Wild in the Woods

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Rings of Knowledge: Dendrochronology

by Fred X. Turck,
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Methuselah's Secrets

Trees are extraordinary plants! They can grow from a seed weighing only fractions of an ounce to a structure hundreds of feet tall, weighing tons and living to be centuries old. Earth's oldest living inhabitant, "Methuselah," is 4,764 years old and has lived more than a millennium longer than any other tree. This pine tree (*Pinus aristata*), commonly known as a bristlecone pine, grows in the White Mountains of eastern California at about 10,000 feet in elevation. Only one other type of tree, the limber pine, grows in this ancient forest because of its highly alkaline soil. Few other plants survive in these conditions. Other species also have a very impressive "life line," such as the Giant sequoia (3,300 years old), the coast redwood (2,200 years old), and the bald cypress (1,622 years old).

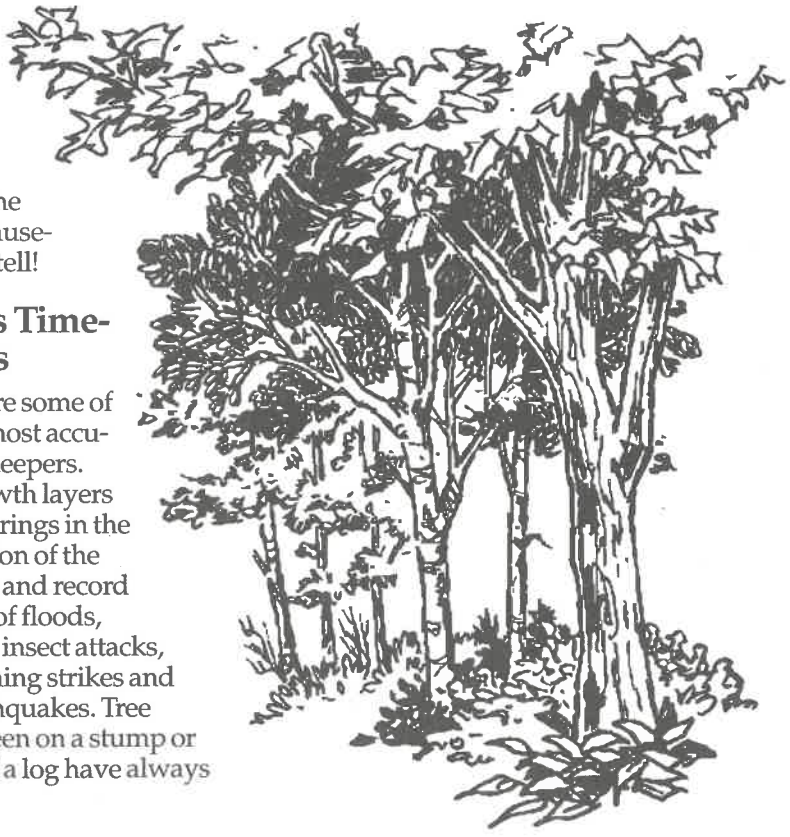
Methuselah is not a tall or stately appearing tree: it is only 30 feet or so tall. The harsh environment has sculpted it into its stubby, twisted shape. The tree is made up of up to 90 percent dead wood; a thin vein of living tissue surrounds and protects this dead wood.

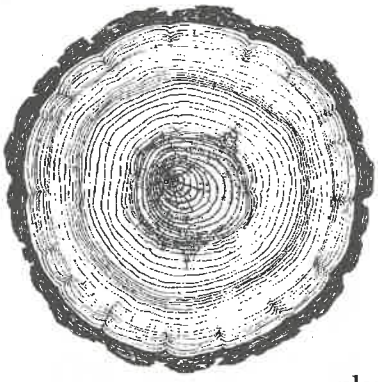
Dendrochronology is the study of tree rings and what they tell of past history. *Dendro* is a word element meaning "tree," and *chronology* signifies "time." Imagine the tales Methuselah could tell!

Trees as Timekeepers

Trees are some of nature's most accurate timekeepers. Their growth layers appear as rings in the cross section of the tree trunk and record evidence of floods, droughts, insect attacks, fire, lightning strikes and even earthquakes. Tree rings as seen on a stump or the end of a log have always intrigued man, and are studied by foresters as indicators of growth.

