have exceeded eight meters. The basal diameter falls within the range of the stump sizes observed at Gilboa. However, the largest stumps at Gilboa are twice the diameter of those studied by Stein et al. (2007), suggesting even greater height for Wattieza.

Stein et al. (2007) have traced the age of *Wattieza* species to the latest Givetian to earliest Frasnian age, for New York's material, but the *Wattieza* material described by Berry (2000) in Sierra de Perijá was dated a little bit earlier: Middle Givetian (380-385 Ma) in Casas et al. (2022), a time in which the world's primitive land plants, first developed characteristics associated with modern-day trees, such as taller trunks, more diverse reproductive methods and the first signs of leaf development. This was also the period when the first seed-bearing plants spread across dry land to form forests.

Figure 1. Reconstruction of Wattieza. Source: https://es.wikipedia.org/wiki/Wattieza#/media/Archivo:Wattieza_reconstruccion.jpg

Wattieza itself did not bear seeds and reproduced with spores, like today's ferns. The scientists presume that each branch contained chlorophyll. But because they lacked leaves, the ancient trees' branches probably weren't efficient at collecting light. Nevertheless, these trees (probably the biggest on Earth at the time), succeeded because their height enabled them to spread spores more effectively than their competition did.

CLADOXYLOPSIDA – THE *WATTIEZA* DISTRIBUTION

Belgium

A single small plant fragment from the Middle Devonian of Belgium was first illustrated by Stockmans (1968) in Berry (2000) as *Wattieza givetiana*. The species are based on a single illustrated specimen, part, and counterpart, but another even smaller fragment is present in the collection. It consists of a small central axis with laterally attached, several times bifurcate, terminally recurved fertile ultimate units (Berry, 2000). Specimens were collected from rocks excavated during work to create a mineral water plant at the source of the Try-Coquia stream near Sart-Dame-Avelines in the Brabant Massif, Belgium

Wattieza givetiana

Locality: Source du Try-Coquia at Sart-Dame-Avelines, Belgium.
Horizon: Mazy Formation
Age: Givetian (Middle Devonian).

Venezuela

Devonian strata in the Sierra de Perijá, western Venezuela, have yielded a large collection of Middle and Late Devonian plant megafossils (Berry et al, 1993). From the Lower Member of the Campo Chico Formation, these include the lycopsids *Leclercqia* cf. *complexa*, *Haskinsia sagittata*, *H. hastata*, *Colpodexylon cachiriense*, *C. coloradense*, *C. camptophyllum* and *Gilboaphyton griersonii*, the zosterophyll *Serrulacaulis* cf. *furcatus*; and the iridopteridaleans: *Anapaulia moodyi* and *Compsocradus laevigatus*, as well as a new aneurophytalean progymnosperm: *Tetraxylopteris reposana*, and other as yet undescribed plants. This locality yields one of the most diverse assemblages found in old Gondwana terrains. It included diverse lycopsids, zosterophylls, progymnosperms, iridopteridaleans, and of course the Pseudosporochnales order, represented by *Wattieza casasii* (Berry 2000; Casas et al. 2023; Berry & Casas 2024).

Wattieza casasii

Locality: Caño Colorado, Sierra de Perijá, Zulia State, western Venezuela.
Material: The description is based on 13 main slabs and numerous other fragments.
Horizon: Green mudstones and shales close to the base of the Campo Chico Formation.
Age: From miospore analysis, samples yield Middle Givetian (about 380-386 Ma), for the lower member of this formation.
Repositories: National Museum and Gallery, Cardiff, Wales and Palaeontological section, Museo de Biologia, Universidad del Zulia, Maracaibo, Venezuela.
Etymology: In honor of Jhonny E. Casas, one of the discoverers of the original material.

Figure 2. System of fertile branches of Wattieza casasii (Campo Chico Formation, Sierra de Perijá, Venezuela). Source: https://www.peapaleontologica.org.ar/index.php/peapa/article/view/401

New York

The name *Wattieza* has become more significant in the last few years because very well-preserved fragments were discovered in New York. They are the distal fertile leaf equivalent appendages carried on the digitate branches of the first forest tree found in New York State (Figure 3), belonging to the family Pseudosporochnaceae in the Class Cladoxylopsida (Stein et al. 2007).

Figure 3. Base from Wattieza trees (NY). Chris Berry as scale.

***Wattieza* sp.**

Locality: Department of Environmental Conservation quarry on the northwest slope of South Mountain, Schoharie County, New York.
Horizon: Oneonta Formation.
Age: Palynostratigraphy of nearby samples, yields the latest Givetian to earliest Frasnian age.

