May 16, 2022

News and notes

Before I go on to taking a look at the plant life during the Jurassic Period, here are some news items that I thought were interesting.

Geopolitics

The war in Ukraine continues. Remembering that all wars involve deception, here are a few sites to observe changes in the war:

- Daily updates at the Institute for the Study of War.
- Live Map; regular updates to the changes in the on ground situation.
- Oryx: Assessments of battlefield losses.
- There is a lot to steal in Ukraine, here is a site on the mineral resources of Ukraine.

Research

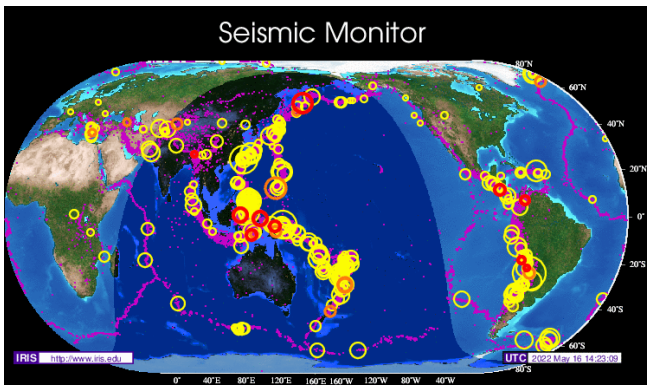
- Stratigraphy: Paleozoic ocean plate stratigraphy unraveled by calcite U-Pb dating of basalt and biostratigraphy.
- Research on the Archean: U-Pb dating reveals multiple Paleoproterozoic orogenic events (Hamersley orogenic cycle) along the southern Pilbara margin (Australia) spanning the onset of atmospheric oxygenation; behind a pay wall.
- Plate tectonics, puling seismic plates apart: Seismic evidence for lithospheric boudinage and its implications for continental rifting; behind a pay wall.
- The Tectonic Map and Structural Provinces of The Late Neoproterozoic Egyptian Nubian Shield: Implications for Crustal Growth of The Arabian-Nubian Shield (East African Orogen); final paper still under preparation.

Paleontology

- Ancient life: 830-million-year-old microorganisms in primary fluid inclusions in halite; Phy.org summary here.
- Really ancient life: Evidence for benthic oxygen production in Neoarchean lacustrine stromatolites.
- A tropically hot mid-Cretaceous North American Western Interior Seaway; behind a pay wall, Phy.org summary here.
- End Permian Mass Extinction: Pulses in silicic arc magmatism initiate end-Permian climate instability and extinction; behind a pay wall, Phy.org summary here.
- Algae and climate: The Long chain Diol Index: A marine palaeotemperature proxy based on eustigmatophyte lipids that records the warmest seasons; Eureka Alert summary here.

- South Australia's Limestone Coast was formed from the bones of dead fish. Cathedral brings the story of these caves to the stage.

Volcanoes, Earthquakes and Geohazards



Seismic Monitor

- Worldwide Volcano News and Updates.
- Predicting volcanic eruptions: The Impact of Ice Caps on the Mechanical Stability of Magmatic Systems: Implications for Forecasting on Human Timescales.
- Researching underwater volcanoes, seamounts: Lu'uaeaahikiikekumu - Ancient Seamounts of Lili'uokalani Ridge; related: Weird 'Yellow Brick Road' Discovered at Bottom of the Ocean.
- Atmospheric waves and global seismoacoustic observations of the January 2022 Hunga eruption, Tonga; Phy.org summary here.
- Volcano research, Réunion Island: 22 years of satellite imagery reveal a major destabilization structure at Piton de la Fournaise.
- Phy.org, earthquake preparedness: A new earthquake warning system will prepare Canada for dangerous shaking.
- QUaternary fault strain INdicators database - QUIN 1.0 - first release from the Apennines of central Italy; database to study fault movements.
- Geohazards: Why Homes Are Collapsing on Cape Hatteras National Seashore.
- Landslides, a Key Landform in the Global Geological Heritage.

