Shrinking and Checking in Roundwood

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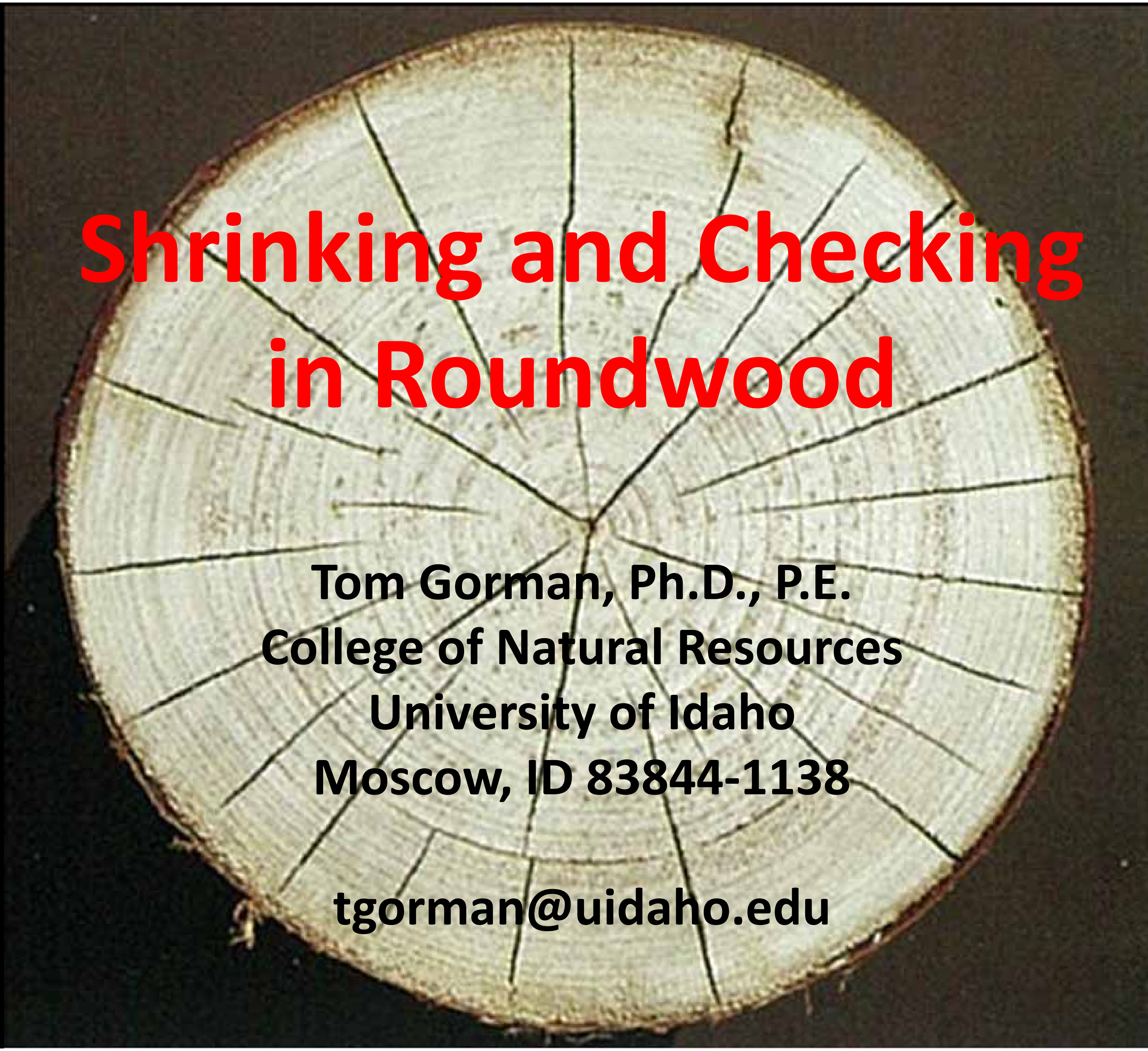


