Dating fires with *dendrochronology,*

the science of studying trees' annual rings to learn about history

Copy down these terms. As you go through the presentation, find the meaning of each term and write it down.

1. Annual ring
2. Cambium
3. Catface
4. Cohort
5. Dendrochronology
6. Fire scar
7. Increment core
8. Low-severity fire
9. Master chronology
10. Pith
11. Stand-replacing fire
12. Tree cookie

Use the "Go figure" questions to see if you "get" a concept or can guess what's on the next slide.

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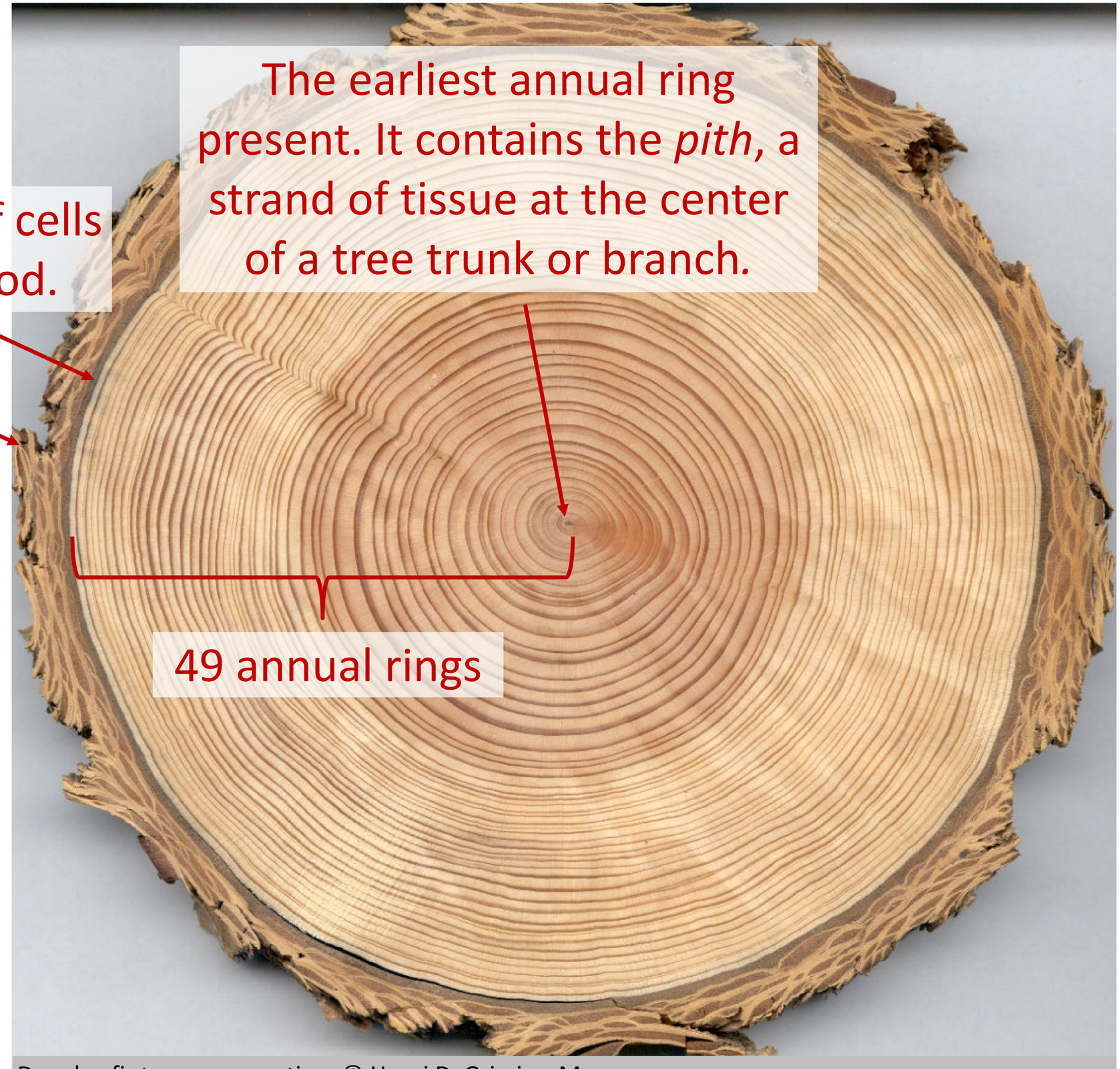
A tree's *annual ring* is the wood produced during 1 year of growth. An annual ring is shaped sort of like a circle. Each ring surrounds all of the wood that the tree produced in previous years.

