

WOOD STRUCTURE OF HIMALAYAN PLANTS, IV

Shuichi NOSHIRO, Akira TAKAHASHI, Chika MOURI, and Mitsuo SUZUKI

This is the fourth report on the wood structure of Nepal Himalayan woody plants. The first part of this series was published in *Himalayan Plants*, Volume 1, pp. 341–397; 1988 (ed. by H. Ohba and S.B. Malla), the second part was in *Himalayan Plants*, Volume 2, pp. 17–65; 1991 (ed. by H. Ohba and S.B. Malla), and the third part in *Himalayan Plants*, Volume 3, pp. 119–170; 1999 (ed. by H. Ohba). We describe here the wood structure of 35 species in three families: Berberidaceae (11 species), Coriariaceae (2), and Euphorbiaceae (22).

We made ten sets of microscopic slides for each wood sample. The microscopic slides of the previous parts will be deposited in the following institutes or laboratories: National Herbarium and Plant Laboratories, Department of Forestry and Plant Research, Nepal, Kathmandu; Department of Botany, the University Museum, University of Tokyo, Tokyo; Forestry and Forest Products Research Institute, Tsukuba; Wood Research Institute, Kyoto University; National Herbarium of the Netherlands, Leiden Branch, Leiden; Royal Botanic Gardens, Kew; Forest Products Laboratory, U.S. Department of Agriculture, Madison, Department of Biology, Faculty of Science, Tohoku University, Sendai, and Hyogo Prefectural Museum of Human and Nature, Sanda. Voucher herbarium specimens will be deposited in the following herbaria: the Department of Forestry and Plant Research (KATH), Nepal, Kathmandu, Department of Botany, the University Museum, University of Tokyo (TI), Tokyo, and Department of Biology, Faculty of Science, Tohoku University (TUS), Sendai.

We are grateful to Dr. S.B. Malla, Dr. S.B. Rajbhandary, and Mr. M.S. Bista, Department of Plant Resources, Kathmandu, and Dr. Hideaki Ohba, the University of Tokyo, for their help and hospitality in the course of this study. Thanks are also due to Dr. Masayuki Mikage, Kanazawa University, and Dr. Takahide Kurosawa, Fukushima University, for their identification of voucher specimens.

This study was partly supported by the following Grants-in-Aid for International Scientific Research (Field Research) by the Ministry of Education, Science, Sports and Culture, Japan: Nos. 58041022 in 1983, 60041018 in 1985, and 08041137 in 1998 to Dr. Hideaki Ohba, the University of Tokyo, Nos. 63041060 in 1988, 03041035 in 1991 and 1992, 06041043 in 1994 and 1995, 09041143 in 1997 and 1998 to Mitsuo Suzuki, and No. 0741132 in 1995 to Dr. Masayuki Mikage.

Asterisked specimens are those on which the descriptions and microscopic photographs are mainly based on.

BERBERIDACEAE (Chika MOURI and Akira TAKAHASHI)

Berberis angulosa Wall. ex Hook. f. et Thoms.

[Plate 82]

Deciduous shrubs in the subalpine zone.

SPECIMENS. No. 9684253, d=1.5 cm, h=1.3 m, alt. 3740 m: Gandaki Zone, Myagdi Distr., Chhau Kharka (3680 m), M. Mikage et al., Sep. 19, 1996.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.1–1.0 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 36–80 and 35–70 μm in radial and tangential diameters, with thin walls of 1.5–2.5 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 4.5–35 and 10–25 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 115–285 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 5–7 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, constituting ground mass of wood, but the wood mostly occupied by narrow vessel elements in very narrow growth rings. Fibers very short, 270–520 μm long, round to polygonal in cross sectional outline, 5–22.5 and 5–13(–16) μm in radial and tangential diameters, thin walled 1.3–3 μm thick. Septate fibers invisible. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 2–2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, rarely uniseriate, 2–5 rays/mm in tangential section. Uniseriate rays 10 μm wide and 3 cells, 75 μm tall. Multiseriate rays (2–)3–10 cells and (15–)20–97(–210) μm wide, and (100–)300–7400 (or more) μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 10–25 x 3–12.5 x 35–90 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 20–90 x 10–21 x 10–43 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits round to horizontally elongated, about 3 μm in horizontal diameter, with small oval or vertically elliptic apertures. Crystals absent.

Berberis asiatica Roxb. ex DC.

[Plate 83]

Evergreen shrubs in the temperate zone.

SPECIMENS. No. 9460185, d=3 cm, h=1.8 m, alt. 2010 m: Gandaki Zone, Manang Distr., Gup (1780 m), M. Suzuki et al., Aug. 3, 1994. No. 9460324, d=5 cm, h=1.5 m, alt. 1885 m: Gandaki Zone, Manang Distr., Dharapani (1850 m), M. Suzuki et al., Aug. 13, 1994. No. 9551040*, d=7 cm, h=2.5 m, alt. 1400 m: Dhawalagiri Zone, Myagdi Distr., Ghara (1550 m) — Tatopani (1240 m), M. Mikage et al., Sep. 17, 1995.

DESCRIPTION. Wood ring porous or semi-ring porous; in the material of No. 9551040, ring porosity obscure because large pores present in late wood. Growth rings distinct or indistinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.5–3.0 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 52–117 and 40–110 μm in radial and tangential diameters, with thin walls of 2–3 μm thick, arranged in 1 row at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in late wood, 10–40 and 7.5–37.5 μm in radial and

tangential diameters, with thin walls of 1 μm thick. In the material of No. 9551040, pores evenly distributed from early wood to late wood.

Vessel elements short, 160–350 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 5–6 μm in horizontal diameter, with small oblique slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers constituting ground mass of wood. Fibers short, 410–680 μm long, round to polygonal in cross sectional outline, 6–27.5 and 4–20 μm in tangential and radial diameters, thin walled 2–2.5 μm . Septate fibers visible. Pits on both radial and tangential walls, nearly simple or minutely bordered, 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–4 rays/mm in tangential section. Multiseriate rays (5–)8–17 cells and (65–)95–245(–275) μm wide, and (220–)475–1975 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 17.5–37.5 x (4–)6–30 x 50–210 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 28–87.5 x 12.5–35 s 20–55 μm in vertical, tangential and radial diameters respectively. Ray vessel pits oval, 6–7 and 6–10 μm in vertical and horizontal diameters. Crystals absent.

Berberis ceratophylla G. Don

[Plate 84]

Evergreen shrubs in the temperate zone.

SPECIMENS. No. 9686116, d=3 cm, h=2 m, alt. 2900 m: Gandaki Zone, Myagdi Distr., Maraini (2520 m) — Jalja La (3300 m), M. Mikage et al., Sep. 15, 1996.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.2–0.8 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 45–100 and 50–92 μm in radial and tangential diameters, with thin walls of 2–3 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 7.5–40 and 12–43 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 175–350 μm long; end walls moderately oblique with simple perforation plates. Intervessel pits alternate and dense, circular or horizontally oblong, 4–8 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, constituting ground mass of wood. Fibers very short, 280–610 μm long, round to polygonal in cross sectional outline, 5–29 and 4–26 μm in radial and tangential diameters, thin walled 2.5–3 μm thick. Septate fibers present among clusters of narrow vessel elements. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–3 rays/mm in tangential section. Multiseri-

ate rays (3–)11–13 cells and (40–)180–205 μm wide, and (143–)1800–3175 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 8–32 x 5–17.5 x 40–117 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 26–85 x 8–25 x 20–50 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits round to horizontally elongated, 3–4 μm in horizontal diameters with small oval or vertically elliptic apertures. Crystals absent.

