

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

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: <u>179</u>

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

Southeast Asia and Pacific (Brazier and Franklin region 76)		~
Thailand, Laos, Vietnam, Cambodia (Indochina)		v)
173 Indomalesia: Indonesia, Philippines, Malaysia, Brunei, Papua, New Guinea, and Solomon Islands		v)
Pacific Islands (including New Caledonia, Samoa, Hawaii, and Fiji)		v)
Australia and New Zealand (Brazier and Franklin region 77)		~
Australia		v)
New Zealand		v)
Tropical mainland Africa and adjacent islands (Brazier and Franklin region 78)		v)
Tropical Africa	Present	v)
Madagascar & Mauritius, Réunion & Comores		~
Southern Africa (south of the Tropic of Capricorn) (Brazier and Franklin region 79)		v)
North America, north of Mexico (Brazier and Franklin region 80)		~)
Neotropics and temperate Brazil (Brazier and Franklin region 81)		v)
Mexico and Central America		v)
Carribean		v)
Tropical South America		v)
	Thailand, Laos, Vietnam, Cambodia (Indochina) Indomalesia: Indonesia, Philippines, Malaysia, Brunei, Papua, New Guinea, and Solomon Islands Pacific Islands (including New Caledonia, Samoa, Hawaii, and Fiji) Australia and New Zealand (Brazier and Franklin region 77) Australia New Zealand Tropical mainland Africa and adjacent islands (Brazier and Franklin region 78) Tropical Africa Madagascar & Mauritius, Réunion & Comores Southern Africa (south of the Tropic of Capricorn) (Brazier and Franklin region 79) North America, north of Mexico (Brazier and Franklin region 80) Neotropics and temperate Brazil (Brazier and Franklin region 81) Mexico and Central America Carribean	Thailand, Laos, Vietnam, Cambodia (Indochina) Indomalesia: Indonesia, Philippines, Malaysia, Brunei, Papua, New Guinea, and Solomon Islands Pacific Islands (including New Caledonia, Samoa, Hawaii, and Fiji) Australia and New Zealand (Brazier and Franklin region 77) Australia New Zealand Tropical mainland Africa and adjacent islands (Brazier and Franklin region 78) Tropical Africa Madagascar & Mauritius, Réunion & Comores Southern Africa (south of the Tropic of Capricorn) (Brazier and Franklin region 79) North America, north of Mexico (Brazier and Franklin region 80) Neotropics and temperate Brazil (Brazier and Franklin region 81) Mexico and Central America Carribean

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:

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

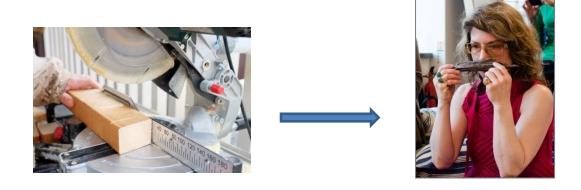
 ρ – Density (kg m⁻³) m – Mass (kg) V – Volume (m³)



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

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

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

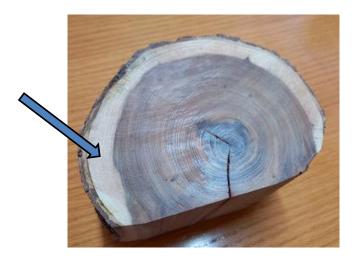


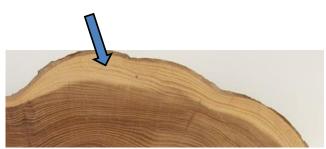
	Heartwood colour	
197	Heartwood basically brown or shades of brown	Present v
198	Heartwood basically red or shades of red	<u> </u>
199	Heartwood basically yellow or shades of yellow	<u> </u>
200	Heartwood basically white to grey	<u> </u>
202	2 Heartwood not as above	<u> </u>

