



***Archaeopteris*, a progymnosperm**

***Archaeopteris:* Part I**

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Life on Land



- **First fossils of life on land**
 - **Ordovician Period**
 - **Possibly Middle Cambrian**
- **Why did Earth go so long without life on land?**
- **What prevented life from inhabiting the land?**

Barriers to life on land

- **Dehydration**
- **Osmoregulation: fresh vs. salt water**
- **Reproductive dispersal**
- **Support**
- **Food supply**
- **Temperature extremes**
- **Exposure to UV and other radiation**

Life on Land

- **What do you suppose the earliest colonizers were like?**
- **Where would they have lived?**
- **What advantages might there be to living on the land?**



The Fossil Record:



- **Limited record of marine macrophytes – environmental requirements vs. preservation**
- **Ordovician (Middle Cambrian?) - spores in marine sedimentary rocks**
- **Spores indicate primitive, moss-like (non-vascular) plants**

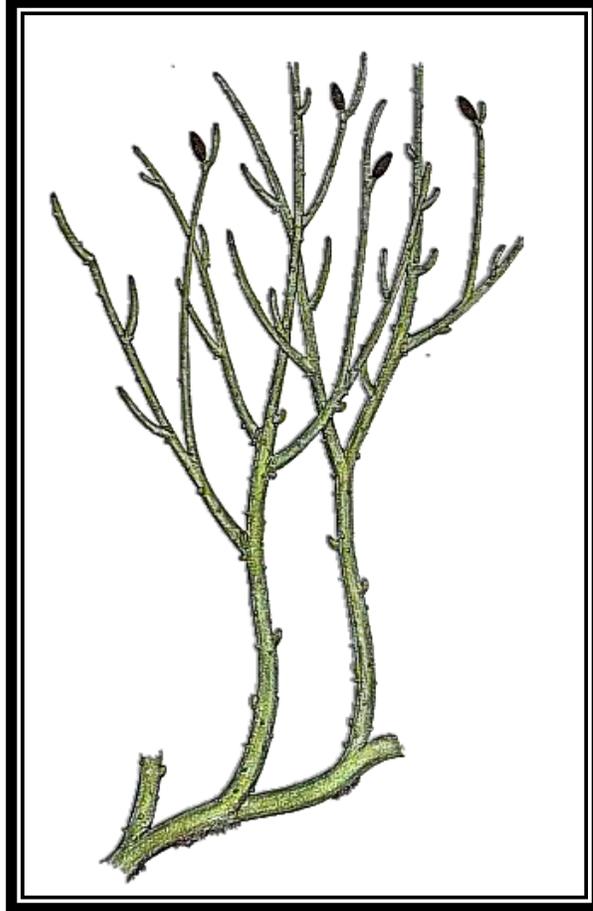
First Vascular Land Plants

- **Conducting tissue**
- **Stomates**
- **No true roots – simple “hold fasts”**
- **Appeared in Late Silurian to Early Devonian**

