

IAWA Hardwood Feature List

Definitions and Illustrations
For Features 1-12.

Numbered photographs from:
IAWA Committee. 1989. IAWA List of
Microscopic Features for Hardwood
Identification. IAWA Bulletin n.s.
10(3): 219-332.

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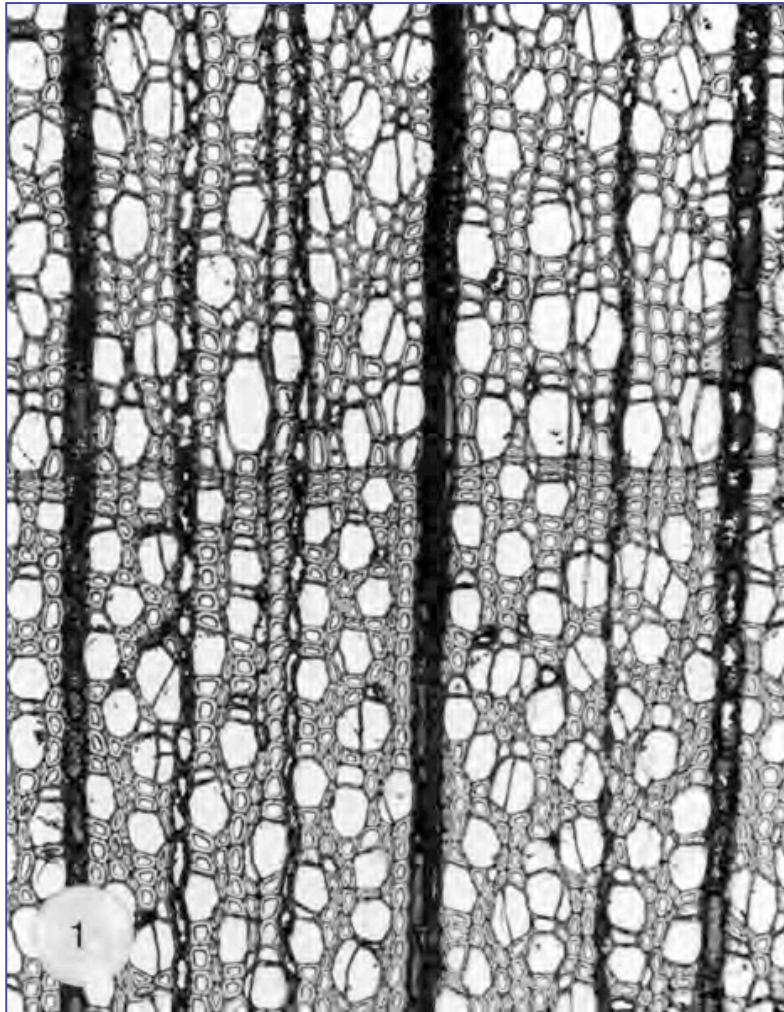
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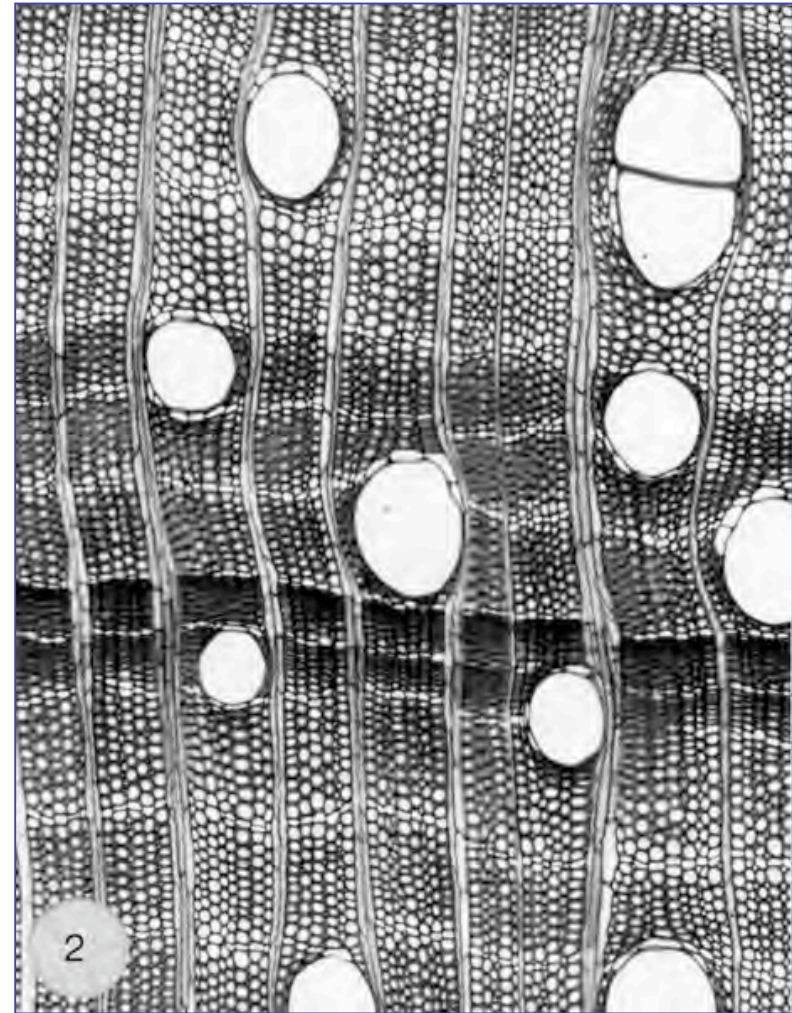
Slide Set Assembled by E.A.Wheeler

GROWTH RINGS

Feature 1. Growth ring boundaries distinct = growth rings with an abrupt structural change at the boundaries between them, usually including a change in fibre wall thickness and/or fibre radial diameter.

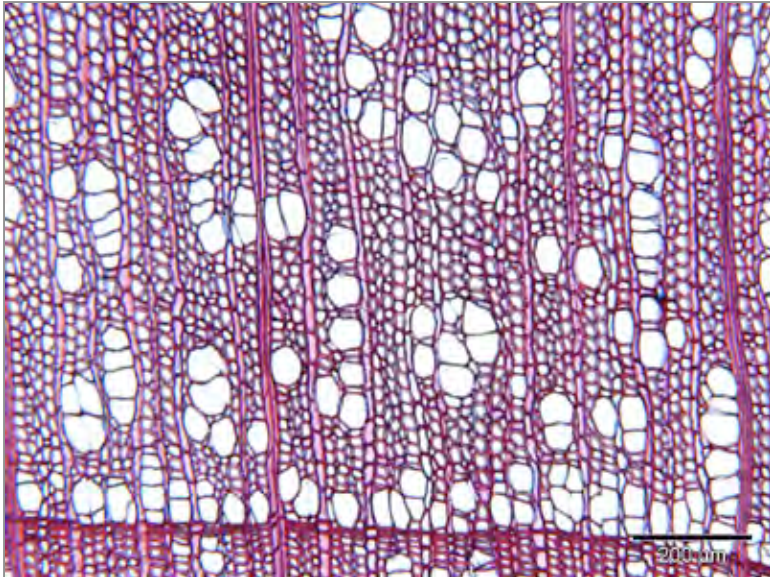


Weinmannia trichosperma: Ken Ogata
(Cunoniaceae)

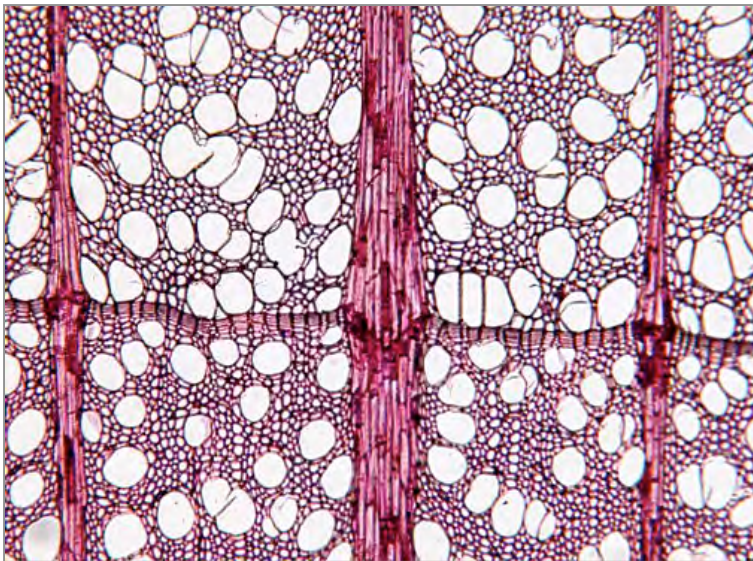


Xylopia nitda: P.E. Gasson
(Annonaceae)

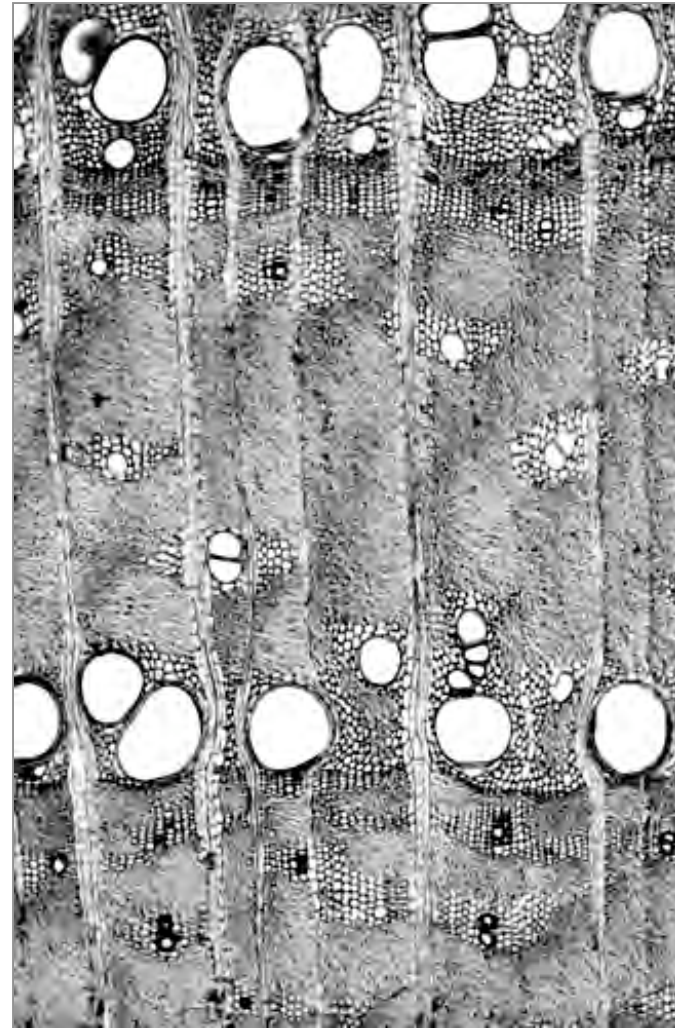
Feature 1. Growth ring boundaries distinct



Halesia diptera: F. Lens (Styracaceae)

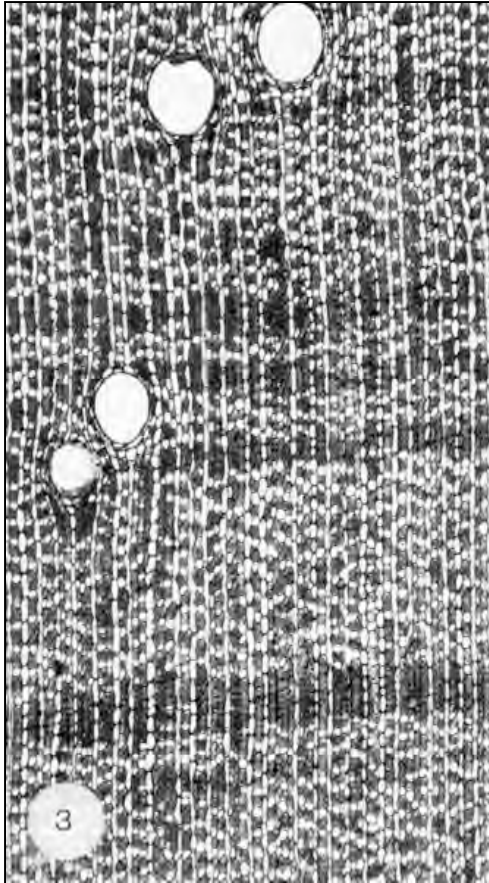


Platanus occidentalis: E.A.Wheeler
(Platanaceae)



Sophora affinis: P.E. Gasson
(Leguminosae - Papilionoideae)

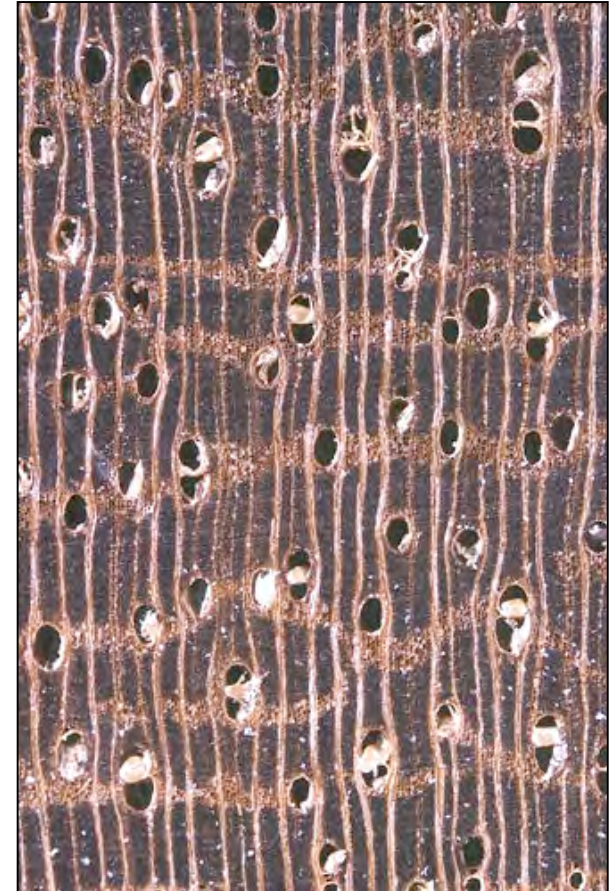
Feature 2. Growth ring boundaries indistinct or absent = growth rings vague and marked by more or less gradual structural changes at their poorly defined boundaries, or not visible.



