

# Conquering the land

The rise of plants

# Ordovician

- Spores
  - Algae (algal mats)
    - Green freshwater algae
  - Bacteria
  - Fungae
  - Bryophytes
    - Moses?
    - Liverworts?
- Little body fossil evidence

# Silurian

- **Wenlock Stage** 423-428mya
- **Psilophytes**
  - **Rhyniopsida** important later in early Devonian
    - *Cooksonia*
    - *Rhynia*
  - Branching stems, flattened sporangia at tips
  - No leaves, no roots short 30 cms rhizoids
  - **Zosterophylls**
    - Early stem group of Lycopodiophytes
    - Ancestors of Class Lycopsidea (clubmosses)
    - Prevalent in Devonian
    - Spores at tips and on branches
- **Lycopsidea** (?) Baragwanathia with microphylls in Australia

# Zosterophylls



# Silurian

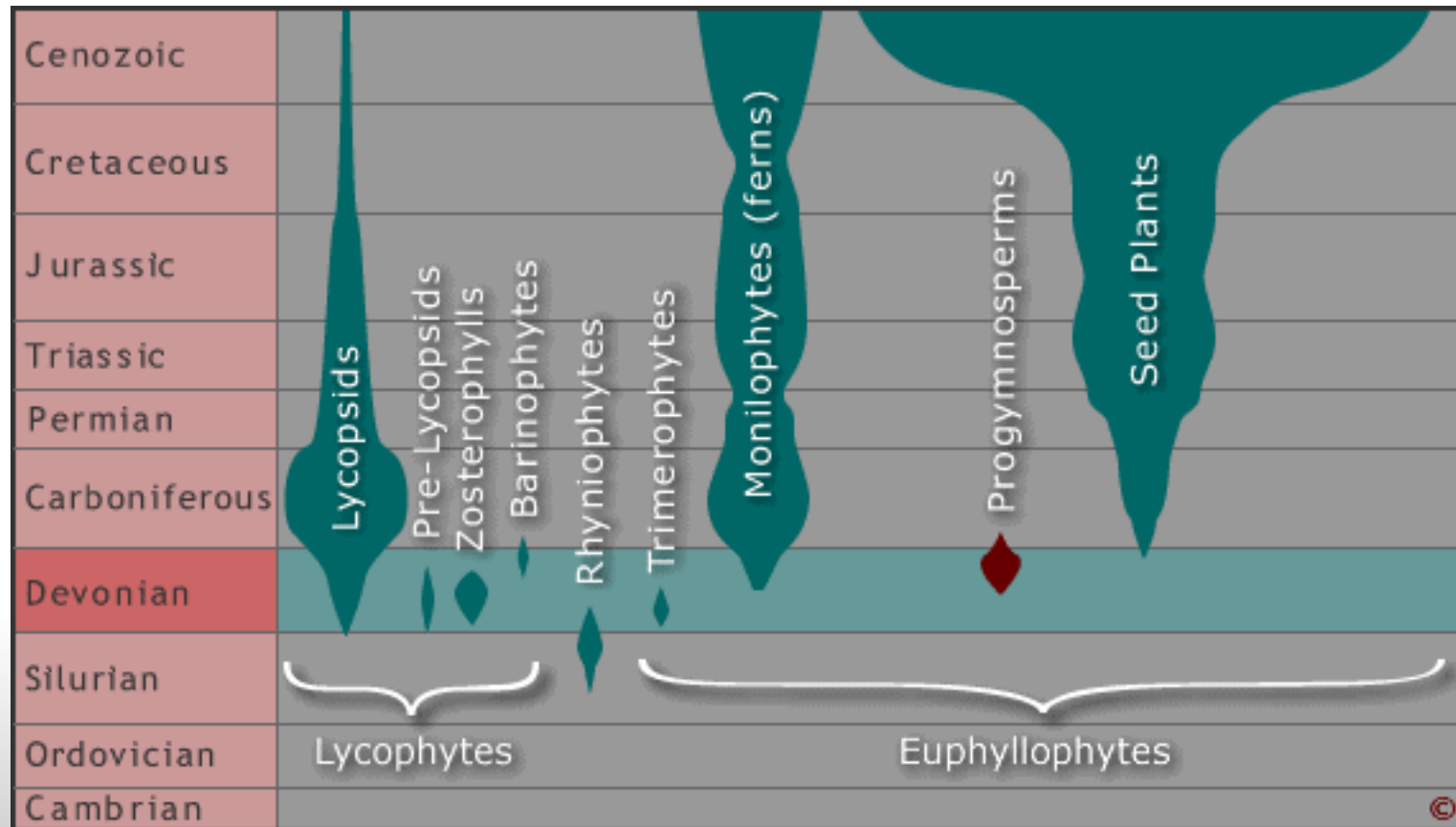


Cooksonia

# Development of Soil

- Fungae
- Bacteria
- Algae
- Organic matter
- Arthropods and annelids
- Change in erosion
- Change in CO<sub>2</sub>