Environmental Geology and Hydrogeology

- Contamination and source-specific risk analysis of soil heavy metals in a typical coal industrial city, central China; behind a pay wall, Phy.org summary here.
- Mercury poisoning: Importance of hydraulic residence time for methylmercury accumulation in sediment and fish from artificial reservoirs; behind a pay wall, Eureka Alert summary here.
- From the European Geosciences Union: Acidification of the Nordic Seas.

- From Virginia: Radon detected in and around Williamsburg means awareness, not panic; see also interactive radon risk map of Williamsburg.

Mining and Energy

- Coal Mines Struggle From Worker Shortage As Demand Soars Worldwide.
- From the United States Energy Information Administration(USEIA): U.S. energy-related CO2 emissions rose 6% in 2021.
- Also from the USEIA: Natural gas consumed for U.S. electric power sets January record in 2022.
- European Natural Gas Prices To Triple In "Perfect Storm".
- Deep sea mining research: Fractionation of germanium and silicon during scavenging from seawater by marine Fe (oxy)hydroxides: Evidence from hydrogenetic ferromanganese crusts and nodules; behind a pay wall, Phy.org summary here.
- Renewable energy demand, financial reforms, and environmental quality in West Africa; behind a pay wall.
- Lithium Valley: A look at the major players near the Salton Sea seeking billions in funding.
- Electric cars to account for over 80% of battery demand in next 20 years despite current challenges – report; here's the report.
- Environmental concerns: Canadian board recommends rejection of Baffinland bid to mine more iron ore.
- Nuclear energy problems: The future of nuclear waste: what's the plan and can it be safe?
- The London Metals Exchange trying to ensure orderly markets after a "short squeeze" on nickel: LME targets off-exchange trades as nickel chaos spurs reform.

Pretty, Shiny Rocks

- New Blue Sapphire from Rakwana, Sri Lanka.
- Panic Grips Billion-Dollar Trade Over Russian Diamond Ban

Malefactors

- People stealing fossils from U.S. National Parks: Who Cut a 200-Million-Year-Old Fossil Out of the Rock in Capitol Reef National Park?
- More people stealing fossils, this time from Yoho National Park: Parks Canada recovers 45 fossils stolen from Burgess Shale, levies $20,000 fine.

Fieldwork Concerns

- Tick-borne illnesses are on the rise. Here's how to protect yourself.

May 16, 2022

Plant Life during the Jurassic

Figure 1 - Jurassic Diorama, Royal Ontario Museum
Credit: Keith Schengili-Roberts, Creative Commons Attribution-Share Alike 3.0 Unported license

If you could be transported to the Jurassic Period, there are a few things that would look familiar, and others that would be strange. The generally warmer climate of the Jurassic favoured the growth of forests. Also, the breakup of Pangaea into Gondwana and Laurasia separated previously unified habitats and created new ones, this led to the diversification of plant life in the Jurassic.

The beginning of the Jurassic Period was marked by the Triassic–Jurassic Extinction Event. The effects of this extinction event on plant life is still under investigation. While there appears to have been a turnover in plant biota there was not a widespread mass extinction. Other research backs up this observation by showing that the change in plant communities could be explained by local ecological succession.

The fossil record tells us that plant life during the Jurassic included Gymnosperms such as the ancestors of modern Pinophyta (conifers). Other seed bearing plant life included Spermatophytes such as Czekanowskiales and Pentoxylales.

One thing that you wouldn't see during the Jurassic are angiosperms, i.e. flowering plants. Although some researchers have claimed to have found the progenitors of flowering plants

during the Jurassic, there is, at present , no such evidence. With that in mind, Let's look at some plants from the Jurassic.