Using tree rings to age wood samples, called *crossdating*, is a very important technique of dendrochronologists. Crossdating is the match-





Making Tree Cookies

[excerpted from an article by Joe Mackenzie in the Spring 1998 issue of *Branch*, the national newsletter of Project Learning Tree.]

Tree Selection

Pine trees are my favorite for tree cookies. The annual rings are easily distinguished, the wood is soft and easy to cut and sand, and the supply is usually plentiful. The trees to cut need to be about the diameter of an aluminum soda can at the base of the tree and between two to four inches in diameter. To keep your tree cookies from all looking the same, look for trees with a variety of growth patterns growing on varied sites—suppressed trees growing slowly as well as rapidly growing trees.

Tree Harvesting

Once selected I use a large tooth pruning saw (available at hardware stores) to cut the tree at the base and trim off the branches. Then cut the main tree stem into segments three or four feet in length (up to about a two inch top) and transport them back to work on. A vital step in the tree cookie recipes is to dry the wood.

After three or four days in a sawmill kiln, the poles should be sufficiently dry and feel much lighter. If you don't have access to such a kiln, just go to the slicing step and worry about drying later.

Tree Cookie Slicing

The next step is to take the poles and slice them into cookies. This means sawing the wood into cookie segments between 1–2 inches thick. This is best accomplished by a motor driven saw such as a radial arm saw. However, the same pruning saw that was suggested to harvest the tree may be used to slice as well.

Tree Cookie Drying

If the wood was not dried in a kiln as previously described, it is necessary to let the wood dry now. This may be done by storing the cut cookies on a dry, well ventilated surface under low humidity for three to 10 days. Take care to turn them over periodically to allow both sides to dry. Placing them on a driveway on a sunny day also works well. If you need faster results, it is possible to very carefully and slowly dry them in an oven set on "warm." Place the cookies on a cookie sheet (of course) or foil and allow to slowly dry for three to five hours, turning cookies over occasionally.

Tree Cookie Sanding

The initial sanding should be done with coarse paper and then a second one with medium paper. Place the sandpaper on a flat surface and sand your cookies until you can count the annual rings easily. Suggestion: this is a dusty job; if possible do it outside under the shade of …a tree.

Tree Cookie Finishing

Now your tree cookies need some kind of finish coating to stand up to the rigors of life in a classroom. You may want to keep some cookies uncoated in order to allow students to smell the wood. For those that are going to be coated, use clear polyurethane. The polyurethane may be brushed, dipped, or sprayed, and the more the better. □

For more information about Project Learning Tree, check out their web page at <www.plt.org>, or contact Glenda Parrish at 804/741-0836

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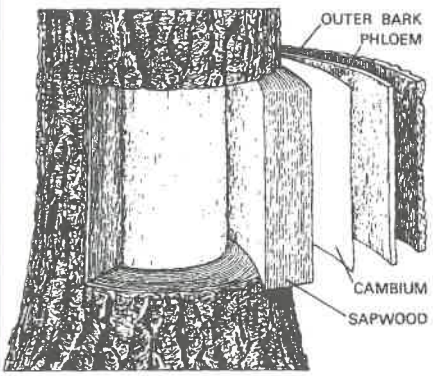
ing of patterns in tree-ring width between a known tree and another tree from the same geographic area. This technique is used to age wood samples, such as the timbers in an old ship, or the rafters in an old dwelling. In this way, living trees can be used to bridge the gap between the modern period and the prehistoric period by overlapping the tree-ring patterns between successively older and older pieces of wood. This method is helpful to archaeologists when they try to date wooden structures on historic sites.

This is a fascinating branch of natural history, and perhaps 1,000 scientists worldwide are now reading stories that reside in living trees or in ancient timbers found at archaeological sites. Dendrochronologists specialize in many fields, such as: dendro**archaeology** (the study of dating when a tree was felled, processed, and used for construction); dendro**ecology** (the study of ecological problems such as air pollution, forest dynamics, and insect outbreaks); and dendro**climatology** (the use of tree rings to reconstruct past climate and better understand the present).

How do You "Look" Inside a Tree?