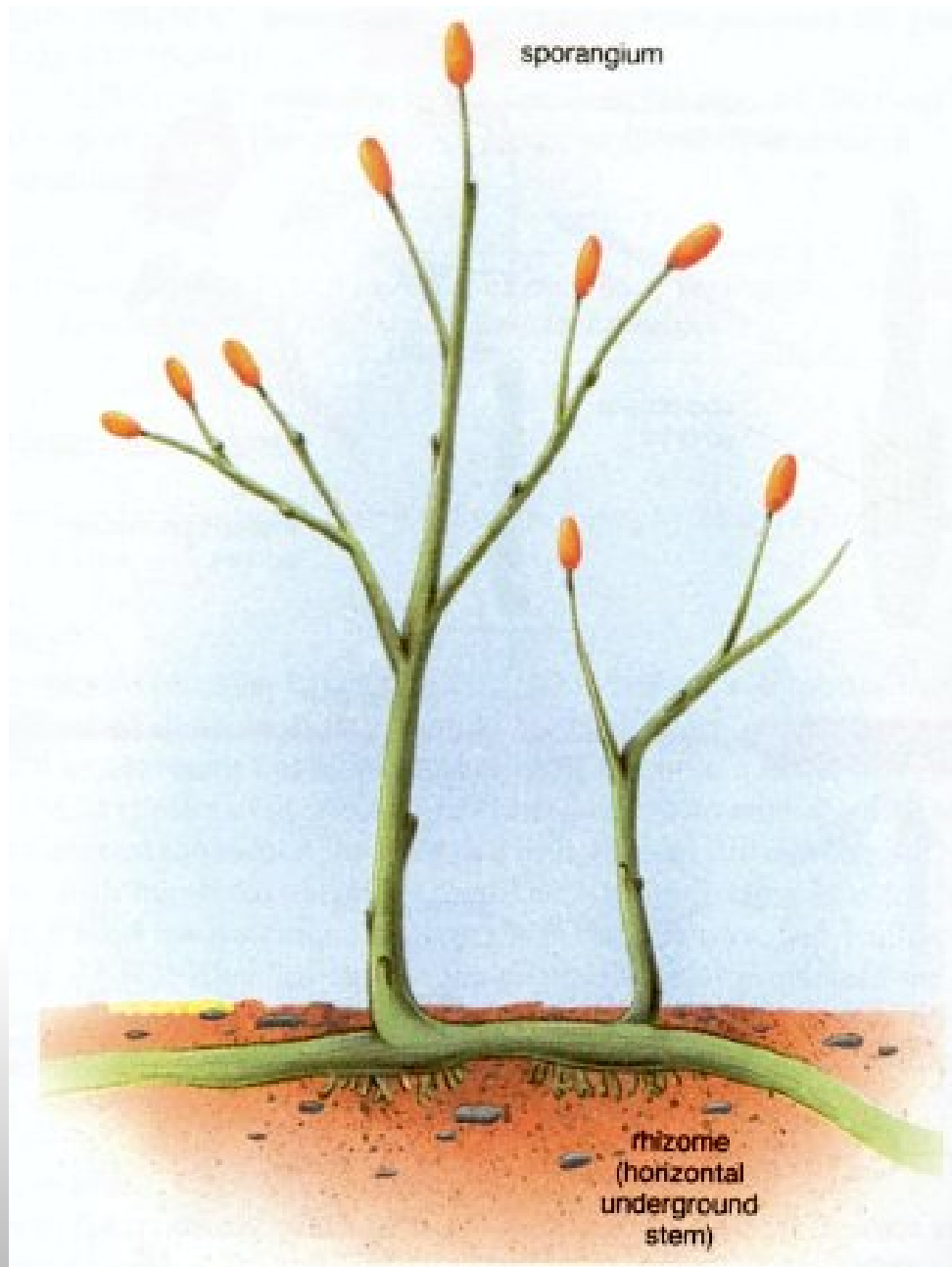
# Devonian



# Devonian

- **Early Devonian** simple structure
  - Rhynie Chert (**Rhyniophytes**)
  - **Trimerophytes**
    - First with main shoot
    - Give rise to Ferns and Progymnosperms
    - Up to 3m tall
  - Animal life (mainly arthropods)
- **Late Devonian** Forests
  - First true wood (lignin)
  - Forest structure develops (stories)
  - Sphenopsids (Calamites)
  - Lycopside (Lepidodendron)
  - Seed Ferns (Pteridosperm)
  - Progymnosperm
    - Archaeopteris
    - Cladoxylopsid
- First vertebrates present





# Upper Devonian

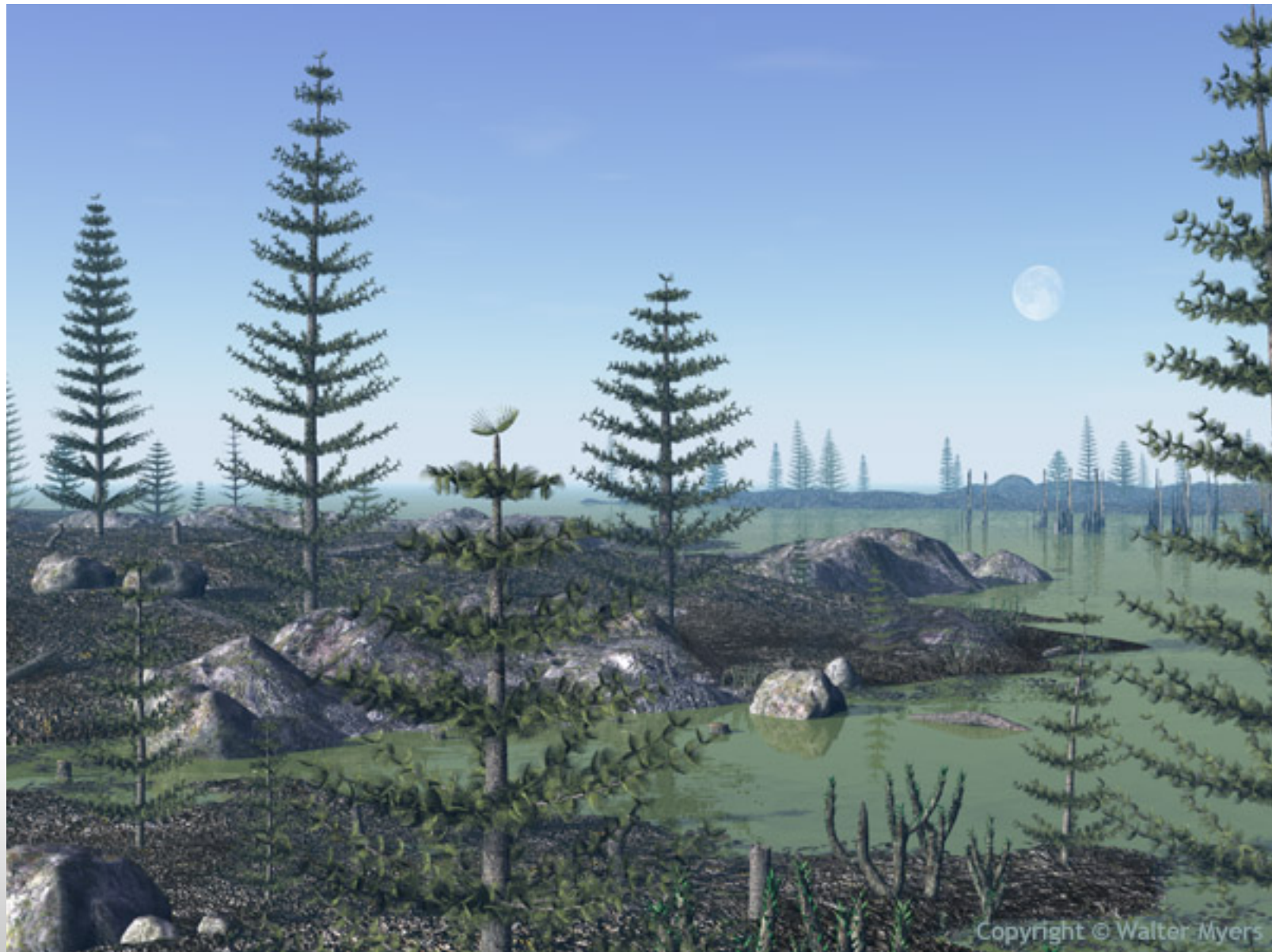
- Lycopsidea
  - 374-360 mya
  - Leaves and roots differentiated
  - Most ancient with living relatives
  - Megaphylls branching in on plane
  - Photosynthetic webbing
  - Shrub size vertical growth limited (weak)
  - Lateral (secondary) growth (woody)
  - Development of roots
  - Homosporous
  - Heterosporous