Xanthophyllum philippinense:
Bridgwater & Baas, IAWA Bull. 1982
(Polygalaceae)

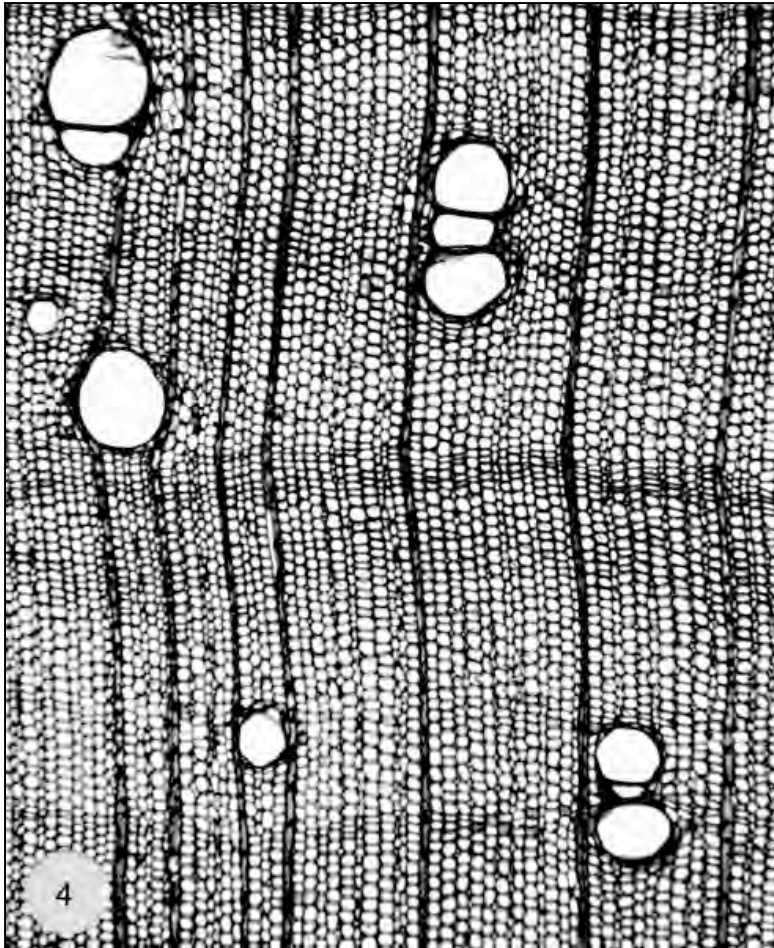


Macaranga tenarius:
FFPRI, Tsukuba, Japan
(Euphorbiaceae)

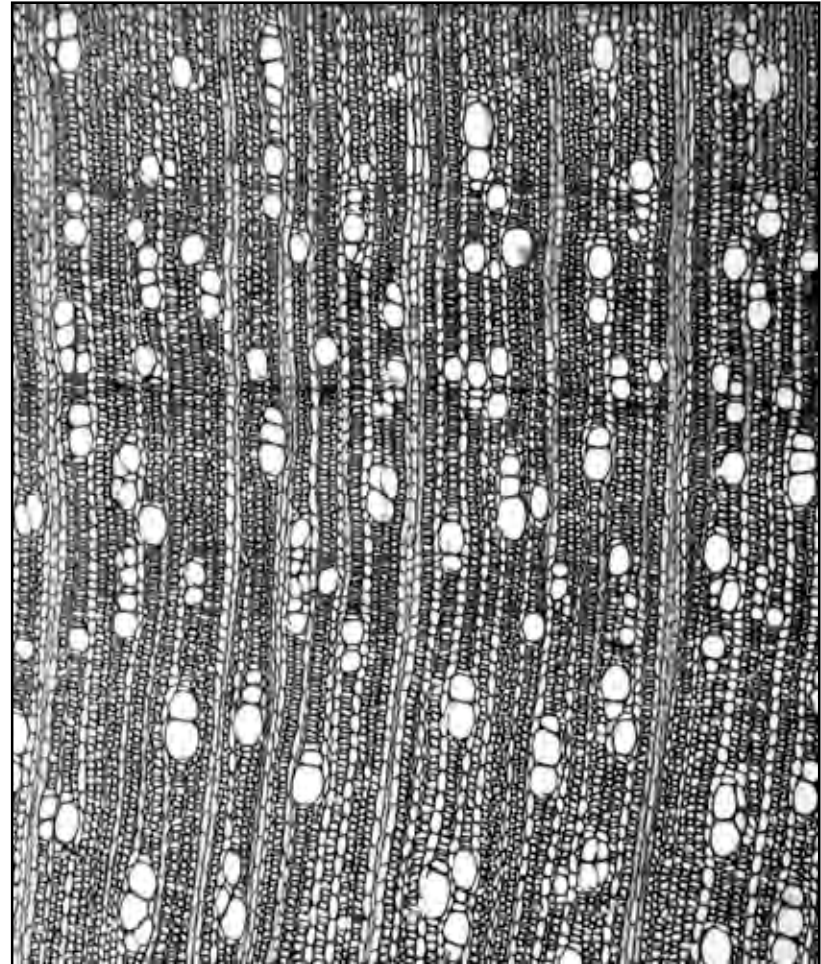


Entandrophragma candollei
L.Y.T. Westra (Meliaceae)

"..the differences between 'indistinct' and 'distinct' [growth ring] boundaries are somewhat arbitrary, and there are intermediates .."



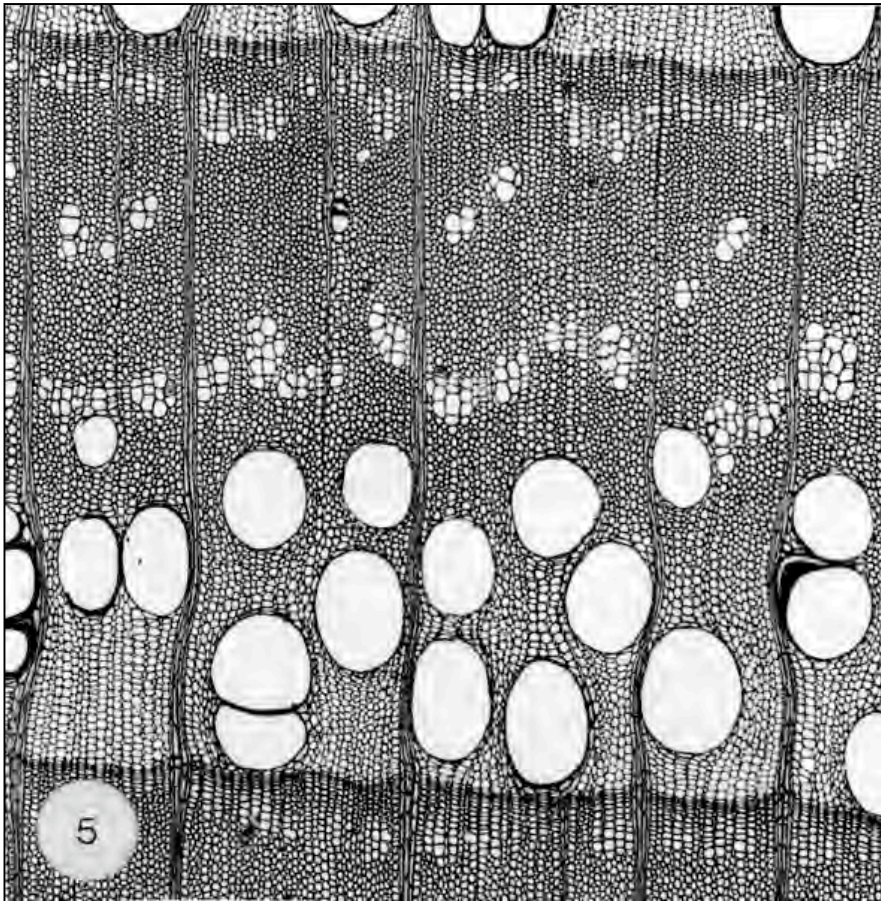
Jacaranda copaia: Growth ring boundaries intermediate between distinct and indistinct. P.E. Gasson (Bignoniaceae)



Claoxylon sandwichense:
A.M.W. Mennega (Euphorbiaceae)

POROSITY

Feature 3. Wood ring-porous = wood in which the vessels in the earlywood are distinctly larger than those in the latewood of the previous and of the same growth ring, and form a well defined zone or ring, and in which there is an abrupt transition to the latewood of the same growth ring.



Phellodendron amurense: K.Ogata
(Rutaceae)



Quercus rubra: L.Y.T. Westra
(Fagaceae)

Feature 4. Wood semi-ring-porous

Wood semi-ring-porous =

1) wood in which the vessels in the earlywood are distinctly larger than those in the latewood of the previous growth ring, but in which there is a gradual change to narrower vessels in the intermediate and latewood of the same growth ring (Fig.7 and *Juglans regia*); or

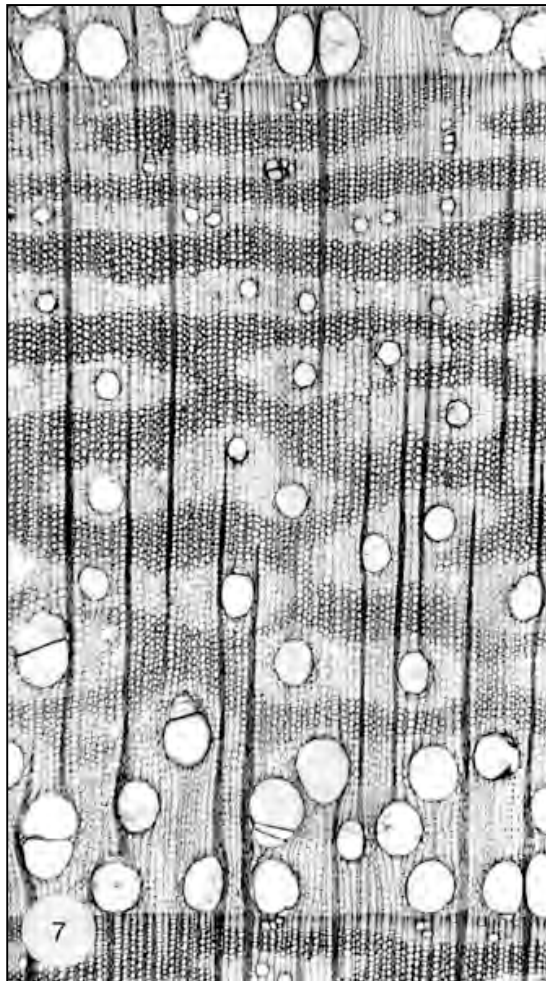


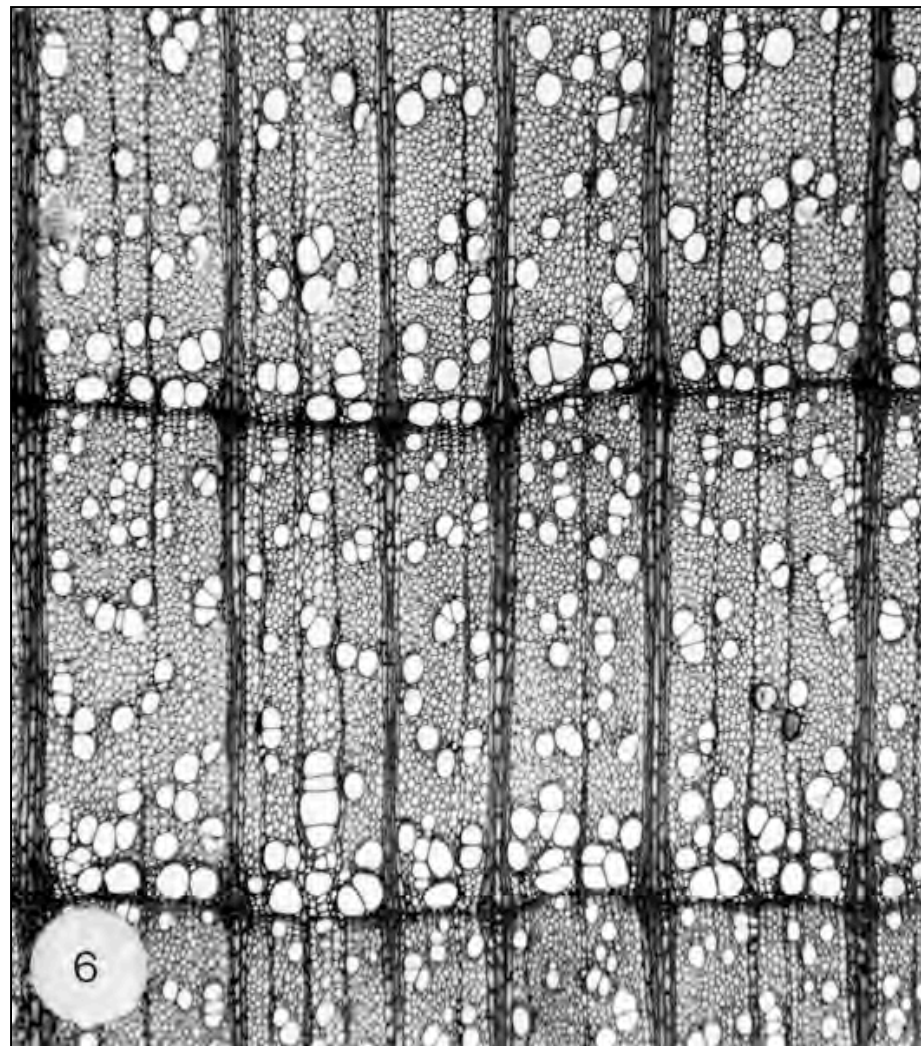
Fig. 7. *Paulownia tomentosa*: P.E. Gasson (Scrophulariaceae)

