Types of Stele in Plants

Protostele
(Stele without Pith)

1. **Haplostele**
   Smooth central xylem.
   Xylem surrounded by phloem
   Eg. *Rhynia, Lygodium*
2. **Actinostele**
   Star shaped xylem
   Phloem between star arms
   Eg. *Lycopodium serratum*
3. **Plectostele**
   Xylem as plates
   Phloem between xylem plates
   Eg. *Lycopodium clavatum*
4. **Mixex protostele**
   Xylem as patches in phloem
   Eg. *Lycopodium sernuum*
5. **Mixed protostele with pith**
   With pith like parenchyma
   Eg. *Hymenophyllum*

Siphonostele
(Stele with Pith, no leaf gap)

1. **Cladosiphonic Siphonostele**
   Without leaf gap. Stele is a continuous ring
   Eg. *Selaginella*
2. **Ectophloic siphonostele**
   Phloem external to xylem
   Eg. *Osmunda*
   Equisetum.
3. **Amphiphloic siphonostele**
   Phloem both sides of xylem
   Eg. *Marsilea* rhizome
   Adiantum

Solenostele
(Stele with pith and leaf gap)
(Perforated Siphonostele)

1. **Ectophloic Solenostele** but leaf gap
   Phloem external to xylem
2. **Amphiphloic solenostele**
   Phloem both sides of xylem
   Eg. *Adiantum pedatum*
3. **Dictyostele** (solenostele with overlapping gaps)
   Many meristels
   Eg. *Pteris*, *Pteridium*, *Dryopteris*
4. **Polycyclic stele**
   Many concentric circles of VB. Inner stele is complete ring & the rest have leaf gaps.
   Eg. *Pteridium aquilinum*
5. **Eustele**
   VB arranged as a broken ring
   Eg. *Dicot Stem*
6. **Atactostele**
   Scattered arrangement of VB
   Eg. *Monocot Stem*

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Stelar System Evolution
(in Pteridophytes & Higher Plants)

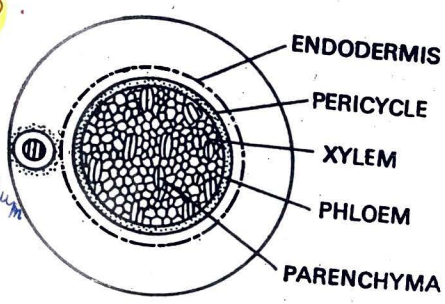
Stelar theory was proposed by Van Tieghem & Douliot in 1886.

Dictyostele

3. In cross section this stele shows the presence of separate strands (VB) called meristele.
→ Each meristele is concentric in str., consisting of a central strip of xylem surrounded by phloem.

PROTOSTELE

5.



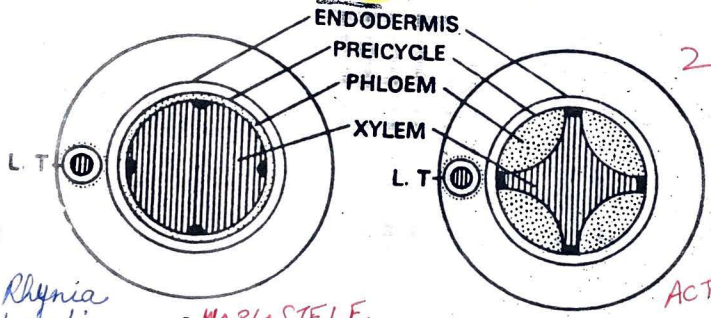
eg Hymenophyllum thin leafed ferns

MIXED PROTOSTELE WITH PITH

Fig. 32.4. Stelar system in ferns. Protostele with mixed pith.

1.

2.



Rhynia
Lygodium

A HAPLOSTELE

B

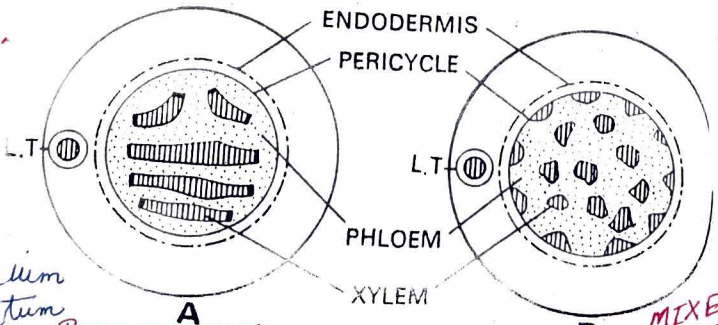
ACTINOSTELE

Lycopodium serratum

Fig. 32.2. Stelar system in ferns. A, haplostele; B, Actinostele.

3.

4



Lycopodium clavatum

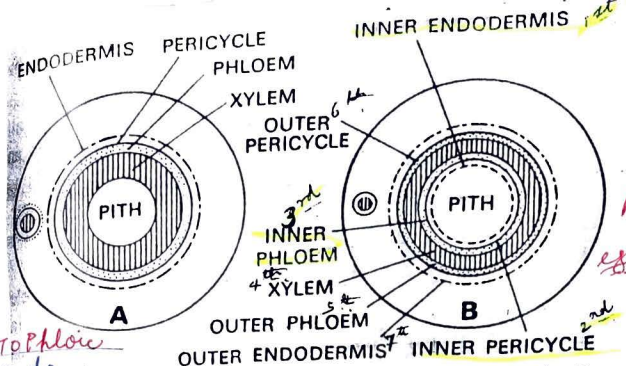
A PLECTOSTELE

B

MIXED PROTOSTELE

Lycopodium sernuum.