Because trees usually produce 1 ring per year, you can estimate a tree's age by counting its rings.

Douglas-fir tree cross section. © Henri D. Grissino-Mayer

Go figure: How many years did this tree live?

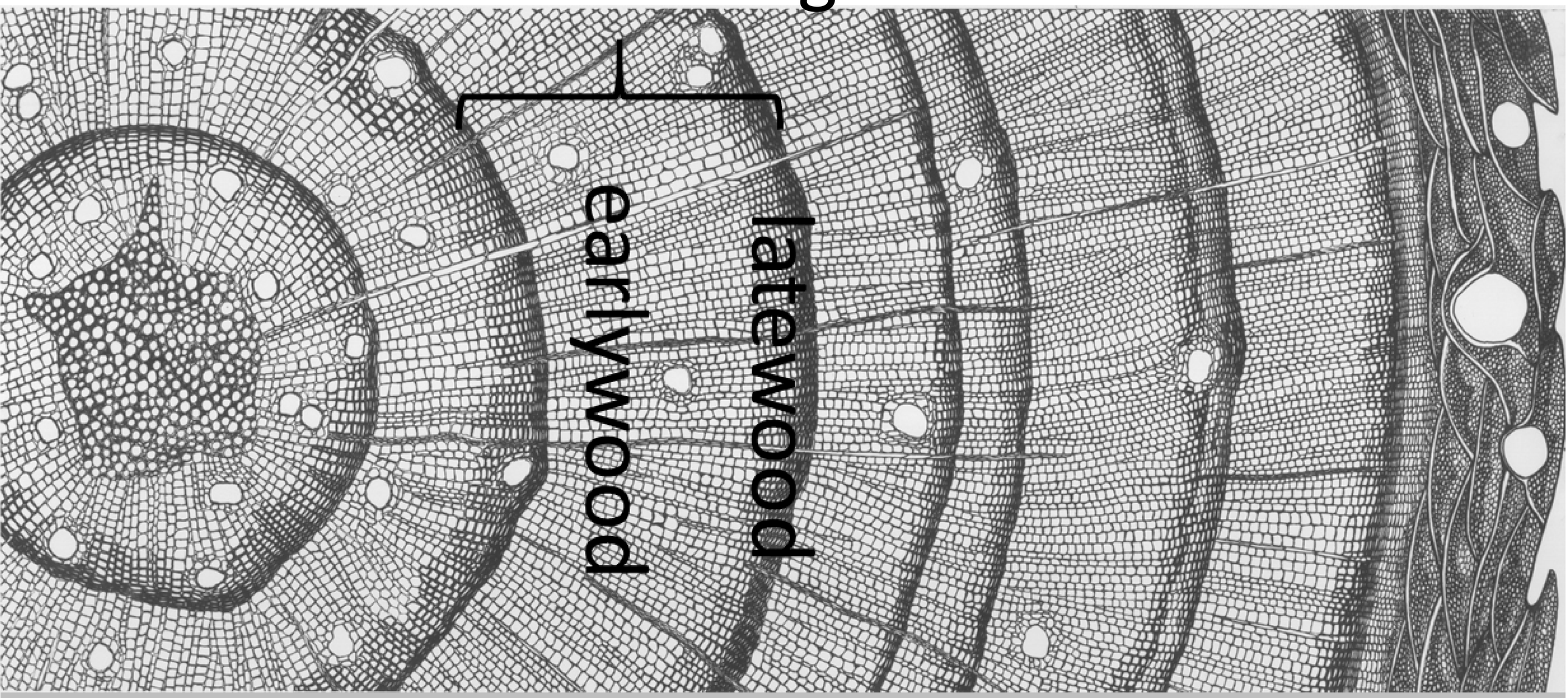
Answer: The tree lived at least 49 years. It could be a little older than 49, if the sample was cut from high above the ground.



