

Identification of the important Japanese woods
by anatomical characters : supplement to the
Anatomical characters and identification of
Formosan woods etc.

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PART I.

ANATOMICAL CHARACTERS OF THE IMPORTANT
JAPANESE WOODS.

Magnoliaceæ.

A family containing many important trees; anatomically the genus *Trochodendron* is entirely different from the other genera, hence it is convenient to deal with the latter only.

Pores evenly distributed, number per square mm. 45–250; solitary or in groups, in the latter case 2 or more connected mostly in radial direction, solitary pores are elliptic, oval or round in outline, their radial diameter 30–130 μ ; length of the vessel segments 450–1,800 μ , their perforation simple (*Magnolia*) or scalariform, with scalariform bordered pits where they are in contact with each other. Wood fibers 16–30 μ in diameter, length 700–2,000 μ , wall 2–4 μ thick. Wood parenchyma rather scarce, sometimes terminal, sometimes scattered among fibers. Pith rays heterogeneous or nearly homogeneous 1–10 (*Euptelea*), usually 1–4 cells wide; cells often with brown substance.

Without vessels	<i>Trochodendron.</i>
With vessels	(1)
(1) { Vessels with simple perforation	<i>Magnolia.</i>
(1) { Vessels with scalariform perforation	(2)
(2) { Pith rays 1–10 cells wide, conspicuous	<i>Euptelea.</i>
(2) { Pith rays less than 5 cells wide	(3)
(3) { Pores standing closely; pith rays 1–2 cells wide.. .. .	<i>Cercidiphyllum.</i>
(3) { Pores more remote; pith rays 1–4 cells wide	(4)
(4) { Vessels with spiral thickenings; wood parenchyma terminal; pith ray cells mostly procumbent.. .. .	<i>Michelia.</i>
(4) { Vessels without spiral thickenings; wood parenchyma scattered; pith rays heterogeneous	<i>Illicium.</i>

1. **Michelia Compressa** MAX. *Ogatama-no-ki.*

A large ever-green tree up to 70 cm. in diameter.

Sap-wood grayish yellow, heart-wood yellowish brown; lustrous when planed; specific gravity 0.55.

Pores evenly distributed, number per square mm. 140–180; mostly connected in radial direction, solitary pores are polygonal in outline, their diameter 30–60 μ ; length of the vessel segments 450–1,100 μ , end walls slanting, their perforation scalariform sometimes simple, in the former case with 1–4 cross bars; with scalariform bordered pits where the vessels are in contact with each other; on the inner surface of the wall with spiral thickenings. Wood fibers 20–25 μ in diameter, length 800–1,400 μ , wall 3–4 μ thick. Wood parenchyma terminal and scattered. Pith rays heterogeneous, most of ray cells procumbent, 1–4 cells wide, 3–40 cells high.

Magnolia LINN.

Number of pores per square mm. 38–50; terminal parenchyma 1 or 2 cells wide; pith rays 1 or 2, rarely 3 cells wide. *M. obovata*.
 Number of pores per square mm. 50–72; terminal parenchyma 3–5 cells wide; pith rays 1–3 cells wide *M. Kobus*.

2. *Magnolia obovata* THUNB. *Hō-no-ki*.

A large tree reaching up to 100 cm. in diameter. With clear colour demarcation between sap and heart-wood, growth rings defined by fine bands of soft tissue; sap-wood light yellowish, heart-wood grayish yellow; light and soft, close-grained, easy to work, does not warp nor split; specific gravity 0.42.

Pores evenly distributed, number per square mm. 38–50; solitary or in groups, in the latter case 2 or more connected, mostly in radial direction; solitary pores are elliptic somewhat polygonal in outline, their diameter radially 60–130 μ , tangentially 50–100 μ ; length of the vessel segments 650–900 μ , end walls horizontal or slanting, their perforation simple; side walls 2 μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers are the principal element of the woods, septate, 24–28 μ in diameter, length 900–1,900 μ , wall 2–3 μ in early wood, in late wood 3–4 μ thick. Wood parenchyma terminal, one or two cells wide in radial direction. Pith rays nearly homogeneous (marginal cells often upright), 1 or 2, rarely 3 cells wide, 5–40 cells high.

3. **Magnolia Kobus** DC. *Kobushi*. Pl. I. Fig. 1.

A large tree, up to 70 cm. in diameter. Heart-wood not clearly marked off from sap-wood; wood grayish white; specific gravity 0.54.

Pores evenly distributed, number per square mm. 50-72, solitary or in groups, in the latter case 2-6 connected mostly in radial direction; solitary pores are elliptic or oval in outline, their diameter 45-90 μ ; length of the vessel segments 450-800 μ , their perforation simple, side walls 2 μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers 25-30 μ in diameter, length 700-1,600 μ , wall 3 μ in early wood, in late wood 3-4 μ thick. Terminal parenchyma 3-5 cells wide in radial direction. Pith rays nearly homogeneous, 1-3 cells wide, 5-30 cells high.

Magnolia Kobus DC. var. *borealis* SARGENT. *Kita-kobushi*. Growth rings distinct; number of pores per square mm. 150-200; mostly grouped, polygonal in outline, their diameter up to 100 μ ; length of the vessel segments 600-900 μ , their perforation simple; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers 25-32 μ in diameter, length 800-1,500 μ , wall 3 μ thick. Wood parenchyma scarce. Pith rays nearly homogeneous, 1-3, sometimes 4 cells wide, up to 60 cells high.

4. **Illicium Anisatum** LINN. *Shikimi*. Pl. I. Figs. 2,3.

A small tree, up to 25 cm. in diameter.

Without heart-wood; wood dark brown, hard, close-grained, difficult to split; specific gravity 0.50.

Pores (of tracheid-vessels) evenly distributed, number per square mm. 100-150, solitary or in groups, in the latter case 2 or more connected; solitary pores are polygonal in outline, their diameter 30-70 μ ; length of the vessel segments 800-1,700 μ , end walls slanting, their perforation scalariform; side walls 2 μ thick; with scalariform bordered pits where they are in contact with each other. Wood fibers 20-25 μ in diameter, length 1,000-2,000 μ , wall 3-4 μ thick. Wood parenchyma scarce and scattered among fibers. Pith rays heterogeneous, 1-5 fibers distant from each other; in two modifications: uniseriate and polyseriate, the former 1-8 cells high, cells always upright; the latter 2 or 3, rarely 4 cells wide, 5-25 cells high; cells with brown resinous substance.

5. **Cercidiphyllum japonicum** S. et Z. *Katsura*. Pl. I. Fig. 4.

A large tree up to 120 cm. in diameter. With clear colour demarcation between sap and heart-wood, growth rings distinct; sap-wood light brown, heart-wood reddish brown; straight-grained, easy to work, does not warp nor split; wood is very remarkable for its content of flavone; specific gravity 0.59.

Pores standing closely, number per square mm. 100–120, usually solitary sometimes 2 or more connected; solitary pores are oval or elliptic in outline, their diameter radially 50–100 μ , tangentially 40–70 μ ; length of the vessel segments 550–1,800 μ , end walls slanting, tails often with spiral thickenings, their perforation scalariform; side walls 3 μ thick. Wood fibers scattered among vessels, 18–22 μ in diameter, length 1,100–2,000 μ , wall 3–4 μ thick. Wood parenchyma scarce. Pith rays heterogeneous, 1 or 2 cells wide, 5–30 cells high; cells with brown substance.

6. **Euptelæa polyandra** S. et Z. *Fusa-zakura*. Pl. I. Figs. 5.6.

A small tree reaching up to 30 cm. in diameter. Without heart-wood; wood grayish white; specific gravity 0.68.

Pores evenly distributed, but somewhat numerous in the early wood and gradually diminishing in number and size through the intermediate to the late wood; number of pores per square mm. 120–250, usually solitary often 2 or more connected, solitary pores are oval to elliptic in outline, their diameter radially 30–75 μ , tangentially 30–65 μ ; their perforation scalariform; side walls 2 μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers 16–18 μ in diameter, length 850–1,800 μ , wall 2–3 μ thick. Wood parenchyma scarce. Pith rays heterogeneous, in two modifications: uniseriate and polyseriate; uniseriate ray cells always upright; polyseriate rays 2–10 cells wide, 10–80 cells high; wall of cells 2 μ thick; cells with brown substance.

7. **Trochodendron aralioides** S. et Z. *Yama-guruma*.

A large tree up to 70 cm. in diameter. Without clear colour demarcation

between sap and heart-wood, growth rings distinct; wood yellowish white, moderately hard.

Without vessels; fiber-tracheids and tracheids are the principal elements of the wood, the former constituting late wood, the latter early wood; late wood tracheids or fiber-tracheids $20-30\mu$ in diameter, length $2,700-4,000\mu$, wall $3-4\frac{1}{2}\mu$ thick, with slit-like bordered pits where they are in contact with each other; early wood tracheids $30-35\mu$ in diameter, length $2,500-3,700\mu$, wall $2-3\mu$ thick, with scalariform bordered pits where they are in contact with each other. Wood parenchyma rather scarce and scattered among fibers. Pith rays in two modifications: uniseriate and polyseriate; uniseriate rays present in great number, cells always upright; polyseriate rays nearly homogeneous, 2-6 cells wide, 15-60 cells (1.5 mm.) high, usually flanked by a few upright uniseriate ray cells; wall of cells $3-4\mu$ thick; cells with brown granules.

Berberideæ.

8. **Berberis Thunbergii** DC. *Me-gi.*

A deciduous shrub up to 12 cm. in diameter.

Without heart-wood; wood bright yellowish, moderately hard, difficult to split.

Ring-porous; early wood pores are one row deep and gradually diminishing in size through the intermediate to late wood, where they are distributed diagonally; early wood pores connected mostly in tangential direction, oval or elliptic in outline, their diameter radially $35-58\mu$, tangentially $30-60\mu$, length of the vessel segments $120-200\mu$; late wood pores connected in diagonal groups, length of the vessel segments $200-300\mu$, on the inner surface of the wall with spirals; end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8μ . Wood fibers sometimes septate, $14-16\mu$ in diameter, length $300-700\mu$, wall $3-4\mu$ thick. Wood parenchyma scarce. Pith rays heterogeneous, marginal ray cells often large and upright, up to 6 cells wide, height ∞ .

Ternstroemiaceæ.

Wood rosy brown sometimes reddish brown, close-grained, moderately hard, moderately heavy.

Pores evenly distributed, number per square mm. from 30 up to 200; with scalariform bordered pits where the vessels are in contact with each other. Fiber-tracheids are the principal element of the wood, length 750-2,400 μ , wall 3-10 μ thick. Wood parenchyma scattered sometimes in short metatracheal bands. Pith rays heterogeneous; 1-5 cells wide, height variable, sometimes up to 100 cells high; cells often with resinous substance.

	Number of pores per square mm. 50-100 .. .. .	..(1)
	Number of pores per square mm. 100-200 .. .. .	..(2)
(1)	{ Maximum diameter of pores up to 130 μ	<i>Stewartia</i> .
	{ Maximum diameter of pores less than 75 μ .. .. .	..(3)
(3)	{ Pith rays up to 100 cells high, tangential diameter of ray cells up to 32 μ	<i>Ternstroemia</i> .
	{ Pith rays up to 30 cells high, tangential diameter of ray cells up to 25 μ	<i>Stachyurus</i> .
(2)	{ Wood parenchyma in short metatracheal bands	<i>Camellia</i>
	{ Wood parenchyma mostly scattered .. .. .	..(4)
(4)	{ Pith rays 1 or 2 cells wide.. .. .	<i>Cleyera</i> .
	{ " 1-4 " "	<i>Eurya</i> .

9. *Stachyurus præcox* S. et Z. *Ki-fuji*.

A small tree.

Pores evenly distributed, number per square mm. 70-100; usually solitary, polygonal in outline, rather evenly sized, their diameter 30-60 μ ; length of the vessel segments 750-1,400 μ , their perforation scalariform. Fiber-tracheids 18-20 μ in diameter, length 750-1,650 μ , wall 3½-5 μ thick. Wood parenchyma scattered among fibers. Pith rays heterogeneous, 1 or 2 fiber-tracheids distant from each other; uniseriate rays present in great number; polyseriate rays up to 4 cells wide, usually flanked by upright uniseriate ray cells; cells with reddish brown substance.

10. *Eurya japonica* THUNB. *Hi-sakaki*.

A small ever-green tree up to 30 cm. in diameter. Wood reddish brown, close-grained, difficult to split; specific gravity 0.75.

Pores evenly distributed, number per square mm. 100–150, polygonal in outline, their diameter $25\text{--}50\mu$; length of the vessel segments $700\text{--}1,400\mu$, their perforation scalariform. Fiber-tracheids $18\text{--}22\mu$ in diameter, length $1,200\text{--}2,000\mu$, wall $3\text{--}4\mu$ thick. Pith rays heterogeneous, 1–4 cells wide; uniseriate rays present in great number, cells upright; polyseriate rays usually flanked by upright uniseriate ray cells.

11. **Cleyera ochracea** DC. *Sakaki.*

A small ever-green tree. Wood light brown; specific gravity 0.70,

Pores evenly distributed, number per square mm. 140–200, polygonal in outline, their diameter $30\text{--}55\mu$; length of the vessel segments $500\text{--}1,500\mu$, their perforation scalariform, cross bars 24–55. Fiber-tracheids $24\text{--}30\mu$ in diameter, length $950\text{--}2,200\mu$, wall $4\text{--}6\mu$ thick. Pith rays heterogeneous, 1- or 2-seriate, 3–30 cells high.

12. **Stewartia monadelpha** MATSUM. *Hime-shara, Saruta.*

A large deciduous tree up to 100 cm. in diameter, Growth rings narrow; sap-wood brown, heart-wood reddish brown; close-grained, difficult to split, moderately hard and heavy; specific gravity 0.85.

Pores evenly distributed, number per square mm. 30–40; usually solitary, round, oval or elliptic in outline, their diameter radially $65\text{--}130\mu$, tangentially $50\text{--}100\mu$; length of the vessel segments $500\text{--}950\mu$, end walls slanting, their perforation scalariform, cross bars 10–30; side walls 2μ thick. Fiber-tracheids $20\text{--}25\mu$ in diameter, length $1000\text{--}2400\mu$, wall 3μ thick. Wood parenchyma scattered but somewhat zonately arranged in late wood. Pith rays heterogeneous, 1–5 fibers distant from each other, 1–3 cells wide; uniseriate ray cells usually upright; polyseriate rays 5–20 cells high, usually flanked by a few upright uniseriate ray cells; cells with brown substance.

13. **Ternstroemia japonica** THUNB. *Mokkoku.*

A small ever-green tree up to 30 cm. in diameter.

Without heart-wood; wood dark reddish, close-grained, difficult to split; specific gravity 0.80.

Pores evenly distributed, number per square mm. 50-70; usually solitary, round, elliptic or polygonal in outline, their diameter 40-75 μ ; length of the vessel segments 1,000-1,350 μ , their perforation scalariform, cross bars 30-40; side walls 2 μ thick. Fiber-tracheids 20-30 μ in diameter, length 1,000-2,530 μ , wall 6-10 μ thick; with many bordered pits where they are in contact with each other. Wood parenchyma scattered sometimes more or less in short metatracheal bands. Pith rays heterogeneous, 1-5 cells wide; uniseriate ray cells usually upright; polyseriate rays 15-100 cells high, often flanked by a few upright uniseriate ray cells; cells with brown substance.

14. **Camellia japonica** LINN. *Tsubaki*. Pl. II. Fig. 7.

A medium-sized ever-green tree up to 30 cm. in diameter, 10 meters in height. Without heart-wood, wood reddish brown; growth rings narrow, fairly distinct; difficult to split, hard and heavy; specific gravity 0.81.

Pores evenly distributed, number per square mm. 120-200; solitary sometimes 2-4 connected; solitary pores are round to elliptic, more or less polygonal in outline, their diameter 25-60 μ ; length of the vessel segments 450-1,150 μ , end walls slanting, their perforation scalariform, cross bars 8-30; side walls 3 μ thick; with transversely drawn bordered pits where the vessels are in contact with each other. Fiber-tracheids are the principal element of the wood, with narrow cavities, 18-20 μ in diameter, length 1,000-2,000 μ , wall 3½-5 μ thick. Wood parenchyma metatracheal, (mostly in late wood) and scattered among fibers, the former rather irregularly arranged, one cell wide in radial direction. Pith rays heterogeneous, 1-4 fibers distant from each other, 1-4 cells wide; uniseriate ray cells upright; polyseriate rays 5-20 cells high, often flanked by a few upright uniseriate ray cells; large ray cells in great number, with crystals of calcium oxalate.

Sterculiaceæ.

15. **Firmiana simplex** F. M. MEYER *Ao-giri*.

A deciduous tree up to 30 cm. in diameter. Sap-wood narrow, yellowish white, heart-wood yellowish brown; wood light and soft, easy to split; specific gravity 0.55.

Ring-porous; early wood pores 1-3 rows deep and abruptly diminishing in late wood, solitary or 2 connected, round or oval in outline, their diameter $160-270\mu$; late wood pores evenly distributed, number per square mm. 4-6; length of the vessel segments $300-450\mu$, end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about $6-7\mu$; on the inner surface of the wall of small vessels with spiral thickenings. Wood fibers $16-25\mu$ in diameter, length $850-2,100\mu$, wall $2-3\mu$ thick. Wood parenchyma paratracheal and scattered; often "gefaser" and arranged in horizontal series; paratracheal parenchyma often connecting tangentially. Pith rays heterogeneous; 1-10 cells wide, up to 180 cells (2.5 mm.) high, marginal ray cells often large and upright.

Tiliaceæ.

16. *Tilia japonica* SIMK. *Shina-no-ki*. Pl. II. Fig. 8.

A large deciduous tree up to 70 cm. in diameter, 20 meters in height. Without clear colour demarcation between sap and heart-wood; growth rings indistinct; wood yellowish white, light and soft, straight-grained, easy to split; specific gravity 0.39.

Pores evenly distributed, but more or less in radial direction; number per square mm. 38-45, solitary or in groups, in the later latter case 2 or more connected radially or in groups; solitary pores are round to elliptic somewhat polygonal in outline, their diameter radially $60-130\mu$, tangentially $60-100\mu$; length of the vessel segments $550-750\mu$, their perforation simple; side walls 2μ thick; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about $6-7\mu$. Tracheids $650-700\mu$ long, on the inner surface of the wall with spirals. Wood fibers often septate near vessels, rather irregularly arranged, 3- to 6-sided in cross section, $20-30\mu$ in diameter, length $1,000-2,300\mu$, wall 2μ thick. Wood parenchyma terminal, metatracheal and scattered among fibers; terminal parenchyma 1-3 cells wide; metatracheal bands 3-10 fibers

distant from each other, one cell wide in radial direction, usually arranged in wavy lines. Pith rays nearly homogeneous; 2-6 fibers distant from each other, 1-4 cells wide, 6-60 cells high; cells with brown substance.

Rutaceæ.

Ring-porous .. .. .	..(1)
Diffuse-porous	<i>Zanthoxylum.</i>
(1) { Small vessels and tracheids with spirals	<i>Phellodendron.</i>
{ Vessels without spirals	<i>Orixa.</i>

17. *Orixa japonica* THUNB. *Ko-kusagi.* Pl. II. Fig. 9.

A small shrub. Wood yellowish white, tough, but easy to split.

Ring-porous; early wood pores usually one row deep, often interrupted, mostly solitary, round or depressed in radial direction, their diameter 150-250 μ ; length of the vessel segments 300-600 μ , end walls horizontal or slanting, their perforation simple, side walls 2-3 μ , common boundary walls of two vessels 3-4 μ thick; late wood pores in groups rarely solitary, the former in circular groups sometimes connected in radial or tangential bands. Tracheids usually present in late wood, 350-600 μ long. Wood fibers 20-25 μ in diameter, length 600-1,100 μ , wall 2-3 μ thick. Wood parenchyma paratracheal and scattered. Pith rays nearly homogeneous, but marginal ray cells rarely upright, 1-4 cells wide, up to 30 cells high.

N. B. The wood specimen young and somewhat doubtful; in Dr. KAWAI'S list,¹⁾ the pores are described as arranged radially similar to *Osmanthus*.

18. *Phellodendron japonicum* MAX. *Kihada.*

A large deciduous tree up to 100 cm. in diameter, 25 meters in height.

Sap-wood narrow, grayish brown, heart-wood grayish yellow; growth rings distinct, coarse-grained, moderately hard and heavy, easy to split, when planed it takes a fine polish; specific gravity 0.47.

Ring-porous; early wood pores 2-4 rows deep and abruptly diminish-

1) S. KAWAI: *Die Unterscheidungsmerkmale der wichtigeren in Japan wachsenden Laubhölzer.* Bul. of Coll. Agr. Tokio Imp. Univ. Vol. 4. No. 2. 1900.

ing in size in late wood, number per square mm. 25-35, tyloses present, usually solitary sometimes 2 connected, round, oval or elliptic in outline, their diameter 150-300 μ ; length of the vessel segments 300-500 μ , their perforation simple, side walls 3 μ ; with very very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 7 μ ; late wood pores generally in circular groups and more or less arranged tangentially, number per square mm. 30-40, length of the vessel segments 350-650 μ , on the inner surface of the wall with spiral thickenings. Tracheids 500-600 μ long, with spirals on the inner surface of the wall. Wood fibers 18-28 μ in diameter, length 800-1,900 μ , wall 2 μ in early wood, in late wood 3 μ thick. Wood parenchyma paratracheal and scattered among fibers. Pith rays homogeneous, 3-10 fibers distant from each other, 1-4 cells wide, 1-20 cell high.

