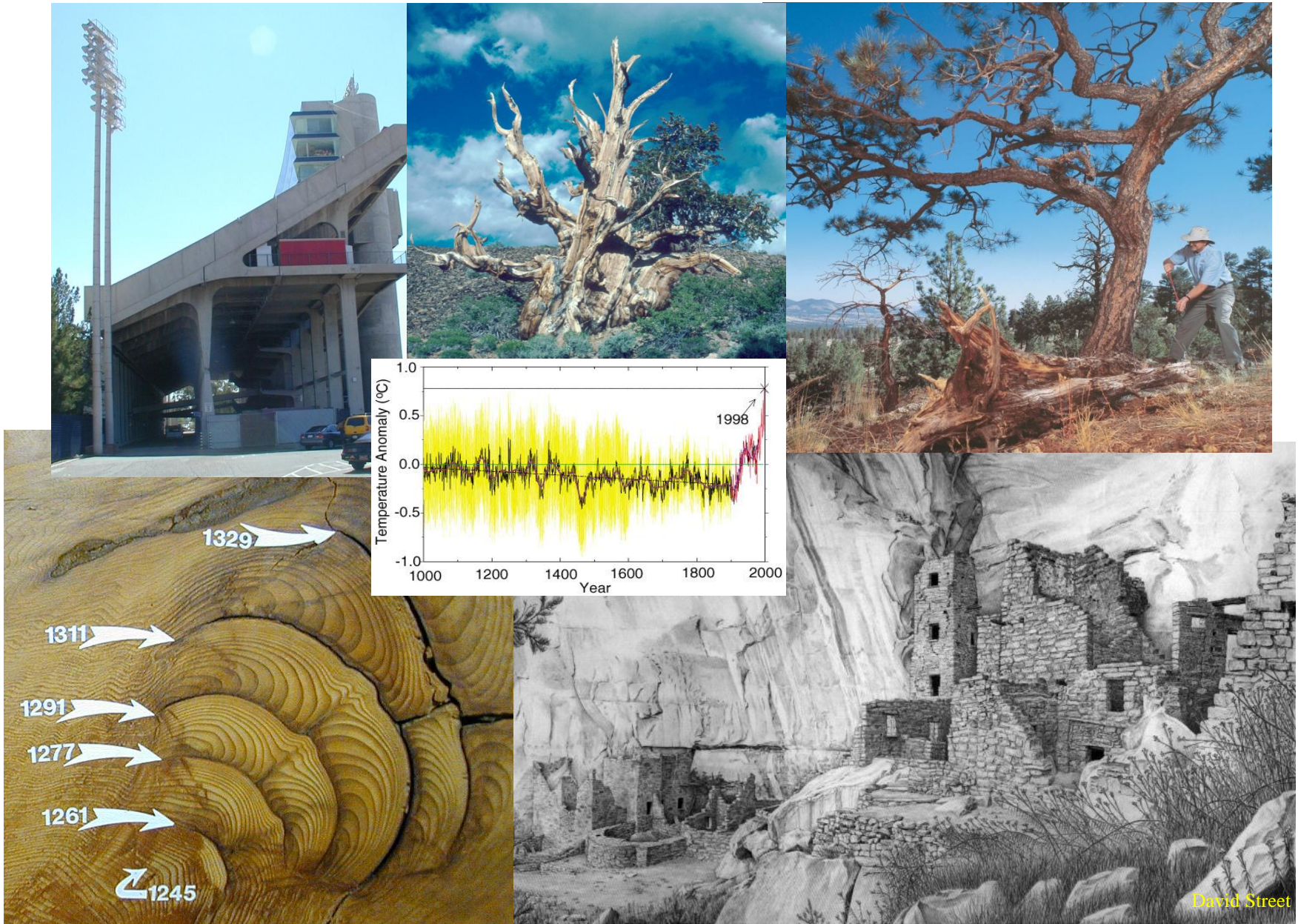


Objectives:

- History and foundations of tree-ring science
- Applications of tree-rings to management in the Jemez Mtns
- Look at tree-ring samples from different species found in the Jemez
- Tree-ring core sampling and preparation technique
- Bring home your very own cross-dated tree-ring core sample

Introduction to Dendrochronology



Tree-Ring Information Resources

Laboratory of Tree-Ring Research – University of Arizona

See “Resources” <http://www.ltrr.arizona.edu/>

Ultimate Tree-Ring Web Pages – Dr. Henri Grissino-Mayer, Univ. Tennessee

<http://web.utk.edu/~grissino/>

Bibliography of Dendrochronology

http://www.wsl.ch/dbdendro/index_EN?redir=1&

Tree-Ring Bulletin/Tree-Ring Research -- Tree-Ring Society

<http://www.treeringsociety.org/TRBTRR/TRBTRR.htm>



Tree-Ring Society

Early Observers of Tree Rings

➤ Aristotle (350 BC) and daVinci (AD 1500) deduced annual nature of tree rings and their relation to moisture availability



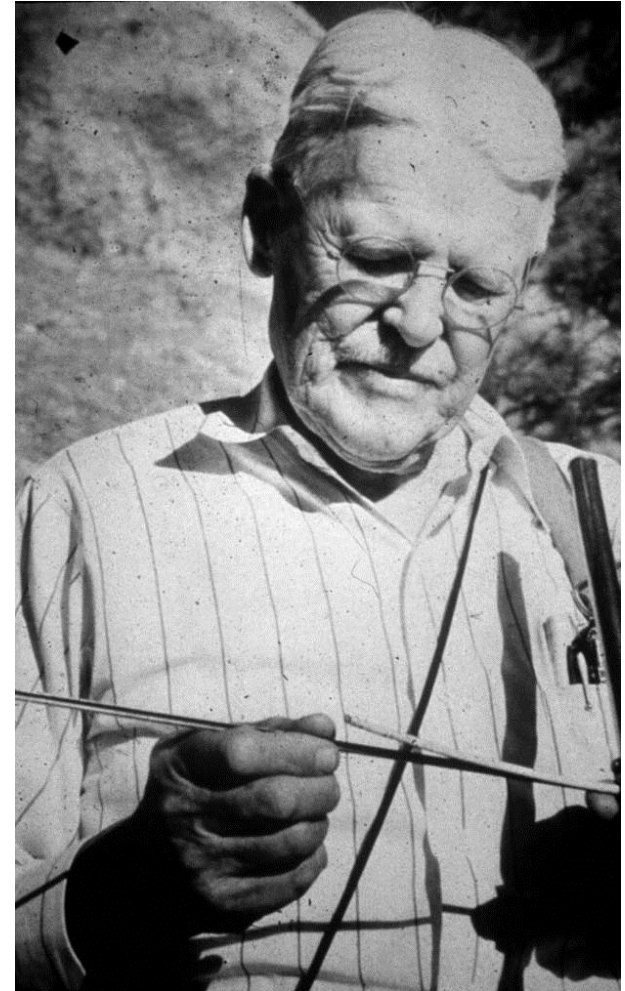
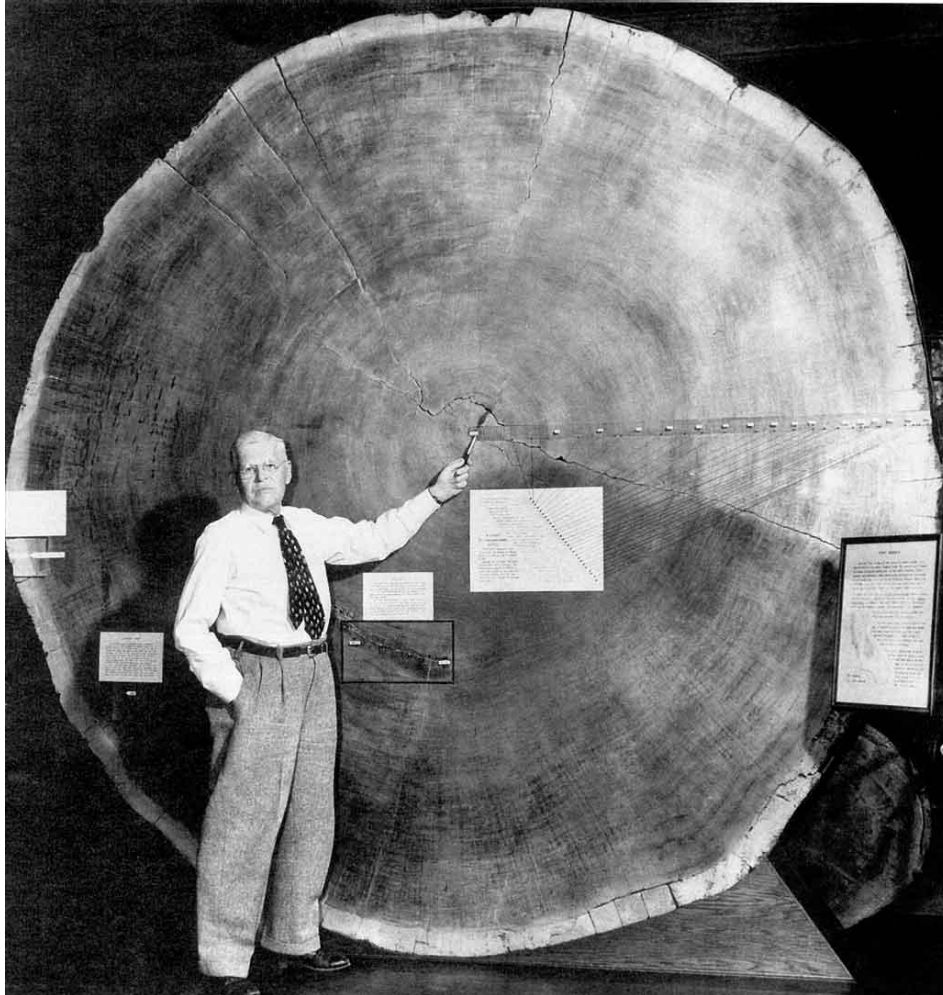
Leonardo da Vinci

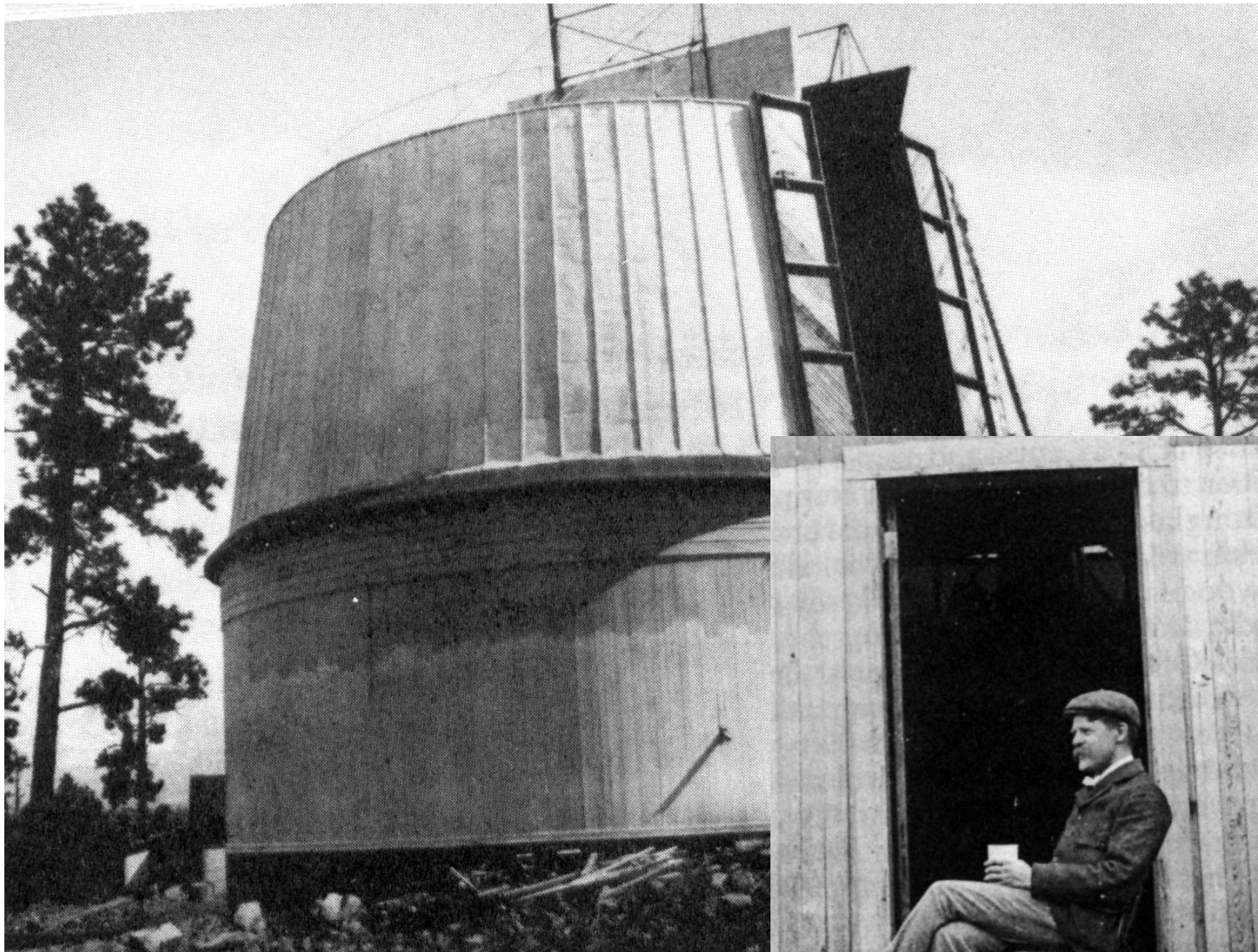
“Rings in the branches of sawed trees show the **number of years** and, according to their thickness, the **years which were more or less dry**. Thus, they reflect the individual worlds to which they belong, in the north [of Italy] they are much thicker than in the south.”

