Cordaites

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History & distribution of the Cordaitales

- Cordaitales are an extinct group of Palaeozoic gymnosperms which were tall trees.
- They formed **“the world’s first great forests”**.
- The name was given to honour an Australian botanist, A.J. Corda.
- Majority of the Cordaitales were tall, large-leaved trees attaining a height of more than 30 metres.
- The group started declining during Permian era and became completely extinct by the end of this period.

- Cordaitales fossils have been found in North and South America, Europe, China, Russia, India, Australia and Africa indicating their world-wide occurrence during Devonian and Permian era.
- Cordaitales in India are found in the form of impressions or compressions of leaves, seeds and petrified woods. Representatives of the only family Cordaitaceae have been reported from India.
- No member of Poroxylaceae has been reported. In India, Cordaitaceae are represented in lower Gondwana fossil formations.
- *Cordaicarpus, Dodoxylon, Noeggerathiopsis* and *Samaropsis* are the Cordaitalean genera reported from India.

Distinguishing features of Cordaitales

- This group of fossil plants had tall trees with slender trunks and a crown of several well- developed branches.
- Plants were present from Devonian to Permian periods of Palaeozoic era.
- The leaves were simple, spirally arranged and strap-shaped, grass-like or paddel-like.
- The leaves attained a length up to 1 metre or even more, and had parallel venation.

- A scanty primary wood was present.
- In mature stems, the secondary wood was mostly pycnoxylic.
- Compound unisexual cones were present.
- Each compound cone had a main axis with bracts subtending secondary fertile shoots possessing fertile and sterile appendages.
- Mega-strobili had sterile appendages below and ovule-bearing fertile appendages above.
- One to four ovules were present on each female fertile appendage.

- Micro-strobili had sterile appendages below and pollen-sac containing fertile appendages above.
- Four to six terminal pollen sacs were present on each male fertile appendage.
- Sperms have not been reported, but presence of pollen chambers suggests that motile sperms might have been formed.

Classification of Cordaitales:

- **Scott (1923) divided Cordaitales into following three families:**

1. Cordaiteae, e.g. *Cordaites*, *Mesoxylon*, etc.
2. Poroxyleae, e.g. *Poroxylon*.
3. Pityeae, e.g. *Pitys*, *Callixylon*, *Dadoxylon*.

- Chamberlain (1935) named the three families as Poroxylaceae, Pityaceae and Cordaitaceae.

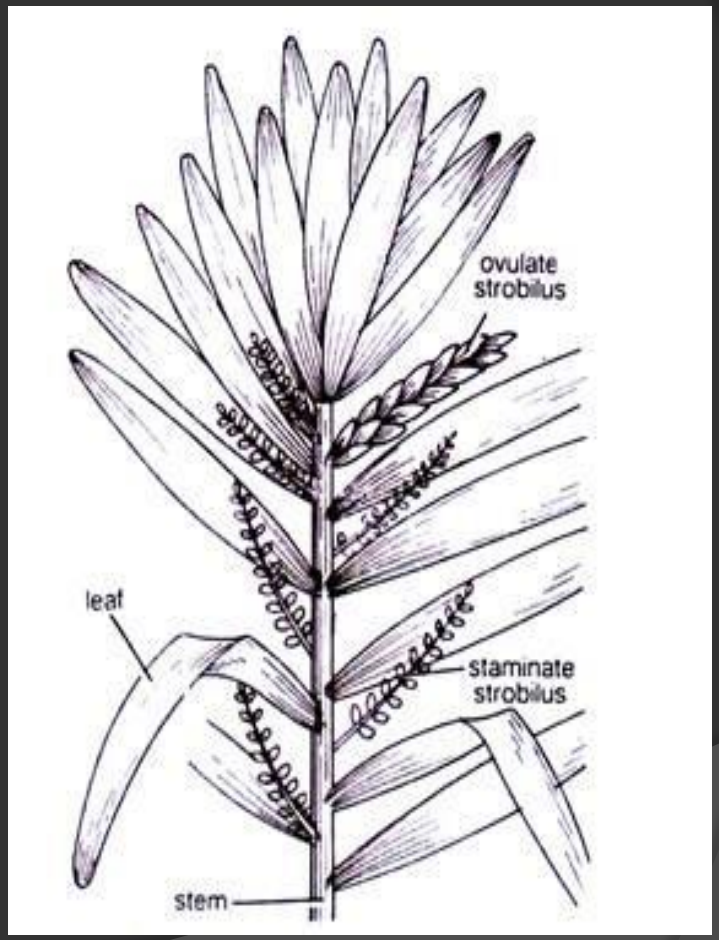
- Cordaitaceae has the following components: *Cordaites* (leaves), *Mesoxylon* (stems), *Amyelon* (roots), *Cordaianthus* (cones), *Cordiocarpus* (seeds).

Cordaitaceae: External Morphology:

- Cordaitaceae grew luxuriously and formed large forests of tall trees during Upper Carboniferous period.
- Plants attained a height of more than 30 metres.
- They had terminal and spirally arranged well-spread branches bearing tufts of leaves.
- The leaves were large, leathery, grass like or paddle-shaped, and attained a length of about 1 metre and a breadth of about 15 cm.
- Leaves were, however, smaller than that of Cycads.
- Some members also had small needlelike leaves. The leaves had a dichotomous venation.

Cordaites- reconstruction

Eu-Cordaites
Reconstruction of a plant (after Grand's Eury).



Eu-Cordaites- leaves and strobili

- The leaves of several members of Cordaitaceae were highly variable in shape and were put under a form-genus *Cordaites*. The same name is now given to the stem as well as to the entire plant.
- Some other stem-genera of Cordaitaceae include *Mesoxylon, Metacordaites, Parapitys, Caenoxylon, Mesopitys, Cordaicladus and Artisia.*
- *Amyelon* is a root-genus while *Cordaianthus* is a name give to the cones or inflorescence.
- Seeds have been described under the form-genera *Cardiocarpus, Mitrospermum* and *Kamaraspermum*.