CONCLUSIONS

Wattieza specimens from Belgium, Venezuela, and New York, provide new insights into Earth's earliest trees and forest ecosystem evolution. The tree-fern-like morphology described is the oldest example so far of an evolutionarily recurrent arborescent body within vascular plants. In forming the first forests (Figure 4), these trees must have changed the Earth system. Given their modular construction, these plants probably produced an abundant litter, indicating the potential for significant terrestrial carbon accumulation and a detritus-based, creating new types of micro-environments for smaller plants and tiny arthropod fauna; and binding the soil together during the Middle Devonian period (Stein et al. 2007).

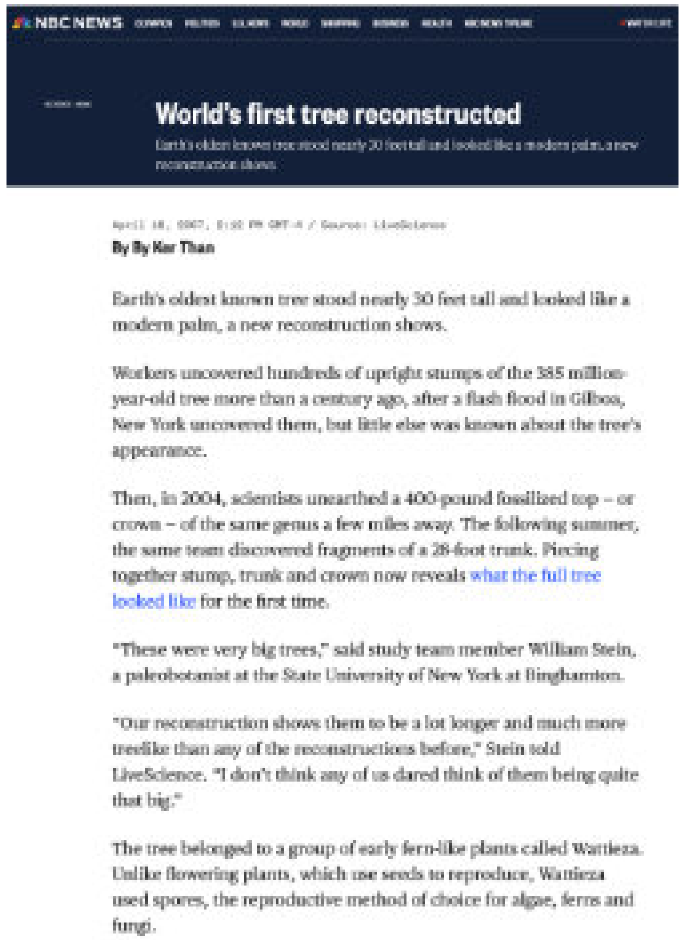
Figure 4. Wattieza trees formed Earth's first forests.

ADDENDUM

During the year 2007, after the publication by Stein et al. (2007) about the new discoveries in New York, *Wattieza* became quite famous, and appeared in many newspapers (Figures 5, 6, 7, 8, 9, 10, 11, 12) and science magazines (Figures 13, 14).

Figure 5. Fossilized trees mystery solved (BBC, United Kingdom).

Figure 6. Reconstructed the oldest type of tree known so far (El Pais, Spain).



NBC NEWS

World's first tree reconstructed

Earth's oldest known tree stood nearly 30 feet tall and looked like a modern palm, a new reconstruction shows

By By Ker Than

Earth's oldest known tree stood nearly 30 feet tall and looked like a modern palm, a new reconstruction shows.

Workers uncovered hundreds of upright stumps of the 385 million-year-old tree more than a century ago, after a flash flood in Gilboa, New York uncovered them, but little else was known about the tree's appearance.

Then, in 2004, scientists unearthed a 400-pound fossilized top – or crown – of the same genus a few miles away. The following summer, the same team discovered fragments of a 28-foot trunk. Piecing together stump, trunk and crown now reveals what the full tree looked like for the first time.

"These were very big trees," said study team member William Stein, a paleobotanist at the State University of New York at Binghamton.

"Our reconstruction shows them to be a lot longer and much more treelike than any of the reconstructions before," Stein told LiveScience. "I don't think any of us dared think of them being quite that big."