Jacob Kuechler in Texas in 1859

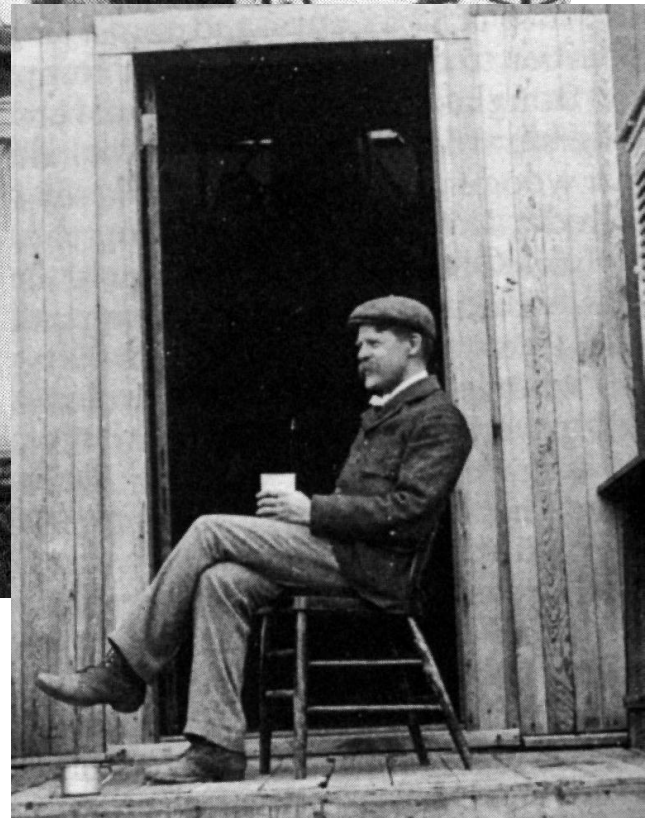
“Our records are of such recent date that we must turn to the annals of Nature, particularly of the plant world. A tree contains the record of its life history, and this history is most closely interwoven with the annual rainfall.”

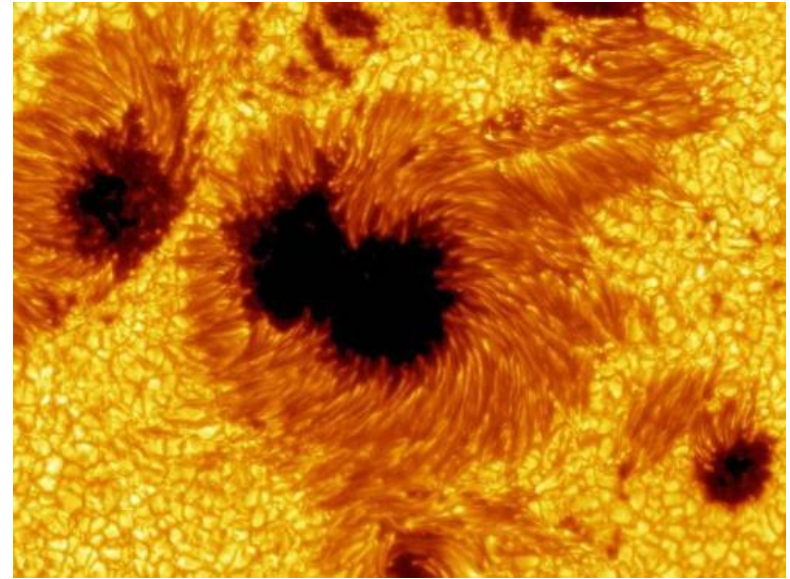
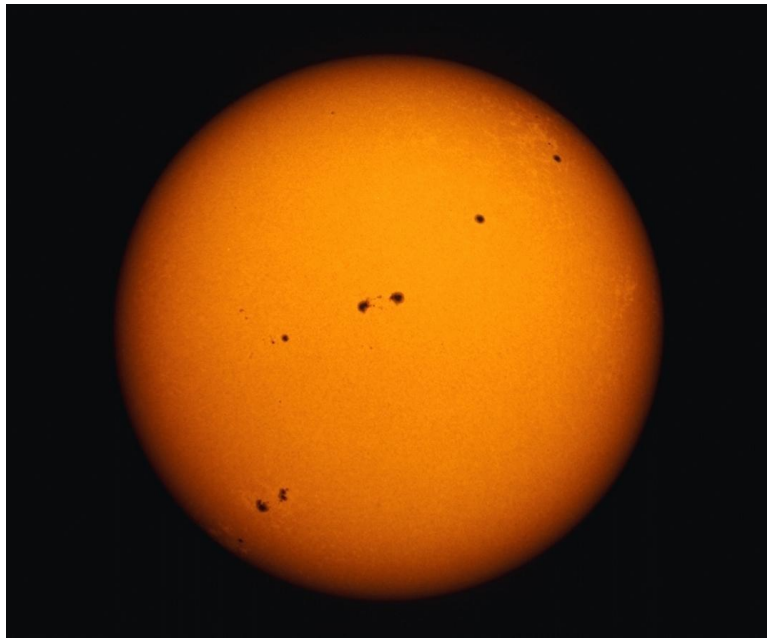
Andrew Ellicott Douglass 1867-1962
Founder of Modern Dendrochronology
&
Laboratory of Tree-Ring Research



