Spiral Grain—The Inside Story

By Robert W. Chambers

Spiral grain is a natural condition of most of the trees that we use for our log homes—it is not “special” or “unusual.” As one scientist has written, “perhaps the most significant characteristic of spiral grain is its nearly universal occurrence.”(1)

Wait a second, we have all seen straight-grain trees. Or *have we?* We all want straight-grain trees…or *should we?* The answer is coming up, and it might surprise you.

Lefthand and Righthand

The surface of a peeled tree can reveal its grain slope and grain direction. If the tree has started to dry, the checks almost always indicate grain slope and direction. Put your right hand on the log, with your forearm parallel to the length of the tree—if the checks follow your fingers it is a righthand spiral; if they follow your thumb then it’s a lefty. Hermann Phleps’ book is the first place I saw this in writing (though in 1983 I’d heard about it from my teacher, Lloyd Beckedorf).

When surface grain goes the direction of the fingers of your right hand, it is righthand grain.

If a tree has not started to check, then a spiral grain “scribe” indicator can help—which is just a small, sharp needle on a free-swiveling arm. It is tough determining spiral when the bark is still on. There can be clues—location of branches; the hollow pits above and below a branch; striations in the bark itself. I have seen Japanese buyers cruising standing trees for temple logs—and they seem to know something about spotting spiral that I don’t. I’d like to know what it is! But, then, it might be 1) tough to train the loggers to see the difference, and 2) get them to sell all the lefties to other customers!

To determine spiral direction you can be at the top end of the log, the butt end, or even in the middle. It is not true that you can only use the ‘right hand test’ if you are standing at the butt end. But really, once you learn to see right spiral and left spiral, you’ll almost never use the hand test. RH and LH are as obvious to log builders as curveball and fastball are to seasoned catchers.

While we can tell spiral grain on a log’s surface, it is not possible to detect grain slope of interior layers of a tree. If you keep peeling off one layer (one year) of growth at a time, and test the grain direction of each layer, you can figure out what that tree was like—but you end up with a large pile of peelings…and no log.

Scientists are trying to develop reliable, non-destructive methods of finding grain slope and direction inside a whole log. But for log builders that may not be very important information to have. After all, we already know the important stuff: if a log is lefthand on its *surface*, then it is likely to cause problems in a scribe-fit wall.

What Is the Problem?

“Poles with severe left-hand spiral tended to be bad twisters. Poles with right-hand spiral usually were more stable, . . . The cause of this difference was found to be the internal grain structure. Poles with surface left-hand spiral contained left-spiraled grain from the center of the pole out to the surface. Poles with surface right-hand spiraled grain usually contained left-hand spiral grain near the pith and right-hand spiraled grain near the surface. The result was counteracting twist forces and little net twist,” of the pole. (4)

The problem is that a tree that has one direction of spiral grain all the way from its center to its outside surface will twist a lot as it dries. Righthand growth layers near the outside of the log help balance the twisting stresses of the lefthand (LH) growth layers that are inside virtually all logs. Lefthand trees are a problem because they do not have interior RH spiral to help keep their stresses balanced.

Virtually no trees start their lives righthand; and almost all trees start out lefthand. And this is why lefties are “bad” for some locations in log walls. I have seen LH logs lift tons of logs, and cause gaps in corner notches as the twist is translated up into higher rounds. Through-bolts, lags, and dowels cannot stop a lefty that wants to twist.

There is just one lefthand tree in this corner, but it is causing gaps in the two logs above it, too.

By the way, trees twist tighter as they dry, they do not “untwist.” If a tree has a 10-degree LH grain when it was green, it will have steeper than 10-degree LH grain when it is dry. Same goes for righthand trees, though they do not twist nearly as much.

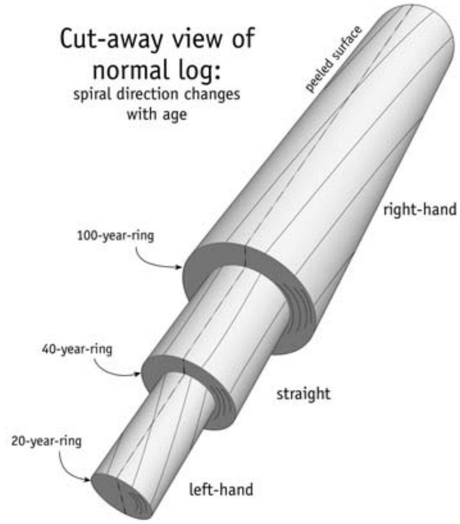
The earliest tests I have found comparing LH and RH spiral were in Montana in the 1950’s—government studies done for power pole companies. Linemen had reported that the cross arms on some poles were rotating over time, and pulling on the wires. The research setup was easy: 290 telephone poles, one end sunk into the ground, with a cross arm attached near the top, and left to dry in place for 5 years. The result? You guessed it—left-hand spiral poles twisted dramatically (40-foot poles twisted to the left up to 40-degrees); righties twisted not so much—40-foot poles twisted to the right less than 15-degrees (3, 4).