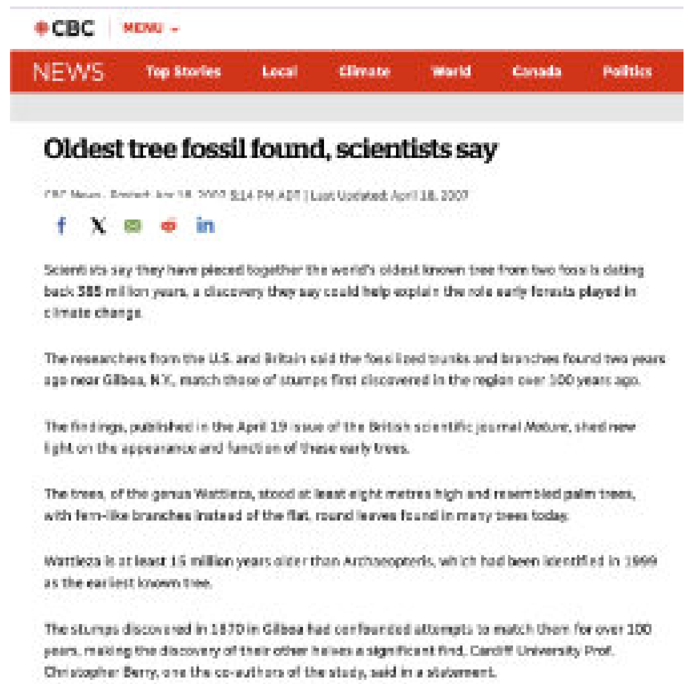
The tree belonged to a group of early fern-like plants called Wattieza. Unlike flowering plants, which use seeds to reproduce, Wattieza used spores, the reproductive method of choice for algae, ferns and fungi.

Figure 7. World's first tree reconstructed (NBC News, USA).

20minutos INTERNACIONAL

Científicos reconstruyen el árbol más antiguo del mundo

Figure 8. Scientists reconstruct the oldest tree in the world (20minutos, Spain).



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Oldest tree fossil found, scientists say

Last Updated: April 18, 2007

Scientists say they have pieced together the world's oldest known tree from two fossils dating back 385 million years, a discovery they say could help explain the role early forests played in climate change.

The researchers from the U.S. and Britain said the fossilized trunks and branches found two years ago near Gilboa, N.Y., match those of stumps first discovered in the region over 100 years ago.

The findings, published in the April 19 issue of the British scientific journal Nature, shed new light on the appearance and function of these early trees.

The trees, of the genus Wattieza, stood at least eight metres high and resembled palm trees, with fern-like branches instead of the flat, round leaves found in many trees today.

Wattieza is at least 15 million years older than Archaeopteris, which had been identified in 1999 as the earliest known tree.

The stumps discovered in 1870 in Gilboa had confounded attempts to match them for over 100 years, making the discovery of their other halves a significant find, Cardiff University Prof. Christopher Berry, one the co-authors of the study, said in a statement.

Figure 9. Oldest tree fossil found, scientists say (CBC News, USA).

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Earth's oldest tree had fronds, not leaves

By Reuters

Figure 10. Earth's oldest tree had fronds, not leaves (Reuters, USA).

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Fossil finds reveal 'feather duster' tree

Last updated at 12:00 19 April 2007

Two new fossils of the Earth's oldest tree, a type of fern that grew 30 feet tall, have shown scientists what forests may have looked like 380 million years ago.

For the first time, it has been possible to piece together an accurate picture of the ancient tree belonging to the plant family Wattieza.

Experts now know it resembled nothing found on Earth.

Reaching 30ft high, the tree had long thin trunk with small anchoring roots, ending in a crown sprouting ferns like the fronds of a feather duster.

It reproduced by shedding spores, in the same way as present-day ferns.

Large numbers of Wattieza appear to have grown together in forests.

Figure 11. Fossil finds reveal 'feather duster' tree (Mail Online, United Kingdom).

MumbaiMirror

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Earth's oldest tree had fronds, not leaves

Mumbai Mirror / Updated: Apr 20, 2007, 02:43 IST

(Left) Fossil tree trunks from the Gilboa Fossil Forest in US. (Right) A trunk of the fern-like Eospermatopteris tree, found in Gilboa

An international research team has found evidence of Earth's earliest forest trees, dating back 385 million years.