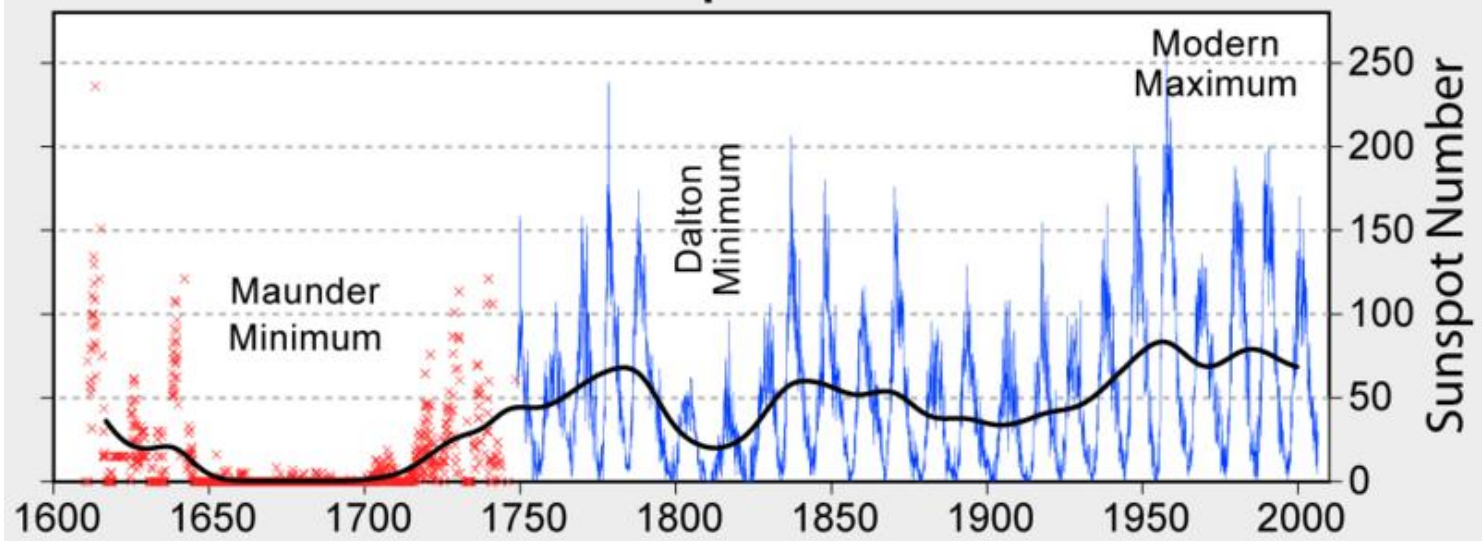


Lowell Observatory in Flagstaff, AZ

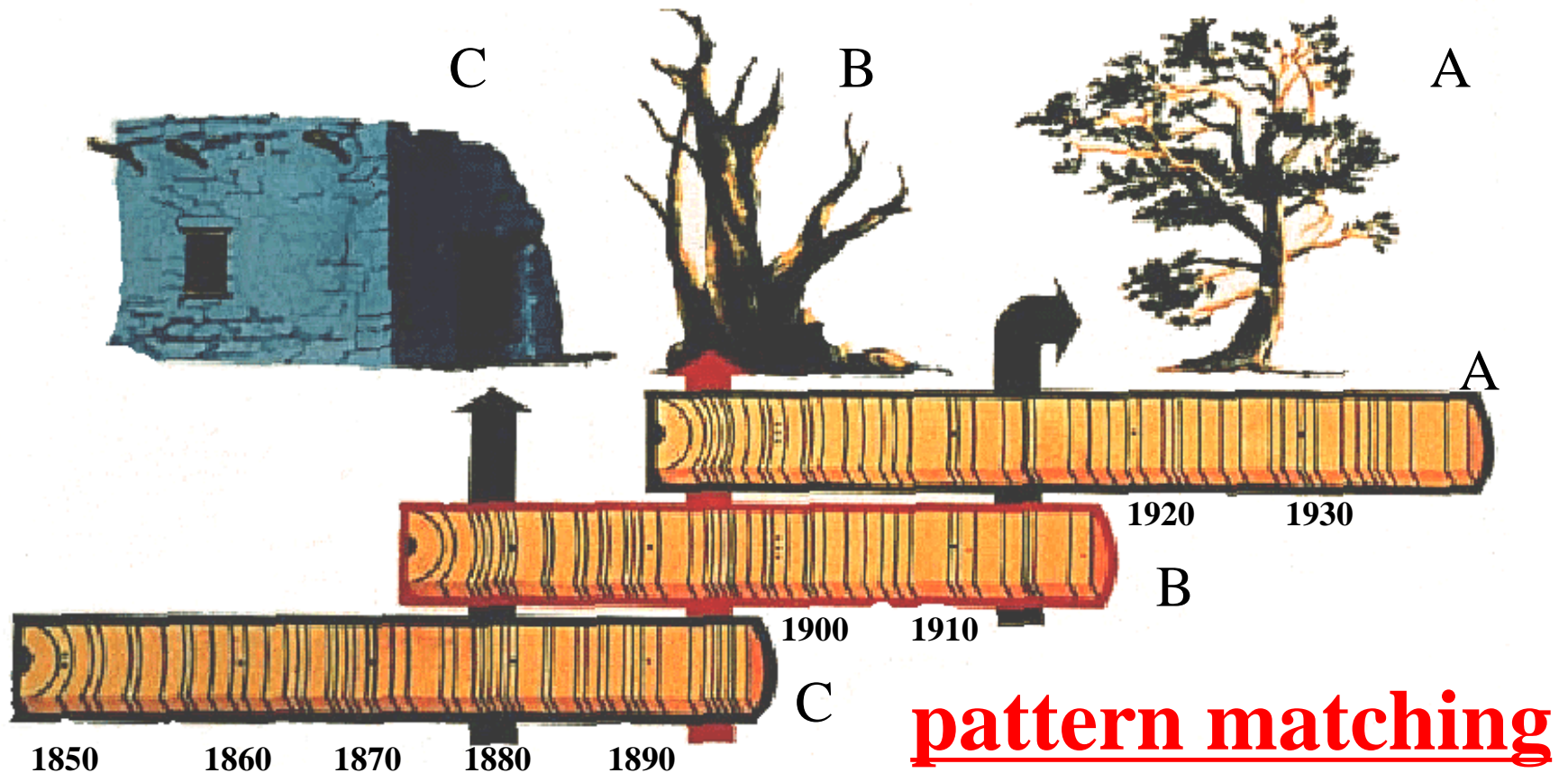




400 Years of Sunspot Observations

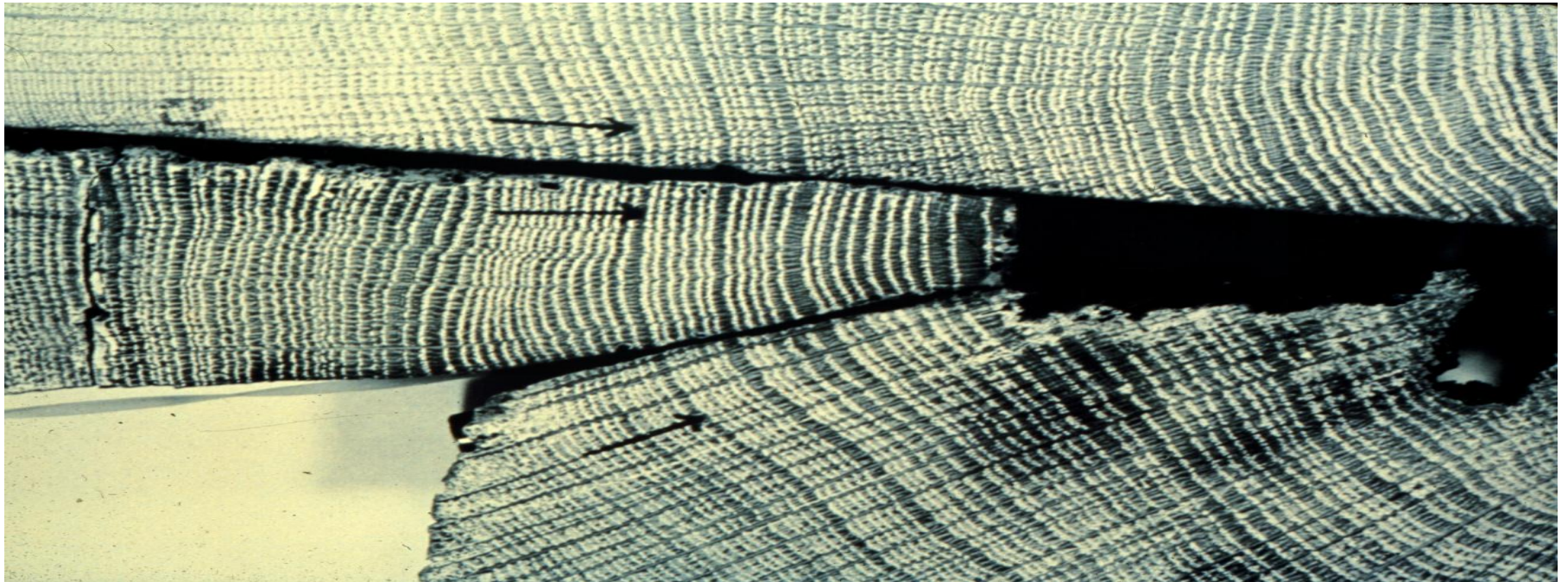


Crossdating: The Basic Principle of Dendrochronology



“Bridge” back in time

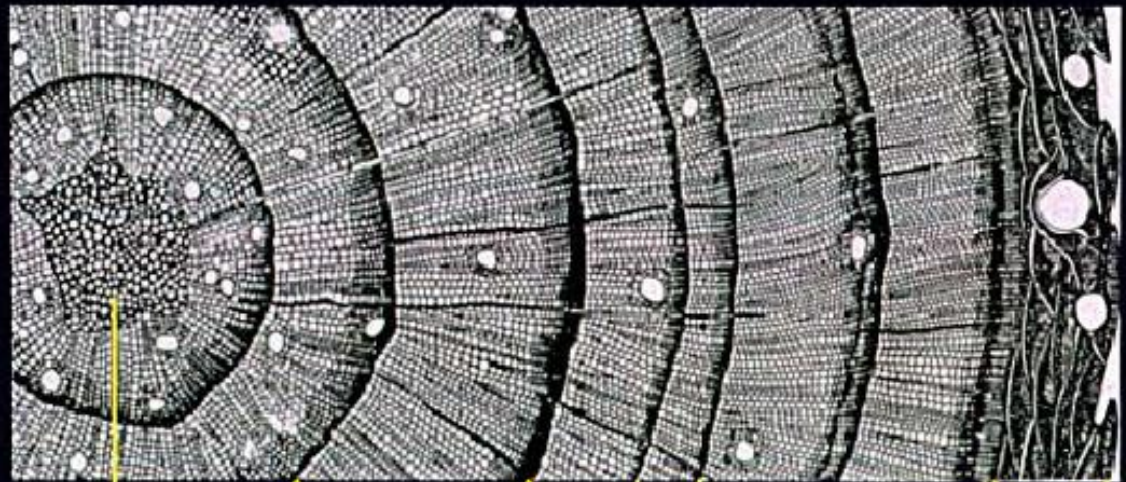
Crossdating Ex: Oak timbers from locations in Ireland up to 200 km apart. Note similarity of patterns - marked year is AD 1580



What exactly are tree rings?
What creates the pattern?



Cross Section of a Conifer

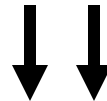


Pith

Annual rings

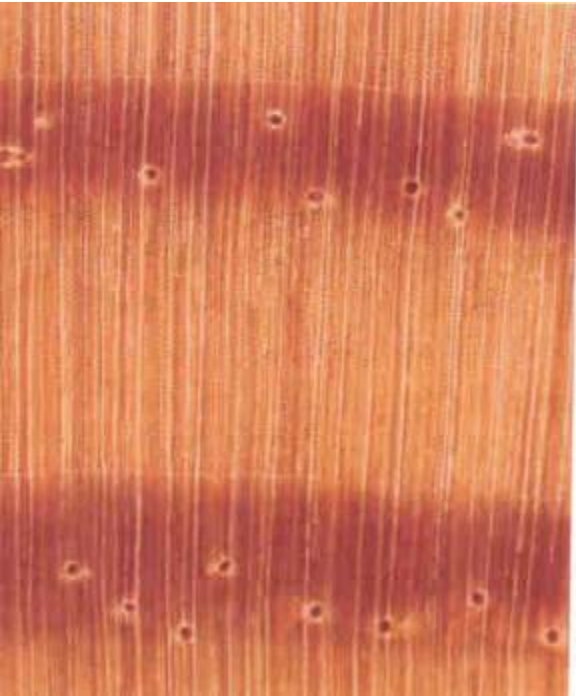
Bark

Environmentally beneficial years



Environmentally stressful year

Yellow Pines = thick latewood



Southern Pines



Ponderosa Pine



Red Pine

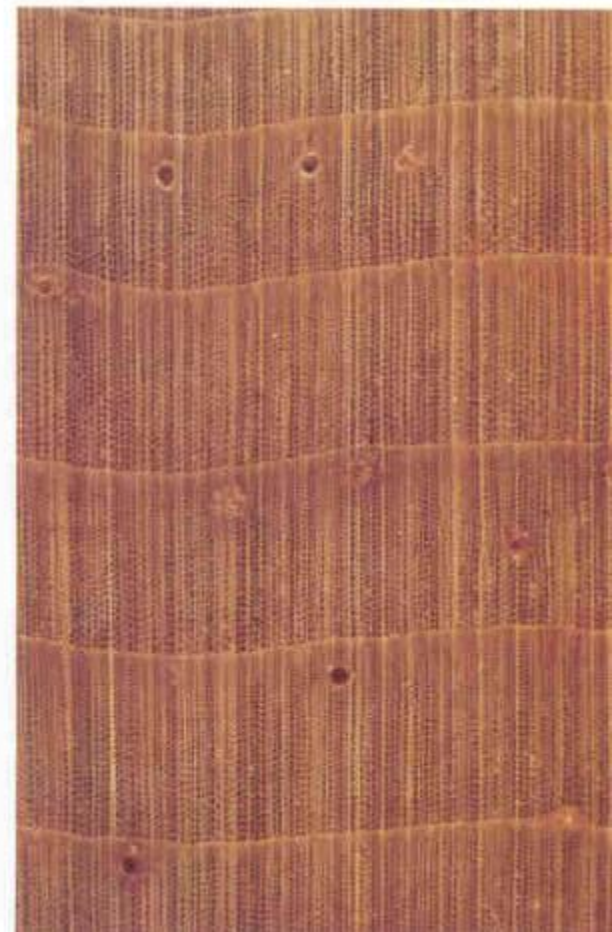
White Pines = thin latewood



Eastern White Pine



Western White Pine

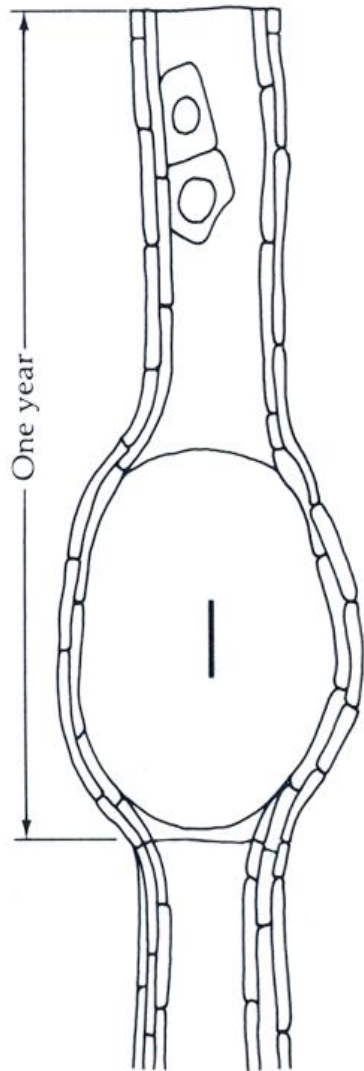


Sugar Pine

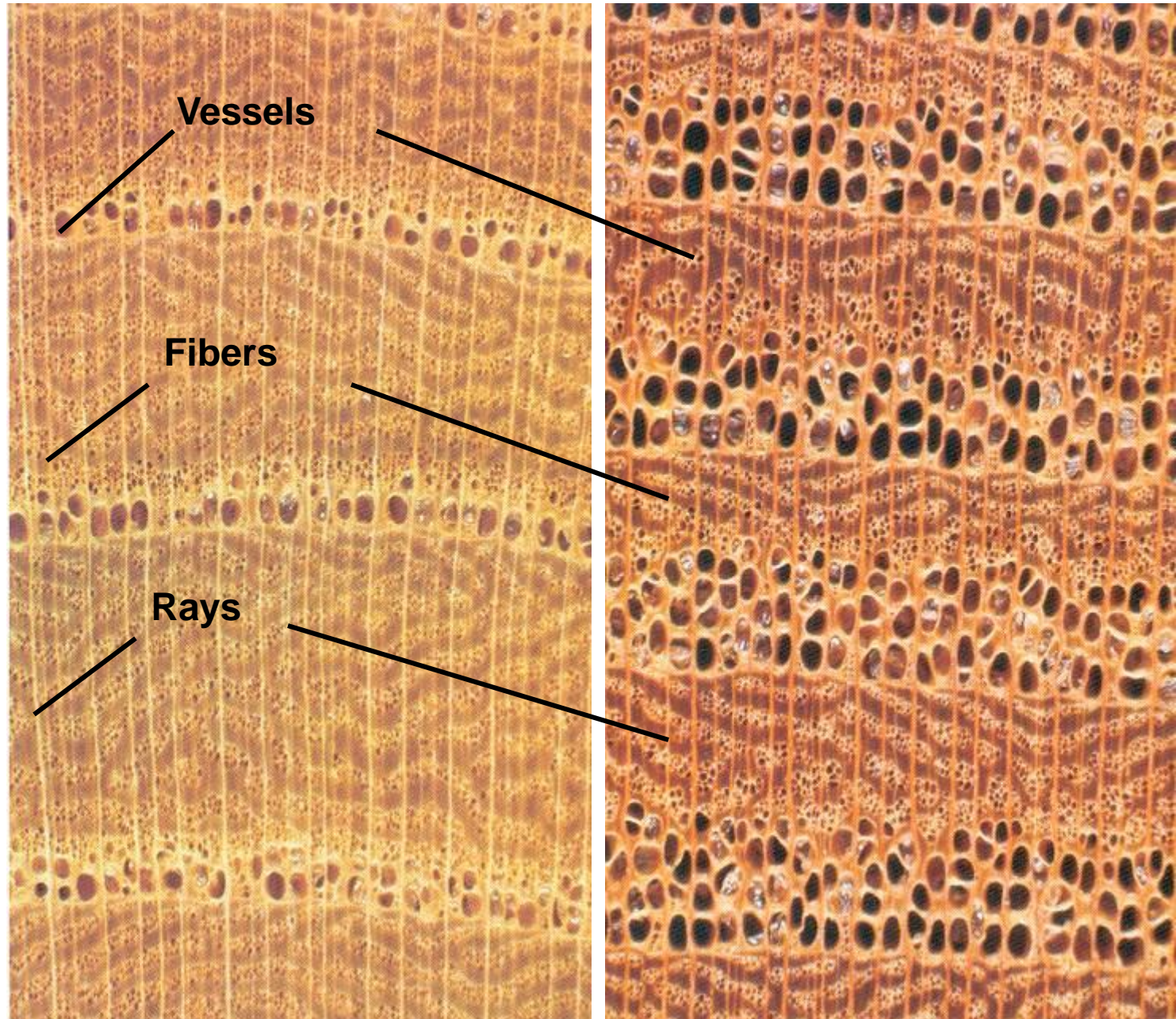
- *Quercus* (Oak): Ring Pours - the ring boundary, like the ring is more complex. There are several types of cells in the wood, and the ring boundary may be harder to define than in many conifers.