Completely Revised and Updated

UNDERSTANDING WOOD

A CRAFTSMAN'S GUIDE TO WOOD TECHNOLOGY

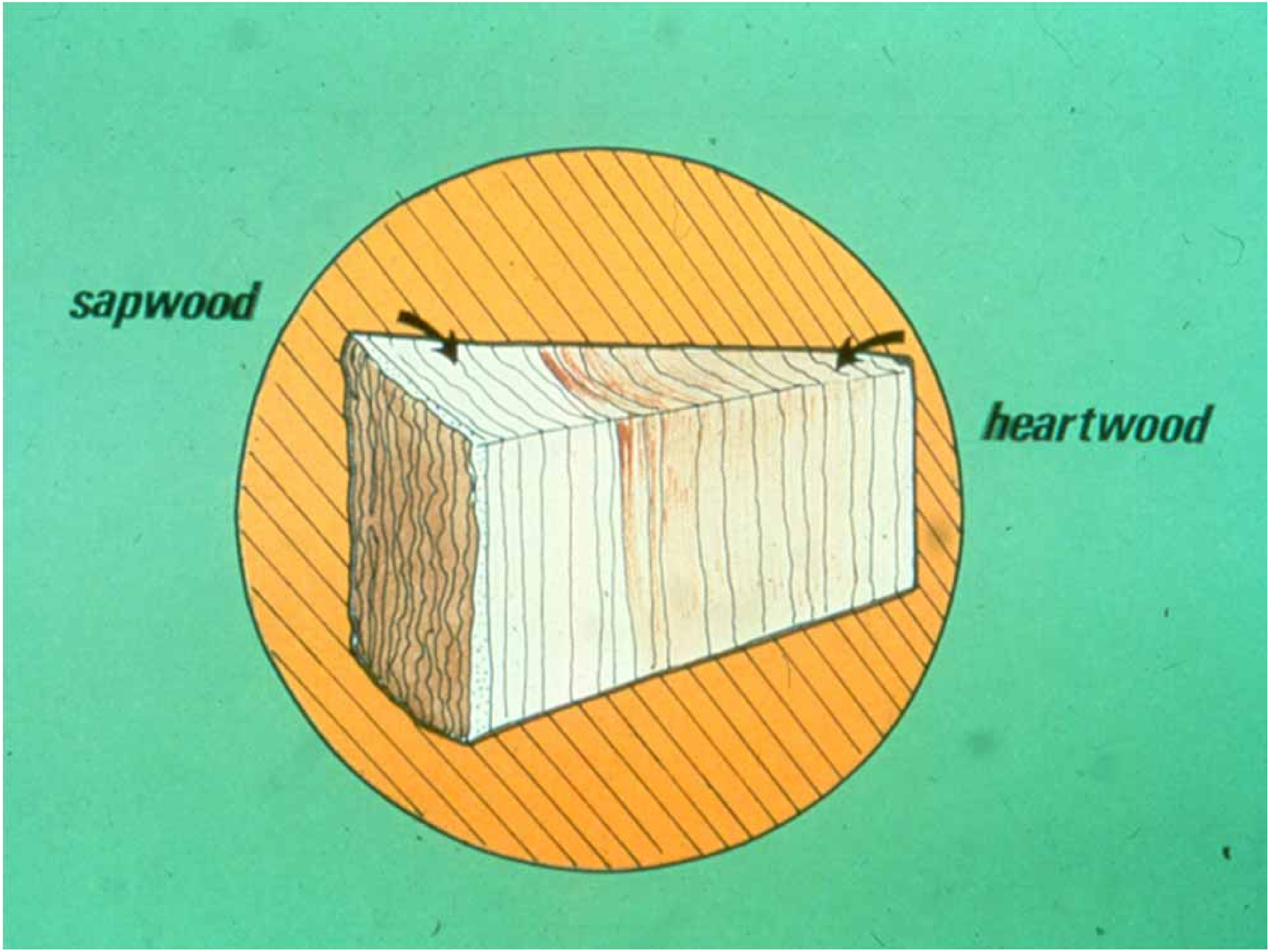
R. Bruce Hoadley

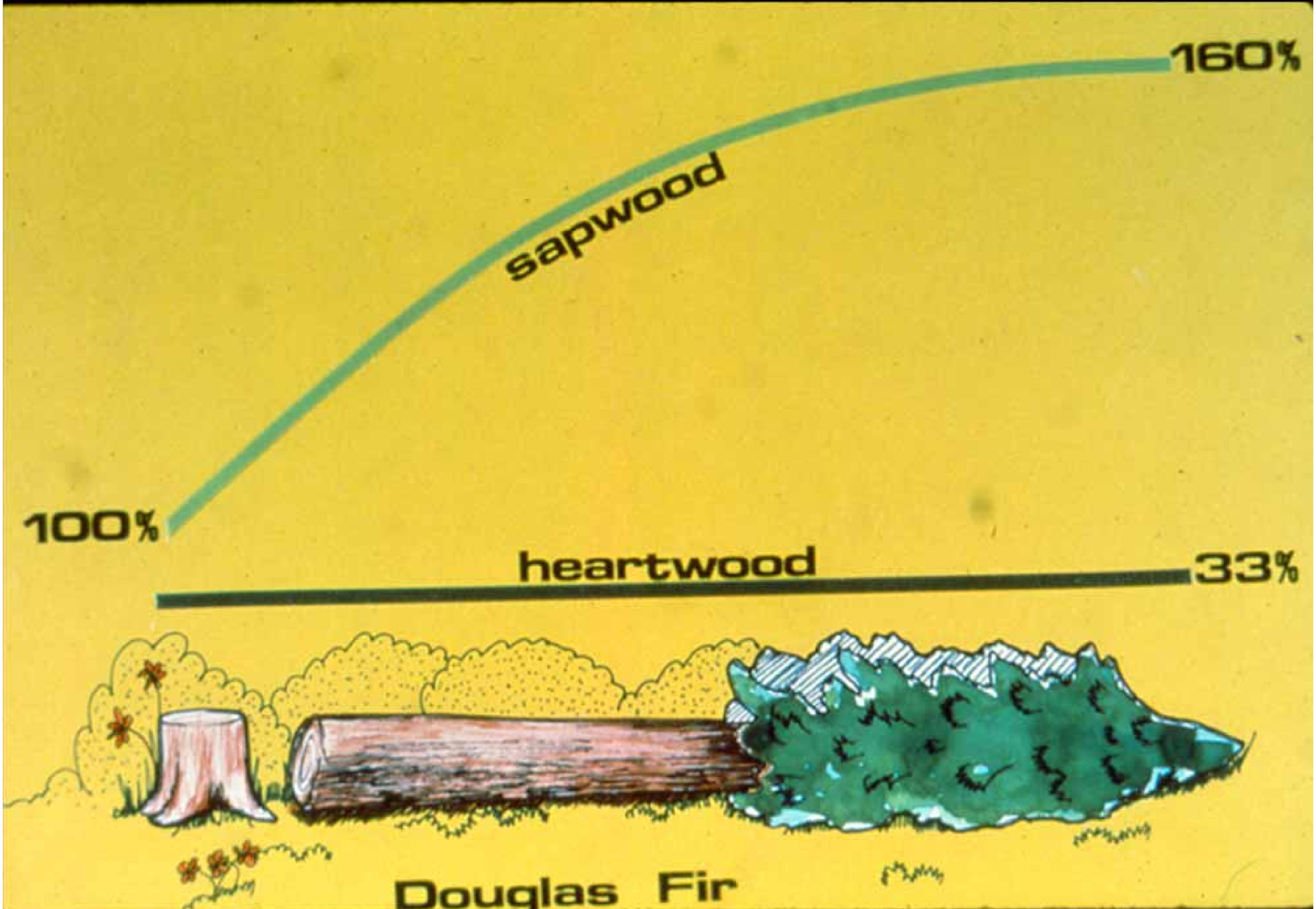
Shrinking and checking is the result of:

Moisture loss

Uneven shrinkage

WOOD MOISTURE


sapwood
heartwood

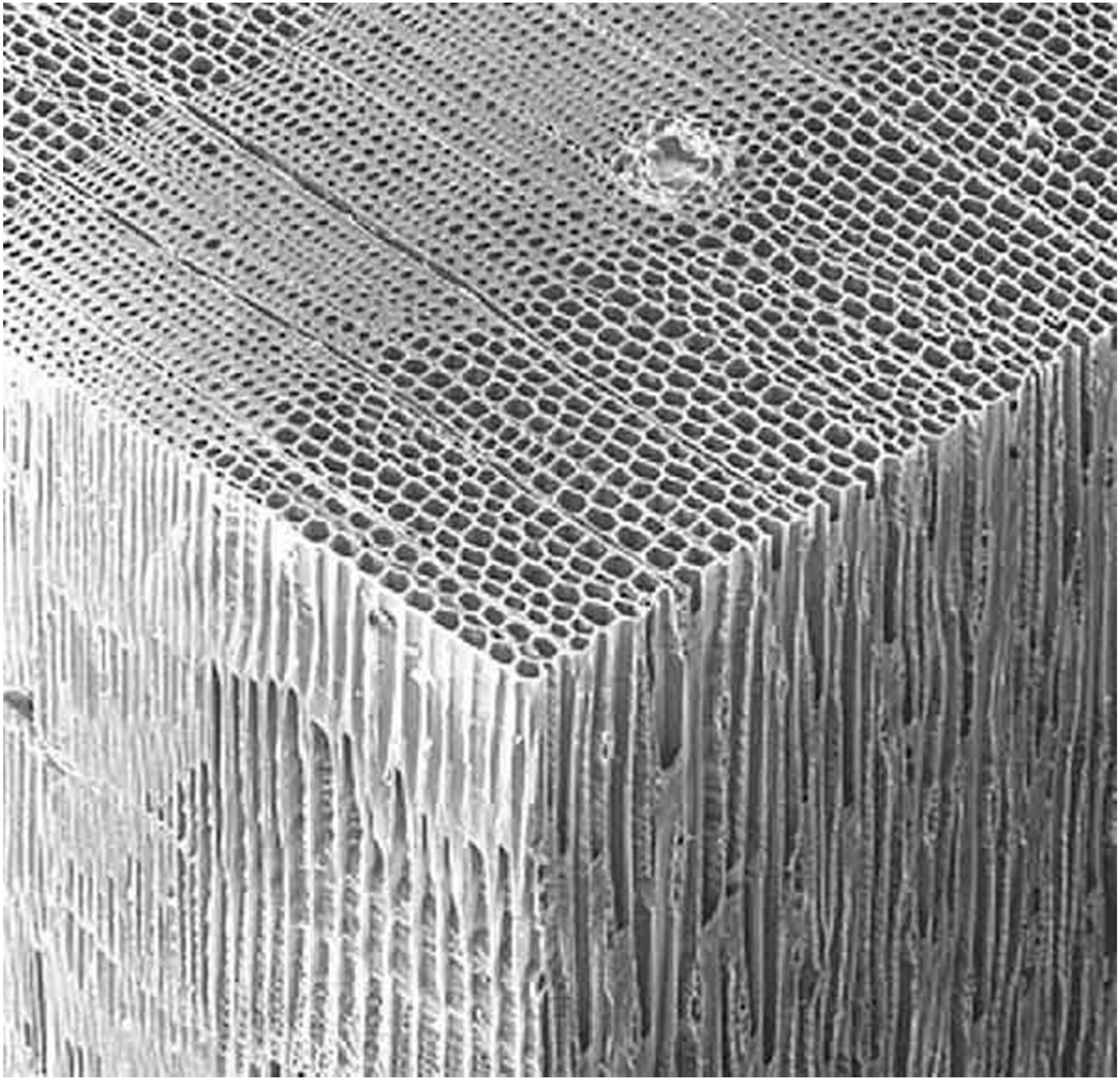


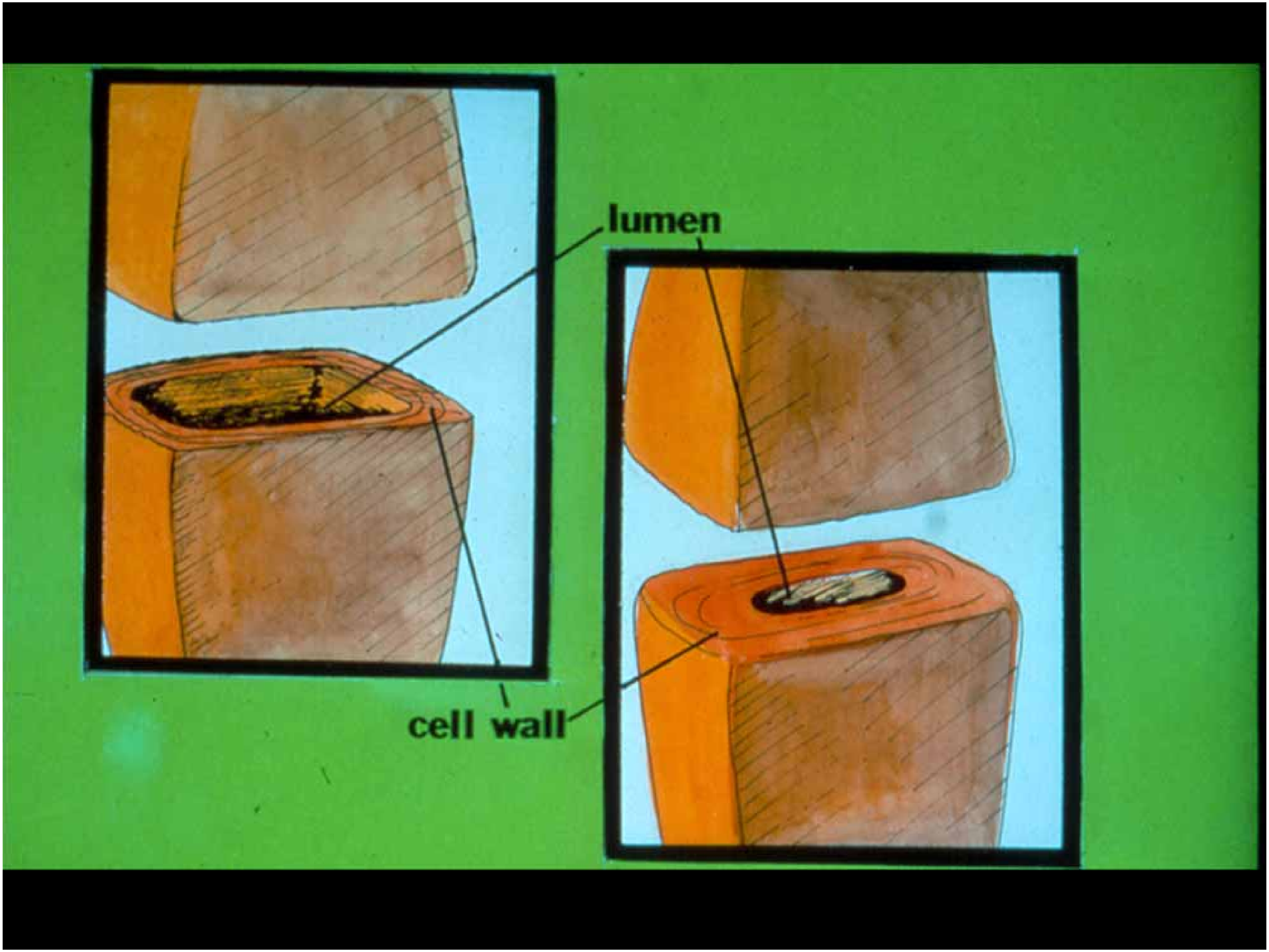
160%
sapwood
100%
heartwood
33%
Douglas Fir

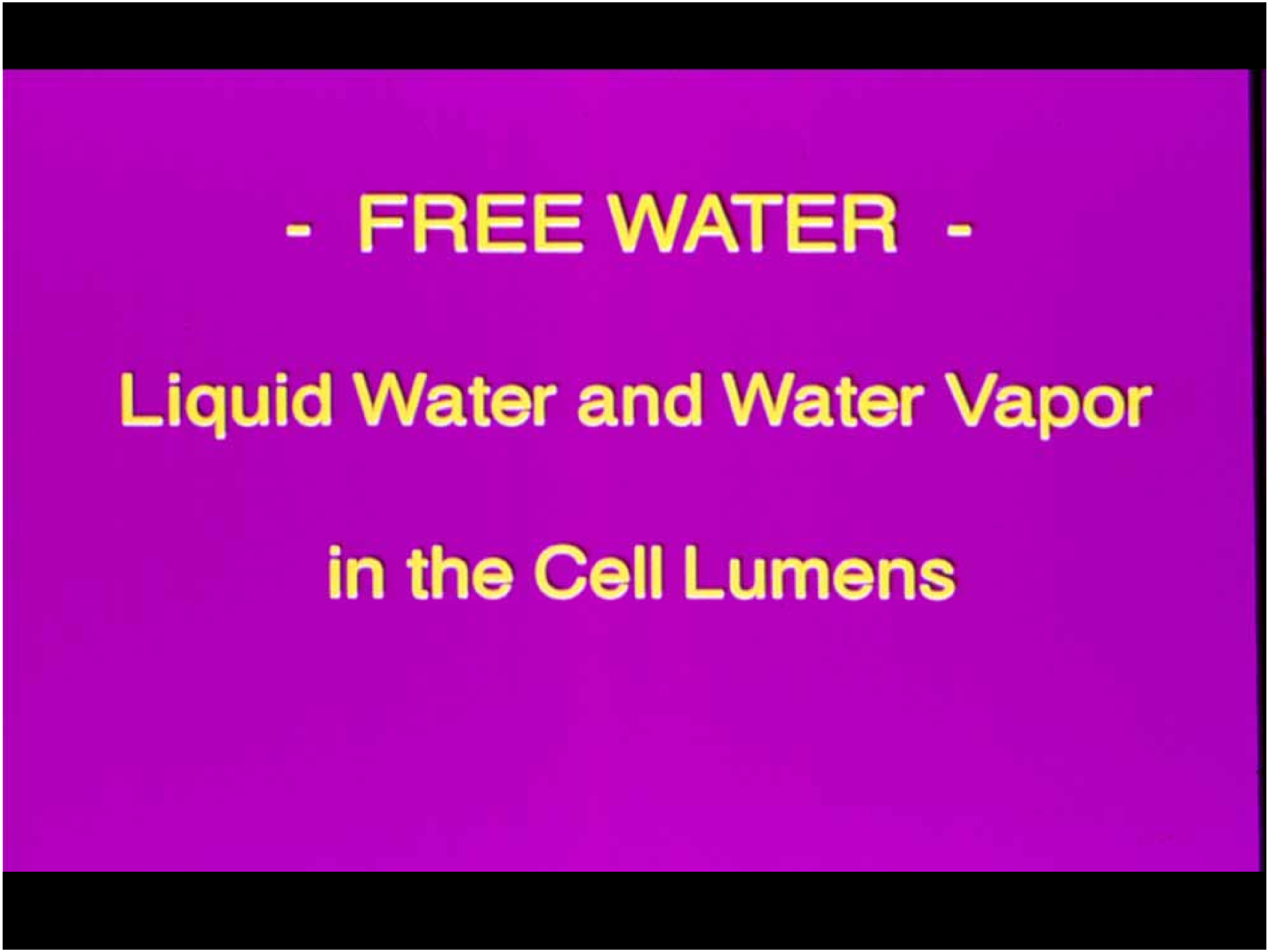
Moisture content of freshly sawn logs

Species	Heartwood	Sapwood
Engelmann spruce	51	173
White pine	62	148
Lodgepole pine	41	120
Douglas fir	37	115
Western redcedar	58	249
Ponderosa pine	40	148
Grand fir	91	136
Western hemlock	85	170