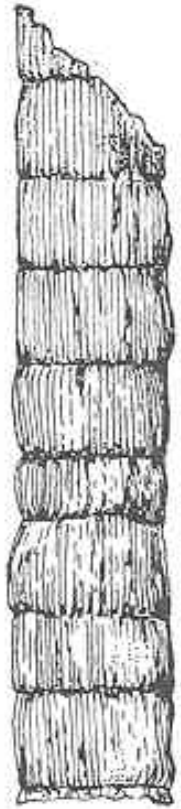
# Upper Devonian

- Calamites (Sphenopsid)
- Horestail\_



# Sphenophyta (Calamites-Annularia)

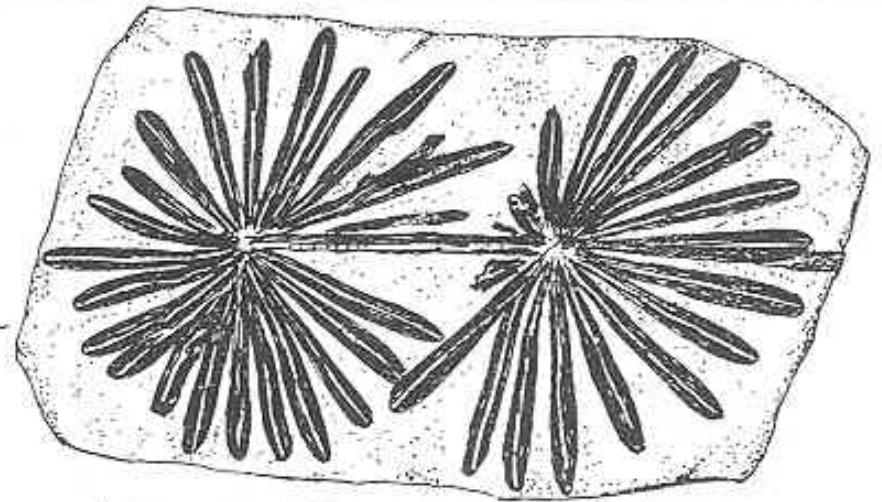