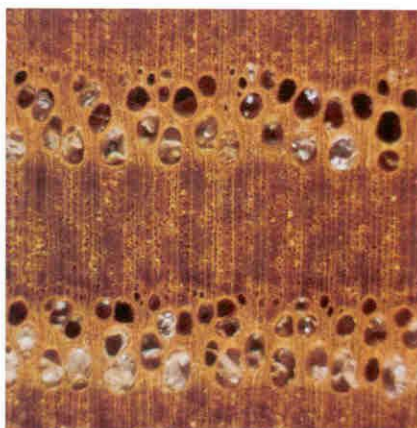
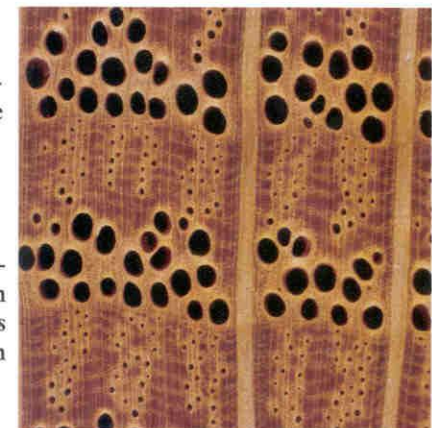


Ring porous: large earlywood vessels

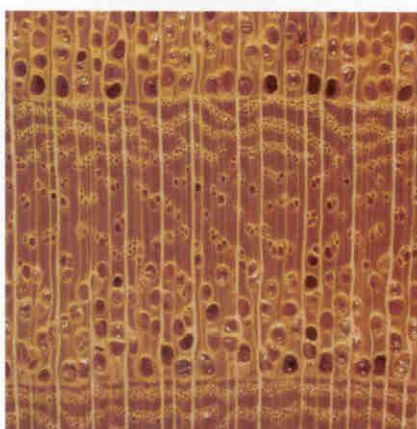
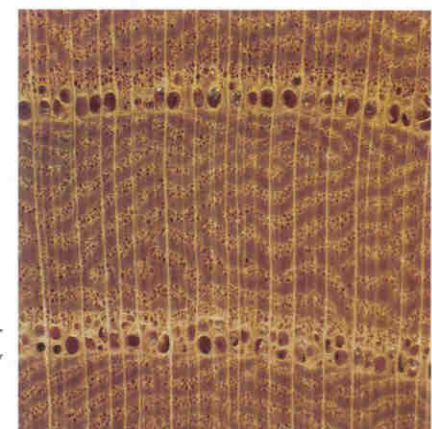


White Oak
Ring Porous

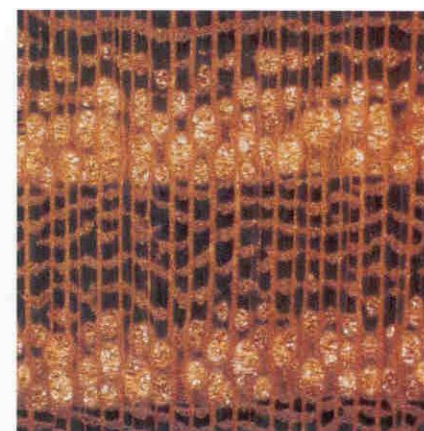
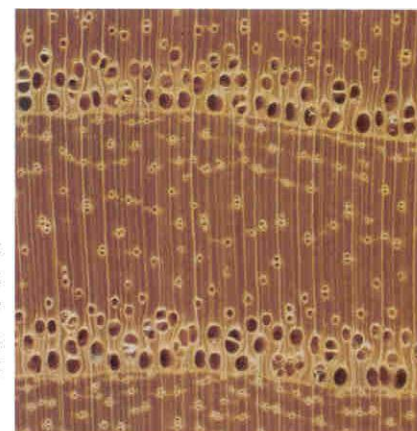




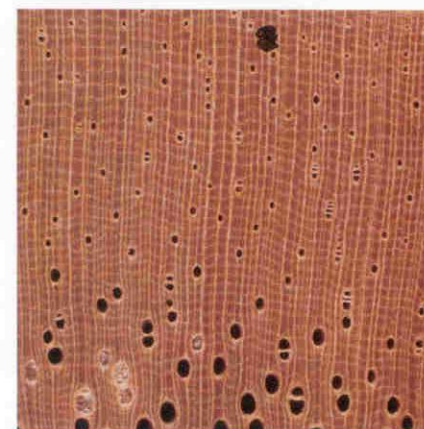
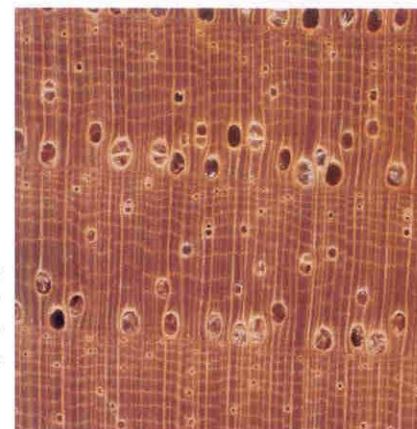
Chestnut and Oak



Sassafras and Black Locust

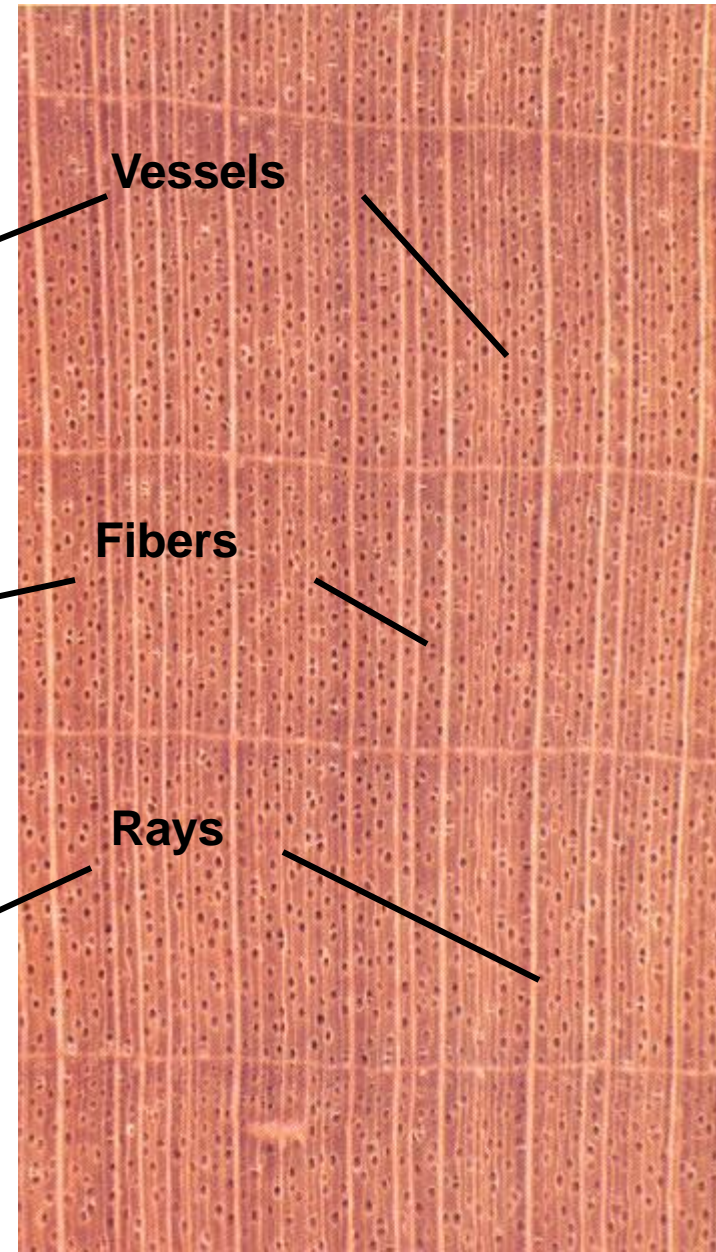
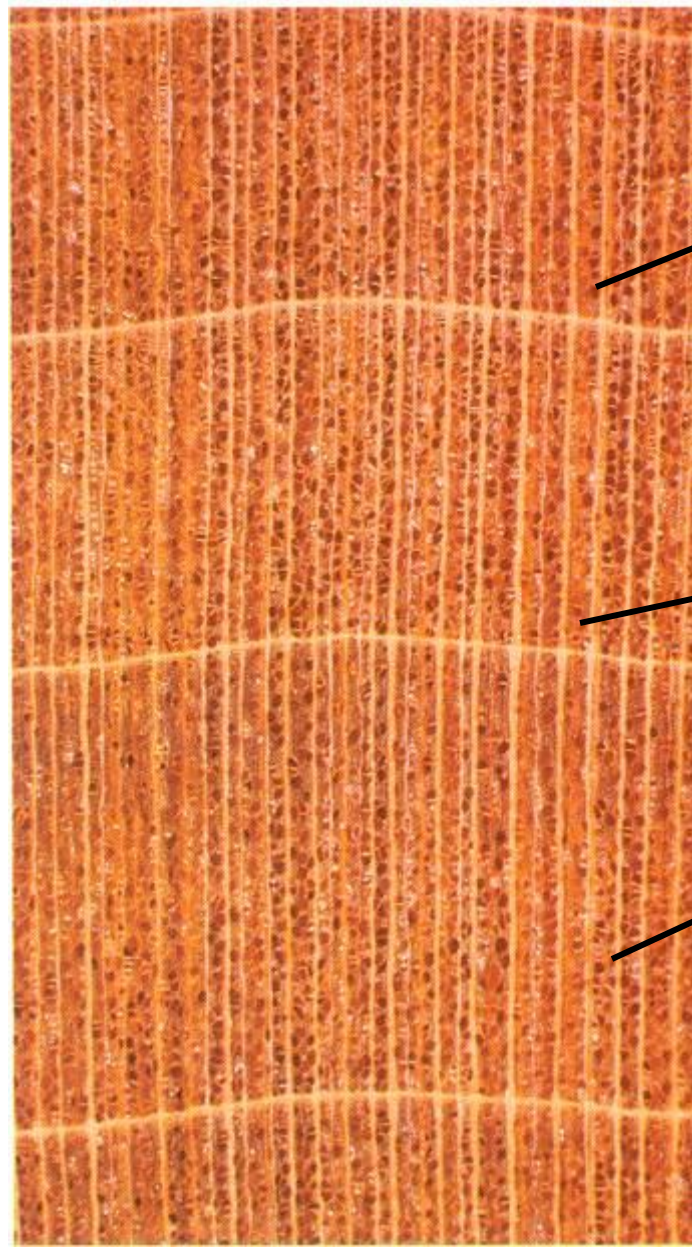
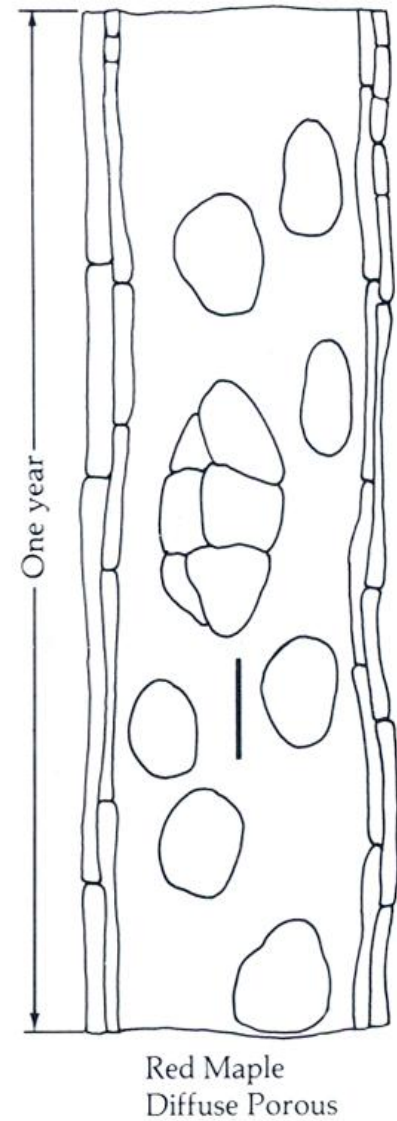


