Floor of oldest forest discovered in Schoharie County

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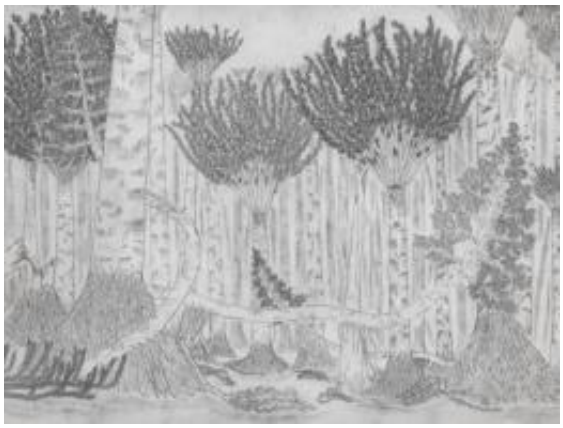


Working in conjunction with William Stein at Binghamton University, Frank Mannolini of the New York State Museum developed a sketch of what the Gilboa forest site might have looked like about 385 million years ago. Credit: Frank Mannolini, New York State Museum

Scientists from Binghamton University and Cardiff University, and New York State Museum researchers, and have reported the discovery of the floor of the world's oldest forest in a cover article in the March 1 issue of *Nature*, a leading international journal of science.

"It was like discovering the botanical equivalent of dinosaur footprints," said William Stein, associate professor of biological sciences at Binghamton University, and one of the article's authors. "But the most exciting part was finding out just how many different types of footprints there were. The newly uncovered area was preserved in such a way that we were literally able to walk among the trees, noting what kind they were, where they had stood and how big they had grown."

Scientists are now piecing together a view of this ancient site, dating back about 385 million years ago, which could shed new light on the role of modern-day forests and their impact on climate change.

The recent discovery was made in the same area in Schoharie County where fossils of the Earth's oldest trees - the Gilboa stumps - were discovered in the 1850s, 1920 and again in 2010 and were brought to the State Museum. The Museum has the world's largest and best collection of Gilboa fossil tree stumps. For decades scientists did not know what the trees connected to the stumps looked like. That mystery was solved when Linda VanAller Hernick, the State Museum's Paleontology collections manager, and Frank Mannolini, Paleontology collections technician, found fossils of the tree's intact crown in a nearby location in 2004, and a 28-foot-long trunk portion in 2005. The discovery of the 385-million-year-old specimens was named one of the "100 top Science Stories of 2007" by Discover Magazine. Stein, Mannolini, Hernick, and Dr. Christopher M. Berry, a paleobotany lecturer at Cardiff University in Wales, co-authored a *Nature* article reporting that discovery, as well as the most recent one. Working in conjunction with Stein, Mannolini also developed a sketch of the ancient forest.

This is Dr. Chris Berry at the quarry. Credit: Cardiff University

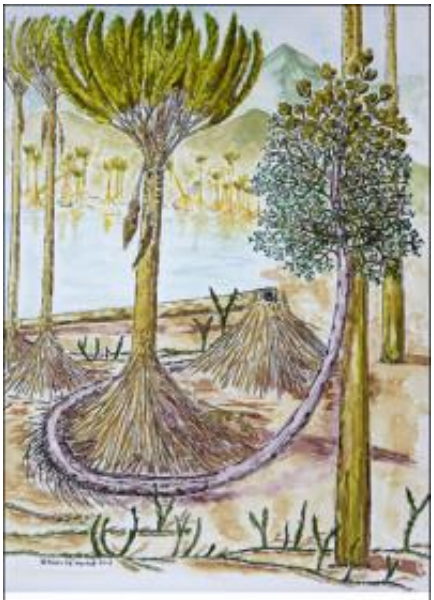
"This spectacular discovery and the resulting research provide more answers to the questions that have plagued scientists for more than a century since the first Gilboa stumps were uncovered and brought to the State Museum," said Hernick, whose passionate interest in the fossils date back to her childhood exposure to the Gilboa fossils.