Conifers

Fossils from the end of the Triassic and beginning of the Jurassic indicate that there was a major diversification of conifers at that time with evolution of voltzialeans. New lineages that unambiguously began or diversified during the included: Araucariaceae, Cheirolepidiaceae, Cupressaceae (cypress trees), Pinaceae (pine trees), *Podozamites*, Podocarpaceae and Taxaceae (yew trees). Here are some examples:

Araucariaceae

Figure 2 - Petrified *Araucaria mirabilis* Cone
Credit: Brocken Inaglory, Creative Commons Attribution-Share Alike 3.0 Unported, 2.5 Generic, 2.0 Generic and 1.0 Generic license

While there are examples of Araucariaceae in Triassic deposits such as the Petrified Forest of Arizona, the oldest definitive records of Araucariaceae are from the Early Jurassic. By the Middle Jurassic, fossils of Araucariaceae included *Araucaria mirabilis*, from Argentina, and *Araucaria sphaerocarpa*, from England. In Argentina, there is an entire petrified forest of *Araucaria mirabilis* at the Cerro Cuadrado Petrified Forest .

Wild examples of Araucariaceae are today confined to the Southern Hemisphere and include trees such as the Norfolk Pine and the Monkey Puzzle Tree. The fossil record does not record any examples of Araucariaceae in the Northern Hemisphere following the Cretaceous–Paleogene Extinction Event.

Cheirolepidiaceae

Cheirolepidiaceae were a variety of conifer that first arose during the Triassic and went extinct at the end of the Mesozoic Era. One of the Cheirolepidiaceae is *Frenelopsis hohenegger*.

Figure 3 - *Frenelopsis hohenegger*
Credit: Peabody Museum of Natural History

A distinct pollen type, assigned to the genus *Classopollis*, defines Cheirolepidiaceae in the fossil record. Several members of the family appear to have lived in semi-arid and coastal settings with a high tolerance of saline conditions. An interesting feature from the fossil evidence is that the plants of this family apparently required scorpionflies for pollination.

Cypress Trees

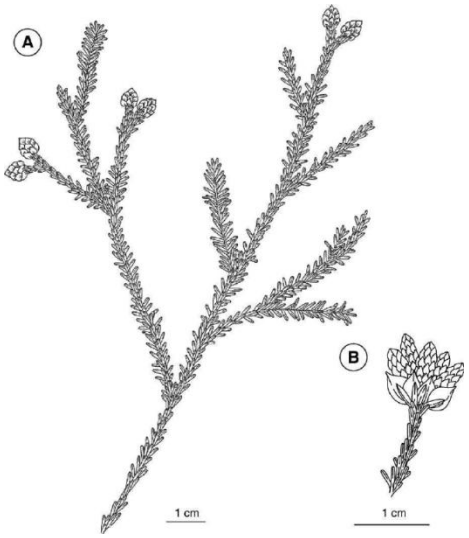
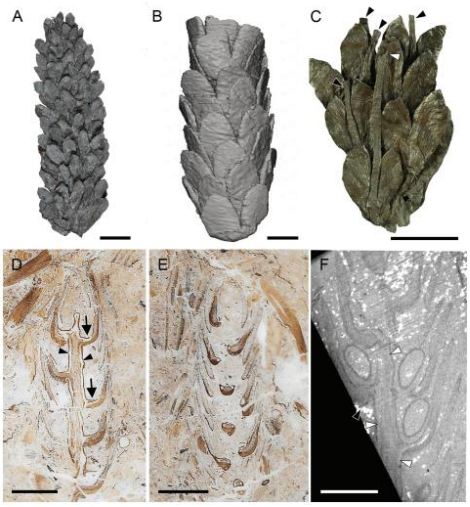


Figure 4 - Reconstruction of *Austrohamia minuta*
Credit: Rubèn Cunéo, Figure 2 in Escapa, Cunéo, & Axsmith, 2008