Source: Wood Handbook. 2010. USDA Forest Products Laboratory, Madison, WI



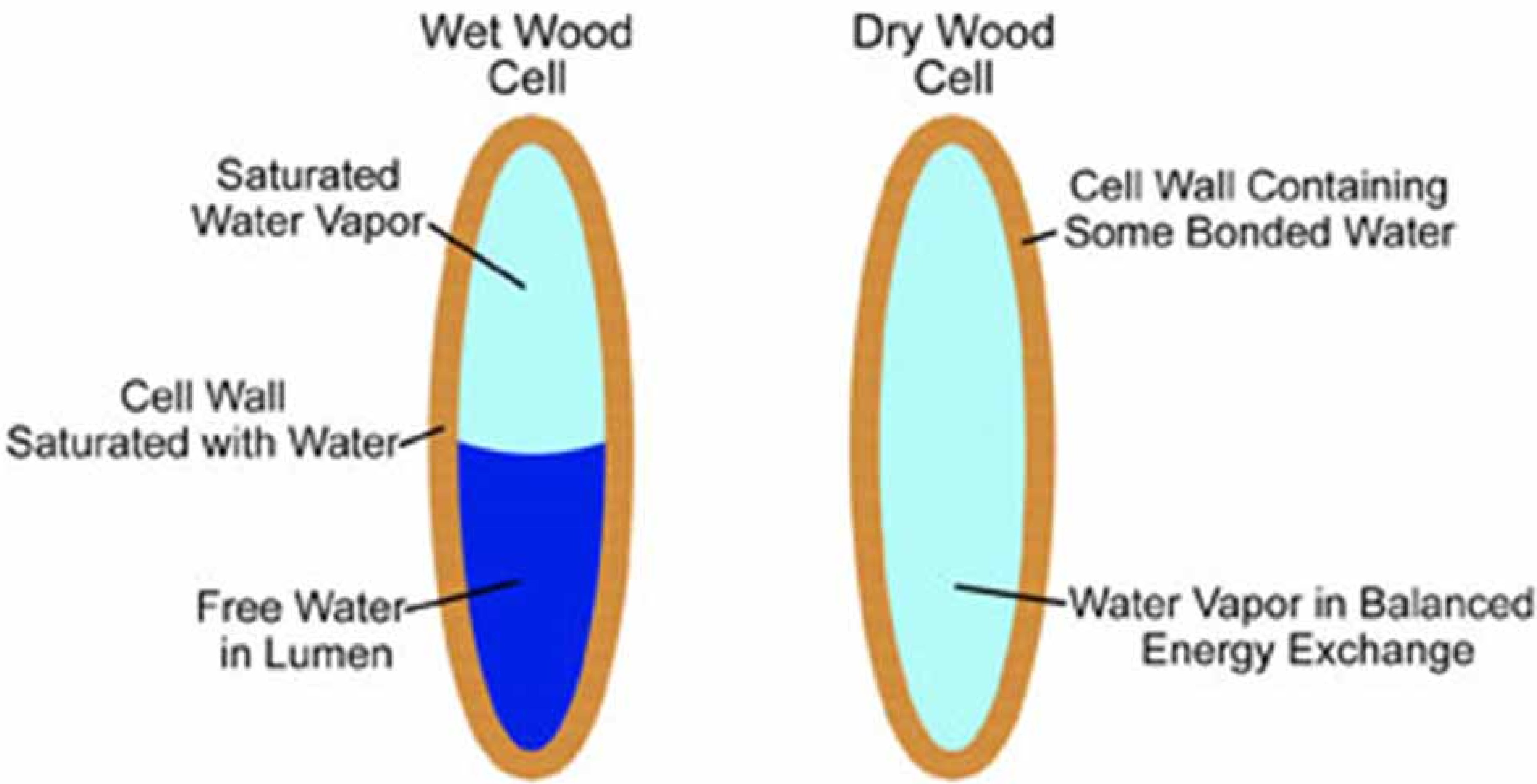

lumen
cell wall


- FREE WATER -
Liquid Water and Water Vapor
in the Cell Lumens

- BOUND WATER -

Water in Cell Walls Bound to Molecular Structure of Wood

(sorption sites)



Wet Wood
Cell
Saturated
Water Vapor
Cell Wall
Saturated with Water
Free Water
in Lumen
Dry Wood
Cell
Cell Wall Containing
Some Bonded Water
Water Vapor in Balanced
Energy Exchange

