

Chamberlain's system of classification

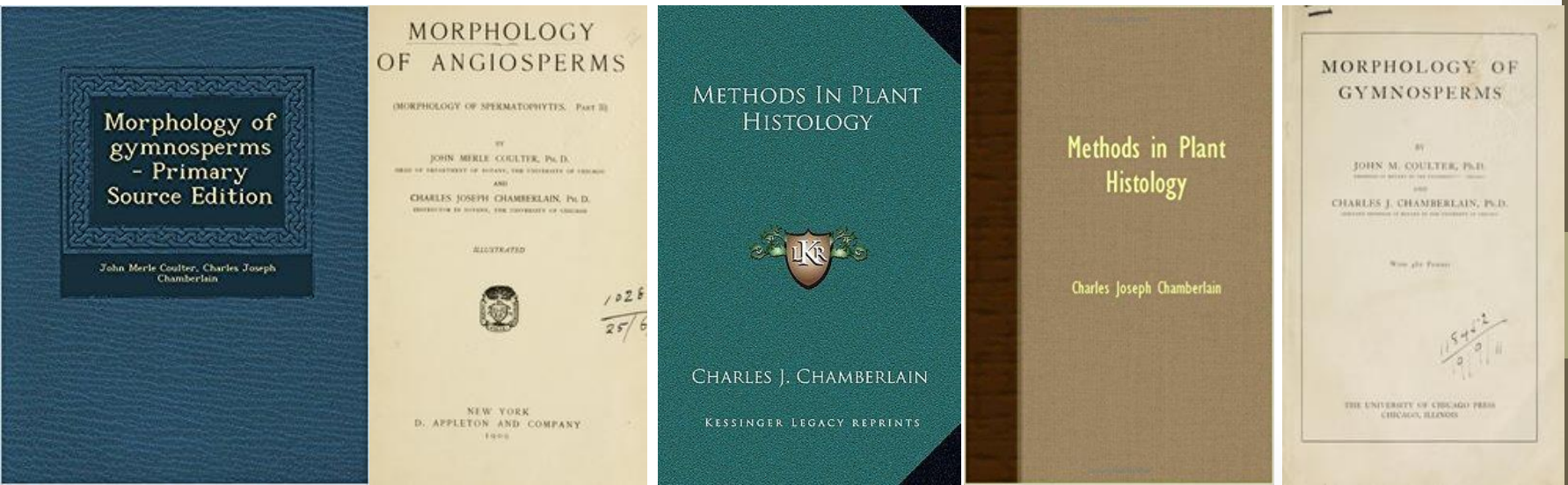
Charles Joseph Chamberlain

(February 23, 1863 – February 5, 1943)

American botanist

Author of *Methods in Plant Histology* (1901) and *The Morphology of Angiosperms* (1903)

In collaboration with John M Coulter he wrote *The Morphology of Gymnosperms* (1910).



Class – Cycadophyta

- Unbranched stumpy stem
- Leaves large and pinnately divided
- Male cone large and compact with simple sporophylls
- Female cone loose and consists of pinnate or simple sporophylls, that bear large ovules.
- Stems with large cortex and manoxylic wood
- It include three orders

Cycadofilicales

Cycadeoideales

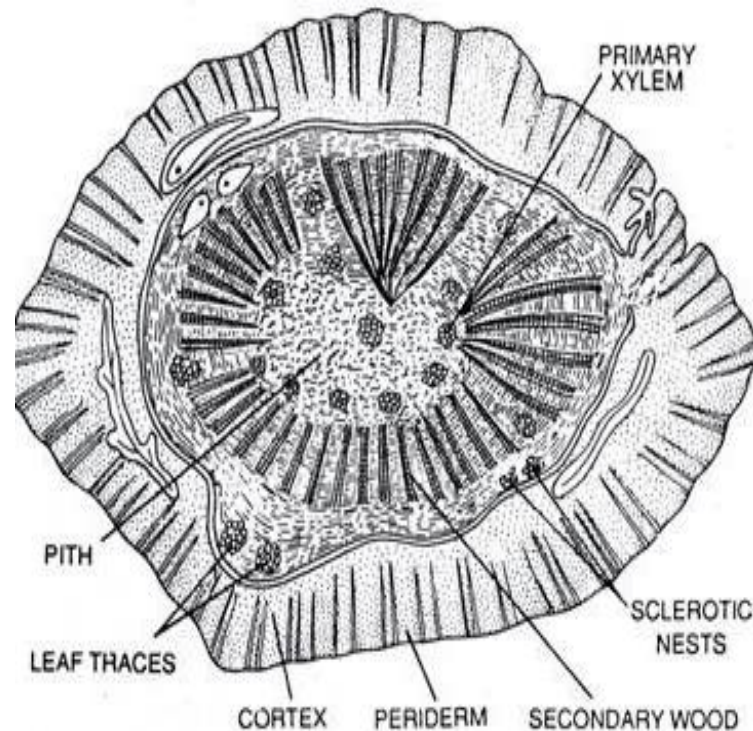
cycadales

Cycadofilicales (Pteridospermales)