Anatomy of *Cordaites: Stem*

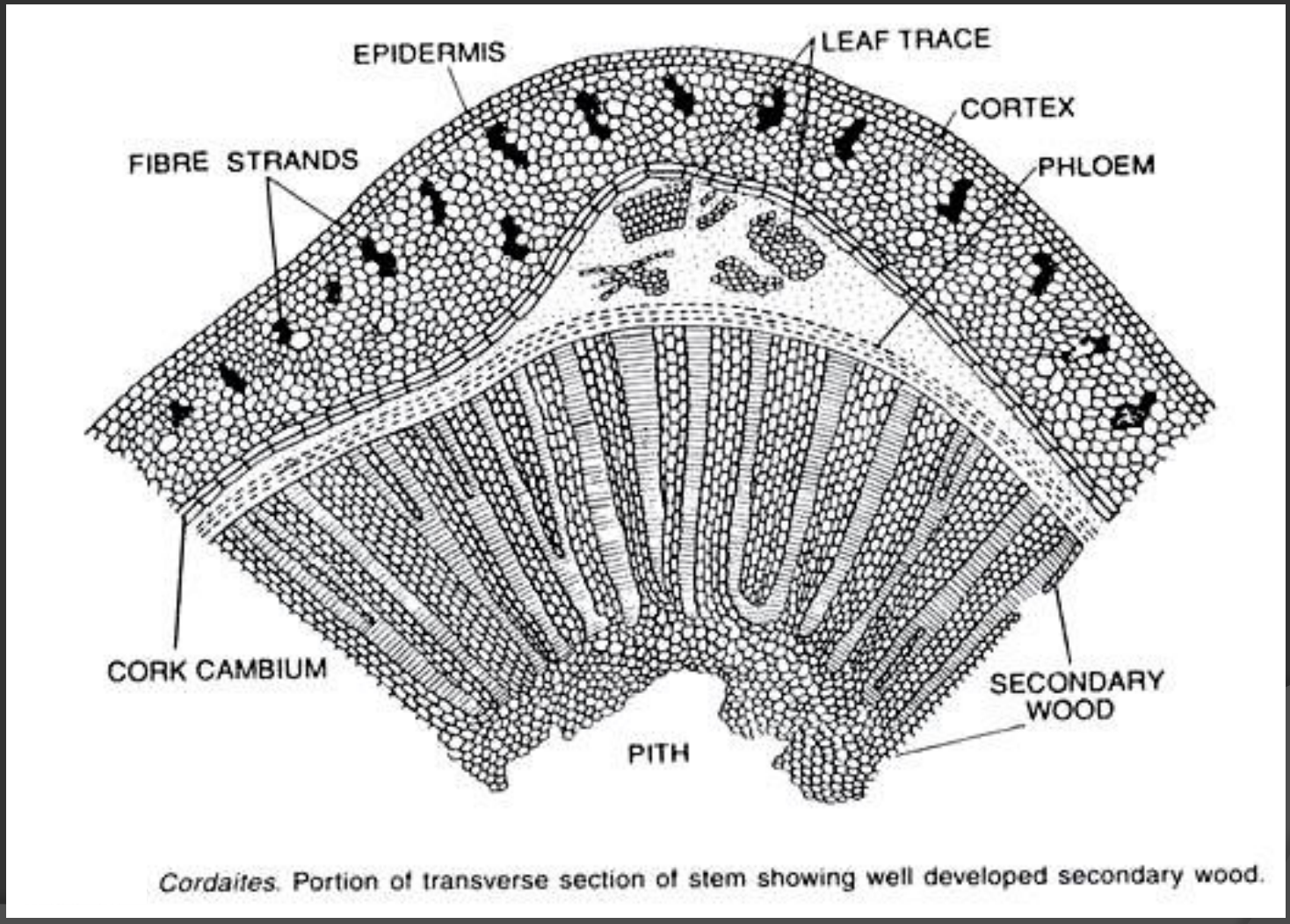
- The stem resembled closely with Conifers.
- Both *Cordaites* and *Mesoxylon* possessed a large central pith and cortex.
- The wood was scanty in some species while in others it developed a large vascular cylinder, and in still other cases distinct growth rings were present.
- The primary wood of *Cordaites* was endarch but in *Mesoxylon* it was mesarch.
- The secondary wood consisted of pitted tracheids having multiseriate pittings.

Stem anatomy

- It shows presence of periderm and wood with usually large discoid pith.
- The cortex is large and shows the presence of scattered patches of sclerenchyma in the parenchyma. The cortex also shows presence of leaf traces.
- The zone of primary wood is very thin.
- The secondary wood is well developed, thick and coniferous.
- It shows the pith which is 1 to 100 cm. or more in diameter. It is entirely parenchymatous but in course of growth it is cracked transversely giving the appearance of a pile of concave discs.

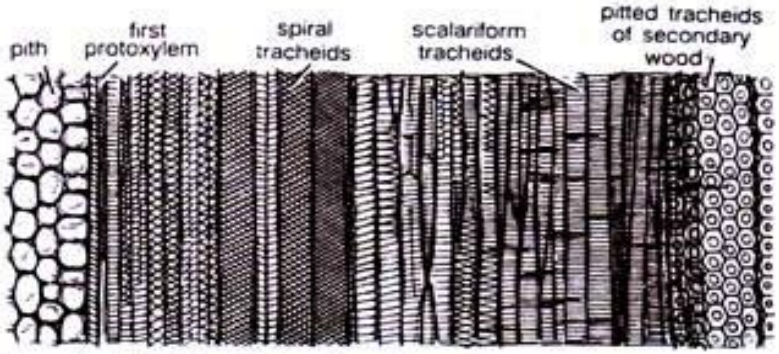
- The tracheids were long and slender. Bordered pits were present, and they were confined mainly on the radial walls. In older tracheids, however, the pits were also present on the tangential walls.
- Medullary rays were one or two cells wide. The bordered tracheids were hexagonal in outline and the large pith was characteristically discoid.
- *Mesoxylon* differed from *Cordaites* in the structure of the leaf trace. A network of sclerenchyma, present in the outer cortex of *Mesoxylon*, was absent in *Cordaites*.
- Since the genus *Cordaites* refers to the leaves of Cordaitaceae, an alternative name *Cordaioxylon* was proposed by Arnold in 1967for the stem.