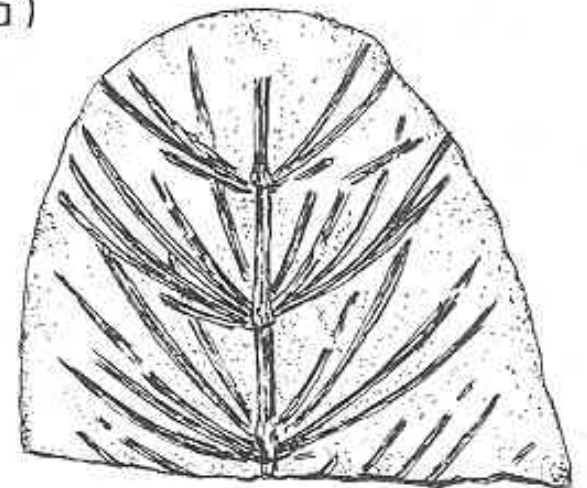
Trunk  
and  
branches



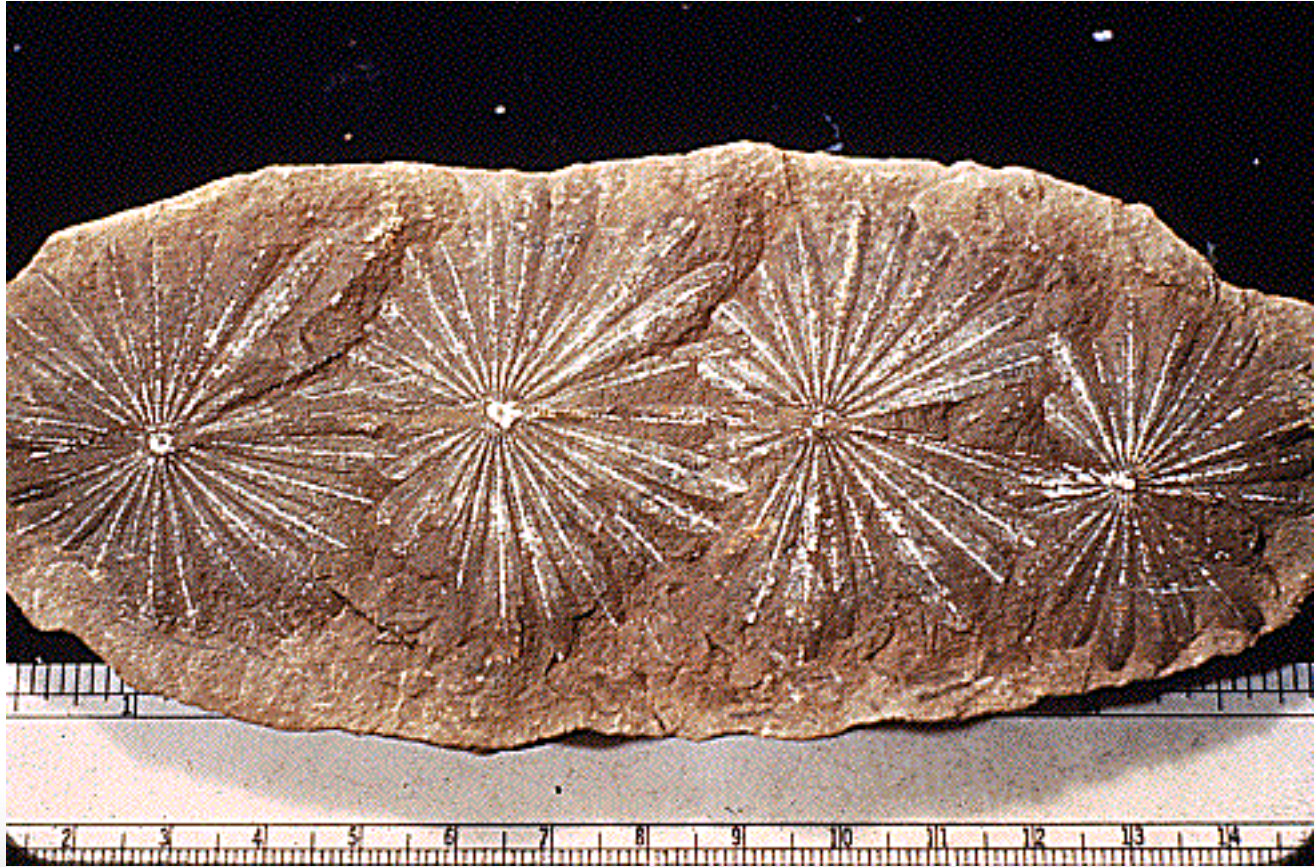
Calamites



Leaves  
(Annularia)



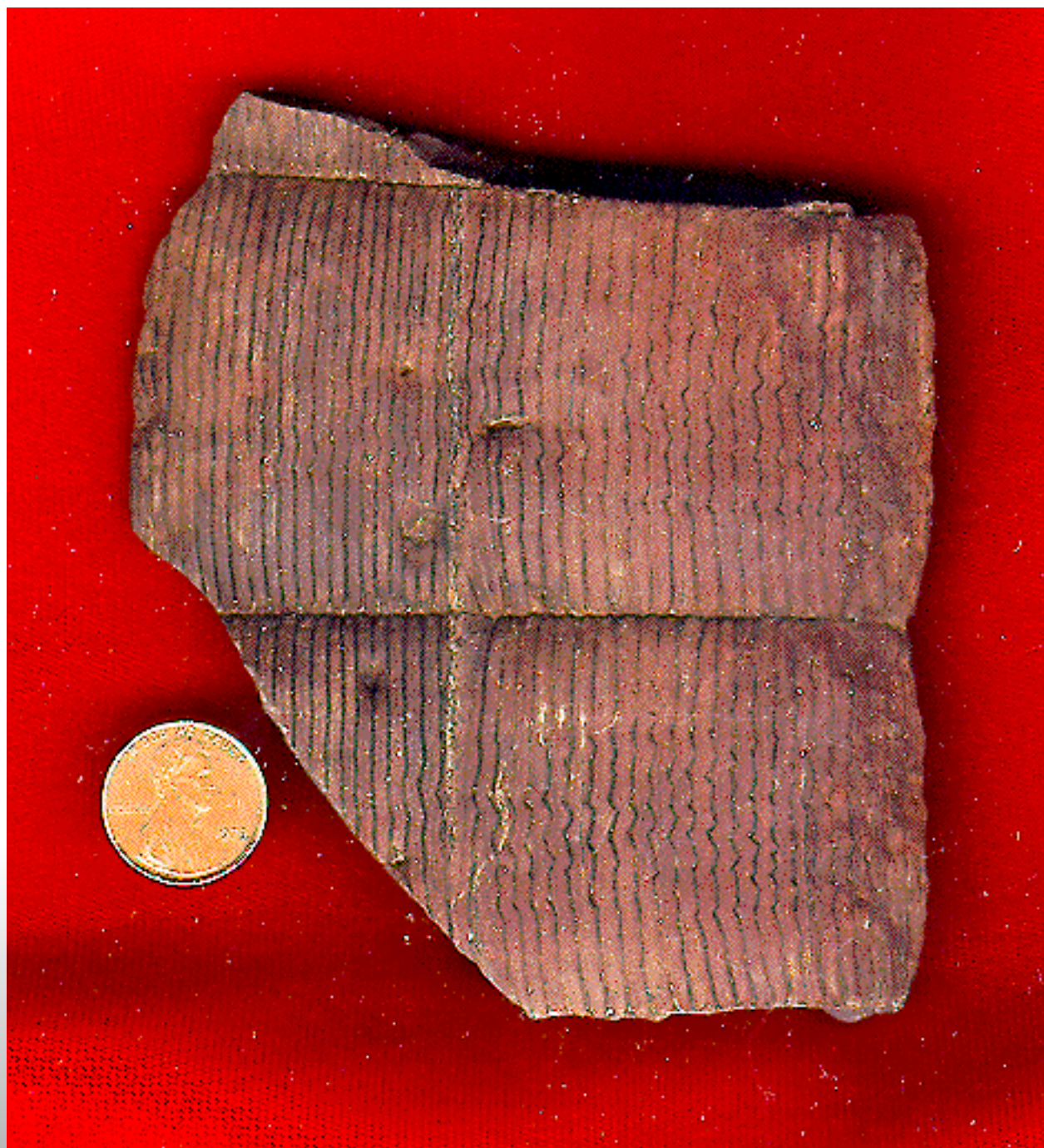
Leaves (Asterophyllites)