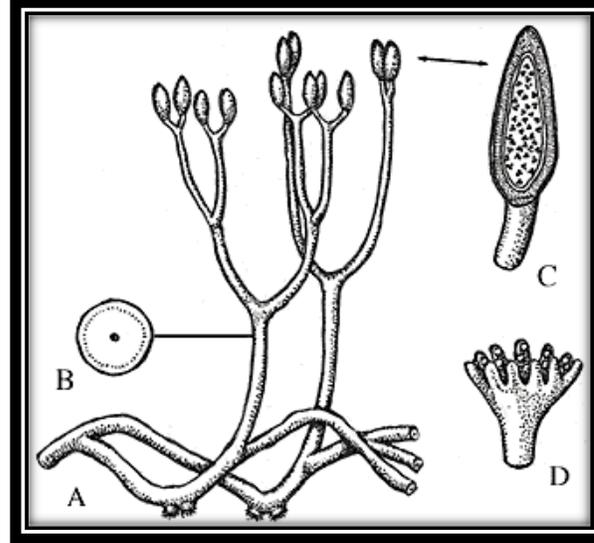




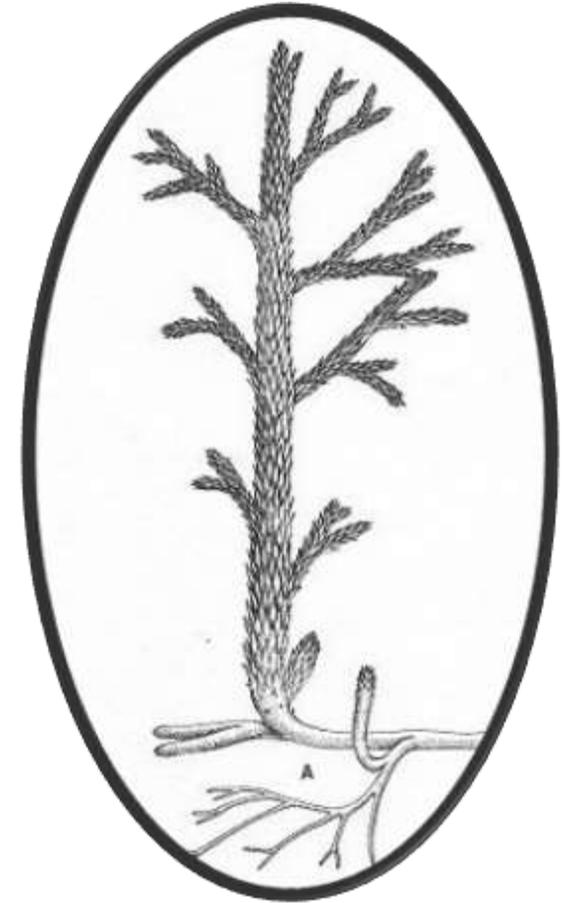
Cooksonia



Rhynia



Aglaophyton



Asteroxylon

Archaeopteris – Middle Devonian

Archaeopteris is one of Earth's earliest trees, if not the earliest. Like all Devonian vegetation, it used to grow close to waters. Diffused in both Laurasia and Gondwana, it reproduced itself through spores. A real revolutionary species, it broke many "rules" of the time, such as vertical-only growth (it could grow lateral) and shallow roots (its roots were deeper than 1 m.). It was the ancestor of many species of the following periods and the first "modern" tree.

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The frond-genus *Archaeopteris* of Pityales is known by about fifteen species, all of which had large fern-like fronds (Fig. 3.1 A). Beck (1960) has demonstrated the organic connection between *Archaeopteris* and the stem genus *Callixylon*. Both these genera have been reported from the rocks of the Upper Devonian period of North America, Russia and several other parts of the globe.