- Includes only extinct forms
- Plants rather large with slender stems.
- The leaves are mostly large, fern-like, and often multipinnate.
- The ovules and microsporangia are borne on unmodified or only slightly modified foliage, not in a cone



- There is a solid or a medullated protosteles with mesarch (rarely exarch) primary xylem, occasionally polystelic.
- The bifacial vascular cambium produced secondary phloem and a limited amount of manoxylic secondary wood composed of tracheids with multiseriate pitting, especially on the radial walls.
- There is a prominent and characteristic outer cortex of longitudinally aligned fiber strands.



Lyginopteris oldhamia. T.S. of the stem showing well-developed secondary wood and leaf traces.

- The seeds are borne on the fronds in a variety of ways. In some, they are partially enclosed in a distinct *cupule*.
- Microsporophylls are pinnately compound and not in a strobili. The microsporangiate organs are terminally clustered sporangia which usually form large complex synangial fructifications



Cycadeoideales(Bennettitales)

Includes only extinct forms

Stems covered with an armour of persistent leaf base

Stems were stout or slender and had a wide pith and with manoxylic wood (secondary wood is monoxylic)

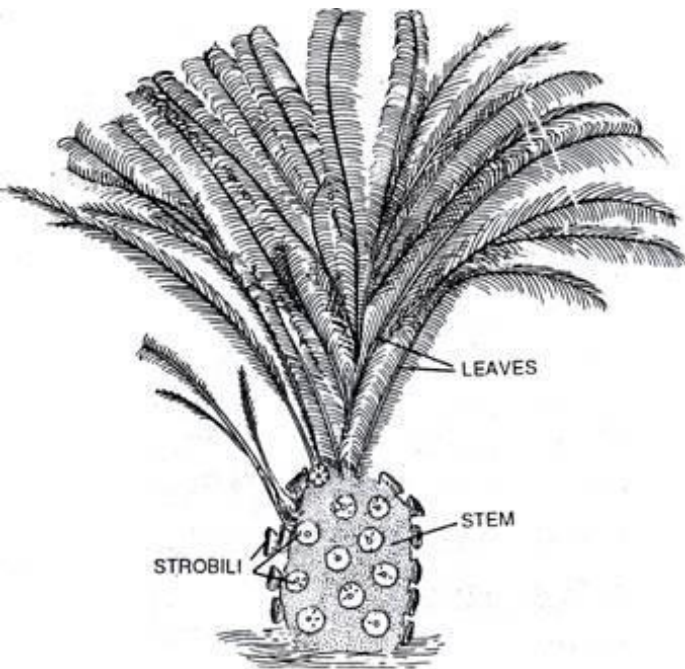


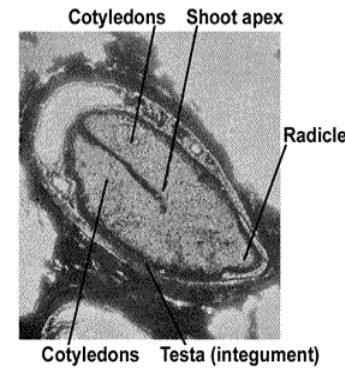
Fig. 2.12. *Cycadeoidea dacotensis*. External features.



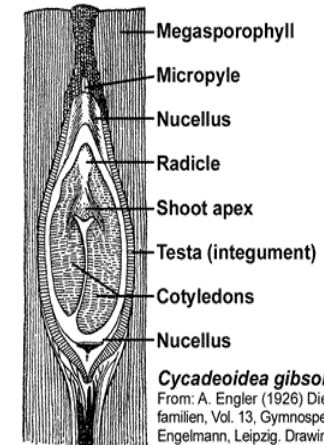


- Syndetocheilic stomata were present
- Reproductive organs arranged on bisexual or unisexual strobilus (flower like structures)
- Male sporophyll frond like forming a loose crown
- Female sporophylls found in a cone like structure, no longer leaf like
- Ovules were numerous stalked borne on a receptacle
- Ovules arranged along with many interseminal scales