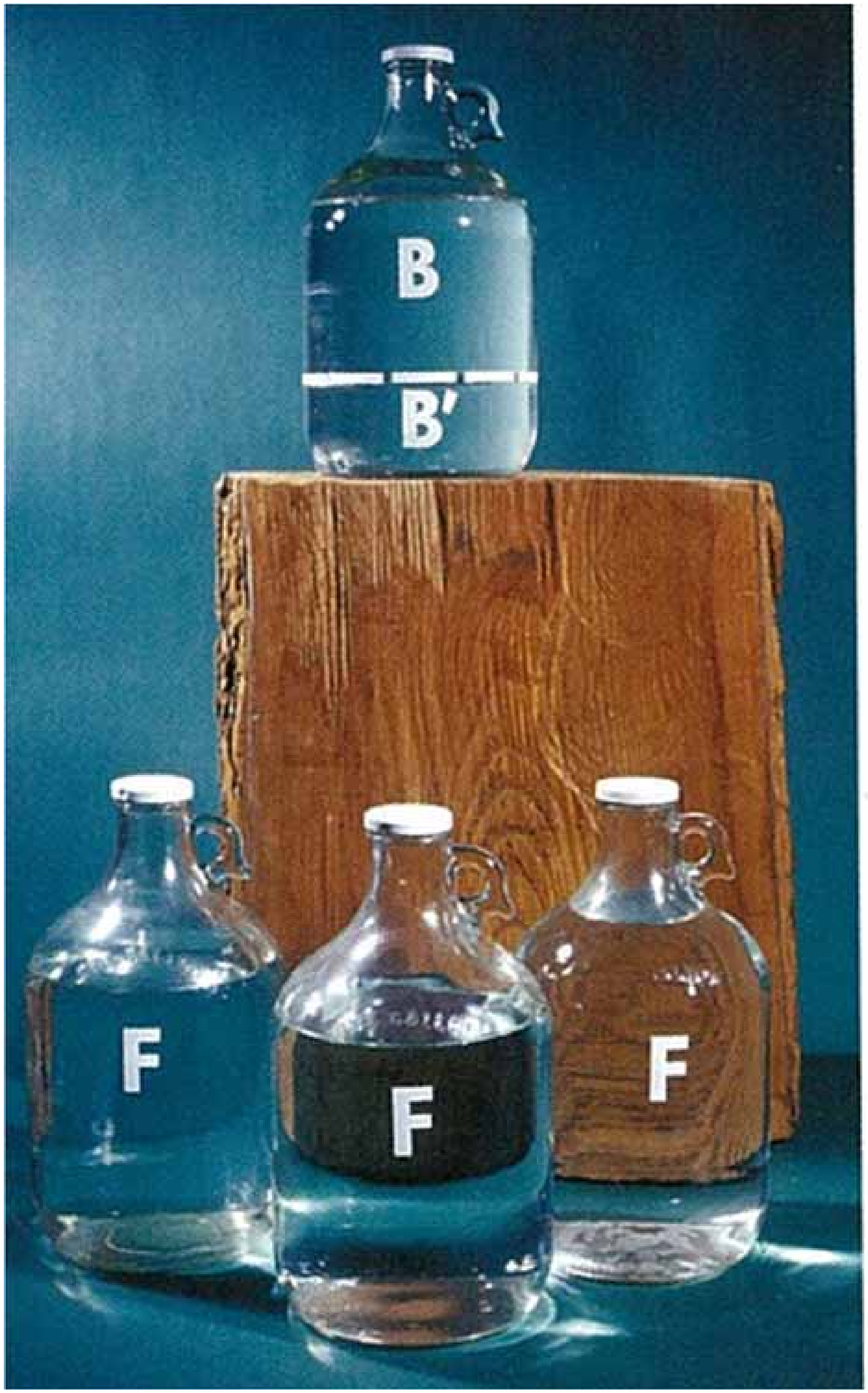
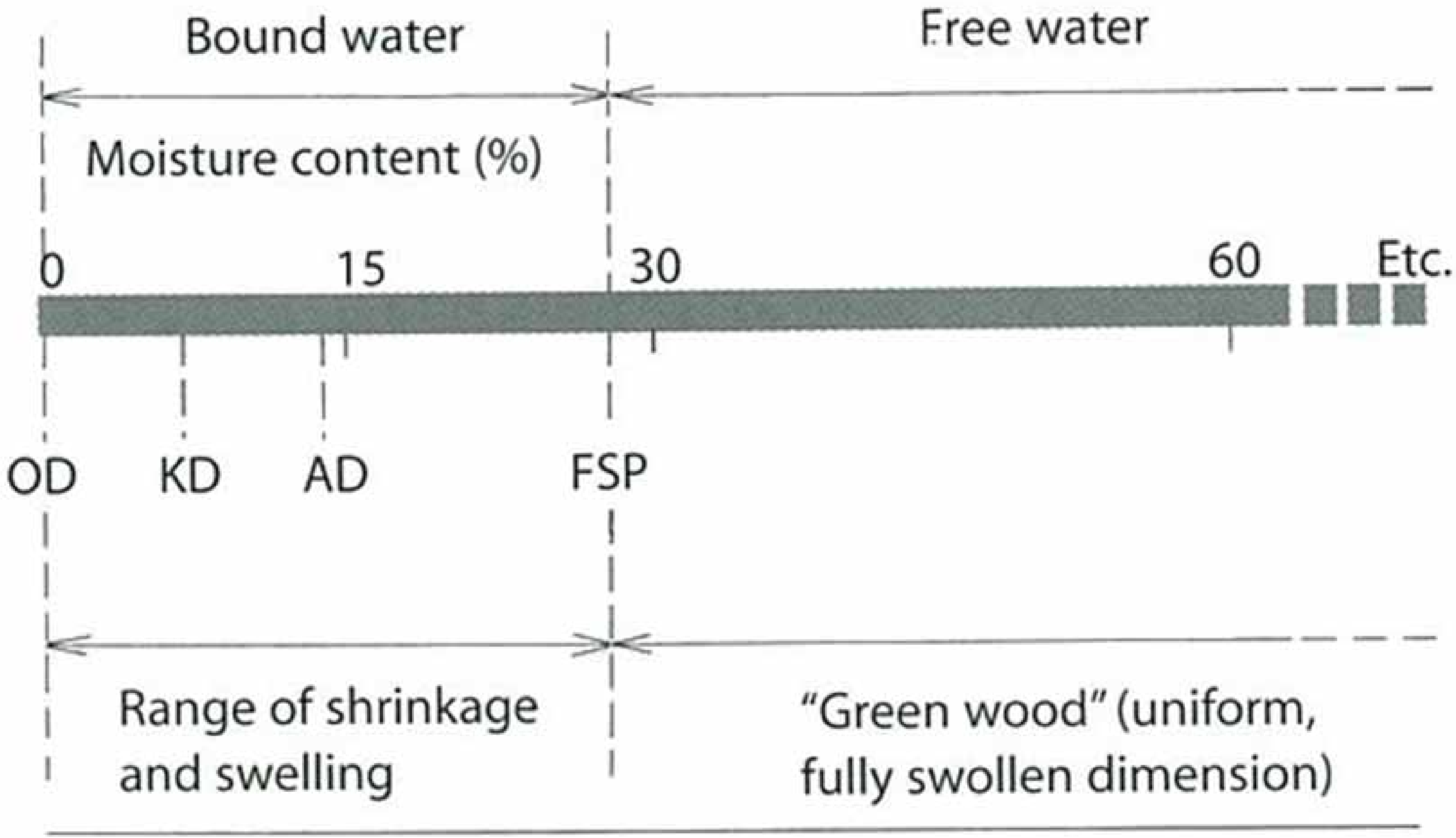


Figure 6.4 • This piece of catalpa had a moisture content of 114% and weighed almost 60 lb. when cut. When dried to 8% MC (for carving), it weighed only 30 lb. The gallon jugs show the amount of free water (F) and bound water (B) that was lost in drying. Some bound water (equivalent to B') still remains in the wood at 8% MC. (Photo by Randy O'Rourke)



OD = Oven-dry

KD = Typical value of lumber kiln-dried for furniture (7%)

AD = Typical value of air-dried lumber (14%)

FSP = Fiber saturation point (28%)

