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## *Calamites*: Habit, Sub-Genera and Structure

### Habit

The name *Catamites* was first proposed by Suckow 1784 and later in 1828, Brongniart established its relationship with Equisetum. *Catamites* was a tall tree that attained a height of about 33 ft (10 m). The plant had a stout underground rhizome with a number of aerial shoots.

The rhizome differentiated into nodes and internodes and had a whorl of adventitious roots at the nodes.Aerial shoots arose from the upper surface of the rhizome. At a certain distance these aerial shoots also produced adventitious roots indicating that some portion of these aerial shoots grew under the soil surface.

Aerial shoots showed prominent nodes and internodes and had whorls of branches at each node.

### Sub-Genera of Calamites:

The pattern of branching was variable. Thus, five sub-genera of Catamites have been recognised, based on their branching pattern.

**These include:**

**(i) Mesocalmites** :Plants are arborescent and some of the primary vascular strands alternate at the node, but most of the strands do not alternate at the node. There is sterile appendages that branch up to four times. These sterile appendages do not show sign of fusion at their bases and function as leaves.

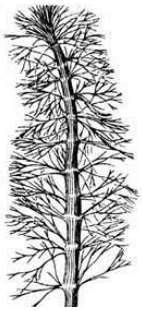

**Fig: Mesocalamite**

**ii) Stylocalamites**

Here the main aerial stem branches at the base giving rise to a few parallel erect branches that do not branch further.

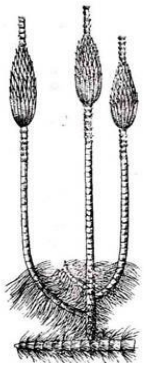

**Fig:Stylocalamites**

**(iii) Crucicalamites**

Here the main aerial stem remain unbranched for a short height and has branches at every node. Thus, the axes form a bushy tree, and their lateral branches with their leaves look like giant bottle brushes.

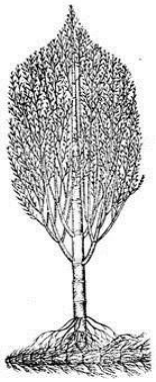

**Fig: Crucicalamites**

**(iv) Diplocalamites:**

There is a main trunk that bears pair of branches at each node in an opposite decussate arrangement

**(v) Calamitina**

Here the branching is regular, but the whorl of branches does not occur at every node, rather, are present only at certain node.

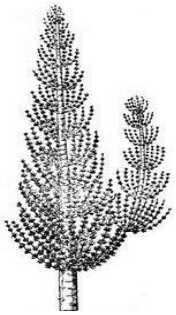

**Fig: Calamitina**

**Structure of Calamites*:***

**1. Stem:**

The stem form-genus is called *Catamites* which was initially applied to fragments of pith costs. The surface of the stem had longitudinal ridges and furrows like *Equisetum*.

The erect shoots suddenly narrow down and become constricted at the point of their attachment to the rhizome . The stele also narrows down at the point of their junction to the rhizome. The stem anatomy of Calamites shows an epidermis, cortex and an endarch siphonostele .

The young stem shows differentiation of cortical tissue: an outer sclerotic zone and an inner thin-walled parenchymatous zone. There is a prominent delicate pith at the centre of the stem which disorganises in mature shoots to form a central pith cavity at the internodes. The vascular bundles are conjoint collateral and open.

The metaxylem tracheids show scalariform thickening. The protoxylem undergoes annular and spiral thickening which disintegrates to form carinal canals as in Equisetum.

Secondary growth takes place by the activity of a cambium which produces abundant secondary xylem (wood) . There is no annual ring formation, thus suggesting the absence of seasonal variations. Unlike Equisetum, the vallecular canals are absent in Calamites. Like Lepidodendron, Calamites also show epidogenesis and apoxogenesis type of development.

The extrastelar secondary growth takes place by the activity of cortical meristem producing thick periderm.

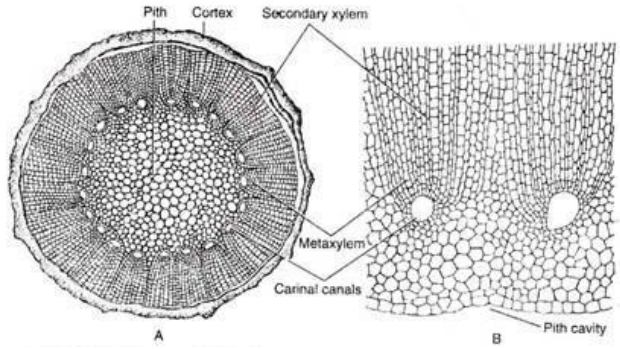


**Fig: Calamites A) T.S of young stem B) T.S of mature stem**

**2. Roots:**

The adventitious roots of Calamites are referred as Astromyelon. Internally, there is parenchymatous pith. The primary stele comprises of a ring of exarch bundles. The important internal feature of root is the absence of carinal canal. In rare instances, cortical lacuna is present which reminds the vallecular canal of Equisetum. Secondary growth has also been reported in Astromyelon.

