UNIVERSITY OF THESSALY

Hardwood identification criteria:

First steps ▪ by George I. Mantanis FIAWS, PhD

Hint: In the arduous identification process of a hardwood species, it is suggested to follow specific **steps** in the beginning to make it easier.

InsideWood: https://insidewood.lib.ncsu.edu/menu/type/MH?1

1

Geographical origin: If you know for sure the exact origin of the specimen, please add the right criterion; e.g., if it originates from the tropical Africa, then add: 179

In most of the cases, this is **not** possible. Thus, leave it **blank**.

171	Southeast Asia and Pacific (Brazier and Franklin region 76)	
172	Thailand, Laos, Vietnam, Cambodia (Indochina)	
173	Indomalesia: Indonesia, Philippines, Malaysia, Brunei, Papua, New Guinea, and Solomon Islands	
174	Pacific Islands (including New Caledonia, Samoa, Hawaii, and Fiji)	
175	Australia and New Zealand (Brazier and Franklin region 77)	
176	Australia	
177	New Zealand	
178	Tropical mainland Africa and adjacent islands (Brazier and Franklin region 78)	
179	Tropical Africa	Present
180	Madagascar & Mauritius, Réunion & Comores	
181	Southern Africa (south of the Tropic of Capricorn) (Brazier and Franklin region 79)	
182	North America, north of Mexico (Brazier and Franklin region 80)	
183	Neotropics and temperate Brazil (Brazier and Franklin region 81)	
184	Mexico and Central America	
185	Carribean	
186	Tropical South America	

2

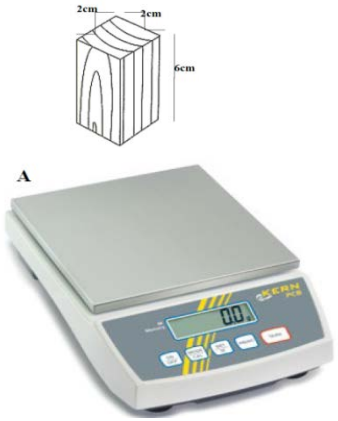
Density: This criterion is important. Cut carefully a small sample having normal dimensions. Estimate then its volume and its mass.

For instance, if the specimen is *medium*, then add: 194

Density is the ratio of mass to volume:

$$\rho = \frac{m}{V}$$

ρ – Density (kg m^{-3})
m – Mass (kg)
V – Volume (m^3)



	Specific gravity	
193	Basic specific gravity low, <= 0.40	
194	Basic specific gravity medium, 0.40-0.75	Present
195	Basic specific gravity high, >= 0.75	

3

Odor: This needs **specific** experience. A freshly cut specimen may or may not smell. Try to smell if there is any **distinct** strong odor. Usually, most of the hardwood species do not smell.

For instance, if the specimen has *no odour*, leave 203 as blank.

	Odour	
203	Distinct odour	

4

Heartwood Color: In this case, you can add one or two colors. But, for the color of the heartwood.

For instance, if the specimen is *brownish*, add: 197

	Heartwood colour	
197	Heartwood basically brown or shades of brown	Present
198	Heartwood basically red or shades of red	
199	Heartwood basically yellow or shades of yellow	
200	Heartwood basically white to grey	
202	Heartwood not as above	

5

Heartwood vs. Sapwood Color: This is easy to distinguish. Check the color difference between the heartwood and the sapwood, if that is possible. Sometimes this cannot be done.

If there is a clear color difference, add: 196p

	Heartwood colour	
196	Heartwood colour darker than sapwood colour	Present

6

Commercial Species: This is easy. Typically, most wood specimens are coming from several wood based products from the market.

Thus, if the specimen is from a commercial use, then add: 192

	Wood of commercial importance		
→	192	Wood of commercial importance	Present

7

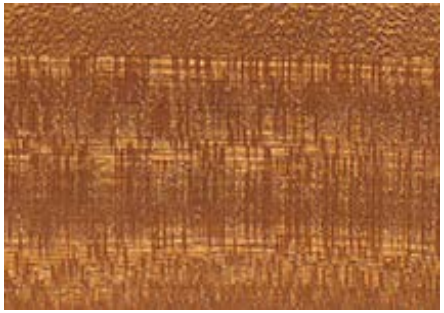
Grain pattern ▪ Streaks: This needs **specific** experience. Typically, all the woods have their own *grain pattern*. Check carefully the sample and write down your opinion about the type of the grain pattern.

Additionally, examine carefully and see if there are any **streaks** on the surface. If the specimen appears to have some streaks, then add: 201

Pattern 1

Pattern 2

Pattern 3



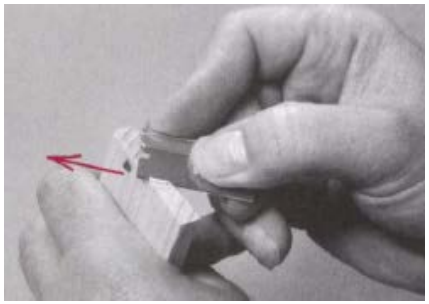
201	Heartwood with streaks	Present

8

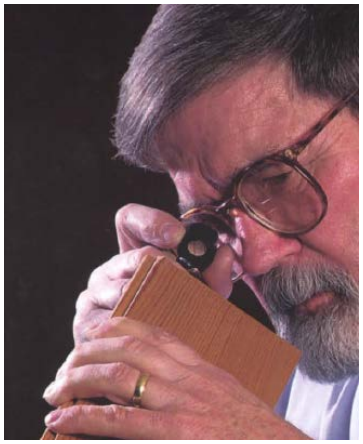
Growth Rings: Cut carefully the specimen in the cross-section by a razor blade or knife. Then, use a hand-lens to make some observations.

If the specimen appears to have **distinct rings**, add: 1

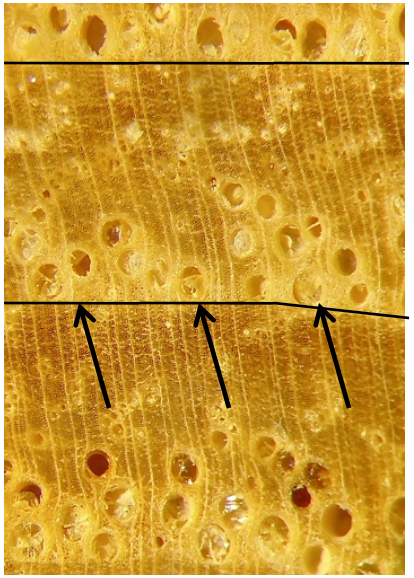
Cutting



Observing



Criterion 1



Criterion 2

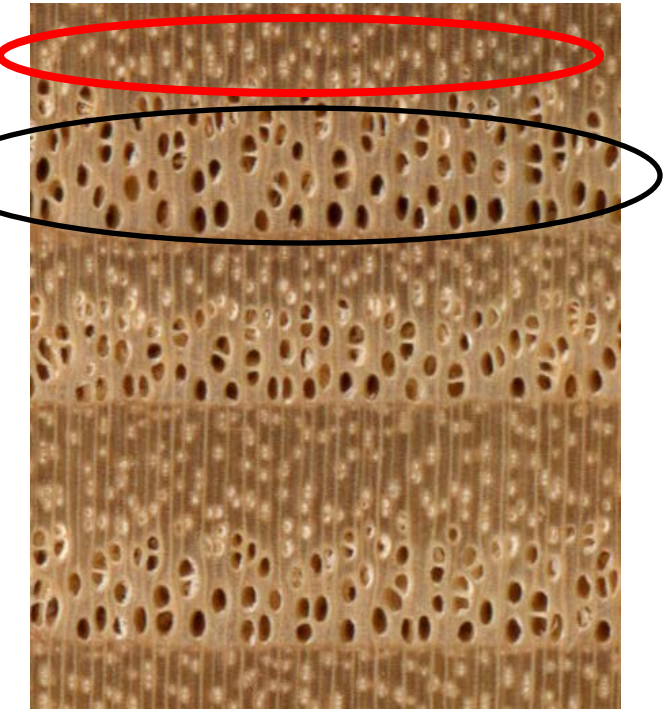
	Growth Rings		
1	Growth ring boundaries distinct	(definition)	Present
2	Growth ring boundaries indistinct or absent	(definition)	