SHRINKING AND SWELLING OF WOOD

SHRINKING OR SWELLING

OCCURS WITH LOSS OR GAIN

OF BOUND WATER

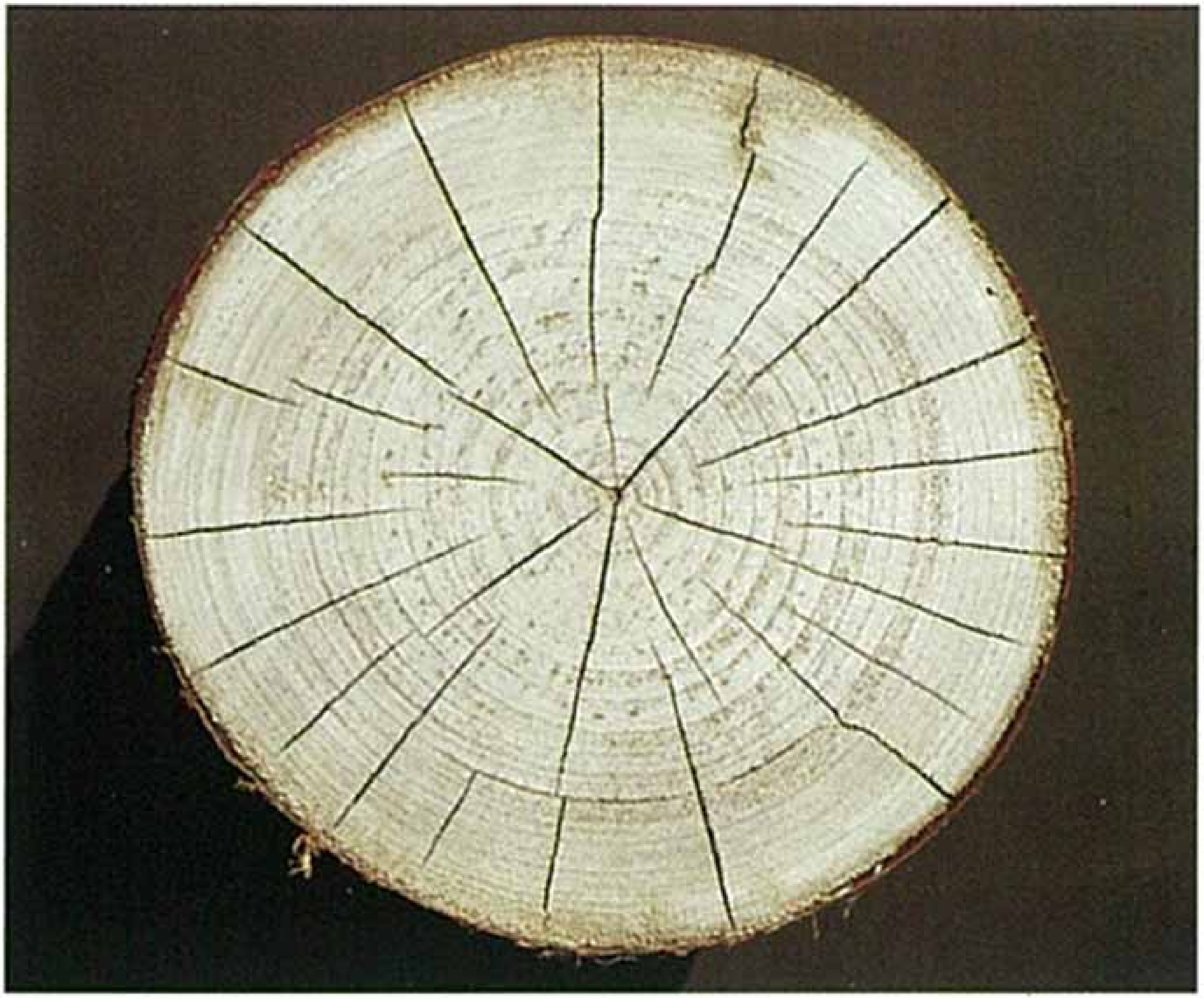
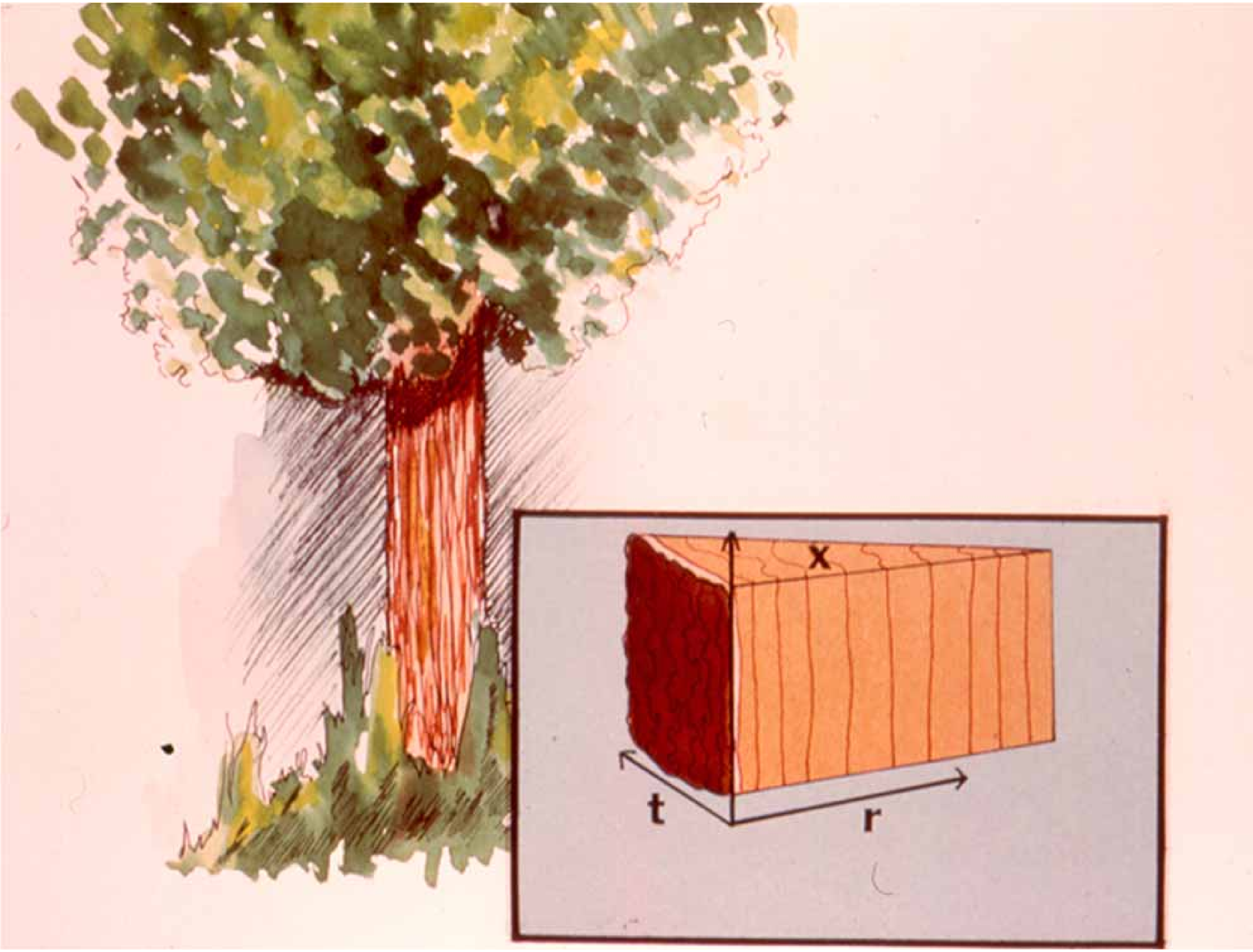