Right: *Juglans regia*:
L.Y.T. Westra
(Juglandaceae)

**Feature 4. Wood semi-
ring-porous =**

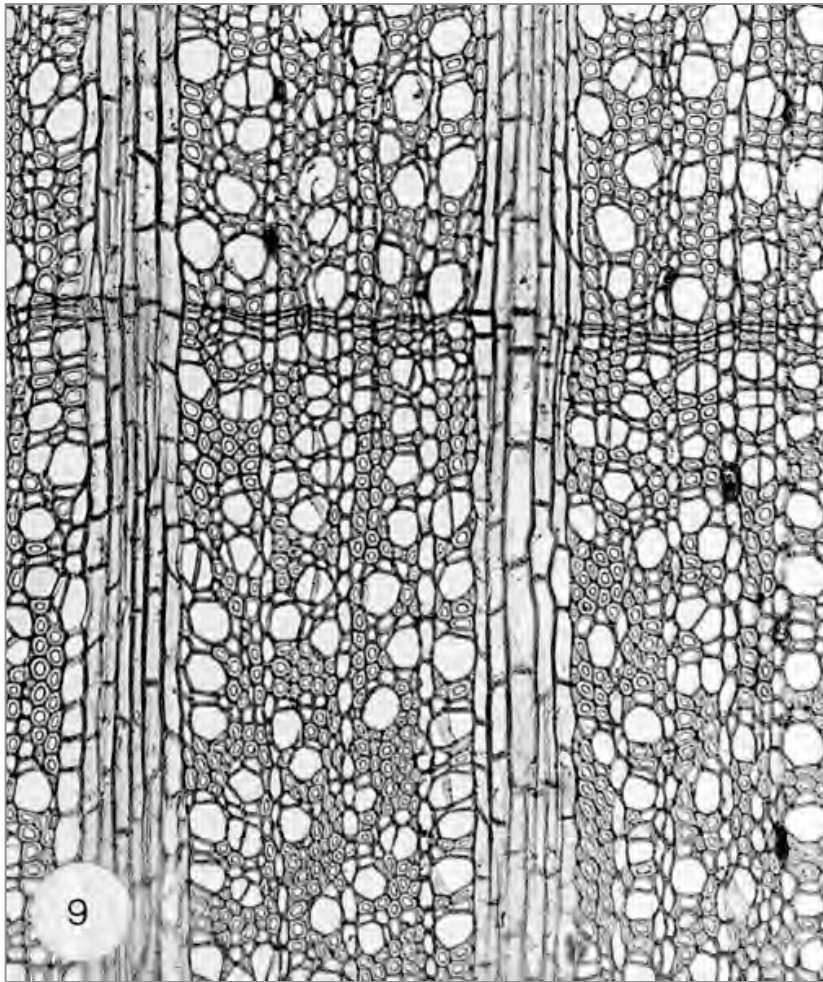
2) wood with a distinct ring of closely spaced earlywood vessels that are not markedly larger than the latewood vessels of the preceding ring or the same growth ring (Fig. 6).

Alternative definition:
intermediate condition
between ring-porous and
diffuse-porous.

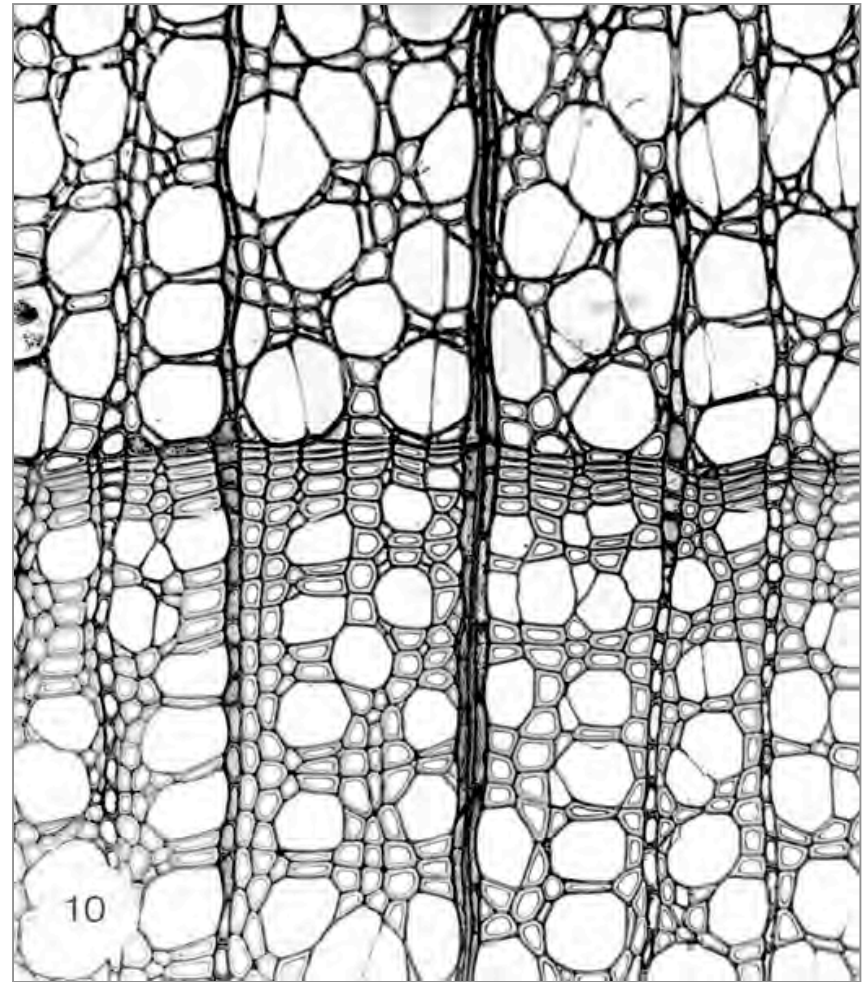


Prunus sp: E.A. Wheeler
(Rosaceae)

Feature 5. Wood diffuse-porous = wood in which the vessels have more or less the same diameter throughout the growth ring.

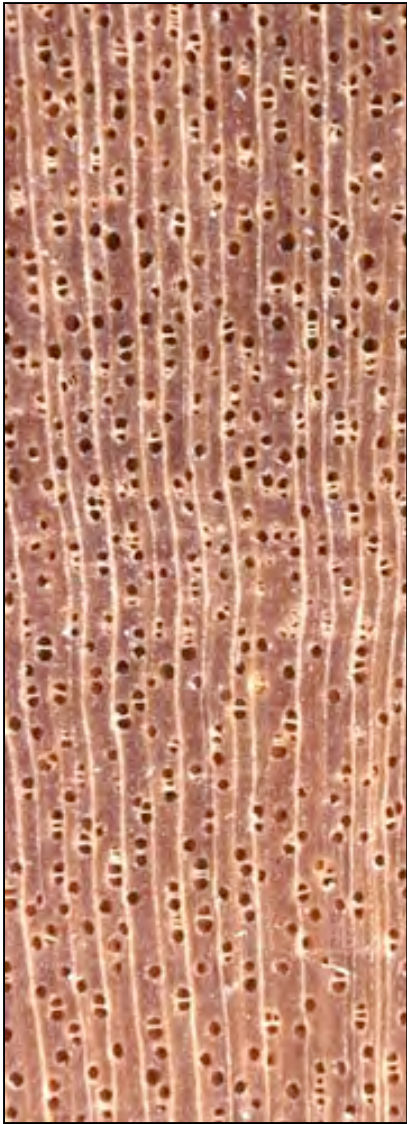


Rhododendron wadanum: K.Ogata
(Ericaceae)

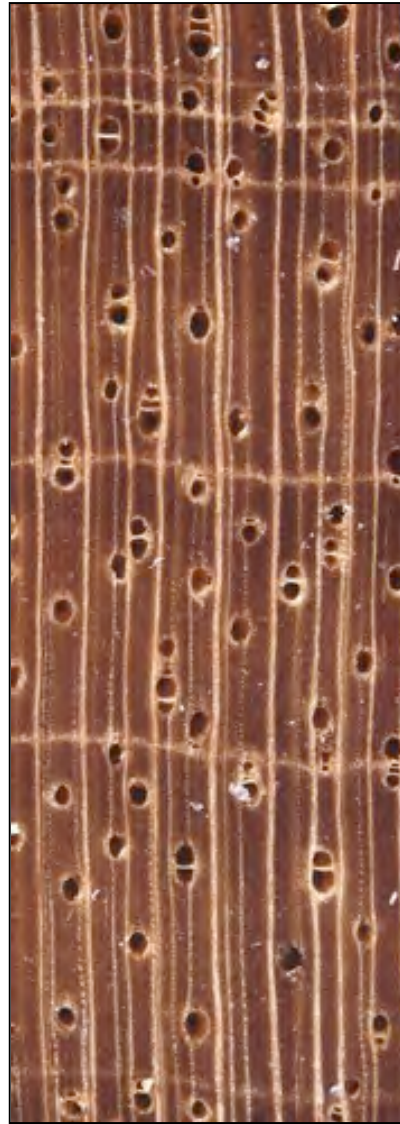


Cercidiphyllum japonicum: Bailey-Wetmore Laboratory Plant
Anatomy and Morphology, Harvard University
(Cercidiphyllaceae)

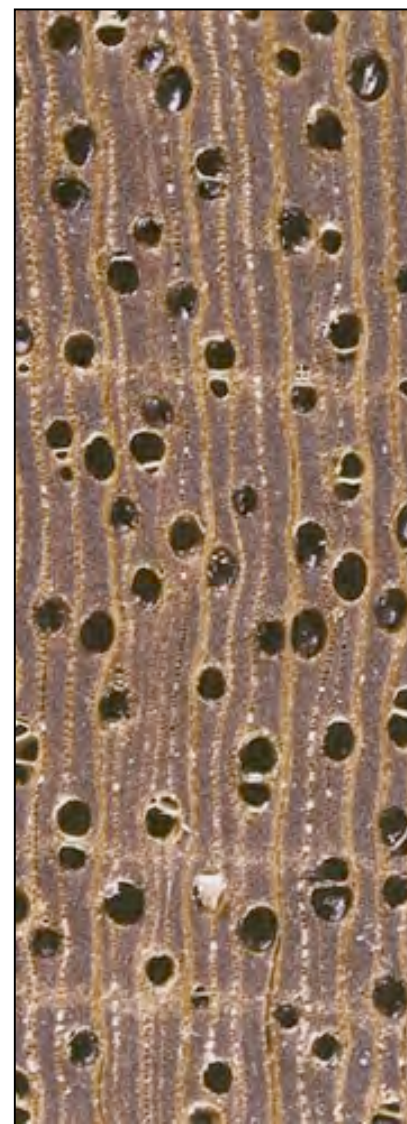
Feature 5. Wood diffuse-porous



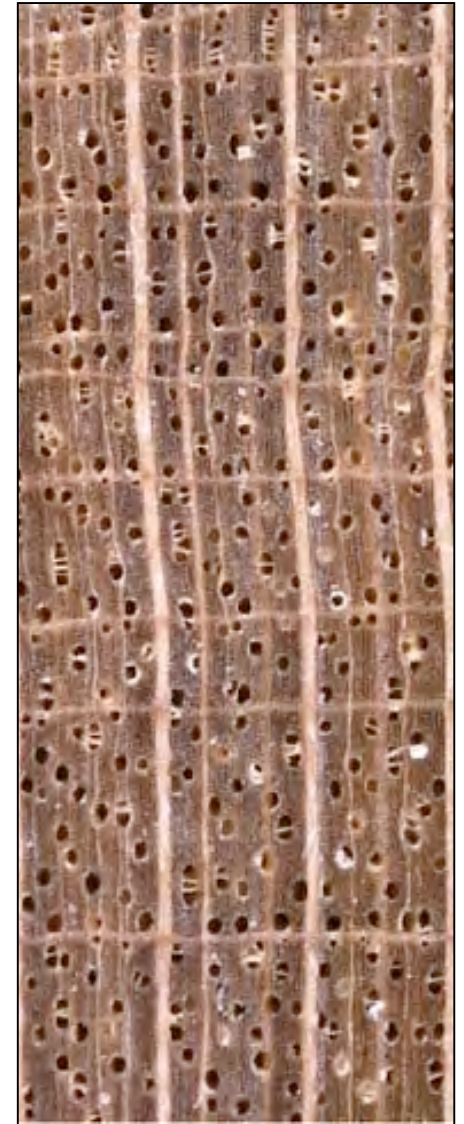
Nectandra coriacea:
L.Y.T. Westra (Lauraceae)



Beilschmiedia tawa
L.Y.T. Westra (Lauraceae)