An *increment borer* is the primary sampling tool used to take a tree ring sample. The borer has two parts: a hollow metal shaft with a threaded cutting bit that is screwed into the tree, and a thin metal probe that can be pulled out from the



shaft. The probe helps remove a small diameter or "core" of wood on which you can see the annual growth rings of the tree in miniature. Tree damage to the living tissue is minimal, as the small hole quickly fills with resin and completely heals in time. Using a borer is a quick method that foresters use to determine tree age without cutting a tree down to look at its rings.

How Rings are Formed as a Tree Grows

When you look at a cross-section of a tree (that is, when you cut a tree down and look at the stump or at a "slice" of the tree, called a "cookie"), you will see a distinct pattern of rings. Some rings may be close together; others may be far apart. Each ring is a layer of wood produced during the tree's growing season.

The growing (living) parts of a tree are the *cambium* (kam-bee-uhm), root tips, and branch tips. The cambium provides growth **width**, which is how the tree gets larger in diameter over time. The branch tips provide growth in **height** above the ground and serve to make a tree taller and taller. Root tips grow below ground and extend the roots into a large **root ball**.

In the spring, when moisture is plentiful, the tree devotes its energy to producing new growth cells. The cambium, one-cell-thick layer between the old wood and the bark, begins dividing at a tremendous pace. New tissue is created on the inside and the outside of the cambium, adding to the diameter of the tree. These first new cells are large; but as the summer progresses, their size decreases until, in the fall, growth stops, with no new growth until the next spring.

The cells produced on the outside of the cambium become part of the *phloem* (flow-uhm). The job of the phloem is to carry food produced in the leaves **down** to the branches, trunk and roots. Some of the phloem dies each year and becomes part of the outer (dead) bark.

Creature Feature: Yellow-bellied Sapsucker

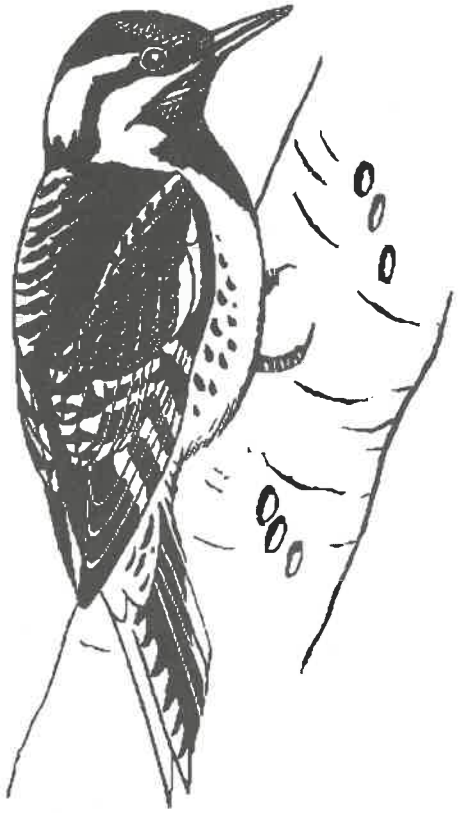
The yellow-bellied sapsucker, like other members of the woodpecker family to which it belongs, is an important *cavity-nester* because it digs out holes in trees to make its nest. The cavities they leave behind provide homes for numerous other species of birds, mammals, reptiles, and insects. A sapsucker has several unique adaptations for life on the tree trunk: four toes—two in front and two in back—for clinging to the bark; *rictal bristles* at the tips of its tail feathers for propping itself up; and a long tongue that retracts into muscle sheaths which coil around the skull.

Sapsuckers are classified as *neotropical migrants*, which means that they move seasonally from a summer breeding area to a winter feeding area. Here in Virginia, the yellow-bellied sapsucker is considered a common to uncommon transient and winter resident statewide. It breeds between mid-May and mid-September, laying four to seven eggs between April and June, usually in trees with heartrot. Their nest entrance, drilled between 10 to 45 feet up the trunk, is about 1 ¼ to 1 ½ inches in diameter. The cavity itself averages about 14 inches deep.

When the sapsucker is not busy nest-building, it spends its time drilling other, much smaller holes in trees to get at the soft inner bark to feed from. Sapsucker holes are only about ¼ inch in diameter and may be round, squarish, or vertical. You may have seen these during a walk in the woods: the holes are arranged in orderly rows encircling the trunks of trees. The bird returns to the tree some time later and uses its long, brush-tipped tongue to lap up the sap flowing from the holes.

