Topic: Stelar Organization
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Stelar Organization

Sach's (1875) formed an idea that the vascular system of the plant body is a continuous system. The idea was introduced with a greater emphasis by Van Tiegham and Douliot (1886) interpreted the plant body of vascular plant in the different way.

According to them, the fundamental parts of a shoot are the cortex and a central cylinder, is known as stele. Thus the stele is defined as a central vascular cylinder, with or without pith and delimited the cortex by endodermis.

The term stele has been derived from a Greek word meaning pillar. Van Tiegham and Douliot (1886) recognized only three types of steles. They also thought that the monostelic shoot were rare in comparison of polystelic shoots.

It is an established fact that all shoots are monostelic and polystelic condition rarely occurs. The stele of the stem remains connected with that of leaf by a vascular connection known as the leaf supply.

Types of Steles

1. Protostele

Jeffrey (1898), for the first time pointed out the stelar theory from the point of view of the phylogeny. According to him, the primitive type of stele is protostele. In protostele, the vascular

tissue is a solid mass and the central core of the xylem is completely surrounded by the strand of phloem. This is the most primitive and simplest type of stele.

There are several forms of protostele-

(a) Haplostele

This is the most primitive type of protostele. Here the central solid smooth core of xylem remains surrounded by phloem (e.g., in Selaginella spp.).

(b) Actinostele

This is the modification of the haplostele and somewhat more advanced in having the central xylem core with radiating ribs (e.g., in Psilotum spp.).

(c) Plectostele

This is the most advanced type of protostele. Here the central core of xylem is divided into number of plates arranged parallel to each other. The phloem alternates the xylem (e.g., in Lycopodium).

(d) Mixed-pith stele

Here the xylem elements (i.e., tracheids) are mixed with the parenchymatous cells of the pith. This type is found in primitive fossils and living ferns. They are treated to be the transitional types in between true protosteles on the one hand and siphonosteles on the other (e.g., in Gleichenia spp. and Osmunda spp.).

2. Siphonostele

This is the modification of protostele. A stele in which the protostele is medullated is known as siphonostele. Such stele contains a tubular vascular region and a parenchymatous central region. Jeffrey (1898) interpreted that the vascular portion of siphonostele possesses a parenchymatous area known as a gap immediately above the branch traces only or immediately above leaf and branch traces.

On the basis of these branch and leaf gaps Jeffrey (1910), distinguished two types of siphonosteles. In one type, however, the leaf gaps are not found and they are known as

cladosiphonic siphonosteles. In the other type both leaf and branch gaps are present and they are known as phyllosiphonic siphonosteles.

Jeffrey (1902, 1910, and 1917) interpreted the evolution of the siphonostele from the protostele as follows. He supported that the parenchyma found internal to the phloem and xylem has been originated from the cortex.

The supporters of this theory believe that the inner endodermis found to the inner face of the vascular tissue and the parenchyma encircled by this endodermis have been originated from the cortex. According to Jeffrey and other supporters of this theory the siphonosteles with internal endodermis are more primitive than those without an internal endodermis.

The siphonosteles which do not possess the inner endodermis are believed to have been originated by disintegration of inner endodermis during evolution.

According to the theory proposed by Boodle (1901), and Gwynne Vaughan, the siphonostele has been evolved from the protostele by a transformation of the inner vascular tissue into parenchyma.

Siphonostele may be of the following types-

(a) Ectophloic

In this type of siphonostele, the pith is surrounded by concentric xylem cylinder and next to xylem the concentric phloem cylinder.

(b) Amphiphloic

In this type of siphonostele the pith is surrounded by the vascular tissue. The concentric inner phloem cylinaer surrounds the central pith. Next to the inner phloem is the concentric xylem cylinder which is immediately surrounded by outer phloem cylinder (e.g., in Marsilea).

3. Solenostele

The vascular plants have been divided into two groups on the basis of the presence or absence of the leaf gaps. These groups are— Pteropsida and Lycopsida. The ferns, gymnosperms

and angtosperms are included in Pteropsida, whereas the lycopods, horse-tails, etc., are included in Lycopsida.

The simplest form of siphonostele has no gaps, such as some species of Selaginella. However, among the simplest siphonostelic Pteropsida and siphonostelic Lycopsida, the successive leaf gaps in the stele do not overlap each other and are considerably apart from each other.