Berberis concinna Hook. f. et Thoms. var. *extensiflora* Ahrendt

[Plate 85]

Semi-evergreen shrubs in the subalpine zone.

SPECIMENS. No. 9684190, d=1.5 cm, h=0.5 m, alt. 3400 m: Dhawalagiri Zone, Myagdi Distr., Ridge SE of Jalja La (3300 m), M. Mikage et al., Sep. 15, 1996.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.2–1.1 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential clusters of 2–3, 27.5–71 and 30–67.5 μm in radial and tangential diameters, with thin walls of 2 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 8–31 and 5–22.5 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 175–275 μm long; end walls moderately oblique with simple perforation plates. Intervessel pits alternate and dense, circular or horizontally oblong, about 5 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, usually constituting ground mass of wood. Fibers short, 335–515 μm long, round to polygonal in cross sectional outline, 5–22 and 5–17 μm in radial and tangential diameters, thin walled about 2.5 μm thick. Septate fibers invisible. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, multiseriate, 3–4 rays/mm in tangential section. Multiseriate rays 3–9 cells and 40–90 μm wide, and 660 to over 9400 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent cells partly sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 12.5–31 x 6–17 x 45–125 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 25–90 x 7–17.5 x 10–40 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits alternate and moderately spaced, round to horizontally elongated, about 2.5–4 μm in diameter, with oval and vertically elliptic apertures, sometimes unilaterally compound. Crystals absent.

Berberis hookeri Lemaire

[Plate 86]

Evergreen shrubs in the temperate zone.

SPECIMENS. No. 9460308*, d=2 cm, h=1.8 m, alt. 2690 m: Gandaki Zone, Manang Distr., Suggi Khoka (2570 m), M. Suzuki et al., Aug. 12, 1994. No. 9681253, d=1.2 cm, alt. 2625 m: Dhawalagiri Zone, Myagdi Distr., Dobang (2360 m) — Camp site (3300 m), M. Mikage et

al., Sep.8, 1996.

DESCRIPTION. Wood semi-ring porous. Growth rings distinct, delineated by radially flattened tracheary elements at the end of growth rings, narrow, 0.1–1.4 mm. Pores usually angular in outline, in clusters and in dendritic pattern in late wood, gradually reduced in size from the beginning of growth rings toward late wood, 7.5–41.3 and 6–35 μm in radial and tangential diameters, with thin walls of 1–2 μm thick.

Vessel elements short, 140–395 μm long, end walls moderately oblique with simple perforation plates. Intervessel pits alternate and dense; pit borders circular to polygonal, 4–5 μm in diameter, with oblique slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, constituting ground mass of wood. Fibers very short, 180–450 μm long, round to polygonal in cross sectional outline, 3.5–19 μm in tangential diameter, walls 1.7–3 μm thick. Septate fibers sometimes present. Pits on both radial and tangential walls, nearly simple or minutely circular bordered, about 1 μm in diameter, with oblique slit-like small apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–4 rays/mm in tangential section. Multiseriate rays usually 3–10 up to 18 cells and 35–150 up to 320 μm wide, and usually 0.3–1.3 mm, occasionally more than 10 mm tall, with 1–3 marginal cells; consisting of procumbent, square, and upright cells; central cores of procumbent cells partly sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 12–27 x 6–22 x 35–120 μm in vertical, tangential, and radial diameters, respectively. Square or upright cells elliptic or vertically oblong in tangential section, 22–153 x 13–24 x 18–52 μm in vertical, tangential, and radial diameters, respectively. Vessel-ray pits rare, small round or elliptic. Crystals absent.

Berberis koehneana Schneid.

[Plate 87]

Deciduous shrubs in the subalpine zone.

SPECIMENS. No. 9460361*, d=5 cm, alt. 3170 m: Gandaki Zone, Manang Distr., Humre (3210 m), M. Suzuki et al., Aug. 16, 1994. No. 9460364, d=1.2 cm, h=1.3 m, alt. 3250 m: Gandaki Zone, Manang Distr., Humre (3210 m), M. Suzuki et al., Aug. 16, 1994. No. 9965171, d=1.0 cm, h=0.4 m, alt. 3250 m: Dhawalagiri Zone, Mustang Distr., Eklebatti (2780 m) — Jharkot (3500 m), M. Mikage et al., Aug. 18, 1999. No. 9965172, d=1.0 cm, h=1 m, alt. 3280 m: Dhawalagiri Zone, Mustang Distr., Eklebatti (2780 m) — Jharkot (3500 m), M. Mikage et al., Aug.18, 1999. No. 9965175, d=1.5 cm, h=2 m, alt. 3300 m: Dhawalagiri Zone, Mustang Distr., Jharkot (3500 m), M. Mikage et al., Aug. 18, 1999. No. 9965179, d=1.5 cm, h=0.3 m, alt. 3420 m: Dhawalagiri Zone, Mustang Distr., Jharkot (3500 m) — Muktinath (3800 m), M. Mikage et al., Aug. 20, 1999. No. 20100432, d=3 cm, h=3 m, alt. 3140 m: Bagmati Zone, Rasuwa Distr., Langtang (3380 m), S. Akiyama et al., May.23, 2001. No. 20100433, d=3 cm, h=3 m, alt. 3110 m: Bagmati Zone, Rasuwa Distr., Langtang (3380 m), S. Akiyama et al., May. 23, 2001.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.6–1.0(–1.3) mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 39–142 and 36–110 μm in radial and tangential diameters, with thin walls of 2–2.5 μm thick, arranged

in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 10–36 and 12–38 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 125–315 μm long; end walls moderately oblique with simple perforation plates. Intervessel pits alternate and dense, circular or horizontally oblong, 4–6 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, usually constituting ground mass of wood. Fibers very short, 230–520 μm long, round to polygonal in cross sectional outline, 5–25 and 6.5–20 μm in radial and tangential diameters, thin walled about 2–2.5 μm thick. Septate fibers invisible. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, multiseriate, 2–5 rays/mm in tangential section. Multiseriate rays 3–12 cells and 40–150 μm wide, and 200–2825 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 8–26 x 8–20 x 40–152.5 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 20–140 x 12.5–20 x 20–45 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits alternate and moderately spaced, round to horizontally elongated, about 2.5–4 μm in diameter, with oval and vertically elliptic apertures, sometimes unilaterally compound. Prismatic crystals and druses present in ray cells only in the material of No. 9460361.

Berberis mucrifolia Ahrendt

[Plate 88]

Deciduous shrubs in the temperate zone.