# Devonian

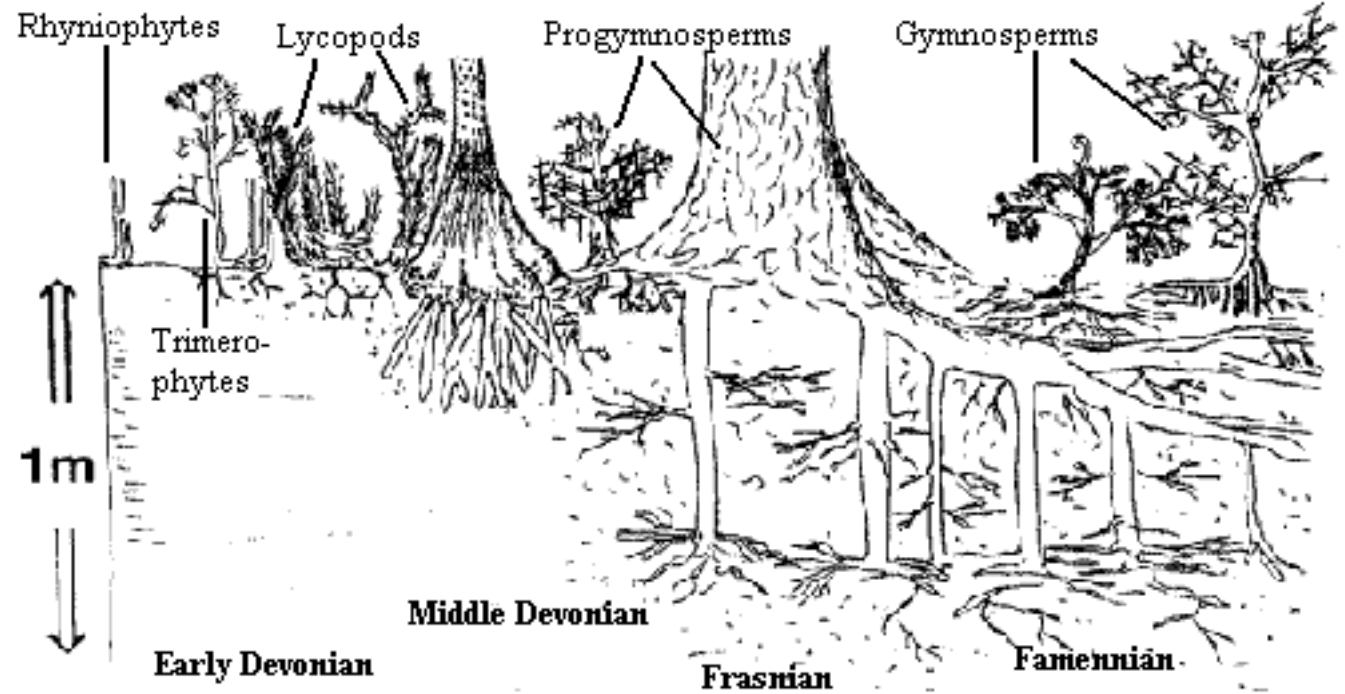
- Archaeopteris
- Ur. Devonian - Lr. Carboniferous
- Progymnosperm
- Tree-like and fern-like characteristics
- True wood
- 10m high



# Devonian



Archaeopteris





# Late Devonian

- Global Regression
- Led to development of seeds  
(Gymnosperms)
- Free from water
- Drier habitats
- Cooling? due to draw down in CO<sub>2</sub>

# Carboniferous

- Upper Carboniferous
  - Major Deltas
  - Fluctuating sea level
  - Coastal plains and flood plains and swamps
- Ferns/Tree Ferns/Seed Ferns
- Seed Ferns /Sphenopsids/ Lycopods/ Cordiatales
- Trees up to 30 meters
- Very high oxygen levels
- Gigantic insects
- Southern Glaciation at end and into Permian

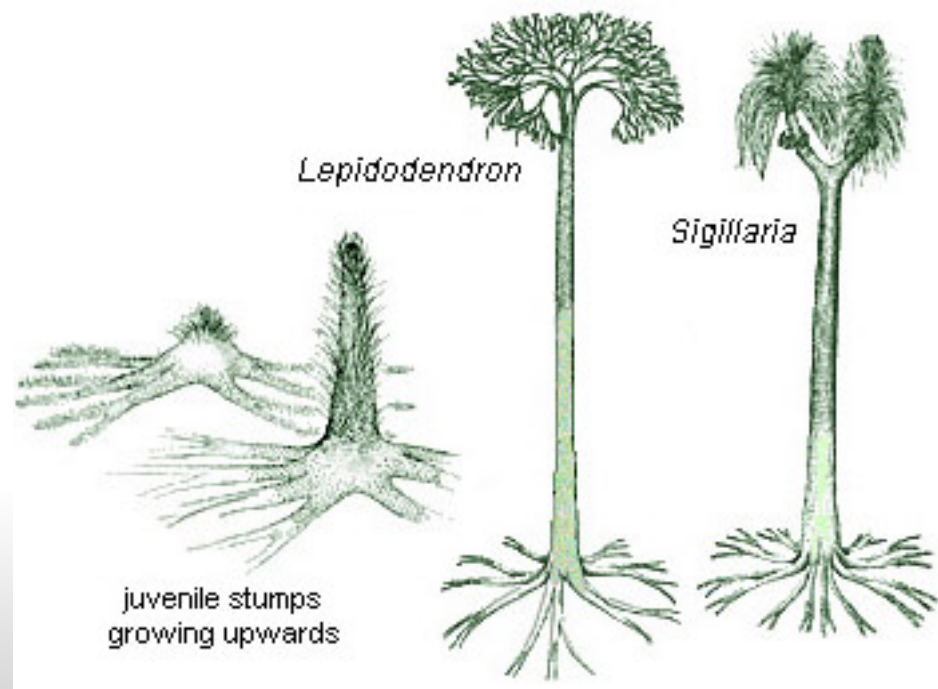
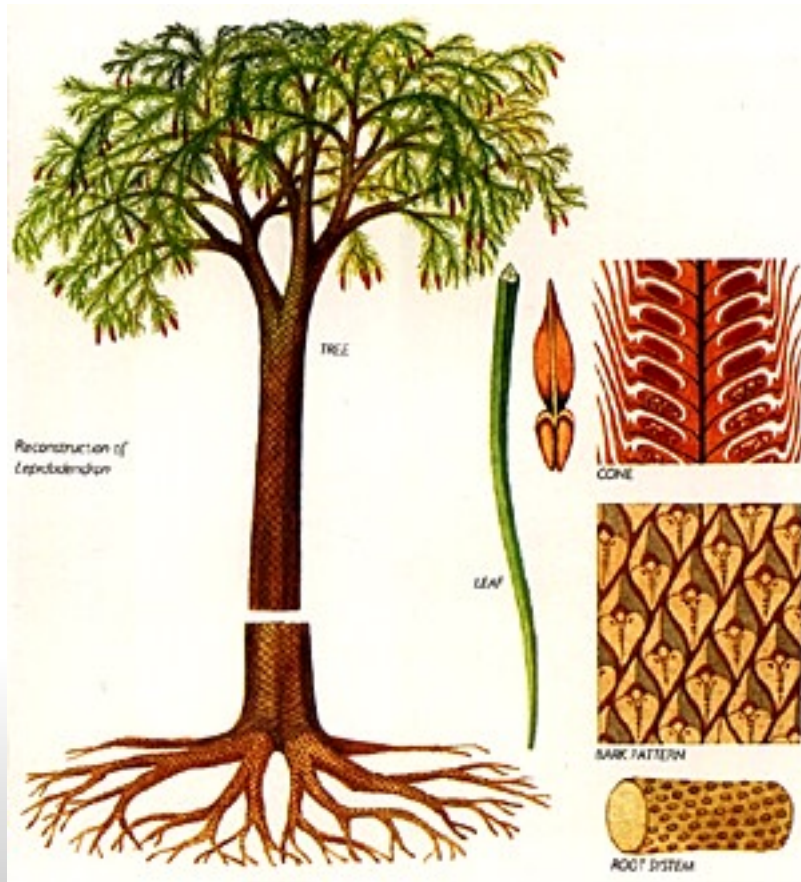
# Lepidodendron