Douglas-fir tree cross section. © Henri D. Grissino-Mayer

Although we call tree rings "annual," they can be tricky. Some years a tree might produce 2 rings. Sometimes it might produce a ring just part-way around, and sometimes it might not produce any ring at all.

Annual ring

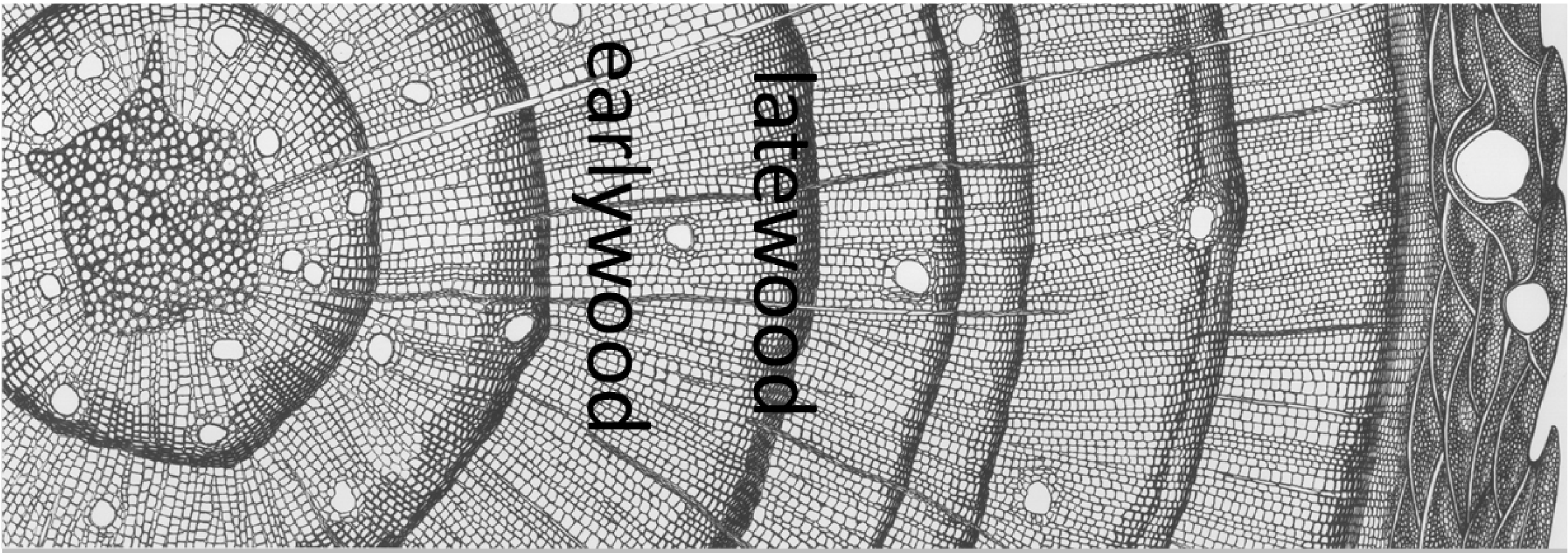


From Stokes, Marvin A.; Smiley, Terah A. 1996. An introduction to tree-ring dating. Tucson: University of Arizona Press. 73 p. Courtesy of Laboratory of Tree-Ring Research.

An annual ring consists of a thick row of large, thin-walled, light-colored cells plus a thin row of tiny, dark-colored cells. The large cells (“earlywood”) are produced in spring and early summer. The tiny cells (“latewood”) are produced later in the growing season.

Go figure: Why would a tree produce its biggest cells in the early summer?

Answer: Early summer is when the days are longest, moisture is usually abundant, the soil is warming up, and the tree can use nutrients stored up during the previous growing season.



From Stokes, Marvin A.; Smiley, Terah A. 1996. An introduction to tree-ring dating. Tucson: University of Arizona Press. 73 p. Courtesy of Laboratory of Tree-Ring Research.