SPECIMENS. No. 9460444, d=2.1 cm, alt. 2615 m: Dhawalagiri Zone, Mustang Distr., Syang (2620 m), M. Suzuki et al., Aug. 24, 1994. No. 9551061*, d=1.3 cm, h=2 m, alt. 2430 m: Dhawalagiri Zone, Mustang Distr., Ghasa (2020 m) — Tukuche (2590 m), M. Mikage et al., Sep. 19, 1995. No. 9965163, d=0.8 cm, h=0.3 m, alt. 2960 m: Dhawalagiri Zone, Mustang Distr., Eklebhatti (2780 m) — Jharkot (3500 m), M. Mikage et al., Aug. 18, 1999. No. 9965184, d=1.0 cm, h=0.3 m, alt. 2620 m: Dhawalagiri Zone, Mustang Distr., Marpha (2635 m), M. Mikage et al., Aug. 22, 1999. No. 9965185, d=1.0 cm, h=0.3 m, alt. 2600 m: Dhawalagiri Zone, Mustang Distr., Marpha (2635 m), M. Mikage et al., Aug. 22, 1999.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.3–0.8 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential clusters of 2–3, 32.5–78 and 25–71 μm in radial and tangential diameters, with thin walls of 2.5–3 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 7.5–32 and 10–22.5 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 190–320 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 3–6 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, usually constituting ground mass of wood, but the wood mostly occupied by narrow vessel elements when growth rings width very narrow. Fibers very short, 250–540 μm long, round to polygonal in cross sectional outline, 5–18(–28) and 6–15 μm in radial and tangential diameters, thin walled about 2–2.5 μm thick. Septate fibers present. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 1.5–2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, uniseriate and 2–5 seriate, 2–4 rays/mm in tangential section. Uniseriate rays 2–10 cells and 50–245 μm tall. Multiseriate rays 2–5 cells and 25–75 μm wide, and 120–2675 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells. Procumbent cells round or elliptic in tangential section, 12–30 x 8–15 x 35–85 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 22–92 x 12.5–22.5 x 12–53 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits alternate and moderately spaced, round to horizontally elongated, about 2.5–4 μm in diameter, with oval and vertically elliptic apertures, sometimes unilaterally compound. Crystals absent.

Berberis sikkimensis (Schneid.) Ahrendt var. *baileyi* Ahrendt

[Plate 89]

Evergreen shrubs in the temperate zone.

SPECIMENS. No. 9460202, d=3.5 cm, alt. 2495 m: Gandaki Zone, Gorkha Distr., Namru (2500 m), M. Suzuki et al., Aug. 4, 1994. No. 9460305, d=5 cm, h=3 m, alt. 2740 m: Gandaki Zone, Manang Distr., Suggi Khola (2570 m), M. Suzuki et al., Aug. 12, 1994. No. 9460454*, d=7 cm, h=5 m, alt. 2460 m: Dhawalagiri Zone, Mustang Distr., Kothethati (2410 m), M. Suzuki et al., Aug. 25, 1994. No. 9551013, d=6 cm, h=2.5 m, alt. 2015 m: Gandaki Zone, Kaski Distr., Ulleri (2020 m) — Banthanti (2200 m), M. Mikage et al., Sep. 16, 1995. No. 9551049, d=4 cm, h=2.5 m, alt. 2030 m: Dhawalagiri Zone, Mustang Distr., Ghasa (2020 m) — Tukche (2590 m), M. Mikage et al., Sep. 19, 1995. No. 9551051, d=2.7 cm, h=8 m, alt. 2180 m: Dhawalagiri Zone, Mustang Distr., Ghasa (2020 m) — Tukche (2590 m), M. Mikage et al., Sep. 19, 1995. No. 9551059, d=2.5 cm, h=3 m, alt. 2420 m: Dhawalagiri Zone, Mustang Distr., Ghasa (2020 m) — Tukche (2590 m), M. Mikage et al., Sep. 19, 1995. No. 9684167, d=3 cm, h=2 m, alt. 2400 m: Gandaki Zone, Myagdi Distr., Dhara Khola (2160 m) — Maraini (2520 m), M. Mikage et al., Sep. 14, 1996. No. 9686043, d=5.5 cm, h=2.5 m, alt. 2700 m: Gandaki Zone, Myagdi Distr., Dobang (2360 m) — Camp site (3300 m), M. Mikage et al., Sep. 8, 1996. No. 9687238, d=2.5 cm, h=3 m, alt. 2340 m: Gandaki Zone, Myagdi Distr., Lapche Kharka (2060 m) — Dobang (2360 m), M. Mikage et al., Sep. 10, 1996. No. 20100407, d=11 cm, h=5 m, alt. 2350 m: Bagmati Zone, Rasuwa Distr., Bamboo (1980 m) — Lama Hotel (2480 m), S. Akiyama et al., May. 18, 2001. No. 20100414, d=8 cm, h=4 m, alt. 2850 m: Bagmati Zone, Rasuwa Distr., Lama Hotel (2480 m) — Ghora Tabela, S. Akiyama et al., May. 19, 2001.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.3–3.4 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 46–150 and 35–123 μm in radial and tangential diameters, with thin walls of 3–4 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 5–35 and 6–31 μm in radial and tangential diameters, with thin walls

of 1 μm thick.

Vessel elements short, 220–351 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 3–7.5 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, constituting ground mass of wood. Fibers short, 265–740 μm long, round to polygonal in cross sectional outline, 5–21 and 5–20 μm in radial and tangential diameters, thin walled 2.5 μm thick. Septate fibers present among clusters of narrow vessel elements. Pits on both radial and tangential walls, nearly minutely bordered, about 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–3 rays/mm in tangential section. Multiseriate rays (4–)8–15 cells and (45–)70–150 μm wide, and 480–2875 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 9.5–27 x 6–17 x (28–)40–170 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 20–107 x (25–)12.5–20 x (11–)25–41 μm in vertical, tangential and radial diameters respectively. Ray vessel pits round to horizontally elongated, 6–7 and 5–15 μm in vertical and horizontal diameters with small oval or vertically elliptic apertures, sometimes unilaterally compound. Crystals absent.

Berberis tsarica Ahrendt

[Plate 90]

Deciduous shrubs in the subalpine zone.

SPECIMENS. No. 9460249, d=1.2 cm, h=0.6 m, alt. 3530 m: Gandaki Zone, Gorkha Distr., Thangmanang Kharka (3730 m), M. Suzuki et al., Aug. 7, 1994. No. 9460389*, d=1.2 cm, h=0.6 m, alt. 3985 m: Gandaki Zone, Manang Distr., Churi Lattar (4000 m), M. Suzuki et al., Aug. 18, 1994.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.1–0.8 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential clusters of 2–3, 35–84 and 27.5–87.5 μm in radial and tangential diameters, with thin walls of 2–3 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 4–27.5 and 12–27.5 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 190–305 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 3.5–5 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements. Vessel elements sometimes contain brown gum.

Non-perforated tracheary elements fibers, constituting ground mass of wood, but the wood mostly occupied by narrow vessel elements when growth rings width very narrow. Fibers very short, 205–590 μm long, round to polygonal in cross sectional outline, 5–26(–32) and 3–17.5 μm in radial and tangential diameters, thin walled about 2.5 μm thick. Septate fibers invisible. Pits on both radial and tangential walls, nearly simple to minutely

bordered, about 2–2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–4 rays/mm in tangential section. Multiseriate rays (2–)5–10 cells and (15–)55–160(–290) μm wide, and (120–)480–3850 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; central cores of procumbent and square cells sheathed by square and upright cells. Procumbent cells round or elliptic in tangential section, 14–29 x 10–20 x 40–95 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 26–160 x 11–25 x 17–50 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits alternate and moderately spaced, round to horizontally elongated, about 3–5 μm in diameter, with oval and vertically or horizontally elliptic apertures, sometimes unilaterally compound. Crystals absent.

