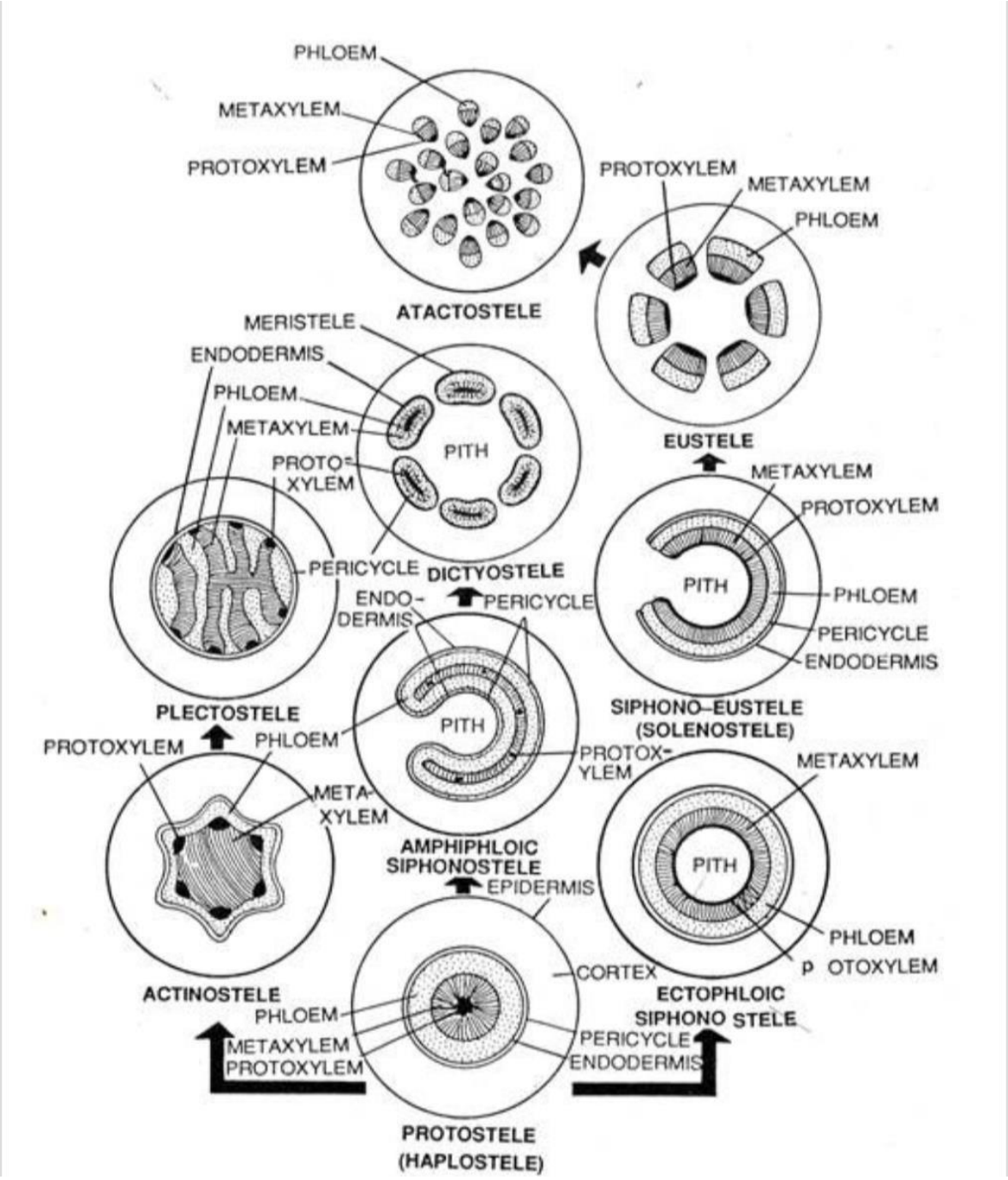
Evolution of Stele

In a vascular plant, the **stele** is the central part of the root or stem containing the tissues derived from the procambium. These include vascular tissue, in some cases ground tissue (pith) and a pericycle, which, if present, defines the outermost boundary of the stele. Outside the stele lies the endodermis, which is the innermost cell layer of the cortex.

The well known genus *Rhynia* represents the simplest kind of vascular plant. It is rootless, leafless and the axis is dichotomously branched.



Haplostele is regarded as most primitive among protostele. Actinostele is somewhat more advanced kind of stele, e.g. extinct *Asteroxylon*, extant *Lycopodium serratum*

etc. Plectostele is most advanced kind of stele in protostele, e.g. *Lycopodium clavatum*. It is thought that the line of evolution among protostele proceeds from haplostele to actinostele and then to plectostele.