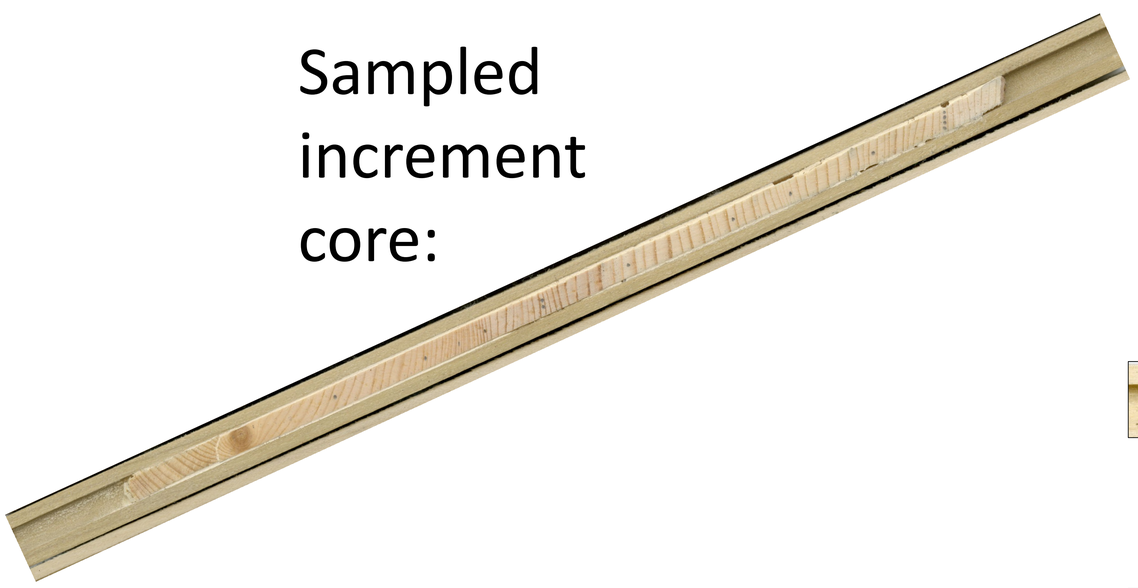
Annual rings are very sensitive to climate patterns. For example, if there is a 3-year drought, trees throughout the area are likely to produce very narrow rings – or no rings - during those years.

Go figure: If annual rings are so "tricky," how can you find out the exact year when one was formed?

Answer: Use dendrochronology. Dendrochronology is usually based on information from *increment cores.* These are thin cylinders of wood removed from a tree so the tree's annual rings can be studied.

Dendrochronologists compare the widths of annual rings in their samples with the width of rings in a *master chronology.* A master chronology is a record of the pattern of wide and narrow rings over time throughout a large area. A master chronology is based on data from dozens to hundreds of increment cores.

Sampled increment core:



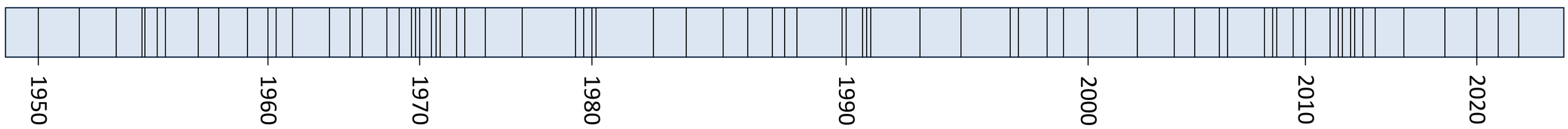
Cores from the master chronology:

Go figure: How do you use a master chronology?

Answer: “Cross-date” your core with the master.

Measure every ring width on your core.
Suppose it shows this pattern:

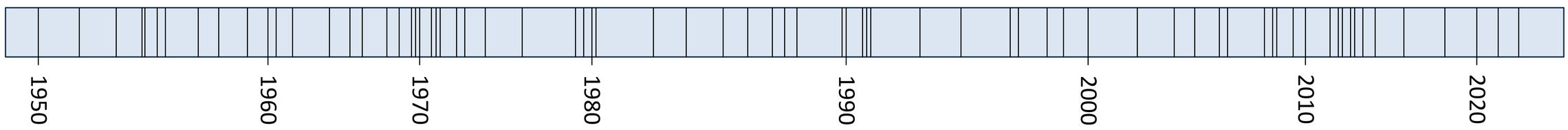
Suppose your region’s master chronology has this pattern:



Answer: “Cross-date” your core with the master.