Phellodendron sachalinensis SARGENT *Hiroha-no-kiwada*. Ring porous; early wood pores 2-5 rows deep, abruptly diminish in late wood, their diameter up to 300 μ ; on the inner surface of the wall of small vessels with spirals; with many scattered bordered pits where the vessels are in contact with each other. Wood fibers sometimes septate, 20-25 μ in diameter, length 700-1,500 μ , wall 2-3 μ thick. Pith rays homogeneous, 1-5 cells wide, up to 32 cells high.

19. **Zanthoxylum ailanthoides** S. et. Z. *Karasu-zanshō*.

A small deciduous tree up to 30 cm. in diameter. Wood whitish or yellowish, fairly hard.

Pores evenly distributed, number per square mm. 6-9, solitary sometimes 2 or 3 connected; solitary pores are oval or round in outline, their diameter 80-200 μ ; length of the vessel segments 300-550 μ , their perforation simple; side walls 2-3 μ , common boundary walls of two vessels 3-5 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits angular in outline by mutual contact, their diameter being 8 μ . Wood fibers 20-30 μ in diameter, length 700-1,500 μ , wall 1-2 μ in early wood, in late wood 2-3 $\frac{1}{2}$ μ thick. Wood parenchyma terminal, partly paratracheal and scattered. Pith rays homogeneous, 3-8 fibers distant from each other, 1-4 cells wide, up to 22 cells high.

Simarubeæ.

20. **Picrasma quassioides** BENNETT. *Nigaki*. Pl. II. Fig. 10.

A medium-sized deciduous tree up to 30 cm. in diameter.

Sap-wood whitish, heart-wood yellowish; growth rings distinct; wood fairly hard and heavy; specific gravity 0.61.

Ring-porous; early wood pores 2-4 rows deep, solitary sometimes connected, oval or round in outline, their diameter 150-250 μ ; late wood pores rather abruptly diminishing in size, solitary or in groups; length of the vessel segments 200-250 μ , end walls horizontal or slanting, their perforation simple; side walls 2-4 μ in large pores, in small pores 4-8 μ thick. Wood fibers irregularly distributed, their diameter 16-18 μ , length 600-1,600 μ , wall 2-3 μ thick. Wood parenchyma paratracheal and scattered; on the inner side of the growth rings (outer portion of late wood) paratracheal parenchyma arranged in broad tangential bands, conspicuous on cross section; parenchyma cells short, wall 2-3 μ thick. Pith rays homogeneous, 1-5 fibers distant from each other, 1-6 cells wide, up to 75 cells high.

Meliaceæ.

Wood dark chestnut brown; small vessels without spirals; paratracheal parenchyma not elongating tangentially *Cedrela*.
 Wood rosy brown; small vessels with spirals; paratracheal parenchyma elongating tangentially and often uniting into metatracheal bands *Melia*.

21. **Cedrela chinensis** JUSS. *Chanclin*.

A large deciduous tree. Sap-wood yellowish white, heart-wood reddish brown; growth rings distinct, wood resembles that of *Melia japonica*; specific gravity 0.55.

Ring-porous; early wood pores 1-3 rows deep, solitary or 2 connected, oval or elliptic sometimes round in outline, their diameter radially 200-340 μ , tangentially 200-320 μ ; late wood pores rather abruptly diminishing in size, number per square mm. 7-10, mostly solitary sometimes 2 or 3 con-

nected, their diameter 70–180 μ ; length of the vessel segments 300–500 μ , end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged in an alternating fashion, their diameter being about 9 μ . Wood fibers 15–20 μ in diameter, length 500–1,100 μ , wall 2–3 μ thick. Wood parenchyma paratracheal and scattered. Pith rays nearly homogeneous, 5–15 fibers distant from each other, 1–4 cells wide, 3–40 cells high.

22. **Melia japonica** DON. *Sendan*. Pl. II. Fig. 11.

A deciduous tree up to 70 cm. in diameter, 15 meters in height. Growth rings broad and distinct; sap-wood narrow, yellowish white, heart-wood light yellowish brown; easy to split, moderately hard and heavy; specific gravity 0.65.

Ring-porous; early wood pores large and gradually diminishing in size through the intermediate to late wood, number per square mm. 6–12, usually solitary, oval or round in outline, their diameter 180–350 μ , length of the vessel segments 250–450 μ , end walls slanting or horizontal, their perforation simple; side walls 3–4 μ thick; late wood pores solitary sometimes 2–4 connected in circular groups, number per square mm. 4–8, length of the vessel segments 300–420 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 20–30 μ in diameter, length 550–1,200 μ , wall 2–3 μ thick. Wood parenchyma metatracheal, paratracheal and scattered among fibers; metatracheal bands irregularly arranged, usually near growth rings; chambered parenchyma cells present, with crystals of calcium oxalate. Pith rays nearly homogeneous, 2–4 cells wide, 6–25 cells high.

Ilicineæ.

23. **Ilex integra** THUNB. *Mochi-no-ki*.

An ever-green tree up to 30 cm. in diameter, 10 meters in height. Without clear colour demarcation between sap and heart-wood; wood whitish with greenish tinge, close-grained, moderately hard and heavy; specific gravity 0.64.

Pores evenly distributed but more or less radially sometimes diagonally, number per square mm. 30-40, usually connected radially; solitary pores are polygonal in outline, their diameter 30-60 μ , length of the vessel segments 650-1,500 μ , their perforation scalariform; on the inner surface of the wall with spiral thickenings. Wood fibers 16-20 μ in diameter, length 1,500-2,500 μ , wall 4-6 μ thick; with spiral thickenings on the inner surface of the wall. Wood parenchyma in short metatracheal bands and also scattered, the former irregularly distributed, mostly one cell wide. Pith rays heterogeneous; uniseriate rays present in great number, 1-10 cells high, cells upright; polyseriate rays up to 8 cells wide, 60 or more cells high, generally flanked by upright ray cells; upright cells often with crystals of calcium oxalate.

24. **Ilex macropoda** MIQ. *Ao-hada*.

A tree up to 60 cm. in diameter, 10 meters in height. Wood whitish, specific gravity 0.69.

Number of pores per square mm. 40-55, solitary pores are polygonal in outline, their diameter 40-65 μ , length of the vessel segments 500-1,000 μ , their perforation scalariform, cross bars 20-40; with spirals on the wall. Wood fibers 20-25 μ in diameter, length 1,000-1,200 μ , wall 3-4 μ thick. Wood parenchyma in short metatracheal bands and scattered. Pith rays heterogeneous; uniseriate rays 1-10 cells high, cells upright; polyseriate rays up to 10 cells wide, 70 or more cells high, generally flanked by few large upright ray cells; upright cells often with crystals of calcium oxalate.

25. **Ilex crenata** THUNB. *Inu-tsuge*.

A small ever-green tree up to 25 cm. in diameter. Wood greenish white, specific gravity 0.90.

Pores arranged radially, number per square mm. 80-160, mostly connected radially; solitary pores are polygonal in outline, their diameter 25-50 μ , length of the vessel segments 600-900 μ , their perforation scalariform; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged in horizontal rows. Wood fibers 20-25 μ in diameter, length 700-1,400 μ , wall 3-4 μ thick; on the inner surface of the

wall with spirals. Wood parenchyma in short metatracheal bands and also scattered. Pith rays heterogeneous, 1-5 cells wide, up to 70 cells high.

26. **Ilex pedunculosa** MIQ. *Soyogo.*

A small ever-green tree up to 30 cm. in diameter. Wood yellowish white; specific gravity 0.82.

Number of pores per square mm. 70-100, diameter of pores 35-65 μ , with spirals on the inner surface of the wall. Wood fibers 30-34 μ in diameter, length 1,000-1,700 μ , wall 4-6 μ thick; with spirals on the wall. Pith rays heterogeneous; uniseriate ray cells generally upright; polyseriate rays up to 5 cells wide, up to 60 cells high; cell walls 3-4 μ thick.

27. **Ilex latifolia** THUNB. *Tarayō.*

A small tree up to 30 cm. in diameter. Wood yellowish white; specific gravity 0.66.

Number of pores per square mm. 140-180; diameter of pores 25-50 μ , length of the vessel segments 500-1,000 μ ; with spirals on the wall. Wood fibers 20-25 μ in diameter, length 900-1,700 μ , wall 3 μ thick. Pith rays heterogeneous, up to 7 cells wide, 80 cells high.

Celastrineæ.

Euonymus LINN.

Diameter of pores up to 40 μ ; pith rays heterogeneous *E. alata.*
 Diameter of pores up to 50 μ ; pith rays nearly homogeneous
 *E. Sieboldiana.*

28. **Euonymus alata** K. KOCH. *Nishiki-gi.*

A small deciduous tree up to 15 cm. in diameter. Wood whitish, close-grained, very hard.

Pores evenly distributed, number per square mm. 250-300, generally solitary, polygonal in outline, their diameter 20-40 μ ; length of the vessel segments 600-750 μ , their perforation simple; on the inner surface of the wall

with spiral thickenings. Wood fibers 14–16 μ in diameter, length 400–900 μ , wall 3 μ thick; on the inner surface of the wall sometimes with spiral thickenings. Wood parenchyma scattered. Pith rays heterogeneous, uniseriate, rarely biseriate in part, 3–20 cells high.

29. **Euonymus Sieboldiana** BL. *Mayumi*.

A small ever-green tree up to 20 cm. in diameter. Wood yellowish white, close-grained, moderately hard, difficult to split; specific gravity 0.55.

Number of pores per square mm. 240–300, mostly solitary, oval or elliptic, more or less polygonal in outline, their diameter radially 25–50 μ , tangentially 20–40 μ ; length of the vessel segments 300–900 μ , end often with long tail; on the inner surface of the wall with spirals. Wood fibers 14–16 μ in diameter, length 800–1,400 μ , wall 3–4 μ thick; on the inner surface of the wall with spirals. Pith rays nearly homogeneous, uniseriate, up to 25 cells high.

Rhamneæ.

30. **Hovenia dulcis** THUNB. *Kempo-nashi*. Pl. II. Fig. 12.

A deciduous tree up to 30 cm. in diameter.

Sap-wood yellowish white, heart-wood yellowish brown or reddish brown; growth rings distinct; wood coarse-grained, not liable to warp nor check, easy to work; specific gravity 0.65.

Ring-porous; number of pores per square mm. 8–14; early wood pores 2–4 rows deep, usually solitary sometimes 2 connected, oval or round in outline, their diameter radially 200–270 μ , tangentially 180–220 μ , side walls 4–8 μ , common boundary walls of two vessels 6–10 μ thick; late wood pores solitary or 2–4 connected radially, their radial diameter 60–140 μ , side walls 6–8 μ , common boundary walls of two vessels 8–10 μ thick; length of the vessel segments 250–350 μ , their perforation simple; with very many bordered pits where the vessels are in contact with each other, the bordered pits angular in outline, their diameter about 8 μ . Wood fibers 20–25 μ in diameter, length 800–

1,300 μ , wall 3–4 μ thick. Wood parenchyma paratracheal, terminal and scattered; paratracheal parenchyma 1–4 cells wide. Pith rays heterogeneous, but mostly of procumbent cells, 1–5 cells wide, 3–30 cells high; upright ray cells generally with crystals of calcium oxalate.

Sapindaceæ.

Ripple marks present; pith rays uniseriate. *Aesculus*.
 Ripple marks absent; pith rays 1–5, sometimes up to 12 cells wide. *Acer*.

31. ***Acer cissifolium*** C. KOCH. *Mitsude-kaede*.

A deciduous tree up to 45 cm. in diameter, 10 meters in height.

Pores evenly distributed, number per square mm. 25–30; solitary sometimes in groups, solitary pores are oval or round in outline, their diameter 40–80 μ , length of the vessel segments 200–370 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 16–18 μ in diameter, length 400–800 μ , wall 2 μ in early wood, in late wood 3 μ thick. Pith rays homogeneous, 1–5 cells wide, 5–80 cells (0.9 mm.) high.

32. ***Acer nikoense*** MAX. *Chōja-no-ki*.

Pores evenly distributed, number per square mm. 45–65; solitary or in groups, in the latter case 2 or more connected mostly in radial direction, solitary pores are oval or round in outline, their diameter 40–80 μ , length of the vessel segments 200–400 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 18–22 μ in diameter, length 300–550 μ , wall 2–3 μ thick. Wood parenchyma terminal and scattered. Pith rays homogeneous; 1–4 cells wide, 3–30 cells high.

33. ***Acer palmatum*** THUNB. *Kaede*.

A deciduous tree up to 60 cm. in diameter, 15 meters in height. Pith flecks present; without heart-wood; wood rosy brown, moderately hard, close-grained, takes a fine luster when polished; specific gravity 0.85.

Growth rings clearly defined. Pores evenly distributed, number per

square mm. 27-35; solitary or in groups, in the latter case, 2-4 connected mostly in radial direction, solitary pores are elliptic, oval or round in outline, their diameter 50-100 μ ; length of the vessel segments 200-450 μ , end walls slanting, their perforation simple; side walls 2 μ thick; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8-9 μ . Tracheids 300-350 μ long, with spiral thickenings. Wood fibers 18-23 μ in diameter, length 500-1,100 μ , wall 2-3 μ thick. Wood parenchyma terminal and scattered among fibers. Pith rays homogeneous, 3-14 fibers distant from each other, 1-4 cells wide, 2-50 cells high; cells with brown substance.

34. **Acer rufinerve** S. et Z. *Urihada-kaede*.

A deciduous tree up to 30 cm. in diameter, 12 meters in height. Wood yellowish white, light and soft; specific gravity 0.64.

Pores evenly distributed, number per square mm. 22-30; solitary pores are oval or round in outline, their diameter 50-100 μ , length of the vessel segments 300-450 μ ; on the inner surface of the wall sometimes with spiral thickenings. Wood fibers 15-20 μ in diameter, length 550-1,300 μ , wall 2-3 μ thick. Wood parenchyma terminal and scattered among fibers. Pith rays homogeneous, 1-4 cells wide, 3-30 cells high; cells with brown substance.

35. **Acer cratægifolium** S. et Z. *Me-urimoki*.

Pores evenly distributed, number per square mm. 20-25, solitary pores are oval, elliptic or round in outline, their diameter 50-100 μ , length of the vessel segments 350-450 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 18-22 μ in diameter, length 550-1,000 μ , wall 2-3 μ in early wood, in late wood 3-4 μ thick. Pith rays homogeneous, 1-4 cells wide, 3-35 cells high.

36. **Acer carpinifolium** S. et Z. *Yama-shiba*.

A deciduous tree up to 70 cm. in diameter, 15 meters in height.

Pores evenly distributed, number per square mm. 30-35, solitary pores are oval or elliptic in outline, their diameter 40-80 μ , length of the vessel

segments 200–350 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 16–20 μ in diameter, length 400–850 μ , wall 2–3 μ in early wood, in late wood 3 μ thick. Wood parenchyma terminal and scattered. Pith rays homogeneous, 1–12 cells wide, 5–65 cells high.

Acer pictum THUNB. *Itaya-kaede*. Number of pores per square mm. 30–40; mostly solitary, oval or round in outline, their diameter 50–100 μ ; on the inner surface of the wall with fine spirals. Wood fibers 16–22 μ in diameter, length 500–1,000 μ , wall 2–3 μ thick. Pith rays homogeneous, 1–5 cells wide, up to 20 cells high.

37. **Aesculus turbinata** BL. *Tochi-no-ki*. Pl. III. Fig. 13.

A very large tree reaching up to 180 cm. in diameter. Heart-wood slightly defined from sap-wood; growth rings distinct; wood rosy white, lustrous, fine-grained, moderately hard, easy to work; fine ripple marks present in the longitudinal section; specific gravity 0.58; water extraction of wood chips exhibits a distinct fluorescence.

Pores distributed more or less radially, number per square mm. 90–85; solitary or in groups, in the latter case 2–6 connected mostly in radial direction; solitary pores are oval or elliptic in outline, their diameter radially 60–115 μ , tangentially 40–70 μ ; length of the vessel segments 350–550 μ , their perforation simple; side walls 2 μ thick; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8 μ . Tracheids 350–500 μ long, with spiral thickenings. Wood fibers 35–30 μ in diameter, length 580–1,000 μ , wall 2 μ thick. Wood parenchyma terminal, usually 1–3 cells wide in radial direction. Pith rays arranged in horizontal series, homogeneous, 1–3 fibers distant from each other, uniseriate, 3–15 cells high; cells with brown substance.

Sabiaceæ.

38. **Meliosma myriantha** S. et Z. *Awabuki*.

A small deciduous tree up to 30 cm. in diameter.

Wood yellowish brown, moderately heavy, liable to warp or check; specific gravity 0.65.

Pores arranged radially, number per square mm. 28-36, mostly connected radially; solitary pores are round in outline, their diameter $70-140\mu$; length of the vessel segments $500-800\mu$, their perforation simple or scalariform, cross bars then 1-6; side walls $6-8\mu$, common boundary walls of two vessels $7-9\mu$ thick; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about $8-7\mu$. Wood fibers sometimes septate, $24-26\mu$ in diameter, length $1,000-1,800\mu$, wall $3-3\frac{1}{2}\mu$ in early wood, in late wood $4-4\frac{1}{2}\mu$ thick. Wood parenchyma paratracheal and scattered; paratracheal 1 or 2 cells wide. Pith rays heterogeneous, 1-4 cells wide, height ∞ .

Anacardiaceæ.

39. *Rhus vernicifera* DC. *Urushi*. Pl. III. Fig. 14.

A deciduous tree up to 40 cm. in diameter, 10 meters in height. Sap-wood grayish white, heart-wood bright yellowish; growth rings broad and distinct; coarse-grained, moderately hard and heavy, rather brittle; specific gravity 0.51.

Ring-porous; early wood pores 5-8 rows deep, gradually diminishing in size in late wood, number per square mm. 8-12, solitary or 2-4 connected mostly in radial direction, solitary pores are oval, elliptic or round in outline, their diameter radially $150-250\mu$, tangentially $130-200\mu$; late wood pores evenly distributed, number per square mm. 13-15; length of the vessel segments $250-480\mu$, end walls horizontal or slanting, their perforation simple, side walls $3-4\mu$, common boundary walls of two vessels $4-7\mu$ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about $9-10\mu$. Wood fibers arranged radially, $16-25\mu$ in diameter, length $450-850\mu$, wall $2-3\mu$ thick. Wood parenchyma terminal, paratracheal and also scattered among fibers. Pith rays heterogeneous; 2-15 fibers distant from each other, 1-5, mostly 2-4 cells wide, 4-28 cells high; marginal ray cells upright, often with crystals of calcium oxalate; procumbent ray cells with brown granulous substance.

40. **Rhus succedanea** LINN. var. **japonica** ENGLER *Haze-no-ki*.

A deciduous tree up to 60 cm. in diameter. Sap-wood grayish white, heart-wood light yellow, growth rings distinct, wood fairly hard; specific gravity 0.76.

Ring-porous; early wood pores are one or two rows deep and gradually diminishing in number and size through the intermediate to the late wood, number per square mm. 5-11, mostly solitary, oval or round in outline, their diameter 100-200 μ , length of the vessel segments 350-500 μ , their perforation simple. Wood fibers arranged radially 20-25 μ in diameter, length 550-1,000 μ , wall 2 μ thick. Wood parenchyma rather scarce, partly paratracheal and scattered. Pith rays heterogeneous, 1-3 cells wide, up to 25 cells high.¹⁾

41. **Rhus javanica** LINN. *Nurude*.

A deciduous tree up to 30 cm. in diameter. Sap-wood clearly marked off from heart-wood; sap-wood whitish, heart-wood yellowish or yellowish brown, rather coarse-grained; specific gravity 0.62.

Ring-porous; early wood pores are 3-6 rows deep, number per square mm. 20-30, mostly solitary, oval or elliptic in outline, their diameter radially 140-220 μ , tangentially 100-200 μ , length of the vessel segments 250-300 μ ; late wood pores grouped radially or tangentially, length of the vessel segments 350-450 μ , on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the diameter of border being 9-11 μ . Wood fibers 20-25 μ in diameter, length 500-800 μ , wall 3-4 μ thick. Pith rays heterogeneous; mostly of procumbent ray cells, 1 or 2 sometimes 3 cells wide, up to 55 cells high.

Leguminosæ.

Usually with heart-wood; growth rings distinct; sap-wood rosy yellow, heart-wood brownish, hard and heavy; water extraction of wood chips of some kinds exhibits a distinct fluorescence and certain species contain flavone.

1) Wood parenchyma and pith rays different from that of Formosan species.

Ring-porous; tyloses sometimes very conspicuous; large pores up to 350μ in diameter, small vessels sometimes with spirals. Wood fibers $12-16\mu$ in diameter, wall $2-4\mu$ thick. Wood parenchyma paratracheal and scattered; the former often elongating tangentially. Pith rays homogeneous, 1-8 cells wide.

	Tyloses very conspicuous	<i>Robinia</i> .
	Tyloses not conspicuous .. .. .	..(1)
(1)	{ Wood contains flavone	<i>Gleditschia</i> .
	{ Wood does not contain flavone .. .. .	..(2)
(2)	{ Small vessels with spirals; terminal parenchyma conspicuous	<i>Maackia</i>
	{ Vessels without spirals; terminal parenchyma not conspicuous.. .. .	..(3)
(3)	{ Diameter of pores up to 250μ ; paratracheal parenchyma elongating tangentially .. .. .	.. <i>Albizzia</i> .
	{ Diameter of pores up to 350μ ; paratracheal parenchyma not elongating tangentially	<i>Sophora</i> .