Khaya senegalensis
L.Y.T. Westra (Meliaceae)



Acer pseudoplatanus: L.Y.T.
Westra (Sapindaceae)

Feature 5. Wood diffuse-porous

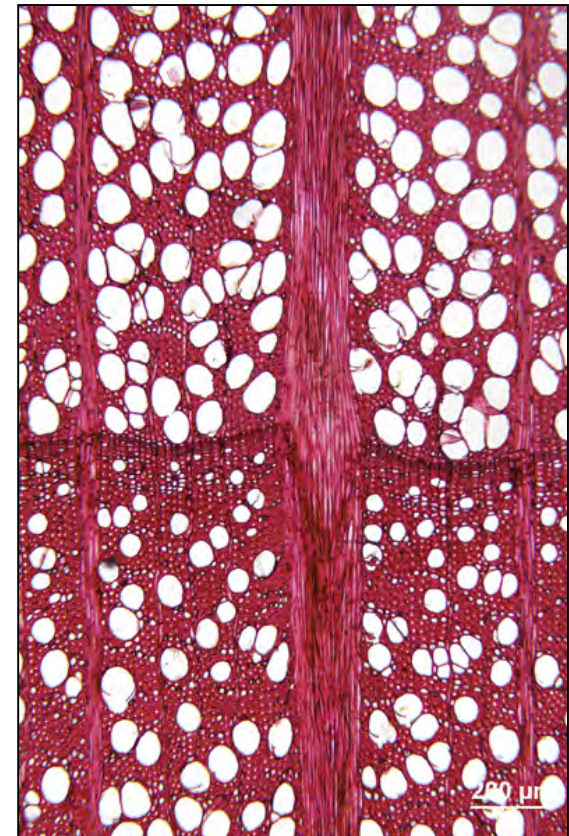
"In some temperate diffuse-porous woods (e.g., *Fagus* spp - Fagaceae, *Platanus* spp - Platanaceae) the latest formed vessels in the latewood may be considerably smaller than those of the earlywood of the next ring, but vessel diameter is more or less uniform throughout most of the growth ring . . . "



Fagus sylvatica
L.Y.T Westra



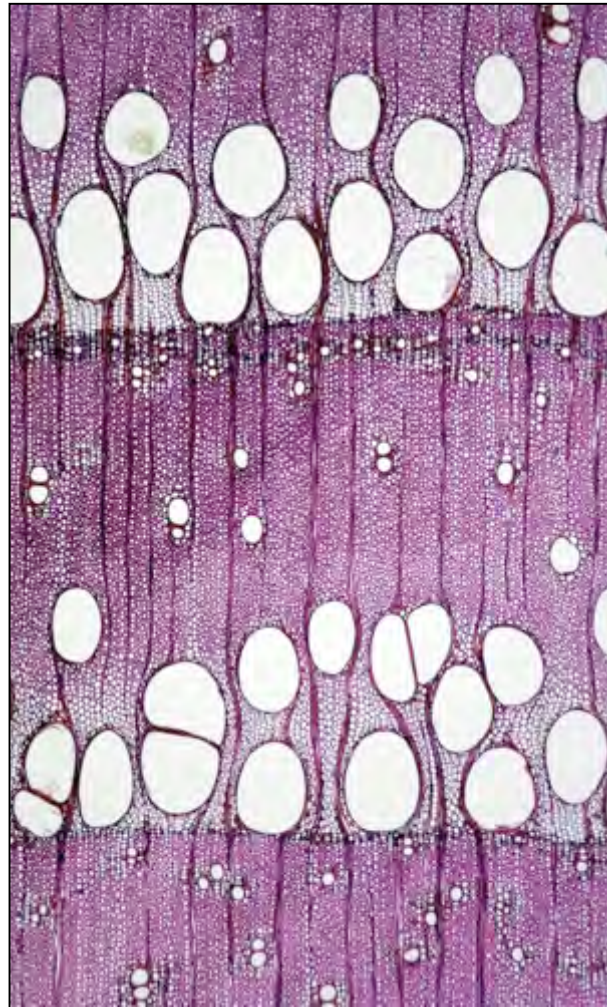
Fagus japonica
FFPRI, Tsukuba, Japan



Fagus grandifolia
E.A. Wheeler

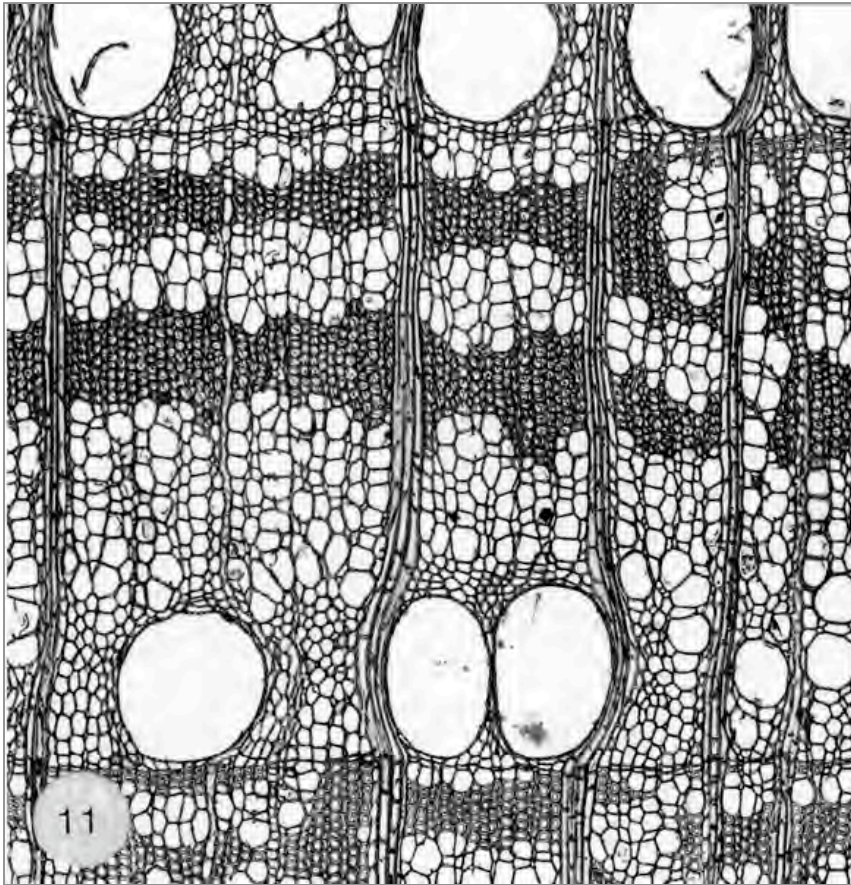
Caution: Slow grown ring-porous woods have narrow growth rings with very little latewood. Be careful not to confuse the closely spaced earlywood zones of slow-grown ring-porous woods with a tangential pattern, or to interpret such woods as diffuse-porous.

Fraxinus mandshurica
(Oleaceae)
FFPRI, Tsukuba,
Japan
Wood ring-porous.
Appearance is
affected by
variation in growth
ring width.
(Oleaceae)

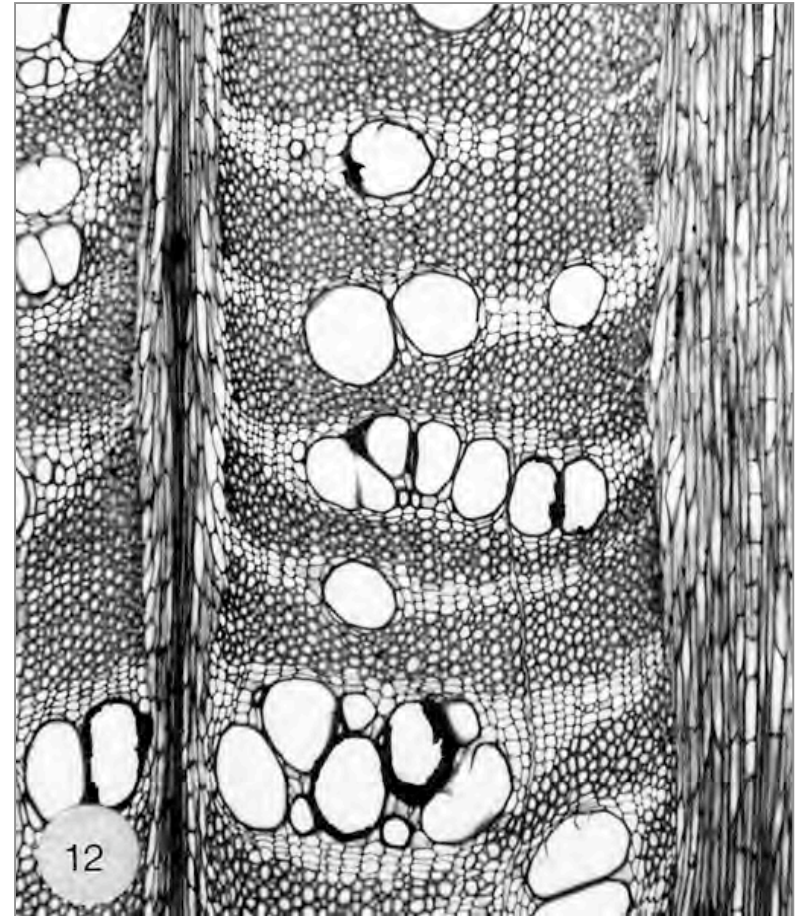


VESSEL ARRANGEMENT

Feature 6. Vessels in tangential bands = vessels arranged perpendicular to the rays and forming short or long tangential bands; these bands can be straight or wavy; includes ulmiform and festooned.

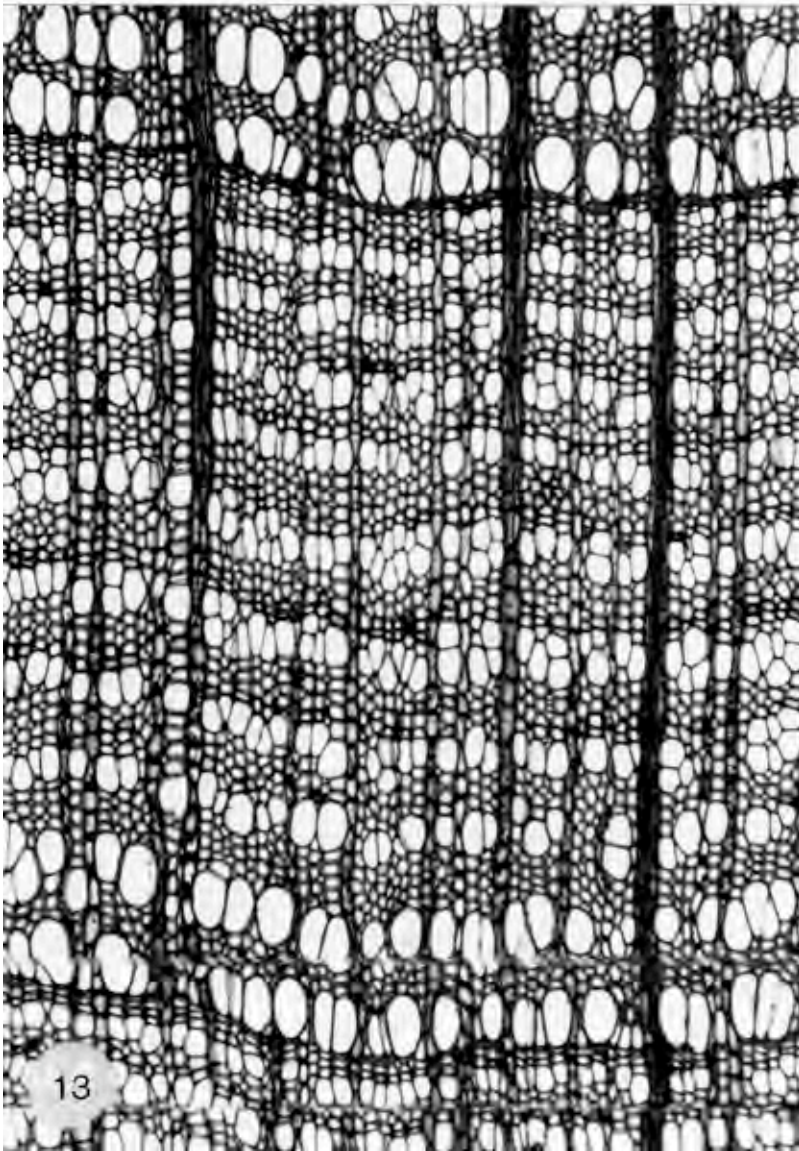


Kalopanax pictus : I.W. Bailey
Bailey-Wetmore Laboratory Plant Anatomy and Morphology,
Harvard University (Araliaceae)

