FOR-126

University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

PART 4

IDENTIFYING WOOD—*A Primer for Everyone*

Grain Patterns and Growth Rings

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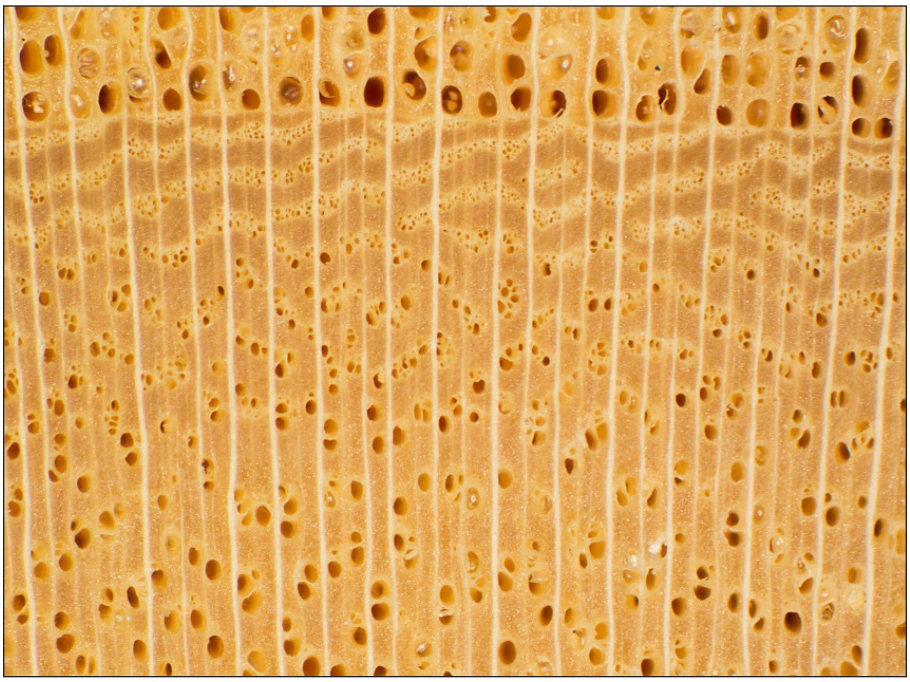

The preceding article, "Identifying Wood–A Primer for Everyone, Part 3: Distinguishing Softwoods from Hardwoods" (FOR-125), described how to distinguish softwoods from hardwoods, and that's the first step in identifying an unknown piece of wood. At this point, additional terminology is necessary to further distinguish between species, and I'll begin by talking about the different sides of a hypothetical piece of wood. Frequently you need to be able to observe wood cells from a particular perspective, and you will need to know where to look for different features on your sample. It's also very helpful to develop a kind of "visual vocabulary" that will let you match a term with a corresponding mental image, and the information in this chapter will start you on your way.

Directional Planes

A road map is two-dimensional representation of part of the earth, and compass bearings on that map point north, east, west, and south at 90-degree intervals; we use headings such as these to give directions, and they're sufficient because we don't normally need directions involving depth or height relative to the surface. In describing wood, however, we need to be able to direct people's attention to surfaces in three dimensions. Do you remember the soda straw-as-fiber analogy? A soda straw would look completely different end-on compared to a side view, and only from the side could we determine whether or not the manufacturer put colored stripes down the length of the straw. The situation in wood is similar; looking at the ends of fibers can only tell us so much, and looking at the sides of the wood cells can give us more information.

Wood anatomists can't look at just any side of the cell we're examining, because sometimes a diagnostic feature is only able to be seen from a certain perspective. Unlike soda straws, wood cells have different structures on different sides, and we need to be able to look at two mutually perpendicular side views in addition to the cross-section to extract all the available information from the sample. By long-standing convention, three standard mutually perpendicular (orthogonal) planes have been defined for this purpose, and these planes are called:

- The **cross-section**, also known as the **transverse plane**, cut perpendicular to the longitudinal (fiber) axis
- The **radial plane**
- The **tangential plane**

These two-dimensional surfaces are sometimes referred to by the shorthand notation of **x**, **r**, and **t**, respectively.

The names of these planes are easy to remember if you think in terms of geometry. Radii extend from the center of a circle to its perimeter, and there is an infinite number of possible radii in a circle. In logs, radial planes extend from the pith at the center of the log towards the bark. Like the radii in a circle, there can be an infinite number of radial planes that could be opened in a log. Similarly, a tangent to a circle is perpendicular to a radius; this means that there can be an infinite number of tangential planes in a piece of wood—not just around the surface of a log, but also extending into its depth.

The directional counterparts to the cross-section, radial plane and tangential plane are called the **transverse direction** (as in "cut the wood in the transverse direction" or "cut a transverse section," which means cut a cross-section), the **radial direction** and the **tangential direction**. The **longitudinal direction** refers to the tree's axis.) Refer to Figures 4-1 and 4-2.