9

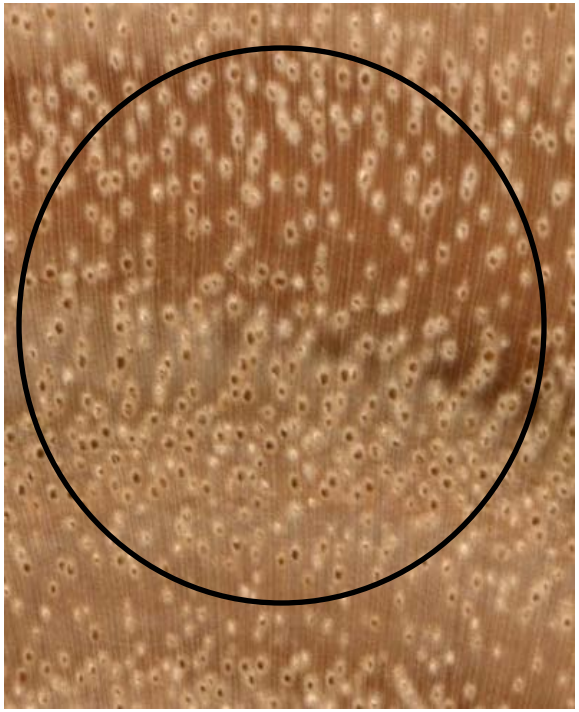
Porosity: This means which category of general ‘’**pore pattern**’’. In the hardwood species, there are three (**3**) specific categories.

If the hardwood sample looks like a *ring-porous* species, add: 3

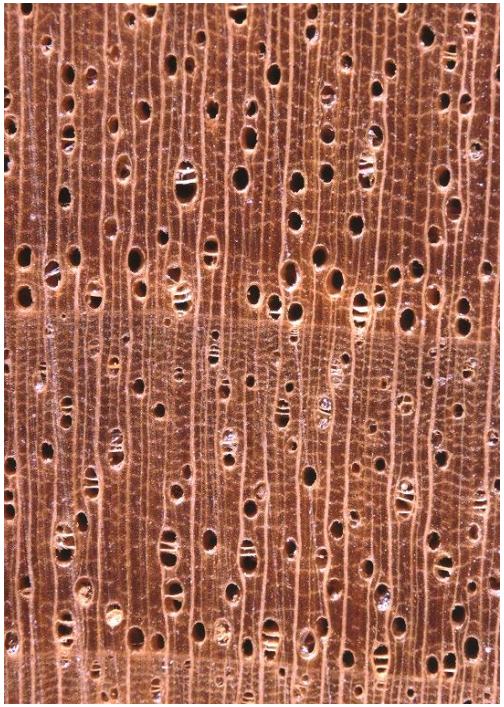
3: Ring-Porous



5: Diffuse-Porous



4: Semi-Ring Porous

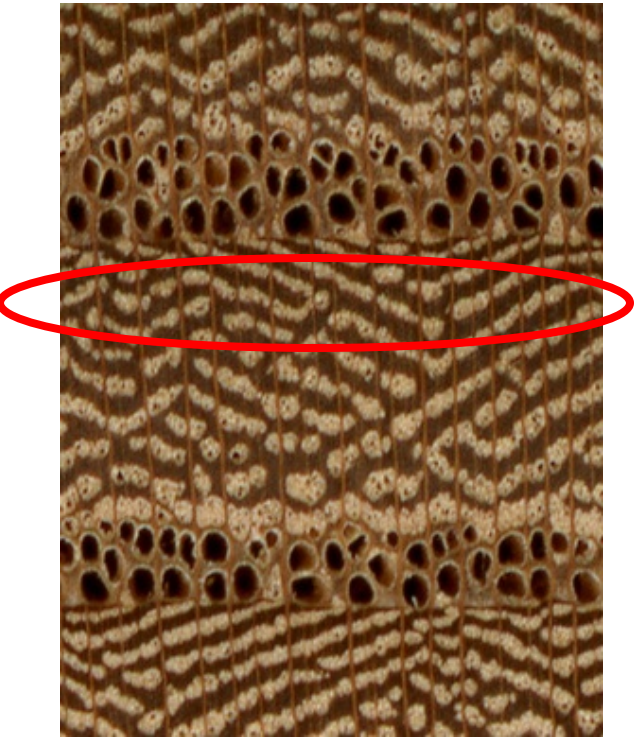


	Vessels		
	Porosity		
3	Wood ring-porous	(definition)	Present
4	Wood semi-ring-porous	(definition)	
5	Wood diffuse-porous	(definition)	

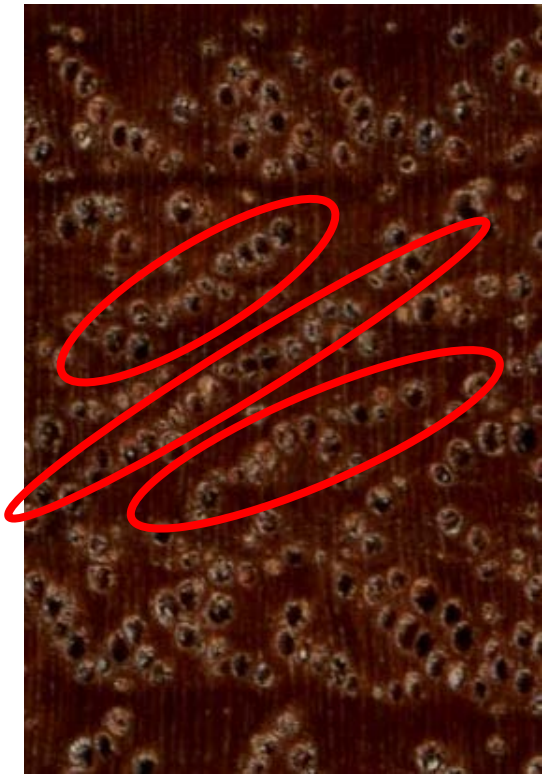
10

Pore Arrangement: This means how the vessels/pores are arranged in the cross section. In hardwoods, there are **3** arrangement types.

