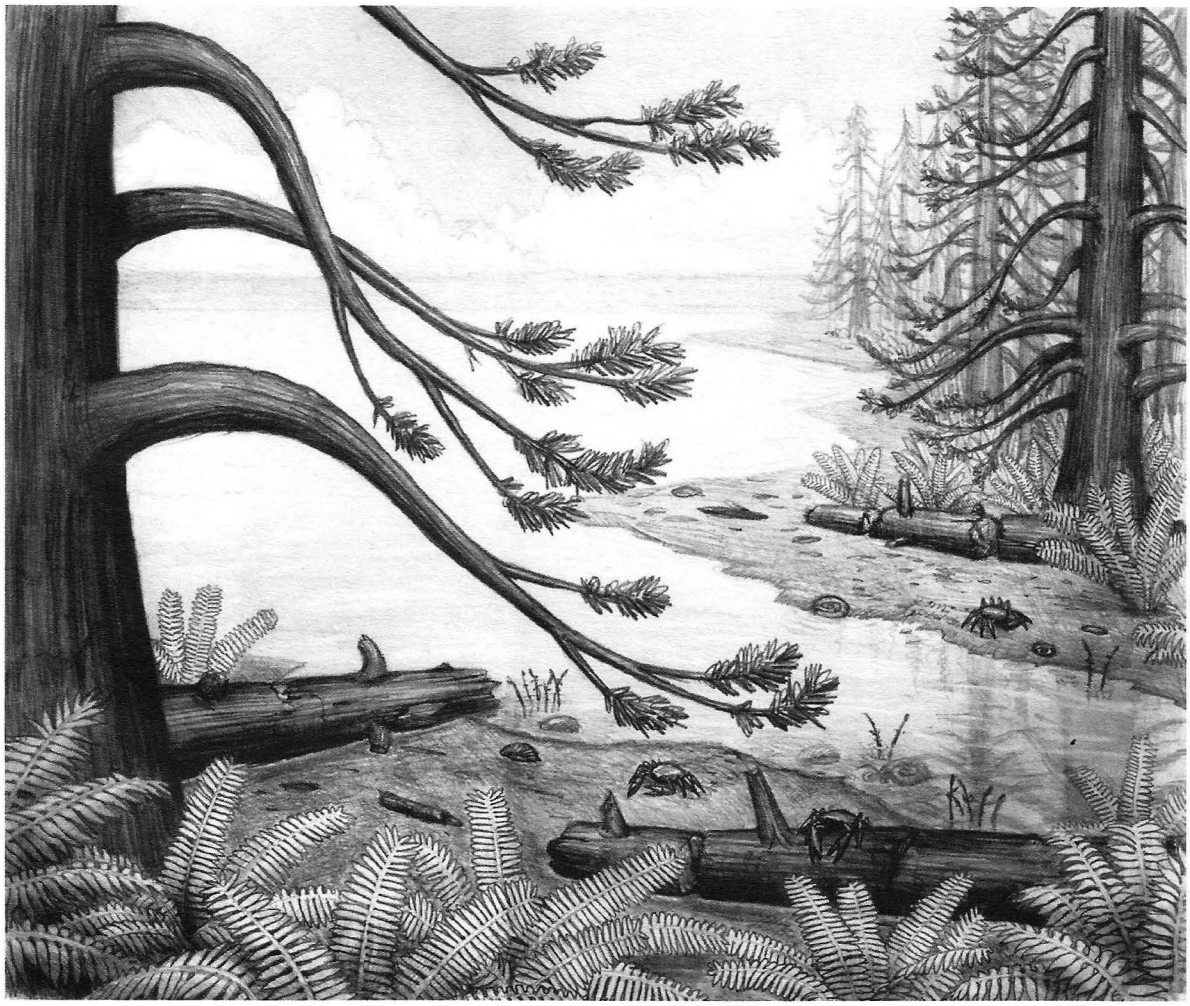


Jurassic Plant Fossils from Cuba

Evidence of a Laurasian Coastal Forest?

Today we know that the greatest plant diversity on the planet is concentrated in the tropics, and Cuba, the largest island in the Caribbean, has the richest vegetation and highest proportion of endemism of the entire region. About half of its approximately 6,000 species of flowering plants and approximately 70 genera are unique to the island.

Above: *Life restoration of the enigmatic San Cayetano Formation of western Cuba. Elements include the bivalve* Trigonia kroemmelbeini, *decapod crustaceans, small perisphinctids ammonites, abundant ferns (Pteridophita:* Piazopteris branneri), *trees (resembling* Araucarioxylon), *and small water-loving ferns resembling* Coniopteris. © *Heraldo Mussolini; used by permission.*

One example of Cuba's remarkable modern-day plant life is the so-called "cork palm," *Microcycas calocoma*, endemic to a small area in Pinar del Río Province on Cuba's westernmost tip. *Microcycas*, descended from a primitive lineage of Mesozoic plants (roughly 230 to 65 million years ago), is considered a "living fossil."