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

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



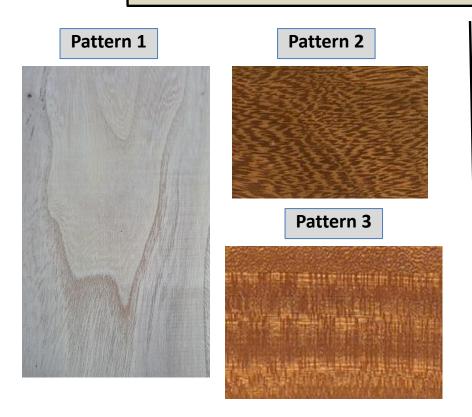


Wood of commercial importance



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 <u>the type of the grain pattern</u>.

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

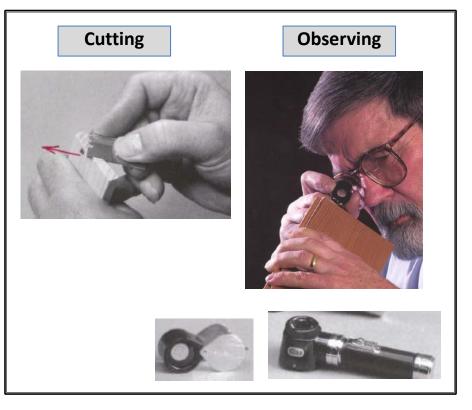


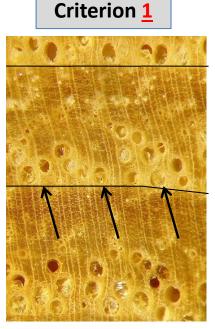




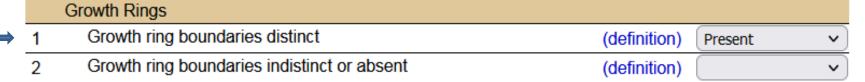
Growth Rings: Cut carefully the specimen in the cross-section by a razor blade or knife. Then, use a hand-lens to make some observations.

If the specimen appears to have **distinct rings**, add: <u>1</u>



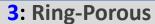


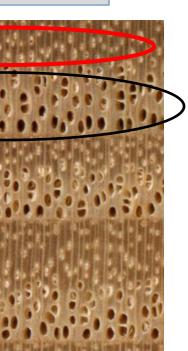




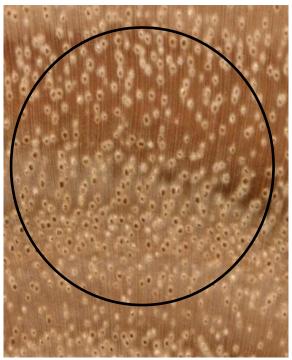
Porosity: This means which category of general "pore pattern". In the hardwood species, there are three (3) specific categories.

