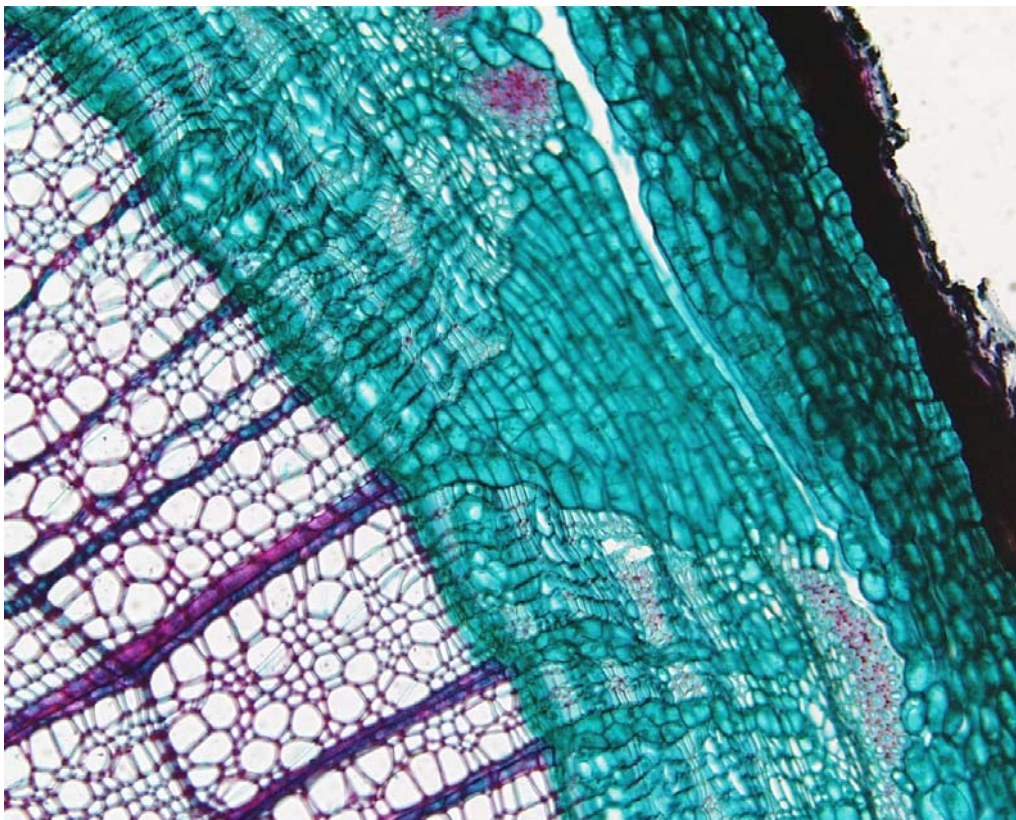


Plant Anatomy Lab 9 – Secondary Growth II

This exercise will consider the secondary tissues produced and appearing on the outer side of the vascular cambium - secondary phloem and the periderm layers. For the secondary phloem, we will look at cells making up the axial and radial systems. Rays do not generally extend (or cannot be traced) into the periderm.

Sectioning and Staining: The toluidine blue stain will be useful for highlighting the cell secondary walls and differentiating the xylem and phloem tissues. The lignified walls of the xylem will appear blue-green but parenchyma cells will appear purple. Cells in the phloem that are heavily sclerified like phloem fibers will be stained more like the xylem cells having thick secondary walls.

Most of the cells in the phloem are thin-walled. This means that in order to see very well, your sections must be very thin and cleanly cut. Use a very sharp blade. Do not use your best blade for the cutting through the whole woody stems. Do not let the blade edge contact glass or the table surface. We are only looking at the outer stem so the sections do not have to include the entire stem.



Liriodendron (tulip poplar) stem section showing ray dilatation in the secondary phloem.

Fresh Material Sections

Quercus (live oak)

Prepare a transverse section of a one-year-old stem. The entire stem is not needed, just tissues of the outer stem and slightly into the xylem.

Note the uniseriate xylem rays extending into the phloem. The radial orientation of these cells should be apparent.

Identify the phloem sieve tube members and the phloem parenchyma.

Notice how the phloem fibers are arranged both in clusters and in bands.

Morus (mulberry)

Prepare a transverse section of a stem as above.

Observe the rays (and their width). The occurrence of starch grains in these cells identifies them as parenchyma. The rays in older parts of the phloem become wavy - Think about why this might be? The appearance of collapsed phloem sieve elements should help.

The differential staining described above should help you to identify the bands of sclerenchyma (phloem fibers).

For the next two observations, an unstained section might be useful:

Note the phloem parenchyma cells with large crystals inside.

Observe the periderm layers in the outer stem. The phellogen cells and phellum cells they produced are wide in the direction parallel to the surface, but very narrow in the radial direction.

Populus (cottonwood)

Prepare a transverse section of a stem as above.