Cordaites stem

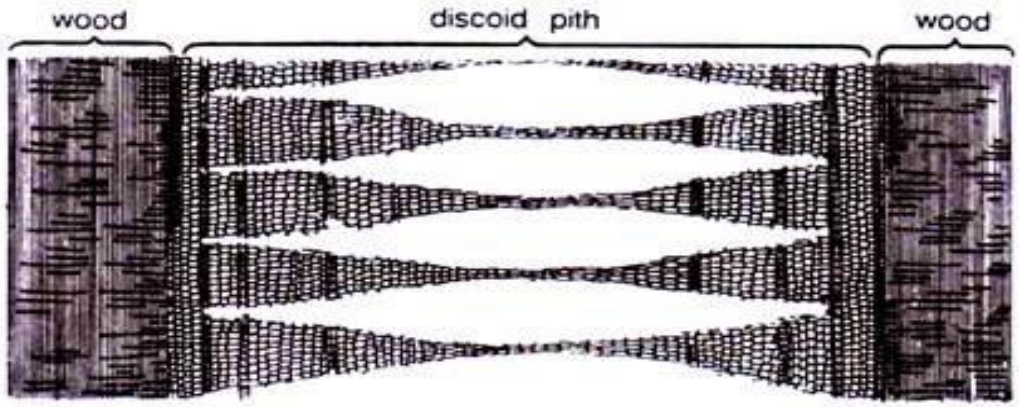


Cordaites. Portion of transverse section of stem showing well developed secondary wood.

Cordaites stem- R.L.S.



Cordaites brandlingii, R.L.S. of stem from the pith to the beginning of secondary wood. (after Scott, 1923)

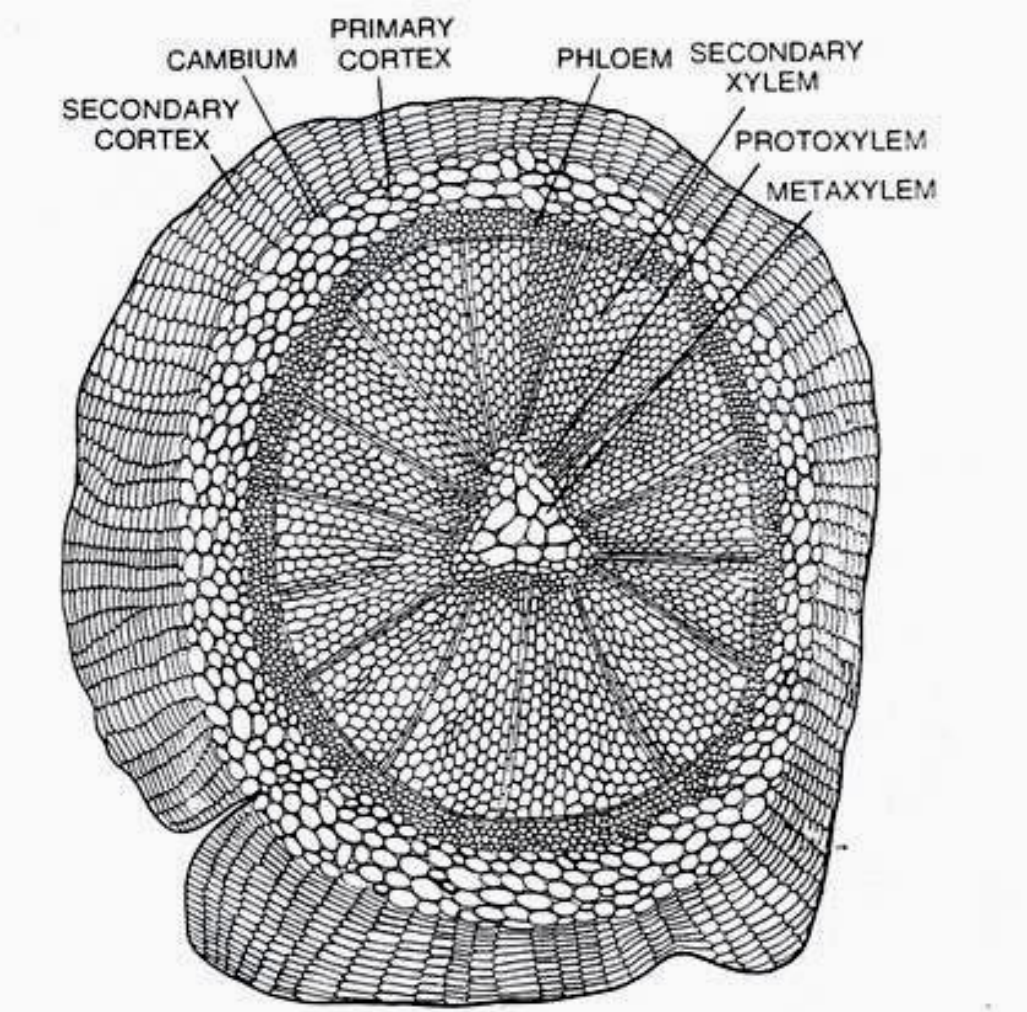


Cordaites brandlingii. R.L.S. stem showing discoid pith and wood.

Cordaites Root- *Amyelon*

- The roots of *Cordaites* are known as *Amyelon* and resembled very much with the modern Conifers.
- Cridland (1964) studied the root system of *Amyelon* and found it to be shallow and highly branched forming stilt roots supporting the stem.
- They were diarch or triarch in structure.
- Ectotrophic mycorrhizal fungi were present on the roots.
- The protoxylem had spiral tracheids while the metaxylem was scalariform in structure.
- Tracheids had multiseriate bordered pits.
- The cortex was quite large and divisible into outer and inner cortex. The secondary cortex and cambium were also quite distinct.