6: Tangential bands



7: Diagonal pattern



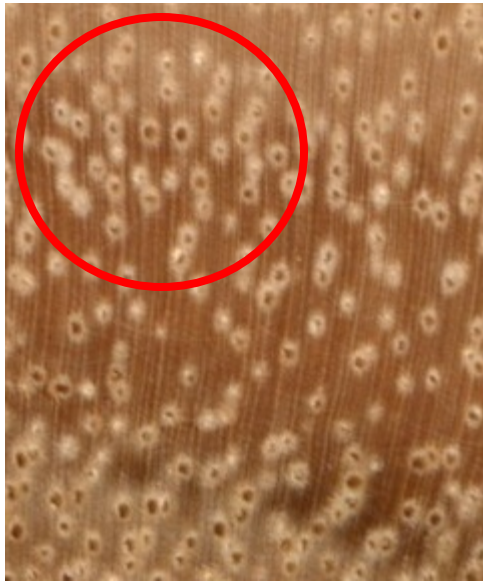
8: Dendritic pattern or **flame-like**

	Vessel arangement		
6	Vessels in tangential bands	(definition)	
7	Vessels in diagonal and / or radial pattern	(definition)	
8	Vessels in dendritic pattern	(definition)	

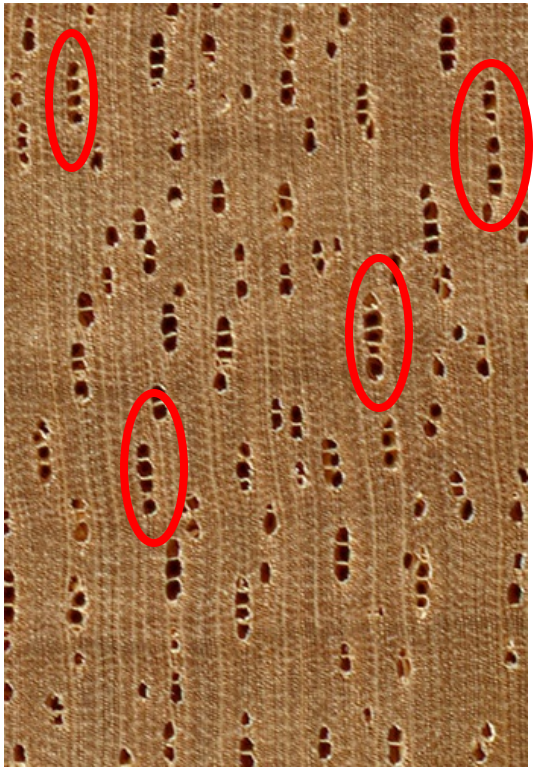
11

Pore Groupings: This actually means how the vessels (pores) are grouped together (if any). In hardwoods, **3** pore-groupings types exist.

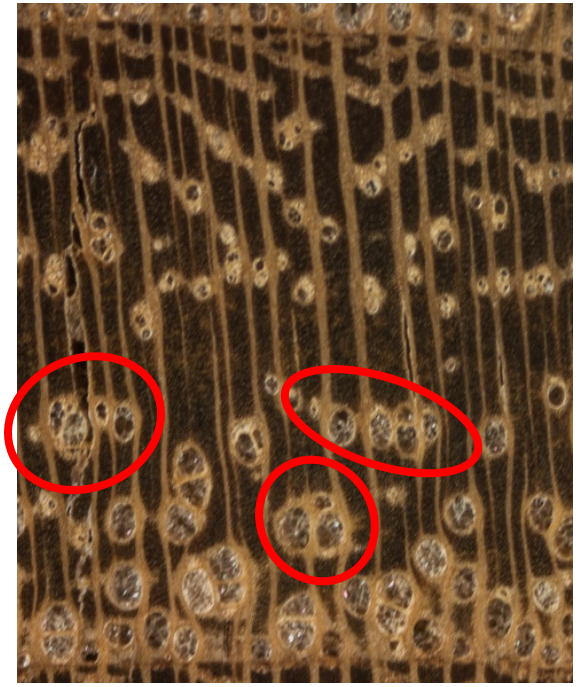
9: Solitary pores



10: In radial multiples



11: In clusters



	Vessel groupings		
9	Vessels exclusively solitary (90% or more)	(definition)	
10	Vessels in radial multiples of 4 or more common	(definition)	
11	Vessel clusters common	(definition)	

12

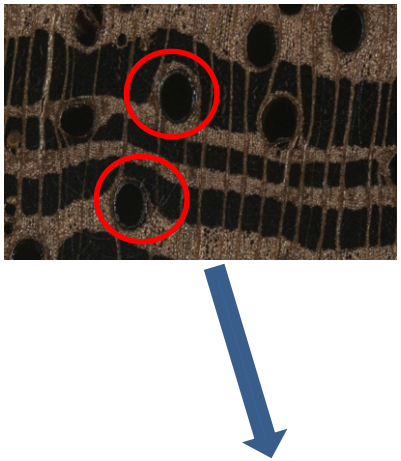
Pore Size: This means how large is the **mean diameter** of the pores (in **µm**). At the *InsideWood*, there are **4** different size classes.

40: Small, D ≤50 µm

41: Medium, D 50-100 µm

42: Large, D 100-200 µm

43: Very large, D ≥200 µm



Tangential diameter of vessel lumina		
Mean tangential diameter of vessel lumina		(definition)
40	<= 50 µm	
41	50 - 100 µm	
42	100 - 200 µm	
43	>= 200 µm	Present

13

Pore Frequency: This really means the **average number** of pores in the area of **1 mm²**. At the *InsideWood*, five different classes exist.