42. *Albizzia Julibrissin* Borv. *Nemu-no-ki*.

A small deciduous tree. Sap-wood yellowish white, heart-wood yellowish gray brown; wood soft, liable to warp; specific gravity 0.50.

Ring-porous; early wood pores 3-5 rows deep but gradually diminishing in late wood, solitary sometimes connected, oval or elliptic in outline, their diameter $150-250\mu$; late wood pores solitary or in groups, number per square mm. 4-7; length of the vessel segments $170-300\mu$, end walls horizontal or slightly slanting, their perforation simple; side walls $3-5\mu$, common boundary walls of two vessels $5-8\mu$ thick; with very many bordered pits where the vessels are in contact with each other, the diameter of border being $7-8\mu$. Wood fibers $14-16\mu$ in diameter, length $500-1,000\mu$, wall $2-3\mu$ thick. Wood parenchyma paratracheal and scattered; paratracheal parenchyma often elongating tangentially. Pith rays homogeneous, 1-4 cells wide, 3-30 cells high.

43. *Maackia amurensis* Rupr. et Max. var. *Buergeri* Schneider

Inu-enju.

A large deciduous tree up to 70 cm. in diameter, 15 meters in height. With clear colour demarcation between sap and heart-wood, growth rings distinct, sap-wood yellowish white, heart-wood dark yellowish brown, coarse-grained, hard, heavy, strong and tough; specific gravity 0.89.

Growth rings clearly defined by tangential bands of tracheid-vessels. Ring-porous or diffuse-porous, number of pores per square mm. 10-14, solitary or in groups, in the latter case 2 or 3 connected, solitary pores are oval or round in outline, their diameter $100-220\mu$; length of the vessel segments $150-300\mu$, end walls horizontal or slightly slanting; side walls $3-5\mu$ thick; on the inner surface of the wall of small vessels with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 10μ . Tracheid-vessels occur along the peripheries of growth rings, arranged in horizontal series, their diameter in cross section $18-30\mu$, length $200-300\mu$, with spirals on the wall. Wood fibers $12-16\mu$ in diameter, length $500-1,400\mu$, wall $3-4\mu$ thick. Wood parenchyma terminal, paratracheal and also scattered. Pith rays homogeneous, 1-8 cells wide, 10-90 cells (1.5 mm.) high.

44. **Gleditschia japonica** MIQ. *Saikachi*. Pl. III. Fig. 15.

A large deciduous tree up to 60 cm. in diameter. Growth rings distinct; sap-wood large, yellowish white, heart-wood rosy; wood hard, heavy and coarse-grained, difficult to split; wood contains flavone; specific gravity 0.74.

Ring-porous; early wood pores 3-6 rows deep, number per square mm. 10-12, gradually diminishing in number and size towards late wood, solitary or 2-4 connected, solitary pores are oval, elliptic or round in outline, their diameter radially $150-250\mu$, tangentially $120-200\mu$; late wood pores evenly scattered, number per square mm. 5-7, solitary or in groups, often in circular groups near the peripheries of growth rings; length of the vessel segments $170-280\mu$, end walls horizontal or slightly slanting, their perforation simple; on the inner surface of the wall of small vessels with spiral thickenings. Wood fibers arranged irregularly, $14-16\mu$ in diameter, length $900-1,700\mu$, wall $2-2\frac{1}{2}\mu$ thick. Wood parenchyma paratracheal; in late wood usually elongating tangentially and uniting into metatracheal bands. Pith rays homogeneous, 1-15 cells wide, up to 140 cells (about 1.2 mm.) high.

45. **Robinia Pseudacacia** LINN. *Hari-enju*. Pl. III. Fig. 16.

A large deciduous tree.

Ring-porous; tyloses conspicuous; early wood pores 2 or 3 rows deep, gradually diminishing in number and size through the intermediate to the late wood, solitary sometimes 2 connected, oval or round in outline, their diameter radially 180–400 μ , tangentially 160–350 μ ; length of the vessel segments 150–250 μ , end walls horizontal or slightly slanting, their perforation simple; on the inner surface of the wall of small vessels with spiral thickenings. Tracheids 130–240 μ long; on the inner surface of the wall with spiral thickenings. Wood fibers 14–16 μ in diameter, length 500–1,300 μ , wall 4 μ thick. Wood parenchyma paratracheal and scattered; in late wood paratracheal parenchyma often extending wing-like; outer portion of growth rings usually consists of wood parenchyma cells. Pith rays homogeneous, 1–5 cells wide, up to 60 cells high.

46. **Sophora japonica** LINN. f. *Enju-no-ki*. Pl. III. Fig. 17.

A large deciduous tree up to 100 cm. in diameter. With clear colour demarcation between sap and heart-wood, sap-wood yellowish white, heart-wood dark brown, growth rings distinct; wood fairly hard; specific gravity 0.74.

Ring-porous; early wood pores 3–5 rows deep and gradually diminishing in size through the intermediate to the late wood; early wood pores are solitary or 2–3 connected, solitary pores are oval or elliptic in outline, their diameter radially 250–350 μ , tangentially 200–280 μ , side walls 3–5 μ , common boundary walls of two vessels 8–10 μ thick; late wood pores evenly distributed, solitary or in circular groups; length of the vessel segments 160–300 μ , end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged in an alternating fashion, the diameter of border being about 8 μ . Wood fibers irregularly arranged, 14–18 μ in diameter, length 700–1,000 μ , wall 2–3 μ thick. Wood parenchyma paratracheal and also scattered. Pith rays nearly homogeneous, 1–6 cells wide, up to 40 cells high.

Rosaceæ.

Heart-wood not clearly distinguished from sap-wood; wood close-grained, lustrous when planed, moderately hard and moderately heavy; wood often contains flavone.

Pores evenly distributed, number per square mm. from 30 up to 350, perforation of vessels always simple; on the inner surface of the wall always (as far as the Japanese species are concerned) with spirals. Wood fibers 12-24 μ in diameter, wall 2-4 μ thick. Wood parenchyma either in short metatracheal bands and scattered, or terminal and scattered. Pith rays heterogeneous, either nearly homogeneous or homogeneous; 1 or 2, sometimes up to 6 cells wide.

- Pith rays 1 or 2 cells wide (1)
- Pith rays more than 3 cells wide (2)
- (1) { Pith rays homogeneous or nearly homogeneous *Micromeles, Sorbus.*
- { Pith rays heterogeneous *Eriobotrya.*
- (2) { Pith rays more than 4 cells wide (3)
- { Pith rays 1-3 cells wide *Amelanchier, Photinia glabra.*
- (3) { Heart-wood usually contains flavone *Prunus.*
- { Heart-wood does not contain flavone *Photinia variabilis.*

47. **Eriobotrya japonica** LINDL. *Birca.* Pl. III. Fig. 18.

An ever-green tree up to 30 cm. in diameter. Wood close-grained, hard and heavy.

Pores evenly distributed but somewhat larger and more numerous in early wood, number per square mm. 120-150; mostly solitary, round or oval in outline, their diameter 25-40 μ ; length of the vessel segments 300-950 μ , end walls slanting, their perforation simple; side walls 2 μ thick; on the inner surface of the wall with spiral thickenings. Tracheids 500-1,000 μ long. Wood fibers 4-to 6-sided in cross section, with narrow cavities, 12-15 μ in diameter, length 750-1,400 μ , wall 3½-4 μ thick. Wood parenchyma in short metatracheal bands and scattered among fibers; cells with brown substance. Pith rays heterogeneous, 1-3 fibers distant from each other, 1 or 2 cells wide, 2-20 cells high.

48. **Prunus serrulata** LINDLEY *Yama-zakura*. Pl. IV.

Fig. 19.

A deciduous tree. Sap-wood yellowish brown, heart-wood dark reddish brown; fairly close-grained, moderately hard and heavy; it takes a fine luster when planed; specific gravity 0.65.

Growth rings defined by radially flattened fibers. Pores evenly distributed, mostly connected radially or diagonally, number per square mm. 60-70, often plugged with dark reddish substance; solitary pores are oval or elliptic in outline, their diameter radially 60-120 μ , tangentially 50-100 μ ; length of the vessel segments 250-500 μ , end walls horizontal or slanting, their perforation simple; side walls 2 μ thick; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about 7-8 μ . Wood fibers 20-24 μ in diameter, length 600-1,500 μ , wall 3 μ thick. Wood parenchyma paratracheal and scattered among fibers. Pith rays heterogeneous; 1-5 cells wide, 3-30 cells high.

49. **Prunus Buergeriana** MIQ. *Inu-zakura*.

A medium-sized deciduous tree up to 30 cm. in diameter. Heart-wood slightly marked off from sap-wood; wood yellowish brown, fairly hard; specific gravity 0.61.

Pores arranged more or less radially, diagonally sometimes tangentially, number per squares mm. 30-45, often plugged with reddish substance; solitary pores are oval or round in outline, their diameter 50-90 μ , length of the vessel segments 350-850 μ ; on the inner surface of the wall with spiral thickenings. Wood fibers 16-18 μ in diameter, length 900-1,600 μ , wall 3-4 μ thick. Pith rays nearly homogeneous, 3-12 fibers distant from each other, 1-5 cells wide; uniseriate rays 3-15, polyseriate rays 30-70 cells high.

50. **Prunus Ssiori** Fr. SCHM. *Shiuri-zakura*.

A deciduous tree up to 50 cm. in diameter. Sap-wood yellowish brown, heart-wood yellowish dark brown with purple tinge; specific gravity 0.60.

Pores evenly distributed, number per square mm. 90-110, vessels often plugged with brownish substance, diameter of pores 40-90 μ ; length of the vessel segments 280-400 μ ; side walls 2-3 μ thick; on the inner surface of the wall with spiral thickenings. Wood fibers 14-16 μ in diameter, length 550-1,200 μ , wall 2-3 μ thick. Pith rays nearly homogeneous 1-5 cells wide, up to 40 cells high.

51. **Prunus cerasoides** MAX. *Chōji-zakura.*

A deciduous tree up to 30 cm. in diameter.

Pores distributed more or less radially or diagonally, number per square mm. 70-80, their diameter 50-120 μ , length of the vessel segments 280-450 μ ; side walls 2-3 μ thick; on the inner surface of the wall with spiral thickenings. Wood fibers 16-18 μ in diameter, length 700-1,450 μ , wall 2-3 μ thick. Pith rays nearly homogeneous, 1-5 cells wide.

52. **Prunus macrophylla** S. et Z. *Biranju.* Pl. IV. Fig. 20.

An ever-green tree up to 100 cm. in diameter. Wood light yellowish brown to reddish brown; close-grained, hard and heavy; specific gravity 0.90.

Pores connected mostly in radial direction, number per square mm. 45-55, their diameter 50-140 μ ; length of the vessel segments 400-700 μ ; side walls 3-5 μ , common boundary walls of two vessels 5-8 μ thick; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about 5 μ . Wood fibers 20-25 μ in diameter, cavities often filled with reddish substance, length 1,000-1,700 μ , wall 3½-5 μ thick. Wood parenchyma paratracheal and metatracheal, the latter conspicuous in cross section. Pith rays heterogeneous; uniseriate rays present in great number, 1-3 fibers distant from each other; polyseriate rays 2-5 cells wide, up to 30 cells high; sometimes two rays connecting vertically.

53. **Prunus Grayana** MAX. *Uwamizu-zakura.*

A deciduous tree up to 30 cm. in diameter. Wood light yellowish brown, very close-grained, hard and heavy; specific gravity 0.80.

Pores distributed more or less diagonally, number per square mm. 60–70, solitary or connected, their diameter up to 100μ ; length of the vessel segments $300\text{--}500\mu$; on the inner surface of the wall with spirals. Wood fibers $16\text{--}20\mu$, length $800\text{--}1,400\mu$, wall 3μ thick. Wood parenchyma terminal(?) and scattered. Pith rays heterogeneous; uniseriate ray cells upright; polyseriate rays up to 6 cells wide, 70 cells high, cells mostly procumbent.

54. **Prunus Maximowiczii** RUPR. *Miyama-zakura.*

A deciduous tree up to 50 cm. or more in diameter. Sap-wood light brown, heart-wood rosy brown; flavone content in heartwood remarkable.

Pores distributed diagonally, number per square mm. 300–340, their diameter up to 50μ , length of the vessel segments $200\text{--}450\mu$; on the inner surface of the wall with spirals. Wood fibers $14\text{--}16\mu$ in diameter, length $500\text{--}1,200\mu$, wall $2\text{--}2\frac{1}{2}\mu$ thick. Wood parenchyma scattered. Pith rays heterogeneous, 1–4 cells wide, up to 40 cells high.

Prunus sachalinensis Koidz. *Ezo-yama-zakura.* Pores arranged more or less in radial or diagonal direction; number per square mm. 200–300, their diameter up to 60μ , on the inner surface of the wall with spiral thickenings. Wood fibers $16\text{--}20\mu$ in diameter, length $800\text{--}1,200\mu$, wall $2\text{--}3\mu$ thick. Pith rays heterogeneous, cells mostly procumbent, 1–3 cells wide, up to 35 cell high.

55. **Photinia variabilis** HEMSL. *Ushikoroshi.*

(*Pourthiana villosa* DCNE.)

A small deciduous tree up to 30 cm. in diameter. Wood light rosy, hard, close-grained, difficult to split.

Pores evenly distributed, number per square mm. 45–60, usually solitary, their diameter $30\text{--}65\mu$, length of the vessel segment $300\text{--}600\mu$, their perforation simple or scalariform; on the inner surface of the wall with spiral thickenings. Wood fibers $14\text{--}16\mu$ in diameter, length $1,000\text{--}1,500\mu$, wall $3\text{--}4\mu$ thick. Wood parenchyma in short metatracheal bands and scattered among fibers, the former irregularly arranged; chambered parenchyma cells present, nearly always with crystals of calcium oxalate. Pith rays heterogeneous, mostly of procumbent cells, 1–4 cells wide, up to 40 cells high; cells with dark reddish substance.

56. **Photinia glabra** THUNB. *Kaname-mochi*.

A small ever-green tree up to 15 cm. in diameter. Sap-wood light brown, heart-wood dark brown, close-grained, fairly hard.

Pores evenly distributed, number per square mm. 200-240, mostly solitary, their diameter $25-40\mu$, length of the vessel segments $450-700\mu$, perforation simple, on the inner surface of the wall with spirals. Wood fibers $12-14\mu$ in diameter, length $700-1,200\mu$, wall 3μ thick. Wood parenchyma scattered sometimes in short metatracheal bands; chambered parenchyma cells present, with crystals of calcium oxalate. Pith rays heterogeneous; uniseriate ray cells upright; polyseriate rays 2 or 3 cells wide, generally flanked by a few upright uniseriate ray cells.

57. **Amelanchier asiatica** ENDL. *Zaifuri-boku*.

A large deciduous tree up to 60 cm. in diameter. Wood rosy white, close-grained, fairly hard; specific gravity 0.68.

Pores evenly distributed, number per square mm. 300-350, mostly solitary, their diameter up to 40μ , end walls slanting, their perforation simple; on the inner surface of the wall sometimes with spiral thickenings. Wood fibers $14-16\mu$ in diameter, length $700-1,300\mu$, wall $4-5\mu$ thick. Wood parenchyma scattered, sometimes more or less in short metatracheal bands. Pith rays heterogeneous, mostly of procumbent ray cells, 1 or 2 sometimes 3 cells wide, up to 22 cells high.

58. **Sorbus commixta** HEDL. *Nanakamado*.

A small deciduous tree up to 30 cm. in diameter. Sap-wood light yellowish, heart-wood dark brown, wood close-grained, hard, tough, difficult to split; specific gravity 0.80.

Pores evenly distributed, number per square mm. 180-220, mostly solitary, their diameter up to 65μ ; length of the vessel segments $300-900\mu$; on the inner surface of the wall sometimes with spirals. Wood fibers $16-18\mu$ in diameter, length $800-1,400\mu$, wall 4μ thick. Wood parenchyma in short metatracheal bands and scattered. Pith rays homogeneous, 1 or 3 cells wide, up to 30 cells high.

59. **Micromeles alnifolia** KOEH. *Azuki-nashi.*

A deciduous tree up to 20 cm. in diameter. Wood rosy white, hard, heavy, close-grained; specific gravity 0.68.

Pores evenly distributed; number per square mm. 130-140, mostly solitary, they are round or oval in outline, their diameter 40-80 μ ; length of the vessel segments 350-1,000 μ , end walls slightly slanting, their perforation simple; side walls 1 $\frac{1}{2}$ -2 μ thick; on the inner surface of the wall with few spirals. Wood fibers 20-22 μ in diameter, length 700-1,900 μ , wall 3 μ thick. Wood parenchyma scattered among fibers. Pith rays nearly homogeneous; usually biseriate sometimes uniseriate, 3-16 cells high; cells with dark reddish substance.

60. **Micromeles japonica** KOEH. *Uraziro-no-ki.*

A large deciduous tree, up to 60 cm. in diameter. Sap-wood light brown, heart-wood dark brown; wood hard, heavy and close-grained.

Pores evenly distributed, number per square mm. 95-110, usually solitary, their diameter 30-75 μ , length of the vessel segments 450-750 μ , on the inner surface of the wall with spirals. Wood fibers 18-20 μ in diameter, length 850-1,500 μ , wall 2-3 μ thick. Wood parenchyma scattered among fibers, sometimes terminal. Pith rays nearly homogeneous, biseriate sometimes uniseriate, 5-22 cells high; cells with reddish substance.

Saxifrageæ.

61. **Deutzia scabra** THUNB. *Utsugi.*

A small deciduous shrub up to 12 cm. in diameter. Wood yellowish white to light brown; close-grained, hard, difficult to split.

Pores evenly distributed; number per square mm. 130-160; mostly solitary, polygonal in outline, their diameter 25-45 μ ; length of the vessel segments 600-1,100 μ , end walls slanting, their perforation scalariform, cross bars numerous; with very many bordered pits where the vessels are in contact

with each other, the diameter of border being about $5-6\mu$. Fiber-tracheids are the principal element of the wood, sometimes septate, $16-18\mu$ in diameter, length $800-1,800\mu$, wall $3-5\mu$ thick; on the inner surface of the wall with spiral thickenings. Wood parenchyma scattered. Pith rays heterogeneous; uniseriate ray cells upright, cells up to 200μ long vertically; polyseriate rays 2-7 cells wide, marginal ray cells often upright, height ∞ .

Hamamelideæ.

62. *Distylium racemosum* S. et Z. *Isu-no-ki*. Pl. IV. Fig. 21.

An ever-green tree up to 60 cm. in diameter, 15 meters in height. Growth rings indistinct; colour demarcation between sap and heart-wood gradual; sap-wood narrow, dark grayish; heart-wood dark reddish brown; wood compact, hard, heavy, lustrous, difficult to split, liable to warp; specific gravity 0.80.

Pores evenly distributed, number per square mm. 60-80, solitary sometimes 2 or more connected, solitary pores are oval or elliptic in outline, their diameter radially $35-70\mu$, tangentially $30-55\mu$; length of the vessel segments $900-1,450\mu$, end walls slanting, their perforation scalariform, cross bars 6-13; side walls $1-2\mu$ thick. Fiber-tracheids with narrow cavities, 4- to 6-sided in cross section, $12-16\mu$ in diameter, length $1,200-2,200\mu$, wall $4-6\mu$ thick. Wood parenchyma metatracheal and scattered; metatracheal bands in regular tangential lines, rather conspicuous on cross section, 2-14, mostly 2-6 fibers distant from each other, one rarely two cells wide in radial direction, cells with brown substance; chambered parenchyma cells present, with crystals of calcium oxalate. Pith rays heterogeneous, 1-3 fibers distant from each other, 1-3, mostly 1 or 2 cells wide, 3-20 cells high; cells with brown substance.

Araliaceæ.

Early wood pores 3-5 rows deep and gradually diminishing in size through the intermediate to the late wood; pith rays heterogeneous *Aralia*.

Early wood pores mostly one row deep, abruptly diminishing in late wood ;
 pith rays nearly homogeneous.. .. . *Acanthopanax*.

63. ***Acanthopanax innovans*** S. et Z. *Imo-no-ki*.

A large deciduous tree up to 70 cm. in diameter. Without clear colour demarcation between sap and heart-wood ; wood yellowish white ; light and soft, easy to split ; specific gravity 0.55.

Ring-porous sometimes diffused ; early wood pores one row deep, their difference in size from that of late wood not very great, their diameter 80–120 μ ; late wood pores distributed radially or diagonally, number per square mm. 100–120, polygonal in outline, their diameter 40–60 μ ; length of the vessel segments 300–800 μ ; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about 10–12 μ . Wood fibers 20–25 μ in diameter, length 600–1,000 μ , wall 2–2½ μ thick. Wood parenchyma terminal and scattered. Pith rays nearly homogeneous, 1–3 cells wide, 3–18 cells high.

64. ***Acanthopanax ricinifolium*** S. et Z. *Hari-giri*. Pl. IV. Fig. 22.

A deciduous tree. Sap-wood yellowish white, heart-wood grayish brown, growth rings distinct ; moderately hard, easy to work ; specific gravity 0.60.

Ring-porous ; large pores in early wood one row deep, oval or round in outline, their diameter 250–350 μ , length of the vessel segments 400–700 μ , end walls horizontal or slanting, their perforation simple ; late wood consists of vessel, vessel-tracheids, sometimes tracheids, and pores are arranged in wavy tangential bands sometimes irregularly branched, they are polygonal in outline, their diameter 35–60 μ , wall 1 μ thick. Wood fibers 14–16 μ in diameter, length 800–1,600 μ , wall 3–4 μ thick. Wood parenchyma rather scarce (sometimes terminal). Pith rays homogeneous, marginal cells rarely upright, 1–5 cells wide, up to 40 cells high.