Elm and Hackberry



Hickory and Pecan

Diffuse porous: small vessels throughout





Sugar Maple

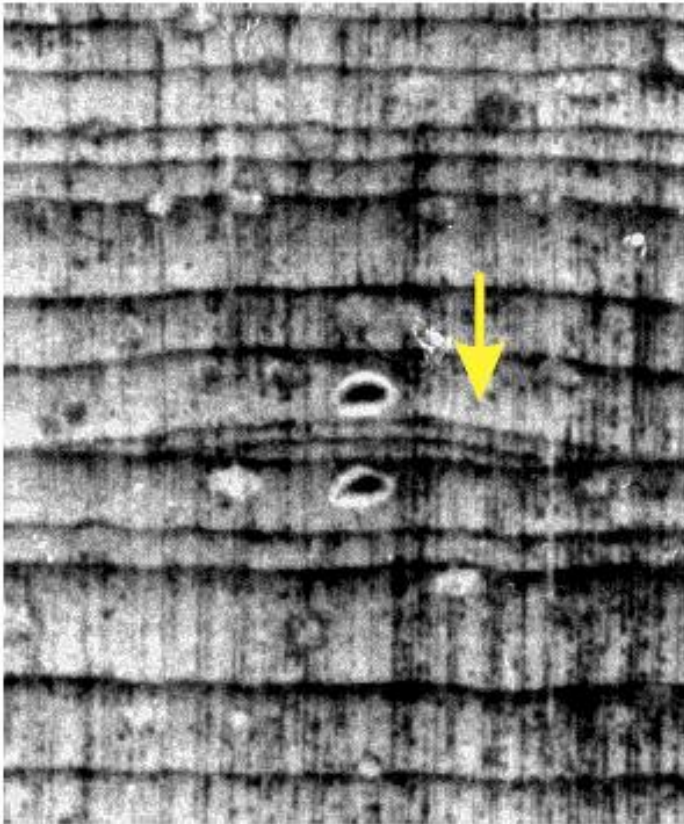


Red Maple

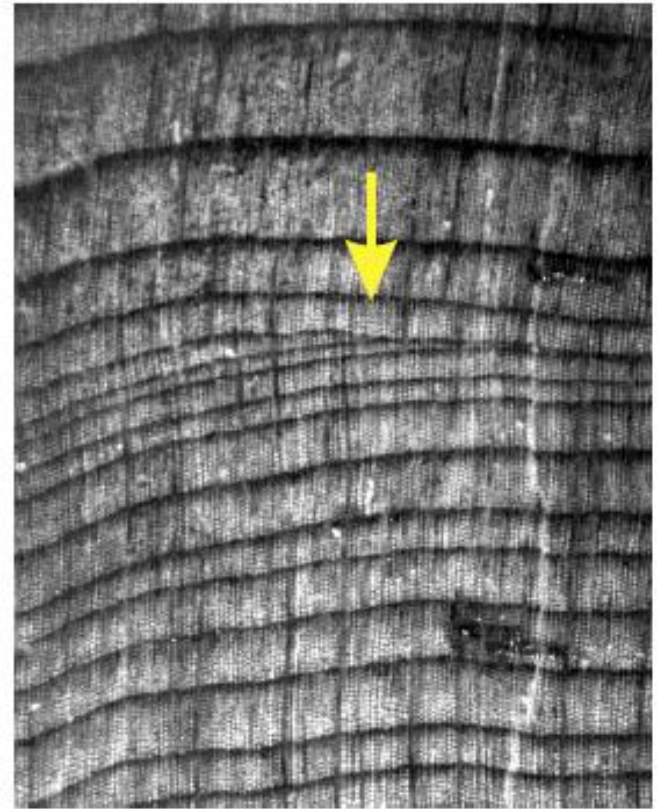


Dogwood

- Not Just Ring Counting: sometimes when a tree is under stress a ring can be **absent** from part of the tree (left picture). In extreme cases several rings may be partially missing, causing **wedging** (right picture).

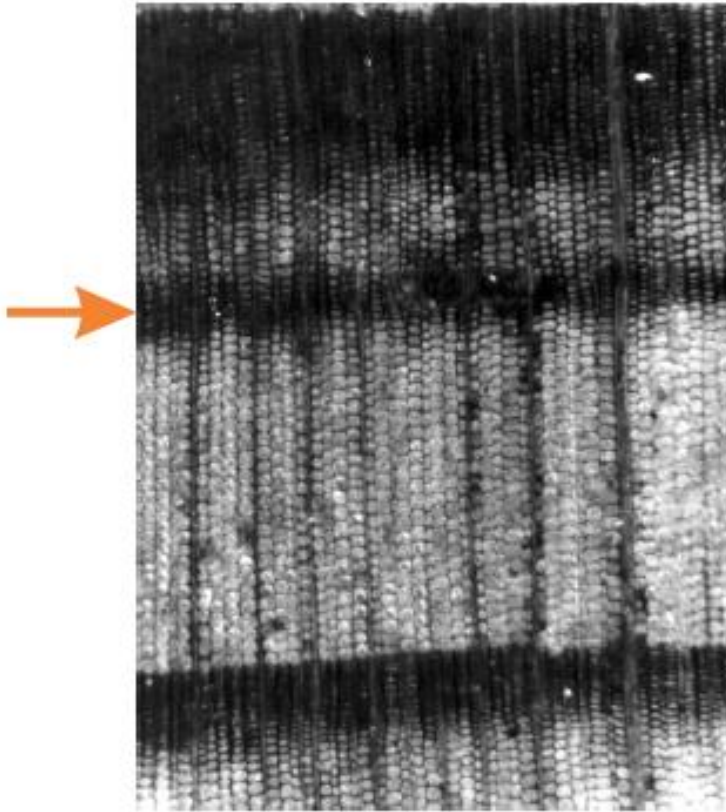


Locally absent micro rings in bristlecone pine

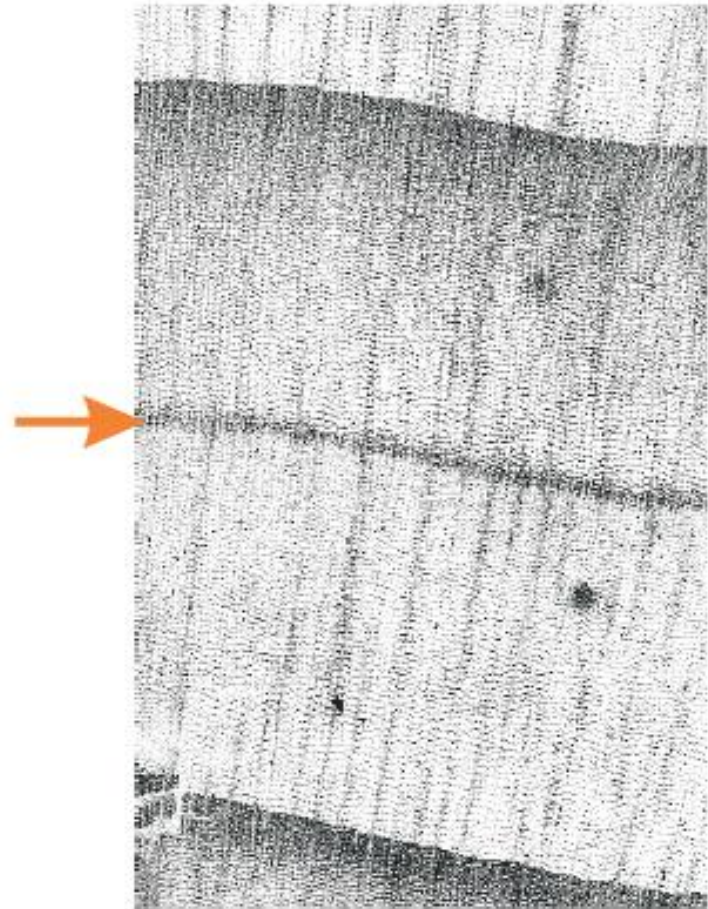


Wedging rings in juniper

There are also “False” rings

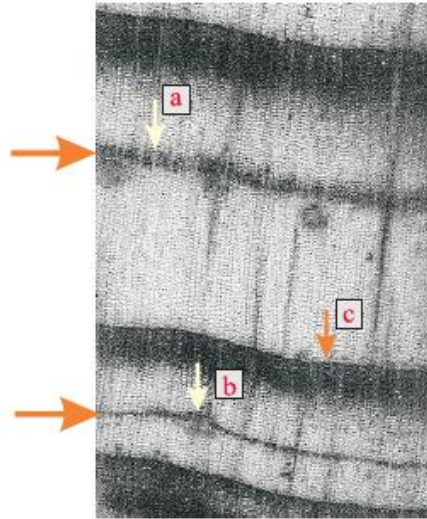


False ring in Douglas-fir

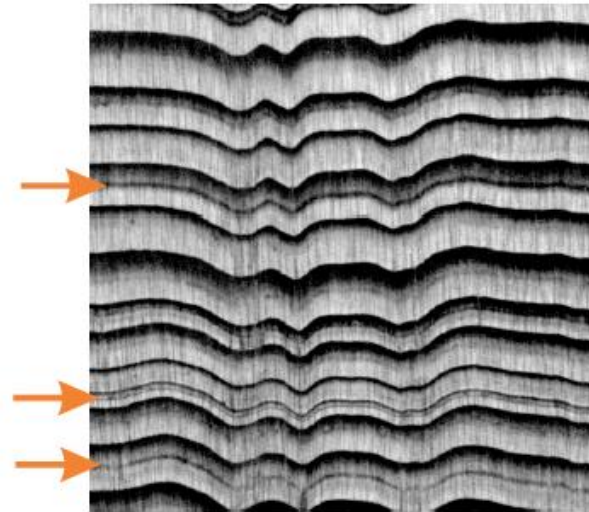


False ring in ponderosa pine

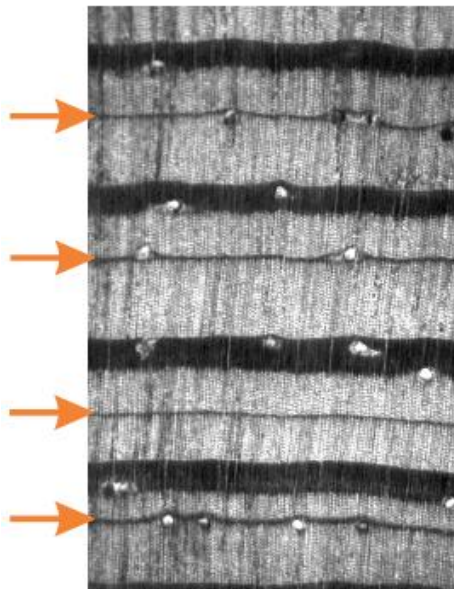
False rings in ponderosa pine



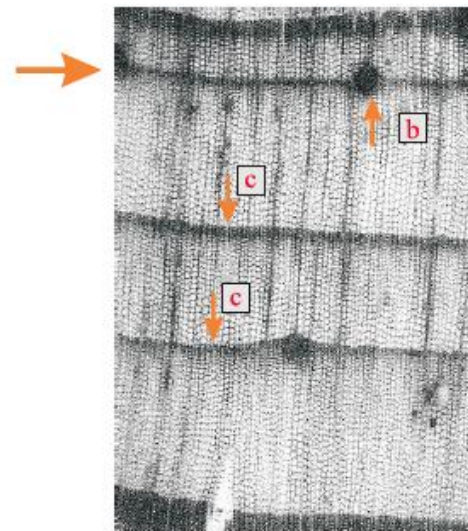
False rings in Douglas-fir



False rings in a Mexican pine



False ring in Apache pine

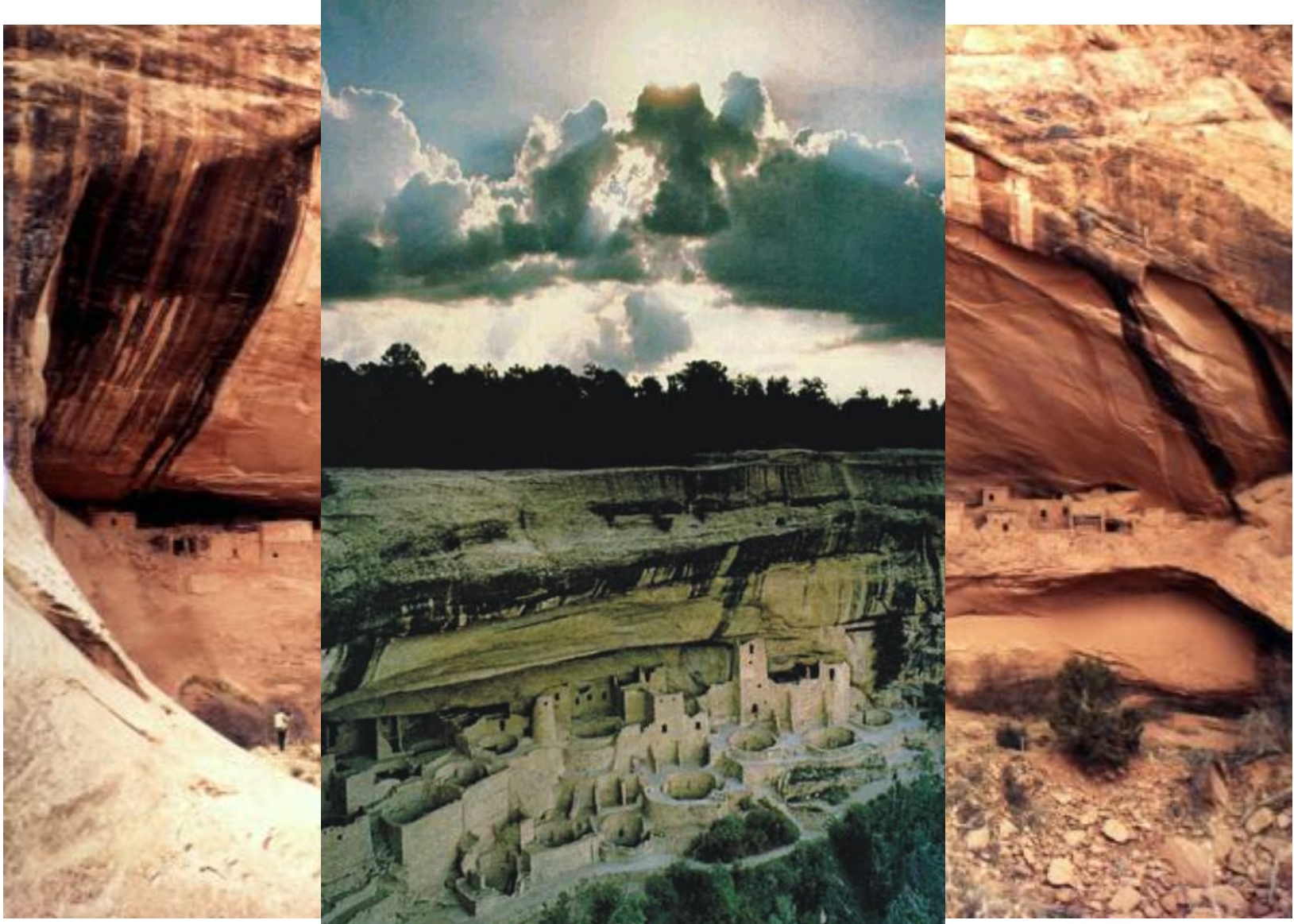


Which trees can be crossdated?