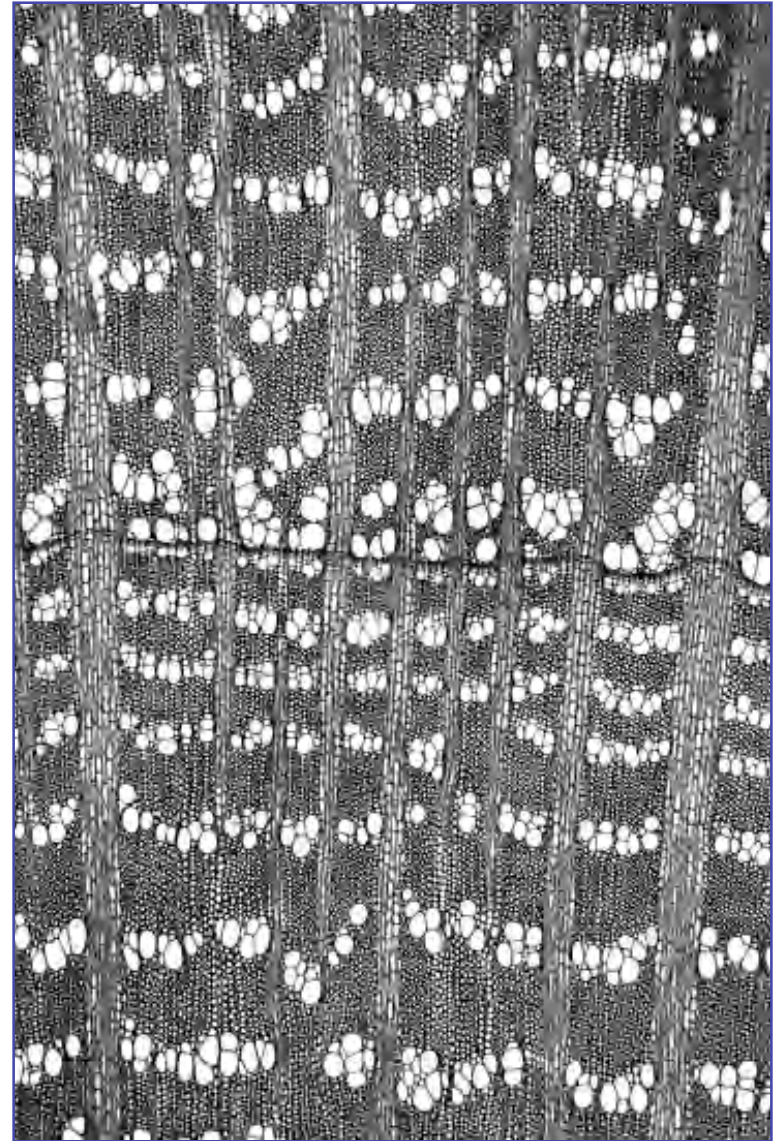


Cardwellia sublimis: P.E. Gasson (Proteaceae)

Feature 6. Vessels in tangential bands

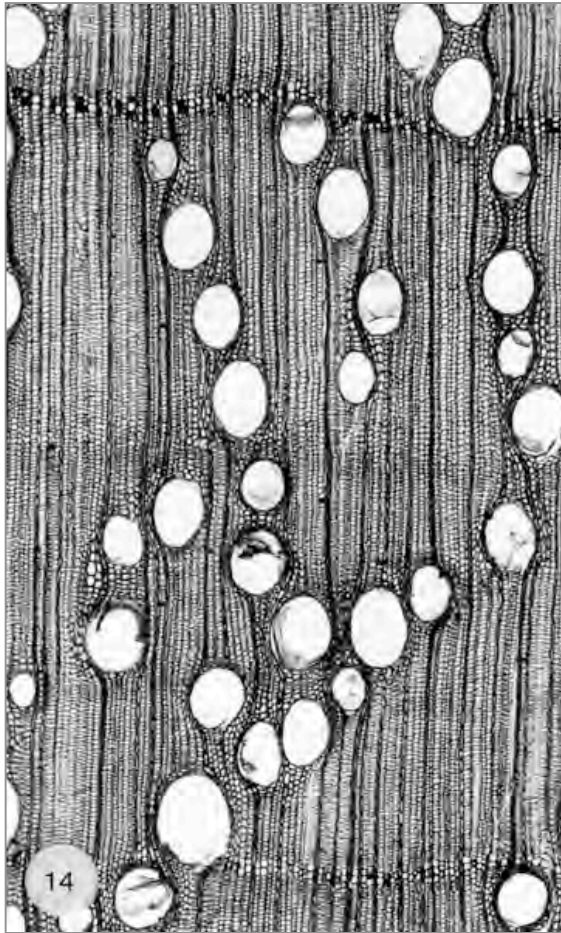


Enkianthus cornuus: K.Ogata (Ericaceae)

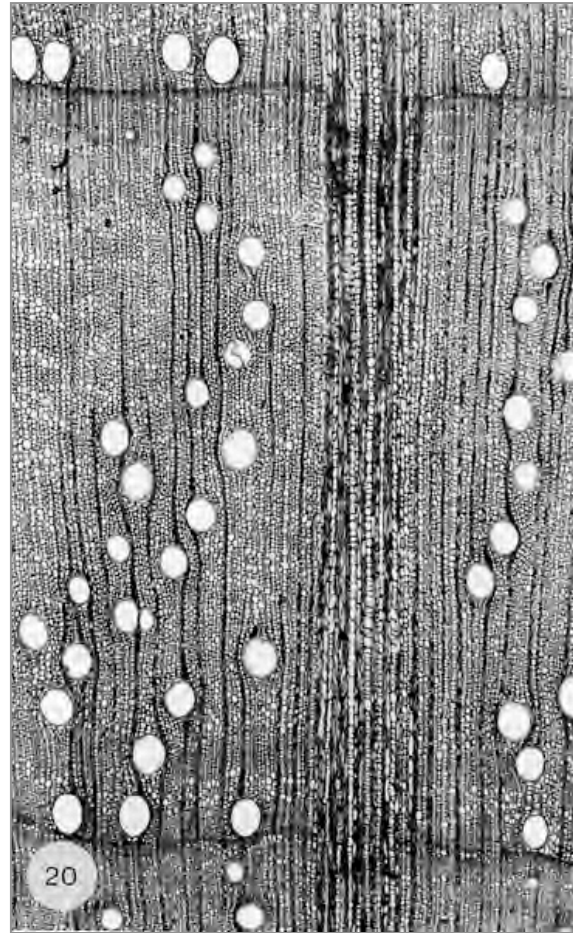


Eleutherococcus spinosus: FFPRI, Tsukuba, Japan
(Araliaceae)

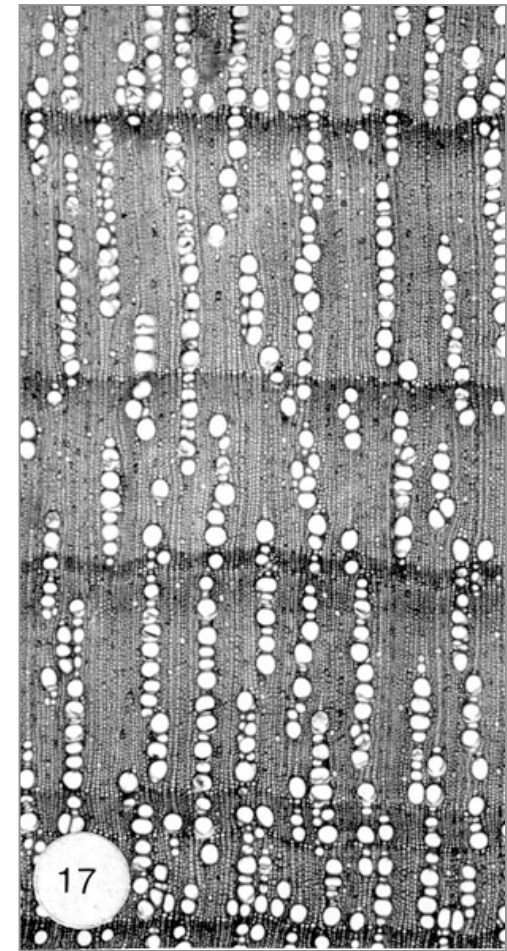
Feature 7. Vessels in diagonal and / or radial pattern
= vessels arranged radially or intermediate between tangential and radial (i. e., oblique),



Calophyllum papuanum: K.Ogata
(Clusiaceae)

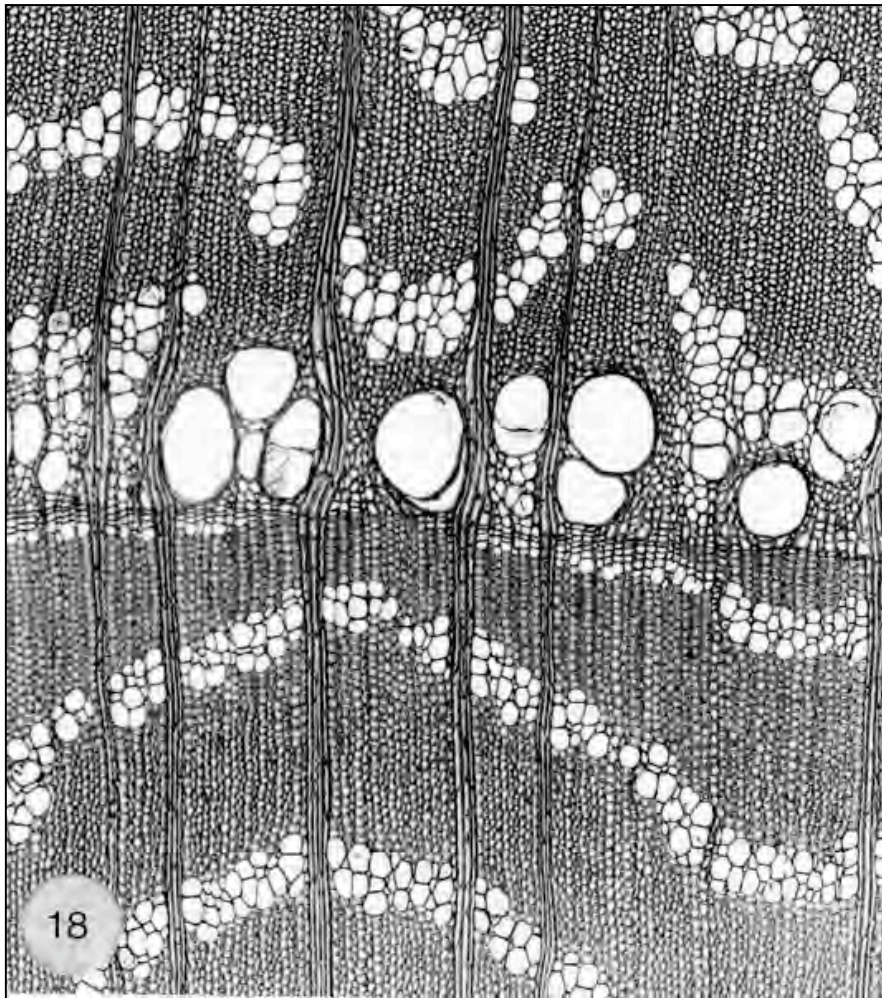


Lithocarpus edulis: K. Ogata
(Fagaceae)



Amyris sylvatica: E.A. Wheeler
(Rutaceae)

Vessel arrangement patterns “often occur in combination. . In ring-porous woods, only the intermediate wood and latewood are examined.” Shown here intermediate between tangential and diagonal.

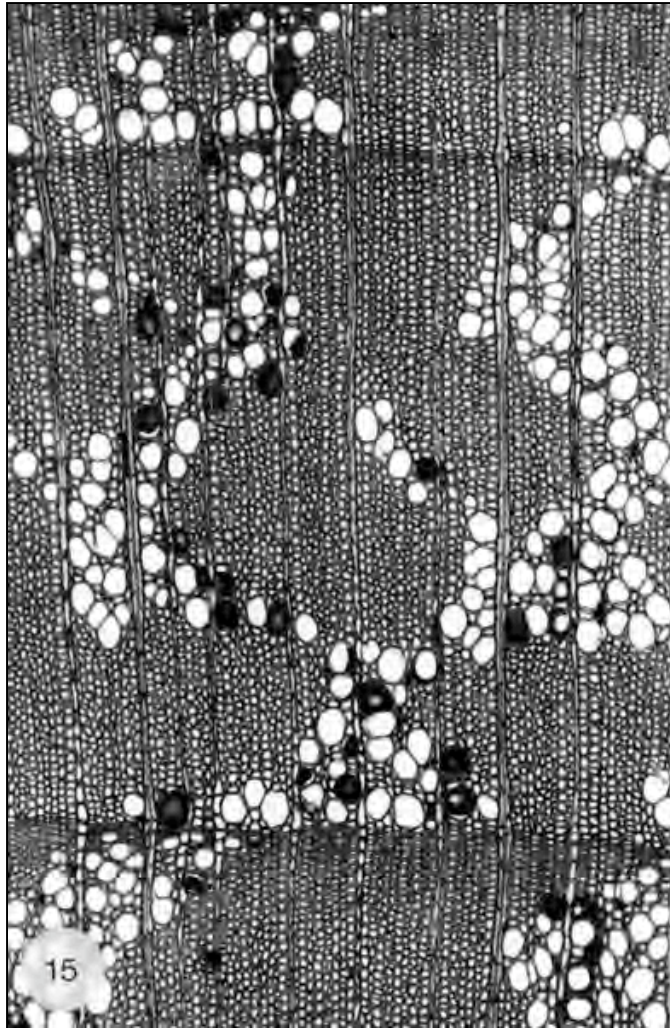


Kalopanax pictus: I.W. Bailey
Bailey-Wetmore Laboratory Plant Anatomy and Morphology,
Harvard University.(Araliaceae)

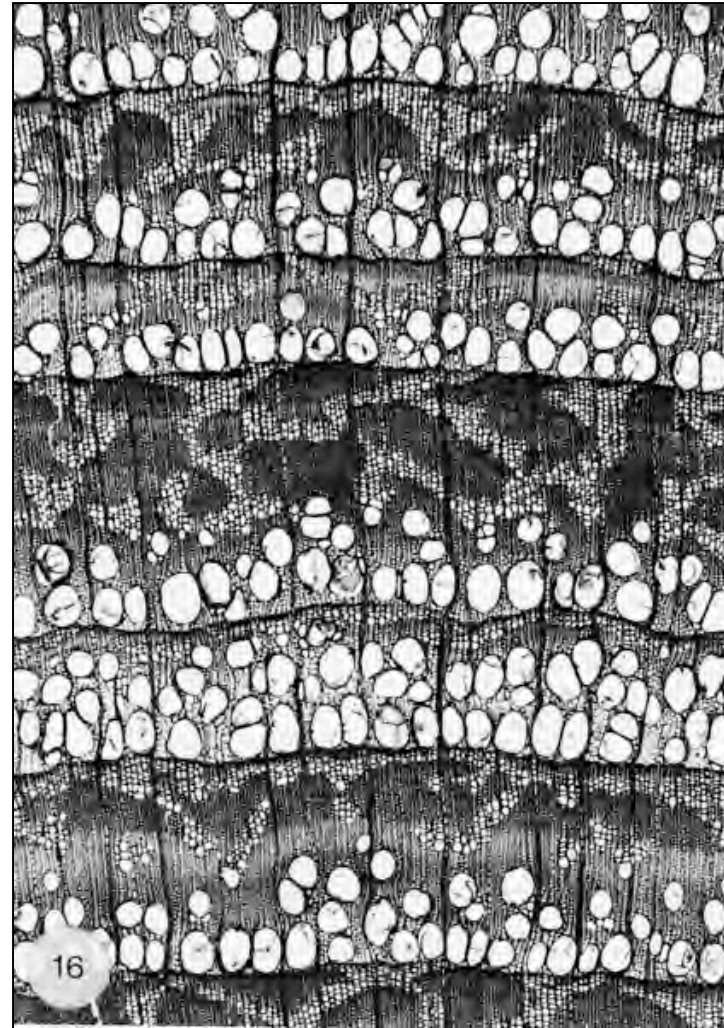


Pittosporum tobira: FFPRI, Tsukuba, Japan
(Pittosporaceae)

Feature 8. Vessels in dendritic pattern = vessels arranged in a branching pattern, forming distinct tracts, separated by areas devoid of vessels.