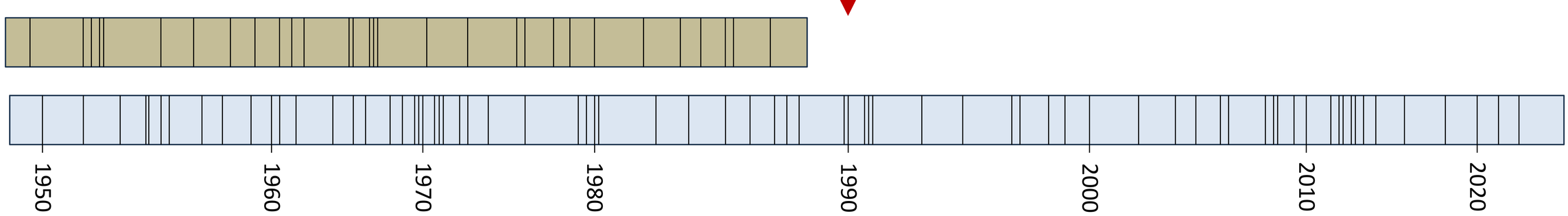
Suppose you measure every ring width on your core.
It shows this pattern:

Suppose your region’s master chronology has this pattern:



Slide your core’s pattern along the master until the ring patterns match up:

It looks like this ring was formed in 1990.



Now you can count backward & forward to figure out the years of other rings!

Go figure: How can you connect information on annual rings to fire history?

USDA FS photo by Emily Heyerdahl.

Photo by Jim Peaco

A.

USDA FS photo by Emily Heyerdahl.

Answers:

Use scars on trees that survived past fires. If you can find out the years of the annual rings in each scar, you'll know when the fires occurred.

B.

Photo by Jim Peaco

Find a stand where most of the trees are about the same age. They may have become established after a fire.

A group of living things that are all about the same age is called a *cohort.* If you can find out when this cohort of trees began, you'll know that the fire happened shortly before that.

Go figure: How severe were the fires that scarred Tree A? How severe was the fire that left so many standing dead trees in Forest B?

Answers:

A.

USDA FS photo by Emily Heyerdahl.

Tree A was scarred by many *low-severity fires*.

Even though these low-severity fires killed some of the tree's cambium, they did not kill the tree.

B.

Photo by Jim Peaco

Forest B was established after a very severe, *stand-replacing* fire killed the old lodgepole pines.

The fire burned through the tree crowns, and its heat opened their cones. Millions of seeds fell to the ground. The burned soil was a perfect place for lodgepole pine seedlings to grow. The new seedlings are *replacing* the forest that was killed by fire.

Look closely at this fire-scarred tree.