Grain Patterns on Different Planes

Logs are sometimes sawn to show particular grain patterns. For example, boards can be sawn to show off the ribbon-like figure resulting from look-

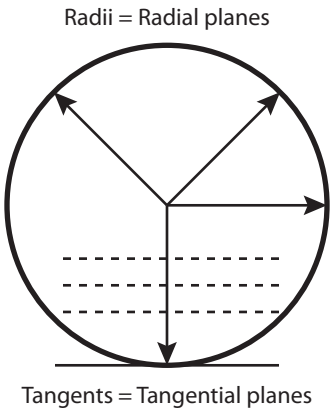

Figure 4-1. There are an infinite number of possible radial and tangential planes in a wood cross-section (transverse plane).

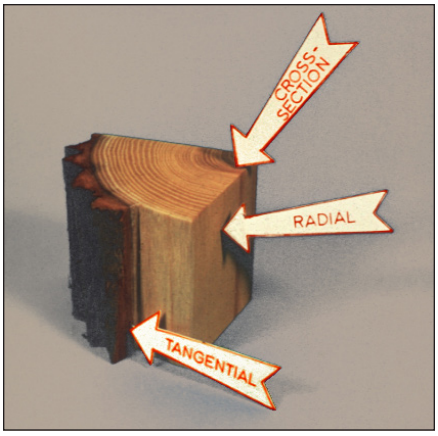

Figure 4-2. The cross-section, radial, and tangential planes in wood.

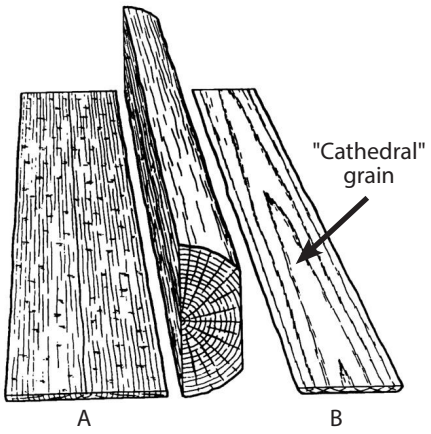

Figure 4-3. Quartersawn board (A) and flatsawn board (B). Source: U.S. Department of Agriculture, *The Wood Handbook*.

ing at the sides of the rays (on the radial face); these boards are called **quartersawn** boards. Boards cut to expose a tangential plane are called **flatsawn** or **plainsawn** boards. Because successive year's growth accumulates like a series of tapered cones, flatsawn boards sawn parallel to the main axis of the tree show "**cathedral grain**" with arched patterns from the contrast between the earlywood and latewood cells in the growth rings. You'll often find cathedral grain on wooden doors or paneling made from rotary-peeled veneer. (To make rotary-peeled veneer, a log is pushed against a sharp knife and peeled, much like unrolling a roll of paper towels. All of the wood grain on these veneer surfaces has a tangential face.) Quartersawn boards take more time for the sawyer to saw (and therefore they're more expensive). In some species the rays are tall enough to show a prominent ribbon-like effect, commonly called "**ray fleck**," and boards or veneer with ray fleck are frequently used for decorative effect.

Take a look at Figure 4-3, from the USDA Wood Handbook,[1] then look at the photographs of red oak in Figure 4-4.

Growth Rings Look Different on Different Faces

Growth increments don't look like rings on the radial and tangential surfaces, but they can still be distinguished on these side grain surfaces. Figure 4-5 shows three views of one of the southern pines (*Pinus* sp.); a cross-section (x), a radial section (r) and a tangential section (t) are shown side-by-side. The earlywood shows up much lighter than the latewood here, and you can even see the darker brown latewood on the side grain images (r, t). Notice the cathedral grain looking like peaks in the tangential section. In contrast, the growth rings on the radial surface look like parallel lines following the longitudinal axis. The darker wood surrounding the center of the tree in the cross-section is the heartwood.

Some people get confused when they first start looking at all three planes of a piece of wood; they look at the radial plane and sometimes think they are looking at the cross-section. It's an understandable mistake; the distinct earlywood and latewood on a radial face can

Figure 4-3. Red oak (*Quercus rubra*) (left) tangential face showing the cathedral grain on the tangential face formed by the large earlywood pores. The rays in oak are large enough to see easily, and they look somewhat like horizontal ribbons on the radial (quartersawn) face of the piece of white oak (Quercus alba) on the right. These ribbon-like patterns are referred to as ray fleck.

1 2011. Wood Handbook: Wood as an engineering material. USDA Forest Products Laboratory General Technical Report FPL-GTR-190, reprinted by the Forest Products Society, Madison, Wisconsin.