The tree sap, in turn, attracts insects; and during the breeding season the sapsucker feeds a mixture of this sap and insects to its young. A sapsucker's diet is almost evenly split between flying insects and plant material: in addition to sap, the birds feed on ants, wasps, hornets, mayflies, grubs, the moths of tent capterpillars, and other bark and tree insects as well as small fruits and berries.

Hang some suet out this fall and winter and see if you can attract this fascinating bird. Look for a white wing patch, a black and white striped back, a buffy belly and a red forehead.



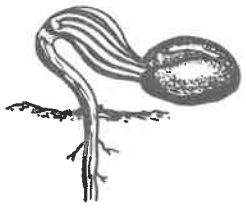
Most cells generated by the cambium collect on the inside of the cambium as *xylem* (zye-lem). Xylem cells account for most of the diameter growth in a tree each year. Xylem transports water and nutrients from the roots **up** to the leaves.

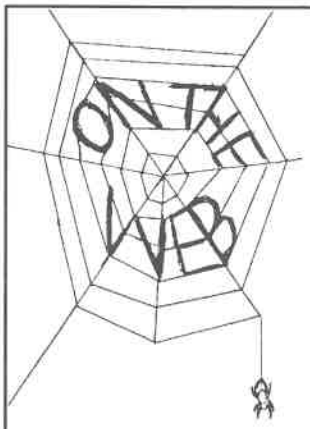
During spring when a tree is growing fast, the xylem cells are large with thin walls. This lighter-colored part of the ring is called *spring wood* or *early wood*. In August and early September, the growth rate slows and eventually stops. As growth slows, the walls of the xylem cells become thicker and appear darker. This area of the annual ring is called *summer wood* or *late wood*. Together, the early wood and the late wood form one annual ring, representing **one** growth season.

Not All Trees Have Rings!

In temperate areas where there are definite changes in seasons, trees put on one growth ring each year. In contrast, tropical trees may have several growth rings per year, depending on the rainy and dry seasons; their rings are therefore not distinct. This makes aging a tropical tree more difficult because the width of each year's annual rings varies.

Tree growth is actually controlled by a complicated mix of climate-related factors. These include soil and air temperatures, soil moisture, sunshine, wind, etc. Ring growth over a number of years is also affected by non-climate-related factors that include tree age, competition, soil fertility, insects, fire, and even changes in the atmosphere. It is the task of the dendrochronologist to try and identify and separate these various influences in an effort to isolate specific details about a tree's growth. □





Searching the Electronic Tree

There are quite a few good web sites for teachers and students who would like to learn more about "dendrochronology" or tree-ring research. Start with Henri Grissino-Mayer's *Ultimate Tree Ring Pages* at the University of Arizona address, **<http://tree.ltrr.arizona.edu/~grissino/henri.htm>**. On the home page menu list click on "Resources," which will take you to "Resources for Dendrochronologists." From there scroll down and click on "educational resources available to teachers" and you'll find all sorts of neat links. Among these are Hal Fritts' "Tales Trees Tell," a series of stories about trees and their rings; Hands-on Science Tree Ring kit ($22.95); a classroom activity called "Log of Straws"; a photo gallery of tree rings accompanied by questions; and much more.

Another good site to try is **<www.serve.com/archaeology/dendro.html>** by Lori Martinez. When you get there, click on "A Guide to Dendrochronology for Educators." This takes you to pages where you can find definitions, basic principles, drawings, scanned wood samples, and examples of how tree-ring dating is applied in the real world.

You can also reach free, downloadable fact sheets on over 180 species of trees at Virginia Tech's Dendrology home page, at **<www.fw.vt.edu/dendro/dendrology/dendro.htm>**. This site also provides a "Tree of the Week," a "Woody I.D." CD, and "Ask Dr. Dendro" for all your tree-related questions!

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This newsletter is a joint effort of the Virginia Department of Game and Inland Fisheries, the Department of Environmental Quality, and the Department of Forestry—sponsors of Project WILD, Project WET and Project Learning Tree, respectively. It is not available by subscription but is found as a special insert in school library copies of *Virginia Wildlife* magazine. An edited version may be viewed on our web site **<www.dgif.state.va.us>**

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