65. ***Acanthopanax sciadophylloides*** Fr. et SAV. *Koshi-abura*.

A deciduous tree up to 60 cm. in diameter. Sap-wood grayish white, heart-wood yellowish gray, easy to split, lustrous when planed ; specific gravity 0.45.

Ring-porous; early wood pores one row deep and gradually diminishing in size in late wood, usually solitary, oval or round in outline, their diameter 100–160 μ , length of the vessel segments 400–900 μ ; late wood constitutes of vessels, tracheid-vessels and tracheids, their pores standing closely, number per square mm. 85–95, mostly in groups, solitary pores are polygonal in outline, their diameter 50–80 μ . Wood fibers 18–25 μ in diameter, length 600–1,000 μ , wall 2–3 μ thick. Pith rays nearly homogeneous, few marginal ray cells rarely upright, 1–3 cells wide, up to 35 cells high.

66. ***Aralia chinensis*** LINN. *Tara-no-ki.*

A deciduous tree. Wood whitish, light and soft.

Ring-porous; early wood pores 3–5 rows deep and gradually diminishing in size through the intermediate to the late wood where they are distributed diagonally or tangentially; early wood pores are solitary sometimes 2 or more connected, oval or round in outline, their diameter 100–180 μ ; late wood pores mostly connected radially or tangentially; length of the vessel segments 400–650 μ , end walls horizontal or slanting, their perforation simple. Wood fibers often septate, arranged regularly in radial direction, 16–20 μ in diameter, length 500–900 μ , wall 3 μ in early wood, in late wood 4 μ thick. Wood parenchyma partly paratracheal and scattered. Pith rays heterogeneous, marginal cells often upright, 2–5 cells wide, up to 50 cells high.

Cornaceæ.

Pith lamellated; vessels with spirals; wood parenchyma scattered; height of pith rays ∞ *Aucuba.*
 Pith solid; vessels without spirals; wood parenchyma more or less meta-tracheal and scattered; pith rays less than 50 cells in height *Cornus.*

67. ***Aucuba japonica*** THUNB. *Aoki.*

A small ever-green tree up to 15 cm. in diameter. Sap-wood grayish white, heart-wood dark brown, fairly hard, easy to split.

Pith lamellated; pores evenly distributed, number per square mm. 70–100, solitary sometimes in groups, solitary pores are polygonal in outline,

their diameter 25-45 μ , length of the vessel segments 700-1,200 μ , end walls slanting, their perforation scalariform, cross bars very many; on the inner surface of the wall of vessels with spiral thickenings. Wood fibers 20-25 μ in diameter, length 800-1,500 μ , wall 4-6 μ thick; with very many slit-like bordered pits where they are in contact with each other. Wood parenchyma scattered. Pith rays heterogeneous; uniseriate ray cells upright, cells up to 200 μ long vertically; polyseriate rays 2-6 cells wide, height ∞ .

68. **Cornus controversa** HEMSL. *Mizuki*.

A deciduous tree up to 70 cm. in diameter, 12 meters in height Without heart-wood; growth rings distinct; wood yellowish white or rosy yellow turning to light brown on exposure; moderately hard and heavy; specific gravity 0.63.

Growth rings clearly defined by thick-walled fibers. Pores evenly distributed, number per square mm. 45-60, solitary or in groups, in the latter case 2-4 connected mostly in radial direction, solitary pores are oval or elliptic in outline, their diameter radially 70-140 μ , tangentially 60-120 μ ; length of the vessel segments 800-1,500 μ , end walls slanting, their perforation scalariform, cross bars 20-30; side walls 2 μ , common boundary walls of two vessels 2-3 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8 μ . Wood fibers 20-25 μ in diameter, length 1,000-2,000 μ , wall 2-3 μ in early wood, in late wood 3-4 μ thick. Wood parenchyma scattered among fibers. Pith rays heterogeneous, 2-7 fibers distant from each other, 1-4 cells wide; polyseriate rays 5-40 cells high, usually flanked by a few upright uniseriate ray cells.

69. **Cornus brachypoda** C. A. MEYER *Sawa-mizuki*.

A deciduous tree. Wood yellowish white, turning darker on exposure; specific gravity 0.63.

Pores evenly distributed, number per square mm. 30-40, solitary sometimes in groups, in the latter case 2 or more connected, mostly in radial direction, solitary pores are oval or round in outline, their diameter 70-110 μ ;

length of the vessel segments 750–1,900 μ , their perforation scalariform, cross bars 25–50. Wood fibers 20–25 μ in diameter, length 1,000–2,000 μ , wall 3–4 μ thick. Wood parenchyma scattered, sometimes 1–3 cells connected irregularly. Pith rays heterogeneous, 2–5 cells wide (uniseriate rays very scarce) up to 30 cells high, usually flanked by large upright uniseriate ray cells.

70. **Cornus Kousa** BUERG. *Yama-bōshi*.

A small deciduous tree. Sap-wood light yellowish, heart-wood light rosy; wood hard, heavy, close-grained, difficult to split; specific gravity 0.90.

Pores evenly distributed, number per square mm. 40–55, usually solitary, round or oval in outline, their diameter 45–80 μ , length of the vessel segments 800–1,400 μ , their perforation scalariform, cross bars 30–60; side walls 2–2½ μ thick. Wood fibers 20–25 μ in diameter, length 1,000–2,000 μ , wall 3½–5 μ thick. Pith rays heterogeneous, up to 7 cells wide, uniseriate ray cells upright; polyseriata rays flanked by few upright uniseriate ray cells.

71. **Cornus officinalis** S. et Z. *Sanshuyu*.

A small deciduous tree. Endemic in Corea, introduced to Japan.

Pores evenly distributed, number per square mm. 40–55; usually solitary, their diameter 45–85 μ , perforation scalariform. Wood fibers 18–22 μ in diameter, length 1,200–2,300 μ , wall 4–6 μ thick. Wood parenchym scattered. Pith rays heterogeneous, uniseriate rays in fairly great number, cells upright; polyseriata rays up to 7 cells wide, 50 cells high, often flanked by few large upright ray cells.

Caprifoliaceæ.

72. **Viburnum Sieboldi** MIQ. *Goma-gi*.

A small deciduous (?) tree. Wood milky white, growth rings fairly distinct, close-grained.

Growth rings defined by radially flattened fibers. Pores evenly distributed, number per square mm. 55–60, usually solitary sometimes 2 or 3 connected, solitary pores are oval or elliptic in outline, their diameter radially 35–80 μ ,

tangentially $30-70\mu$; length of the vessel segments $700-1,400\mu$, end walls slanting, their perforation scalariform, cross bars numerous; side walls 2μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers $16-20\mu$ in diameter, length $1,000-2,000\mu$, wall $3-4\mu$ thick. Wood parenchyma metatracheal and scattered; metatracheal bands one cell wide in radial direction, rather irregularly distributed. Pith rays heterogeneous, 1-3 fibers distant from each other, uniseriate ray cells always upright, polyseriate rays 2-or 3-seriate, up to 30 cells high, always flanked by a few upright uniseriate ray cells.

73. **Viburnum Awabucki** KOCH. *Sango-ju.*

A small ever-green tree up to 30 cm. in diameter. Without heart-wood, wood whitish turning to grayish on exposure, moderately hard; specific gravity 0.73.

Pores evenly distributed, number per square mm. 60-75, solitary sometimes connected, solitary pores are polygonal in outline, their diameter $30-65\mu$; on the inner surface of the wall of vessels with spiral thickenings. Wood fibers $22-30\mu$ in diameter, length $1,500-2,100\mu$, wall $4-5\mu$ thick; on the inner surface of the wall with spirals. Wood parenchyma metatracheal and scattered; metatracheal bands one cell wide radially, irregularly distributed. Pith rays heterogeneous; uniseriate ray cells upright; polyseriate rays up to 4 cells wide, 40 cells high, always flanked by upright uniseriate ray cells; cells with dark reddish substance.

Ericaceæ.

74. **Enkianthus perulatus** SCHNEIDER *Dōlan-tsutsuji.* Pl. IV.

Fig. 23.

A small tree up to 15 cm. in diameter, 3 meters in height.

Pores arranged more or less tangentially, somewhat larger in early wood and gradually diminishing in late wood, number per square mm. 250-300, solitary or in groups, solitary pores are polygonal in outline, their diameter $25-50\mu$; length of the vessel segments $400-700\mu$, end walls slanting, their

perforation scalariform; cross bars 7-13; side walls 1-2 μ thick; on the inner surface of the wall of vessels with spiral thickenings. Wood fibers 10-16 μ in diameter, length 450-950 μ , wall 2 μ thick. Wood parenchyma scarce and scattered among fibers. Pith rays heterogeneous, 1-4 fibers distant from each other, 1-3 cells wide, 1-18 cells high; cells with brown substance.

75. **Clethra barbinervis** S. et Z. *Ryōbu*. Pl. IV. Fig. 24.

A deciduous tree up to 20 cm. in diameter, 7 meters in height. Sap-wood yellowish brown, heart-wood dark brown, hard and heavy; specific gravity 0.74.

Pores evenly distributed, number per square mm. 30-40, usually solitary rarely 2 or 3 connected, solitary pores are oval or elliptic in outline, their diameter radially 60-120 μ , tangentially 40-80 μ ; length of the vessel segments 800-1,500 μ ; end walls slanting, their perforation scalariform, cross bars numerous; side walls 2-3 μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers 20-25 μ in diameter, length 1,400-2,000 μ , wall 2-3 μ in early wood, in late wood 3 μ thick. Wood parenchyma scattered among fibers. Pith rays heterogeneous, 1-6 fibers distant from each other, 1-4 cells wide; uniseriate ray cells upright; polyseriate rays 10-40 cells high, marginal ray cells often large and upright, always flanked by few upright ray cells; cells with brown substance.

76. **Rhododendron quinquefolium** BISS. et MRE. *Goyō-tsutsuji*.

Pl. V. Fig. 25.

A small shrub.

Pores arranged tangentially, number per square mm. 200-300, usually connected tangentially, polygonal in outline, their diameter 30-65 μ ; length of the vessel segments 750-1,200 μ , their perforation scalariform, cross bars 25-50; with very many bordered pits where the vessels are in contact with each other. Wood fibers 15-17 μ in diameter, length 800-1,900 μ , wall 2-3 μ in early wood, in late wood 3-4 μ thick. Wood parenchyma metatracheal and scattered; metatracheal bands 1 or 2 cells wide in radial direction, irregularly distanced from each other. Pith rays heterogeneous, in two modifications; uniseriate

ray cells upright; polyseriate rays 2-4 cells wide, up to 30 cells high, often flanked by upright uniseriate ray cells.

Ebenaceæ.

77, **Diospyros Lotus** LINN. *Mame-gaki*.

A deciduous tree up to 60 cm. in diameter, 10 meters in height. Sapwood yellowish when fresh, turning to grayish white, heart-wood black; wood close-grained, moderately hard, rather brittle, easy to work; ripple marks present especially on tangential section; specific gravity 0.74.

Pores evenly distributed, number per square mm. 4-5; solitary sometimes 2-4 connected radially, solitary pores are oval to elliptic in outline, their diameter radially 120-280 μ , tangentially 100-220 μ ; length of the vessel segments 350-500 μ , end walls horizontal or slanting, their perforation simple; side walls 4-8 μ , common boundary walls of two vessels 7-10 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 6 μ . Wood fibers 18-22 μ in diameter, length 700-1,600 μ wall 2-3 μ thick. Wood parenchyma paratracheal, metatracheal and also scattered; metatracheal bands (also terminal) 3-5 fibers distant from each other, one cell wide radially. Pith rays heterogeneous; arranged in horizontal series, 1-3 fibers distant from each other, uniseriate and biseriate; uniseriate rays 1-12 cells high, cells mostly upright; biseriate rays 3-15 cells high, usually flanked by upright uniseriate ray cells.

78. **Diospyros Kaki** L.f. *Kaki*. Fig. 26.

A deciduous tree. Ripple marks appear on tangential section.

Pores evenly distributed, number per square mm. 4-6, solitary pores are oval or elliptic in outline, their diameter radially 100-200 μ , tangentially 80-160 μ ; side walls 5-8 μ , common boundary walls of two vessels 7-10 μ thick. Wood fibers 16-20 μ in diameter, length 800-1,400 μ , wall 3 μ thick. Wood parenchyma paratracheal, metatracheal and also scattered; chambered parenchyma cells present, always with crystals of calcium oxalate. Pith rays

heterogeneous, arranged in horizontal series, 1-3 cells wide; uniseriate ray cells upright; polyseriate rays 4-16 cells high, usually flanked by upright uniseriate ray cells.

Styraceæ.

- Vessels without spirals; with bordered pits where the vessels are in contact with each other(1)
- Vessels usually with spirals; with scalariform bordered pits where the vessels are in contact with each other *Symplocos*.
- (1) { Pores arranged more or less diagonally; wood parenchyma scattered;
pith rays 1 or 2 cells wide *Pterostyrax*.
Pores evenly distributed; wood parenchyma in short metatracheal bands and scattered; pith rays more than 2 cells wide *Styrax*.

79. *Styrax japonica* S. et Z. *Ego-no-ki*.

A deciduous tree up to 30 cm. in diameter, 10 meters in height; without heart-wood, growth rings distinct, wood yellowish white, close-grained; specific gravity 0.60.

Pores evenly distributed, but somewhat more numerous and larger in early wood and gradually diminishing in size through the intermediate to the late wood, number per square mm. 45-55, solitary or in groups, in the latter case 2-4 connected mostly in radial direction, solitary pores are oval or elliptic in outline, their diameter radially 60-120 μ , tangentially 40-90 μ ; length of the vessel segments 650-1,000 μ , end walls slanting, their perforation scalariform, cross bars 9-13; side walls 1-1 $\frac{1}{2}$ μ , common boundary walls of two vessels 2 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 6 μ . Wood fibers 16-20 μ in diameter, length 900-2,000 μ , wall 2-3 μ in early wood, in late wood 3 μ thick. Wood parenchyma metatracheal and scattered among fibers; metatracheal bands mostly in late wood, one cell wide radially, rather inconspicuous in cross section. Pith rays heterogeneous, 1-3 fibers distant from each other, in two modifications: uniseriate and polyseriate; uniseriate rays 3-10 cells high, cells upright;

polyseriate rays 2 or 3 cells wide, 10-25 cells high, always flanked by a few upright uniseriate ray cells.

80. **Styrax Obassia** S. et Z. *Hakuumboku.*

A small deciduous tree up to 30 cm. in diameter. Wood yellowish white, close-grained.

Pores more numerous and larger in early wood, gradually diminishing in number and size through the intermediate to the late wood, number of pores per square mm. 55-75; solitary or in groups, oval or elliptic, more or less polygonal in outline, their diameter radially 40-80 μ , tangentially 30-60 μ ; length of the vessel segments 500-800 μ , their perforation scalariform, cross bars 5-20. Wood fibers 16-18 μ in diameter, length 600-1,200 μ , wall 2-3 μ thick. Wood parenchyma in short metatracheal bands. Pith rays heterogeneous, present in great number, uniseriate and biseriate sometimes triseriate, often 2 rays connecting vertically.

81. **Pterostyrax corymbosum** S. et Z. *Asagara.*

A large deciduous tree up to 60 cm. in diameter. Sap-wood broad white, heart-wood brown; wood light and soft, easy to split.

Pores arranged more or less radially or diagonally, number per square mm. 60-80, solitary pores are polygonal in outline, their diameter 45-90 μ ; length of the vessel segments 700-1,100 μ , their perforation scalariform, cross bars 16-40; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged in horizontal rows. Wood fibers 20-25 μ in diameter, length 1,000-1,800 μ , wall 3-4 μ thick. Wood parenchyma scattered. Pith rays heterogeneous, most of ray cells procumbent, 1-or 2-seriate, up to 25 cells high.

82. **Symplocos myrtacea** S. et Z. *Hai-no-ki.*

An ever-green tree up to 30 cm. in diameter, 10 meters in height. Wood light yellowish white, close-grained, moderately hard and heavy.

Pores evenly distributed, number per square mm. 90-100, solitary or in groups, in the latter case 2 or more connected radially, solitary pores are

polygonal in outline, their diameter $35-65\mu$; length of the vessel segments $700-1,200\mu$, end walls slanting, their perforation scalariform, cross bars 25-70; side walls 2μ thick; on the inner surface of the wall with spiral thickenings. Wood fibers $16-24\mu$ in diameter, length $1,000-1,800\mu$, wall $2-3\mu$ thick; nearly always with spiral thickenings on the wall. Wood parenchyma rather scarce and scattered among fibers. Pith rays heterogeneous, 1-3 fibers distant from each other, 1-3 cells wide, uniseriate rays 1-10 cells high, cells upright, polyseriate rays 6-20 cells high, often two rays connecting vertically, always flanked by upright uniseriate ray cells.

83. **Symplocos prunifolia** S. et Z. *Some-shiba.*

An ever-green tree up to 30 cm. in diameter, 10 meters in height.

Pores evenly distributed, number per square mm. 75-90, solitary or 2-5 connected, solitary pores are polygonal in outline, their diameter $45-75\mu$; length of the vessel segments $600-1,400\mu$, their perforation scalariform; on the inner surface of the wall of vessels with spirals. Wood fibers $20-30\mu$ in diameter, length $1,200-2,000\mu$, wall $3-3\frac{1}{2}\mu$ thick; nearly always with spiral thickenings on the wall. Pith rays heterogeneous, 1-3 fibers distant from each other, 1-3 cells wide, uniseriate rays numerous, cells upright; polyseriate rays always flanked by several upright uniseriate ray cells; often two rays connecting vertically.

84. **Symplocos cratægoides** HAM. *Sawa-futagi.*

A small deciduous tree up to 20 cm. in diameter, 3 meters in height. Wood yellowish white, tough and elastic.

Number of pores per square mm. 30-40, usually solitary, polygonal in outline, their diameter $30-55\mu$, length of the vessel segments $600-1,200\mu$, their perforation scalariform. Wood fibers sometimes septate, $20-25\mu$ in diameter, length $800-1,700\mu$, wall $3-5\mu$ thick. Pith rays heterogenous; uniseriate rays 1-10 cells high, cells upright; polyseriate rays 2-5 cells wide, 5-20 cells high, usually flanked by a few upright ray cells.

Oleaceæ.

- Ring-porous (1)
 Pores arranged in flame-like groups *Osmanthus*.
 (1) { Diameter of pores more than 200μ ; pith rays more than 3 cells wide *Fraxinus*.
 { Diameter of pores less than 80μ ; pith rays 1-2 cells wide *Ligustrum*.

85. **Fraxinus Bungeana** DC. var. **pubinervis** Wg. *Toneriko*.

A large deciduous tree up to 100 cm. in diameter, 16 meters in height.

Ring-porous; early wood pores 2 or 3 rows deep, solitary or 2 or 3 connected radially; solitary pores are oval or elliptic in outline, their diameter radially $140-200\mu$, tangentially $120-160\mu$; late wood pores abruptly diminish in size, thick-walled, usually in groups, sometimes solitary, in the former case 2 or more connected mostly in radial direction; length of the vessel segments $250-330\mu$. Wood fibers are the principal element of the wood, their diameter $14-18\mu$ in late wood, in early wood $18-22\mu$, length $730-1,400\mu$, wall $2-3\mu$ thick. Wood parenchyma terminal, paratracheal and also scattered among fibers; chambered parenchyma cells present in great number. Pith rays homogeneous; 1-4, mostly 2 or 3 cells wide, 3-20 cells high.

86. **Fraxinus Sieboldiana** Bl. *Shioji*. Pl. V. Fig. 27.

A large deciduous tree up to 100 cm. in diameter, 20 meters in height. Sap-wood yellowish white, heart-wood yellowish brown; wood strong, tough, elastic and durable, specific gravity 0.60.

Ring-porous; early wood pores 2-4 rows deep, solitary sometimes 2 connected; solitary pores are oval or elliptic in outline, their diameter radially $250-400\mu$, tangentially $200-300\mu$; late wood pores abruptly diminish in size, their diameter $70-150\mu$; length of the vessel segments $250-350\mu$. Wood fibers arranged radially, their diameter $14-20\mu$ in late wood, in early wood $20-28\mu$, length $900-1,900\mu$, wall $3-4\mu$ in late wood, in early wood $2-3\mu$ thick. Wood parenchyma terminal (sometimes metatracheal), paratracheal and also scattered among fibers; metatracheal arrangement resulting from the union of paratracheal groups in late wood; chambered parenchym cells present in

great number. Pith rays homogeneous, 1-4, mostly 2 or 3 cells wide, 5-20 cells high.

87. **Fraxinus longicuspis** S. et Z. *Aotago*.

A large deciduous tree up to 70 cm. in diameter, 12 meters in height.

Ring-porous; early wood pores 1-3 rows deep, abruptly diminishing in late wood, solitary sometimes 2 connected radially, number per square mm. 12-16, oval or elliptic in outline, their diameter radially 200-250 μ , tangentially 150-200 μ ; late wood pores evenly distributed, thick-walled, mostly 2 or more connected radially, their diameter 50-100 μ ; length of the vessel segments 300-450 μ , side walls 6-8 μ thick. Wood fibers 20-26 μ in diameter, 800-1,500 μ long, wall 2-3 μ thick. Wood parenchyma terminal, paratracheal (more evident in late wood) sometimes metatracheal; metatracheal arrangement resulting from the union of paratracheal groups in late wood. Pith rays homogeneous, 1-3 cells wide, 3-25 cells high.