Amyelon



. *Amyelon*. T.S. of root of *Cordaites* showing various structures.

T.S. of Leaf of *Cordaites*

- The Cordaitalean leaf is described under the name *Cordaites*.
- Several xerophytic internal characters were present in the leaf.
- The epidermal and hypodermal cells were thick-walled, and the hypodermal cells on both sides were grouped into ribs. Epidermis was present on both sides of the leaf (bifacial).
- Several mesarch vascular bundles were present.
- Each vascular bundle was surrounded by a thick-walled strong bundle sheath.
- The transfusion tissue was present in the form of some elongated cells in between two vascular bundles.
- The mesophyll was clearly differentiated into palisade and spongy parenchyma in species such as *Cordaites lingulatus.*

T.S. of *Cordaites* leaf

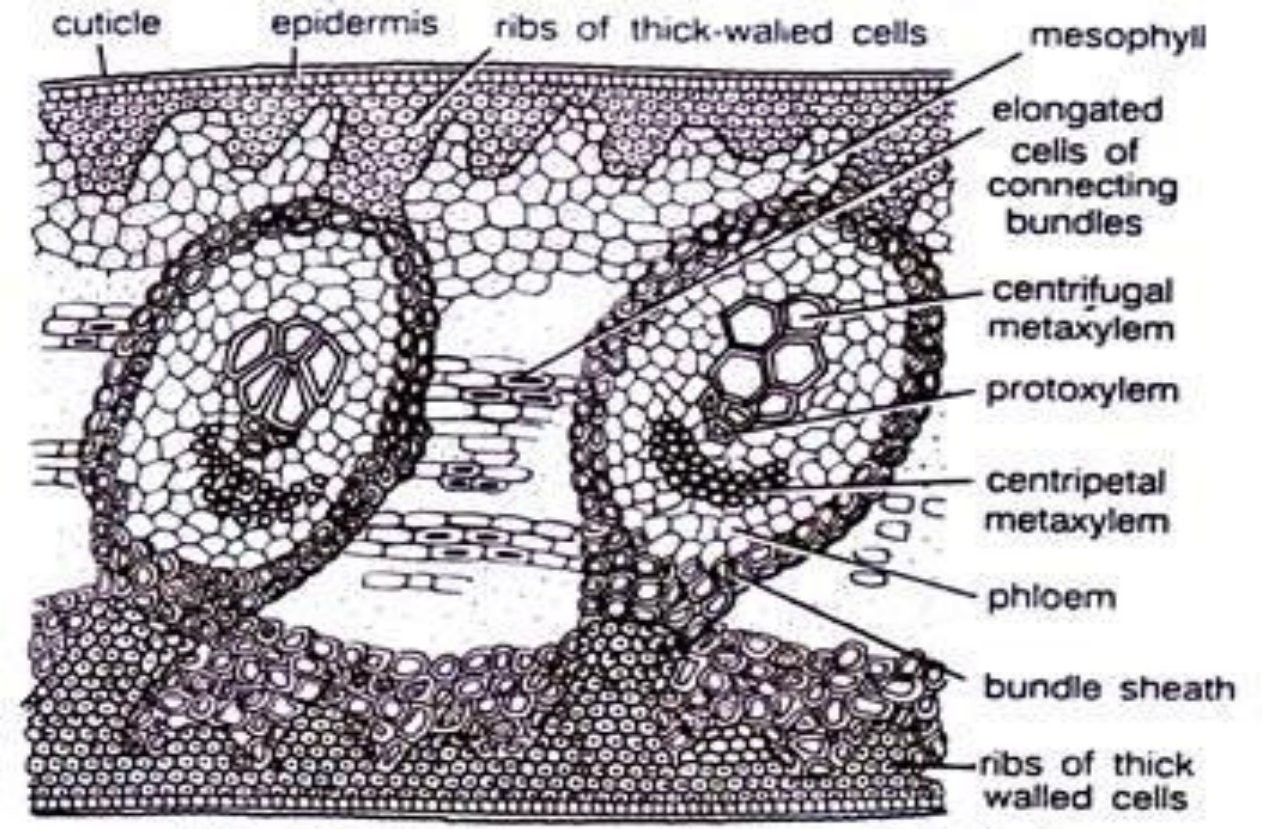


Fig. 9.7. *Cordaites angulostriatus*. T.S. leaf.

Spore-producing Organs:

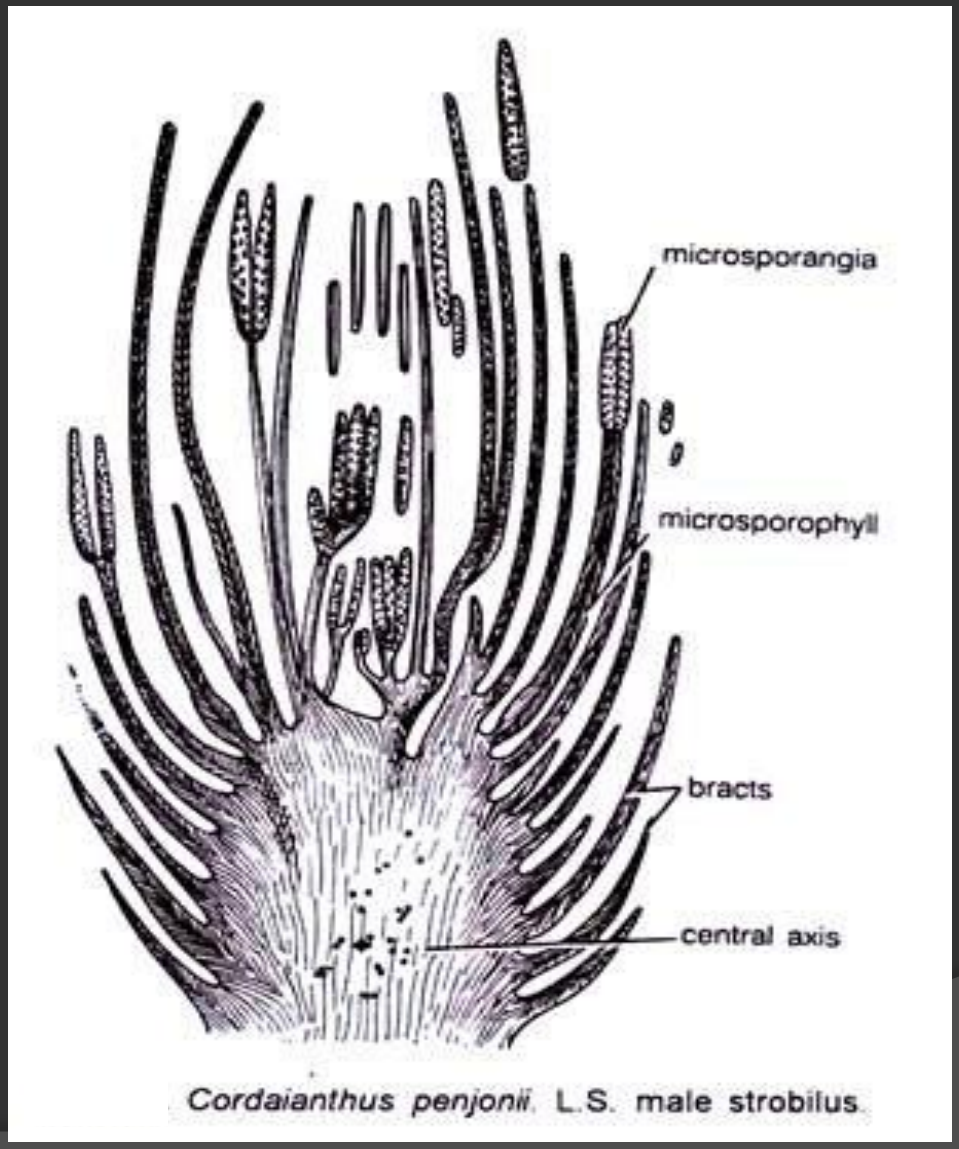
- The strobili were usually monoecious but some Cordaitales were also dioecious. They were never bisporangiate.
- The fructifications were borne on slender branches of about 10 cm length.
- These branches developed on the stem among the leaves.
- The slender stalk had many stiff but tapering bracts.
- A short bud-like strobilus was present within the axil of each bract.
- The bracts were probably spirally arranged.
- Each strobilus attained a length of about 1 cm. Both male and female reproductive organs are known as *Cordaianthus*.

Male strobilus

- It consisted of a thick central axis possessing many spirally arranged bracts and some microsporophylls.
- At the tip of each microsporophyll were present 1-4 microsporangia.
- These sporangia probably dehisced longitudinally.
- Three well-studied forms of male strobilus include *Cordaianthus concinnus, C. penjonii* and *C. saportanus*.

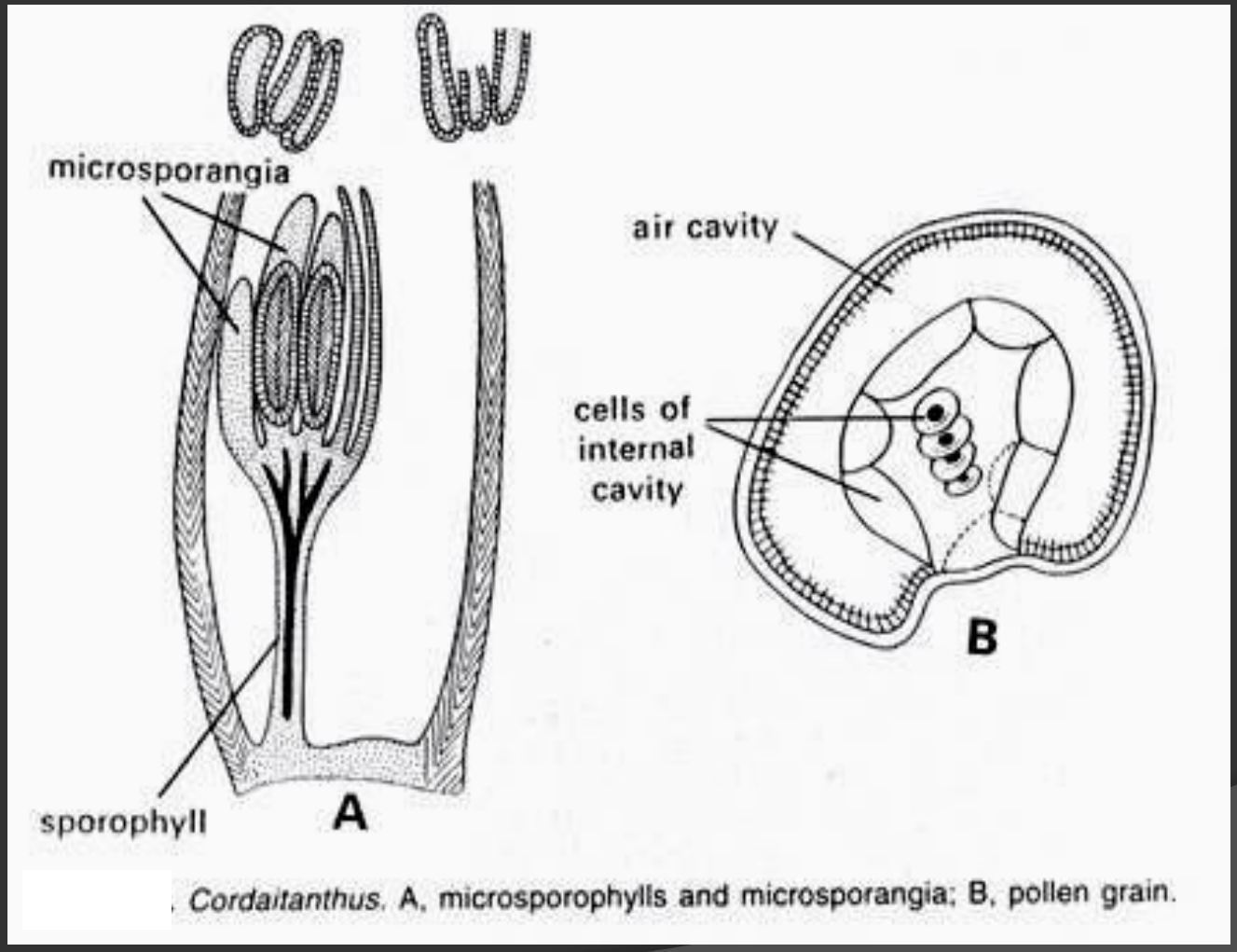
- The microsporangium wall was probably only one-celled thick and enclosed many microspores.
- Taylor and Taylor (1987) studied the structure of pollen grains of Cordaitales. According to them the grains may be alete or range from monolete to trilete.
- They are mono-saccate with saccus attached on both distal and proximal poles.