The uniseriate rays of the xylem only extend a modest distance into the phloem.

Locate the fibers in the phloem - some occur in bundles, while a band of younger fibers may have also formed. You should be able to tell which are older by their position with respect to the cambium.

Also observe the periderm and identify its tissues. See the atlas in front of the lab for help with these tissue layers.

Sycamore

Prepare a transverse section of a stem as above.

Observe the wide xylem rays and note how they widen further in the phloem. These proliferations seem to divide the phloem sieve elements into clusters.

Find examples of how the fibers that are forming clusters seem to develop from parenchyma cells next to the rays.

What are the phloem parenchyma cells loaded with?

Prepared Slides

Pinus (pine, one-year-old stem)

Find the phloem tissues. Are there fibers in the phloem?

What has happened to the sieve cells with regard to the presence or absence of fibers?

Also observe the location and appearance of older, crushed sieve cells.

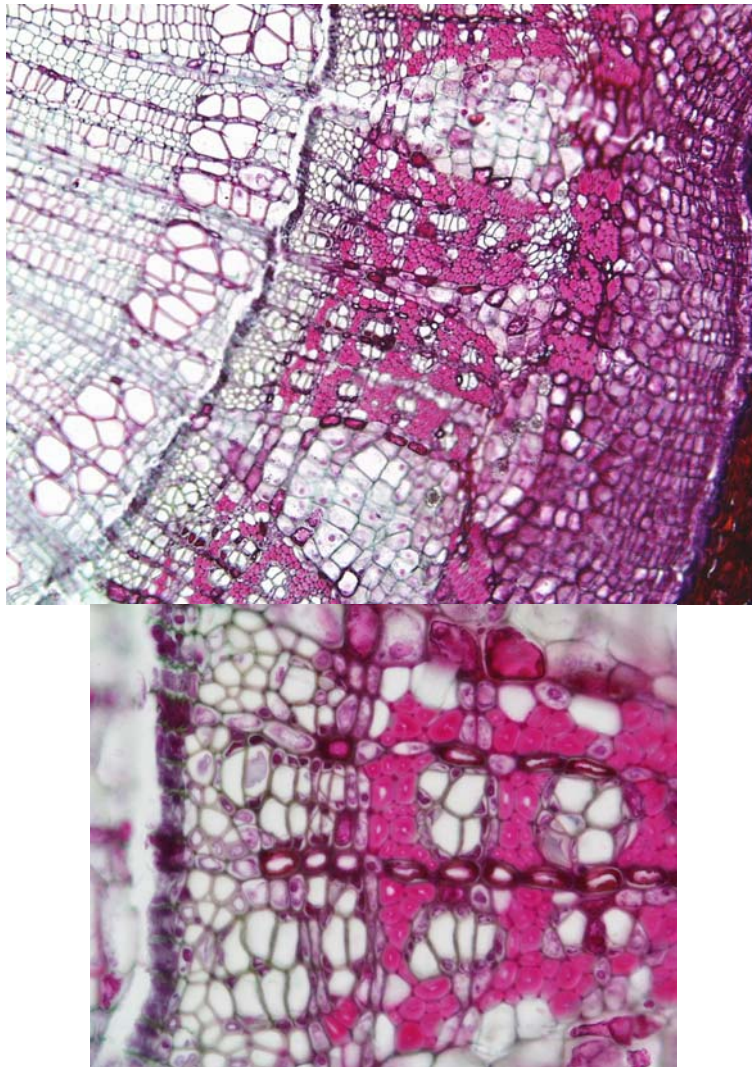
Tilia (basswood)

Look at the proliferation of rays from the xylem into the phloem (ray dilatation). The xylem has both uniseriate and multiseriate rays. Which ones undergo the massive dilatation in the phloem?