88. **Fraxinus mandshurica** RUPR. *Yachi-damo*.

A large deciduous tree up to 100 cm. in diameter, 20 meters in height. Sap-wood yellowish white, heart-wood light yellowish brown, growth rings distinct, moderately hard and heavy, coarse-grained, easy to work.

Ring-porous; early wood pores 2-4 rows deep, solitary sometimes 2 connected, solitary pores are oval or round in outline, their diameter 250-400 μ ; late wood pores abruptly diminish in size, their diameter 60-100 μ ; length of the vessel segments 250-350 μ , end walls horizontal or slanting, their perforation simple; side walls 4-8 μ , common boundary walls of two vessels 8-10 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 6-7 μ . Wood fibers are the principal element of the wood, their diameter 20-30 μ in early wood, in late wood 14-20 μ , length 900-1,900 μ , wall 2-3 μ , in early wood, in late wood 3-5 μ thick. Wood parenchyma terminal, paratracheal and also scattered among fibers; chambered parenchyma cells present in great number, cells thick-walled. Pith rays homogeneous, 3-10 fibers distant from each other, 1-3, mostly 1 or 2 cells wide, 2-15 cells high; cells with brown granulous substance.

89. **Ligustrum Ibot** SIEB. *Ibota-no-ki*.

A small deciduous (sometimes almost ever-green) tree. Growth rings distinct; sap-wood whitish, heart-wood dark brown; close-grained, very hard and very heavy, difficult to split; specific gravity 0.86.

Ring-porous; early wood pores 1-3 rows deep, abruptly diminishing in size through the intermediate to the late wood, where the number of pores per square mm. 100-150, mostly solitary, their diameter up to 80μ ; length of the vessel segments $250-600\mu$, end walls slanting, their perforation simple; on the inner surface of the wall of vessels with spiral thickenings. Wood fibers $12-14\mu$ in diameter, length $500-950\mu$, wall $2-3\mu$ thick. Wood parenchyma scattered. Pith rays heterogeneous, mostly procumbent, marginal cells usually upright, 1 or 2 cells wide, up to 25 cells high.

90. **Osmanthus Aquifolium** B. et H. *Hiragi*.

An ever-green tree up to 30 cm. in diameter, 7 meters in height. Without clear colour demarcation between sap and heart-wood; wood yellowish white, close-grained, hard and heavy, difficult to split; specific gravity 0.93.

Pores arranged in flame-like groups; pores are polygonal in outline, their diameter $20-40\mu$; length of the vessel segments $300-550\mu$, end walls slanting, their perforation simple; on the inner surface of the wall of vessels with spiral thickenings. Tracheids $350-550\mu$ long, with spirals on the inner surface of the wall. Wood fibers $12-14\mu$ in diameter, length $700-1,500\mu$, wall $2-3\mu$ thick. Wood parenchyma terminal and scattered. Pith rays heterogeneous, 2-8 fibers distant from each other, 1 or 2 cells wide, uniseriate ray cells upright, biseriate rays 5-15 cells high, usually flanked by one or two large upright ray cells.

Boragineæ.

91. **Ehretia acuminata** R. BR. *Chisha-no-ki*.

A deciduous tree up to 100 cm. in diameter. Heart-wood not clearly marked off from sap-wood; wood yellowish white turning to yellowish brown on exposure, fairly hard and tough; specific gravity 0.70.

Ring-porous; early wood pores one sometimes two rows deep and clearly marked off from late wood pores, usually solitary, oval, round or elliptic in outline, their diameter 150–380 μ , length of the vessel segments 200–300 μ , their perforation simple; late wood pores evenly distributed, number per square mm. 10–16, solitary or 2–3 connected, solitary pores are elliptic in outline, their diameter 70–150 μ , length of the vessel segments 200–300 μ ; on the inner surface of the wall of small vessels with spiral thickenings. Wood fibers irregularly arranged, 3- to 6-sided in cross section, 18–22 μ in diameter, length 1,000–1,800 μ , wall 3–4 μ thick. Wood parenchyma paratracheal, metatracheal and also scattered; metatracheal bands one cell wide in radial direction. Pith rays nearly homogeneous, 1–4 cells wide, up to 25 cells high.

Scrophularineæ.

92. **Paulownia tomentosa** H. Bn. *Kiri*. Pl. V. Fig. 28.

A deciduous tree. Pith large; without clear colour demarcation between sap and heart-wood; growth rings distinct; wood yellowish gray to light brown, light and soft, rather incombustible, difficult to split, does not absorb moisture; specific gravity 0.28.

Ring-porous; early wood pores 1–3 rows deep and gradually diminishing in size through the intermediate to the late wood, number per square mm. 6–8 in early wood, in late wood 4–9; solitary sometimes 2 or 3 connected, oval or round in outline, their diameter 80–200 μ , length of the vessel segments 200–400 μ , end walls horizontal or slanting, their perforation simple; side walls 3 μ thick. Wood fibers 25–30 μ in diameter, length 500–1,200 μ , wall 2 μ thick. Wood parenchyma paratracheal and scattered among fibers, in the former case often elongating tangentially. Pith rays nearly homogeneous, 3–10 fibers distant from each other, 1–4 cells wide, 2–25 cells high.

Bignoniaceæ.

93. **Catalpa Kæmpferi** S. et Z. *Ki-sasage*.

A large deciduous tree up to 60 cm. in diameter. Sap-wood grayish, heart-wood grayish brown, light and soft, easy to split; specific gravity 0.45.

Ring-porous; tyloses present, early wood pores conspicuous, 4-6 rows deep and gradually diminishing in size through the intermediate to the late wood, their diameter 120-180 μ ; late wood pores are arranged in diagonal groups, in continuous tangential bands near the peripheries of growth rings; length of the vessel segments 350-700 μ , end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the diameter of border being 10-12 μ . Wood fibers 15-18 μ in diameter, length 550-1,000 μ , wall 3 μ in early wood, in late wood 4 μ thick. Wood parenchyma scattered. Pith rays heterogeneous; mostly procumbent but marginal ray cells often large and upright, 3-10 cells wide, up to 40 cells high.¹⁾

94. **Clerodendron trichotomum** THUNB. *Kusagi*.

A small deciduous shrub. Sap-wood yellowish white, heart-wood bright yellowish, light and soft.

Ring-porous; early wood pores large and gradually diminishing in size through the intermediate to the late wood, rather evenly distributed, late wood pores arranged more or less tangentially; number per square mm. 6-8 in early wood, in late wood 15-22; early wood pores are oval or round in outline, their diameter 110-220 μ ; length of the vessel segments 230-550 μ , their perforation simple. Wood fibers arranged radially, 16-20 μ in diameter, length 650-1,100 μ , wall 2-3 μ thick. Wood parenchyma paratracheal and scattered; in late wood, paratracheal parenchyma generally connecting tangentially. Pith rays heterogeneous, 1-3 cells wide, up to 32 cells high.

Laurineæ.

95. **Actinodaphne acuminata** MEISN. *Ao-kagonoki*.

An ever-green tree up to 50 cm. in diameter. Wood light yellowish, easy to split; specific gravity 0.50.

1) Stands very near to *Ardisia chinensis* but differs from it by having broader rays.

Pores evenly distributed, number per square mm. 12-20, solitary or in groups, in the latter case 2-4 connected mostly in radial direction; solitary pores are round in outline, their diameter $50-100\mu$; length of the vessel segments $350-600\mu$, their perforation simple; side walls $4-6\mu$, common boundary walls of two vessels $4-7\mu$ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about $8-10\mu$. Wood fibers usually septate, $24-28\mu$ in diameter, length $600-1,100\mu$, wall $2-3\mu$ thick. Wood parenchyma paratracheal and also scattered among fibers; paratracheal parenchyma one or two cells wide. Pith rays 1-6 fibers distant from each other, 1-4 cells wide, 3-23 cells high; cells with dark reddish substance.

96. **Actinodaphne lancifolia** MEISN. *Kago-no-ki*. Pl. V. Fig. 29.

An ever-green tree. Wood quite similar to "Tabu"; specific gravity 0.70.

Growth rings rather clearly defined by thick-walled fibers in late wood. Pores evenly distributed, number per square mm. 15-30, solitary or 2-4 connected radially, solitary pores are round in outline, their diameter $40-120\mu$; length of the vessel segments $300-550\mu$; side walls $5-7\mu$, common boundary walls of two vessels $5-8\mu$ thick. Wood fibers $20-24\mu$ in diameter, length $500-1,000\mu$, wall $2-3\mu$ in early wood, in late wood $3-5\mu$ thick. Wood parenchyma paratracheal and scattered. Pith rays heterogeneous, 1-3 cells wide, 3-22 cells high.

97. **Cinnamomum Camphora** NEES. et EBE. *Kusu-no-ki*. Pl. V.

Fig. 30.

A large ever-green tree. Sap-wood grayish white, heart-wood reddish brown; wood fragrant, moderately hard, rather coarse-grained, easy to work, durable under ground.

Early wood sharply defined by late wood. Pores evenly distributed, number per square mm. 10-20, solitary or in groups, in the latter case 2-5 connected radially, solitary pores are elliptic or oval in outline, their diameter radially $80-200\mu$, tangentially $80-180\mu$; length of the vessel segments $300-600\mu$, end walls horizontal or slanting, their perforation simple; side walls

5-7 μ , common boundary walls of two vessels 6-8 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 11 μ . Wood fibers arranged radially, their diameter 20-25 μ in early wood, length 650-1,300 μ , wall 3 μ in early wood, in late wood 3-4 μ thick. Wood parenchyma paratracheal and also scattered among fibers; secretory cells present especially near vessels. Pith rays heterogeneous, 2-6 fibers distant from each other, 1-3 cells wide, 5-25 cells high.

98. **Cinnamomum pedunculatum** NEES. *Yabu-nikkei*.

A large ever-green tree up to 60 cm. in diameter. Heart-wood not clearly distinguished from sap-wood; wood yellowish white to light brown, rather close-grained, lustrous when planed.

Pores evenly distributed, number per square mm. 13-16, solitary or in groups, in the latter case 2 or 3 connected mostly in radial direction, round or oval in outline, their diameter 70-120 μ ; length of the vessel segments 350-550 μ , their perforation simple or scalariform, cross bars 2-6. Wood fibers are the principal element of the wood, their radial diameter 22-28 μ in early wood, in late wood 15-22 μ , wall 2-3 μ in early wood, in late wood 3-3½ μ thick. Wood parenchyma paratracheal and also scattered. Pith rays heterogeneous, 1-3 cells wide, 1-20 cells high.

99. **Litsea glauca** SIEB. *Shiro-damo*.

A small ever-green tree. Wood grayish white; specific gravity 0.60.

Growth rings defined by thick-walled fibers.

Pores evenly distributed, number per square mm. 25-35, usually solitary sometimes 2 connected radially, oval in outline, their diameter 50-100 μ ; length of the vessel segments 250-500 μ , their perforation simple; side walls 3-5 μ , common boundary walls of two vessels 5-6½ μ thick. Wood fibers 20-25 μ in diameter, length 650-1,300 μ , wall 2-3 μ in early wood, in late wood 3-4 μ thick. Wood parenchyma paratracheal and also scattered. Pith rays heterogeneous, 1-4 cells wide, 1-20 cells high.

100. **Machilus Thunbergii** S. et Z. *Tabu.* Pl. VI. Fig. 31.

A large ever-green tree up to 100 cm. in diameter, 10 meters in height. Sap-wood yellowish brown, heart-wood reddish brown; wood moderately hard and heavy, difficult to split; specific gravity 0.62.

Pores evenly distributed, number per square mm. 16-22, solitary sometimes in groups, in the latter case 2-4 connected mostly in radial direction; solitary pores are round or oval in outline, their diameter $70-160\mu$; length of the vessel segments $400-700\mu$, end walls slanting, their perforation simple sometimes scalariform, cross bars then 3-8; side walls $4-6\mu$, common boundary walls of two vessels $6-8\mu$ thick. Wood fibers $20-25\mu$ in diameter, length $850-1,800\mu$, wall $3-4\mu$ thick. Wood parenchyma paratracheal and scattered among fibers; paratracheal parenchyma 1-5 cells wide in cross section; secretory cells present in fairly great number. Pith rays heterogeneous, 1-4 cells wide, 3-20 cells high.

Elæagnaceæ.

101. **Elæagnus multiflora** THUNB. *Natsu-gumi.*

A small ever-green tree up to 20 cm. in diameter. Wood yellowish, tough, difficult to split.

Ring-porous; early wood pores 2-5 rows deep and gradually diminishing in number and size through the intermediate to the late wood; early wood pores are oval or elliptic in outline, their diameter radially $60-110\mu$, tangentially $50-100\mu$; late wood pores evenly distributed, number per square mm. 40-60; length of the vessel segments $180-300\mu$, their perforation simple. Wood fibers $14-18\mu$ in diameter, length $700-1,500\mu$, wall $1-2\frac{1}{2}\mu$ in early wood, in late wood $2\frac{1}{2}-4\mu$ thick; on the inner surface of the wall with spiral thickenings. Wood parenchyma paratracheal, in short metatracheal bands and also scattered. Pith rays nearly homogeneous, up to 8 cells wide, 40 cells high.

Euphorbiaceæ.

	Ring-porous; with simple perforation	<i>Mallotus.</i>
	Diffuse-porous; „ scalariform „ .. .. .	..(1)
(1)	Number of pores per square mm. 280-400, their diameter 20-32 μ ; with very many bordered pits where the vessels are in contact with each other.	<i>Buxus.</i>
		Number of pores per square mm. 75-95, their diameter 30-80 μ ; with scalariform bordered pits where the vessels are in contact with each other .. .. .	Daphniphyllum.

102. *Buxus japonica* MUELL. *Tsuge.*

A small ever-green tree up to 30 cm. in diameter, 10 meters in height. In large tree, heart-wood marked off from sap-wood; sap-wood light yellowish, heart-wood dark yellowish brown; wood close-grained, hard and heavy, difficult to split, works up smoothly, with slight silky luster; specific gravity 0.70.

Growth rings defined by thick-walled fibers. Pores evenly distributed, number per square mm. 280-400, usually solitary, they are oval or round in outline, their diameter 20-32 μ ; length of the vessel segments 350-750 μ , their perforation scalariform, cross bars 5-15; side walls 3-3½ μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 4-5 μ . Wood fibers with narrow cavities, 12-16 μ in diameter, length 600-1,100 μ , wall 4-5 μ thick. Wood parenchyma scattered, occasionally more or less gathering in short metatracheal bands. Pith rays heterogeneous; 1-3 fibers distant from each other, in two modifications: uniseriate rays 3-9 cells high, cells upright; polyseriate rays 2 or 3 cells wide, 7-18 cells high, sometimes two rays connecting vertically, always flanked by many upright uniseriate ray cells.

103. *Daphniphyllum glaucescens* BL. *Hime-yuzuriha.*

A small ever-green tree up to 30 cm. in diameter, 10 meters in height. Without clear colour demarcation between sap and heart-wood; wood yellowish gray, close-grained; specific gravity 0.66.

Pith lamellated. Pores evenly distributed, number per square mm. 75-95, usually solitary; they are oval, elliptic, more or less polygonal in outline,

their diameter radially 40–80 μ , tangentially 30–60 μ ; length of the vessel segments 800–1,300 μ , end walls slanting, their perforation scalariform, cross bars 22–90, side walls 2 μ thick; with scalariform bordered pits where the vessels are in contact with each other. Wood fibers 20–24 μ in diameter, length 800–1,800 μ , wall 2–3 μ in early wood, in late wood 3–4 μ thick. Wood parenchyma in short metatracheal bands and scattered; metatracheal bands one cell wide, irregularly arranged. Pith rays heterogeneous, 1–3 fibers distant from each other, 1–4 cells wide, 3–18 cells high.

104. **Mallotus japonicus** MUELL. ARG. *Akame-gashiwa*. Pl. VI.
Fig. 32.

A deciduous tree up to 30 cm. in diameter. Without heart-wood, growth rings distinct; wood light yellowish brown, light and soft, easy to split; specific gravity 0.59.

Ring-porous; early wood pores 3–6 rows deep and rather abruptly diminishing in number and size in late wood, solitary or in groups, the former are oval or elliptic in outline, their diameter radially 120–220 μ , tangentially 100–200 μ , side walls 3–5 μ , common boundary walls of two vessels 5–7 μ thick; late wood pores are distributed radially, solitary or connected radially, their diameter 60–120 μ , side walls 7–8 μ , common boundary walls of two vessels 8–10 μ thick; length of the vessel segments 400–750 μ , end walls horizontal or slanting, their perforation simple; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about 8–9 μ . Wood fibers arranged radially, their diameter 20–25 μ , length 850–1,200 μ , wall 1–2 μ in early wood, in late wood 2–2½ μ thick. Wood parenchyma metatracheal, paratracheal and scattered; metatracheal bands one cell wide, rather irregularly distributed. Pith rays heterogeneous, 1–3 fibers distant from each other, uniseriate, height variable; cells sometimes with crystals of calcium oxalate.

Urticaceæ.

Diffuse-porous .. .. .	..(1)
Ring-porous .. .. .	..(2)

- | | | | |
|-----|---|--|---------------------|
| (1) | { | Wood parenchyma terminal, paratracheal and also scattered; paratracheal parenchyma often connecting in tangential lines | <i>Aphananthe</i> . |
| | | Wood parenchyma paratracheal, metatracheal and also scattered | <i>Ficus</i> . |
| (2) | { | Pith rays heterogeneous | ..(3) |
| | | Pith rays homogeneous or nearly homogeneous | ..(4) |
| (3) | { | Early wood pores abruptly diminishing in size in late wood, where the pores are usually connected in circular or tangential groups; paratracheal parenchyma conspicuous | <i>Celtis</i> . |
| | | Early wood pores gradually diminishing in size in late wood, where the pores are generally solitary; paratracheal parenchyma not conspicuous. | <i>Morus</i> . |
| (4) | { | Heart-wood contains flavone. Late wood pores generally connecting tangentially; pith rays nearly homogeneous, 1-8 cells wide; tangential diameter of ray cells up to 18 μ | <i>Zelkova</i> . |
| | | Heart-wood does not contain flavone. Late wood pores generally connecting diagonally or tangentially; pith rays homogeneous, up to 6 cells wide; tangential diameter of ray cells less than 12 μ | <i>Ulmus</i> . |

105. ***Aphananthe aspera*** PLANCH. *Muku-no-ki*. Pl. VI. Fig. 33

A large deciduous tree up to 100 cm. in diameter, 20 meters in height. Sap-wood light yellowish, heart-wood yellowish brown; wavy tangential lines of soft tissue conspicuous on cross section; wood coarse-grained, strong, tough hard and heavy, difficult to split; specific gravity 0.84.

Pores evenly distributed,¹⁾ but more numerous and larger in early wood and gradually diminishing in number and size through the intermediate to the late wood, number per square mm. 3-7, solitary or in groups, in the latter case 2 or 3 connected mostly in radial direction; solitary pores are elliptic or oval in outline, their diameter 120-200 μ ; end walls of vessels horizontal, or slanting, their perforation simple; side walls 5-7 μ , common boundary walls of two vessels 6-10 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8 μ . Wood fibers irregularly arranged, 12-16 μ in diameter, length 650-1,400 μ , wall 2 μ thick. Wood parenchyma metatracheal (also terminal), paratracheal and also scattered among fibers; metatracheal bands variably distanced from each other, 3-10 cells wide, radially arranged in regular or wavy tangential direction; paratracheal parenchyma 1-5 cells wide. Pith rays heterogeneous, mostly of procumbent ray cells, 2-10 fibers

1) This species is usually grouped with the ring-porous type.

distant from each other, 1-6 cells wide, 3-40, mostly 10-30 cells high; cells with brown substance, sometimes flanked by a few upright uniseriate ray cells.

106. **Celtis sinensis** PERS. *Enoki*.

A large deciduous tree up to 100 cm. in diameter. Heart-wood not clearly marked off from sap-wood, growth rings distinct; wood light yellowish gray, difficult to split, fairly hard but brittle, liable to decay; specific gravity 0.70.

Ring-porous; early wood pores one or two rows deep, tyloses sometimes present, solitary sometimes connected; solitary pores are oval or round in outline, their diameter $150-250\mu$; length of the vessel segments $180-280\mu$, end walls horizontal or slanting, their perforation simple; late wood consists mainly of tracheid-vessels and tracheids, their pores gradually diminishing in size toward the peripheries of the growth rings, mostly connected in circular groups or in short tangential bands; on the inner surface of the wall of tracheid-vessels with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being angular in outline by mutual contact, their diameter about $8-9\mu$. Tracheids $180-250\mu$ long; on the inner surface of the wall with spiral thickenings. Wood fibers irregularly arranged, $14-16\mu$ in diameter, length $750-1,300\mu$, wall $1\frac{1}{2}-2\frac{1}{2}\mu$ thick. Wood parenchyma paratracheal, terminal and also scattered. Pith rays heterogeneous, 1-10 cells wide, up to 75 cells high.

107. **Ficus Wightiana** WALL. var. **japonica** MIQ. *Akō*.

An ever-green tree, but old leaves fall once a year. Wood dark grayish, coarse-grained, light and soft; specific gravity 0.45.