Berberis umbellata Wall. ex G. Don

[Plate 91]

Evergreen shrubs in the temperate and subalpine zone.

SPECIMENS. No. 9460143*, d=2.5 cm, h=3 m, alt. 3125 m: Gandaki Zone, Gorkha Distr., Lungdang Gompa (3150 m), M. Suzuki et al., Jul. 30, 1994. No. 9460252, d=3.0 cm, h=2.5 m, alt. 3340 m: Gandaki Zone, Gorkha Distr., Syallagaon (3300 m), M. Suzuki et al., Aug. 7, 1994. No. 9460298, d=4.5 cm, h=4 m, alt. 3010 m: Gandaki Zone, Manang Distr., Bimtang (3350 m), M. Suzuki et al., Aug. 12, 1994. No. 9551023, d=2.0 cm, h=2.3 m, alt. 2570 m: Dhawalagiri Zone, Myagdi Distr., Ghorepani (2710 m) — Tatopani (1240 m), M. Mikage et al., Sep. 17, 1995. No. 9687214, d=2.0 cm, alt. 2890 m: Dhawalagiri Zone, Myagdi Distr., Dobang (2360 m) — camp site (3300 m), M. Mikage et al., Sep. 8, 1996. No. 9687235, d=2.0 cm, alt. 3100 m: Dhawalagiri Zone, Myagdi Distr., above Dobang (2360 m), M. Mikage et al., Sep. 9, 1996.

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 0.4–1.7 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential clusters of 2–3, 40–113 and 35–105 μm in radial and tangential diameters, with thin walls of 2.5–5 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 8–42 and 5–35 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short, 160–320 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 5–10 μm in horizontal diameter, with small oblique slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, constituting ground mass of wood. Fibers very short, 155–561 μm long, round to polygonal in cross sectional outline, 5–25 and 5–15 μm in radial and tangential diameters, thin walled 1.5–4 μm . Septate fibers rarely present. Pits on both radial and tangential walls, nearly simple or minutely bordered, 1.5–2 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, usually multiseriate, 2–4 rays/mm in tangential section. Multiseriate rays 3–5 cells and 30–65 μm wide, and 220–2000 μm up to 3325 μm tall, with 1–2 mar-

ginal cells; consisting of procumbent, square and upright cells; outside mostly of square and upright cells. Procumbent cells round or elliptic in tangential section, 7–28 x 7–17.5 x 36–163 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 24–145 x 7.5–20 x 18–45 μm in vertical, tangential and radial diameters respectively. Ray vessel pits oval, 2.5–3 and 1.5–2 μm in vertical and horizontal diameters. Crystals present in some materials (No. 9460252, 9551023, 9687214, 9687235); prismatic crystals and druses in procumbent ray cells

Berberis zebeliana Schneid.

[Plate 92]

Deciduous shrubs in the temperate zone.

SPECIMENS. No. 9460344, d=6 cm, h=5 m, alt. 2650 m: Gandaki Zone, Manang Distr., Kaleku (2680 m), M. Suzuki et al., Aug. 15, 1994

DESCRIPTION. Wood ring porous. Growth rings distinct, delineated by ring porosity and radially flattened tracheary elements, narrow, 1.0–1.3 mm. Pores of two distinct sizes; larger round or slightly angular pores solitary and in tangential culsters of 2–3, 60–120 and 50–116 μm in radial and tangential diameters, with thin walls of 2–2.5 μm thick, arranged in 1–2 rows at the beginning of growth rings; smaller angular pores in clusters and in dendritic pattern in latewood, 12.5–52 and 10–47 μm in radial and tangential diameters, with thin walls of 1 μm thick.

Vessel elements short to medium sized, 165–453 μm long; end walls moderately oblique with simple perforation plates, sometimes with long tails. Intervessel pits alternate and dense, circular or horizontally oblong, 7–7.5 μm in horizontal diameter, with small slit-like apertures. Helical thickenings present on inner walls of vessel elements, conspicuous on narrow elements.

Non-perforated tracheary elements fibers, usually constituting ground mass of wood. Fibers short, 405–720 μm long, round to polygonal in cross sectional outline, 5–25 and 7–20 μm in radial and tangential diameters, thin walled about 2–3 μm thick. Septate fibers invisible. Pits on both radial and tangential walls, nearly simple to minutely bordered, about 2.5 μm in diameter, with small slit-like apertures.

Axial parenchyma absent.

Rays heterocellular, mostly multiseriate rarely uniseriate, 3–5 rays/mm in tangential section. Uniseriate rays 9 cells and 160 μm tall. Multiseriate rays 3–7 cells and 40–120 μm wide, and 200–2575 μm tall, with 1–2 marginal cells; consisting of procumbent, square and upright cells; outside mostly of square and upright cells. Procumbent cells round or elliptic in tangential section, 11–33 x 10–20 x 45–135 μm in vertical, tangential and radial diameters respectively. Square or upright cells elliptic or oblong in tangential section, 34–98 x 17.5–26 x 20–55 μm in vertical, tangential and radial diameters respectively. Vessel-ray pits alternate and moderately spaced, round to horizontally elongated, about 2.5–4 μm in diameter, with oval and vertically elliptic apertures, sometimes unilaterally compound. Crystals absent.

CORIARIACEAE (Mitsuo SUZUKI)

Coriaria napalensis Wall.

[Plate 93]

Deciduous shrub or small trees in the temperate zone.

SPECIMENS. No. 8340287*, d=25 cm, h=5 m, alt. 2850 m: Gandaki Zone, Manang Distr., Bardang (2850 m) — Chame (2630 m), H. Ohba et al., Aug. 5, 1983. Nos. 854009 & 854010, d=20 cm, h=5 m, alt. 2050 m: Bagamati Zone, Rasuwa Distr., Dunche (1980 m) — Barke (1840 m) — Munga (2050 m) — Syabru (2240 m), M. Suzuki & S. Noshiro., May 23, 1985.

DESCRIPTION. Wood diffuse to semi-ring porous. At the beginning of growth rings, clusters of large pores arranged in one concentric series. Growth rings fairly distinct or sometimes indistinct, 0.5–4 mm.

Pores and pore clusters often arranged in tangential direction showing distinct tangential bands with confluent parenchyma, rather few, 24–52/mm², mostly grouped in clusters with several pores (2–20, mostly 2–6 pores in a multiple) and rarely solitary, mostly polygonal in outline with rather thin walls, moderately large in earlywood (140–210 x 160–240 µm in tangential and radial diameters) and a little smaller in latewood (35–120 x 35–115 µm in tangential and radial diameters).

Vessel elements short (120–195 µm). Perforation plates exclusively simple. Intervessel pits dense (35–43 pits/ 1000 µm²), polygonal in outline with about 5–10 µm in diameter and arranged in alternate; vestured pits invisible. Spiral thickenings absent.