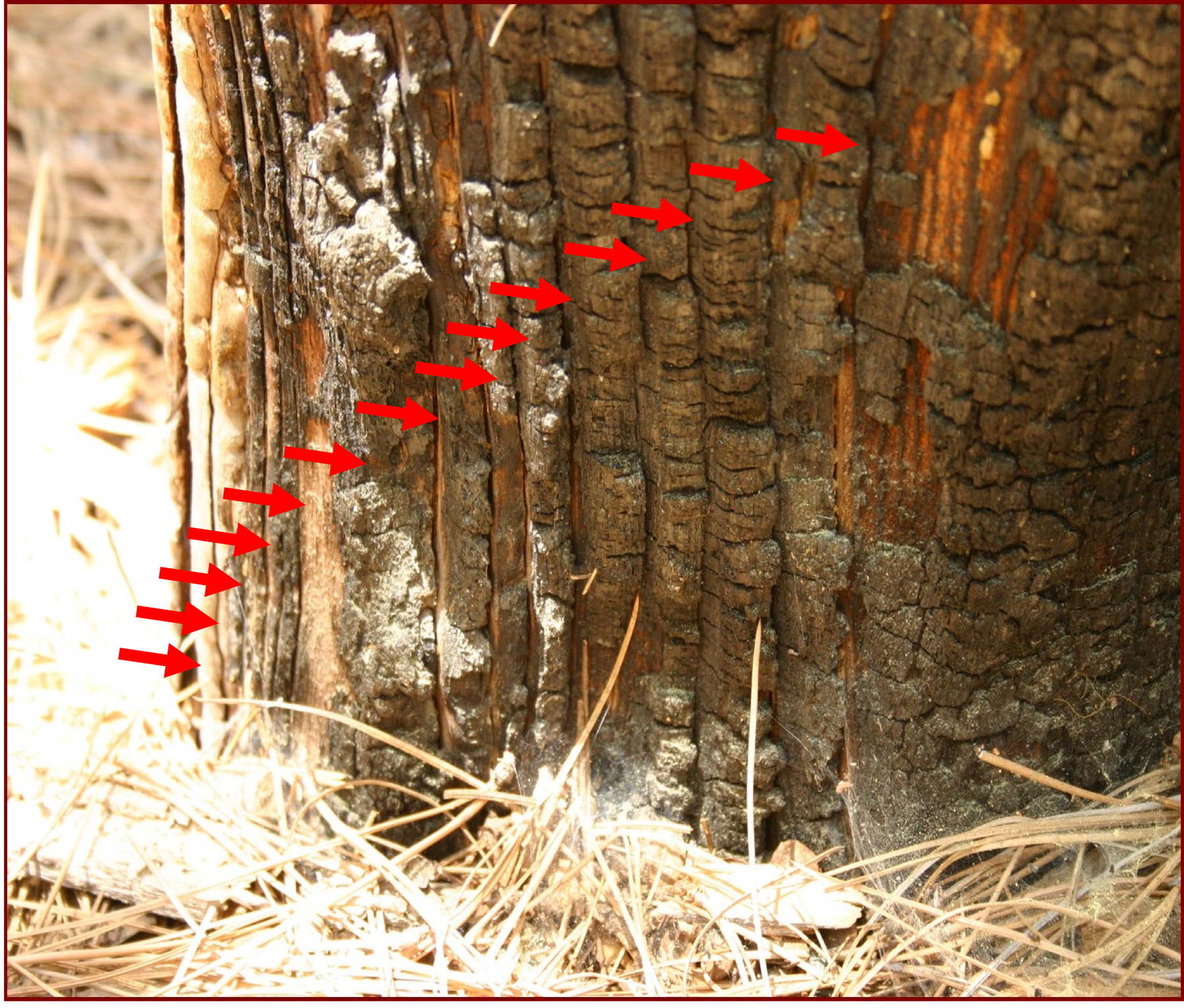
Fire-scarred catface at base of a ponderosa pine (USDA FS photo by Emily Heyerdahl).

The big, black wound on this tree, called a *catface,* tells us that the tree was scarred by fire. A close-up look (below) shows many vertical creases in the catface. These are *fire scars.* Each scar was made by a low-severity fire that killed part of the tree's cambium. But cambium cells survived along the edge of the injured area, and they grew well after the fire.

Close-up showing fire scars in a catface (photo courtesy of Peter Brown).

Go figure: How many fire scars are in this catface?

Answer: The catface contains 14 scars from low-severity fires.