Figure 6.28 • The ends of logs dry first, and the resulting shrinkage causes end-grain checks, as shown here in cherry. (Photo by R. Bruce Hoadley)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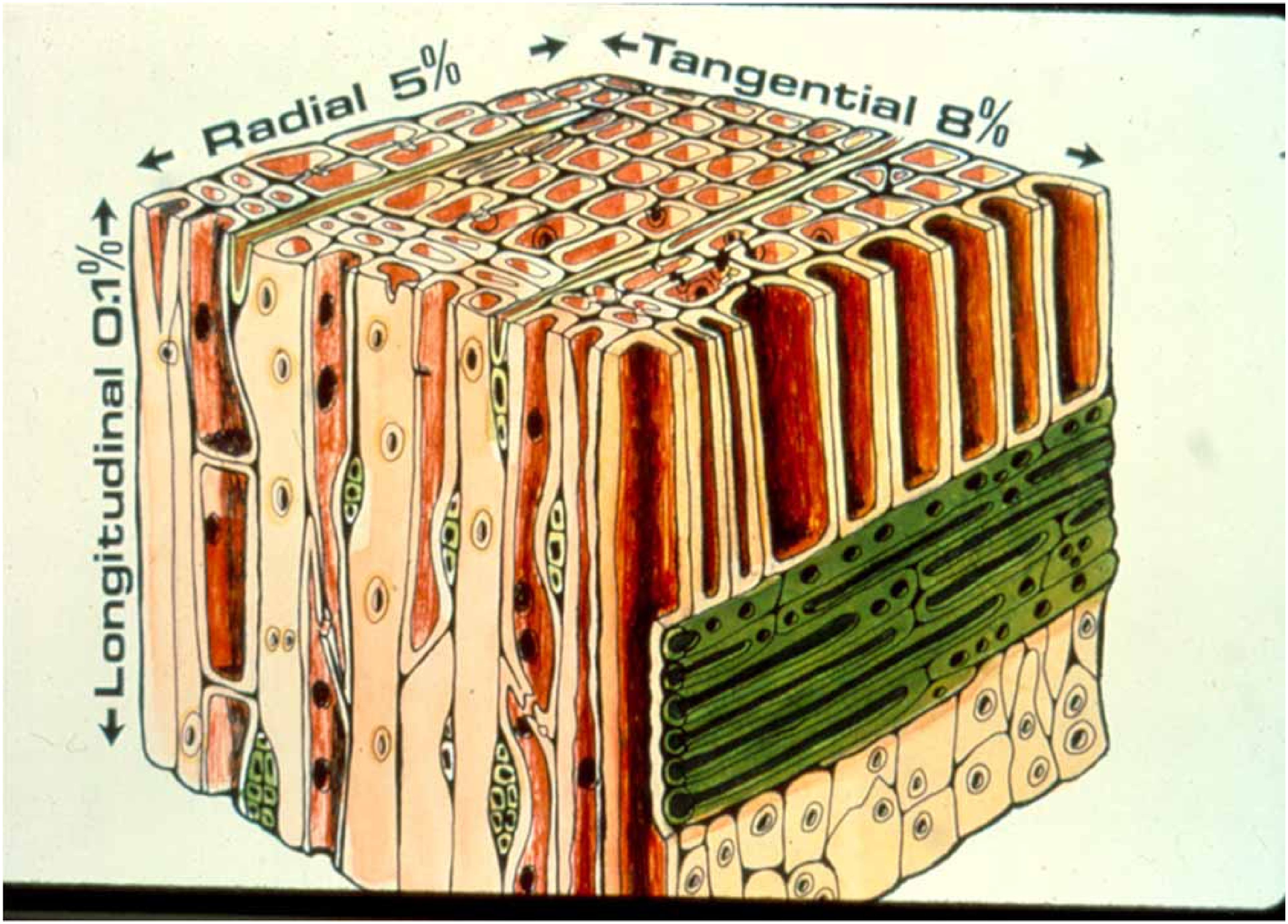


Radial 5%
Tangential 8%
Longitudinal 0.1%

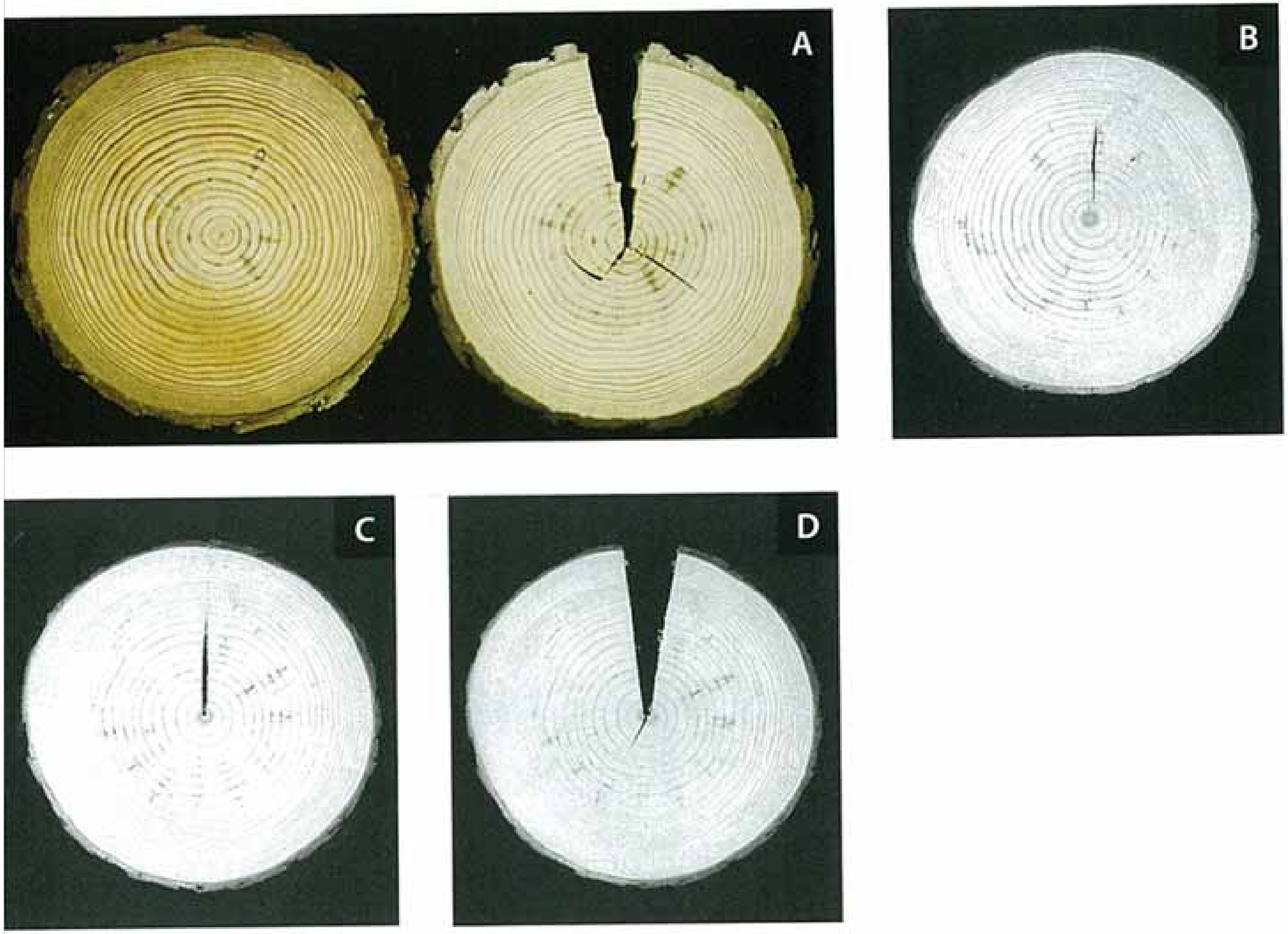
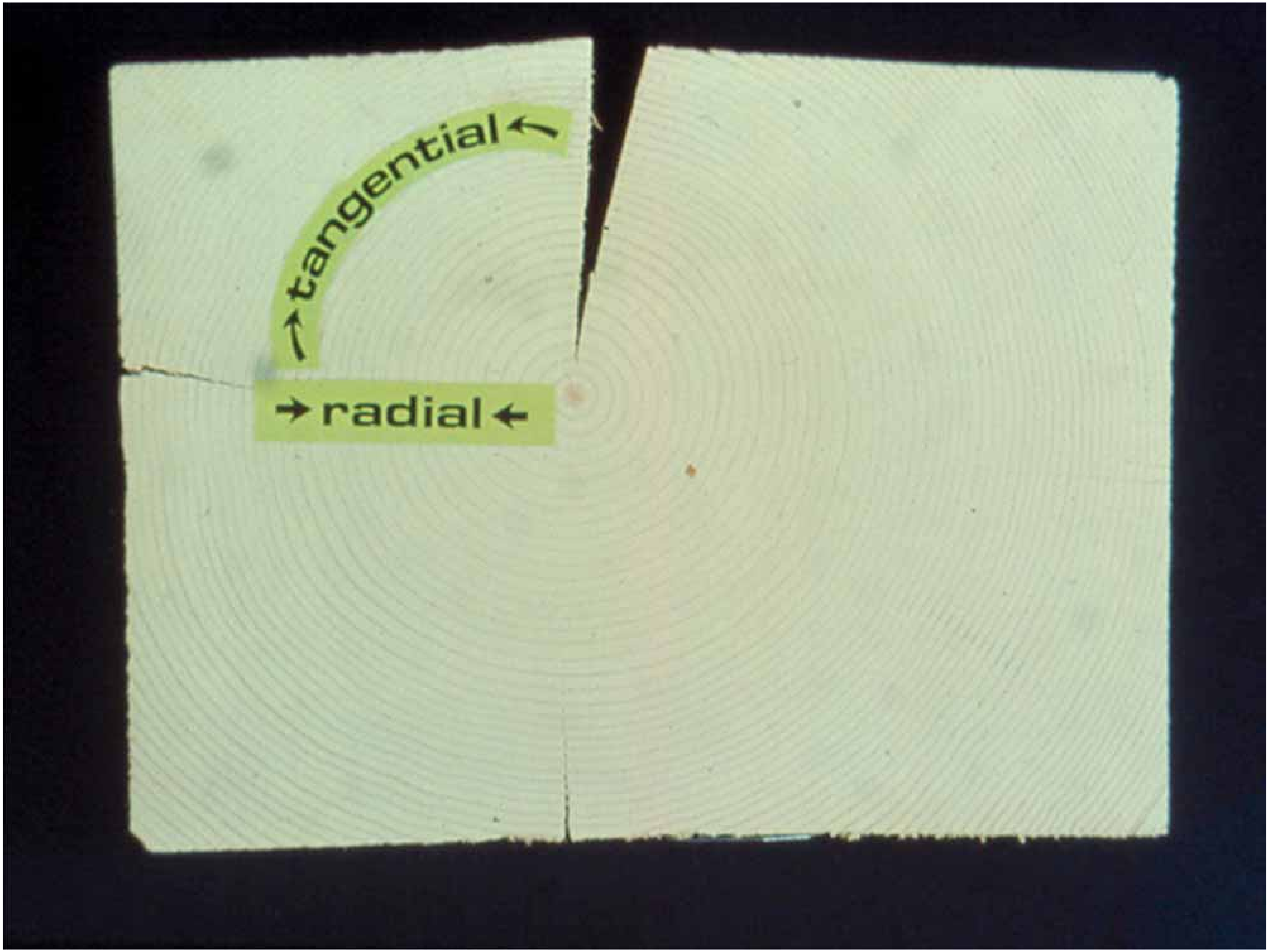