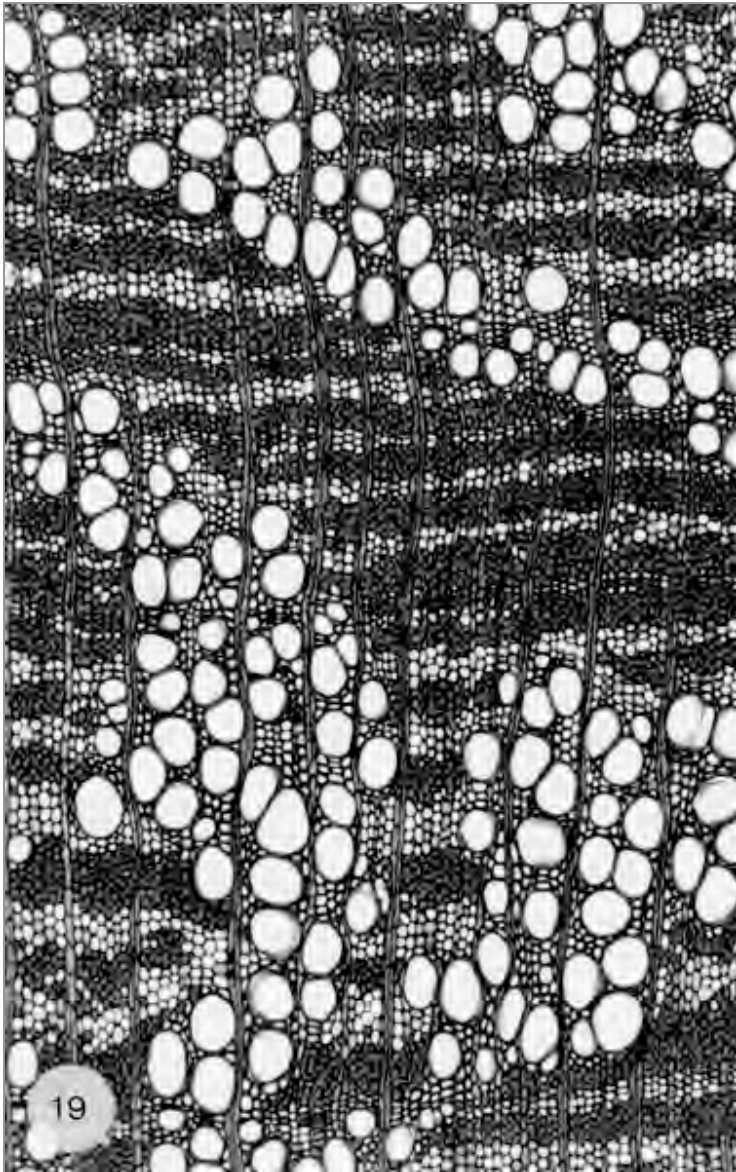


Rhamnus cathartica: D. Grosser
(Rhamnaceae)

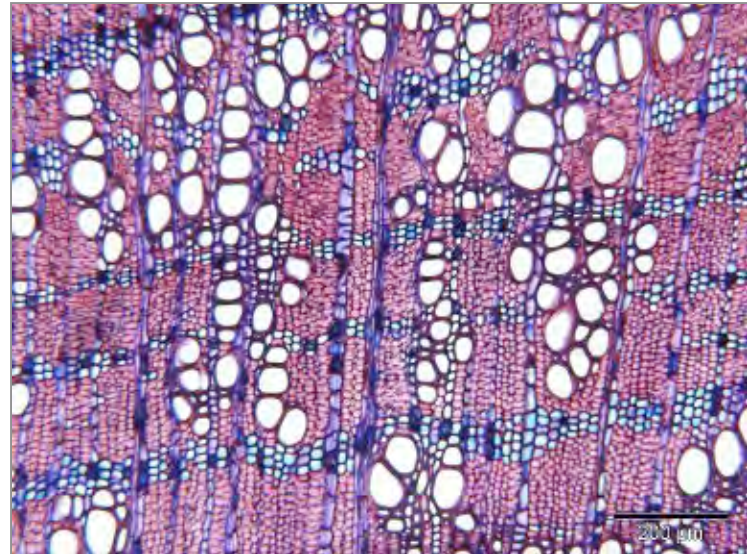


Rhus aromatica: I.W. Bailey
Bailey-Wetmore Laboratory Plant Anatomy and Morphology,
Harvard University (Anacardiaceae)

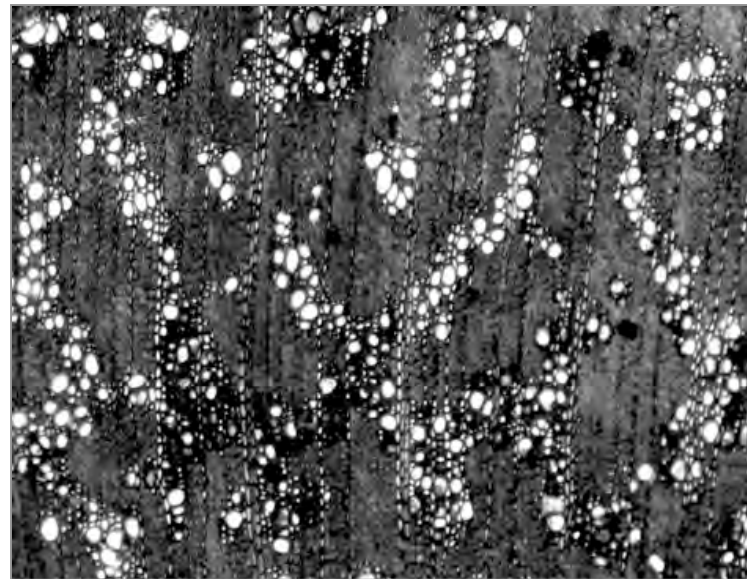
Diagonal (feature 7) to dendritic pattern (feature 8)



Bumelia obtusifolia: P.E. Gasson
(Sapotaceae)



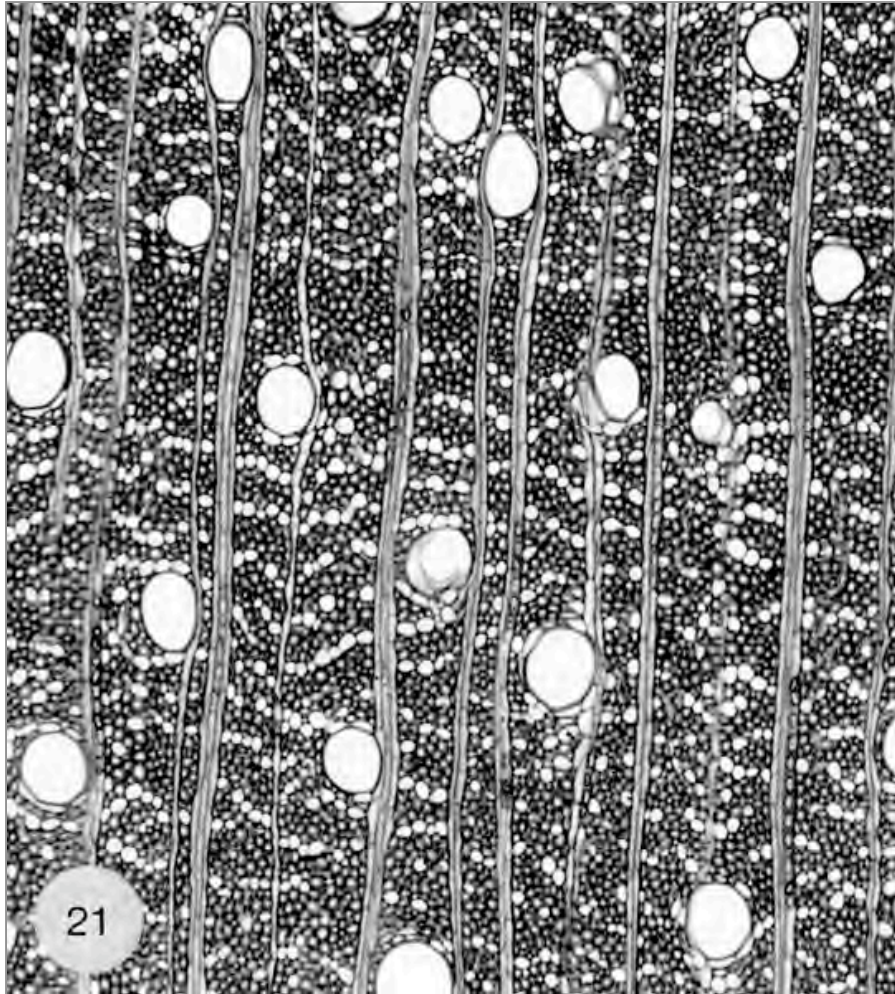
Argania spinosa: F. Lens (Sapotaceae)



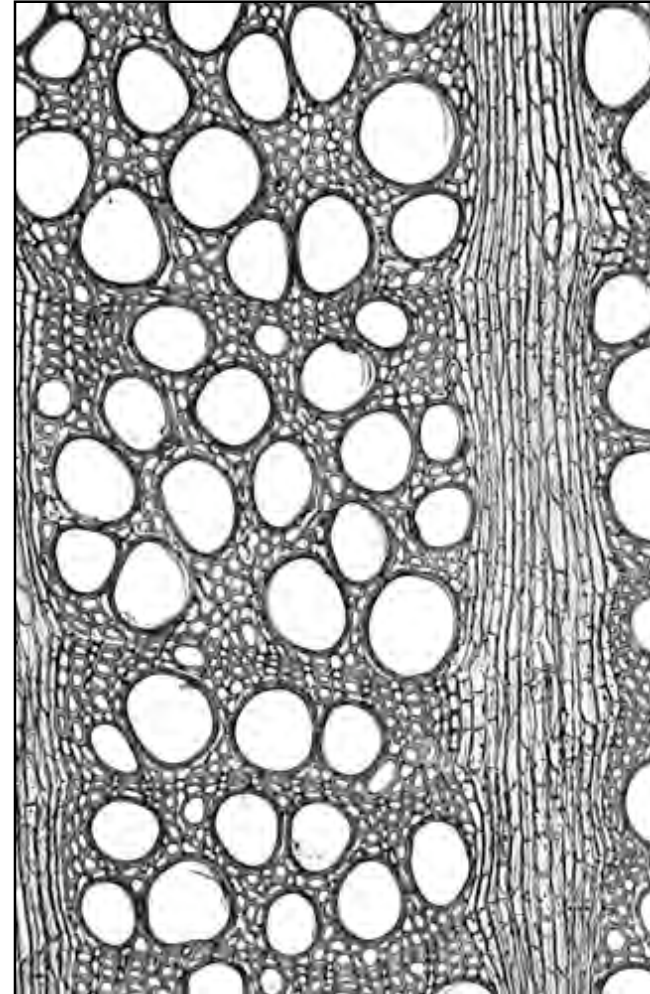
Rosmarinus officinalis: S. Carlquist (Lamiaceae)

VESSEL GROUPINGS

Feature 9. Vessels exclusively solitary = 90% or more of the vessels are completely surrounded by other elements, i.e., 90% or more appear not to contact another vessel, as viewed in cross section.