Male strobilus



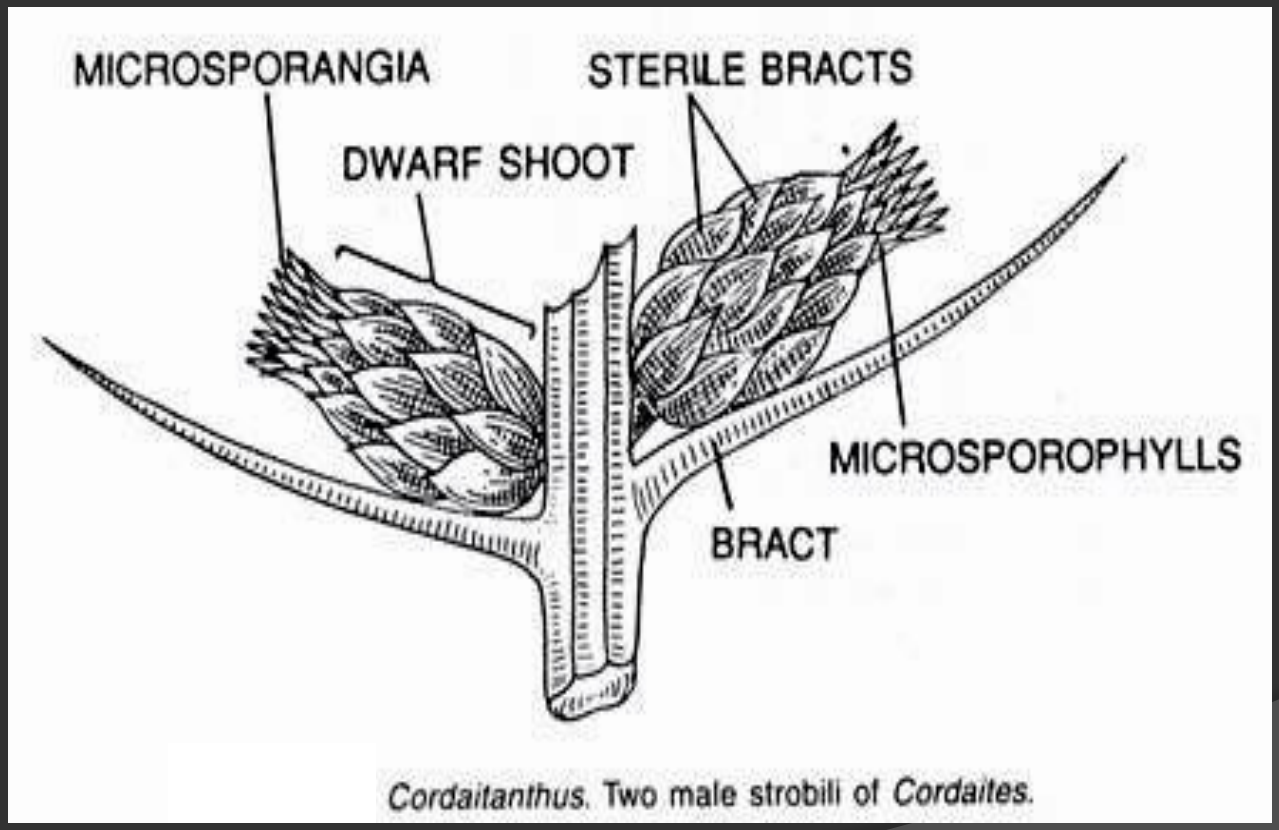
Cordaianthus penjonii. L.S. male strobilus.

Microsporophyll



Cordaitanthus. A, microsporophylls and microsporangia; B, pollen grain.

Male strobili



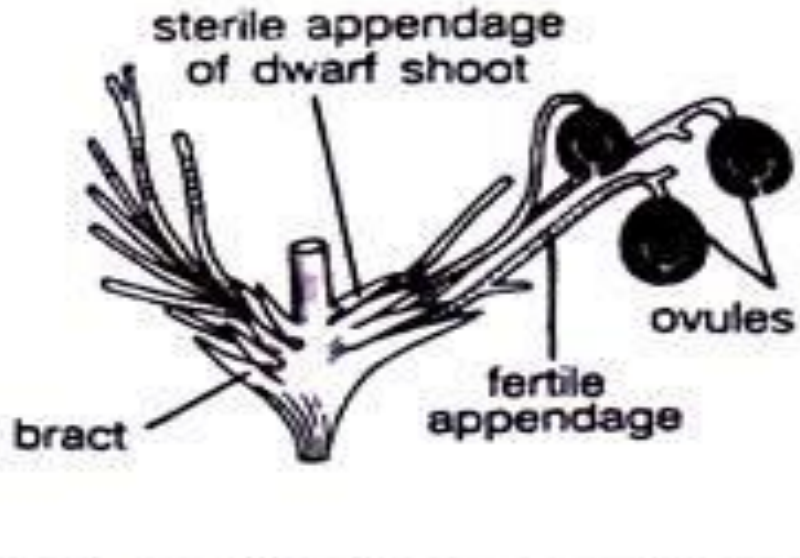
Cordaitanthus. Two male strobili of *Cordaites*.