1. Distinct and detectable rings
2. Reliably annual ring formation
3. Ring formation is sensitive to environmental conditions
4. Sensitivity is reflected in variability among rings (years)
5. Strong common patterns of properties such as ring width

First Major Breakthrough with Tree-Rings: Dendro - archeology

When were the great cliff dwelling of the Southwest built and abandoned?





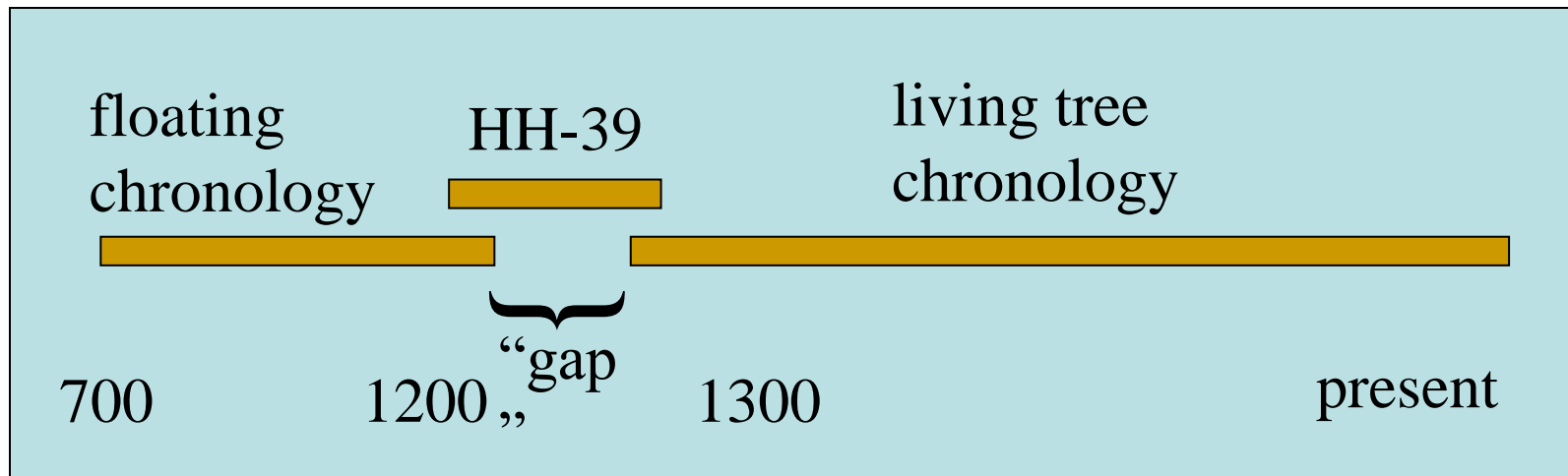
The search for tree rings that would “bridge the gap” between living trees and the beams in abandoned cliff dwellings included the sampling of beams in Hopi villages.



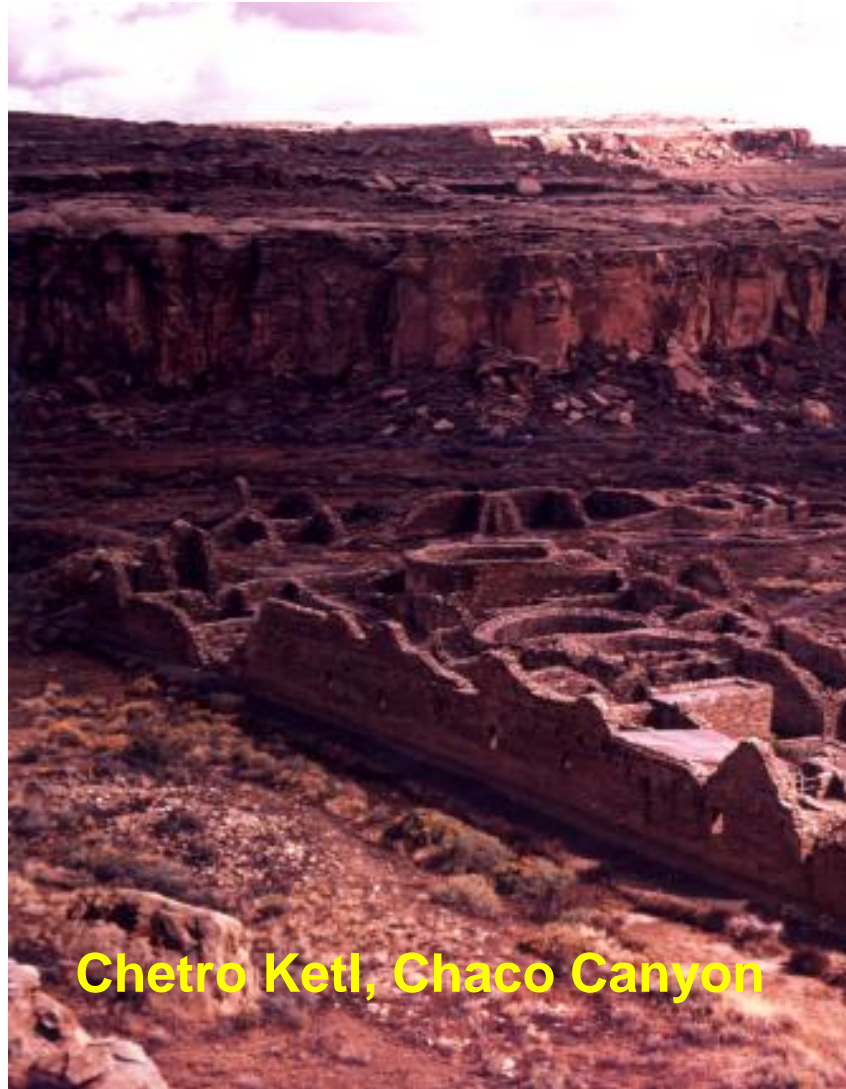
Stuck in the mud! National Geographic Society sponsored “Beam Expeditions” 1920s



Excavating specimen HH-39, which “bridged the gap” – Show Low, Arizona, July 22, 1929



Thousands of wooden roof and floor beams have been recovered from Chaco Canyon, enabling tree-ring scientists to precisely date the periods of constructions of these massive stone townhouses.



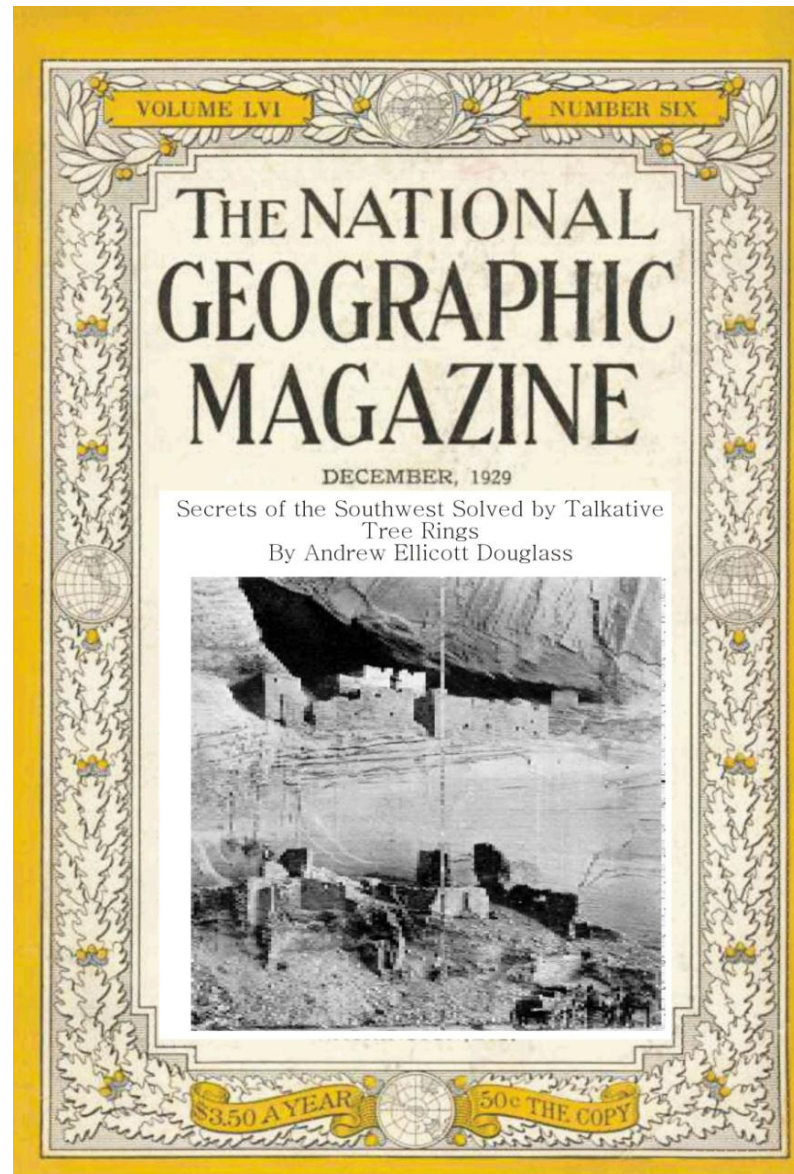
Chetro Ketl, Chaco Canyon



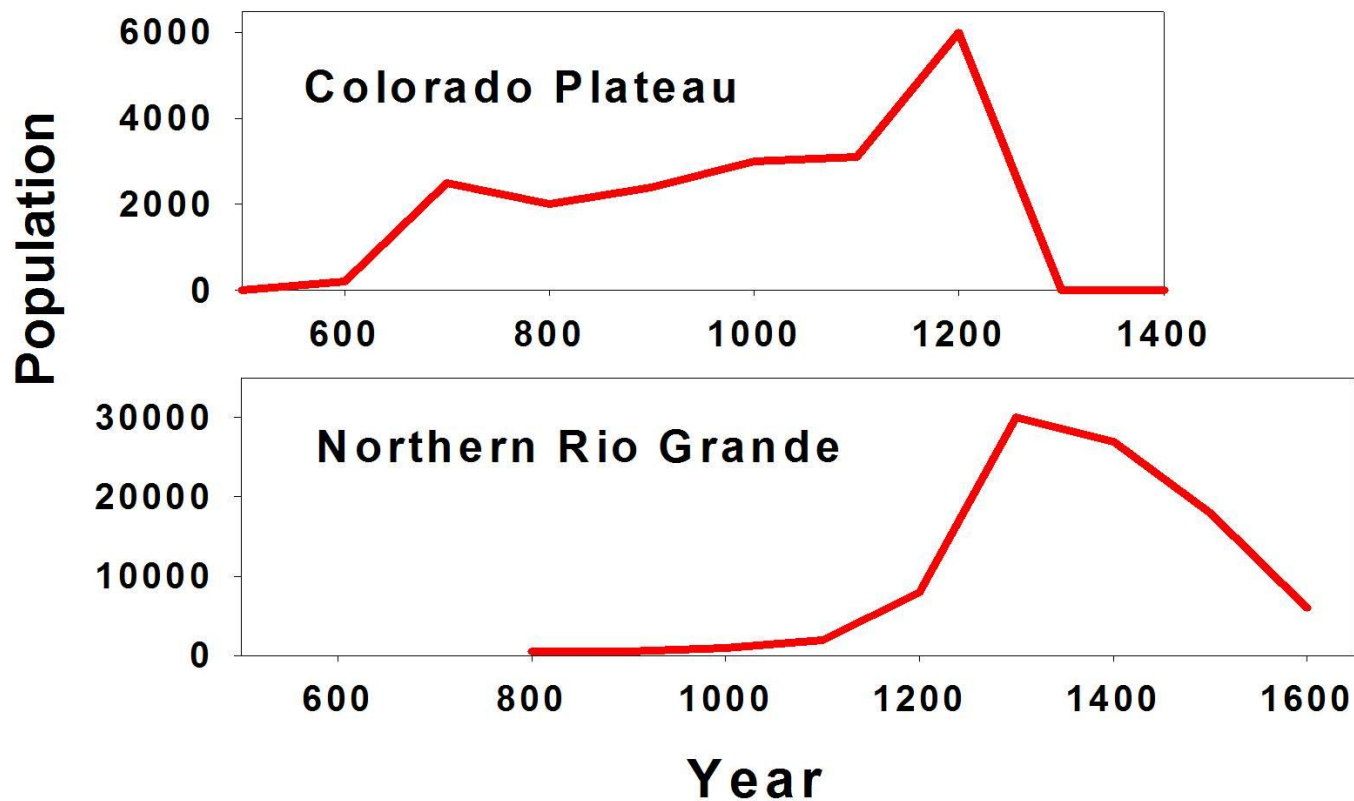
Photograph by O. C. Havens

CEILING POLES IN ONE OF THE ROOMS OF PUEBLO DEL ARROYO, CHACO CANYON

“Secrets of the Southwest Solved by Talkative Tree Rings”, by A. E. Douglass, National Geographic magazine, December 1929