Non-perforated tracheal elements libriform fibers; fibers constituting ground mass of wood, polygonal in transverse section, 10–25 x 18–23 µm in radial and tangential diameters, with rather thick walls, about 3 µm, fairly short, 120–230 µm, very small pits with slit-like apertures often present. Fibers tending to be storied with wood parenchyma and narrow vessel elements.

Wood parenchyma abundant, vasicentric and confluent, polygonal in transverse section, 12–30 µm in diameter, mostly fusiform and sometimes strands with two or four cells; fusiform parenchyma 130–180 µm in length, crystals invisible.

Rays heterogeneous and sheathed, very large and variable in size, 3–24 cells or 50–480 µm in width, very high, 0.33–5.35 mm or more. Rays occupying great quantity of total wood volume, 32.7–45.4%. Rays consisting of three kinds of cells; very high and short upright cells (60–170, 18–25 and 18–35 µm in vertical, tangential and radial diameters, respectively) around the central cores of the square cells (25–47, 20–23 and 28–47 µm in vertical, tangential and radial diameters, respectively) and procumbent cells (18–22, 8–15 and 55–88 µm in vertical, tangential and radial diameters, respectively). Crystals often present in the square cells. Upright cells sheathing rays often very tall, up to the height of fusiform parenchyma cells, making exact recognition of upright cells from parenchyma cells fairly difficult.

Coriaria terminalis Hems.

[Plate 94]

Herbaceous plants of about 1 m tall with persistent rhizomes with small amount of secondary growth.

SPECIMEN. No. 12316*, d=1.3 cm (three years old), h=1 m: Bhutan, Upper Mo Chu, Chamsa (3500 m) — Kohina (3000 m) — Yabu Thang (3200 m), H. Kanai et al., May 15, 1967.

DESCRIPTION. Wood diffuse to semi-ring porous. Growth rings fairly distinct or sometimes indistinct, 1.5–3 mm.

Pores and pore clusters arranged in oblique tangential direction, rather few, 32–52/mm²,

mostly grouped in clusters with several pores (2–6 pores in a multiple) and rarely solitary, mostly polygonal in outline with rather thin walls, small in earlywood (55–110 x 85–120 μm in tangential and radial diameters) and a little more small in latewood (40–55 x 35–85 μm in tangential and radial diameters).

Vessel elements short (115–170 μm). Perforation plates exclusively simple. Intervessel pits dense (48–58 pits/ 1000 μm^2), polygonal in outline with about 5 μm in diameter and arranged in alternate; vestured pits invisible. Spiral thickenings absent.

Non-perforated tracheal elements libriform fibers, short, 80–200 μm in length, polygonal in transverse section, 10–18 and 15–23 μm in tangential and radial diameters, with walls of 2 μm thick, fairly short, 130–200 μm in length, very small pits with slit-like apertures often present. Fibers non-storied.

Wood parenchyma sparse, vasicentric, polygonal in transverse section, 15–25 μm in diameter, fusiform and strands with two or four cells; fusiform parenchyma 100–150 μm in length; crystals invisible. Wood parenchyma tending to be storied.

Rays heterogeneous, 8–12 cells or 180–350 μm in width, very high, 0.38–5.97 mm or more. Rays occupying great quantity of total wood volume, 40.7%. Rays consisting of upright cells (50–95, 12–20 and 20–35 μm in vertical, tangential and radial diameters, respectively), square cells (40–55, 15–25 and 35–60 μm in vertical, tangential and radial diameters, respectively) and rarely procumbent cells (10–13, 10–15 and 45–60 μm in vertical, tangential and radial diameters, respectively). Crystals rarely present in square cells.

EUPHORBIACEAE (Shuichi Noshiro)

Alchornea mollis (Benth.) Müll.Arg.

[Plate 95]

Shrubs in the tropical zone.

SPECIMEN. No. 9840040, d=3 cm, h=3.5 m, alt. 1090 m: Koshi Zone, Sankhuwasawa Distr., Gola (1120 m) — Barun Dobhan (1110 m) — Simbung (1740 m), S. Noshiro et al., Aug. 15, 1998.

DESCRIPTION. Wood diffuse porous with medium-sized vessels often in radial multiples. Growth rings usually distinct, marked by smaller vessels and flattened fibers at the end of growth rings; false growth rings occasionally formed; growth ring width 0.2–3.15 mm.

Vessels evenly distributed, 33.8/mm², reduced in size within the final 50 μm of growth rings; solitary, in radial multiples of up to 12, or in clusters made of two fused radial multiples, radial multiples often continuing across growth ring boundaries; round, slightly polygonal in outline, (14–)41–85(–114) and (11–)36–101(–147) μm in radial and tangential diameters respectively, walls rather thick (about 6 μm).

Vessel elements medium in length, (380–)460–690(–820) μm ; perforation plates simple; intervessel pits densely alternate, slightly polygonal, 7–12 and 7–15 μm in vertical and horizontal diameters respectively; vessel-ray pits with reduced, but distinct borders, alternate to opposite, 7–10 and 7–25 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses common, thin-walled, pitted.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; rather short, (740–)770–1050(–1400) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 6–17 and 5–25 μm in radial and tangential diameters respectively; walls fairly thin (about 2 μm);

spiral thickenings absent; non-septate.

Axial parenchyma scanty paratracheal forming an incomplete sheath around vessels and in dense lines one cell wide sparser at the beginning of growth rings; mostly 7–8 cells per strand; crystals absent.

Rays heterocellular, 1–2(–3) cells wide, consisting of a mixture of tall and short upright cells with occasional short procumbent cells, 20–24 rays/mm in tangential section; multiseriate body usually consisting of short upright cells and occasional short procumbent cells, but rarely including tall upright cells; rays often merging with upper or lower rays, forming chains over 5 mm long; tall and short upright cells and short procumbent cells 40–125 and 7–15, 13–35 and 7–30, 8–20 and 25–85 μm in vertical and radial diameters respectively. Prismatic crystals, 15–25 μm in side length, in short upright cells, usually one per cell. Silica bodies absent.

Antidesma acidum Retz.

[Plate 96]

Shrubs in the tropical zone.

SPECIMEN. No. 9455031, d=3 cm, h=2.5 m, alt. 980 m: Bagmati Zone, Dhading Distr., Lapang (580 m) — Ringne Bazar (590 m) — Karkigaon (980 m) — Mulabari (1260 m), M. Suzuki et al., July 18, 1994.

DESCRIPTION. Wood diffuse porous with small vessels. Growth rings distinct, marked by smaller vessels and flattened fibers at the end of growth rings, or indistinct; false growth rings occasionally formed; growth ring width 0.25–1.7 mm.

Vessels evenly distributed, $68.6/\text{mm}^2$, reduced in size within the final 50 μm of growth rings; solitary or in radial multiples of up to 5, rarely in clusters of up to 4; round, slightly polygonal in outline, (15–)26–52(–72) and (11–)30–65(–101) μm in radial and tangential diameters respectively, walls thin (about 1.5 μm thick).

Vessel elements medium in length, (410–)520–790(–850) μm ; perforation plates with thick borders, simple or scalariform with up to 7 bars, often two perforation plates at one vessel end; intervessel pits alternate, slightly polygonal, about 5 μm in diameter; vessel-ray pits with reduced borders, opposite or scalariform, 4–6 and 5–18 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; rather short, (530–)850–1180(–1250) μm . Fibers constituting ground mass of wood, polygonal in outline, 10–32 and 12–30 μm in radial and tangential diameters respectively; walls medium in thickness (about 3.5 μm); spiral thickenings absent; septate.