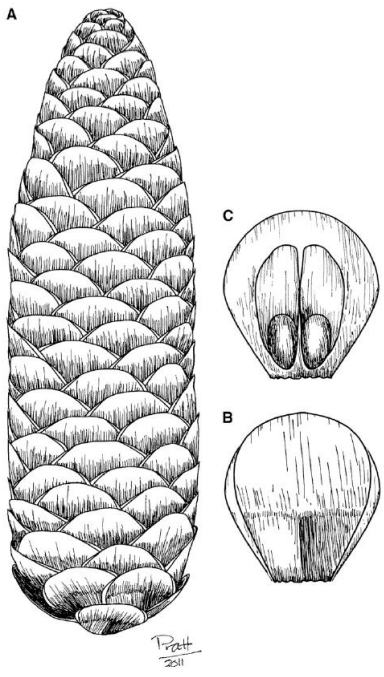
Cupressaceae or cypress trees are another family of conifers that first arose during the Jurassic. Modern cypress trees include junipers, cypress and giant sequoia. *Austrohamia minuta* is known from fossils in the Jurassic formations of Argentina. Research published in 2019 identified another species of the genus, *Austrohamia asfaltensis*, also in fossils from Argentina.

Pinaceae - Schizolepidopsis and Eathiestrobus



Lignitized and permineralized ovulate cones of Schizolepidopsis ediae sp. nov. A, Apical fragment of a cone from compressed lignite. Note the variation of apex morphology, which ranges from rounded to short-acuminate, and that the ovuliferous scales decrease in size distally. PP59848. Scale bar p 5 mm. B, Three-dimensional rendering of a permineralized cone from a micro–computed tomography (mCT) scan. Note the similarity to cones preserved in lignite (A, C) in size and morphology. PB23506A. Scale bar p 3 mm. C, Cone fragment from compressed lignite with connected bracts (arrowheads). Note that the bracts are linear and exceed the length of the ovuliferous scale that they subtend. Most bracts shown are broken at the tip, but one is intact, with a short-acuminate apex (white arrowhead). PP59844. Scale bar p 5 mm. D, Longitudinal section of a cone lacking seeds. Note the divergence angles of the bract-scale complexes (arrows) and the wide cortical resin cavity (arrowheads; see fig. 3A–3D for details of the cortical resin cavity). PB23507, peel 1. Scale bar p 5 mm. E, Longitudinal tangential section of a cone lacking seeds. Note the stalks of the bract-scale complexes in transverse section (see fig. 3D, 3E for detail) and the dark color of the bract-scale complexes proximally and abaxially, indicating a greater concentration of sclerenchyma. PB23508, peel 4. Scale bar p 5 mm. F, Longitudinal section of a permineralized cone from a mCT scan. Note the presence of seeds and a resin cavity in the cone axis (white arrowheads) and the absence of bracts (broken base; black arrowhead). PB23506A. Scale bar p 5 mm.

Figure 5 - Fossil Cones of *Schizolepidopsis ediae*
Credit: Kelly K.S. Matsunaga, Matsunaga *et al* 2021



Eathiestrobus mackenziei Rothwell, Mapes, Stockey et Hilton gen. et sp. nov. Reconstructions of (A) cone and bract/ovuliferous scale complex in (B) abaxial and (C) adaxial views.

Schizolepidopsis is among the earliest genera of Pinaceae (pine trees) in the fossil record. It appears to be the root genus of all subsequent pine trees. *Schizolepidopsis* fossils are first found in the Early Jurassic and flourished throughout Laurasia during the Lower Cretaceous but apparently dying out before the Upper Cretaceous.

Another early pine tree was *Eathiestrobus* is known from fossil pine cones found in the Upper Jurassic Kimmeridge Clay Formation of Scotland. One species of *Eathiestrobus* has been identified, *Eathiestrobus mackenziei*. It was found in Eathie, Scotland by a Mr. W. Mackenzie, who collected the specimen and donated it to the Hunterian Museum in 1896.

Figure 6 - *Eathiestrobus mackenziei*
Credit: Figure 20 in Rothwell *et al*, 2012

Podozamites

Podozamites fossils are the leaves of an extinct conifer. First appearing in the Permian, *Podozamites* became common in what is now East Asia during the Jurassic. The last *Podozamites* fossils are from the Late Cretaceous.