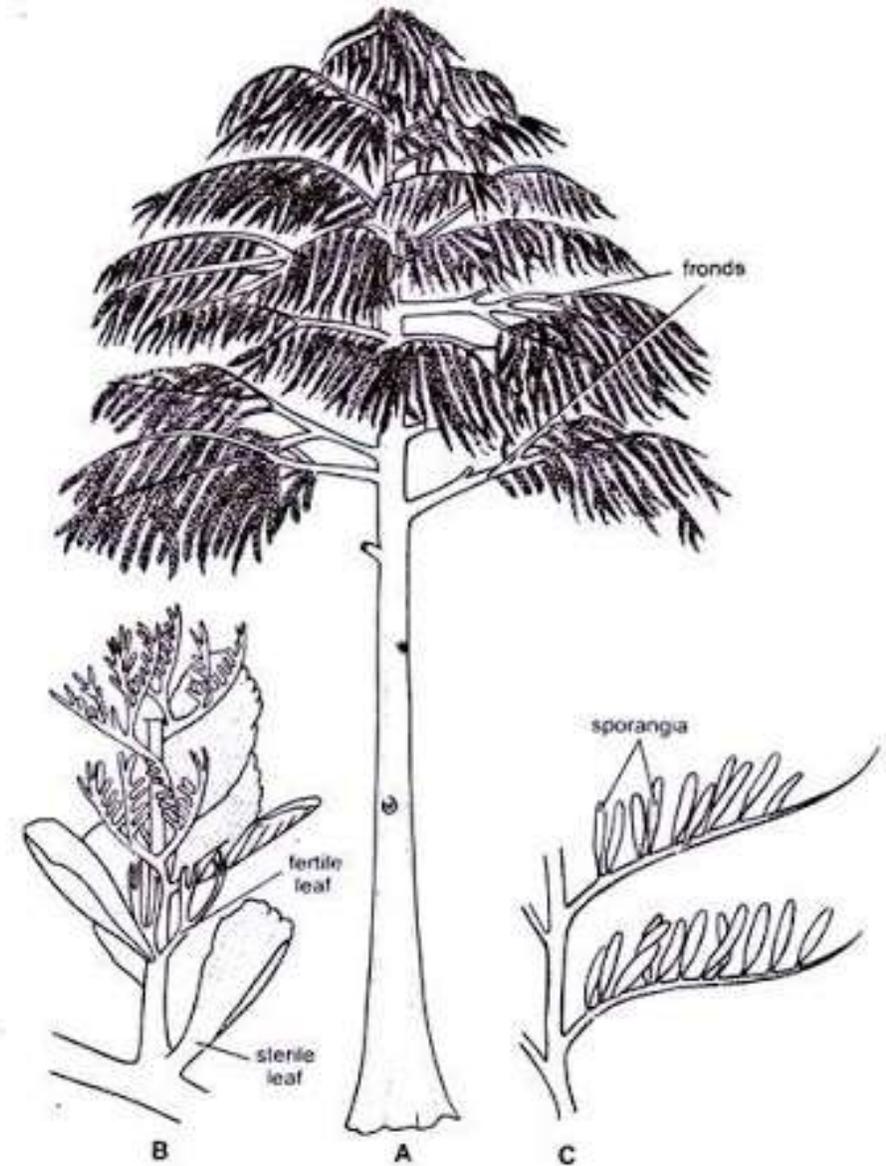


Fig. 3.1. A, Reconstruction of a tree of *Archaeopteris*; B, A branch of *A. macilenta* bearing sterile and fertile leaves; C, Fertile leaves bearing micro- and megasporangia.

Archaeopteris / Callixylon



According to Bonamo (1975) Progymnosperms are the “**plants exhibiting the features of pteridophytic reproduction and gymnospermic anatomy**”.

Callixylon / Archaeopteris

- The “Gilboa Forest”
- First forest – Gilboa, NY
- A new ecosystem
- New conditions –
adaptations to shade





***Archaeopteris*-dominated forests are common in Late Devonian localities from elsewhere in Euramerica (North America and Western Europe), Gondwana (Africa, Antarctica, Australia and South America), China and Siberia. It has been found at paleolatitudes ranging from equatorial to sub-polar. From its first appearance in the middle Frasnian *Archaeopteris* quickly became an important and typically dominant component of the flora. Indeed, it became the lynchpin of the [first true forests](#). *Archaeopteris* remained paramount until the end of the Devonian, at which time it mysteriously became extinct.**

Origin and Evolution of Gymnospermous Leaf

The progymnosperms of the middle and upper Devonian such as Aneurophyton possess a three dimensional and dichotomously branched system. The simple wedge shaped and laminated leaves appeared first in Archaeopteris in the upper Devonian. The simple leaf is considered to have evolved in the progymnosperms through the process of plantation and lamination of an original three dimensional ultimate branch system. In some progymnosperms like Siderella and Archaeopteris, the lateral branches are flattened and are considered to represent an intermediate stage in the evolution of gymnospermous compound leaf(Singh,2006).