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

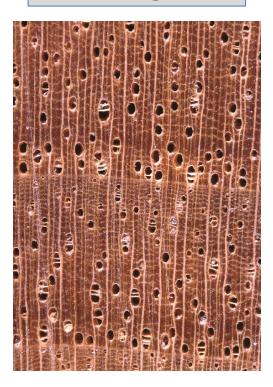




5: Diffuse-Porous



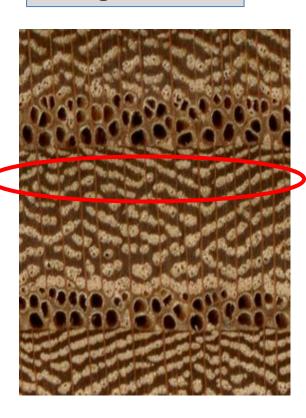
4: Semi-Ring Porous



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

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

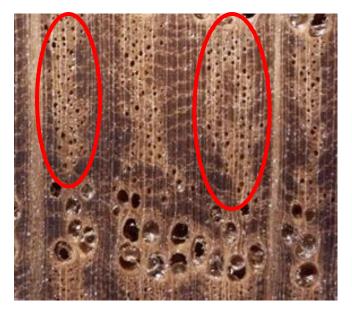
6: Tangential bands



7: Diagonal pattern



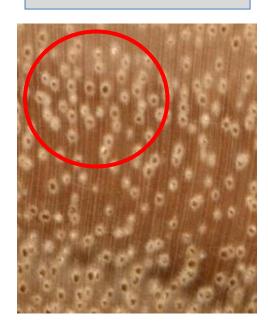
8: Dendritic pattern or flame-like



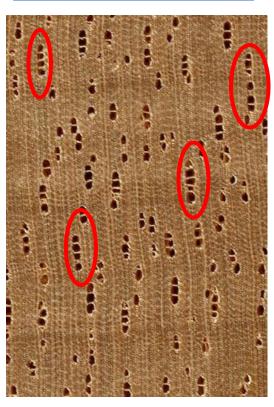
	Vessel arangement		
6	Vessels in tangential bands	(definition)	v
7	Vessels in diagonal and / or radial pattern	(definition)	~
8	Vessels in dendritic pattern	(definition)	v

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

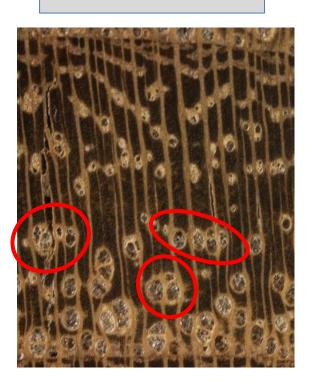
9: Solitary pores



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)	<u> </u>
11	Vessel clusters common	(definition)	<u> </u>

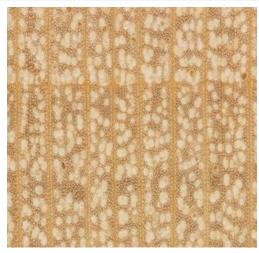
Pore Size: This means how large is the **mean diameter** of the pores (in µm). At the *InsideWood*, there are **4** different size classes.

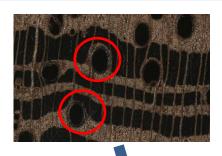
: Small, D ≤50 μm

: Large, D 100-200 μm

: Medium, D 50-100 μm







The same of the sa				
	Tangential diameter of vessel lumina			
	Mean tangential diameter of vessel lumina	(definition)		
40	<= 50 μm			~
41	50 - 100 μm			v
42	100 - 200 μm			v)
43	>= 200 μm		Present	~

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

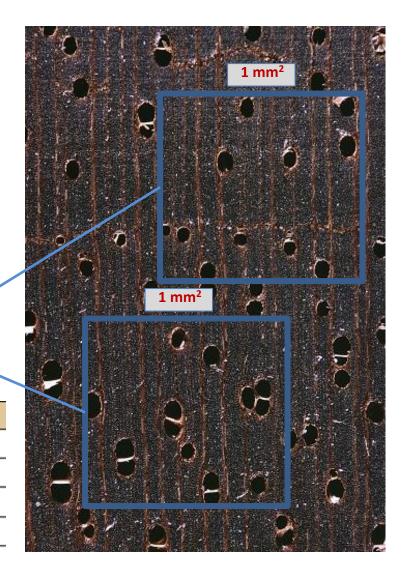
48: 20-40 pores/mm²

49: 40-100 pores/mm²

50: \geq 100 pores/mm²

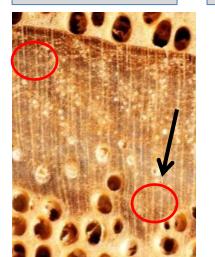
11-14 pores/mm²

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

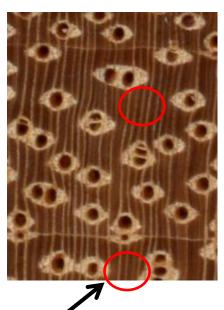


Ray Width: This feature is related to the total number of cells which constitute each ray. In hardwoods, 4 groupings exist (see below).