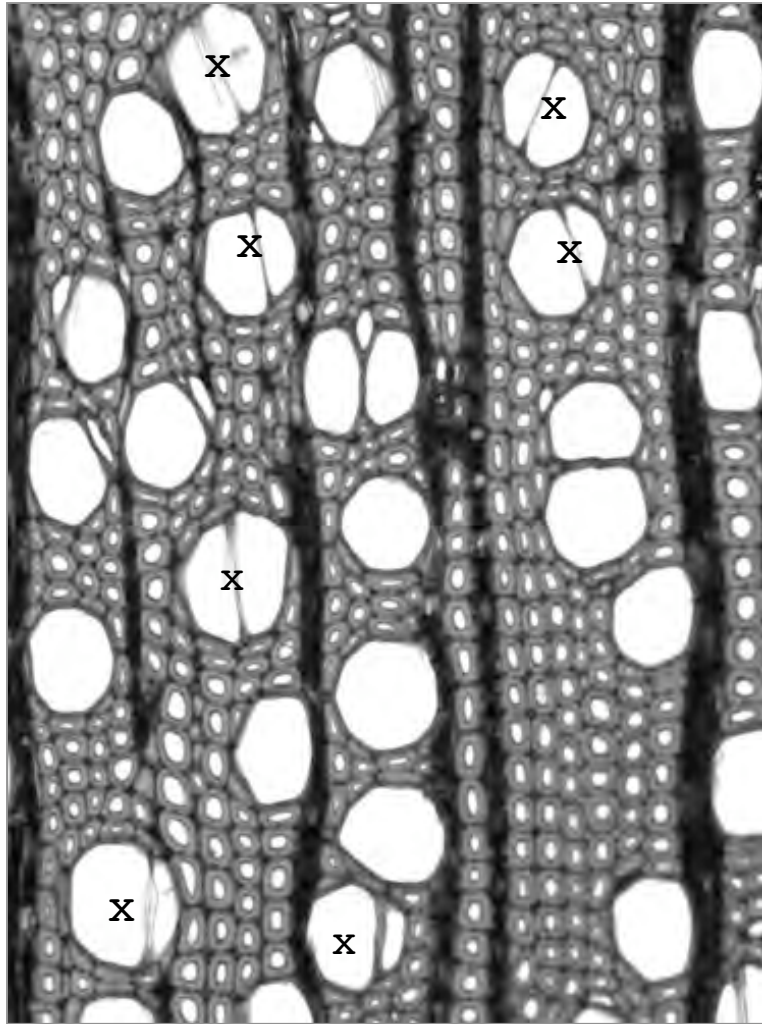


Aspidosperma quebracho: P.E. Gasson
(Apocynaceae)



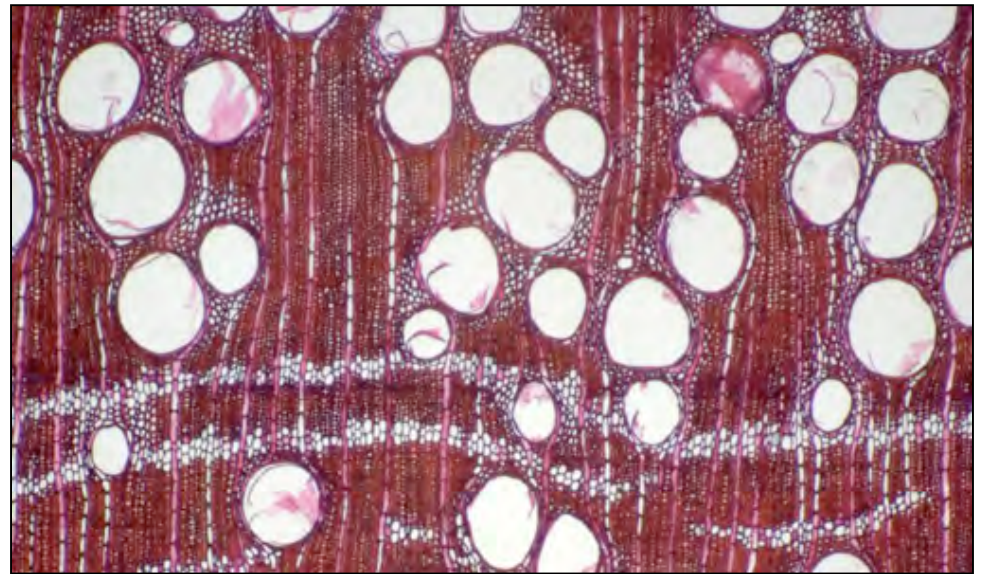
Gelsemium sempervirens: A.M.W. Mennega
(Loganiaceae)

"Care is needed to recognize the following as **not** being multiples



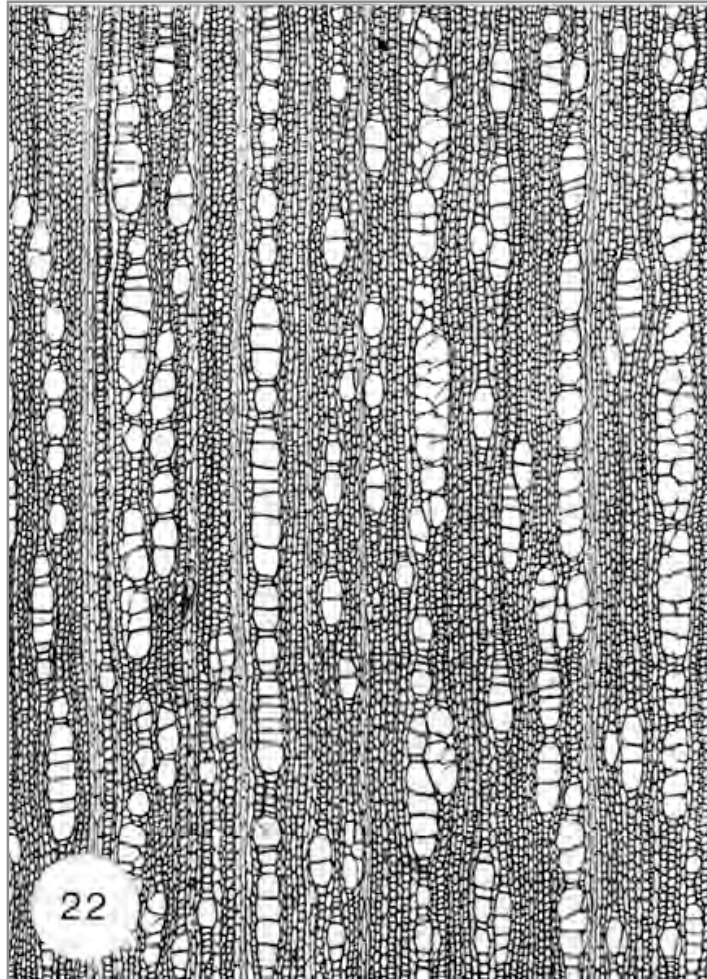
Rhodoleia championii (Hamamelidaceae)
X in vessels with overlapping vessel
element end walls.

- (i) Solitary vessels composed of vessel elements with oblique overlapping end walls giving the appearance of vessel pairs on the cross section as in *Cercidiphyllum* (see Fig.10) and *Illicium*"
- (ii) closely associated solitary vessels, as in some species of *Eucalyptus* .. and *Calophyllum*."

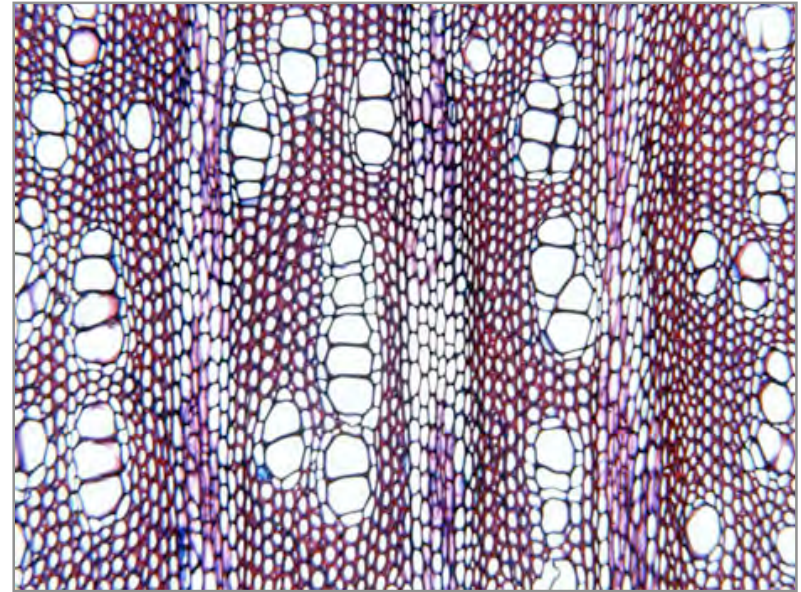


Calophyllum lucidum M.E. Bakker (Clusiaceae)

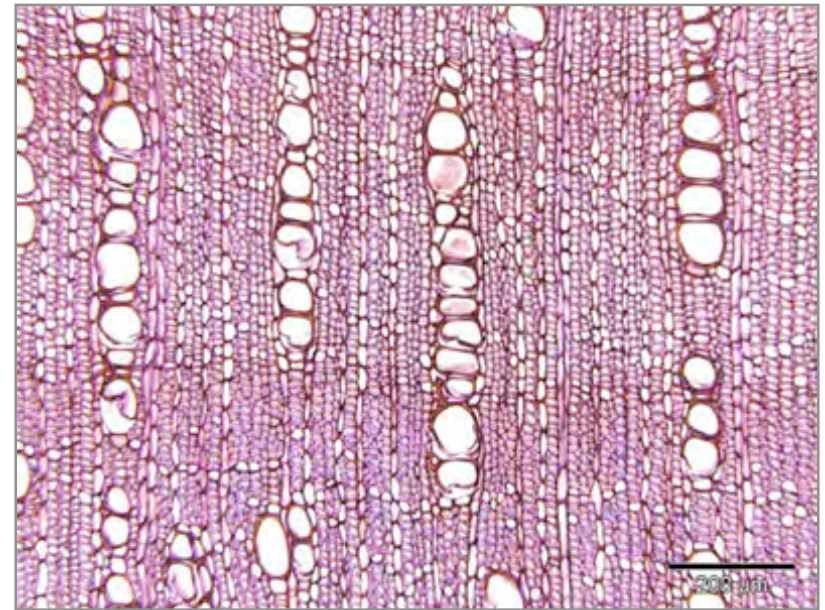
Feature 10. Radial multiples of 4 or more common = radial files of 4 or more adjacent vessels of common occurrence



Elaeocarpus hookerianus: K.Ogata
(Elaeocarpaceae)

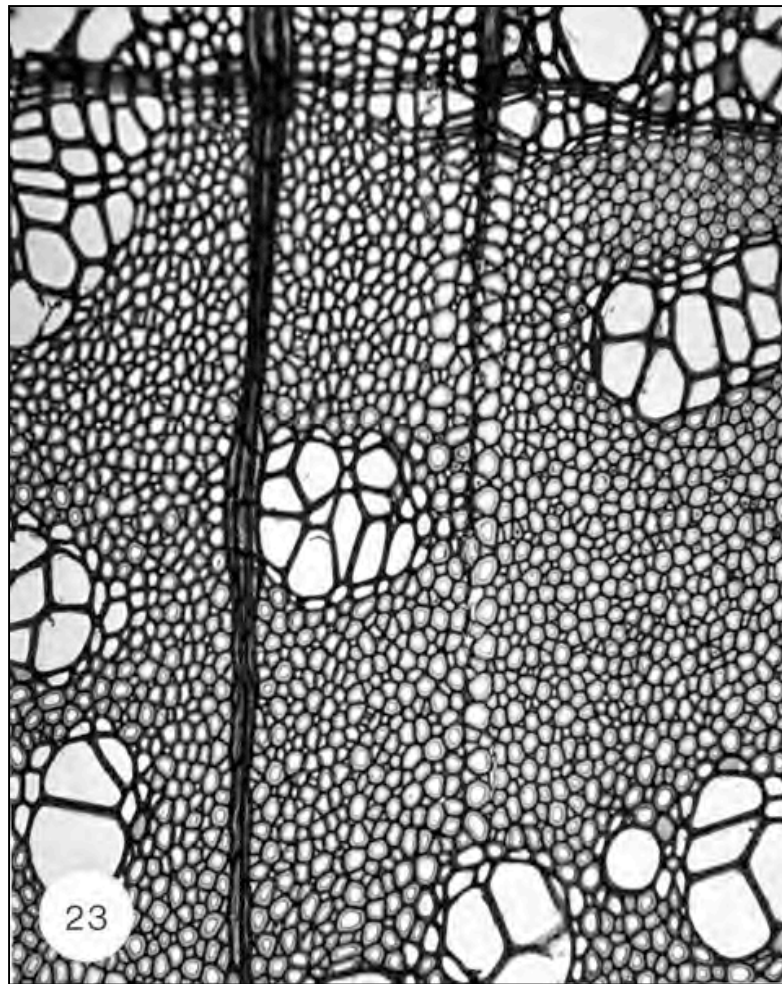


Ardisia cauliflora: F. Lens (Myrsinaceae)



Diospyros whyteana. F. Lens (Ebenaceae)

Feature 11. Vessel clusters common = groups of 3 or more vessels having both radial and tangential contacts, and of common occurrence.