**3. Leaves:**

The detached leaves of Calamites belong to the form-genera Annularia and Asterophyllites. These leaves are whorled in arrangement and mostly found on the smallest twigs. The Annularia leaves are disposed in an oblique plane to the branch which form stellate patterns at each node

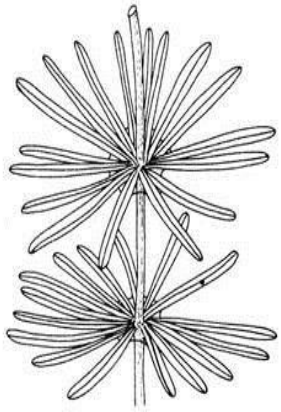

**Fig: Annularia**

The Asterophyllites leaves are attached in a plane right angle to the branch. Annularia leaves are linear, fused at the base to form an inconspicuous collar. Both the leaf types are microphyllous and provided with an unbranched mid-vein.

Anatomically, the leaves are rectangular to five-sided consisting of a concentric vascular bundle with a central xylem surrounded by a layer of phloem . A conspicuous bundle sheath encircles the entire vein. The mesophyll cells made up of palisade parenchyma are present in between the vein sheath and the epidermis. Stomata are arranged parallel to the long axis and are scattered all over the surfaces.

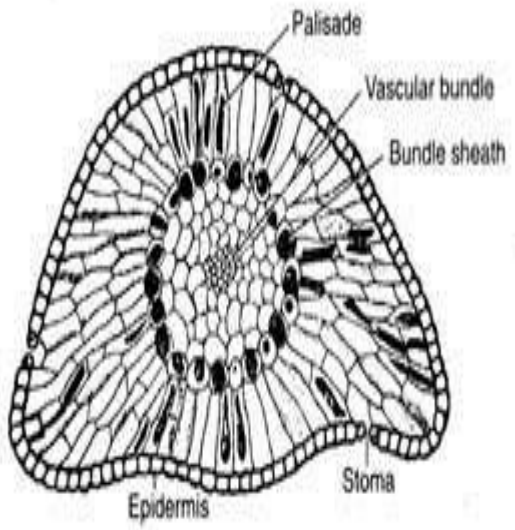


**Fig: Asterophyllites**

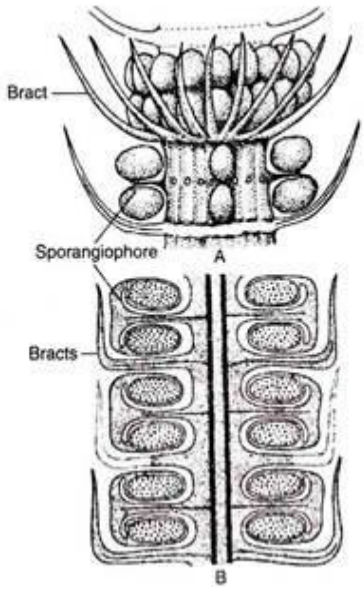


**Fig:Calamostachys A) 3-dimensional view of a part of strobilus B) L.S of strobilus**

**4. Cones:**

The cone of Calamites has a central axis bearing alternating whorls of peltate sporangiophores and sterile appendages called bracts.

**There are a number of different forms of cones in Calamites which may be distinguished on the basis of two important features:**

(i) the position of sporangiophore attachment, and

(ii) the number of sporangia per sporangiophore.

**These include:**

**a. Calamostachys**

Here verticels of sporangiophores are attached at right angles midway between successive verticels of sterile bracts. This Lower Carboniferous cone type is supposed to be an ancestral form which gave rise to the other Upper Carboniferous forms. Each peltate sporangiophore bore four sporangia which faces the cone axis.

The number of sporangiophore and bracts per whorl also varies depending upon the species. Generally 6-18 sporangiophore per whorl and 10-45 bracts are borne. The bracts of a whorl are usually laterally fused at the base forming expanded discs with free tips. Calamostachys binneyana is a homosporous member bearing isospores with three circinate coiled elaters

**b. Palaeostachya**

This cone-type is more or less similar to Calamostachys and is characterised by the arrangement of its sporangiophores in the axils of bracts at an angle of 45°. In addition, the sporangiophore trace arose from the node ascended at an oblique angle and then descended to enter the axillary sporangiophore.

The general ratio of bracts to sporangiophores is about 2:1. Palaeostachya andrewsii is a heterosporous member bearing microspores (56-110 µm in diameter) with elaters- and megaspores (235-345 µm in diameter) devoid of elaters.

**c. Mazostachys**

Here sporangiophores are borne in a whorl just below the vertical of bracts. The ratio of bracts to sporangiophores is 2 : 1, where a whorl of 12 bracts subtended by a whorl of 6 sprangiophores. The sporangiophores bear two pendant sporangia. The sporagiophore trace arose directly from the node before bending outward into the sporangiophore.

**d. Cingularia**

In general, it resembles Mazostachys. Here both the whorls of bracts and sporangiophores are fused and develop horizontally. The sporangiophores are flat and bifurcate at their tips bearing four pendant sporangia.

**e. Calamocarpon**

It is the most highly evolved cone among Calamites. In general organisation, Calamocarpon resembles Calamostachys. The bracts to sporangiophores ratio is 1 : 1. There are variable numbers of bracts per whorl.

Each sporangiophore bears four sporangia. Calamocarpon shows true heterospory. The megasporangium contains a single functional megaspore surrounded by sterile tissue and epidermis which were shed from the cone as a unit.