Axial parenchyma diffuse, sparse.

Rays heterocellular, uniseriate and multiseriate, 13–17 rays/mm in tangential section. Uniseriate rays consisting of tall upright cells with occasional short upright to square cells, mostly 1–13 cells and 25–590 μm tall. Multiseriate rays 2–5 cells and 30–80 μm wide and up to 1040 μm tall; multiseriate body made up of short upright to square cells occasionally with marginal tall upright cells and rarely with procumbent cells; uniseriate wings usually made up of 1–9 tall upright cells; tall upright, short upright to square, and procumbent cells 50–85 and 20–40, 25–50 and 25–50, 10–15 and 30–85 μm in vertical and radial diameters respectively. Perforated ray cells sporadic, with simple perforations occasionally with an incomplete bar. Prismatic crystals absent. Silica bodies, about 20 μm in diameter,

in short upright and procumbent cells forming multiseriate ray body.

Antidesma bunius (L.) Spreng.

[Plate 97]

Small trees in the subtropical zone.

SPECIMEN. No. 9455034, dbh=30 cm, h=7 m, alt. 1100 m: Bagmati Zone, Dhading Distr., Lapang (580 m) — Ringne Bazar (590 m) — Karkigaon (980 m) — Mulabari (1260 m), M. Suzuki et al., July 18, 1994.

DESCRIPTION. Wood diffuse porous with small vessels. Growth rings weakly distinct marked by smaller vessels and flattened, thicker-walled fibers at the end of growth rings; growth ring width 1.3–3.75 mm.

Vessels evenly distributed, $41.1/\text{mm}^2$, reduced in size within the final 50–100 μm of growth rings; solitary or in radial multiples of up to 5; round, slightly polygonal in outline, (16–)33–76(–95) and (16–)37–84(–114) μm in radial and tangential diameters respectively, walls thin (about 2.5 μm thick).

Vessel elements fairly long, (810–)1080–1600(–1870) μm ; perforation plates simple with thick borders, occasionally two perforation plates at one vessel end; intervessel pits densely alternate, polygonal, about 7–10 μm in diameter; vessel-ray pits with reduced borders, opposite to scalariform or slanting (rarely palisade), 6–12 and 5–50 μm in vertical and radial diameters respectively, occasionally unilaterally compound. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 6 μm in diameter; fairly long, (1550–)1920–2690(–3125) μm . Fibers constituting ground mass of wood, polygonal in outline, 10–32 and 12–30 μm in radial and tangential diameters respectively; walls medium in thickness (about 4 μm); spiral thickenings absent; septate.

Axial parenchyma rarely scanty paratracheal or diffuse.

Rays heterocellular, uniseriate and multiseriate. Uniseriate rays consisting of upright cells with occasional square (including short upright to short procumbent) cells, mostly 1–17 cells and 25–2100 μm tall, 2–5 rays/mm in tangential section. Multiseriate rays 2–5 cells and 40–130 μm wide and up to 4.5 mm tall, 3–6 rays/mm in tangential section; multiseriate bodies made up of upright and square cells occasionally with procumbent cells and marginal upright cells; uniseriate wings usually made up of 1–9 upright cells; upright, square, and procumbent cells 60–180 and 30–50, 40–60 and 35–90, 15–20 and 65–125 μm in vertical and radial diameters respectively. Perforated ray cells common, with simple perforations. Prismatic crystals absent. Silica bodies, 10–20 μm in diameter, in square and procumbent cells forming multiseriate bodies.

Balakata baccata (Roxb.) Esser

[Plate 98]

Trees in the tropical to subtropical zones.

SPECIMENS. No. 9455056*, dbh=47 cm, h=9 m, alt. 680 m: Gandaki Zone, Gorkha Distr., Arkhet Bazar (570 m) — Soti (630 m) — Almara (700 m) — Khorsanedanda (830 m), M. Suzuki et al., July 20, 1994. No. 9755247, dbh=72 cm, h=24 m, alt. 950 m: Koshi Zone, Sankhuwasawa Distr., Nurbu Chaur (2080 m) — Yangluwa (1880 m) — Tenggaug (1750 m) — Thanke (1620 m) — Tallo Wollung (1340 m) — Apsuwa Doban (660 m), S. Noshiro et al., Aug. 30, 1997.

DESCRIPTION. Wood diffuse porous with sparse large vessels. Growth rings indistinct, barely marked by change in vessel size and flattened fibers.

Vessels evenly and sparsely distributed, $2.1\text{--}8.8/\text{mm}^2$; solitary or in radial multiples of up to 5, radial multiples often continuous across indistinct growth ring boundaries; round in outline, (21–)50–205(–252) and (22–)49–266(–297) μm in radial and tangential diameters respectively, walls thick (about 8 μm thick).

Vessel elements medium in length, (170–)260–740(–850) μm ; perforation plates simple; intervessel pits densely alternate, slightly polygonal, 8 and 8–14 μm in vertical and horizontal diameters respectively; vessel-ray pits with reduced borders, alternate or opposite, rectangular, 7–12 and 7–14 μm in vertical and radial diameters respectively, occasionally unilaterally compound. Helical thickenings absent. Tyloses common, thin-walled, pitted.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 5 μm in diameter; medium in length, (625–)770–1400(–1475) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 8–30 and 8–60 μm in radial and tangential diameters respectively; walls fairly thin (about 2 μm); spiral thickenings absent; non-septate.

Axial parenchyma scanty paratracheal and in dense lines, 1–2 cells wide; mostly 6–8 cells per strand; crystals absent.

Rays heterocellular, 1–2(–3) cells wide, up to 820 μm tall, consisting of a mixture of short upright, square, and short procumbent cells, 12–17 rays/mm in tangential section; short upright, square, and short procumbent cells 45–80 and 30–50, 35–65 and 40–65, 15–30 and 55–120 μm in vertical and radial diameters respectively. Prismatic crystals absent. Silica bodies, 5–8 μm in diameter, throughout rays.

Bridelia retusa (L.) A. Juss.

[Plate 99]

Small trees in the tropical to subtropical zones.

SPECIMENS. No. 9755271*, dbh=20 cm, h=6 m, alt. 490 m: Koshi Zone, Sankhuwasawa Distr., Pikuwa (610 m) — Mengtewa Besi (500 m) — Bumlingtar (460 m), S. Noshiro et al., Sept. 1, 1997. No. 9840218, dbh=25 cm, h=7 m, alt. 330 m: Koshi Zone, Sankhuwasawa Distr., Tumlingtar (440 m) — Katle Bhanjyang (410 m) — Sabha Khola (310 m) — Khahare (410 m) — Pikuwa Khola (320 m) — Surtibari (320 m) — Baireni Bagar (320 m), S. Noshiro et al., Aug. 31, 1998.

DESCRIPTION. Wood diffuse porous with medium-sized vessels. Growth rings weakly marked by difference in vessel diameter and marginal parenchyma; growth ring width from 0.6 to over 6 mm.