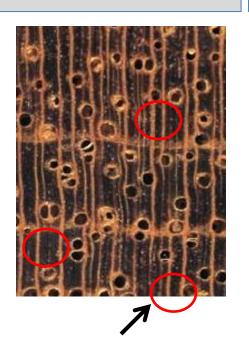
96: Uniseriate



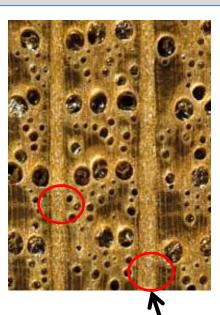
97: Ray width 1-3 cells



98: Ray width 4-10 cells

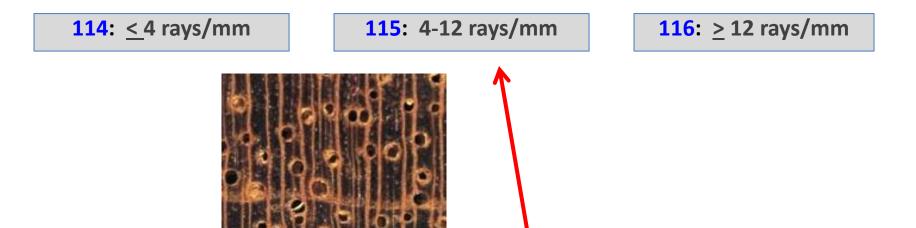


99: Thick rays >10 cells



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

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



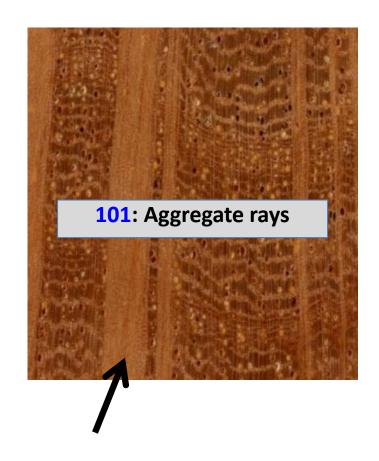
	Rays per millimetre	(definition)
114	<= 4 / mm	
115	4-12 / mm	
116	>= 12 /mm	

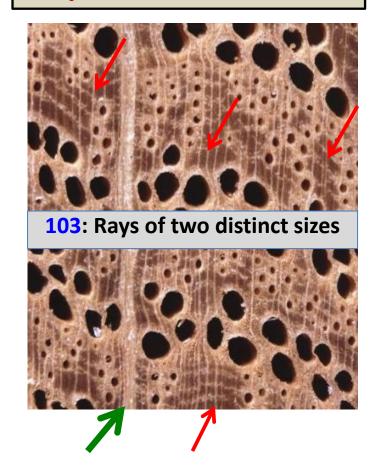
1 mm

9-10 rays

Aggregate rays

Rays of two distinct sizes



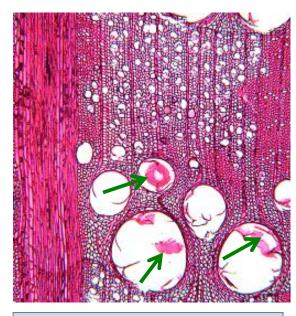


Rays of two distinct sizes		Rays of two distinct sizes	(definition)	
Ī	103	Rays of two distinct sizes	(definition)	•