- Secondary growth
- Woody bark
- Leaves in spiral around trunk
- Cones where leaf meets stem
- Both male and female (Megaspore and Microspore)



# Lepidodendron and Sigillaria

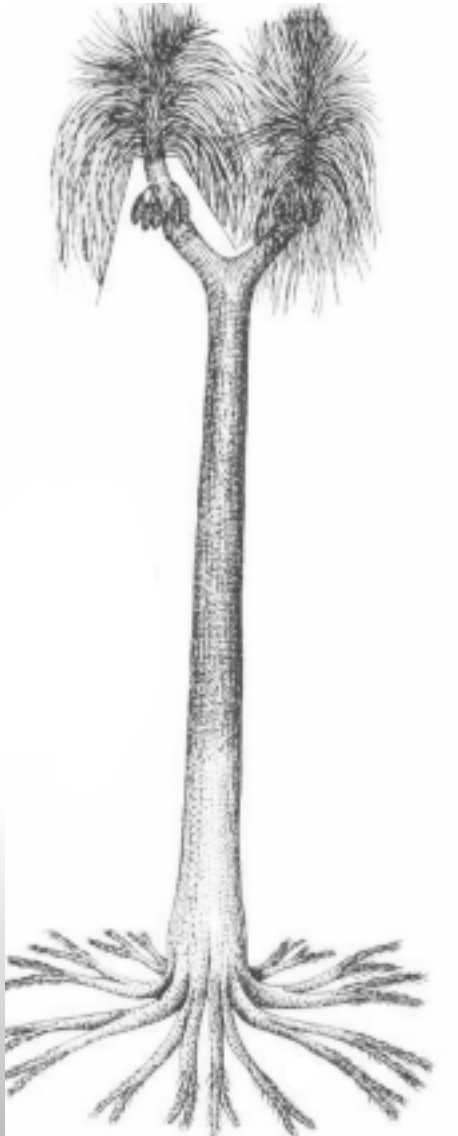
## Lycopodiophyta





Univ. of Michigan Exhibit Museum of Natural History Diorama

# Sigillaria





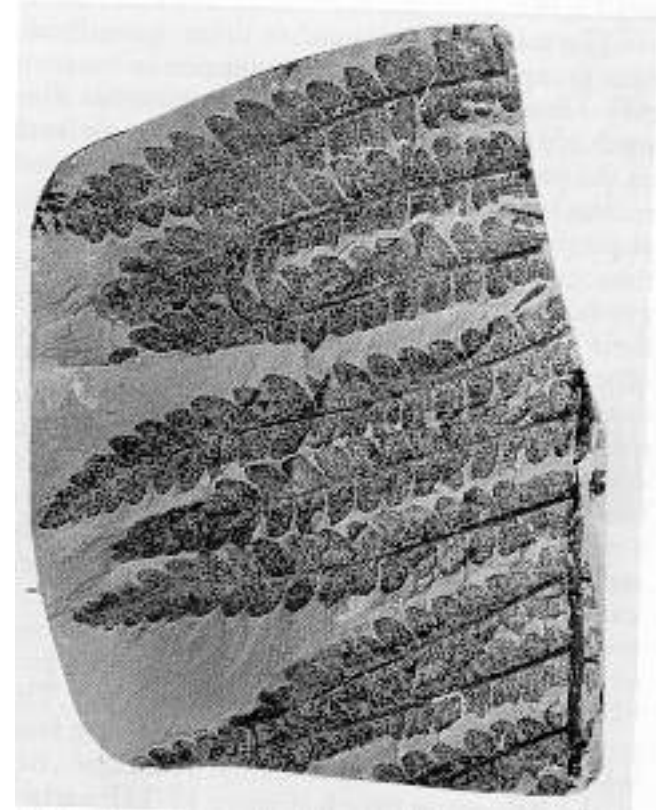
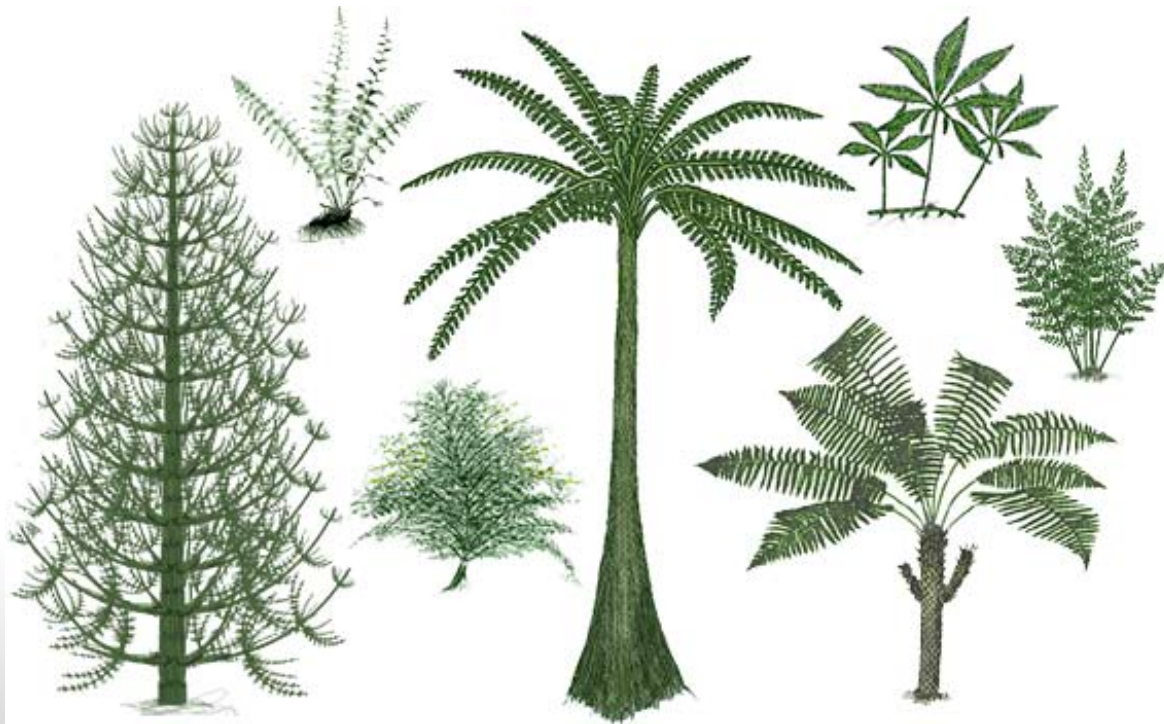
Terminal Branches and Cone  
Lepidodendron





