

Laboratory 13 - Leptosporangiate Ferns: Vegetative Morphology

I. Organography

Observe living specimens of the following genera:

Adiantum capillis-veneris
Asplenium nidus
Azolla sp.
Davallia sp.
Lygodium sp.
Marsilea vestita
Nephrolepis exaltata
Platycerium bifurcatum
Polypodium sp.
Salvinia sp.

and herbarium sheets as available. For each of the above, observe the organography of the plant as a whole, locating the rhizome, frond, stipe, rachis. For each determine whether the frond is once pinnate, twice pinnate or pinnatifid. Notice the degree of morphological variability present in basic plant organization in these Filicalean (and heterosporous) representatives. In fact, only the angiosperms are a more morphologically diverse group among land plants. To what extent is the morphological expression of these plants indicative of their habitat? Are ferns restricted to moist areas?

II. Stellar Anatomy

Nowhere else in the plant kingdom is there such a wealth of variability of the primary plant form than within the ferns, and this is reflected particularly well in the primary vasculature. As you examine the diversity of stelar types assembled today, be aware that stelar organization is a three-dimensional task, and that this is a very difficult task to study from simple cross sectional views.

Protostelic Organization

Examine the following prepared microscope slides in order:

Gleichenia - rhizome
Lygodium - rhizome X-section
Trichomanes - rhizome (Hymenophyllaceae)

Notice that each of the above genera express a protostelic organization of the vascular tissue. In *Lygodium* the vascular tissues alone seem to occupy the center of the stem, but in *Trichomanes*, some parenchyma seems to be present. In *Gleichenia*, the presence of parenchyma within the xylem is better expressed, and is an excellent example of the so-called vitalized or medullated protostele. Notice the large number of cells which have not matured into tracheids and remain as parenchyma. To what extent does this stelar arrangement support the "transformation" or "stelar" origin of the pith? Consult the phylogenetic chart of the ferns in Gifford and Foster (Fig. 13-46) and determine whether these protostelic genera are primitive or advanced members of the Filicales.

Ectophloic Siphonostele

Obtain slides of the relatively primitive Filicalean genus *Osmunda* which show an ectophloic siphonostele which has a large number of leaf gaps making this almost a eustele. Locate the xylem,

phloem, and leaf gaps. Notice that the phloem seems to occupy the leaf gap position causing the vascular tissue to appear as a group of amphicribal bundles.

Amphiphloic Siphonostele

An amphiphloic siphonostele is a vascular cylinder surrounding a pith in which the cylinder of xylem is surrounded both to the outside and to inside by separate cylinders of phloem. Obtain prepared slides of *Adiantum* sp. and *Dicksonia* sp. Notice in both of these genera, the leaf gaps do not overlap so the cylindrical nature of the stele is obvious. Locate the xylem, phloem, and pith. Where is the leaf gap? Obtain a prepared slide of transverse sections of the genus *Matonia* showing a fantastic complex solenostele with concentric amphiphloic cylinders. Where does the leaf trace appear? Is the leaf trace also complex? To what extent is the so-called "polystelic" organization of the vasculature in *Matonia* a misnomer?

Dissected Solenostele (Dictyostele)

A dictyostele is a solenostele (amphiphloic siphonostele) which has been seemingly broken up into separate amphicribal bundles. Also, there is a separate type of dictyostele known as a dissected dictyostele which is characterized by having additional gaps not associated with the divergence of leaf traces and also by usually having two traces associated with a single gap. It is very difficult to discern a simple dictyostele from a dissected dictyostele in cross section. Most ferns are characterized by the possession of some type of dictyostele. Obtain prepared slides of the following:

Polypodium
Pteris
Woodwardia

Notice that *Polypodium* and *Woodwardia* have their dictyostelic elements (dissected in both) arranged in a ring around the outside of the stem circumference. In these vascular segments, locate the areas of xylem and phloem. The genus *Pteris* shows a vascular organization which represents a great level of sophistication in the Filicales. In *Pteris* the dictyostele is now dissected to the point in which discrete *meristeles* may be located, each with its own endodermis. Locate each meristele and note differences in the organization of each meristele. Notice that the entire stele is no longer radially arranged as in *Polypodium*, but has taken on a dorsiventral aspect.

III. Roots

Observe the roots of *Pteris* as an example of the organization of the filicalean root. Locate the epidermis, cortex, and stele. To what extent is the complexity of the rhizome expressed in the structure of the root? Examine living material and determine where the roots arise and how they originate. How extensive is xylem development in roots. Is the maturation of the xylem endarch or exarch? Endarch, mesarch, or exarch in the rhizome?

IV. Venation

Make a cursory examination of the vascular system of the leaves or pinnae of some of the herbarium sheets observed in the first section. To what extent is the dichotomous venation pattern expressed in the photosynthetic organs of ferns? Obtain a prepared microscope slide showing clearings of pinnae with open dichotomous venation patterns.