Criteria

46: ≤ 5 pores/mm²

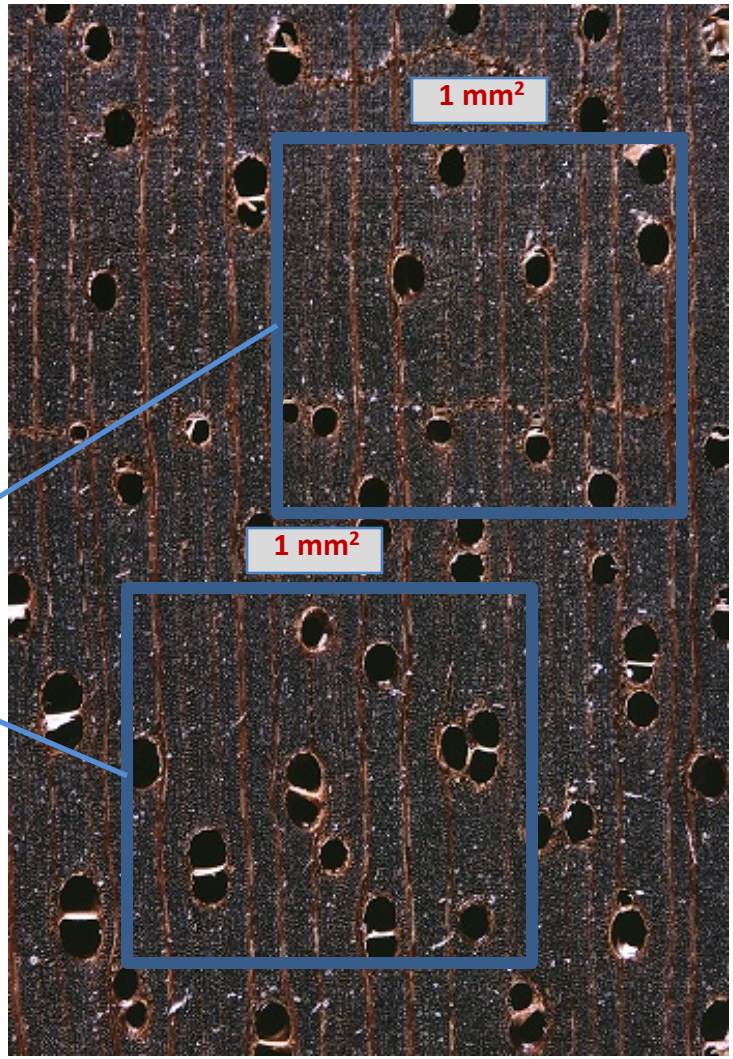
47: 5-20 pores/mm²

48: 20-40 pores/mm²

49: 40-100 pores/mm²

50: ≥ 100 pores/mm²

11-14 pores/mm²

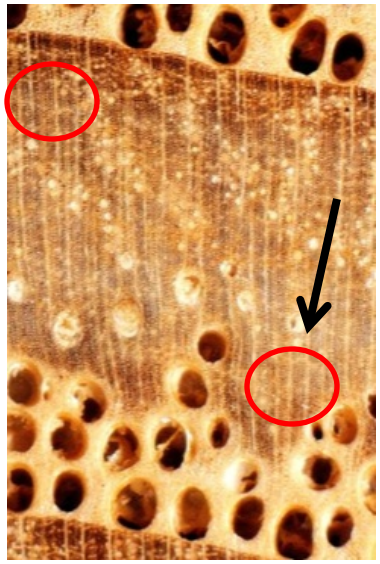


	Vessels per square millimetre
46	<= 5 vessels per square millimetre
47	5 - 20 vessels per square millimetre
48	20 - 40 vessels per square millimetre
49	40 - 100 vessels per square millimetre
50	>= 100 vessels per square millimetre

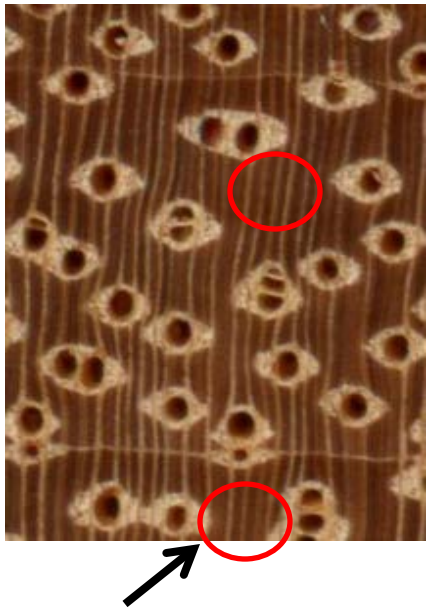
14

Ray Width: This feature is related to the **total number** of cells which constitute each ray. In hardwoods, **4** groupings exist (see below).

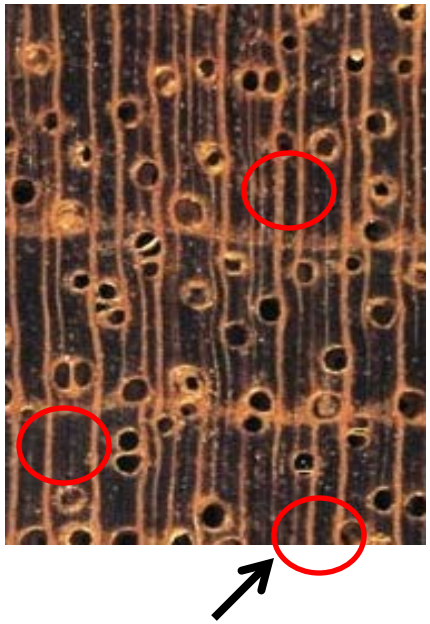
96: Uniseriate



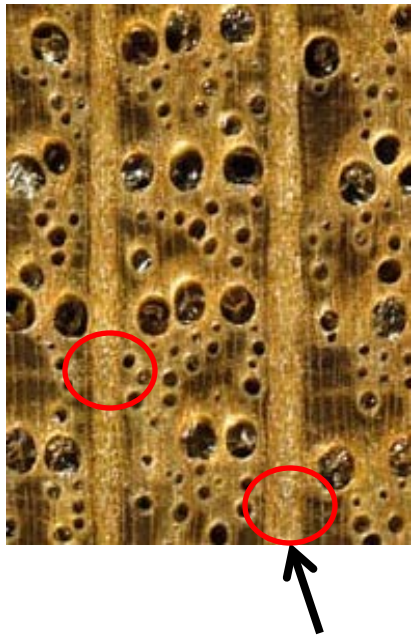
97: Ray width 1-3 cells



98: Ray width 4-10 cells



99: Thick rays >10 cells



	Ray width	(definition)	
96	Rays exclusively uniseriate		
97	Ray width 1 to 3 cells		
98	Larger rays commonly 4 - to 10 seriate		
99	Larger rays commonly > 10-seriate	(definition)	

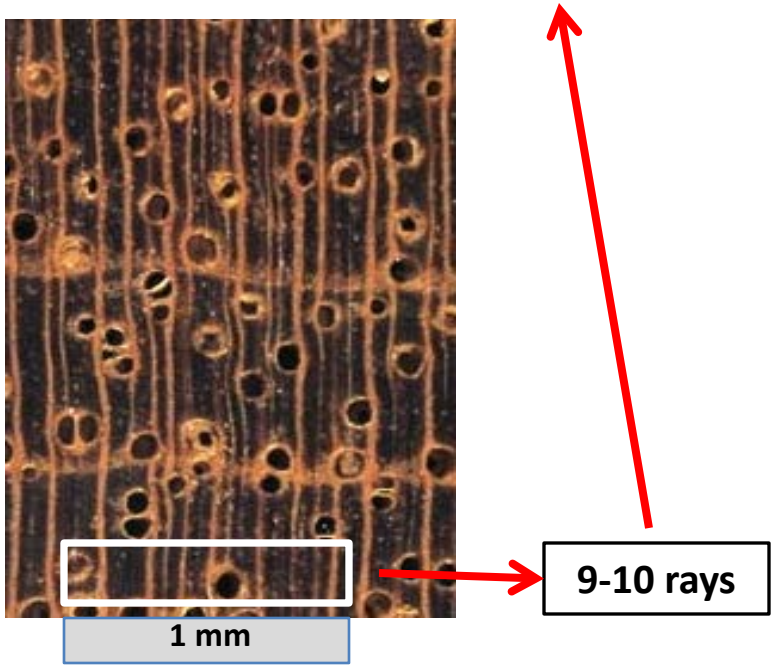
15

Rays per mm: This feature measures the total number of rays present in **1 tangential millimeter**. In hardwoods, **3** categories exist.