# Ferns and Tree Ferns

- Carboniferous



# Ferns and Tree Ferns

- Carboniferous



# Ferns and Tree Ferns

- Carboniferous





# Tree Ferns

- Carboniferous



# Tree Ferns

- Carboniferous



# Cordaites (Early conifer)

- Carboniferous
- Early Conifer
- Wet ground
- Florida-like swamp
- Woody
- Seeds



# Pteridosperms (seed ferns)

- Permian to Triassic
- Glossopteris
- 30m tall
- Wood
- Seeds Pollen
- 70 species
- Dominant in S.Hemisphere

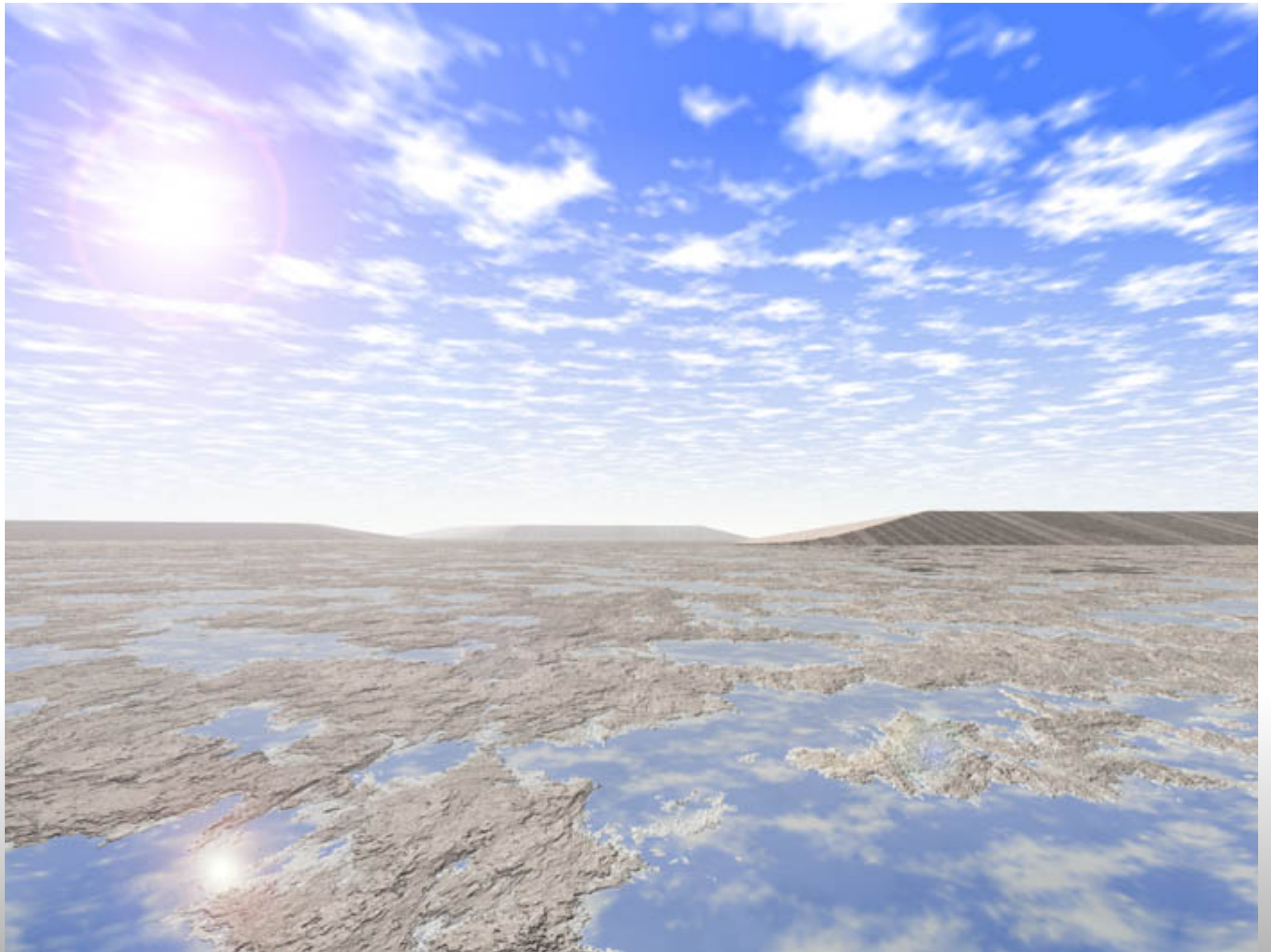


# Permian

- Permo-Carboniferous Southern Glaciation
- Significant regression in sea level
- Dry due to "supercontinent"
- Continental interiors hot and dry
- Red beds abundant (draw down oxygen)
- Changes in ocean circulation lead to stagnation
- Cycads and Ginkgos appear
- Gymnosperms spread widely
- Lycopods and swamp forest confined to equatorial zone

# Permian Extinction

- Major extinction on land and in the oceans
  - Low oxygen levels down to 15% or less
  - Dense gymnosperm forests disappear
  - *Glossopteris* (Seedfern) decline
  - *Cordaites* (Gymnosperm) decline
  - Early Triassic recovery fauna of ferns and herbaceous Lycophytes
  - Gymnosperms recover after 4-5 million years
  - Lycopside and Sphenopsids permanently reduced