In 2003 Hernick wrote "The Gilboa Fossils," a book published by the State Museum, about the history and significance of the fossils and their use in an iconic exhibition about the Earth's oldest forest that was in the Museum's former location in the State Education Department building on Washington Avenue. One of the key planners of the exhibition, which influenced generations of paleontologists, was Winifred Goldring, the nation's first female state paleontologist who was based at the State Museum. She worked tirelessly to study and interpret the Gilboa fossils and named the trees Eospermatopteris, or "ancient seed fern." In 1924, her paper about the stumps, together with the Museum exhibition, brought the "Gilboa forest" to the attention of the world. One of the Gilboa stumps will be on display in the Museum lobby, beginning March 2.

William Stein, associate professor of biological sciences at Binghamton University, carefully places one of the world's oldest trees in the University's greenhouse. Credit: Jonathan Cohen, Binghamton University

Following the discovery of the tree's crown, a thorough investigation was conducted by Stein and Christopher M. Berry, a paleobotany lecturer at Cardiff University in Wales and the other co-author of both *Nature* articles. They were able to determine that these trees actually resembled modern-day cycads or tree ferns, but interestingly enough, were not related to either one. Many questions still remained about what the surrounding area looked like, whether other plant life co-existed with these trees and how.

In 2010, during ongoing repair of the Gilboa Dam, New York City Department of Environmental Protection (DEP) engineers excavated infill from a quarry in Schoharie County. They agreed to allow researchers to re-examine the site where the fossils had been found when the dam was built in the 1920s. What they found this time was a large, substantially intact portion of the ancient forest horizon, complete with root systems. As they had expected, Eospermatopteris root systems of different sizes were the most abundant. But what they didn't expect to find was the level of detail of the overall composition of the forest.



This illustration by Kristen V.H. Wyckoff shows what the ancient forest in Schoharie County may have looked like.

The first glimpse of the unexpected complexity of

this ancient forest came when Stein, Berry, Hernick and Mannolini found the remains of large scrambling tree-sized plants, identified as aneurophytaleans. These plants were likely close ecological associates to the original trees, living among them on the forest floor like modern ferns, possibly scrambling into the forest canopy much as tropical vines do today. The aneurophytes are the first in the fossil record to show true "wood" and the oldest known group in the lineage that lead to modern seed plants.

Work on the new discoveries also pointed to the vital importance that the State Museum's collections have played in the paleontological research. "Discovery of scrambling aneurophytaleans at Gilboa was a complete surprise, but pointed to the likelihood that similar material had already been found at the site, but was unrecognized," said Hernick. "Sure enough in the State Museum collections a wonderful specimen, originally collected in the 1920s, provided additional key evidence."

The team also came across a tree belonging to the class Lycopsida, or club mosses, which predates an earlier discovery made in Naples, NY and an ecologically important group in the history of land plants. The lycopsids are an ancient group of non-seed plants represented today by low growing forms such as the "running pines" of the northern hardwood forests of New York. They also inhabited swamps and ended up being much of the Pennsylvanian coal we burn today.

Based on the new research, the team now believes that the area probably enjoyed a wetland environment in a tropical climate. It was filled with large Eospermatopteris trees that resembled weedy, hollow, bamboo-like plants, with roots spreading out in all directions, allowing other plants to gain a foothold. Scrambling among these roots on the forest floor were aneurophytaleans, acting much like ferns do today, and possibly climbing into the forest canopy as vines. The lycopsids, although seemingly rare, may also have been very important in certain places although perhaps not yet as specialized inhabitants of swamps.

But what the research team believes is most important about this particular site is what it was doing to impact the rest of the planet. At the time the Gilboa forest began to emerge -- during the Middle Devonian period, about 385 million years ago - Earth experienced a dramatic drop in global atmospheric carbon dioxide levels and the associated cooling led ultimately to a period of glaciation.

"Trees probably changed everything," said Stein. "Not only did these emerging forests likely cause important changes in global patterns of sedimentation, but they may have triggered a major extinction in fossil record."

For Stein, it all comes down to one thing - how much we don't know but need to understand about our ancient past. "The complexity of the Gilboa site can teach us a lot about the original assembly of our modern day ecosystems," said Stein. "As we continue to understand the role of forests in modern global systems, and face potential climate change and deforestation on a global scale, these clues from the past may offer valuable lessons for managing our planet's future."

More information: "Surprisingly complex community discovered in the mid-Devonian fossil forest at Gilboa" *Nature* (2012).

Provided by Binghamton University