Looking *inside* the tree "explains the stability of the right-spiraled poles. Poles containing only left spiral [from center to surface] respond to moisture content changes [more] than poles containing both left-hand and right-spiraled grain." (4)

How Trees Grow

Almost all softwoods (pines, spruces, firs cedars, and the like) start out with left-hand twist. The first few years, called *juvenile* wood, is steeply LH. I have found no report of any softwood tree that starts out growing RH when it is young.

In one study, 93-percent of the trees changed the direction of their spiral as they got older. (5) As a tree gets older it may slowly switch its grain slope from left-hand to righthand, or it can stay lefthand (3). If it does switch, then at some time it will pass through a few years when it will have a straight-grained surface. If the tree is cut down and peeled at this stage, we would say it is straight-grained. But straight-grain is usually just a phase that a tree goes through.



And, if a tree is straight-grained on its peeled surface, then it has nearly a 100% chance that it is lefthand closer to its center. "No tree seems to be completely straight-grained throughout." (11) In a study of more than 1800 Douglas fir, "not one tree was found to contain all straight-grained samples." (5)

Those trees that change their spiral direction seem to make the change when they are between about 10 to 40 years old.

I have seen trees that were quite straight grained at their butt end, but had a lefthand spiral twist at the top end. How can one tree be both straight and left-hand? Easy: the butt end of a tree is older than the top end of the tree.

That shouldn't surprise us, if we think about it. Count the growth rings at the stump you might find 75. Count the growth rings at the top end-cut you might find 35. So, the butt is 40 years older than the top of the same tree. The butt has had time to get old enough to start the switch over to RH grain, while the top is still too young (35 years old) to have switched spiral direction.

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Strength . . and more

"It is . . . slope of grain that is truly the most important growth-related feature of a particular log that determines its overall strength and suitability for us," Ed Burke.

It's not just that LH trees tend to twist more over time—LH trees are also weaker and less stiff. One study found that only 4-degrees of grain slope (1:14) decreased bending strength (MOR) by about 20-percent (3), and ASTM D-3957 advises using a 25-percent strength reduction.

"Right spiral-grained poles are nearly as strong as straight-grained poles." (3) A lesson for log builders is to avoid using LH trees as beams like ridges, purlins, joists, and so on. One report decided that "a slope of grain greater than 1 in 12 (5-degrees) should not be permitted in beams." (6)

The ASTM standard for poles restricts the amount of spiral, but does not distinguish between lefthand and righthand. When the ASTM standard was written it was not known that RH trees were LH inside, and that LH trees were LH all the way through. ASTM D-3957 says that "the exact relationship between slope of grain and bending strength has not been determined for unsawn round timbers [logs]," but provides an estimate in which a log with 1:8 (7-degrees) spiral slope has about half of the bending strength (MOR) of straight-grained, clear samples.

Unfortunately, ASTM assumes that *all* spiral is LH (bad) spiral—which is, I think, a cop-out by engineers who may assume we can't tell left from right. The result is an unfortunate waste: many RH trees get downgraded without any good cause—6° RH trees get lumped together with 6° LH trees, even though all the research says it is lefties we need to be careful with.

The Modulus of Elasticity ("E" or MOE) which is a measure of how stiff a log will be—not how strong, but how much it will bend or deflect under a given load—is also lower for LH logs than for RH logs. LH trees will bend more than RH spiral trees under the same load.

LH trees also shrink more lengthwise than RH trees. Most wood does not shrink much in length—it can shrink quite a bit in diameter (as we all know), but not length. But LH spiral trees can shrink significantly in length.

The full log below the window sill log (third layer up from bottom) is lefthand, and so is the log post. Both are good places to use LH trees.

How to Use Spiral Trees

In Sweden, *very* small, young trees are harvested for making 2x4 studs—sometimes they only get two studs from one "tree." This means that LH spiral is severe— since all the wood is juvenile wood. An innovative way to produce straight studs from severe LH trees is to start out by *sawing* them in a spiral shape (7). The log is rotated as it is fed through a bandsaw so that the green studs have a severe twist. Then, as the studs dry, they come back towards straight. The idea is that if every stud could be sawn so that the ripping cuts followed the grain slope, then the stud would not have any cross-grain face—it would be a straight-grained stud! Very clever.

For log building, LH trees can be used as posts, and low in log walls. Moderate-spiral RH trees can be used anywhere in a log wall except the top round. Go to the ILBA *Log Building Standards*, Section 2.A for more guidance.

Coriolis?

I have read news articles and internet postings about wind pushing on branches, about northern and southern hemispheres, about Coriolis effect (the earth is turning all the time, after all, and, as Neil Young sings, "it's a wonder tall trees ain't laying down"), about the slope of the hill and which way the slope faces, about how fast or slow the tree grows, and so on. And I know there are old loggers who "know" why trees spiral.

But *all* the science I have read agrees: spiral grain is overwhelmingly genetic. The seeds and cones from righthand trees tend to produce righthand young'ns. It is not surprising that most of the trees on a north slope somewhere have about the same spiral grain—they're closely related…I guess cones don't fall far from the tree.

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