	Aggregate rays	(definition)	
101	Aggregate rays	(definition)	~

Tyloses, common

Gums and other deposits



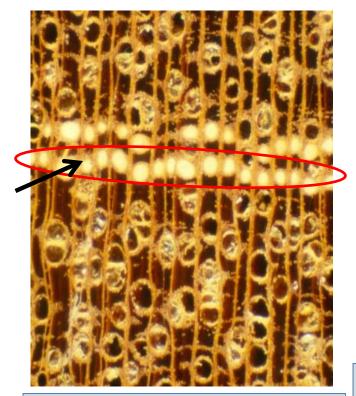
56: Tyloses, common

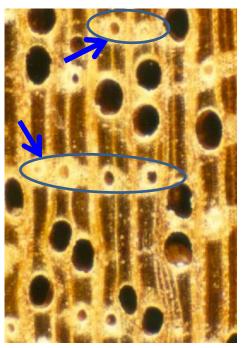


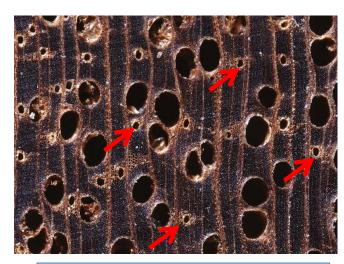
58: Gums and other deposits

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

Axial Canals







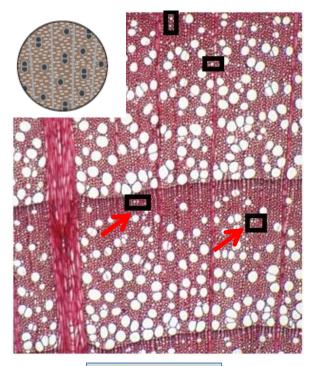
129: Axial canals diffuse

127: In long tangential lines

128: In short tangential lines

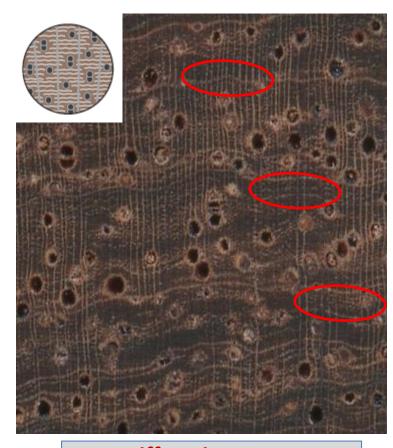
	Intercellular canals	(definition)	
127	Axial canals in long tangential lines	(definition)	v)
128	Axial canals in short tangential lines	(definition)	~
129	Axial canals diffuse	(definition)	v

Axial Parenchyma: Apotracheal



76: Diffuse

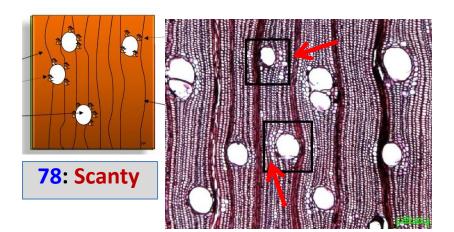
Apotracheal parenchyma
Not associated with vessels



77: Diffuse-in-aggregates

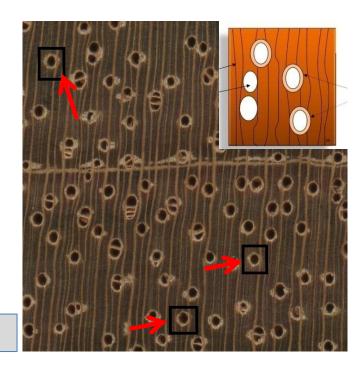
	Apotracheal axial parenchyma	(definition)	
76	Axial parenchyma diffuse	(definition)	~
77	Axial parenchyma diffuse-in-aggregates	(definition)	~

Axial Parenchyma: Paratracheal



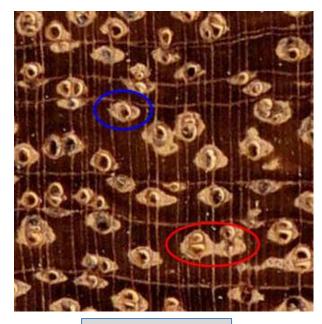
Paratracheal parenchyma
Associated with vessels