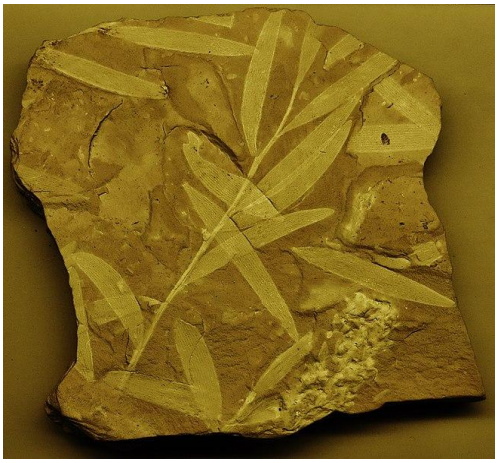


Figure 7 - *Podozamites distans*
Credit: Ghedoghedo, Creative Commons Attribution-Share Alike 4.0 International license

There are about seven identified species of *Podozamites*. As well, *Podozamites* fossils are associated with conifer cones of the genera *Swedenborgia*, *Cycadocarpidium*, and *Krassilovia*. *Podozamites* fossils have been found in rocks associated with fluvial flood plains and lagoon environments.

Podocarpophyllum

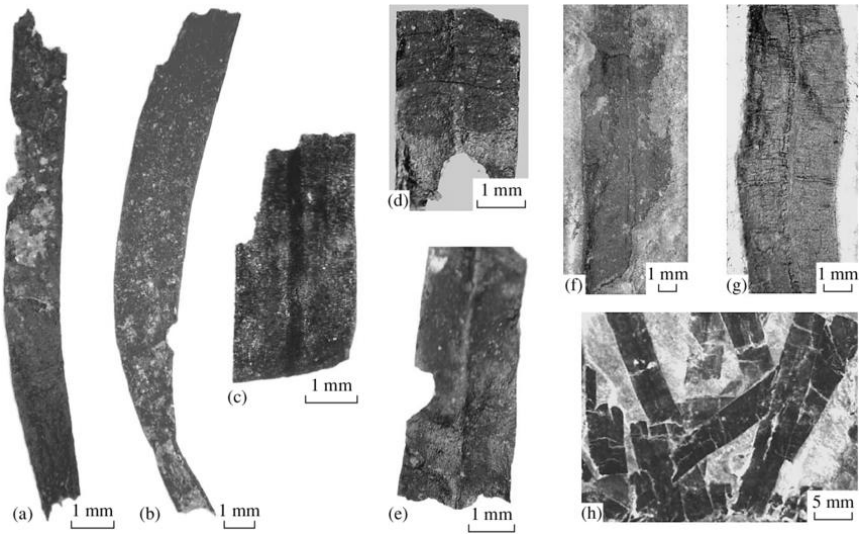


Figure 8 - Fragmentary Leaves of *Podocarpophyllum*
Credit: Figure 1 in Nosova & Kiritchkova,2008

Podocarpophyllum were a genus within Podocarpaceae family. Fossils of *Podocarpophyllum* are known from Middle Jurassic rocks in Uzbekistan and Kazakhstan. Three species have been identified: *P. singulare, P. dorofeevii,* and *P. mesozoicum.*