114: ≤ 4 rays/mm

115: 4-12 rays/mm

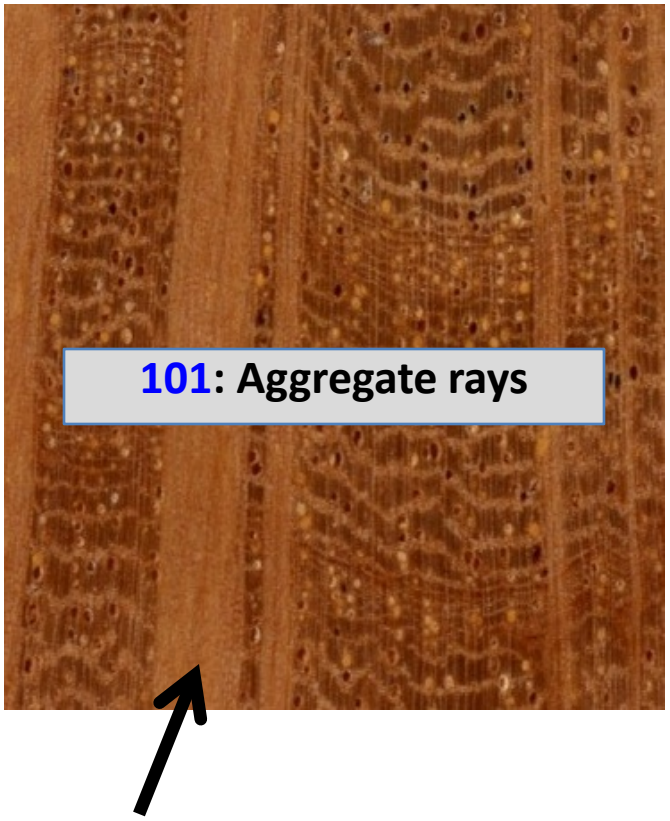
116: ≥ 12 rays/mm



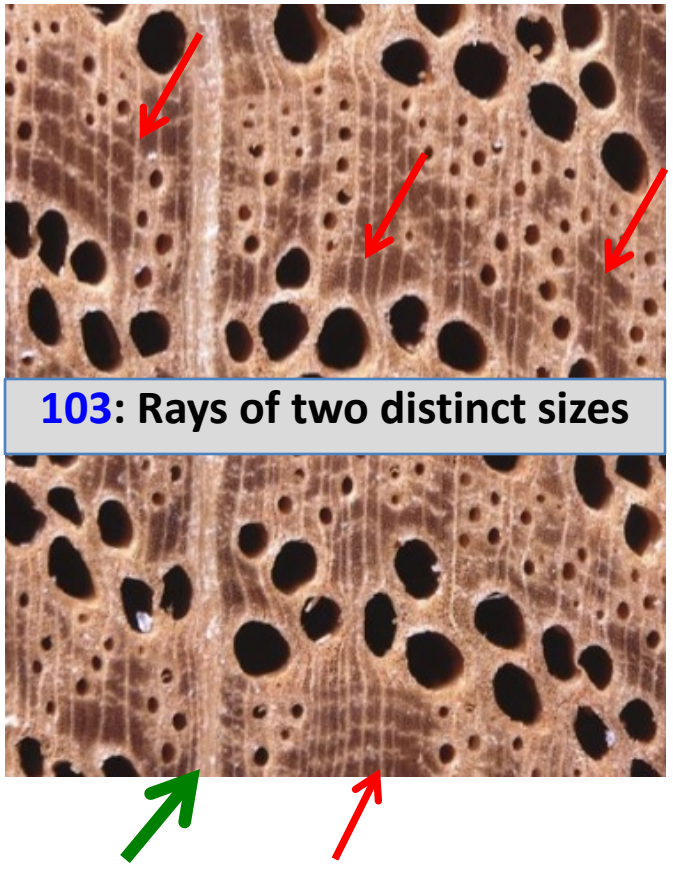
	Rays per millimetre	(definition)
114	<= 4 / mm	
115	4-12 / mm	
116	>= 12 /mm	

16

Aggregate rays



Rays of two distinct sizes

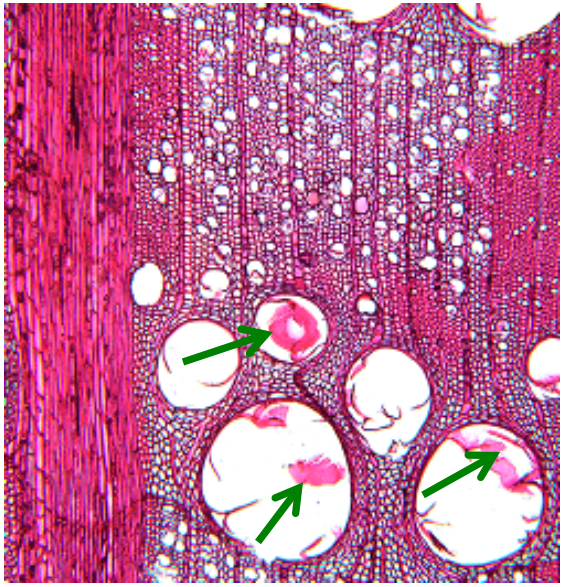


	Rays of two distinct sizes	(definition)
103	Rays of two distinct sizes	(definition)

	Aggregate rays	(definition)
101	Aggregate rays	(definition)