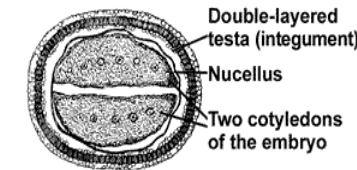
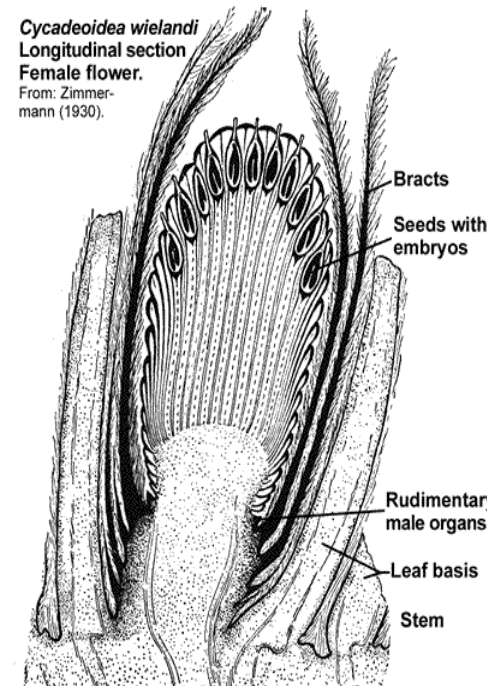
Bennettitales (cycadeoids): Fossil seeds of extinct gymnosperms



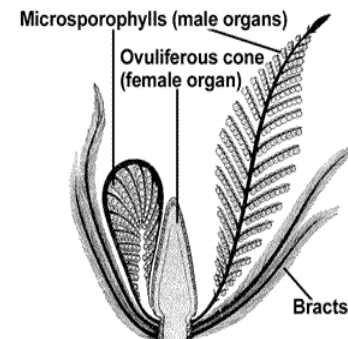
Bennettites gibsonianus seed section.
From: D. H. Scott (1909) Studies in Fossil Botany, Vol. II, Spermatophyta, Adam and Charles Black, London. Photograph: Dr. Bousfield; S. Coll. 351.



Cycadeoidea gibsonianus seed section.
From: A. Engler (1926) Die natürlichen Pflanzenfamilien, Vol. 13, Gymnospermae, Verlag von Wilhelm Engelmann, Leipzig. Drawing: Solms-Laubach.



Bennettites gibsonianus seed section.
Transverse section of a seed. Note the vascular bundles in the cotyledons. From: D. H. Scott (1909).



Cycadeoidea dacotensis bisexual flower.
From: W. Zimmermann (1930) Die Phylogenie der Pflanzen. Verlag von Gustav Fischer, Jena. Drawing: Wieland.

Cycadales

Include both living and extinct forms

Plants are with palm like habit

Young leaves shows circinate vernation

Stomata is haplocheilic

Broad pith and cortex with mucilage canals

Leaf traces are diploxylic

Plants are dioecious without exception. Male and female sporophylls grouped into cones, except in *Cycas*

Male gamete motile and are very large, largest among them is

Chigua-400 micrometer (*Cycas* – 180-200 micrometer)

Class – Coniferophyta

- Stems are profusely branched and the foliage gives a cone like appearance
- Leaves simple
- Male and female strobili are compact and bear complex sporophylls
- Wood pycnoxylic
- It include four orders;