Pores evenly distributed, number per square mm. 2-4, usually solitary sometimes 2 or 3 connected in radial direction; solitary pores are oval or elliptic in outline, their diameter radially $120-260\mu$, tangentially $110-220\mu$; length of the vessel segments $200-350\mu$, end walls horizontal or slanting, their perforation simple; side walls $3-4\mu$, common boundary walls of two vessels $4-7\mu$ thick. Wood fibers septate, $20-30\mu$ in diameter, length $700-1,500\mu$, wall $3-3\frac{1}{2}\mu$ thick. Wood parenchyma metatracheal, paratracheal and also

scattered; metatracheal bands conspicuous on cross section, 8-20 cells wide in radial direction. Pith rays heterogeneous, 1-6 cells wide, up to 30 cells high.

108. **Ficus retusa** LINN. var. **nitida** MIQ. *Gazumaru.*

A large ever-green tree. Wood yellowish gray.

Pores evenly distributed, number per square mm. 1-3, usually solitary, oval or elliptic in outline, their diameter radially 120-220 μ , tangentially 100-200 μ , length of the vessel segments 200-350 μ . Wood fibers sometimes septate, 18-25 μ in diameter, length 750-1,700 μ , wall 2-3 μ thick. Metatracheal parenchyma 10-20 cells wide in radial direction. Pith rays heterogeneous, 1-9 cells wide, up to 40 cells high.

109. **Morus bombycis** KOIDZ. *Yama-guwa.*

A large deciduous tree. Sap-wood light yellowish, heart-wood yellowish brown; growth rings distinct; lustrous when planed; fairly hard, easy to work.

Ring-porous; tyloses present; early wood pores not clearly differentiated from late wood pores, the transition of their size gradual; number of pores per square mm. 8-30 in early wood, in late wood 30-50; early wood pores usually solitary, late wood pores connected radially or in circular groups, solitary pores are elliptic or oval in outline, their diameter up to 250 μ ; length of the vessel segments 150-320 μ , end walls horizontal or slanting, their perforation simple; with spiral thickenings on the inner surface of the wall of small vessels; with very many bordered pits where the vessels are in contact with each other, the bordered pits angular in outline by mutual contact, their diameter being about 9-11 μ . Wood fibers irregularly arranged, 14-16 μ in diameter, length 800-1,900 μ , wall 2-3 μ thick. Wood parenchyma paratracheal and scattered. Pith rays heterogeneous, 5-15 fibers distant from each other, 1-6 cells wide, up to 45 cells high; cells sometimes with crystals of calcium oxalate.

110. **Ulmus Sieboldii** DAV. *Aki-nire.*

A large deciduous tree up to 60 cm. in diameter. Sap-wood light brown, heart-wood reddish brown; wood hard, heavy, difficult to split; specific gravity 0.76.

Ring-porous; early wood pores 3-5 rows deep, gradually diminishing in size in late wood where they are very often connected in circular groups, number per square mm. 13-30, solitary pores are round or oval in outline, their diameter $70-200\mu$; length of the vessel segments $150-300\mu$; with spiral thickenings on the inner surface of the wall of small vessels. Tracheids $170-220\mu$ long, with spirals on the wall. Wood fibers $12-15\mu$ in diameter, length $600-1,000\mu$, wall $2-3\mu$ thick. Pith rays homogeneous, 1-6 cells wide, up to 40 cells high, cells with dark reddish substance.

111. **Ulmus japonica** SARGENT *Kobu-nire.* Pl. VI. Fig. 34.

A large deciduous tree.

Ring-porous; early wood pores one or two rows deep, mostly solitary, oval, round or depressed in radial direction, their diameter $170-250\mu$; late wood pores generally connected in circular groups sometimes in short tangential bands; length of the vessel segments $180-300\mu$, end walls horizontal or slanting, their perforation simple; on the inner surface of the wall of small vessels with spiral thickenings. Tracheids present mostly together with vessels, length $200-300\mu$; with spirals on the inner surface of the wall. Wood fibers irregularly arranged, their diameter $14-16\mu$, length $800-1,500\mu$, wall $2-3\mu$ thick. Wood parenchyma terminal sometimes partly paratracheal and also scattered. Pith rays homogeneous, 1-6 cells wide, up to 30 cells high, cells with dark reddish substance.

112. **Ulmus laciniata** MEYR *Ohyō-nire.* Pl. VI. Fig. 35.

A large deciduous tree. Sap-wood yellowish, heart-wood light brown; growth rings distinct; wood close-grained, tough, difficult to split; specific gravity 0.58.

Ring-porous; early wood pores 2-4 rows deep, solitary or 2 connected, oval or elliptic in outline, their diameter radially 200-300 μ , tangentially 180-250 μ ; late wood pores arranged in circular groups, or in tangential or diagonal bands; length of the vessel segments 170-320 μ ; on the inner surface of the wall of small vessels with spiral thickenings. Wood fibers irregularly arranged, 14-16 μ in diameter, length 900-1,700 μ , wall $2\frac{1}{3}$ -3 $\frac{1}{2}$ μ thick. Pith rays homogeneous, 1-5 cells wide, up to 45 cells high, cells with dark reddish substance.

113. **Zelkova acuminata** PLANCH. *Keyaki*. Pl. VI. Fig. 36.

A large deciduous tree up to 180 cm. in diameter, 30 meters in height. With clear colour demarcation between sap and heart-wood; growth rings distinct; sap-wood yellowish white, heart-wood yellowish brown; wood moderately hard and heavy, easy to split, strong, tough, elastic, not liable to warp or check, rather coarse-grained but works smoothly, takes a fine luster when polished, durable; specific gravity 0.41.

Ring-porous; early wood pores one sometimes two rows deep, usually solitary, round to oval in outline, their diameter 200-400 μ ; length of the vessel segments 180-240 μ , their perforation simple, side walls 4-8 μ thick; late wood pores abruptly diminish in size, connected in tangential bands, each band 1-8 rows deep, diameter of pores 50-100 μ ; length of the vessel segments 200-350 μ ; on the inner surface of the wall with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the diameter of border being 10 μ . Tracheids 200-250 μ long, on the inner surface of the wall with spiral thickenings. Wood fibers irregularly arranged, 3- to 7-sided in cross section, 12-16 μ in diameter, length 1,100-2,000 μ , wall 3-5 μ thick. Wood parenchyma paratracheal and also scattered among fibers, (since pores are arranged in tangential direction, paratracheal parenchyma naturally uniting into metatracheal bands). Pith rays nearly homogeneous, mostly of procumbent cells, 5-20 fibers distant from each other, 1-8, mostly 3-6 cells wide, 15-50 cells high; upright marginal ray cells usually large and contain crystals of calcium oxalate.

Juglandeæ.

- Diffuse-porous (1)
 Ring-porous *Platycarya*.
 (1) { Pith lamellated; number of pores per square mm. 4-7, their diameter up
 to 250 μ ; pith rays 1-4 cells wide *Juglans*.
 Pith solid; number of pores per square mm. 45-60, their diameter up
 to 120 μ ; pith rays uniseriate *Pterocarya*.

114. **Juglans Sieboldiana** MAXIM. *Oni-gurumi*. Pl. VII. Fig. 37.

A large deciduous tree up to 100 cm. in diameter, 20 meters in height. Sap-wood grayish white, heart-wood reddish brown or dark brown; growth rings fairly distinct; wood moderately hard, does warp nor check; specific gravity 0.60.

Pith lamellated. Pores evenly distributed, number per square mm. 4-7, solitary or in groups, in the latter case 2-5 connected always radially; solitary pores are oval or elliptic in outline, their radial diameter radially 120-250 μ , tangentially 100-200 μ ; length of the vessel segments 460-600 μ , end walls horizontal or slanting, their perforation simple; side walls 3 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 9-12 μ . Wood fibers sometimes septate, 22-30 μ in diameter, length 800-1,750 μ , wall 2-3 μ in early wood, in late wood 3-4 μ thick. Wood parenchyma metatracheal, partly paratracheal and also scattered among fibers; metatracheal bands more numerous in late wood, one cell wide in radial direction, variably distanced from each other. Pith rays homogeneous, 3-8 fibers distant from each other, 1-4 cells wide, 3-40 cells high, cells with brown substance.

115. **Platycarya strobilacea** S. et Z. *Nobu-no-ki*.

A large deciduous tree up to 60 cm. in diameter. Sap-wood yellowish white, heart-wood yellowish brown; wood coarse-grained, moderately hard; specific gravity 0.72.

Ring-porous; early wood pores 1-3 rows deep, oval or round in outline, their diameter 70-140 μ , length of the vessel segments 200-400 μ ; late wood

pores arranged diagonally, length of the vessel segments 250–450 μ , perforation simple; on the inner surface of the wall with spiral thickenings. Wood fibers 14–16 μ in diameter, length 600–1,100 μ , wall 3 μ thick. Wood parenchyma metatracheal, paratracheal and also scattered; metatracheal bands 1–3 cells wide radially. Pith rays homogeneous, 1–6 cells wide, up to 40 cells high.

116. **Pterocarya rhoifolia** S. et Z. *Sawa-gurumi*. Pl. VII. Fig. 38.

A large deciduous tree up to 100 cm. in diameter, 25 meters in height; without heart-wood; growth rings fairly distinct; wood yellowish white, light and soft, not liable to warp nor split; specific gravity 0.41.

Growth rings clearly defined. Pores evenly distributed, number per square mm. 45–60, solitary or in groups, in the latter case 2–4 connected mostly in radial direction; solitary pores are elliptic or oval in outline, their diameter radially 60–120 μ , tangentially 50–100 μ ; end walls horizontal or slanting, their perforation simple; side walls 2 μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8–10 μ . Wood fibers 20–30 μ in diameter, length 700–800 μ , wall 1½–2 μ in early wood, in late wood 2–2½ μ thick. Wood parenchyma scarce. Pith rays homogeneous, 1–5 fibers distant from each other, uniseriate, 2–15 cells high.

Myricaceæ.

117. **Myrica rubra** S. et Z. *Yama-momo*.

An ever-green tree up to 60 cm. in diameter, 13 meters in height. Sap-wood yellowish brown, heart-wood dark reddish, close-grained, hard, difficult to split; wood contains flavone; specific gravity 0.52.

Pores evenly distributed, number per square mm. 45–60, usually solitary, they are polygonal in outline, their diameter radially 50–90 μ , tangentially 40–80 μ ; length of the vessel segments 350–950 μ , end walls slanting, their perforation scalariform, cross bars 1–11; side walls 2 μ thick. Tracheid-fibers 15–20 μ in diameter, length 950–1,800 μ , wall 3–5 μ thick; with very many

slit-like semi-bordered pits where they are in contact with each other. Wood parenchyma in short metatracheal bands and scattered; metatracheal bands 2-5 connected tangentially, irregularly distanced from each other, one cell wide radially; chambered parenchyma cells present in great number, with crystals of calcium oxalate. Pith rays heterogeneous, 1-3 fibers distant from each other, 1-4 cells wide, 5-28 cells high; polyseriate rays sometimes flanked by few upright uniseriate ray cells; cells with brown substance.

Cupuliferæ.

- Perforation of vessels always scalariform. (1)
 Perforation of vessels always simple, or sometimes simple sometimes scalariform (2)
- (1) { Pores arranged more or less in radial direction; pith rays usually uniseriate *Alnus*.
 { Pores evenly distributed; pith rays 1-4 cells wide *Betula*.
 (2) { Perforation of vessels always simple. (3)
 { Perforation of vessels sometimes simple sometimes scalariform ("simple-scalariform") (4)
- (3) { Pith rays of two kinds; broad rays and uniseriate rays present. (*Pasania*), *Quercus*.
 { Pith rays of one kind; uniseriate or 1-3 cells wide (5)
- (4) { Pores arranged radially; terminal parenchyma present; compound rays up to 6 cells wide *Carpinus*.
 { Pores evenly distributed; terminal parenchyma absent; broad rays more than 12 cells wide *Fagus*.
 (5) { Ring-porous; pith rays uniseriate *Castanea*.
 { Diffuse-porous; pith rays 1-3 cells wide. *Ostrya*.

118. *Alnus japonica* S. et Z. *Hannoki*.

A large deciduous tree up to 60 cm. in diameter, 15 meters in height.

Without heart wood; growth rings distinct; wood yellowish white when fresh, turning darker on exposure, close-grained, moderately hard; specific gravity 0.59.

Early wood sharply defined from late wood, the latter 3-5 cells wide, radially flattened in cross section. Pores distributed radially, number per square mm. 50-60, usually in groups sometimes solitary, in the former case 2 or more connected mostly in radial direction; solitary pores are round, oval or elliptic somewhat polygonal in outline, their diameter 50-100 μ ; length of

the vessel segments $650-1,50\mu$, end walls slanting, their perforation scalariform, cross bars 15-30; side walls $2-3\mu$, common boundary walls of two vessels 3μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 7μ . Tracheids $550-1,000\mu$ long. Wood fibers often septate, their diameter $20-28\mu$ in early wood, length $800-1,700\mu$, wall $2-3\mu$ in early wood, in late wood $3-4\mu$ thick. Wood parenchyma scattered among fibers. Pith rays homogeneous, 1-3 fibers distant from each other, uniseriate rarely biseriate; compound rays present, 3-20 cells high; cells with brown substance, wall $2-3\mu$ thick.

119. **Alnus tinctoria** SARGENT *Yama-hannoki*. Pl. VII.

Fig. 39.

A large tree up to 70 cm. in diameter, 20 meters in height. Sap-wood narrow, grayish white, heart-wood light rosy brown.

Pores distributed radially, number per square mm. 60-100, usually in groups sometimes solitary, in the former case 2-15 connected radially; solitary pores are oval or elliptic in outline, their diameter $50-100\mu$; length of the vessel segments $600-900\mu$, their perforation scalariform, cross bars 20-30; side walls 2μ thick; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about $7-8\mu$. Wood fibers $20-25\mu$ in diameter, length $850-1,400\mu$, wall $2-3\mu$ thick in early wood. Wood parenchyma scattered, sometimes distributed tangentially near the peripheries of growth rings. Pith rays homogeneous, uniseriate, 3-30 cells high, cells with brown substance.

120. **Alnus Maximowiczii** CARR. *Miyama-hannoki*.

A large deciduous tree up to 30 cm. in diameter.

Number of pores per square mm. 120-160, mostly connected in radial groups, solitary pores somewhat polygonal in outline, their diameter radially $35-65\mu$, tangentially $30-60\mu$; length of the vessel segments $500-700\mu$, their perforation scalariform, cross bars 25-40; with very many bordered pits where the vessels are in contact with each other, the bordered pits arranged in

horizontal rows, the diameter being about $4-5\mu$. Wood fibers $16-18\mu$ in diameter, length $500-900\mu$ wall $2-2\frac{1}{2}\mu$ thick. Wood parenchyma more or less terminal and scattered among fibers. Pith rays homogeneous, uniseriate, cells with brown substance.

Alnus hirsuta Turcz. *Keyama-hannoki*. Pores arranged more or less in radial direction, number per square mm. 80-100, their diameter up to 100μ , their perforation scalariform. Wood fibers $22-32\mu$ in diameter, length $1,000-1,7000\mu$, wall 3μ thick. Pith rays homogeneous, uniseriate.

121. **Betula Maximowicziana** RGL. *Sailada-kamba*. Pl. VII.

Fig. 40.

A large deciduous tree up to 60 cm. in diameter, 20 meters in height. Without heart-wood, growth rings fairly distinct; wood yellowish white, rather close-grained, moderately hard and heavy; specific gravity 0.69.

Pores evenly distributed, number per square mm. 18-28, solitary or in groups, in the latter case 2 or more connected mostly in radial direction; solitary pores are round, oval or elliptic in outline, their diameter radially $100-200\mu$, tangentially $70-150\mu$; length of the vessel segments $750-1,300\mu$, end walls slanting, their perforation scalariform, cross bars 4-7; side walls 2μ , common boundary walls of two vessels 4μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about $3-4\mu$. Tracheids $900-1,100\mu$ long. Wood fibers $20-25\mu$ in diameter, length $1,000-2,300\mu$, wall $3-4\mu$ thick. Wood parenchyma terminal and also scattered among fibers. Pith rays homogeneous, 2-6 fibers distant from each other, 1-4 cells wide, 3-22 cells high; cells with brown substance; wall of cells 3μ thick.

122. **Betula japonica** SIEB. *Shira-kamba*.

A large deciduous tree up to 60 cm. in diameter, 20 meters in height.

Pores evenly distributed, number per square mm. 14-17, solitary sometimes 2-4 connected mostly in radial direction, solitary pores are round, oval or elliptic in outline, their diameter radially $100-200\mu$, tangentially $80-150\mu$; their perforation scalariform, cross bars 4-11; side walls $2-3\mu$, common boun-

dary walls of two vessels $3-4\mu$ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about $3-4\mu$. Wood fibers $20-25\mu$ in diameter, length $900-1,800\mu$, wall $3-4\mu$ thick. Wood parenchyma terminal and also scattered among fibers, in the latter case sometimes 2 or more connected tangentially. Pith rays homogeneous, 1-4 cells wide, 3-20 cells high; cells with brown substance, wall of cells 2μ thick.

123. **Betula grossa** S. et Z. *Mizume.*

A deciduous tree up to 60 cm. in diameter, 20 meters in height. Growth rings indistinct to unaided eye; sap-wood white, heart-wood light rosy brown, very hard, heavy, close-grained, difficult to split; specific gravity 0.80.

Pores evenly distributed, number per square mm. 10-15, solitary or in groups, in the latter case 2 or more connected in radial direction, solitary pores are oval or elliptic in outline, their diameter radially $90-180\mu$, tangentially $80-130\mu$; length of the vessel segment $900-1,200\mu$, their perforation scalariform, cross bars 7-13. Tracheids $900-1,100\mu$ long. Wood fibers $24-28\mu$ in diameter, length $1,000-2,100\mu$, wall $3-4\mu$ thick. Wood parenchyma terminal and also scattered, in the latter case 2 or 3 cells connected tangentially. Pith rays nearly homogeneous, 1-6 fibers distant from each other, 1-4 cells wide, 2-30 cells high; cells with brown substance.

124. **Betula ulmifolia** S. et Z. *Yoguso-minebari.*

Wood quite similar to *B. grossa*.

Pores evenly distributed, number per square mm. 14-18, solitary pores are oval or elliptic in outline, their diameter radially $90-180\mu$, tangentially $60-120\mu$; length of the vessel segments $750-1,600\mu$, their perforation scalariform, cross bars 8-16. Tracheids $1,100-1,300\mu$ long. Wood fibers $20-25\mu$ in diameter, length $1,400-2,600\mu$, wall $4-6\mu$ thick. Wood parenchyma terminal and scattered. Pith rays nearly homogeneous, 1-4 cells wide, 5-25 cells high.

125. **Betula Schmidtii** REGEL *Ono-ore.*

A deciduous tree up to 70 cm. in diameter. Sap-wood yellowish white, heart-wood dark reddish brown; wood very hard, very close-grained; specific gravity 0.95.

Pores evenly distributed, number per square mm. 14–21, tyloses present; solitary sometimes connected radially, solitary pores are oval in outline, their diameter radially 70–150 μ , tangentially 60–120 μ ; length of the vessel segments 600–1,500 μ , end walls slanting, their perforation scalariform, cross bars 3–9; with very many bordered pits where the vessels are in contact with each other, the diameter of border being about 3 μ . Tracheids 750–1,200 μ long, on the inner surface of the wall with spiral thickenings. Wood fibers 14–16 μ in diameter, length 950–2,100 μ , wall 4–5 μ thick. Wood parenchyma terminal and scattered. Pith rays homogeneous, 1–4 cells wide, up to 30 cells high.

126. **Carpinus yedoensis** MAX. *Inu-shide.* Pl. VII. Fig. 41.

A deciduous tree up to 60 cm. in diameter, 13 meters in height. Growth rings sineous; without clear colour demarcation between sap and heart-wood; wood grayish or yellowish white; specific gravity 0.73.

Pores arranged radially, number per square mm. 10–25, solitary or in groups, in the latter case 2 or more connected radially, solitary pores are oval or elliptic in outline, their diameter radially 70–140 μ , tangentially 60–120 μ ; length of the vessel segments 750–1,100 μ , their perforation simple. Wood fibers 20–25 μ in diameter, length 1,200–2,400 μ , wall 2–3 μ thick. Wood parenchyma terminal, metatracheal and also scattered. Pith rays nearly homogeneous, compound rays 2–6 cells wide.

127. **Carpinus japonica** BL. *Kuma-shide.*

A deciduous tree up to 40 cm. in diameter.

Pores arranged radially, number per square mm. 20–35, mostly connected radially, solitary pores are oval or elliptic in outline, their diameter radially 65–130 μ , tangentially 50–90 μ ; length of the vessel segments 500–1,200 μ , their

perforation scalariform, cross bars 2-6. Wood fibers 14-18 μ in diameter, length 800-1,600 μ , wall 2-3 μ thick.

128. **Carpinus laxiflora** BL. *Aka-shide*.

A deciduous tree up to 40 cm. in diameter. Growth rings undulating, wood grayish white.

Pores distributed radially, number per square mm. 20-30, solitary or 2-6 connected in radial direction, solitary pores are oval or elliptic in outline, their diameter radially 60-120 μ , tangentially 50-100 μ ; length of the vessel segments 550-900 μ , their perforation scalariform, cross bars 3-7; side walls 2-3 μ , common boundary walls of two vessels 3 μ thick; on the inner surface of the wall with fine striations; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 7-8 μ . Wood fibers 14-16 μ in diameter, length 600-1,500 μ , wall 3 μ thick. Wood parenchyma terminal, metatracheal and also scattered; metatracheal bands irregularly distanced, often sineous, one sometimes two cells wide in radial direction. Pith rays heterogeneous, only marginal cells upright; in two modifications: uniseriate rays 5-20 cells high, compound rays 2-5 cells wide.