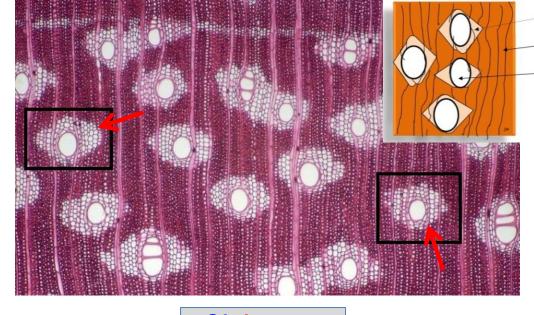
79: Vasicentric



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

Axial Parenchyma: Paratracheal



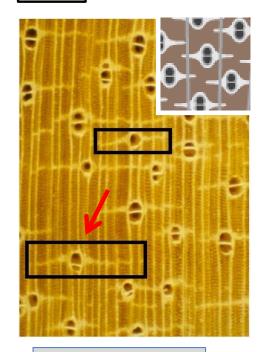


80: Aliform

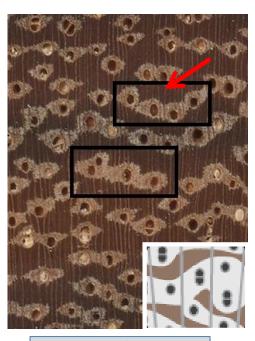
81: Lozenge

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

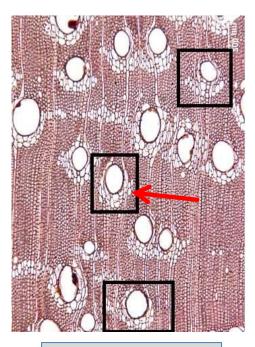
Axial Parenchyma: Paratracheal



82: Winged



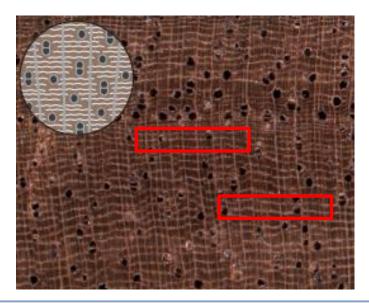
83: Confluent



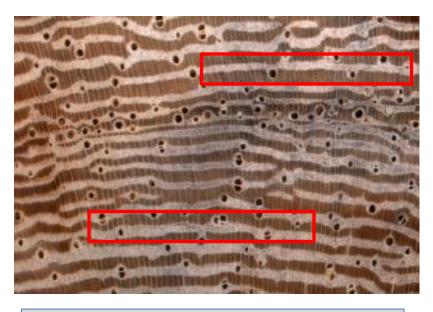
84: Unilateral

	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)	v
83	Axial parenchyma confluent	(definition)	~
84	Axial parenchyma unilateral paratracheal	(definition)	~

Axial Parenchyma: Banded



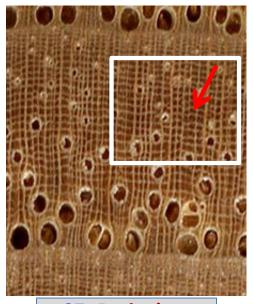
86: Narrow Bands less than 3 cells wide



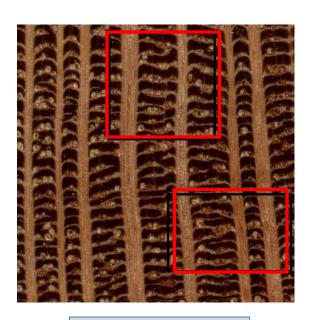
85: Thick Bands more than 3 cells wide

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

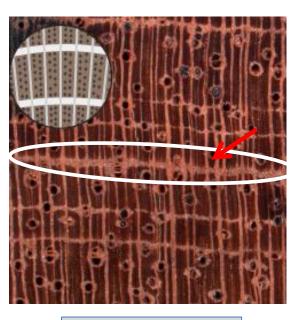
Axial Parenchyma: Banded



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)	~

Acknowledgements

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Commercial timbers:

DELTA IntKey

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Wood Database
https://www.wood-database.com/



Special thanks

- Dr. Elisabeth Wheeler NCSA link
- Dr. Gerald Koch Thünen-Institute of Wood Research link