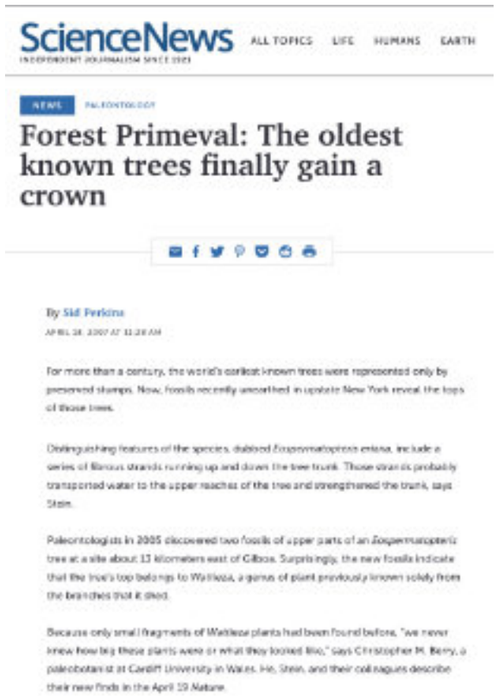
Upright stumps of fossilised trees were uncovered after a flash flood in Gilboa near New York in the US, more than a century ago. However, until now, no one has known what the entire trees looked like.

Two years ago, near Gilboa again, two fossils were found of trees which had fallen sideways, with their trunk, branches, twigs and crown still intact.

American researchers called in Dr Christopher Berry of the School of Earth, Ocean and Planetary Sciences. Dr Berry is an expert who has studied tree fossils around the world for the last 17 years. He was able to identify the trunks as being of the genus Wattieza, a tree fern-like plant.

While small fragments of Wattieza have been found in the past, these new specimens show that they reached at least 8 metres in height and formed the first known forests on earth.

Figure 12. Earth's oldest tree had fronds, not leaves (Mumbai Mirror, India).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NEWS PALEONTOLOGY

Forest Primeval: The oldest known trees finally gain a crown

By Sid Perkins

For more than a century, the world's earliest known trees were represented only by preserved stumps. Now, fossils recently unearthed in upstate New York reveal the tops of those trees.

Distinguishing features of the species, dubbed *Eospermatopteris eriana*, include a series of fibrous strands running up and down the tree trunk. Those strands probably transported water to the upper reaches of the tree and strengthened the trunk, says Stein.

Paleontologists in 2005 discovered two fossils of upper parts of an *Eospermatopteris* tree at a site about 13 kilometers east of Gilboa. Surprisingly, the new fossils indicate that the tree's top belongs to *Wattieza*, a genus of plant previously known solely from the branches that it shed.

Because only small fragments of *Wattieza* plants had been found before, "we never knew how big these plants were or what they looked like," says Christopher M. Berry, a paleobotanist at Cardiff University in Wales. He, Stein, and their colleagues describe their new finds in the April 19 *Nature*.

Figure 13. Forest Primeval: The oldest known trees finally gain a crown (Science News, USA).


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World's First Tree Reconstructed

News By Ker Than published April 18, 2007

Reconstruction line drawing of Wattieza. (Image credit: Frank Mannolini/New York State Museum)

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Workers uncovered hundreds of upright stumps of the 385 million-year-old tree more than a century ago, after a flash flood in Gilboa, New York uncovered them, but little else was known about the tree's appearance.

Then, in 2004, scientists unearthed a 400-pound fossilized top—or crown—of the same genus a few miles away. The following summer, the same team discovered fragments of a 28-foot trunk. Piecing together stump, trunk and crown now reveals what the full tree looked like for the first time.

"Our reconstruction shows them to be a lot longer and much more treelike than any of the reconstructions before," Stein told *LiveScience*. "I don't think any of us dared think of them being quite that big."

The tree belonged to a group of early fern-like plants called *Wattieza*. Unlike flowering plants, which use seeds to reproduce, *Wattieza* used spores, the reproductive method of choice for algae, ferns and fungi.

The finding, detailed in the March 19 issue of the journal *Nature*, will help scientists understand a crucial turning-point in our planet's history—when the first forests appeared.

Figure 14. World's First Tree Reconstructed (Live Science, USA).

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Dr. Cristopher Berry es un paleobotánico que se especializa en comprender la radiación temprana de los grandes grupos de plantas y el nacimiento de los ecosistemas forestales en el período Devónico, hace unos 380 millones de años. Esto se basa en la formación que recibió de la profesora Dianne Edwards, FRS y de Muriel Fairon-Demaret (Lieja, Bélgica). Su experiencia se basa en un apasionante programa de trabajo de campo en lugares tan variados como: Svalbard, Groenlandia, China, EE. UU., Venezuela, Colombia, Argentina, Europa; y una preparación de los fósiles recuperados, en los laboratorios de Cardiff. Sus publicaciones de más alto perfil, que versan sobre los primeros bosques fósiles y el crecimiento de los primeros árboles, han recibido publicidad mundial.

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