# Triassic and Jurassic

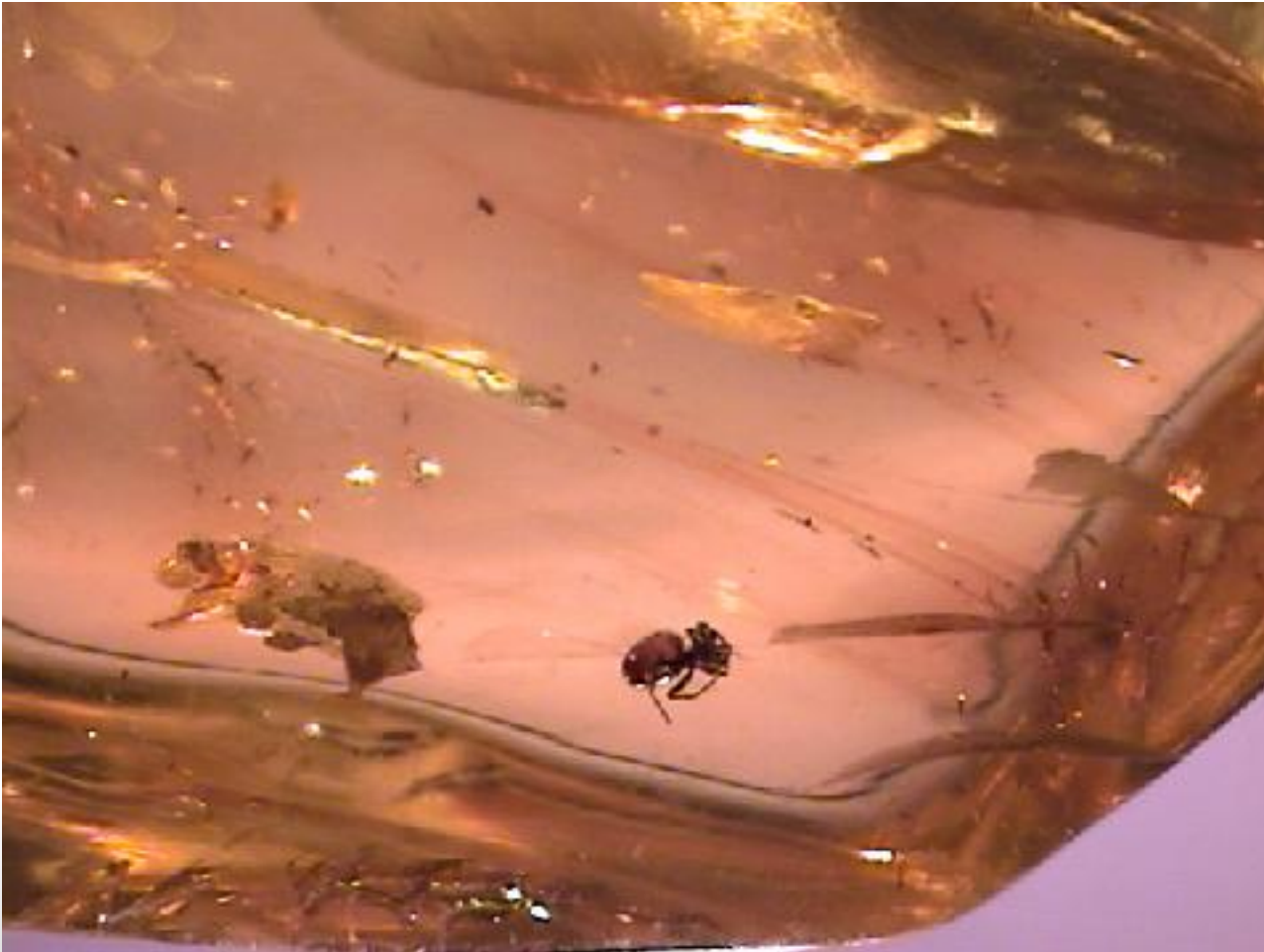
- Lycopod trees extinct (smaller forms survive)
- Large Sphenopsids survive to early Jurassic
- New Dominant Flora
  - Conifers (Pines)
  - Tree ferns
  - Ferns
  - Gingkos
  - Cycads





VIEWIMAGES™

Fossil Pine

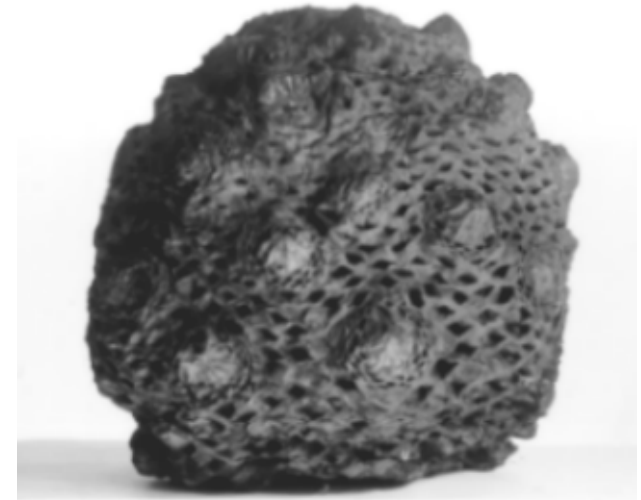


Insects preserved in amber



Gymnosperm logs





# Cretaceous

- **Early Cretaceous** major changes
  - Angiosperms evolve
  - Herbaceous, ground cover
  - Insect and flowers develop together
- **Middle Cretaceous**
  - Angiosperms start to spread from equator
  - Wood forms appear
  - Dominate all stories in forest ecosystem
  - Compete with ferns/Sphenopsids/Lycopsids
- **Late Cretaceous**
  - Gymnosperms only at higher latitudes
  - Oak, maple, Birch, Willow all appear
  - Early grasses (found in dinosaur coprolites)



Cretaceous Flower

# End Cretaceous

- World wide extinction
- Hotspot volcanism (more next week)
- Meteorite impact
- 60% of species annihilated
- Fern Spike
- Dominance of Angiosperm/insect alliance





Late Cretaceous

# Tertiary

- Angiosperms rule!
- Oak, Maple, Birch, Willow
- Grasses
- Diversification of insects
- Rise of mammals
- Grazing herds on grasslands