Female strobilus

- Similar to male strobilus, the female strobilus also had a stout axis bearing a large number of spirally arranged bracts.
- The bracts were more in number than that of male strobilus.
- *Cordaianthus pseudofluitans* possessed a few elongated and dichotomously branched fertile megasporophylls.
- Two or more ovules were present at the apex of each megasporophyll.

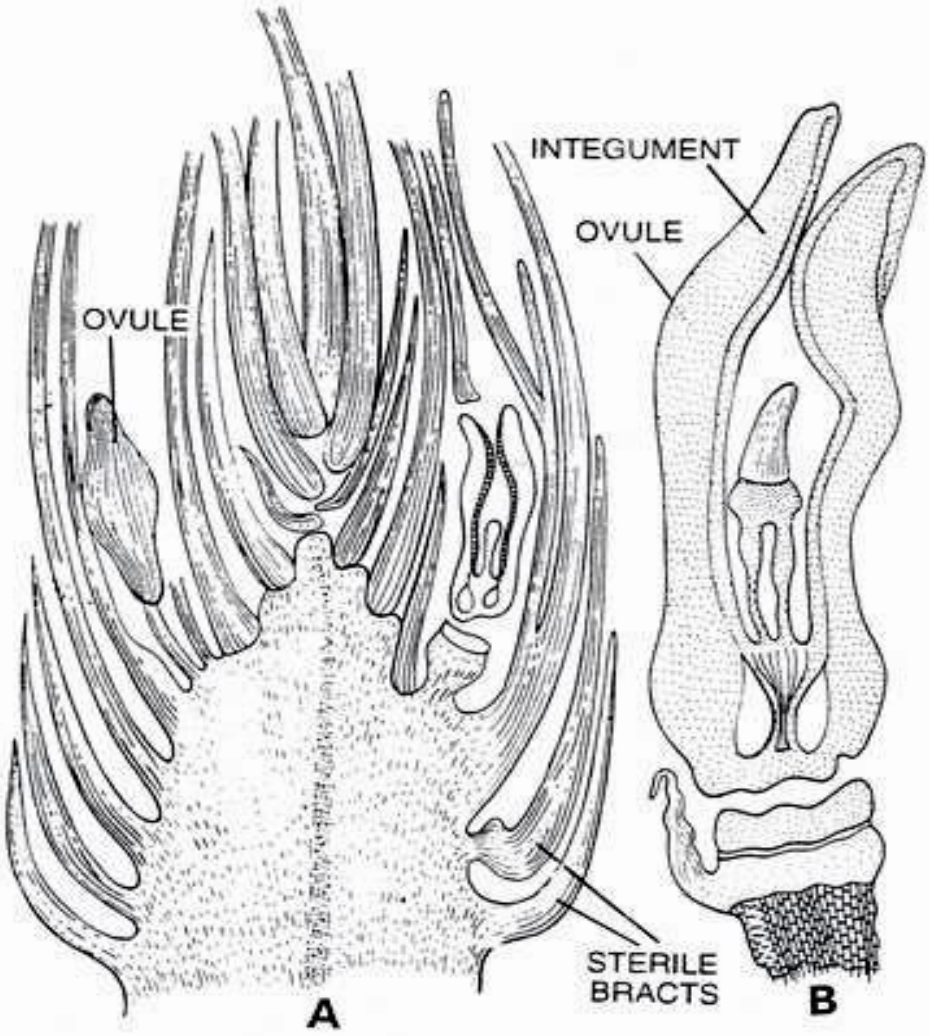
- In *Cordaianthus williamsonii*, a single ovule was present on each fertile appendage.
- The ovule was bitegmic and the integuments were free in the lower part but fused above.
- The nucellus of the ovule was free from the integument throughout.
- A prominent beak with a large pollen chamber was also present.

Female strobilus



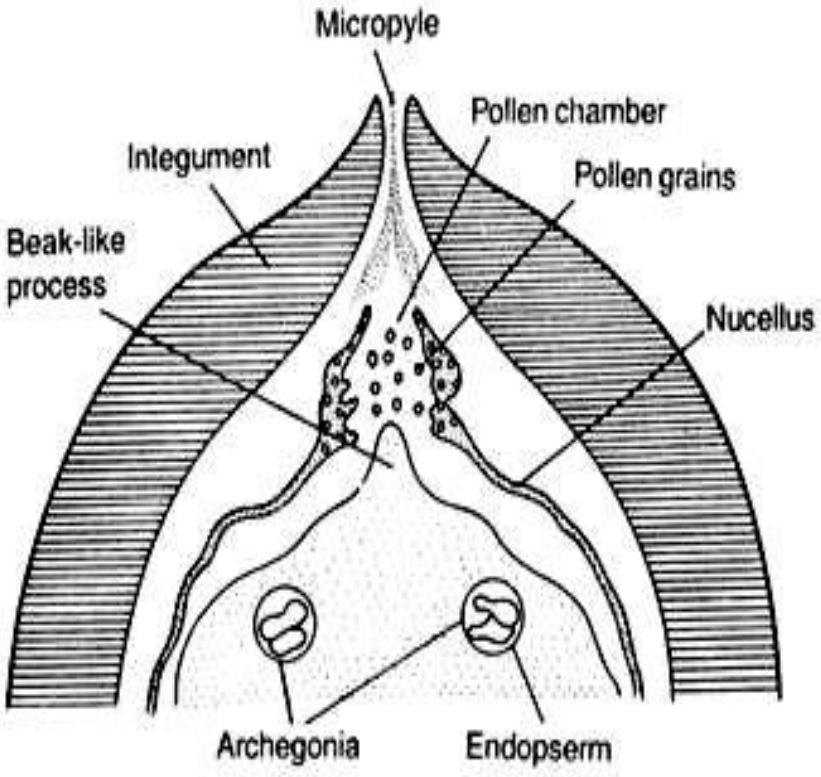
Cordaianthus pseudofluitans. A part of female inflorescence with two dwarf shoots, each in the axil of a sterile bract.