Marskea

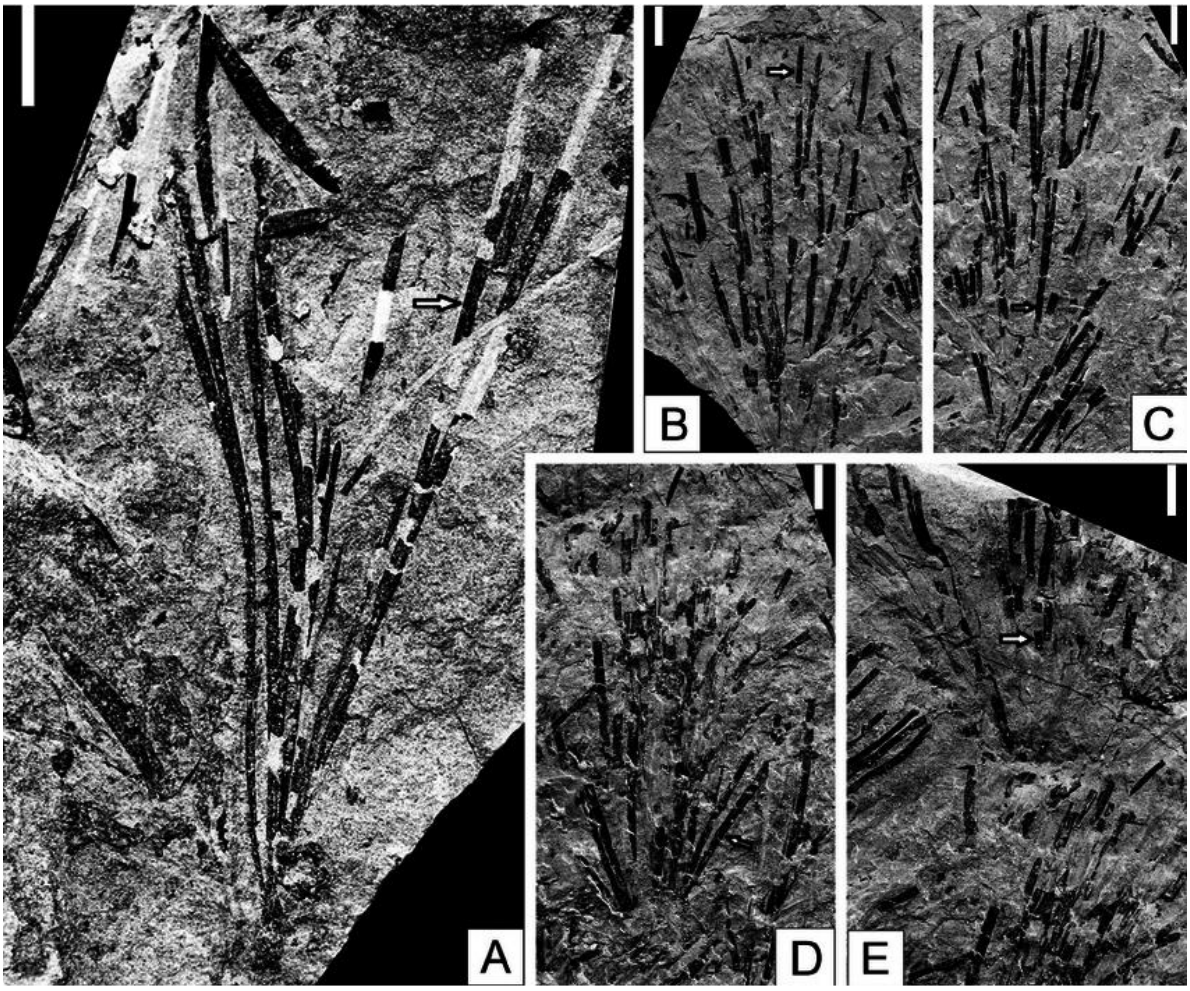
Figs. 1–12. Marskea heeriana N. Nosova et Kiritchkova, sp. nov., leafy twigs: 1 –7, 9–12 – Topka Gully, Upper Prisayan Subformation, Aalenian–Bajocian: (1) specimen no. 1434/1140; (2, 6) specimen no. 1434/1146; (3) specimen no. 1434/1129; (4) specimen no. 1434/1143; (5) specimen no. 1434/1145; (7) specimen no. 1434/1151; (9) holotype no. 1434/1138; (10) specimen no. 1434/1139; (11) specimen no. 1434/1142; (8) Idan Gully, Lower Prisayan Subformation, Aalenian, specimen no. 1434/866.