Vessels evenly distributed, $11.5\text{--}12.2/\text{mm}^2$, reduced in size within the final 100 μm of growth rings; solitary or in radial multiples of up to 5; round in outline, (28–)72–129(–149) and (21–)76–171(–204) μm in radial and tangential diameters respectively, walls medium in thickness (about 5 μm).

Vessel elements medium in length, (380–)500–740(–790) μm ; perforation plates simple; intervessel pits densely alternate, polygonal, about 7–9 μm in diameter; vessel-ray pits with reduced borders, opposite to alternate or scalariform (rarely palisade), 5–15 and 7–30 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses absent. Dark deposits in some vessels.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; long, (900–)1490–2100(–2300) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 6–26 and 8–33 μm in radial and tangential diameters respectively; walls rather thin (about 2.5 μm); spiral thickenings absent; septate.

Axial parenchyma vasicentric with narrow sheath, diffuse, and marginal; diffuse and marginal parenchyma consisting of slender cells 110–200 μm tall, mostly 6–8 cells per strand; vasicentric parenchyma consisting of broad cells 30–140 μm tall, mostly 8–10 cells per strand; prismatic crystals, 12–22 μm in side length, occasionally in chambered cells.

Rays heterocellular, 1–5 cells and 15–95 μm wide, up to 1.3 mm or more tall, consisting of a mixture of short upright, square, and short procumbent cells, about 7 rays/mm in tangential section; often merging with upper or lower rays, forming chains over 4 mm long; short upright, square, and short procumbent cells 55–100 and 18–40, 25–40 and 30–45, 12–25 and 45–100 μm in vertical and radial diameters respectively. Prismatic crystals absent. Silica bodies absent.

Bridelia stipularis (L.) Blume

[Plate 100]

Scrambling shrubs in the tropical zone.

SPECIMEN. No. 9194191, d=8.9 cm, h=2.5 m, alt. 1410 m: Seti Zone, Bajura Distr., Serigaon (1690 m) — Ukhadi (1630 m) — a river (1370 m) — Jugalo (1430 m) — a pass (1600 m) — Budhiganaga Khola (bridge) (1400 m) — Bashala (1760 m), M. Suzuki et al., Aug. 14, 1991.

DESCRIPTION. Wood diffuse porous with rather small vessels often in radial multiples. Growth rings distinct, weakly marked by difference in vessel diameter and marginal parenchyma; growth ring width 1–2 mm.

Vessels evenly distributed, 24.2/mm², reduced in size within the final 100 μm of growth rings; solitary or in radial multiples of up to 7; round in outline, (18–)39–71(–95) and (15–)41–86(–123) μm in radial and tangential diameters respectively, walls medium in thickness (about 5 μm).

Vessel elements rather short, (220–)330–510(–600) μm ; perforation plates simple; intervessel pits densely alternate, round, about 4–5 μm in diameter; vessel-ray pits with reduced borders, opposite to alternate or scalariform (rarely palisade), 6–15 and 6–22 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; rather short, (710–)860–1170(–1300) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 8–20 and 8–38 μm in radial and tangential diameters respectively; walls rather thin (about 2.5 μm); spiral thickenings absent; septate.

Axial parenchyma vasicentric with narrow sheath, diffuse, and marginal; diffuse and marginal parenchyma consisting of slender cells 95–130 μm tall; vasicentric parenchyma consisting of broad cells 30–100 μm tall; mostly 6–8 cells per strand; prismatic crystals, 8–12 μm in side length, frequently in chambered cells.

Rays heterocellular, 1–5 cells and 10–75 μm wide, up to 1.7 mm tall, consisting of a mixture of short upright, square, and short procumbent cells, 11–13 rays/mm in tangential section; short upright, square, and short procumbent cells 50–95 and 25–40, 30–50 and 35–50,

13–30 and 35–95 μm in vertical and radial diameters respectively. Perforated ray cells with simple or scalariform perforations occasional. Prismatic crystals, 17–25 μm in side length, common throughout rays, occasionally in chambered ray cells, one per cell or occasionally with smaller crystals, 2–4 μm in side length. Silica bodies absent.

Excoecaria acerifolia Didr.

[Plate 101]

Deciduous shrubs in the subtropical to warm temperate zones.

SPECIMENS. No. 8840516*, d=2.5 cm, h=2.5 m, alt. 1530 m: Dhawalagiri Zone, Myagdi Distr., Shika – Khipang (Khibang) – Paudwar – Jibang – Gaunapani – Narchang (Nracheng), M. Suzuki et al., Aug. 26, 1988. No. 9194194, d=3 cm, h=2.6 m, alt. 1380 m: Seti Zone, Bajura Distr., Serigaon (1690 m) — Ukhadi (1630 m) — a river (1370 m) — Jugalo (1430 m) — a pass (1600 m) — Budhiganaga Khola (bridge) (1400 m) — Bashala (1760 m), M. Suzuki et al., Aug. 14, 1991.

DESCRIPTION. Wood diffuse porous with small vessels often in radial multiples. Growth rings weakly or indistinctly marked by smaller vessels and flattened fibers at the end of growth rings; growth ring width 0.5–4 mm.

Vessels evenly distributed, 52.5–72.5/ mm^2 , reduced in size within the final 100 μm of growth rings; solitary or in radial multiples of up to 9; round in outline, (12–)27–56(–69) and (9–)20–58(–72) μm in radial and tangential diameters respectively, walls medium in thickness (about 4 μm).

Vessel elements rather short, (210–)310–510(–570) μm ; perforation plates simple with thick borders; intervessel pits densely alternate, round to polygonal, about 6–8 μm in diameter; vessel-ray pits with distinct borders, opposite to alternate, 5–8 and 5–11 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3–4 μm in diameter; short, (430–)540–870(–1050) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 5–20 and 7–25 μm in radial and tangential diameters respectively; walls rather thin (about 2 μm); spiral thickenings absent; septate.

Axial parenchyma scanty paratracheal, diffuse-in-aggregate to in lines one cell wide, and in marginal lines; mostly 4–8 cells per strand; crystals absent.

Rays heterocellular, mostly uniseriate, rarely biseriate, consisting of a mixture of upright and square cells with occasional procumbent cells, 18–22 rays/mm in tangential section; upright, square, and procumbent cells 40–85 and 25–35, 25–40 and 22–45, 12–16 and 35–55 μm in vertical and radial diameters respectively. Perforated ray cells with simple perforations occasional. Prismatic crystals, about 10 μm in side length, occasional in chambered square or upright cells, usually one per cell. Silica bodies absent.

Glochidion ellipticum Wight

[Plate 102]

Deciduous small trees in the tropical zone.

SPECIMEN. No. 9840197, dbh=15 cm, h=5 m, alt. 790 m: Koshi Zone, Sankhuwasawa Distr., Gadhi Danda (1180 m) — Arun Bridge (820 m) — Num (1540 m) — Mude (2000 m), S. Noshiro et al., Aug. 28, 1998.

DESCRIPTION. Wood diffuse porous with small vessels. Growth rings indistinct, barely marked by smaller vessels and marginal parenchyma; pith flecks common.

Vessels evenly distributed, $17.0/\text{mm}^2$; solitary or in radial multiples of up to 6; vessel round, slightly polygonal in outline, (19–)36–73(–96) and (18–)45–105(–131) μm in radial and tangential diameters respectively, walls medium in thickness (about 5 μm).