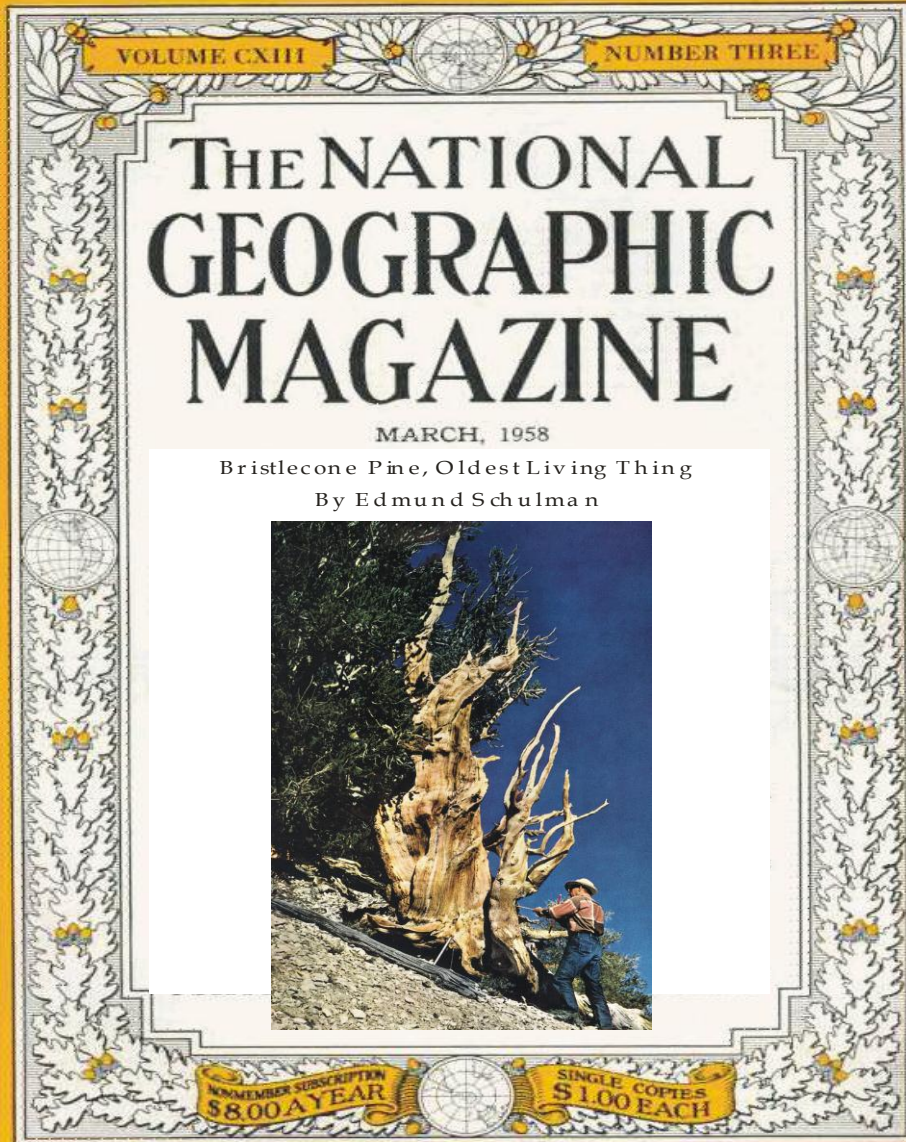


Population estimates from tree-ring dated dwellings indicate nearly total abandonment of the Colorado Plateau by AD 1300, while a major influx of people occurred in northern New Mexico at this time.



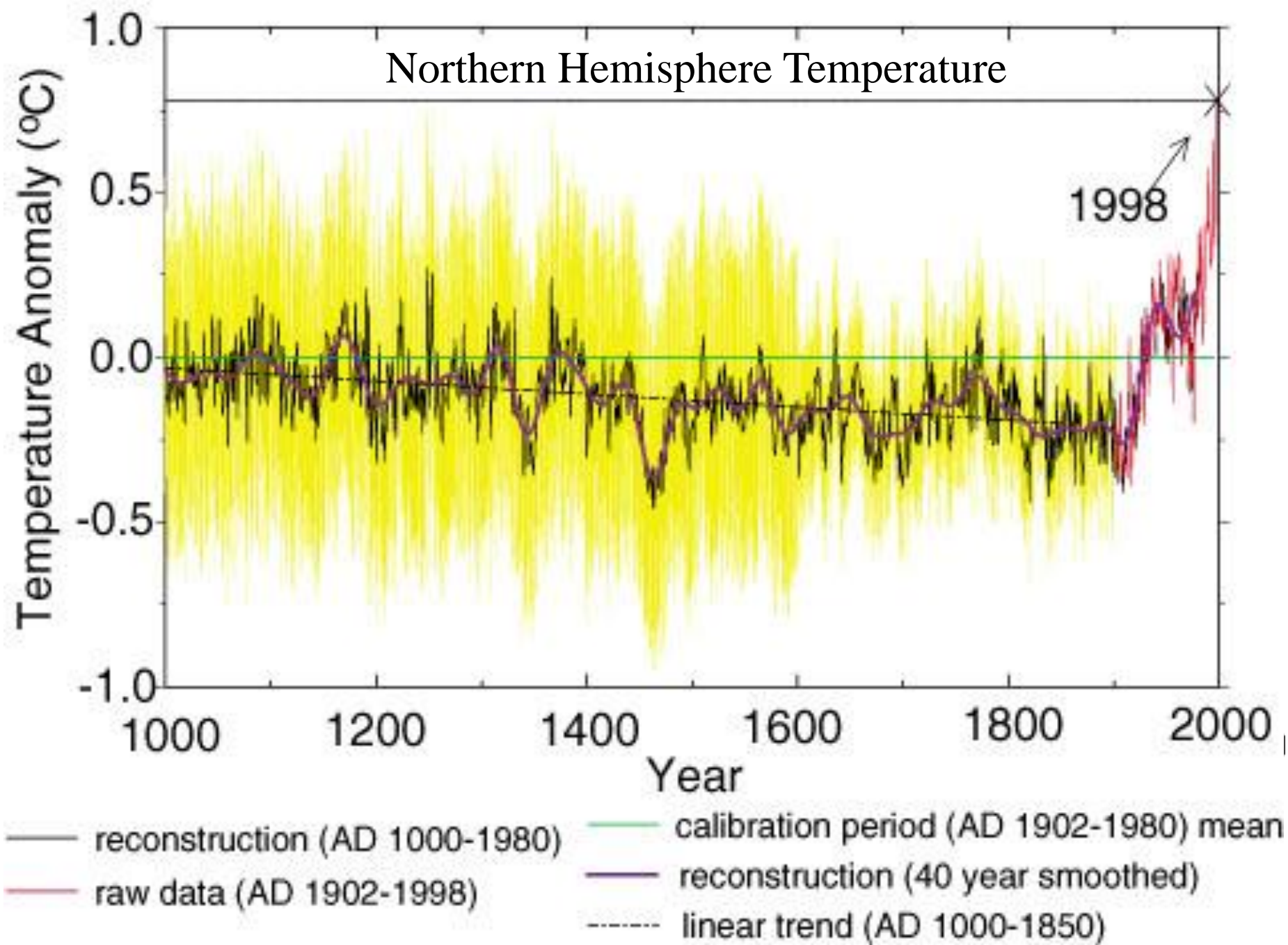
From Dean, Doelle, & Orcutt 1994

Ancient Bristlecone Pine

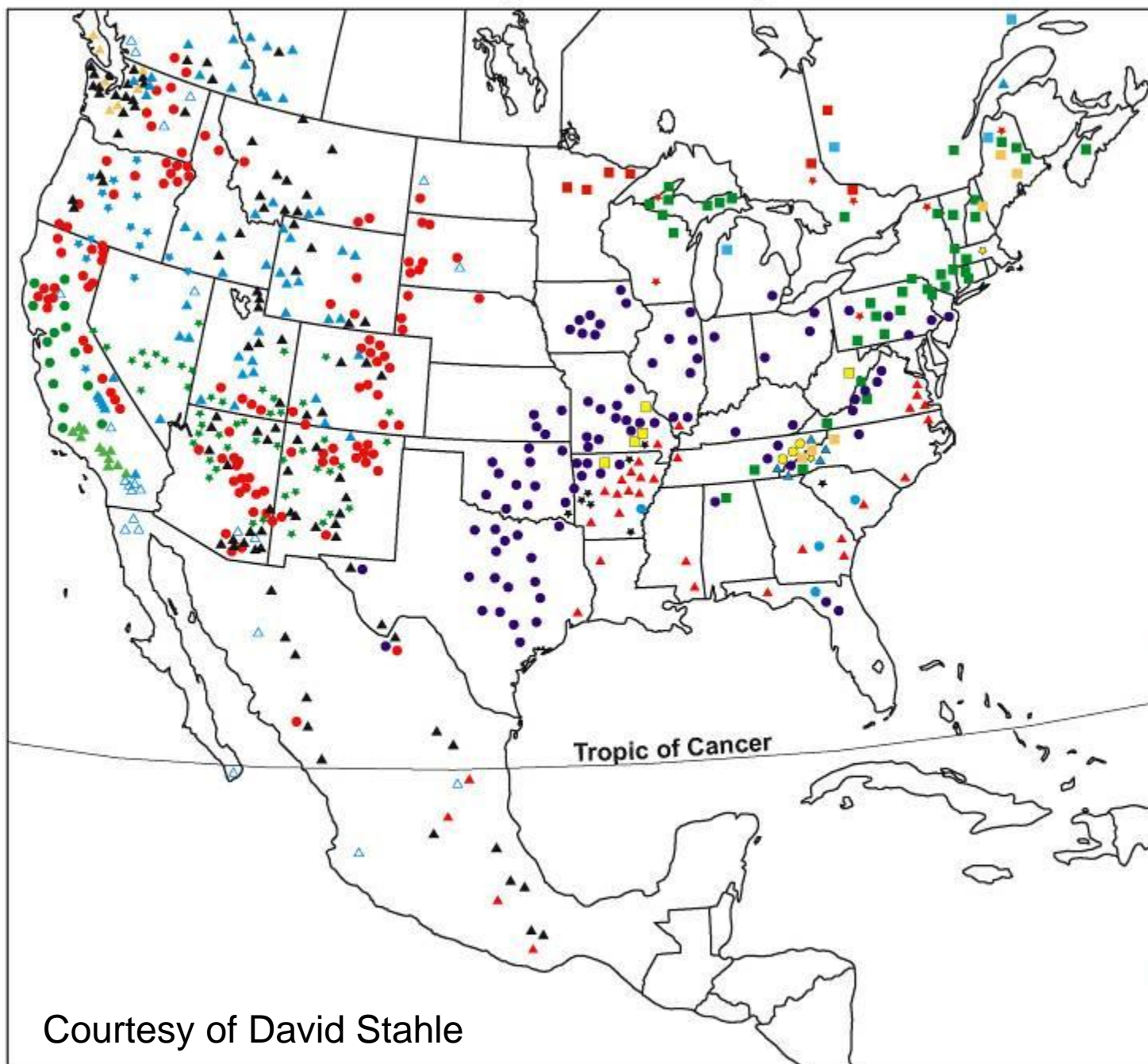


Used to calibrate C-14 curve

Now crossdated back to 6800 B.C.!!!