Once the supercontinent of Pangaea had broken apart, the tropical coasts of Laurasia and Gondwana opened onto a proto-Caribbean seaway. A variety of studies have concluded that the tropical coasts along this ancient sea were populated by a high diversity of terrestrial plant life, as is demonstrated by the relatively abundant fossil remains found in Jurassic outcrops in Pinar del Río. These fossils have considerable value in interpreting the climate and environment of prehistoric times.

Petrified wood from the Jagua Formation.

Making the Rocks Speak

Geologists assigned rocks found in western Cuba to the Upper Jurassic (early Oxfordian) period and named them the San Cayetano Formation because of their proximity to the town of San Cayetano, in the northeast Vueltabajo area. Thousands of fern impressions have been discovered in the San Cayetano Formation, one of Cuba's most enigmatic.

In 1965, the Russian paleontologist V.A. Vachrameev identified fragments of sterile and fertile fronds of a pteridophyte plant as a new species, *Phlebopteris cubensis*, and later published the first scientific study of Jurassic plant fossils in Cuba. In Vachrameev's view, *Phlebopteris* grew in a swamp or lake near the shoreline, and he considered the species related to varieties found in Eurasia and Greenland.

Some years later, however, Cuban paleontologist Alberto Areces-Mallea revised the taxon after studying better preserved material collected between 1984 and 1988. He suggested that *Phlebopteris cubensis* was actually a synonym of *Piazopteris branneri,* a species known since 1914 from the Early Jurassic Huayacocotla Formation of Mexico. This same fern has ALSO been reported from Jurassic rocks in Honduras and northern Africa.

Areces-Mallea not only proposed a correlation between the age of the San Cayetano Formation and the Huayacocotla Formation, he determined that the paleoflora of both formations was very similar, indicating that the Early Jurassic climate was warm and humid across the entire Gulf of Mexico. He further hypothesized that the outcrops containing *Piazopteris branneri* fossils represented the ancient coastal delta of a large river that drained from the continent to the south of Cuba, where the Yucatán basin exists today.

A Window on the Past ... Still Only Half-Open

The San Cayetano Formation produced another remarkable discovery in 1976 when Polish geologist Grzegorz Haczewski reported accumulations of plant debris, poorly preserved pollen and spores, and petrified wood resembling *Araucarioxylon*, an extinct genus of conifer known only from Triassic deposits in North America and, therefore, presumably a more ancient plant than *Piazopteris.* In a letter, Haczewski remarked that "the growth-rings in the fossils were slightly marked and carbonization [was present] that suggested fire."

Deepening the mystery, in February 1999, a number of fossil specimens of another strange and very tiny plant were discovered in the San Cayetano Formation near the town of Matahambre during intensive field work by paleontologists Manuel Iturralde-Vinent and Reinaldo Rojas-Consuegra of the Havana Museum of Natural History.

These rare specimens were conserved in the museum's paleontology collections and tentatively identified by experts at the Université Pierre-et-Marie-Curie in Paris as a small fern from the Family Hymenophyllaceae.

In September 2011, however, paleobotanist Sidney R. Ash from the University of New Mexico examined photographs of the specimens and argued that they might, instead, be examples of the Jurassic fern, *Coniopteris.* "These fossils very closely resemble some sterile forms of *Coniopteris simplex,* a member of the Family Dicksoniaceae," Ash wrote, "but without seeing the sporangia [i.e., the struc-