Cordaitales

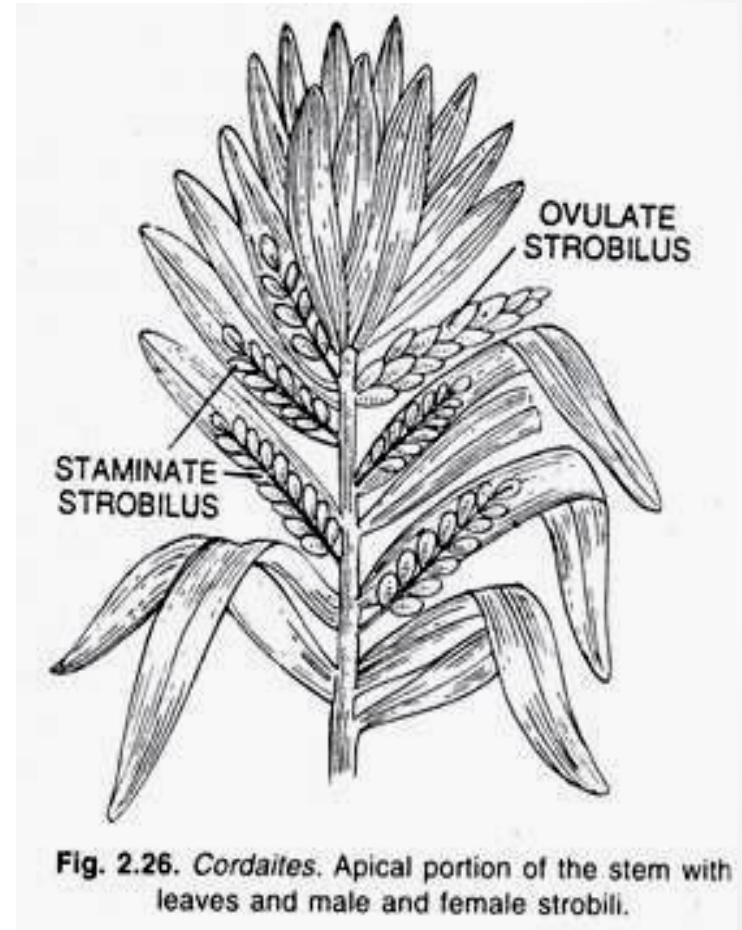
Ginkgoales

Coniferales

Gnetales

Cordaitales

- Includes only extinct forms
- Large trees with slender stem and flat strap shaped leaves as crowns on many branches
- Leaves simple and spirally arranged
Leaves spirally arranged with parallel venation



- Secondary xylem pycnoxylic
- Stem monopodial
- Fructification in cones which were compound and unisexual
- Compound cone had a main axis with secondary shoots which may be sterile or fertile
- 1-4 ovules were present on each female fertile appendage
- 1-6 terminal pollen sacs were present on each male fertile appendage
- Seeds bilateral

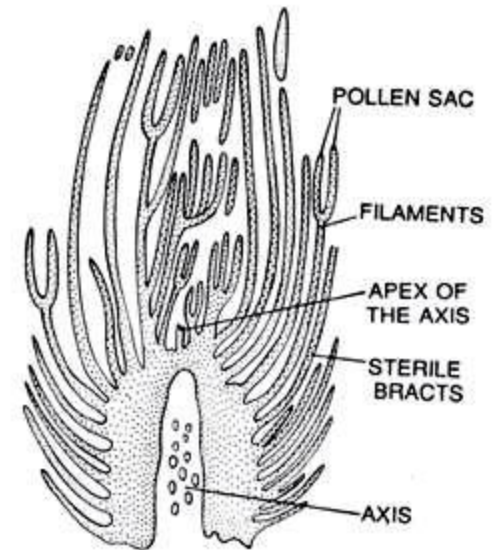


Fig. 2.35. *Cordaitanthus*. The staminate strobilus of *Cordaites*, showing sterile bracts and stalked stamens.

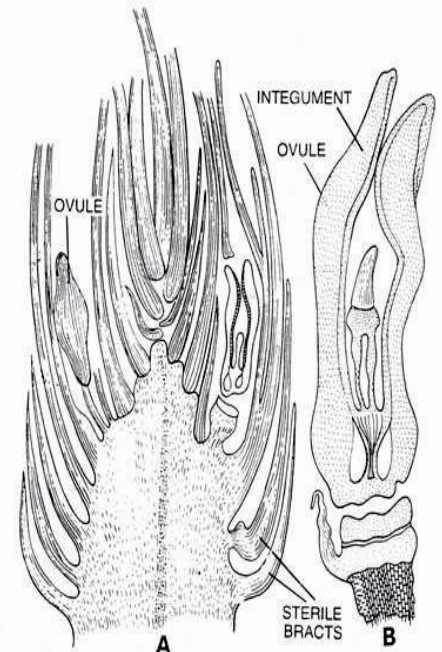


Fig. 2.38. *Cordaitanthus*. The female reproductive organs of *Cordaites*. A, longitudinal section of female strobilus; B, longitudinal section of an ovule.



CORDAITUS CONE



Ginkgoales

- Represented by only one living member, *Ginkgo biloba*
- Medium sized trees
- Wood is pycnoxylic
- Leaves flattened and lobed in various ways with dichotomous venation
- Male flowers collected into strobili
- Male gametes are motile



Coniferales

- Large trees or shrubs
- Leaves needle or scale like, sometimes flattened
- Leaf and stem shows dimorphism
- Resin canals may be present in cortex, pith and wood
- Secondary wood consists of trachieds with uniseriate or multiseriate pits on radial wall



- Plants monoecious or dioecious
- Cones unisexual
- Male flowers are arranged in more or less compact clusters or catkins
- Male cells never motile
- Pollen grains are winged or unwinged
- Pollination is anemophilous
- Female flowers clustered to form a cone
- Polyembryony is very common
- Seeds endospermic and winged



Gnetales

- Small trees , shrubs or climbing shrubs
- Leaves simple, opposite or whorled
- Vessels present in the secondary wood
- Usually dioecious (monoecious in some species of Gnetum)
- Compound cones (Both male and female)



- Male flower with antherophore and 1-8 sporangia surrounded by perianth
- Presence of micropylar tube
- Archegonia is completely eliminated
- Dicotyledonous embryo