Tree-Ring Chronologies



Eastern

- White Oak Group
- Hemlock
- ▲ Baldcypress
- Tulip Poplar
- Overcup Oak
- ★ Northern Red Oak
- ▲ American Chestnut
- Eastern Red Cedar
- Northern White Cedar
- Red Pine
- ★ Shortleaf Pine
- ★ E. White Pine
- Red Spruce

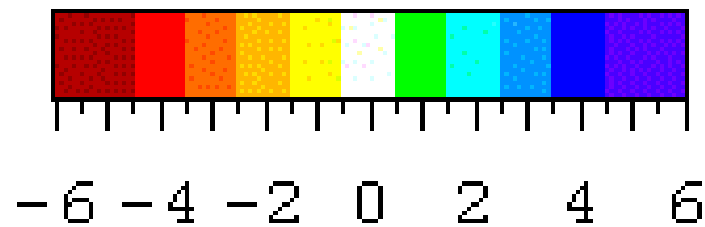
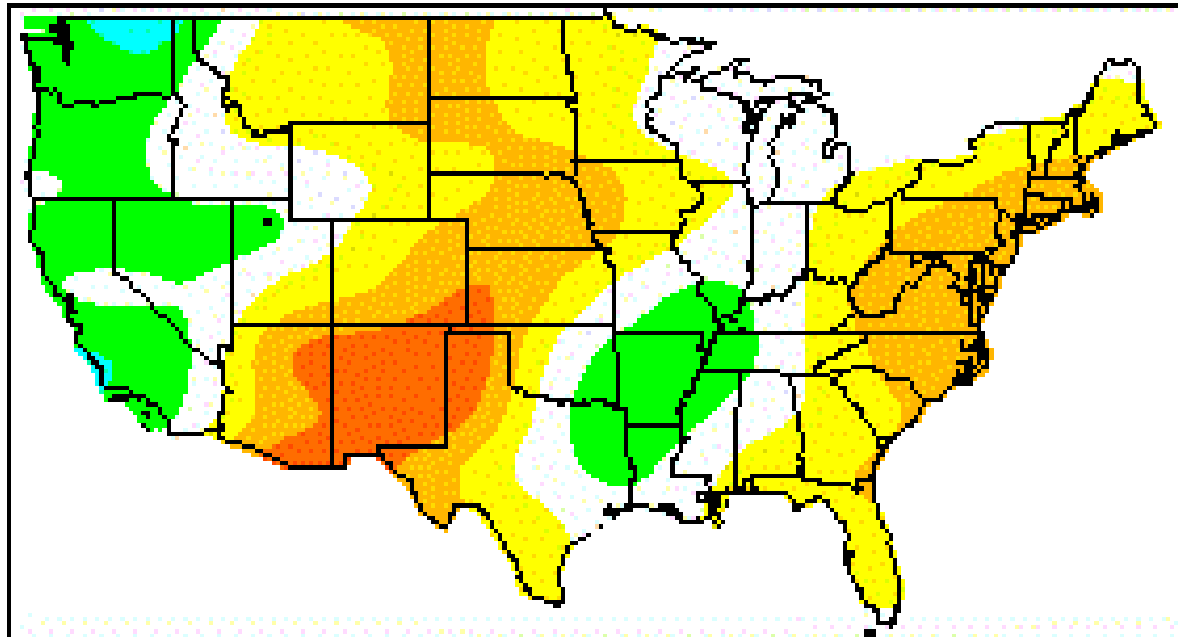
Western

- Ponderosa Pine
- ▲ Douglas-fir
- ▲ Big Cone Douglas-fir
- ▲ High Elevation Conifer
- ▲ Mountain Hemlock
- ▲ Other Conifer
- ★ Pinyon Pine
- ★ Western Juniper
- Blue Oak / Valley Oak

Courtesy of David Stahle

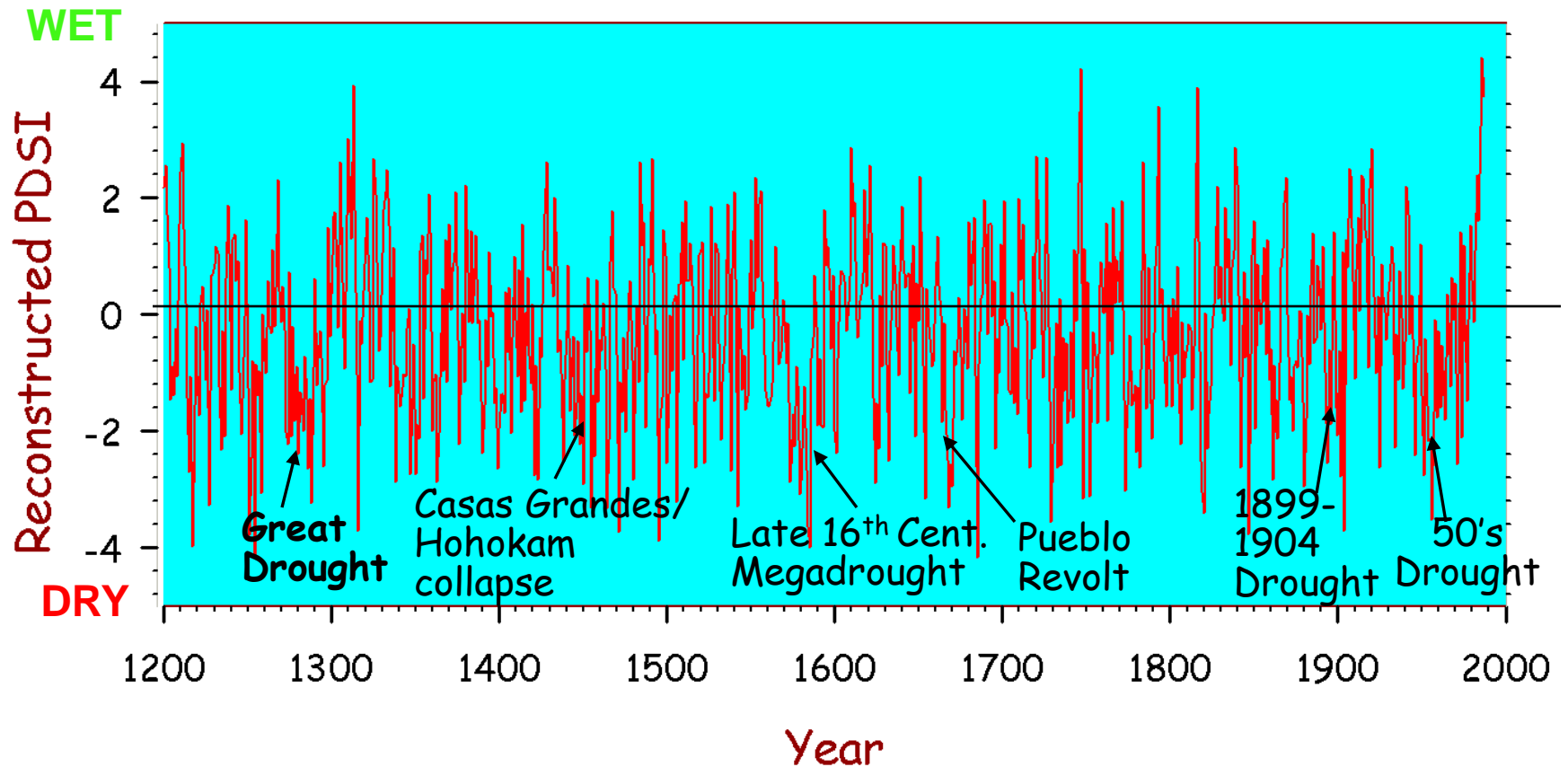
Reconstructed drought patterns

1819



Reconstructed Drought Index for the SW United States, AD 1200 to 2000.

Cook's Southwest Drought Index



Major disciplines of Dendrochronology

Dendro +

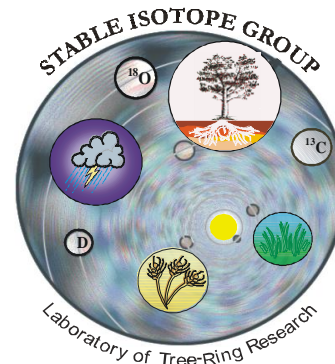


Climatology

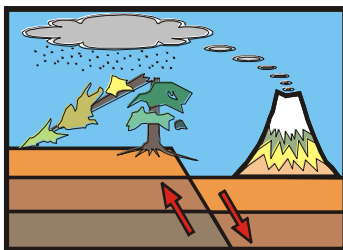


Fire History

Ecology



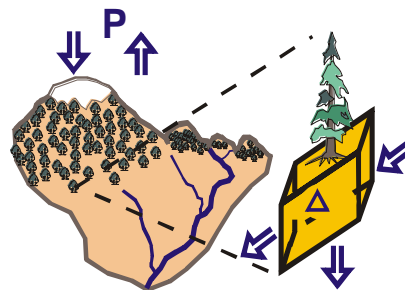
Stable Isotopes



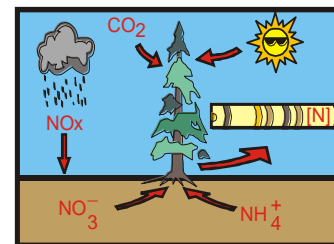
Geology



Archaeology



Hydrology

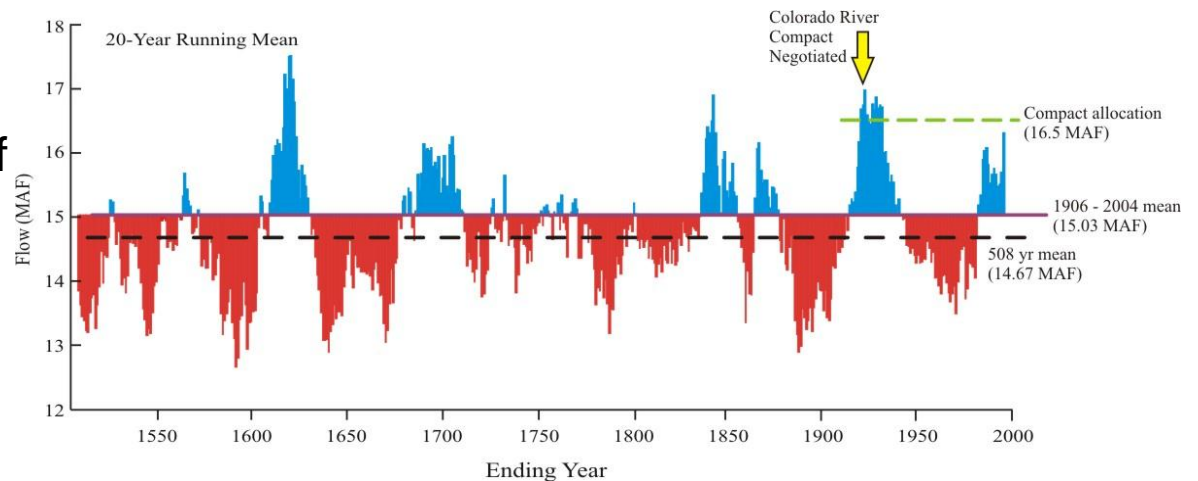


Biogeochemistry

Dendro - hydrology

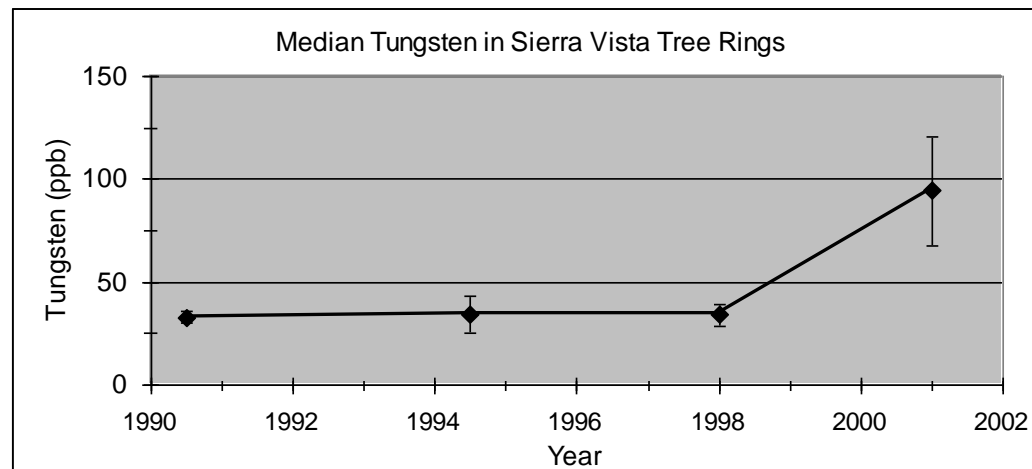
Reconstructed streamflow to aid in water resource management

Tree-ring reconstructed flow of the Colorado River, show that flow levels during the period used to establish the Colorado Compact were among the highest in the past 500 years. This resulted in overestimation of available water in the Colorado River.



Dendro – chemistry

Tree rings reveal increased levels of chemicals at locations of childhood leukemia clusters in Fallon, Nevada, Sierra Vista, Arizona, and Calvine-Florin, California.



Dendro – ecology

Forest Fires & Climate

Reconstructed
giant sequoia fire
scar record goes
back > 3000 yrs!