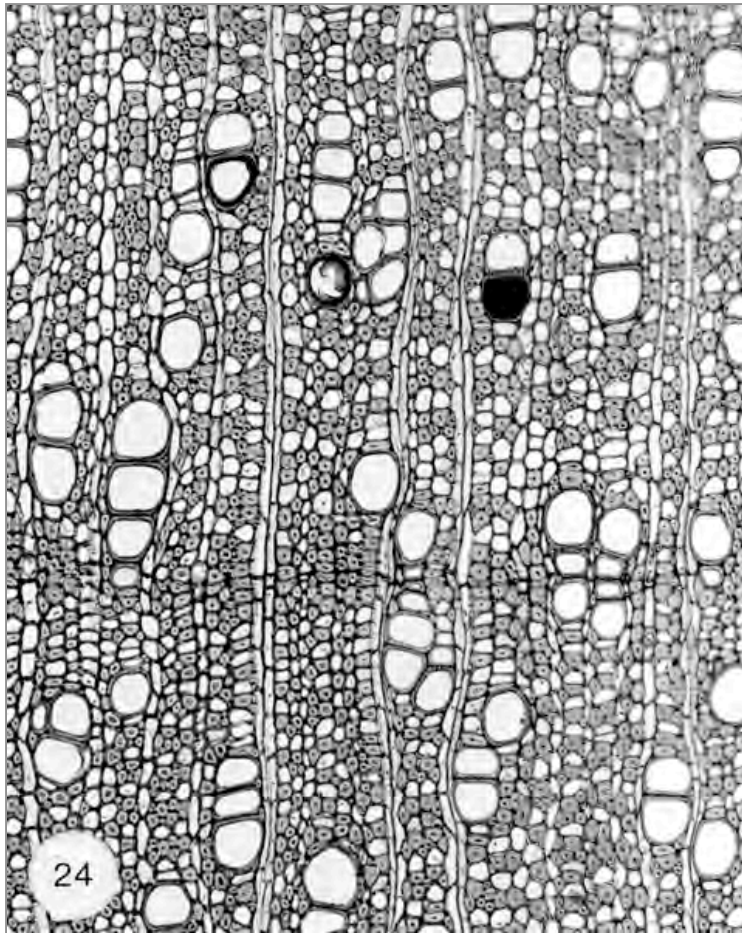
Gymnocladus dioica: E.A. Wheeler
(Leguminosae - Caesalpinioideae)



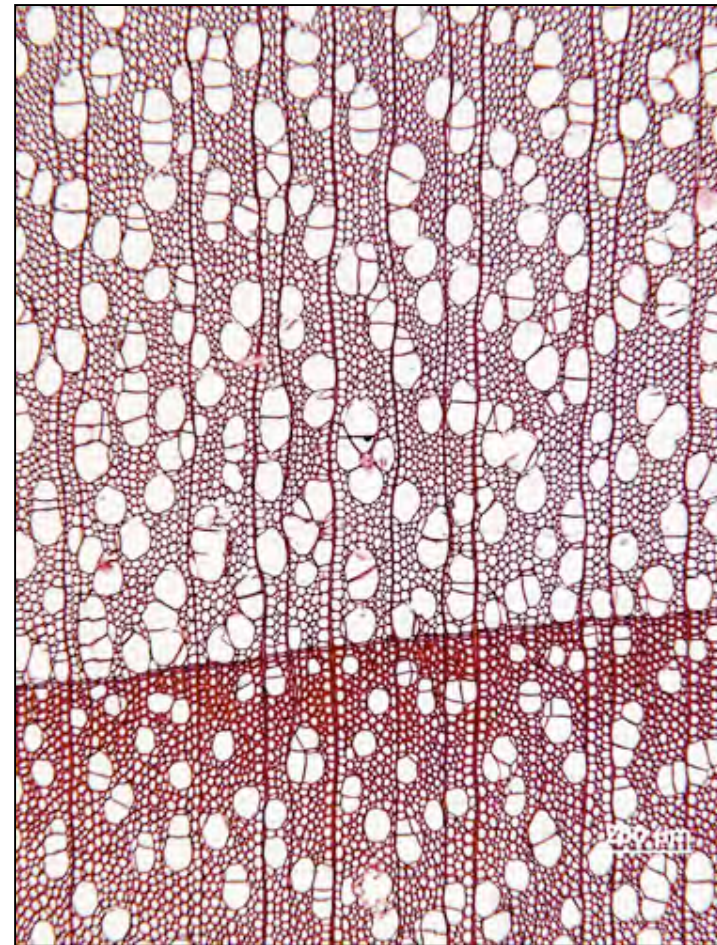
Robinia pseudoacacia: E.A. Wheeler
(Leguminosae - Papilionoideae)

Vessels partly solitary, partly in radial multiples of 2-4, or small clusters.

Absence of features 9, 10, and 11: "The most common vessel grouping.."



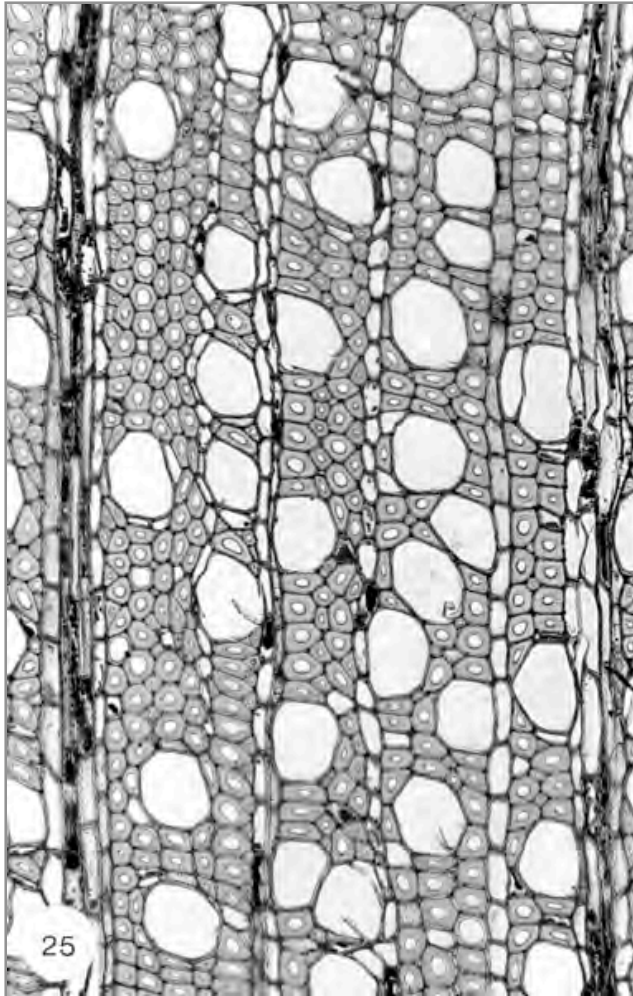
Drypetes gerrardii: K. Ogata
(Putranjavaceae)



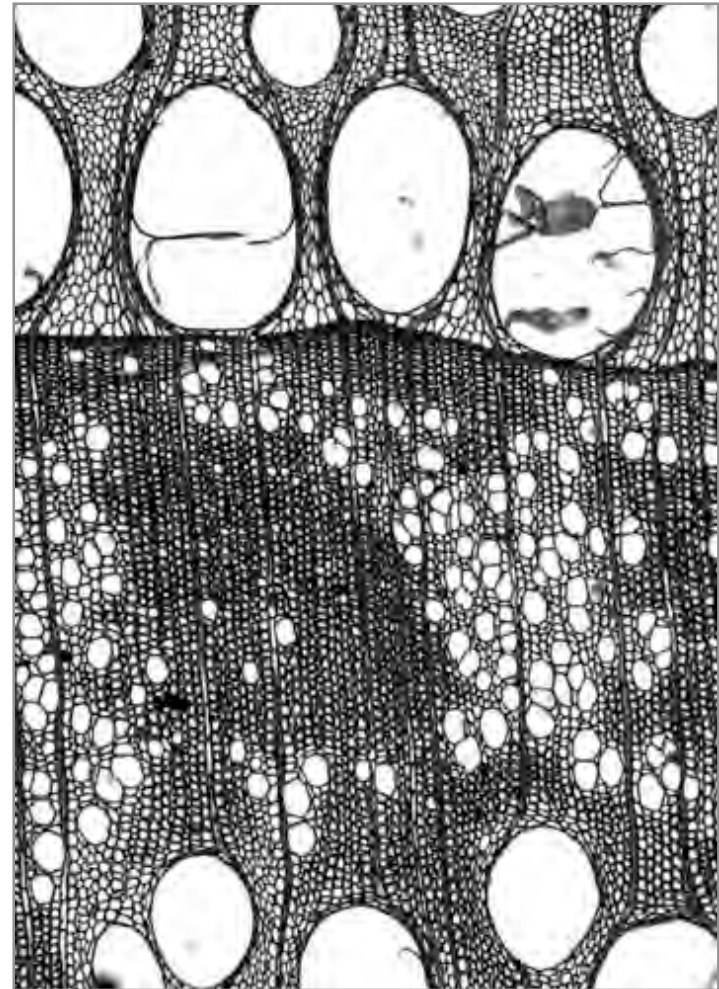
Populus balsamifera: E.A. Wheeler
(Salicaceae)

SOLITARY VESSEL OUTLINE

Feature 12. Solitary vessel outline angular = shape of solitary vessel outline is angular as viewed in cross section.

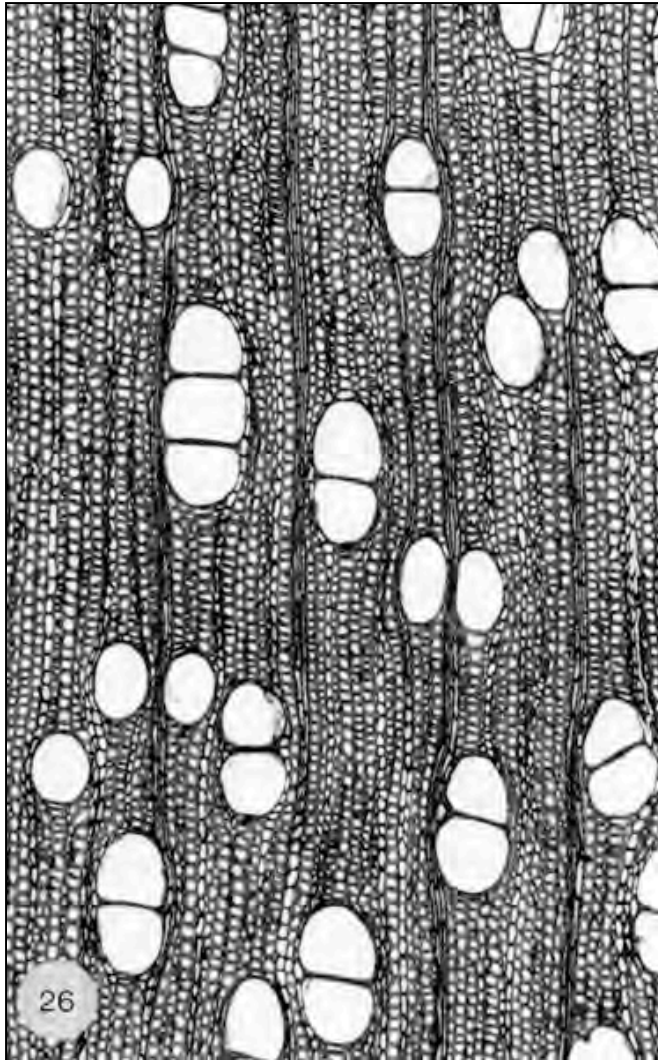


Stemonurus luzoniensis: (Stemonuraceae) K.Ogata

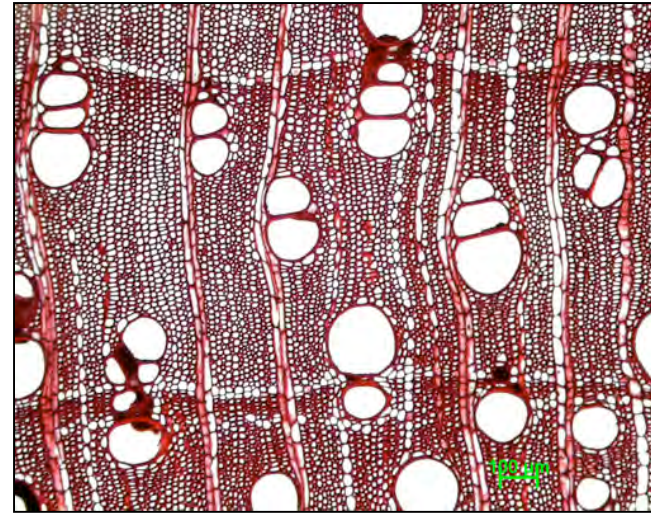


Castanea dentata: (Fagaceae)
Latewood vessels angular in outline

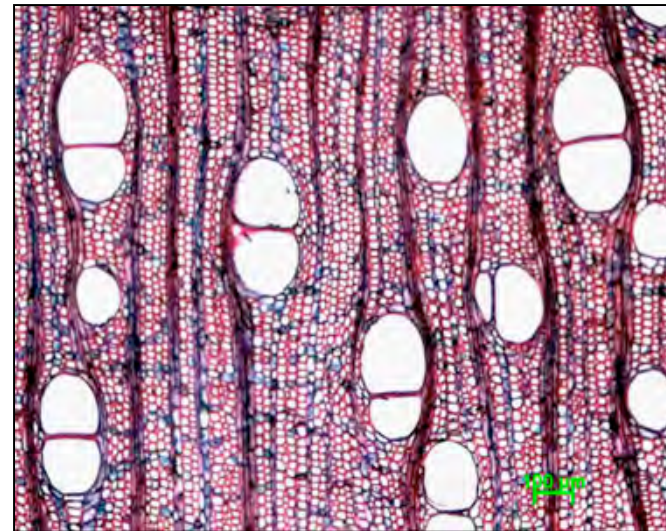
Absence of feature 12: Solitary vessel outline circular to oval. Note: All photos show diffuse porous wood (feature 5 present) with vessels partly solitary and partly in short radial multiples (absence of features 9, 10, 11).



Banara regia: P.E. Gasson (Salicaceae)



Swietenia mahagoni: P.E. Gasson (Meliaceae)



Anthocephalus cadamba: P.E. Gasson (Rubiaceae)