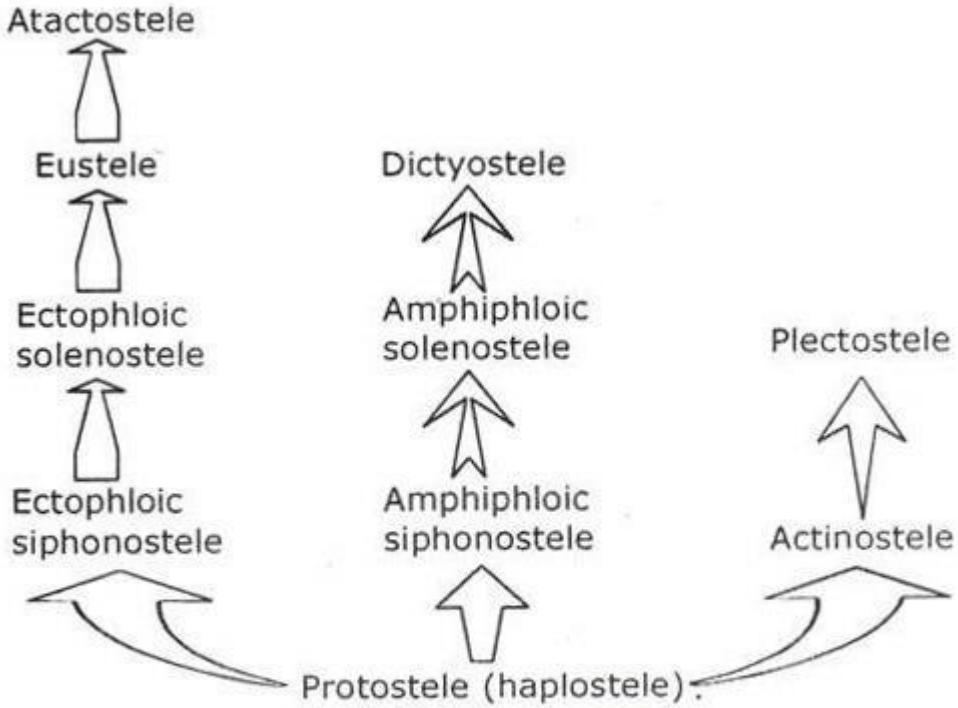


Figure 15.4

Diagram depicting the possible lines of stelar evolution.

Pith remains surrounded by xylem that in turn is surrounded by phloem on the

peripheral side (ectophloic siphonostele) only or on both outside and inside (amphiphloic siphonostele). Such steles are referred to as siphonostele. Ectophloic siphonostele, in its primitive form, has a continuous cylinder of vascular tissues.

In the course of evolutionary specialization non-overlapping leaf gap arises and this results in the formation of siphonoeustele (also termed as ectophloic solenostele). Overlapping leaf gaps dissect the stele and thus eustele originates. In course of evolution atactostele arises where there is no definite arrangement of vascular bundles.

Siphono-eustele, eustele and atactostele have collateral vascular bundles. The evolutionary specialization proceeds from ectophloic siphonostele to siphonoeustele and then to eustele. This line of evolutionary sequence is exhibited in seed plants.

Amphiphloic siphonostele, in its primitive form, is in the form of a continuous cylinder. Non-overlapping leaf gap appears in course of evolution and dissects the vascular cylinder to form solenostele (also termed amphiphloic solenostele).

Ultimately overlapping leaf gaps appear and a dictyostele results. This line of evolutionary specialization proceeds from amphiphloic siphonostele to amphiphloic solenostele and then to dictyostele. This line of evolutionary sequence is exhibited in cryptogams.

Evolution of Stele is explained by following two theories--

i. Expansion Theory:

Proponents of this theory believe that pith has originated from stelar tissues. During differentiation of xylem certain living cells at the center never modified into non-living xylem. In protostele the solid central core of xylem mainly consists of tracheids. The

siphonostele (of pteridophyta) possesses parenchyma cells at the centre that is pith, surrounded by tracheids.

In the transitional forms some amount of parenchyma remains mingled with tracheids- termed mixed pith. So the evolution occurred in the following way: stele without pith-stele with mixed pithstele with pith (siphonostele).

It appears that during transition from protostele to siphonostele, some of the initials of tracheids are transformed to the initials of parenchyma that formed pith. This view also finds support due the presence of isolated tracheids in the pith of *Botrychinm lunaria* and *Osmunda regalis*.

ii. Invasion Theory:

According to this view pith is regarded as extrastelar in origin. Jeffrey who proposed the invasion theory, is of opinion that the cortical parenchyma cells invaded the central core of xylem of protostele where

they established as pith. According to Jeffrey the invasion occurred through the leaf-and branch gaps.

The rest of the areas of xylem strand become indented. Thus the margin of xylem mass becomes undulated and this results in the formation of actinostele. This stage is exampled by *Aneurophyton* . During evolutionary specialization the protruding areas of actinostele become isolated. As a result a stele is formed that consists of interconnected vascular strands.Parenchyma surrounds the vascular strands. This parenchyma is cortical parenchyma and it extends between the regions of vascular strands.