129. **Carpinus cordata** BL. *Sawa-shiba*.

A deciduous tree up to 40 cm. in diameter, 16 meters in height. Growth rings usually undulating; without clear colour demarcation between sap and heart-wood; wood grayish or yellowish white; specific gravity 0.75.

Pores distributed radially, number per square mm, 20-40; mostly in groups sometimes solitary, in the former case 2-10 connected radially; solitary pores are oval or elliptic in outline, their diameter 50-100 μ ; length of the vessel segments 400-850 μ , their perforation scalariform, cross bars 4-14; on the inner surface of the wall with fine spirals. Wood fibers 14-16 μ in diameter, length 800-1,600 μ , wall 2-3 μ thick. Wood parenchyma terminal, metatracheal and also scattered. Pith rays heterogeneous (only marginal cells upright), compound rays 2-5 cells wide.

130. *Castanea pubinervis* SCHN. *Kuri*. Pl. VII. Fig. 42.

A large deciduous tree up to 70 cm. in diameter. Sap-wood narrow, light brown, heart-wood dark brown; growth rings distinct; wood hard, elastic, easy to spilt, very durable especially under ground; specific gravity 0.59.

Ring-porous; early wood pores 1-4 rows deep, usually solitary, they are oval or elliptic in outline, their diameter radially 250-500 μ , tangentially 200-380 μ ; length of the vessel segments 400-800 μ , end walls horizontal or slightly slanting, their perforation simple; side walls 3-4 μ thick; late wood pores abruptly diminish in size, often in fan-like groups, their diameter 80-130 μ , usually plugged with dark reddish substance. Tracheids 600-1,000 μ long. Wood fibers arranged radially, 16-18 μ in diameter, filled with dark reddish substance, length 800-1,300 μ , wall 2-3 μ thick. Wood parenchyma rather scarce; metatracheal bands one cell wide, irregularly arranged, celles with dark substance. Pith rays nearly homogeneous, broad rays absent, uniseriate, 3-20 cells high, cells with dark reddish substance.

Fagus LINN.

Number of pores per square mm. 80-100	<i>F. Sieboldi</i> .
Number of pores per square mm. 140-200.. .. .	<i>F. japonica</i> .

131. *Fagus Sieboldi* ENDL. *Buna*.

A large deciduous tree up to 150 cm. in diameter, 30 meters in height.

Growth rings distinct; without clear colour demarcation between sap and heart-wood; wood light rosy when fresh, turning to reddish brown; hard and heavy, with conspicuous silver-grain on radial surface; specific gravity 0.60.

Late wood recognized by tangential flattening of the outermost rows of fibers. Pores evenly distributed but somewhat more numerous and larger in early wood and gradually diminishing in number and size in late wood; number per square mm. 80-100, solitary sometimes in groups, in the latter case 2 or more connected radially sometimes diagonally, solitary pores are oval or elliptic in outline, their diameter radially 50-100 μ , tangentially 40-70 μ ; length of the vessel segments 300-700 μ , end wall slanting, their per-

foration scalariform or simple, in the former case cross bars 10-30; side walls 2μ , common boundary walls of two vessels 2μ thick; with very many bordered pits where the vessels are in contact with each other. Tracheids 700-750 μ long. Wood fibers 12-16 μ in diameter, length 750-1,550 μ , wall 3-4 μ thick. Wood parenchyma scattered sometimes 2 or 3 connected tangentially. Pith rays heterogeneous, only marginal cells upright; broad rays fairly numerous, non-aggregate, 15-20 cells wide, 1.0-2.5 mm. in height; intermediate rays 1-6 cells wide, 10-50 (1.0 mm.) cells high.

132. **Fagus japonica** MAX. *Inu-buna*.

A small deciduous tree.

Early wood pores are larger and more numerous than those of late wood, number per square mm. 140-200; solitary sometimes grouped, oval or elliptic in outline, their diameter radially 40-80 μ , tangentially 30-60 μ , length of the vessel segments 400-650 μ , their perforation simple or scalariform. Wood fibers 12-14 μ in diameter, length 650-1,500 μ , wall $2\frac{1}{2}$ -3 μ thick. Wood parenchyma in short metatracheal bands and scattered; metatracheal bands one cell wide in radial direction. Pith rays heterogeneous, mostly of procumbent ray cells, up to 1.2 mm. high.

133. **Ostrya japonica** SARGENT. *Asada*. Pl. VIII. Fig. 43.

A large deciduous tree up to 60 cm. in diameter, 15 meters in height. Sap-wood rosy yellow, heart-wood reddish brown; close-grained, moderately hard and heavy; specific gravity 0.65.

Pores distributed radially and larger in early wood, number per square mm. 15-40; solitary or in groups, in the latter case 2-7 connected always radially, solitary pores are oval or elliptic in outline, their diameter radially 80-170 μ , tangentially 60-120 μ ; length of the vessel segments 490-1,000 μ , end walls horizontal or slanting, their perforation simple; side walls 3 μ thick; on the inner surface of the wall sometimes with spiral thickenings; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 9-11 μ . Tracheids 700-1,100 μ long. Wood fibers 20-25 μ in diameter, length

950-2,100 μ , wall 4 μ in early wood, in late wood 4-5 μ thick. Wood parenchyma metatracheal and scattered among fibers; metatracheal bands more numerous in late wood, irregularly arranged, one cell wide in radial direction. Pith rays homogeneous; 1-4 fibers distant from each other, 1-3 cells wide, 10-60 cells high, often two or more rays connecting vertically.

134. **Pasania cuspidata** OERST. *Shii-no-ki*.

A large ever-green tree up to 150 cm. in diameter. Mostly without heart-wood; wood light yellowish or whitish, moderately hard and heavy, coarse-grained, liable to decay; specific gravity 0.52.

Pores in irregular radial rows; early wood pores are large and gradually diminishing in size through the intermediate to the late wood, usually solitary, their diameter radially 200-300 μ , tangentially 180-270 μ ; late wood pores are solitary or connected radially, reaching up to the peripheries of growth rings; length of the vessel segments 400-800 μ , end walls horizontal or slanting, their perforation simple rarely scalariform, their cross bars then 3 or 4. Wood fibers 20-25 μ in diameter, length 800-1,500 μ , wall 3-4 μ thick. Wood parenchyma metatracheal and scattered; metatracheal bands one cell wide, irregularly distributed; chambered parenchym cells present, with crystals of calcium oxalate. Pith rays homogeneous, uniseriate; broad rays usually absent sometimes present, if present irregularly distributed.

135. **Quercus gilva** BL. *Ichii-gashi*.

A large ever-green tree up to 150 cm. in diameter, 30 meters in height. Sap-wood usually merging into darker heart-wood; heart-wood dark reddish brown; straight-grained, strong, elastic, easy to split; specific gravity 0.86.

Growth rings defined by terminal parenchyma. Pores distributed radially, number per square mm. 4-8, mostly solitary, oval, round or elliptic in outline, their diameter 100-200 μ ; length of the vessel segments 650-850 μ , end walls horizontal or slanting, their perforation simple; side walls 4-6 μ thick. Tracheids present mostly near vessels; with many bordered pits with slit-like aperture where they are in contact with each other, the diameter of border being 7-8 μ . Wood fibers 12-15 μ in diameter, length 1,000-2,000 μ , wall

3-4 μ thick. Wood parenchyma metatracheal also terminal and scattered; metatracheal bands 3-30 fibers distant from each other, 1-3 cells wide in radial direction. Pith rays homogeneous, in two modifications: uniseriate rays present in great number, 1-3 fibers distant from each other, 1-23 cells high; polyseriate or large rays up to 20 cells wide, height variable, often transversed by fibers; ray cells with brown substance.

136. **Quercus serrata** THUNB. *Kanugi.*

A deciduous tree up to 60 cm. in diameter, 15 meters in height. Sap-wood grayish white, heart-wood dark brown; easy to split, the best timber for fire-wood; specific gravity: 0.90.

Ring-porous; early wood pores 1 or 2 rows deep, usually solitary, oval or elliptic in outline, their diameter radially 250-450 μ , tangentially 200-350 μ ; late wood pores abruptly diminish in size, arranged more or less radially, number per square mm. 6-8, tyloses present, their radial diameter 100-180 μ ; side walls 5-7 μ thick. Wood fibers with small cavities, 4-to 6-sided in cross section, 14-16 μ in diameter, length 900-2,000 μ , wall 4-5 μ thick. Wood parenchyma metatracheal and scattered; metatracheal bands 1-3 cells wide, irregularly arranged in tangential sometimes somewhat diagonal direction. Large pith rays up to 25 cells wide.

137. **Quercus variabilis** BL. *Abe-maki.*

A deciduous tree up to 60 cm. in diameter. Sap-wood grayish white, heart-wood reddish brown; specific gravity 0.98.

Ring-porous; early wood pores 1, sometimes 2 or 3 rows deep, tyloses present, solitary, round to oval in outline, their diameter 200-300 μ ; late wood pores gradually diminish in size, arranged in radial rows, number per square mm. 6 or 7. Wood fibers 12-14 μ in diameter, length 850-1,900 μ , wall 4 μ thick. Metatracheal parenchyma 1-4 cells wide. Large pith rays up to 30 cells wide, large cells often with crystals of calcium oxalate.

138. **Quercus crispula** BL. *Mizu-nara.*

A large deciduous tree up to 150 cm. in diameter. Sap-wood wide, light

yellowish brown, heart-wood dark brown; hard and heavy; wood contains an exceptional amount of water in fresh state and is difficult of combustion; specific gravity 0.85.

Ring-porous; early wood pores usually one sometimes two rows deep, oval or round in outline, their diameter 200–350 μ ; late wood pores abruptly diminish in size, usually arranged in flame-like groups; length of the vessel segments 350–600 μ . Wood fibers 14–16 μ in diameter, length 800–1,500 μ , wall 3–4 μ thick. Fiber-tracheids present. Wood parenchyma metatracheal, in regular tangential lines, 1–4, mostly 2 or 3 cells wide in radial direction. Pith rays homogeneous; primary rays up to 20 cells wide.

139. **Quercus dentata** THUNB. *Kashiwa*.

A large deciduous tree up to 70 cm. in diameter. Sap-wood wide, yellowish brown, heart-wood dark reddish brown; specific gravity 0.98.

Ring-porous; early wood pores 2 or 3 rows deep, tyloses present, oval or elliptic in outline, their diameter radially 200–450 μ , tangentially 200–350 μ ; late wood pores abruptly diminish in size, usually arranged in flame-like groups; length of the vessel segments 350–550 μ . Wood fibers with small cavities, 14–16 μ in diameter, length 850–1,400 μ , wall 4–5 μ thick. Metatracheal parenchyma usually one cell wide, rather irregularly arranged. Pith rays homogeneous, primary rays up to 40 cells wide.

140. **Quercus glauca** THUNB. *Ara-kashi*. Pl. VIII. Fig. 44.

An evergreen tree up to 60 cm. in diameter. Sap-wood light brown, heart-wood dark brown; wood strong and tough; specific gravity 0.96.

Pores scattered radially sometimes diagonally, number per square mm. 6–12, round in outline, their diameter 100–150 μ , length of the vessel segments 350–600 μ , side walls 5–8 μ thick. Wood fibers 12–15 μ in diameter, length 800–1,600 μ , wall 3–4 μ thick. Metatracheal parenchyma in regular tangential lines, rather conspicuous in cross section, 3–8 fibers distant from each other, 1–3 cells wide in radial direction, diameter of cells 15–25 μ ; chambered parenchyma cells present in great number, always with crystals of calcium oxalate. Large pith rays up to 50 cells wide (0.8 mm.).

141. **Quercus stenophylla** MAKINO *Urajiro-gashi.*

An ever-green tree up to 30 cm. in diameter, 10 meters in height. Without clear colour demarcation between sap and heart-wood; wood grayish white; specific gravity 0.84.

Pores scattered radially, number per square mm. 5-7, round to oval in outline, their diameter radially 100-150 μ , tangentially 90-120 μ , length of the vessel segments 250-500 μ , side walls 5-7 μ thick. Wood fibers 15-18 μ in diameter, length 800-1,400 μ , wall 3 μ thick. Metatracheal parenchyma rather irregularly arranged in wavy tangential bands; chambered parenchyma cells present in fairly great number, with crystals of calcium oxalate. Large pith rays up to 25 cells wide; cells with brown substance.

142. **Quercus aliena** BL. *Ô-nara.* Pl. VIII. Fig. 45.

A deciduous tree up to 60 cm. in diameter. Sap-wood light reddish; heart-wood dark brown; specific gravity 0.85.

Ring-porous; early wood pores 1 sometimes 2 rows deep, round to oval in outline, their diameter 250-400 μ ; late wood pores abruptly diminish in size, arranged in irregular radial bands or flame-like groups, surrounded by tracheids. Wood fibers 14-16 μ in diameter, length 800-1,500 μ , wall 3 μ thick. Metatracheal parenchyma in irregular tangential lines, 1-3 cells wide in radial direction, often discontinuous. Large pith rays up to 35 cells wide, cells with brown substance.

143. **Quercus glandulifera** BL. *Ko-nara.*

A deciduous tree up to 60 cm. in diameter. Sap-wood grayish white, heart-wood dark grayish brown; specific gravity 0.92.

Ring-porous; early wood pores 1 sometimes 2 or 3 rows deep, round to oval in outline, their diameter 150-250 μ ; late wood pores rather abruptly diminish in size, scattered in broad radial rows. Wood fibers 14-16 μ in diameter, length 650-1,150 μ , wall 2½-3 μ thick. Wood parenchyma metatracheal and scattered; metatracheal bands 1-3 cells wide, arranged in wavy

146. **Populus Sieboldii** MIQ. *Yamanarashi*. Pl. VIII. Fig. 46.

A large deciduous tree up to 70 cm. in diameter, 16 meters in height; grows rapidly. Without heart-wood, wood white, close-grained, light and soft; specific gravity 0.48.

Pores evenly distributed but somewhat diagonally, number per square mm. 30-50, solitary or in groups, in the latter case 2-4 connected mostly in radial direction; solitary pores are oval or elliptic in outline, their diameter radially 60-100 μ , tangentially 50-80 μ ; length of the vessel segments 450-850 μ , end walls horizontal or slanting, their perforation simple; side walls 2 μ , common boundary walls of two vessels 2-3 μ thick; on the inner surface of the wall with striations; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8-10 μ . Wood fibers 22-26 μ in diameter, length 850-1,700 μ , wall 2-3 μ thick. Wood parenchyma terminal and scattered. Pith rays homogeneous, uniseriate, 5-25 cells high.

147. **Populus Maximowiczii** HENRY *Doro-yanagi*.

A large deciduous tree.

Pores evenly distributed but somewhat diagonally or radially, number per square mm. 50-80, solitary or in groups, in the latter case 2 or more connected radially or diagonally; solitary pores are oval or elliptic in outline, their diameter 50-100 μ , length of the vessel segments 350-650 μ ; on the inner surface of the wall with striations. Wood fibers 22-28 μ in diameter, length 650-1,400 μ , wall 2-3 μ thick. Pith rays homogeneous, uniseriate, 5-20 cells high.

148. **Salix Caprea** LINN. *Saru-yanagi*.

A deciduous tree up to 60 cm. in diameter, 16 meters in height. Sap-wood white, heart-wood light yellowish brown; growth rings fairly distinct; wood light and soft, it takes a fine luster when polished; specific gravity 0.45.

Growth rings defined by terminal parenchyma cells. Pores evenly distributed, more or less in diagonal direction, number per square mm. 65-75, solitary or in groups, in the latter case 2 or more connected mostly in radial direction; solitary pores are polygonal in outline, evenly sized, their diameter 60-100 μ ; length of the vessel segments 320-500 μ , end walls slanting, their perforation simple; side walls 1-2 μ , common boundary walls of two vessels 2-2½ μ thick; with very many bordered pits where the vessels are in contact with each other, the bordered pits being arranged like the cells of a honey comb with a diameter of about 8-9 μ . Wood fibers 20-25 μ in diameter, length 500-1,000 μ , wall 1½-2 μ thick. Wood parenchyma terminal and also scattered among fibers. Pith rays heterogeneous, 1-3 fibers distant from each other, uniseriate, 3-15 cells wide.

149. **Salix Urbaniana** SEEM. *Aka-yanagi*.

A large deciduous tree up to 70 cm. in diameter, 20 meters in height. Sap-wood yellowish white, heart-wood reddish brown; wood light and soft; specific gravity 0.45.

Pores evenly distributed, number per square mm. 50-70, solitary pores are oval or elliptic in outline, their diameter 50-90 μ , length of the vessel segments 300-700 μ . Wood fibers sometimes septate, 16-20 μ in diameter, length 600-1,300 μ , wall 2-3 μ thick. Pith rays heterogeneous, uniseriate, 3-25 cells high.

150. **Salix babylonica** LINN. *Shidare-yanagi*.

A deciduous tree.

Pores distributed more or less diagonally, number per square mm. 60-80, mostly solitary, elliptic in outline, their diameter radially 80-120 μ , tangentially 50-80 μ ; length of the vessel segments 300-550 μ . Wood fibers 20-25 μ in diameter, length 900-1,500 μ , wall 3-4 μ thick. Pith rays heterogeneous, uniseriate, up to 18 cells high.

Coniferæ.

Resin ducts vertical and horizontal present; ray tracheids present(1)

- Resin ducts normally absent; may be present as a result of injury in which case they are arranged in a compact peripheral row; ray tracheids absent sometimes present. (2)
- (1) { Resin ducts plainly visible to the unaided eye, numerous, tyloses present, epithelium thin-walled; ray cells with large simple pits (3)
 Resin ducts mostly small, inconspicuous, not numerous, chiefly without tyloses, epithelium thick-walled; ray cells with small semi-bordered pits (4)
- (3) { Upper and lower walls of ray tracheids uniformly thickened or smooth; pits present in tangential wall of late wood tracheids.
 Five-leaved pine (*Pinus*).
 Upper and lower walls of ray tracheids irregularly thickened, dentate to reticulate; pits rarely present in tangential wall of late wood tracheids
 Two-leaved pine (*Pinus*).
- (4) { Tracheids normally with spirals *Pseudotsuga*.
 Tracheids normally without spirals. (5)
- (5) { Sap-wood sharply defined from heart-wood; wood contains flavone *Larix*.
 Without clear colour demarcation between sap and heart-wood; wood does not contain flavone. *Picea*.
- (2) { Ray tracheids present. *Tsuga*.
 Ray tracheids normally absent. (6)
- (6) { Wood consists only of tracheids (7)
 Wood consists of tracheids and wood parenchyma (8)
- (7) { With schizogenous sacks with crystals of calcium oxalate *Ginkgo*.
 Without schizogenous sacks (9)
- (9) { Tracheids with spirals *Torreya, Taxus*.
 Tracheids without spirals (10)
- (10) { Ray cells with large simple pits *Sciadopitys*.
 Ray cells with small pits; sometimes traumatic resin ducts present *Abies*.
- (8) { Tracheids with spirals *Cephalotaxus*.
 Tracheids without spirals (11)
- (11) { Tangential wall of ray cells strongly pitted. *Juniperus*.
 Tangential wall of ray cells thin and entire, sometimes locally thickened (12)
- (12) { Decided contrast between seasonal growths; transition of early and late wood abrupt (13)
 Moderate contrast between seasonal growths; transition of early and late wood chiefly gradual (14)
- (13) { Tangential section of ray cells narrowly oblong *Thuja*.
 Tangential section of ray cells round or more or less oblong *Cryptomeria*.
- (14) { Resin cells numerous and scattered. *Podocarpus*.
 Resin cells not numerous, often zonate *Chamaecyparis, Thujaopsis*.

151. **Abies firma** S. et Z. *Momi*.

A large tree up to 150 cm. in diameter. Without clear colour demarcation between sap and heart-wood; wood whitish or light yellowish brown; growth rings usually broad; late wood rather sharply defined from early wood; straight-grained, soft; specific gravity 0.39.

Resin ducts normally absent sometimes present in consequence of an injury. Resin cells normally absent. Radial diameter of early wood tracheids 48–55 μ , tangential diameter 45–55 μ ; radial diameter of late wood wood tracheids 16–40 μ , tangential diameter 30–45 μ ; length 3,200–6,000 μ ; wall 2–3 μ in early wood, in late wood 4–6 μ thick. Radial bordered pits usually in one row. Pith rays uniseriate, 1–25, mostly 3–12 cells high; marginal ray tracheids absent; ray parenchyma cells in early wood with 1–4 round pits in each cross-field, with 1 oval pit in late wood.

152. **Abies homolepis** S. et Z. *Nikkō-momi*.

A large tree up to 120 cm. in diameter.

Length of tracheids 2,200–5,000 μ , wall 2 μ in early wood, in late wood 4–5 μ thick. Pith rays uniseriate rarely biseriate, 3–30 cells high.

153. **Abies sachaliensis** MAST. *Todo-matsu*.

A large tree up to 100 cm. in diameter.

Length of tracheids 1,800–3,500 μ , wall 2–3 μ in early wood, in late wood 4–6 μ thick. Pith rays 2–26 cells high.

154. **Abies umbilicata** MAYR. *Heso-momi*.

A large tree up to 120 cm. in diameter.

Length of tracheids 1,800–3,550 μ , wall 2–3 μ in early wood, in late wood 4–6 μ thick.

155. **Abies Veitchii** LINDL. *Shirabe*.

A tree up to 60 cm. in diameter.

Length of tracheids 2,000–3,000 μ , wall 2 μ in early wood, in late wood 3–5 μ thick.

156. **Cephalotaxus drupacea** S. et Z. *Imi-gaya*.