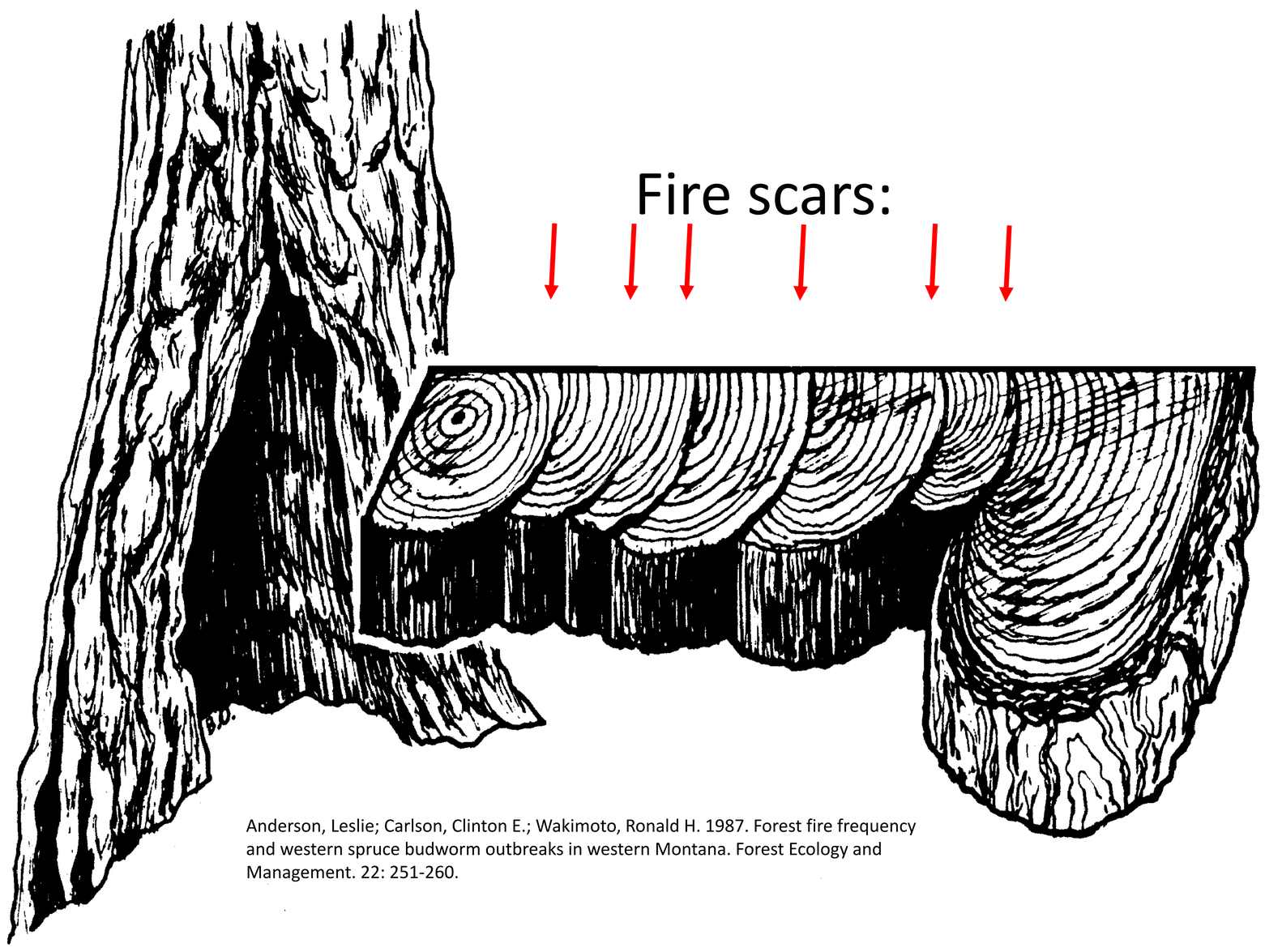
Close-up showing fire scars in a catface (photo courtesy of Peter Brown).

Go figure: Can you figure out a tree's fire history without cutting it down?

Answer: Yes, you can figure out a tree's fire history from a narrow section of wood.

To figure out the years of fire scars, dendrochronologists collect *tree cookies.* A tree cookie could be a full cross section or a partial one – a narrow section cut from one side of the catface.

USDA Forest Service photo by Emily Heyerdahl.