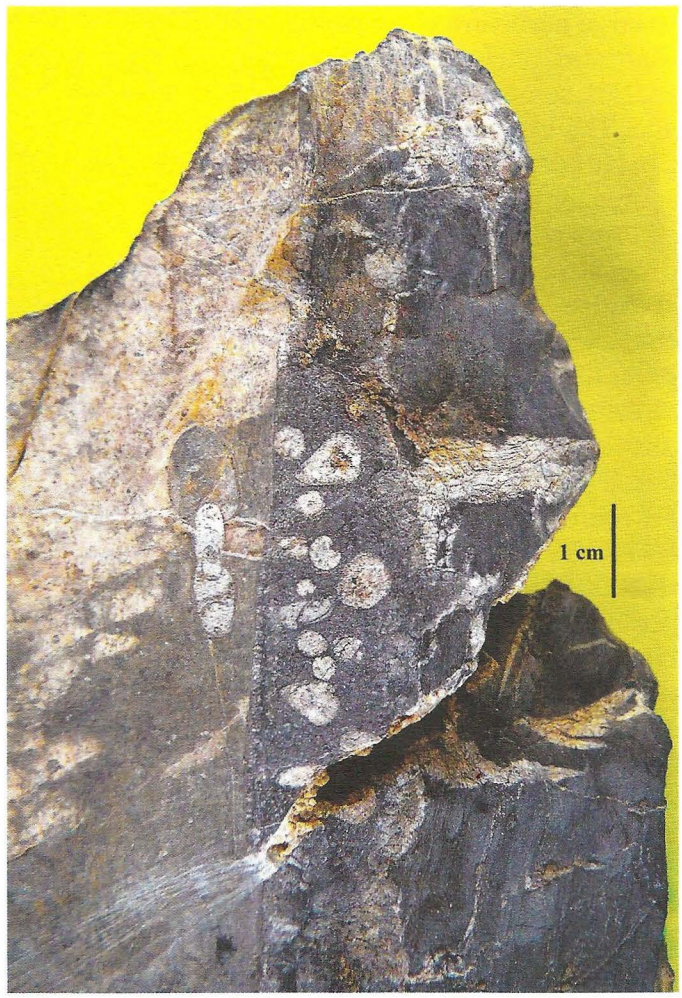
tures in which spores form and are enclosed] it just isn't possible to determine with total confidence which family the fossils belong to. I would think that these ferns, whatever they are called, lived in a humid environment along rivers or a coastline and were transported only a short distance prior to burial on a coastal plain."

Based upon the same photographs, another detective of the past, the paleobotanist Brian Axsmith, concurred with the identification of the specimens as *Coniopteris*. "*Coniopteris* was very common during the Jurassic period," he remarked, "so it wouldn't surprise me to learn they were discovered [in that part of the Caribbean]."

A Younger Plant-Bearing Horizon

Other well-preserved plant fossils, including fine leaf detritus, fern impressions, logs, large trunks, and branch and wood fragments (some of them showing bore marks) were collected by Manuel Iturralde-Vinent and his colleagues at the Havana Museum of Natural History while they were searching for marine reptiles, pterosaurs, and dinosaurs in the fossiliferous mid-to early-Late Oxfordian Jagua Formation in the Sierra de Los Órganos, a mountain range in the Guaniguanico Cordillera in Pinar del Río province. These beds also yield ammonites, bivalves, and fish.

Iturralde-Vinent's expedition yielded a large collection of plant fossils whose identification has yet to be completed. In the meantime, they are housed at the Havana Museum of Natural History, awaiting future research.



Borings in fossil wood produced by marine bivalves.

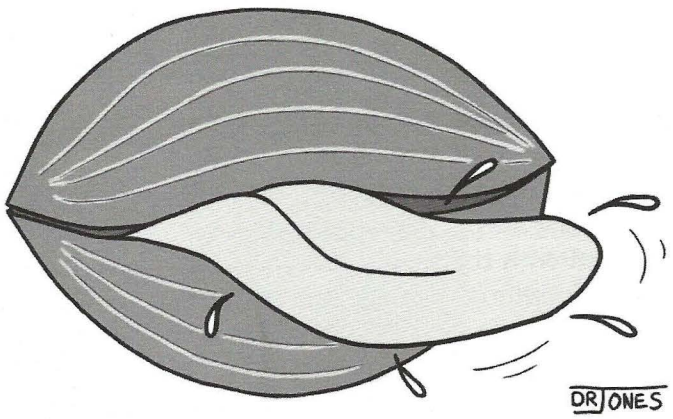
Iturralde-Vinent's fossils, however, are believed to have come from plants that lived in an ancient near-shore forest or "savannah" that was also home

to large herbivorous sauropod dinosaurs, including Camarasaurids, some 156 million years ago. The vegetation may have provided an excellent food source for these dinosaurs.

From all evidence, however, dinosaurs were not the only creatures to have nourished themselves on the abundant plant life of this ancient coastal forest. More recently, tiny ichnofossils (trace fossils) found in petrified wood that Iturralde-Vinent collected from the Jagua Formation were interpreted as bore holes, presumably produced by marine bivalves (probably pholadids of the subfamily *Martesiinae*) that colonized floating logs. These fossil traces were given the name *Teredolites clavatus*. The logs on which *Teredolites* lived and fed were likely transported to the sea by rivers that flowed from an exposed land mass, possibly on the supercontinent of Laurasia.

The discovery and study of plant fossils from formations in western Cuba add depth and dimension to our picture of what life was like in this part of the planet during the time of the dinosaurs and can tell us how Cuba's ancient vegetation was similar to or different from plants that grew elsewhere. Much of the rich variety of plant fossils in Cuba's Jurassic rocks, however, has yet to receive thorough study. Until that happens, we must wait to know the full story they might tell.

— Yasmani Ceballos Izquierdo; English translation by Yasmani Ceballos Izquierdo and Wendell Ricketts



The Rudest Bivalve