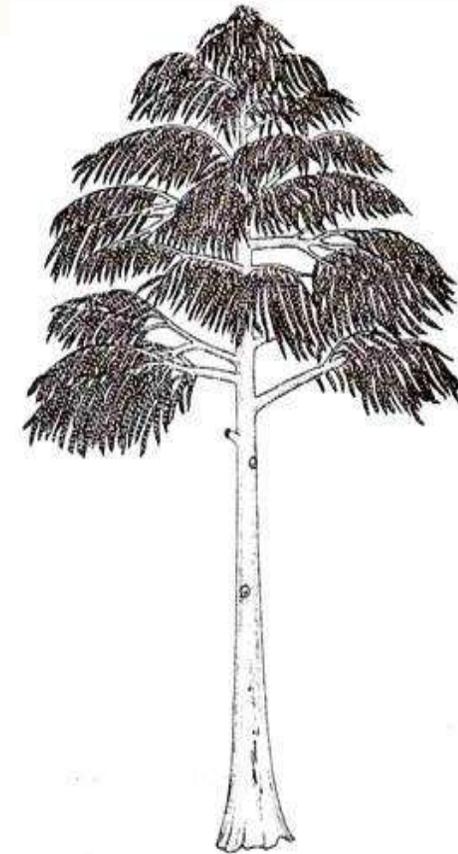
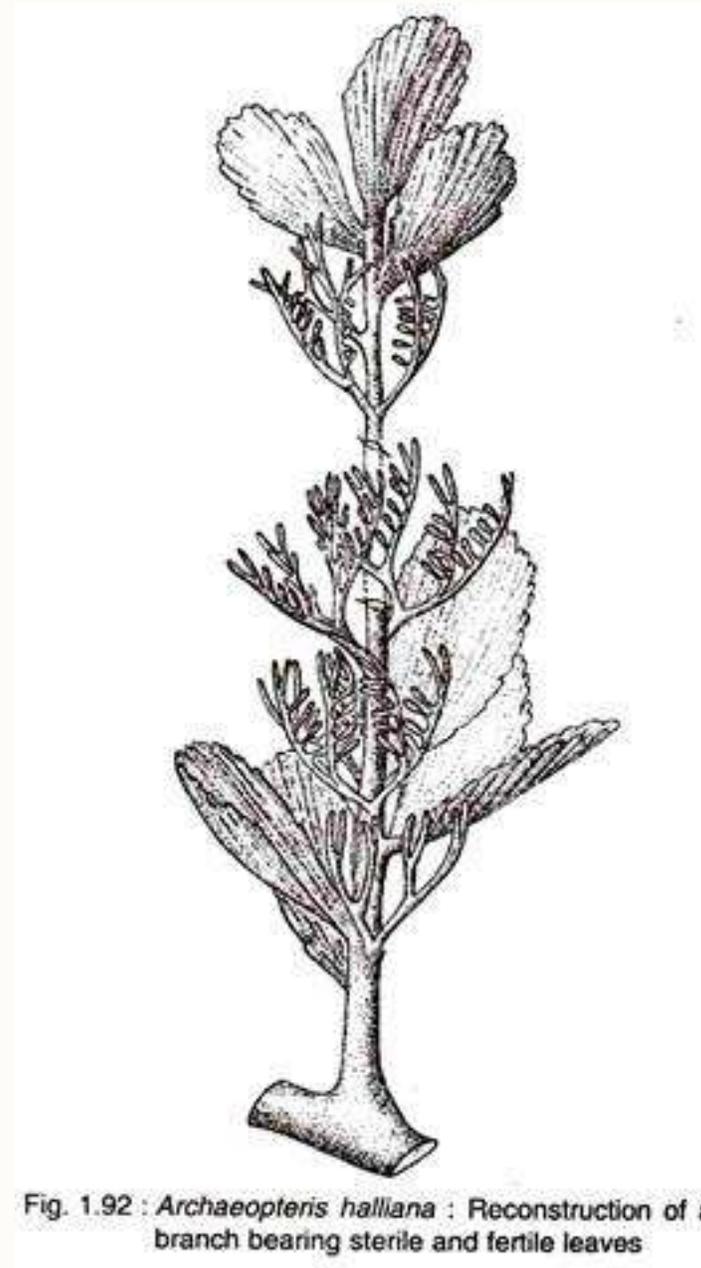
1. Habit of *Archaeopteris*:

Large trees up to 18 m high with a large crown of spirally arranged pseudomonopodial branches (Fig. 1.91) in which the penultimate branches bear both ultimate branches and leaves in a spiral.

2. Morphology of *Archaeopteris*:

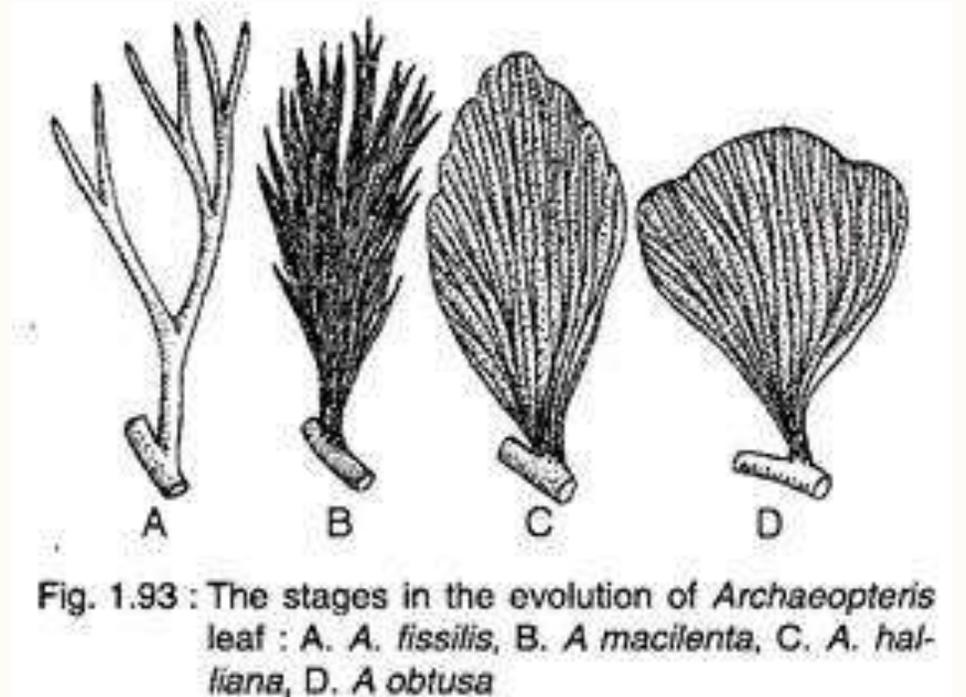
Both the branches and leaves show determinate growth which are developed in the same organotactic spiral. There is a continuity between the xylem of the branches and the parental axes. This suggests that the branches of *Archaeopteris* were not produced by lateral buds, rather developed from primordia like those that produced the leaves. The fertile ultimate branches may occur as the most basal units of a branch system. In some species, both fertile branches (strobili) and sterile branches (leaves) are intermixed and are arranged spirally (Fig.1.92). The fertile branches bear one or two rows of fusiform sporangia on adaxial surface.