A small tree. Without clear colour demarcation between sap and heart-wood; wood light yellowish brown.

Wood parenchyma present. Radial diameter of early wood tracheids 15–30 μ , tangential diameter 20–30 μ ; length 1,500–3,000 μ ; wall 2–3 μ in early wood, in late wood 3–4 μ thick; the inner surface of the wall of tracheids with spiral thickenings. Radial bordered pits of early wood tracheids mostly in one row, with lenticular aperture. Pith rays uniseriate, 1–8, mostly 2–5 cells high; ray parenchyma cells in early wood with 2 or 3 semi-bordered pits in each cross-field, in late wood with 1.

157. **Chamæcyparis obtusa** S. et Z. *Hinoki*. Pl. VIII. Fig. 47.

A large tree. Heart-wood sometimes clearly marked off from sap-wood, sometimes gradually merging into the latter; sap-wood yellowish white, heart-wood rosy yellow; wood odorous, close-grained, easy to split, durable; specific gravity 0.39.

Resin cells evenly distributed but more numerous in late wood, often zonate. Radial diameter of early wood tracheids 35–50 μ , tangential diameter 30–35 μ ; radial diameter of late wood tracheids 10–25 μ , tangential diameter 30–35 μ ; length 2,500–3,200 μ ; wall 2 μ in early wood, in late wood 3–4 μ thick. Radial bordered pits mostly in one row; small tangential bordered pits present in late wood. Pith rays uniseriate, 1–14 cells high; horizontal wall almost smooth, tangential wall thin and straight; ray parenchyma cells in early wood with 2–4 oval semi-bordered pits with elliptic aperture in each cross-field, with 1 narrowly elliptic pit in late wood.

158. **Chamæcyparis pisifera** S. et Z. *Sawara*. Pl. VIII. Fig. 48.

A large tree. Sap-wood yellowish white, heart-wood yellowish; wood light and soft, easy to work, but rather brittle; specific gravity 0.31.

Resin cells zonately arranged in late wood. Early wood tracheids rather sharply defined from late wood; radial diameter of early wood tracheids 30–45 μ , tangential diameter 30–40 μ ; radial diameter of late wood tracheids 10–25 μ , tangential diameter 30–35 μ ; length 1,400–2,800 μ ; wall 1–2 μ in early wood, in late wood 3–4 μ thick. Radial bordered pits mostly in one row. Pith rays 1–13 cells high.

159. **Cryptomeria japonica** DON. *Sugi*. Pl. IX. Fig. 49.

A large tree up to 200 cm. in diameter. With clear colour demarcation between sap and heart-wood; sap-wood rather broad, white; heart-wood variable in colour, reddish brown to dark brown; wood light and soft, texture rather coarse, straight-grained, easy to split and has special odour; specific gravity 0.37.

Resin cells present, usually scattered in late wood often in tangential lines. Late wood tracheids rather sharply marked off from early wood. Radial diameter of early wood tracheids 30–50 μ , tangential diameter 30–48 μ ; radial diameter of late wood tracheids 15–30 μ , tangential diameter 25–40 μ ; length 2,900–4,500 μ ; wall of tracheids in early wood 2–3 μ , in late wood 4–7 μ thick. Radial-bordered pits usually in one row; bars of SANIO fairly distinct. Pith rays uniseriate, 2–15 cells high; ray parenchyma cells in early wood with 2 sometimes 3 semi-bordered pits with elliptic or oval and almost horizontally lying aperture in each cross-field with 1 (or 2 in marginal cells) pit with narrowly elliptic and almost vertical aperture in late wood.

160. **Ginkgo biloba** LINN. *Ichō*. Pl. IX. Fig. 50.

A large tree up to 240 cm. in diameter. Heart-wood hardly distinguished from sap-wood; transition from early wood to late wood gradual; wood yellowish white, soft, fairly close-grained; wood characterized by scattered small coloured spots in cross section; specific gravity 0.45.

The structure of wood is clearly archaic, as there are no parenchymatous element present other than those related to the rays. The thickness of wall of tracheids rather uniform in early and late wood, the latter defined by radially flattened cavities. Radial diameter of tracheids 25–70 μ , tangential diameter 50–65 μ , length 3,200–5,500 μ , wall of tracheids 3–5 μ in early wood, in late wood 4–5 μ thick. Terminal tangential pittings present. Radial bordered pits are round, opposite, usually in pairs, sometimes in one or three rows; transverse bars of pectic cellulose or the bars of SANIO present. The striking feature is the presence of schizogenous sacks with crystals of calcium oxalate; they are scattered in fairly great number. Pith rays uniseriate, 1–

15 cells high; ray parenchyma cells in early wood with 2-5 elliptic and slanting semi-bordered pits in each cross-field, in late wood with 1 or 2 linear and slanting pits.

161. **Juniperus chinensis** LINN. *Byakushin*.

A tree up to 60 cm. in diameter. Sap-wood yellowish white, heart-wood reddish brown; growth rings narrow, undulating, late wood sharply defined from early wood; strongly odorous, hard, heavy, close-grained, lustrous when planed; with specific gravity 0.73.

Resin cells arranged zonately; cross walls with sieve-like pits. Radial diameter of early wood tracheids 20-32 μ , tangential diameter 20-32 μ ; radial diameter of late wood tracheids 8-20 μ , tangential diameter 15-25 μ ; length 1,000-2,300 μ ; wall 2-3 μ in early wood, in late wood 3-4 μ thick. Radial bordered pits mostly in one row. Pith rays uniseriate, 1-9 cells high tangential and horizontal walls of ray cells thickened; ray parenchyma cells in early wood with 2 or 3 sometimes 4 elliptic semi-bordered pits in each cross-field, with 1 linear and slanting pit in late wood.

162. **Larix leptolepis** GORD. *Kara-matsu*.

A deciduous tree up to 70 cm. in diameter. With clear colour demarcation between sap and heart-wood; sap-wood narrow, yellowish white, heart-wood rosy red brown; late wood sharply defined from early wood; wood hard, easily split, liable to warp, durable in water; specific gravity 0.52. Heart-wood characterized by containing flavone.

Horizontal and vertical resin ducts present, the former inconspicuous, epithelium thick-walled, chiefly without tyloses. Resin cells usually absent.¹⁾ Late wood sharply defined by early wood; radial diameter of early wood tracheids 40-65 μ , tangential diameter 40-60 μ ; radial diameter of late wood tracheids 15-40 μ , tangential diameter 30-40 μ ; length 2,100-3,900 μ ; wall 2-4 μ in early wood, in late wood 5-8 μ thick; spirals sometimes may occur in the wall of early wood tracheids. Radial bordered pits in one or two rows,

1) According to S. J. RECORD, resin cells rare and terminal; *Economic woods of U. S.* (2nd. ed.) p. 78.

in the latter case opposite; bars of SANIO very evident. Pith rays 1-24 cells high; ray parenchyma cells in early wood with 3-6 elliptic semi-bordered pits in each cross-field, in late wood with 1 or 2 pits.

163. **Larix kurilensis** MAYR. *Shikotan-matsu.*

A medium-sized deciduous tree up to 70 cm. in diameter. Sap-wood yellowish, heart-wood yellowish brown; moderately hard; specific gravity 0.55; flavone reaction very distinct in most cases.

Resin ducts rather large. Radial diameter of early wood tracheids 45-70 μ , tangential diameter 45-60 μ ; radial diameter of late wood tracheids 20-40 μ , tangential diameter 40-50 μ ; length 2,300-5,000 μ ; wall 3-5 μ in early wood, in late wood 5-9 μ thick. Radial bordered pits in one or two rows; bars of SANIO evident. Pith rays 1-17 cells high.

164. **Picea hondoensis** MAYR. *Tôhi.*

A tree up to 70 cm. in diameter. Without clear demarcation in colour between sap and heart-wood; sap-wood white, heart-wood light rosy; wood light and soft, fairly close-grained, elastic; specific gravity 0.40.

Vertical and horizontal resin ducts present, the former rather irregularly scattered or grouped, tyloses often present, epithelium thick-walled. Resin cells normally absent. Radial diameter of early wood tracheids 40-56 μ , tangential diameter 38-52 μ ; radial diameter of late wood tracheids 12-40 μ , tangential diameter 30-45 μ ; length 2,100-4,900 μ ; wall 2-3 μ in early wood, in late wood 3-5 μ thick. Radial bordered pits mostly in one row; bars of SANIO evident. Pith rays with small marginal ray tracheids, 2-26, mostly 5-18 cells high; ray parenchyma cells in early wood with 2-5 pits in each cross-field, with one or none in late wood.

165. **Picea bicolor** MAYR. *Iramomi.*

A tree up to 100 cm. in diameter. Wood yellowish white, fairly hard; specific gravity 0.55.

Radial diameter of early wood tracheids 32-50 μ , tangential diameter

32–50 μ ; radial diameter of late wood tracheids 15–40 μ , tangential diameter 30–40 μ ; length 3,200–5,000 μ ; wall 2–4 μ in early wood, in late wood 5–7 μ thick. Pith rays 2–15 cells high; cells with crystals of calcium oxalate.

166. **Picea ajanensis** FISCH. *Ezo-matsu.*

Radial diameter of early wood tracheids 40–55 μ , tangential diameter 40–50 μ ; radial diameter of late wood tracheids 10–40 μ , tangential diameter 30–40 μ ; length 2,500–4,700 μ ; wall 2 μ in early wood, in late wood, 3–5 μ thick. Pith rays 2–21 cells high.

167. **Pinus parviflora** S. et Z. *Hime-komatsu.*

A tree up to 100 cm. in diameter.

Sap-wood whitish, heart-wood yellowish red or brown; growth rings narrow; wood has peculiar odour, very close-grained; specific gravity 0.60.

Horizontal and vertical resin ducts present, the latter evenly distributed. Diameter of early wood tracheids 40–50 μ ; radial diameter of late wood tracheids 10–32 μ , tangential diameter 28–40 μ ; length 3,500–5,200 μ ; wall 2–3 μ in early wood, in late wood 3–5 μ thick. Radial bordered pits in one or two rows, bars of SANIO fairly distinct; small tangential bordered pits present in late wood. Pith rays 1–20 cells high; upper and lower walls of small ray tracheids smooth, with small bordered pits; ray parenchyma cells communicating with the adjacent wood tracheid by 1 or 2 large simple pits in each cross-field.

168. **Pinus pumila** PALL. *Hai-matsu.*

A small dwarf tree up to 20 cm. in diameter. Growth rings narrow, wood close-grained.

Length of tracheids 1,000–1,800 μ ; wall 3 μ in early wood, in late wood 3–4 μ thick. The wall of early wood tracheids with sporadic spiral thickenings. Pith rays 1–6, mostly 1–4 cells high.

169. **Pinus koraiensis** S. et Z. *Chōsen-matsu.*

A tree up to 100 cm. in diameter. Wood rather coarse-grained, light and soft, easy to work; specific gravity 0.46.

Length of tracheids 2,100–4,900 μ , wall $1\frac{1}{2}$ –3 μ in early wood, in late wood 3–5 μ thick.

170. **Pinus densiflora** S. et Z. *Aka-matsu.*

A tree up to 150 cm. in diameter. Sap-wood yellowish white, heart-wood yellowish brown; wood elastic, very durable especially under ground; specific gravity 0.42.

Horizontal and vertical resin ducts present, the latter evenly distributed in late and early wood, epithelium thin-walled, their outside often covered with septate tracheids. Resin cells absent. Radial diameter of early wood tracheids 50–60 μ , tangential diameter 48–56 μ ; radial diameter of late wood tracheids 15–48 μ , tangential diameter 40–50 μ ; length 2,500–5,000 μ ; wall $2\frac{1}{2}$ –3 μ in early wood, in late wood 3–8 μ thick; the wall of late wood tracheids sometimes with sporadic spirals, their angle with the axis very small. Radial bordered pits in one, sometimes two rows; tangential bordered pits absent. Pith rays 1–10 cells high; upper and lower walls of small ray tracheids dentate or reticulate; ray parenchyma cells communicating with the adjacent wood tracheid by 1 or 2 large simple pits in each cross-field.

171. **Pinus Thunbergii** PARL. *Kuro-matsu.*

A tree up to 70 cm. in diameter. Sap-wood light yellowish white, heart-wood reddish brown; wood hard, heavy, elastic and fairly durable under ground: specific gravity 0.68. Length of tracheids 1,100–3,900 μ , wall 2–3 μ in early wood, in late wood 4–8 μ thick.

Podocarpus L'HÉRIT.

Wood lustrous; tracheids 2,400–4,000 μ long; contrast between early and late wood fairly distinct *P. macrophylla.*

Wood without luster; tracheids 1,900-2,900 μ long; contrast between early and late wood not sharp *P. Nageia*

172. **Podocarpus macrophylla** DON. *Maki*. Pl. IX. Fig. 51.

A tree up to 60 cm. in diameter. Sap-wood white, not sharply distinguished from heart-wood, heart-wood reddish brown; wood has pronounced agreeable odour; hard, close-grained; lustrous when planed, very durable above and under ground; specific gravity 0.73.

Resin cells scattered in fairly great number. Radial diameter of early wood tracheids 30-40 μ , tangential diameter 30-40 μ ; radial diameter of late wood tracheids 15-30 μ , tangential diameter 20-32 μ ; length 2,400-4,000 μ ; wall 3-4 μ in early wood, in late wood 4-5 μ thick. Tangential bordered pits of late wood tracheids small and scarce, their diameter 14 μ ; radial bordered pits mostly in one row. Pith rays uniseriate, up to 22 cells high; ray parenchyma cells in early wood with 1 or 2 elliptic and slanting semi-bordered pits in each cross-field, in late wood with 1 narrowly elliptic and slanting pit.

173. **Podocarpus Nageia** R. BR. *Nagi*. Fig. 52.

Without clear colour demarcation between sap and heart-wood; wood hard, fairly close-grained.

Resin cells scattered. Radial diameter of early wood tracheids 20-40 μ , tangential diameter 25-40 μ , radial diameter in late wood 15-25 μ , tangential diameter 20-30 μ ; tracheids 1,900-2,900 μ long, wall 3-5½ μ thick. Pith rays uniseriate, 1-25 cells high.

174. **Pseudotsuga japonica** SARGENT *Togawara*. Pl. IX. Fig. 53.

A large tree up to 100 cm. in diameter. Sap-wood yellowish white, heart-wood light reddish brown; wood rather soft and coarse-grained; specific gravity 0.45; wood is very remarkable for its high content of flavone.

Horizontal and vertical resin ducts present. Resin cells present but very scarce, usually near the outer limit of the late wood. Radial diameter of early wood tracheids 40-60 μ , tangential diameter 50-65 μ ; radial diameter of

late wood tracheids $18-40\mu$, tangential diameter $48-60\mu$; length $1,700-4,000\mu$; wall 2μ in early wood, in late wood $3-7\mu$ thick; on the inner surface of the wall of early wood tracheids with spirals. Radial bordered pits in one or two rows, in the latter case in pairs. Pith ray 1-18 cells high; marginal ray tracheids present, with spirals; ray parenchyma cells in early wood with 2-5 elliptic or oval pits in each cross-field, with 1 or 0 in late wood.

175. **Sciadopitys verticillata** S. et Z. *Kōya-maki*. Pl. IX. Fig. 54.

A tree up to 100 cm. in diameter. Sap-wood narrow, whitish, heart-wood light yellowish; growth rings narrow, sometimes undulating; wood has characteristic smell; grain straight, texture fine, easy to split; very durable in water; specific gravity 0.44.

Without resin cells. Transition of early wood to late wood abrupt. Radial diameter of early wood tracheids $30-50\mu$, tangential diameter $30-50\mu$, radial diameter in late wood $15-35\mu$, tangential diameter $30-40\mu$; length $1,700-4,000\mu$; wall 3μ in early wood, in late wood $5-6\mu$ thick. Tangential bordered pits present in late wood, aperture slit-like and almost vertical; radial bordered pits usually in one row, bars of SANIO fairly distinct. Pith rays uniseriate, 1-10, mostly 2-5 cells high; cell walls thin and smooth. The ray pits on the radial wall are very characteristic: in the late wood with one narrowly elliptic to linear pit in each cross-field, while that of the early wood show one (sometimes two in marginal cells) large simple pit like those of *Pinus*.

176. **Taxus cuspidata** S. et Z. *Araragi*.

A small tree up to 30 cm. in diameter. With clear colour demarcation between sap and heart-wood; sap-wood narrow, yellowish white, heart-wood dark reddish; growth rings narrow; wood fairly hard, texture very fine, elastic, not liable to warp and very durable; specific gravity 0.46.

Resin ducts and resin cells absent. Radial diameter of early wood tracheids $30-40\mu$, tangential diameter $30-38\mu$; radial diameter of late wood tracheids $15-30\mu$, tangential diameter $30-35\mu$; length $1,600-2,800\mu$; wall 3μ in early wood, in late wood $4-5\mu$ thick; on the inner surface of the

wall with spiral thickenings. Tangential bordered pits small and scarce; radial bordered pits usually in one row, in late wood small and scarce, aperture elliptic. Pith rays uniseriate, 1-14 cells high; ray parenchyma cells in early wood with two or three round semi-bordered pits in each cross-field, in late wood with one or two semi-bordered pits with linear aperture.¹⁾

177. **Thuja Standishii** Carr. *Nezuko.*

A medium-sized tree up to 60 cm. in diameter. With clear colour demarcation between sap and heart-wood; sap-wood narrow, white, heart-wood light brown to yellowish brown; texture fine, light and soft; specific gravity 0.42.

Resin cells present, but very scarce, mostly scattered in late wood. Radial diameter of early wood tracheids 28-40 μ , tangential diameter 30-35 μ ; radial diameter of late wood tracheids 15-30 μ , tangential diameter 25-32 μ ; length 2,000-3,100 μ ; wall 1-2 μ in early wood, in late wood 2-5 μ thick. Radial bordered pits usually in one, sometimes two rows. Pith rays uniseriate, 1-15 cells high; tangential walls thin and smooth, horizontal walls occasionally thickened; on the corner where the horizontal and tangential walls meet, a small gutter-like channel present; ray parenchyma cells in early wood with 1-6 pits in each cross-field, in late wood with 1 or 2 pits.

178. **Thujopsis dolabrata** S. et Z. *Hiba.*

A tree up to 100 cm. in diameter. Heart-wood not sharply marked off from sap-wood; sap-wood light yellowish white, heart-wood dark yellowish; wood close-grained, soft, durable under ground; with characteristic odour when fresh; specific gravity 0.49.

Resin cells present, mostly in late wood, more or less in tangential lines. Radial diameter of early wood tracheids 25-40 μ , tangential diameter 30-40 μ ; radial diameter of late wood tracheids 12-25 μ , tangential diameter 30-40 μ , length 2,000-3,500 μ ; wall 2-3 μ in early wood, in late wood 3-4 μ thick. Radial bordered pits usually in one row. Pith rays uniseriate, 1-12, mostly 3-7

1) It is rather impossible to find out the microscopical difference between two species of *Taxus* and *Torreya*.

cells high; tangential wall of ray cells thin and smooth, while horizontal wall more or less thickened and not entirely smooth; ray parenchyma cells in early wood with 2 or 3 semi-bordered pits with narrowly elliptic and almost vertical aperture in each cross-field, with 1 or 2 linear pits in late wood.

179. **Torreya nucifera** S. et Z. *Kaya*.

A tree up to 100 cm. in diameter. Sap-wood fairly broad, light yellowish white, merging gradually into heart-wood, heart-wood yellowish; growth rings somewhat undulating; wood has characteristic smell; hard, close-grained, elastic, easy to split, very durable in water; specific gravity 0.59.

Resin cells absent. Radial diameter of early wood tracheids 30–50 μ , tangential diameter 30–48 μ ; radial diameter of late wood tracheids 16–30 μ , tangential diameter 30–40 μ ; length 2,300–5,000 μ ; wall 3 μ in early wood, in late wood 3–5 μ thick; on the inner surface of the wall with spiral thickenings, spirals 1–3, mostly 2. Radial bordered pits mostly scattered in one row, diameter of border being about 16–18 μ . Pith rays uniseriate, 1–20 cells high; tangential wall of cells very thin and smooth, horizontal wall fairly thin but rarely thickened; ray parenchyma cells in early wood with 1–4 pits in each cross-field, in late wood with 1 or 2 pits.

180. **Tsuga Sieboldii** CARR. *Tsuga*.

A large tree up to 100 cm. in diameter. Without clear colour demarcation between sap and heart-wood; wood light yellowish brown; fairly hard, liable to decay above ground; specific gravity 0.53.

Resin ducts normally absent sometimes present; if present vertical ducts arranged in a compact tangential row. Resin cells rather scarce, mostly near the outer limit of late wood. Radial diameter of early wood tracheids 40–55 μ , tangential diameter 40–50 μ ; radial diameter of late wood tracheids 15–45 μ , tangential diameter 35–42 μ ; length 2,600–4,000 μ ; wall 2 μ in early wood, in late wood 3–6 μ thick. Radial bordered pits in one or two rows in early wood, in late wood in one row. Pith rays with small marginal ray tracheids, 2–20 cells high; ray parenchyma cells in early wood with 2–4 pits in each cross-field, in late wood with 1.

181. ***Tsuga diversifolia*** MASTERS *Kome-tsuga*.

Radial diameter of early wood tracheids $45-50\mu$, tangential diameter $40-45\mu$; radial diameter of late wood tracheids $12-40\mu$, tangential diameter $25-40\mu$; length $1,550-3,000\mu$; wall 2μ in early wood, in late wood $3-5\mu$ thick. Pith rays 1-15 cells high.