Figure 9 - *Marskea heeriana*
Credit: Plate 16 in Nosova & Kiritchkova, 2018

An early type of yew tree, *Marskea* is known from Jurassic rocks in Europe and Siberia. Four species of *Marskea* have been identified: *M. jurassica, M. thomasiana, M. latifolia* and *M. heeriana*. *Marskea* fossils are generally found in shales and coal deposited in fluvial and deltaic environments.

Marskea fossils have been found in the Sorthat Formation of Denmark, from Middle Jurassic formations in Yorkshire, England, and from the Middle Jurassic of the Irkutsk Coal Basin. Fossils of *M. latifolia* are known from Early Cretaceous rocks of the Lena Basin in Siberia.

Czekanowskiales



Leaves of Czekanowskia (subg. Harrisella) ordosensis sp. nov. from the Middle Jurassic Yan'an Formation, Ordos, Inner Mongolia, China. Arrows denote areas where cuticle was removed for preparation. All scale bars = 10 mm. A – Holotype, YJT062. Specimen collected from the Yanjiata locality. Note dichotomizing leaf segments on the left. B, C – Paratypes, SSG024, SSG025. Specimens collected from the Shenshangou locality. Note five leaves in B and at least 7 leaves in C. D, E – other specimens examined, SSG026, SSG027. Specimens collected from the Shenshangou locality

Figure 10 - Leaves of *Czekanowskia*
Credit: Hongshan Wang Figure 3 in Sun *et al*, 2015

Czekanowskiales are an extinct family of seed bearing trees and shrubs that first arose in the Late Permian and apparently thrived in the Jurassic and Early Cretaceous only to go extinct at the end of the Mesozoic. Their fossils are found mostly in the Northern Hemisphere in rocks that were deposited in warm-temperate and temperate climates under humid conditions.

Pentoxylales

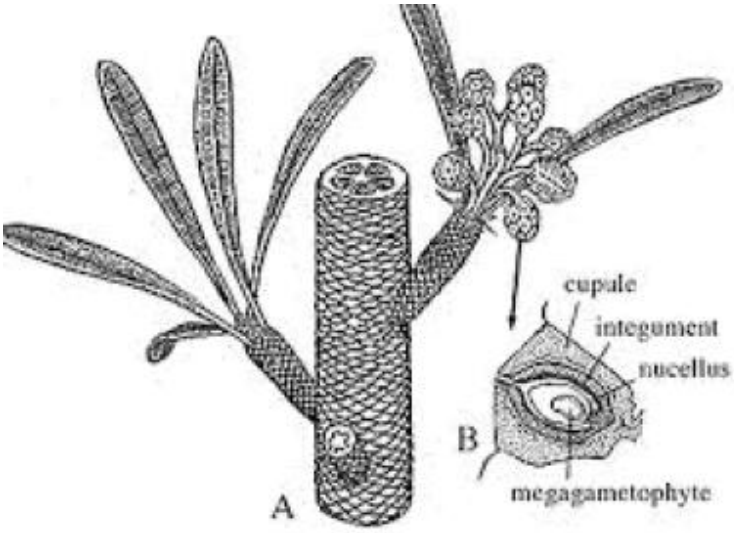


Figure 11 - Reconstruction of the Male Shoots of the Pentoxylales
Credit: ucmp.berkeley.edu Figure 1 in Agarwal, 2018

Pentoxylales is an extinct order of seed plants known from Jurassic and Cretaceous aged fossils. Researchers have found fossils of in Pentoxylales in India, New Zealand, Australia and Antarctica, all of which were part of ancient Gondwana.

Pentoxylales plants were probably small shrubs that grew beside water. It appears to have grown branched leafy shoots. After a few seasons of growth, the plants formed a thicket after settling onto the ground or on other stems.

Winding it Up

There are many more fossil plants from the Jurassic than those I've discussed here. If this interests you, follow up on some of the links and enjoy.

Standard Caveat

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.