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Archaeopteris shows considerable variations of ultimate branches in different species, suggesting the origin of megaphyllous leaves from a planated and webbed telome truss (Fig. 1.93A-D). In *A. fissilis* (Fig. 1.93A), the leaves are represented by planated terete telomes that dichotomise two to three times.

In *A. macilenta* (Fig. 1.93B), the telomes are planated with various degrees of incomplete webbing so that the distal margins of leaves are deeply incised. The wedge-shaped megaphyllous leaves of *A. halliana* (Fig. 1.93C) and *A. obtusa* (Fig. 1.93D) are formed due to the complete webbing where a single vein enters the decurrent base and forms repeated dichotomies.



3. Stem Anatomy of Archaeopteris:

- ❑ Several logs of Archaeopteris (Callixylon) were discovered from the Upper Devonian strata which were up to 10 m long and about 1.5 m in diameter. Archaeopteris possesses a eustele with a ring of mesarch primary bundles surrounding a pith (Fig. 1.94A). The primary bundles are surrounded by thick-walled, compactly arranged secondary xylem (pycnoxylic wood), composed of radially arranged tracheids and narrow rays.
- ❑ In a few specimens, the wood shows growth rings. The wood rays are generally narrow, but may be broader in the region of the pith. The rays are variable in height, comprising of ray tracheids and ray parenchyma. The secondary tracheids have circular bordered pits arranged on the radial walls in groups (6-20) and are multiseriate in most species.
- ❑ These groups of pits are arranged horizontally and are separated by unpitted tracheid walls (Fig. 1.94B). The crassulae are often present in the tracheids and those are formed as a result of the separation of wall layers in the tracheids.