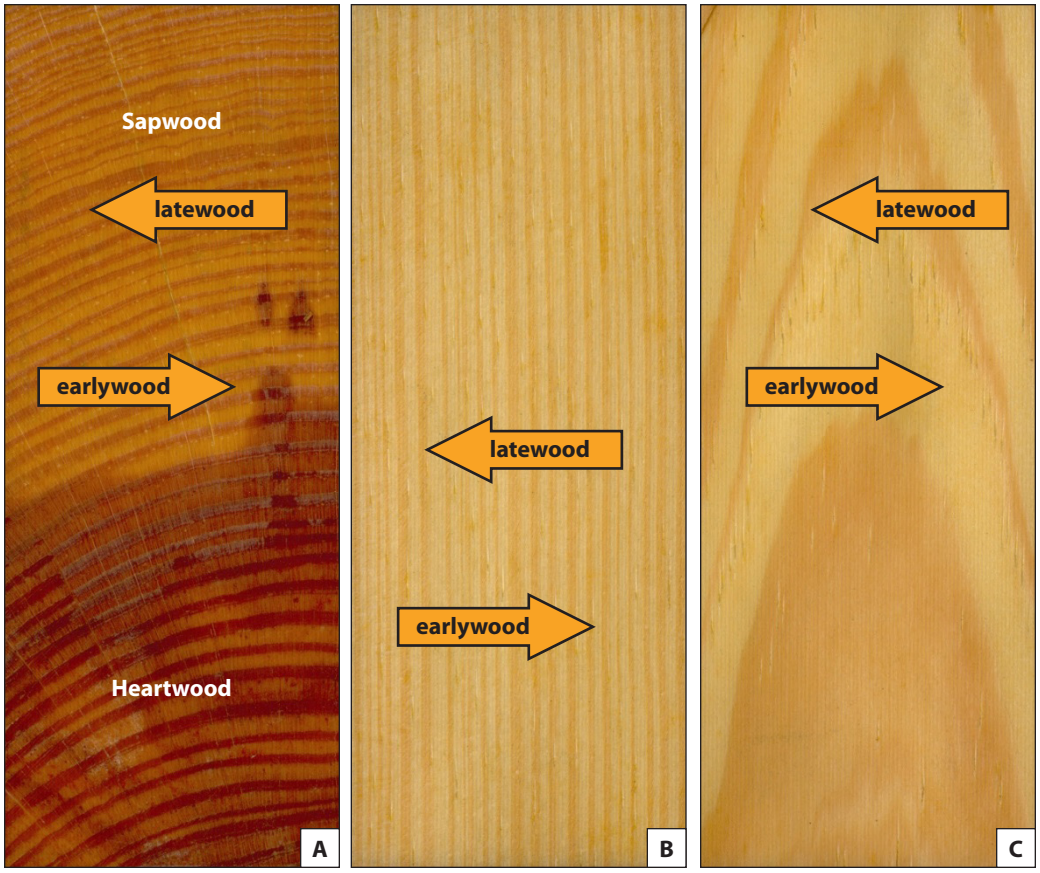

Figure 4-5. One of the southern pines (*Pinus* sp.). **A:** Cross-section (x); **B:** Radial section (r); **C:** Tangential section (t). When looking at the growth rings, the earlywood is light-colored wood and the latewood is dark-colored wood in this species. Heartwood (the darker wood surrounding the center of the tree, at the bottom of the photograph) is visible on the cross-section. Based on the light color, it appears as though both the radial and the tangential sections were cut from the sapwood region in the tree. Source: American Woods.[1]

1 Hough, Romeyn Beck. 1888-1910. The American woods : exhibited by actual specimens and with copious explanatory text. Published by the author, Lowville, NY.

resemble a cross-section. Nonetheless, if you look carefully you'll notice that the "growth rings" aren't curved on the radial face—they're much straighter, so that should clue you in. Also, remember to look for the rays; rays run perpendicular to the growth rings, and for many species they're pretty narrow on the cross-section. If you see rays on a radial face they will appear more like a ribbon.

Summary

Wood anatomists refer to three mutually perpendicular reference planes when they examine a piece of wood: the cross-section, the radial section, and the tangential section. The growth rings are intersected at different angles by these three planes, so they will look different depending on the plane being examined. Cathedral grain and ray fleck are two different features whose appearance can be affected by the way the wood is sawn.

Vocabulary

If you don't remember what any of the following words mean, please review this section.

1. Cross-section (x)
2. Radial section (r)
3. Tangential section (t)
4. Transverse direction
5. Radial direction
6. Tangential direction
7. Longitudinal direction
8. Cathedral grain
9. Ray fleck
10. *Pinus* spp. (southern pine)
11. *Quercus rubra* (red oak)
12. *Quercus alba* (white oak)

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