Female strobilus



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

Female gametophyte

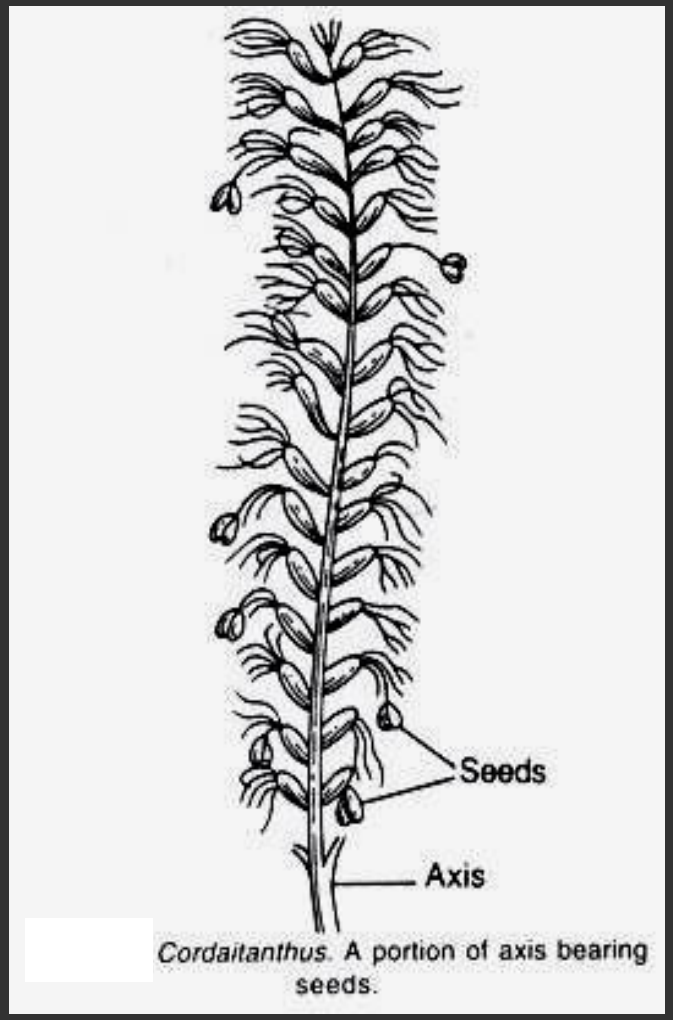


. *Cycadinocarpus*. Longitudinal section of the apical portion of a mature ovule showing various parts and pollen grains within pollen chamber.

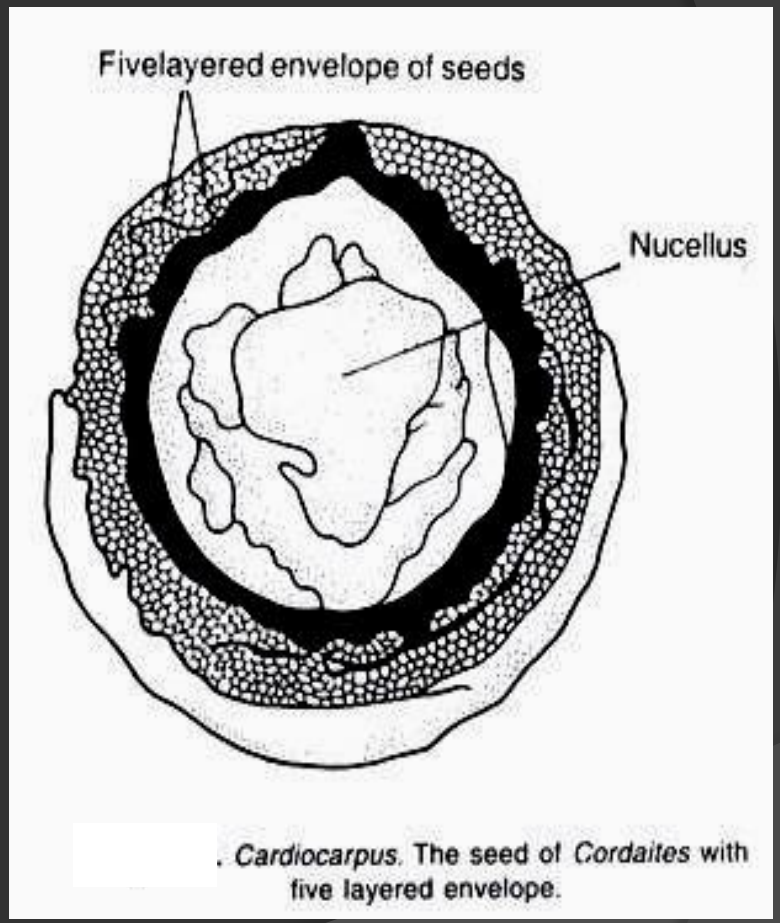
Seed

- It is believed that *Cordaianthus* type of strobili possessed seeds known as *Cardiocarpus* (=*Cordaicarpus*=*Samaropsis*).
- *Mitrospermum* and *Kamarospermum* are the other two seed-genera of Cordaitaceae. Seeds were heart-shaped, bilaterally symmetrical.
- Central nucellus was surrounded by a two-layered envelope, of which the outer layer was probably expanded in the form of a wing.
- In *Cardiocarpus spinatus* the seeds were large and surrounded by five distinct layers, including two layers each of sarcotesta and sclerotesta and a layer of endotesta.

Seed



Cordaitanthus. A portion of axis bearing seeds.



. *Cardiocarpus*. The seed of *Cordaites* with five layered envelope.

Systematic position of Cordaites:

Division. Gymnospermae

Class. Coniferophyta

Order. Cordaitales

Family. Cordaitaceae

Genus. *Cordaites*