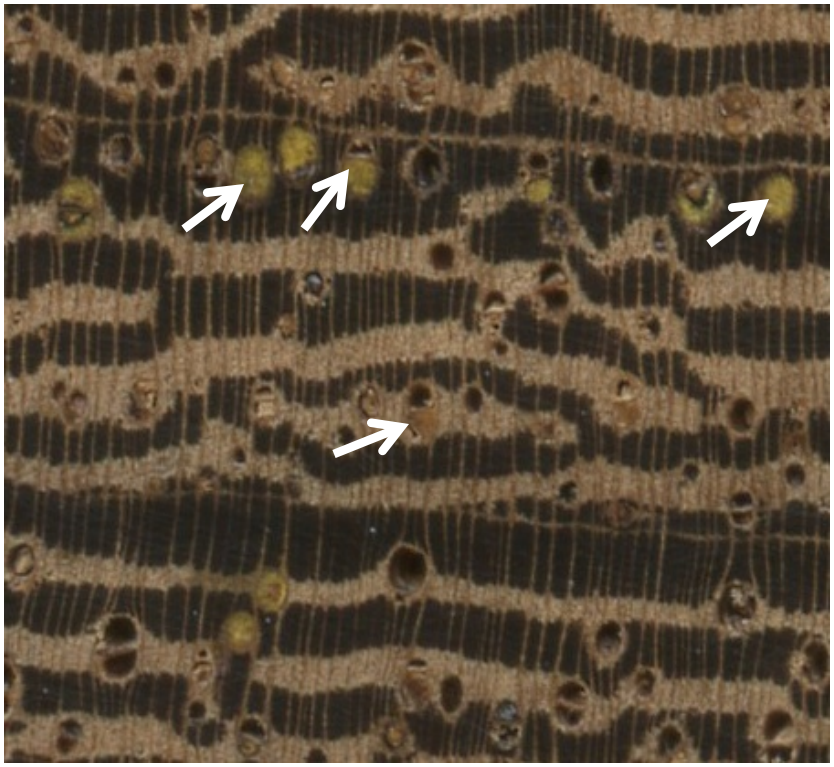
17

Tyloses, common



56: Tyloses, common

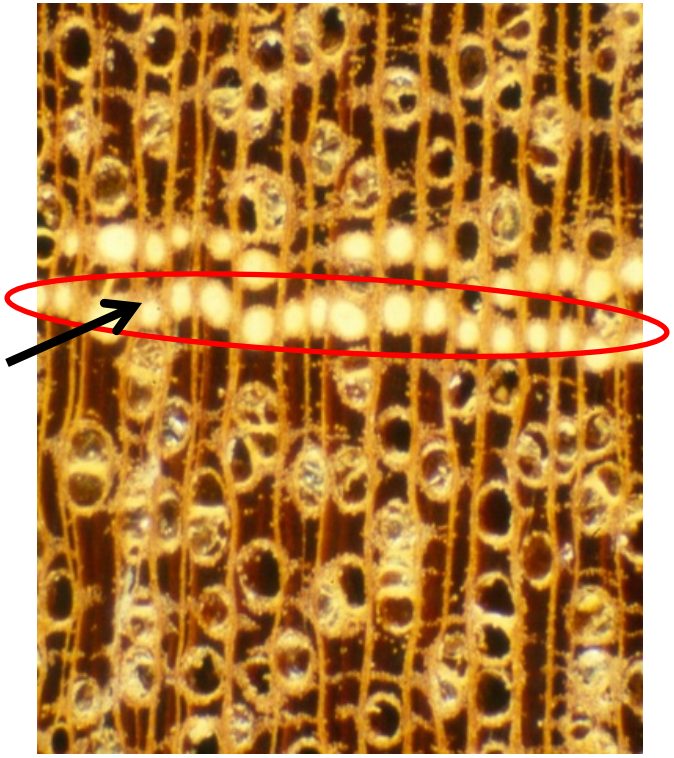
Gums and other deposits



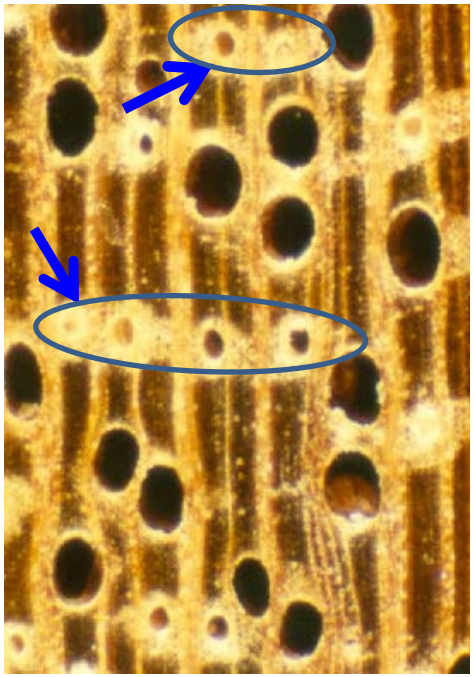
58: Gums and other deposits

	Tyloses and deposits in vessels		
56	Tyloses common	(definition)	
58	Gums and other deposits in heartwood vessels	(definition)	

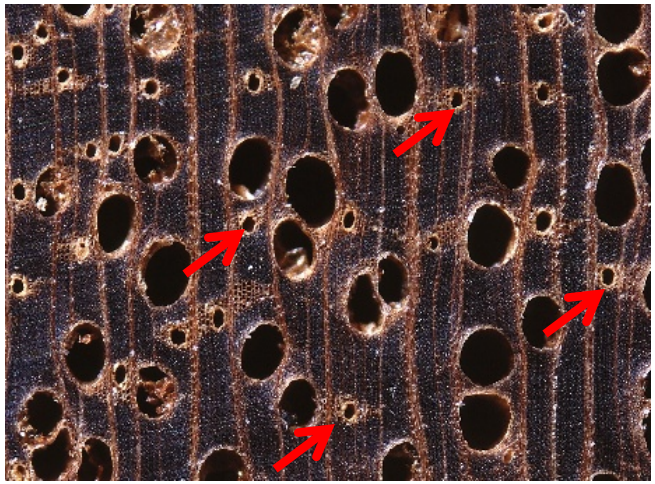
18 Axial Canals



127: In long tangential lines



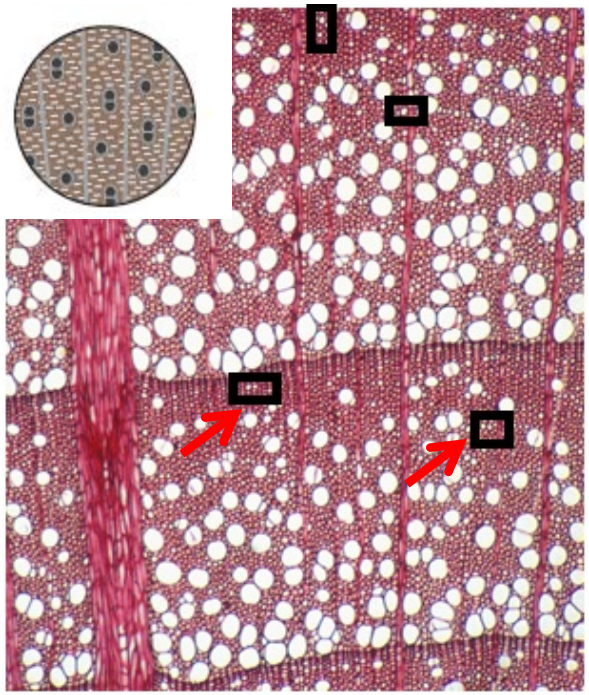
128: In short tangential lines



129: Axial canals diffuse

	Intercellular canals	(definition)	
127	Axial canals in long tangential lines	(definition)	
128	Axial canals in short tangential lines	(definition)	
129	Axial canals diffuse	(definition)	

19 Axial Parenchyma: Apotracheal



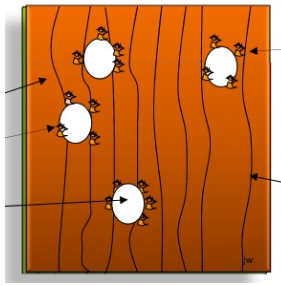
76: Diffuse

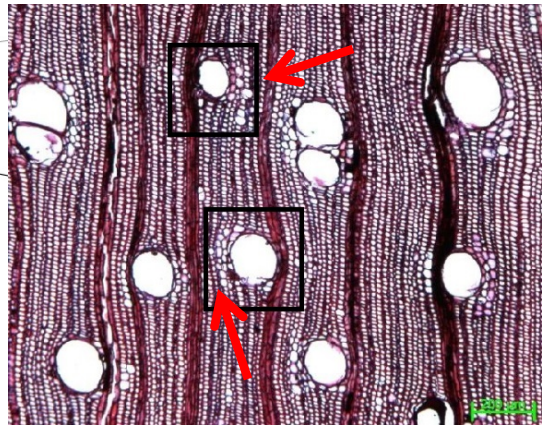
77: Diffuse-in-aggregates

Apotracheal parenchyma
Not associated with vessels

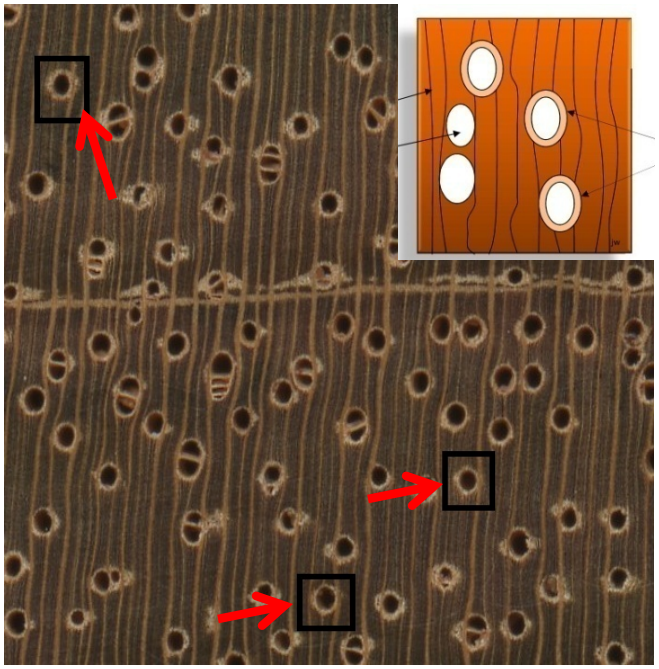
	Apotracheal axial parenchyma	(definition)	
76	Axial parenchyma diffuse	(definition)	
77	Axial parenchyma diffuse-in-aggregates	(definition)	