Figure 6.20 • The results of drying cross-sectional disks of red pine. When a green disk (A, left) dries, the greater tangential shrinkage results in a radial crack (A, right). As a disk dries, the crack may open first near the pith (B) because the hardwood has a lower moisture content and shrinks first. (It would later open as in A, right). If a disk first has a radial slot sawn in it, the slot may open first in the heartwood (C), and eventually the unrestrained disk opens the slot wide (D). (Photo A by R. Bruce Hoadley; photos B, C, D by Richard Starr)

Shrinkage values for western softwoods

Species	Tangential	Radial	T/R
Engelmann spruce	7.1	3.8	1.9
White pine	7.4	4.1	1.8
Lodgepole pine	6.7	4.3	1.6
Subalpine fir	7.4	2.6	2.8
Douglas fir	7.6	4.1	1.9
Western redcedar	5.0	2.4	2.1
Ponderosa pine	6.2	3.9	1.6
Grand fir	7.5	3.4	2.2
Western hemlock	7.9	4.3	1.8

Source: Wood Handbook. 2010. USDA Forest Products Laboratory, Madison, WI


tangential
radial

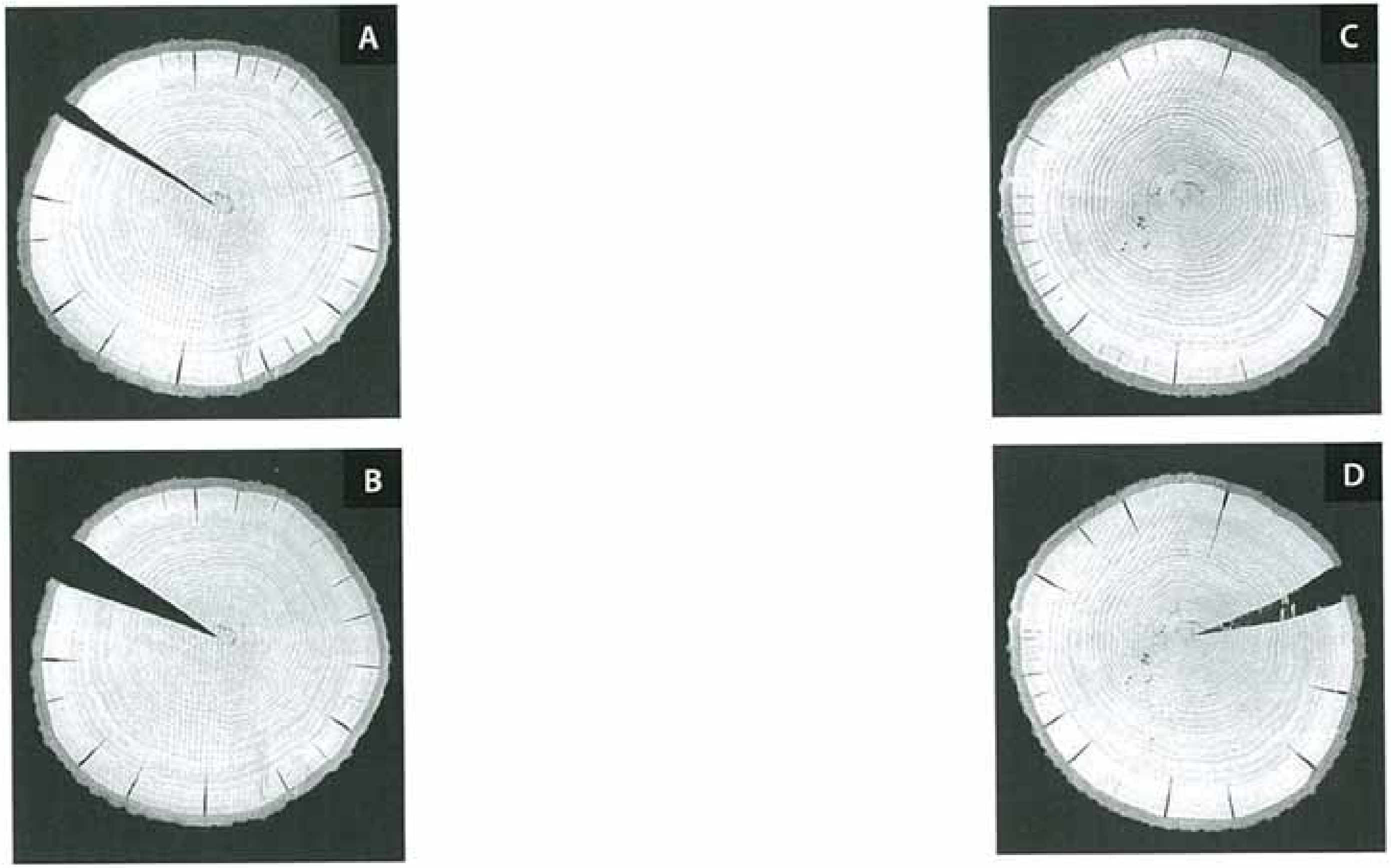


Figure 6.21 • Results of drying cross-sectional disks of northern red oak. This disk had a radial slot sawn in it (A). Because of heartwood extractives, the sapwood dries first and shrinks more, resulting in radial sapwood checks. When the heartwood dries, the slot opens wide (B). A disk without a slot (C) also forms sapwood cracks in early stages of drying. Eventual shrinkage stress opens a radial crack (D). (Photos by Richard Starr)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