Fig. 32.3. Stelar system in ferns. A, plectostele; B, mixed



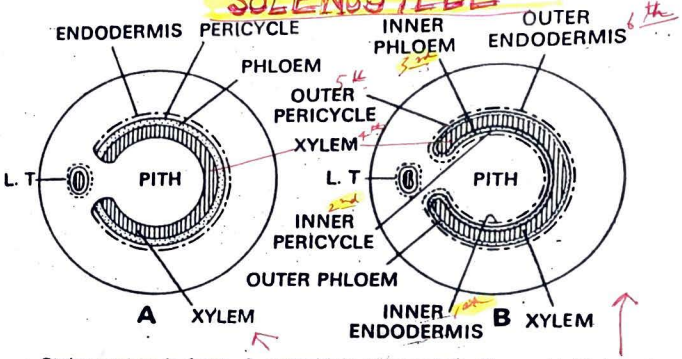
Cladosiphonic Stele
eg. Selaginella

Amphiphloic
eg. Marsilea rhizome

ECTOPhloic
eg. Osmunda

Fig. 32.5. Stelar system in ferns. A, ectophloic siphonostele; B, amphiphloic siphonostele.

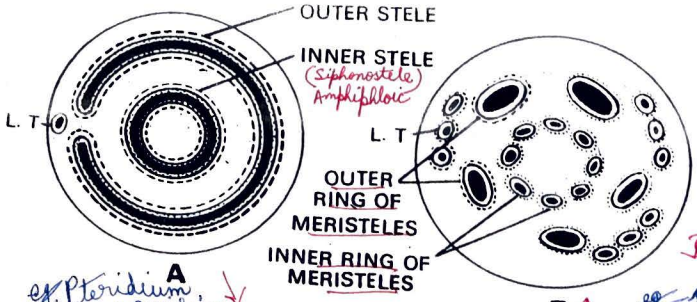
SOLENOSTELE



. Stelar system in ferns. A, ectophloic solenostele; B, amphiphloic solenostele.

Adiantum pedatum

Many Circles of Vascular Bundle



eg. Pteridium aquilinum

Polycyclic

eg. Pteridium aquilinum

Stelar system in ferns. A, polycyclic solenostele; B, polycyclic stele showing the meristeles

Amphiphloic Solenostele + Amphiphloic Siphonostele

All primitive plants are *protostelic*. *plostele*, *actinostele* and *plectostele* conditions are progressively seen in all the groups Pteridophytes. *Siphonostele*, *solenostele* and *dictyostele* are seen in the more advanced forms. *Polystelic* structures are also seen in a few cases. In some ferns the lower parts are *protostelic*, then *solenostelic* and finally *dictyostelic* and sometimes even *polystelic*. *Branch traces* and *leaf traces* with consequent *gaps* are seen in the advanced Pteridophytes.

Zimmermann's concept of the evolution of the stelar structure is shown in Figure 663.

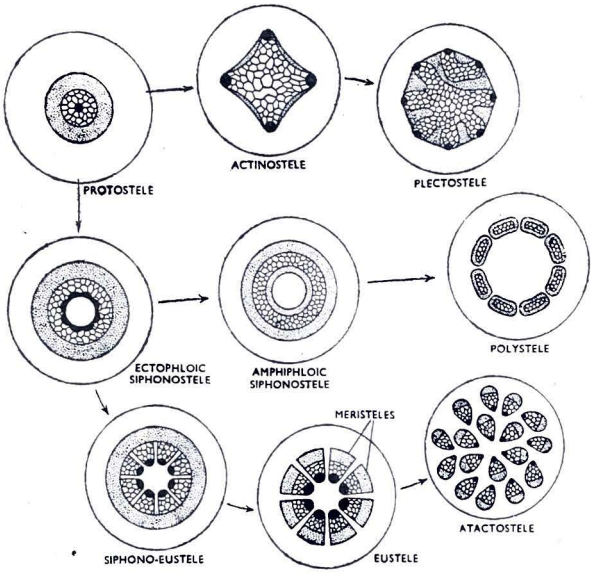
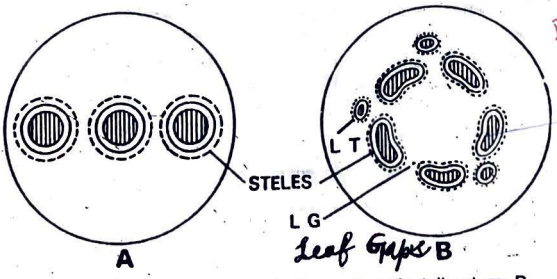


Fig. 3
actinc



Dictyostele

Meristeles
many Vascular Strands
Separated by leaf Gaps

Leaf Gaps

Fig. 32.7. Stelar system in ferns. A, polystelic stem; B,

eg Pteris