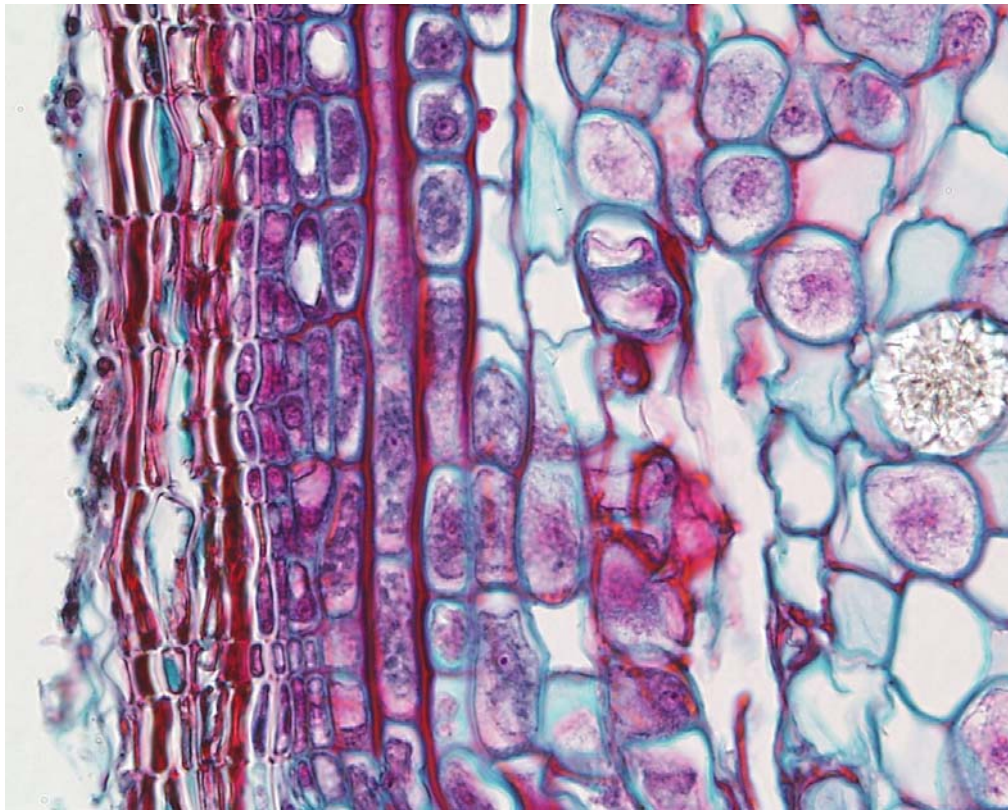
Observed crush sieve tube members in the older phloem. Identify the companion cells with their nuclei.

Observe the bands of fibers in the phloem. How many bands are there *versus* the number of xylem rings? Can you determine the age of this stem by phloem fiber production?

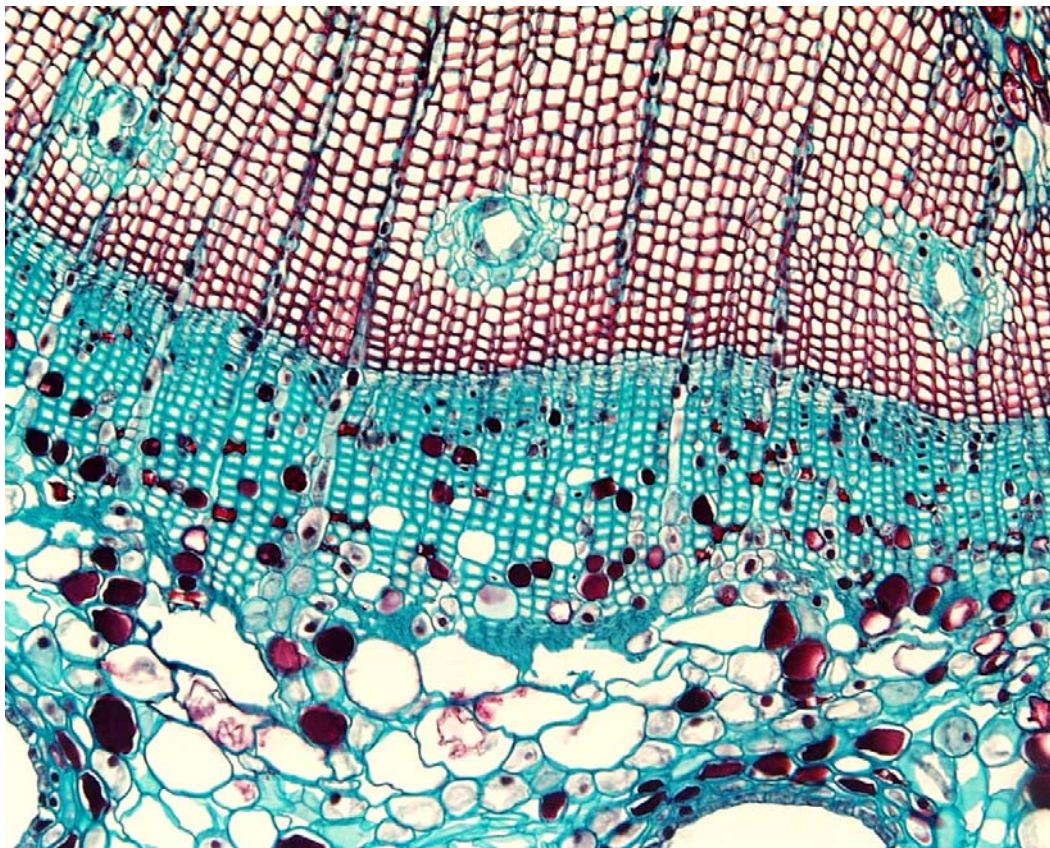
Find the three periderm tissues.



Tilia stem transverse sections.



Tilia stem section showing periderm layer formation



Pine stem transverse section showing secondary xylem and phloem. Regions of crushed older phloem are also visible.