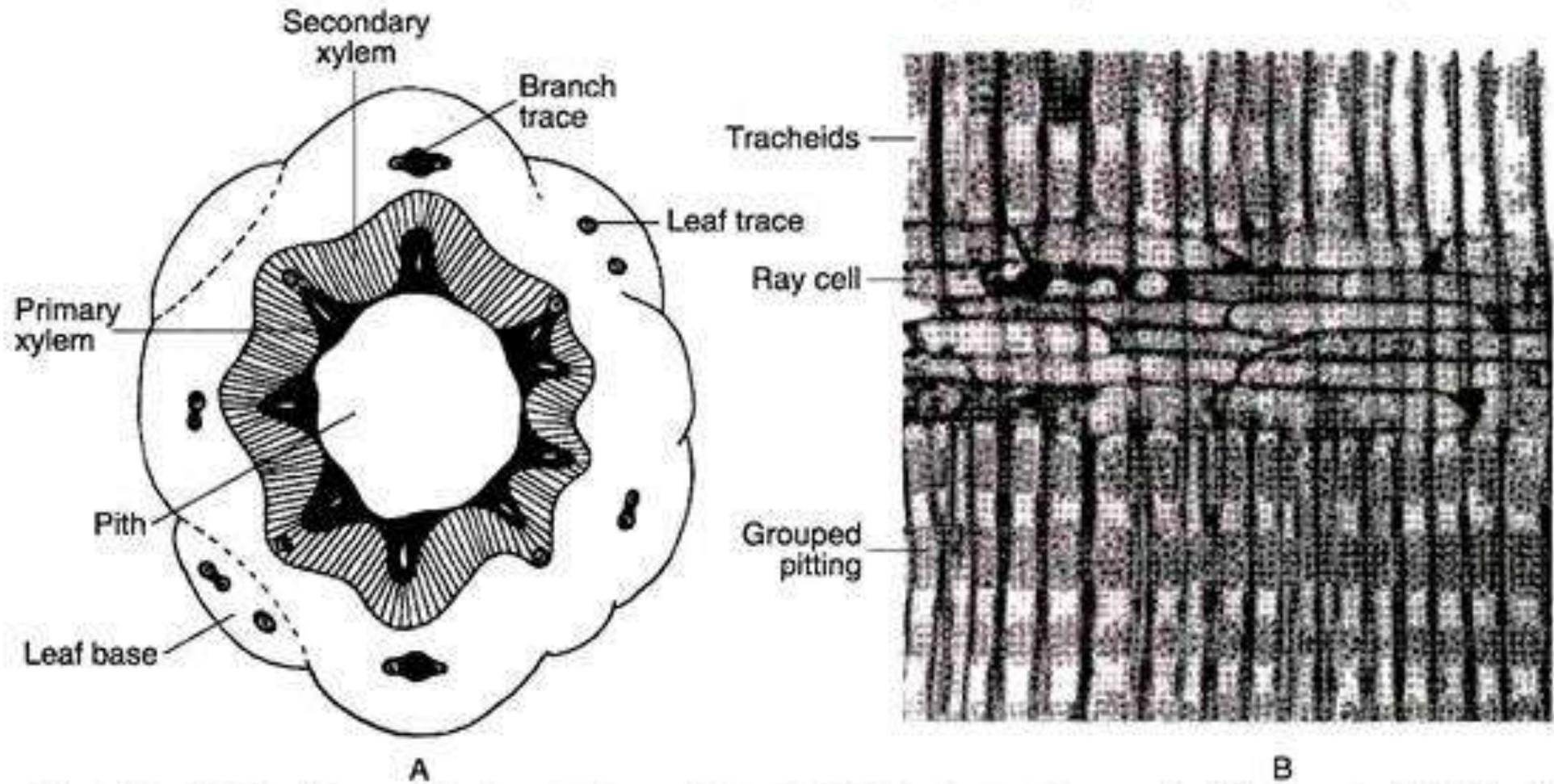
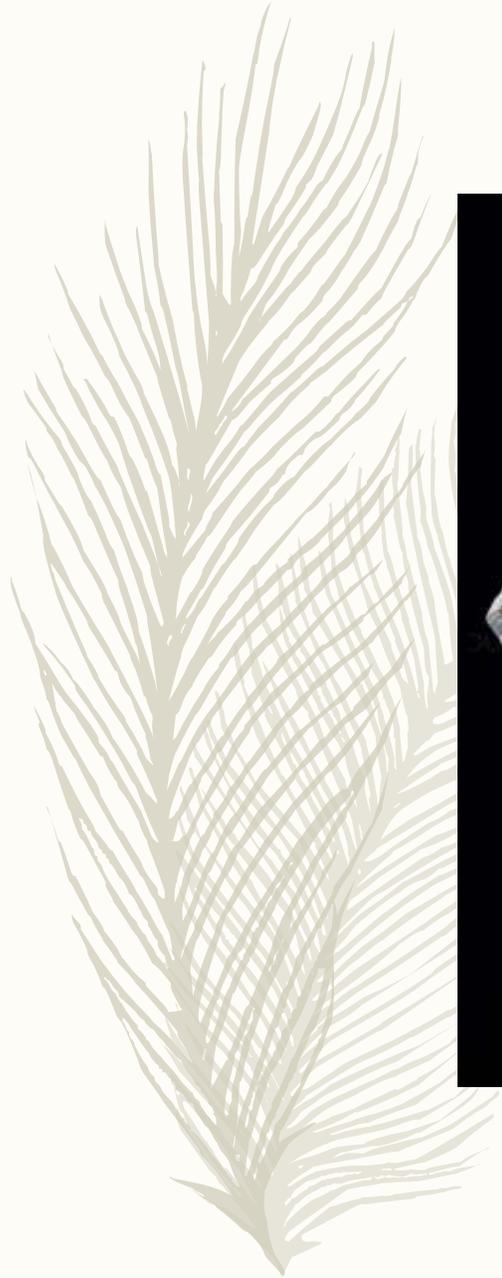


Fig. 1.94 : A. T.S. of shoot of *Archaeopteris macilenta*, B. R.L.S. of secondary wood of *Archaeopteris* (*Callixylon*)



THANK YOU ALL

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