20 Axial Parenchyma: Paratracheal





78: Scanty

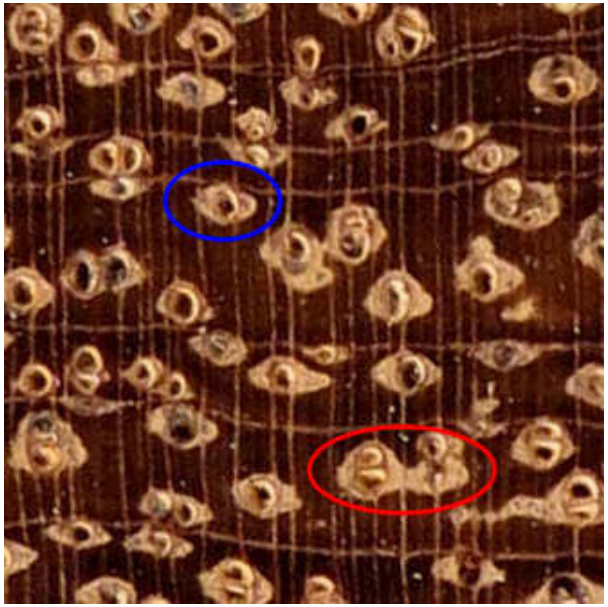


79: Vasicentric

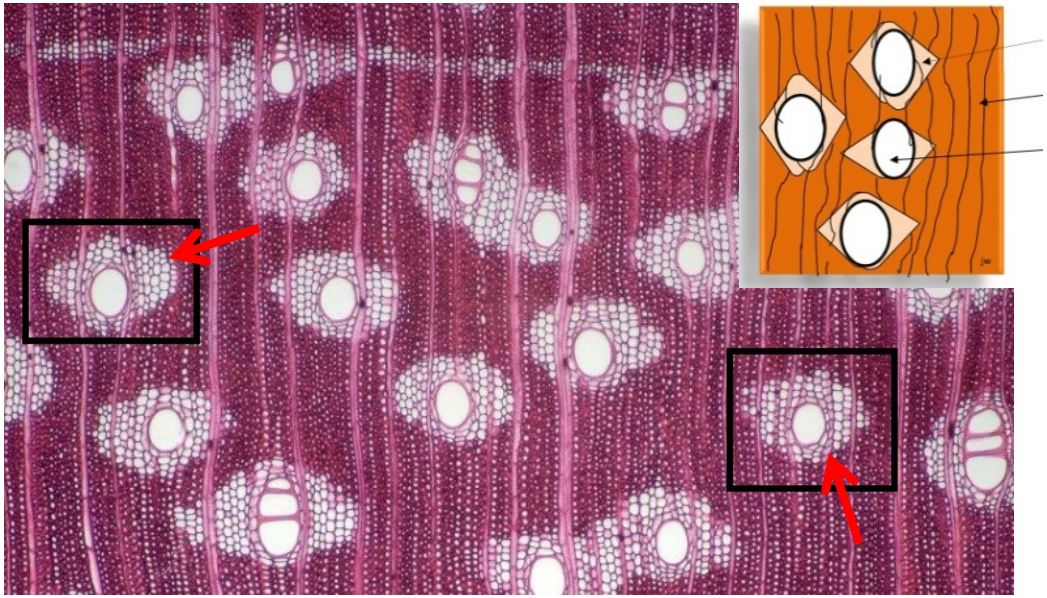
Paratracheal parenchyma
Associated with vessels

	Paratracheal axial parenchyma	(definition)	
78	Axial parenchyma scanty paratracheal	(definition)	
79	Axial parenchyma vasicentric	(definition)	
80	Axial parenchyma aliform		
81	Axial parenchyma lozenge-aliform	(definition)	
82	Axial parenchyma winged-aliform	(definition)	
83	Axial parenchyma confluent	(definition)	
84	Axial parenchyma unilateral paratracheal	(definition)	

21 Axial Parenchyma: Paratracheal



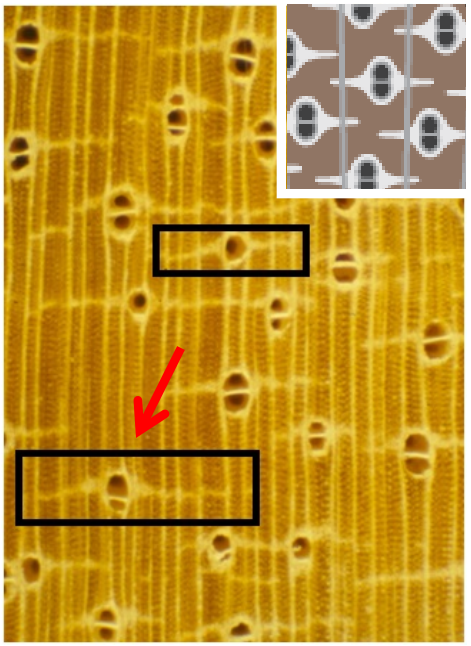
80: Aliform



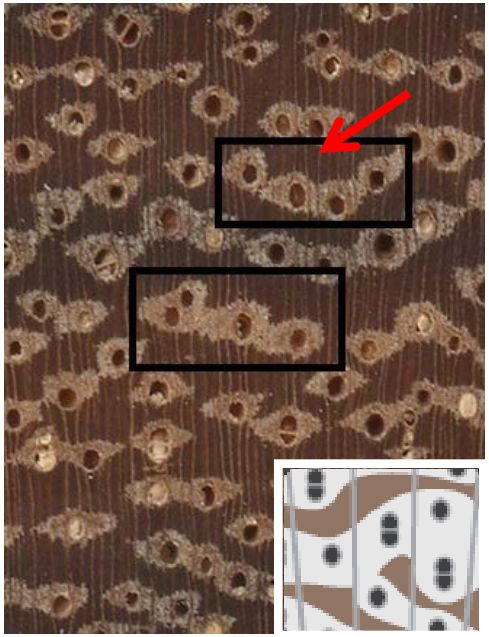
81: Lozenge

	Paratracheal axial parenchyma	(definition)	
78	Axial parenchyma scanty paratracheal	(definition)	
79	Axial parenchyma vasicentric	(definition)	
80	Axial parenchyma aliform		
81	Axial parenchyma lozenge-aliform	(definition)	
82	Axial parenchyma winged-aliform	(definition)	
83	Axial parenchyma confluent	(definition)	
84	Axial parenchyma unilateral paratracheal	(definition)	