According to Brebner (1902), Gwynne-Vaughan (1901) such siphonosteles which lack overlapping of gaps are known as solenosteles. They may be ectophloic or amphiphloic. Some authors (Bower, 1947; Wardlaw, 1952; Esau, 1953) however, interpret the solenostele as an amphiphloic siphonostele.

4. Dictyostele

In the more advanced siphonosteles of Pteropsida, the successive gaps may overlap each other. Brebner (1902) called the siphonosteles with overlapping gaps as dictyosteles. In such cases the intervening portion of the vascular tissue between lateral to such leaf gaps is known as meristele. Each meristele is of protostelic type. The dictyostele with many meristeles looks like a cylindrical meshwork.

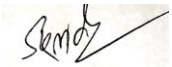
5. Polycylic Stele

This type of stelar organization is the most complex one amongst all vascular cryptogams (pteridophytes). Such types of steles are siphonostelic in structure. Each such stele possesses an internal vascular system connected with an outer siphonostele. Such connections are always found at the node.

A typical polycyclic stele possesses two or more concentric rings of vascular tissue. This may be a solenostele or a dictyostele. Two concentric rings of vascular tissue are found in Pteridium aquilinum and three in Matonia pectinata.

6. Eustele

According to Brebner (1902), there is one more modification of the siphonostele known as eustele. Here the vascular system consists of a ring of collateral or bicollateral vascular



bundles situated on the periphery of the pith. In such steles, the inter-fascicular areas and the leaf gaps are not distinguished from each other very clearly. The example of this type is Equisetum.

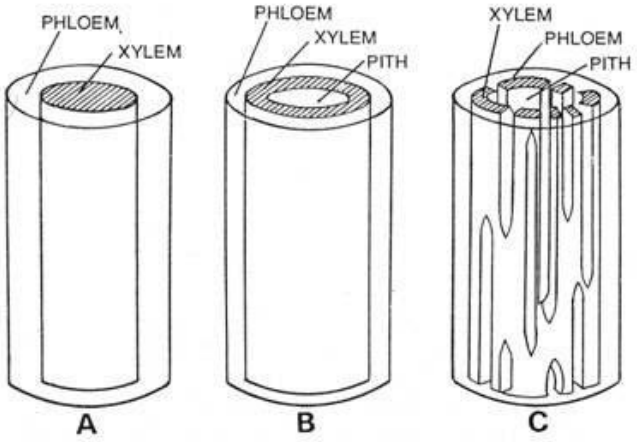


Fig. Types of arrangements of vascular tissues in steles. A, protostele; B, siphonostele; C, dictyostele.

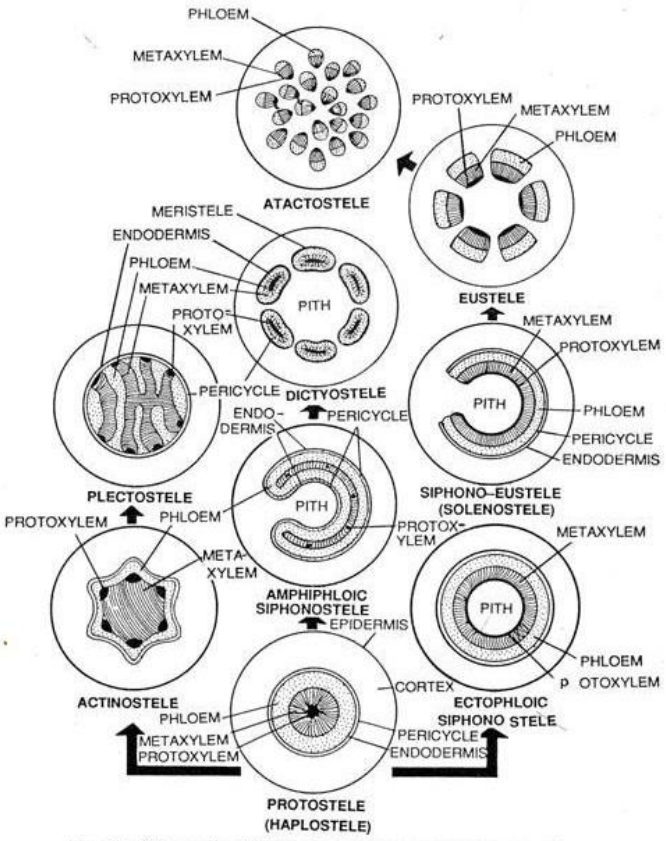


Fig. The stelar system. Different types of steles arranged in evoluntionary sequence.

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