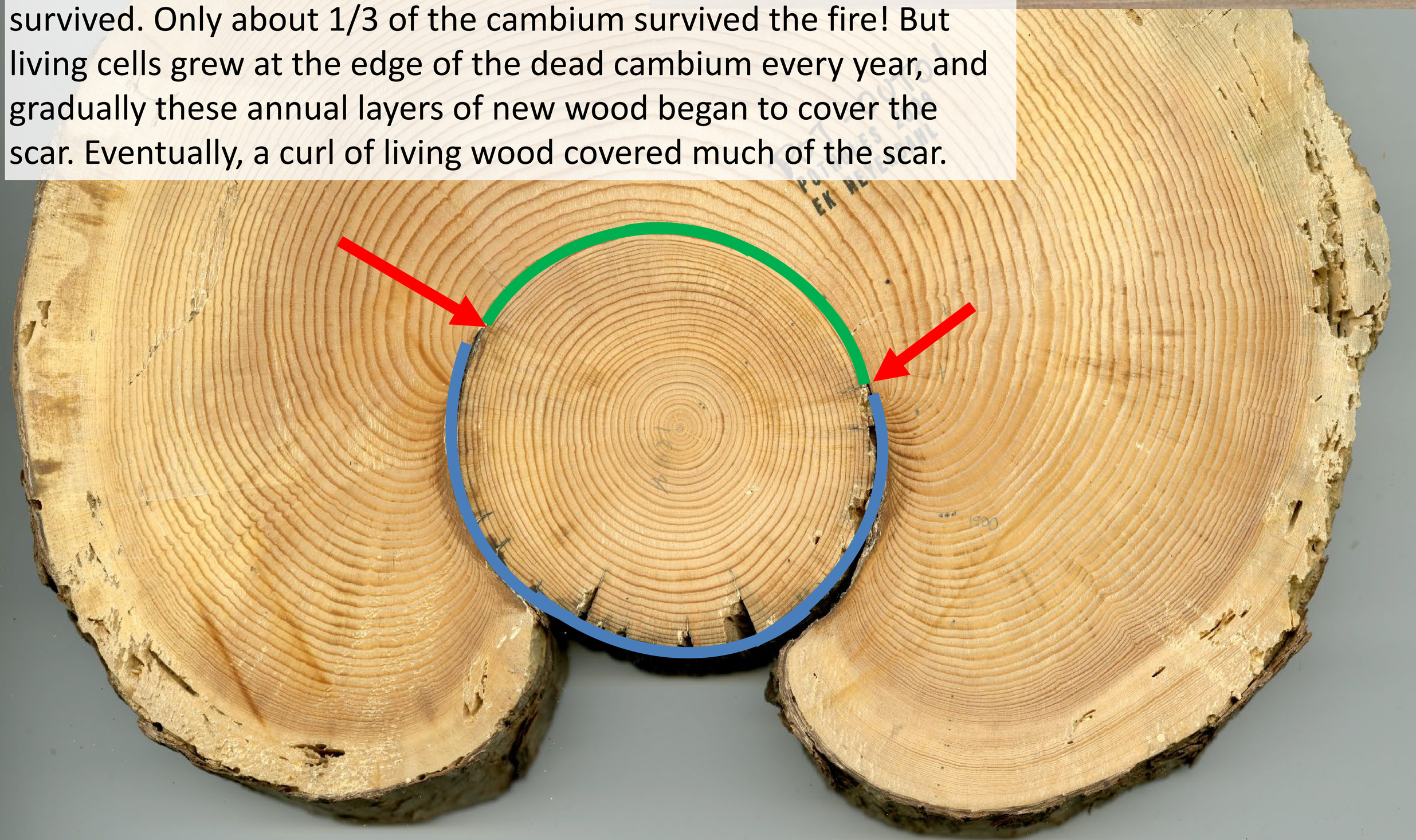


Anderson, Leslie; Carlson, Clinton E.; Wakimoto, Ronald H. 1987. Forest fire frequency and western spruce budworm outbreaks in western Montana. Forest Ecology and Management. 22: 251-260.

Go figure: How many fires have scarred this lodgepole pine?

Answer: Just one fire has scarred this tree.

Red arrows point to the two ends of the fire-killed cambium. The **blue line** beneath the arrows shows where the cambium was killed. The **green line** above the arrows shows where the cambium survived. Only about 1/3 of the cambium survived the fire! But living cells grew at the edge of the dead cambium every year, and gradually these annual layers of new wood began to cover the scar. Eventually, a curl of living wood covered much of the scar.



Go figure: Do you know what these terms mean? If not, go back through the program to find out.

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As a FIRE HISTORIAN, you can now figure out the fire history of individual trees and whole forests.

USDA Forest Service - Region 2 - Rocky Mountain Region , USDA Forest Service, Bugwood.org.

USDA Forest Service photo courtesy of Emily Heyerdahl.

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