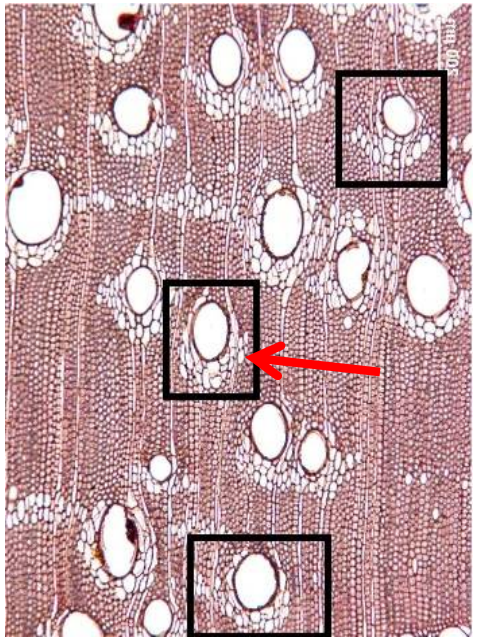
22 Axial Parenchyma: Paratracheal



82: Winged



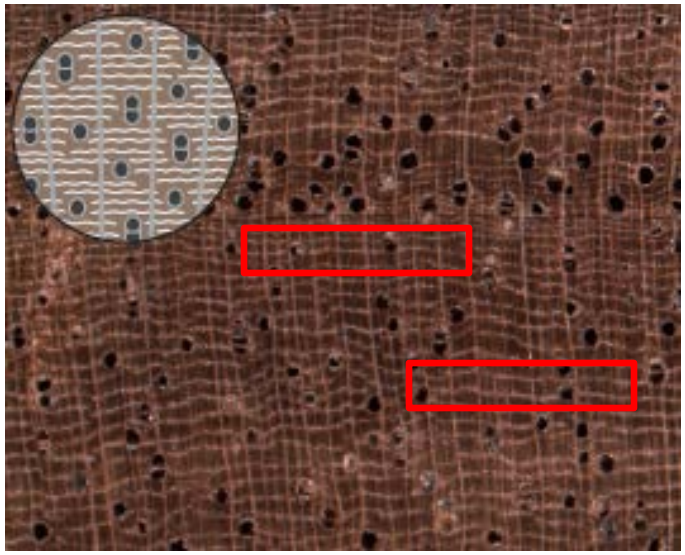
83: Confluent



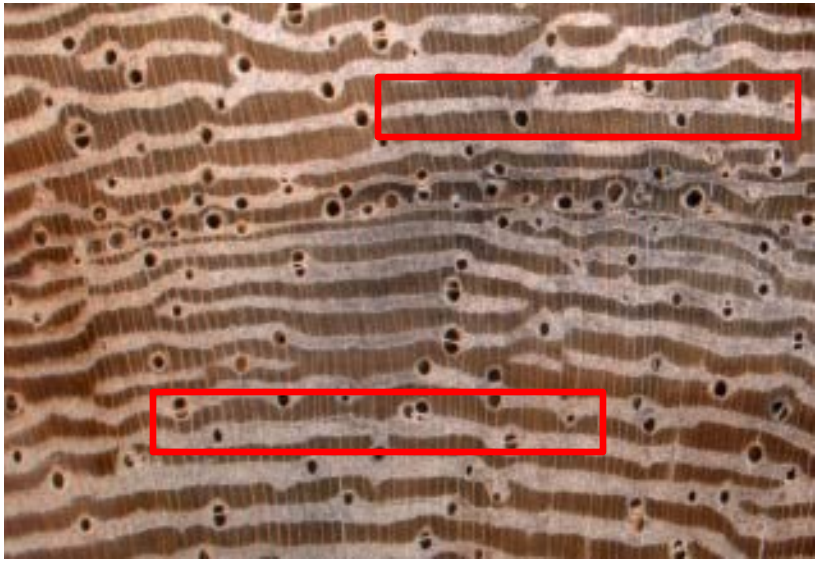
84: Unilateral

	Paratracheal axial parenchyma	(definition)	
78	Axial parenchyma scanty paratracheal	(definition)	
79	Axial parenchyma vasicentric	(definition)	
80	Axial parenchyma aliform		
81	Axial parenchyma lozenge-aliform	(definition)	
82	Axial parenchyma winged-aliform	(definition)	
83	Axial parenchyma confluent	(definition)	
84	Axial parenchyma unilateral paratracheal	(definition)	

23 Axial Parenchyma: Banded



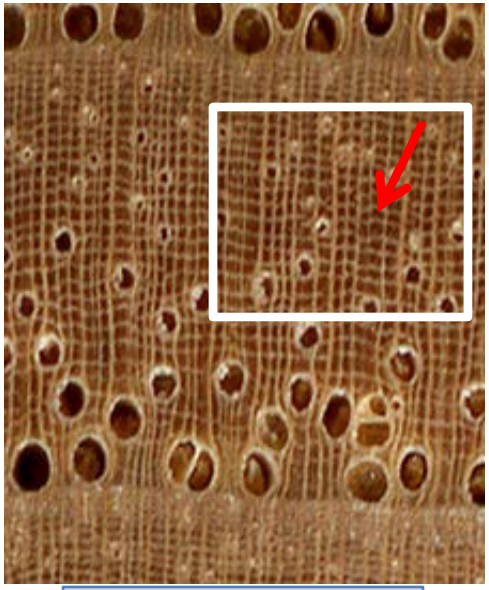
86: Narrow Bands less than 3 cells wide



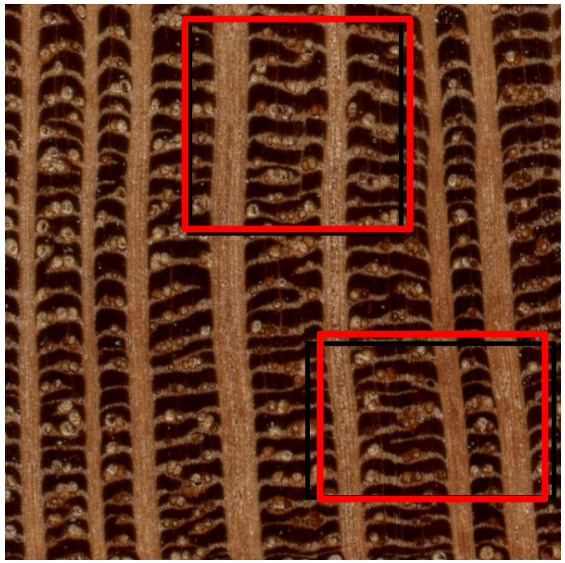
85: Thick Bands more than 3 cells wide

	Banded parenchyma	(definition)	
85	Axial parenchyma bands more than three cells wide	(definition)	
86	Axial parenchyma in narrow bands or lines up to three cells wide	(definition)	
87	Axial parenchyma reticulate	(definition)	
88	Axial parenchyma scalariform	(definition)	
89	Axial parenchyma in marginal or in seemingly marginal bands	(definition)	

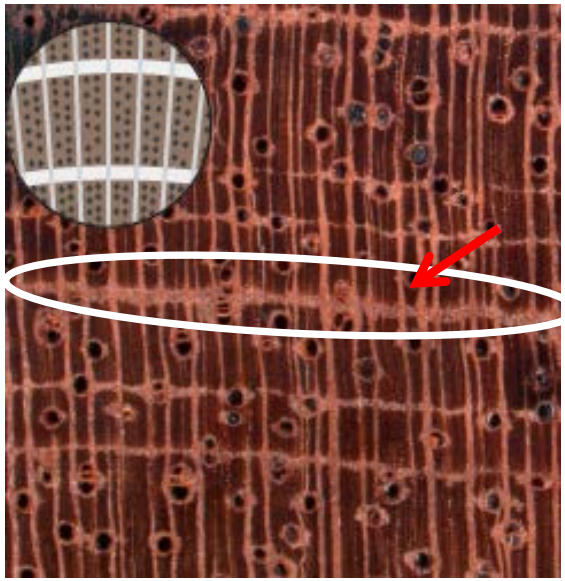
24 Axial Parenchyma: Banded



87: Reticulate



88: Scalariform



89: Marginal

	Banded parenchyma	(definition)	
85	Axial parenchyma bands more than three cells wide	(definition)	
86	Axial parenchyma in narrow bands or lines up to three cells wide	(definition)	
87	Axial parenchyma reticulate	(definition)	
88	Axial parenchyma scalariform	(definition)	
89	Axial parenchyma in marginal or in seemingly marginal bands	(definition)	