Vessel elements medium in length, (300–)390–730(–810) μm ; perforation plates simple with thick borders; intervessel pits densely alternate, round to polygonal, about 3–5 μm in diameter; vessel-ray pits with distinct borders, densely alternate, round to elliptic, 4–7 and 4–12 μm in vertical and radial diameters respectively, often unilaterally compound. Helical thickenings absent. Tyloses occasional, thin-walled, pitted.

Non-perforated tracheal elements fibers with dense, distinctly bordered pits mostly on radial walls with chambers of about 6 μm in diameter; medium in length, (800–)1060–1650(–2025) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 10–35 and 10–40 μm in radial and tangential diameters respectively; walls rather thin (about 3 μm); spiral thickenings absent; septate.

Axial parenchyma scanty paratracheal, diffuse, and marginal; mostly 4–13 cells per strand; prismatic crystals, 20–115 μm in longest axis, common, 1–3 per cell; druses rare, one per cell.

Rays heterocellular, 1–5 cells and 20–75 μm wide, up to 900 μm tall, 12–14.5 rays/mm in tangential section; multiseriate body consisting of a mixture of upright, square, and procumbent cells, uniseriate wings and uniseriate rays mostly of upright cells with occasional square cells; upright, square, and procumbent cells 50–125 and 25–70, 35–70 and 45–55, 15–25 and 50–125 μm in vertical and radial diameters respectively. Perforated ray cell with simple perforations occasional. Prismatic crystals, 60–110 μm in longest axis, occasional, 1–2 per cell. Silica bodies absent.

Glochidion heyneanum (Wight & Arn.) Wight

[Plate 103]

Deciduous small trees in the tropical to warm temperate zones.

SPECIMENS. No. 9194141, d=12.9 cm, h=2.5 m, alt. 1350 m: Seti Zone, Bajura Distr., Tolebhir (1700 m) — Kabhri (1500 m) — Berma (1170 m), M. Suzuki et al., Aug. 9, 1991. No. 9455063*, dbh=17 cm, h=5 m, alt. 730 m: Gandaki Zone, Gorkha Distr., Khorsanedanda (830 m) — Lapubesi (830 m) — Kanbesi (920 m) — Macha Khola (850 m), M. Suzuki et al., July 21, 1994. No. 9755297, dbh=7 cm, h=6 m, alt. 520 m: Koshi Zone, Bhojpur Distr., Bumlingtar (460 m) — Arun bridge (450 m) — Chelisa Besi (530 m) — Chapabote (560 m) — Chewa Besi (370 m), S. Noshiro et al., Sept. 3, 1997.

DESCRIPTION. Wood diffuse porous with rather small vessels. Growth rings distinct, marked by smaller vessels, flattened fibers, and occasional marginal parenchyma at the end of growth rings, or indistinct; false growth rings occasional; growth ring width 1.1–5 mm.

Vessels evenly distributed, $14.4\text{--}31.4/\text{mm}^2$, reduced in size within the final 100–200 μm of growth rings; solitary or in radial multiples of up to 4, two to three multiples often merging radially or tangentially; round, slightly polygonal in outline, (21–)47–113(–149) and (17–)45–141(–192) μm in radial and tangential diameters respectively, walls medium in thickness (about 4 μm).

Vessel elements medium in length, (290–)460–880(–1130) μm ; perforation plates simple with thick borders; intervessel pits densely alternate, polygonal, about 3.5 μm in diameter; vessel-ray pits with distinct borders, opposite to alternate, round, about 4 μm in diameters. Helical thickenings absent. Tyloses absent. Dark deposits occasional.

Non-perforated tracheal elements fibers with dense, distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; long, (550–)860–2090(–2325) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, and 12–45 and 12–50 μm in radial and tangential diameters respectively; walls medium in thickness (about 5 μm); spiral thickenings absent; septate.

Axial parenchyma vasicentric with narrow sheath, diffuse, and occasionally marginal; mostly 8 cells or more per strand; prismatic crystals, 35–95 μm in longest axis, common, one per cell.

Rays heterocellular, 1–6 cells and 15–105 μm wide, up to 2.5 mm tall, 7.5–10.5 rays/mm in tangential section; multiseriate body consisting of a mixture of upright, square, and procumbent cells, uniseriate wings and uniseriate rays mostly of upright cells with occasional square cells; upright, square, and procumbent cells 55–150 and 25–60, 40–50 and 35–55, 20–35 and 60–110 μm in vertical and radial diameters respectively. Perforated ray cell with simple perforations occasional. Prismatic crystals, 65–75 μm in longest axis, occasionally in upright or square cells, one per cell. Silica bodies absent.

Leptopus cordifolius Wall. ex Decne.

[Plate 104]

Shrubs in the subtropical and temperate zones.

SPECIMENS. No. 8840510, d=3 cm, h=2 m, alt. 1800 m: Dhawalagiri Zone, Myagdi Distr., Shika – Khipang (Khibang) – Paudwar – Jibang – Gaunapani – Narchang (Nracheng), M. Suzuki et al., Aug. 26, 1988. No. 9194111*, d=2.5 cm, h=2.5 m, alt. 1290 m: Karnali Zone, Kalikot Distr., Badarigaon (1330 m) — Manma (1710 m) — Karnali Nadi (bridge) (810 m) — Rengila (850 m) — Kota (810 m), M. Suzuki et al., Aug. 6, 1991.

DESCRIPTION. Wood diffuse porous with small vessels, occasionally tending to be semi-ring-porous due to larger first-formed earlywood vessels along the growth ring boundaries. Growth rings distinct, marked by difference in vessel diameter across growth ring boundaries and flattened tracheids at the end of growth rings; false growth rings frequent; growth ring width 0.2–2.5 mm.

Vessels evenly and densely distributed, 235–272/mm², gradually reduced in size toward growth ring boundaries; mostly solitary, rarely in radial multiples up to 4; polygonal in outline, (9–)16–33(–45) and (13–)23–44(–62) μm in radial and tangential diameters respectively, walls thin (about 2 μm).

Vessel elements medium in length, (410–)600–890(–1080) μm ; perforation plates simple with thick borders; intervessel pits laxly alternate, round, 4–6 μm in diameter; vessel-ray pits with distinct borders, densely alternate or opposite, 3–7 μm in diameter. Helical thickenings throughout body of vessel element. Tyloses absent.

Non-perforated tracheal elements fibers and vascular tracheids constituting ground mass of wood. Fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; medium in length, (720–)830–1250(–1430) μm ; rectangular or polygonal in outline, 7–28 and 7–28 μm in radial and tangential diameters respectively; walls medium in thickness (about 3 μm); spiral thickenings absent; usually septate. Vascular tracheids in thin terminal bands, accompanying vessels, or in diffuse clusters; with distinctly bordered pits on both radial and tangential walls with chambers of about 6 μm in diameter; helical thickenings throughout tracheids.

Axial parenchyma absent.

Rays heterocellular, 1–4(–5) cells wide, 20.5–22 rays/mm in tangential section; uniseriate rays and uniseriate wings of multiseriate rays consisting of tall upright cells; body of multiseriate rays mostly consisting of short upright cells with occasional tall upright, square, or procumbent cells; tall and short upright, square, and procumbent cells 50–130 and 17–25, 30–45 and 13–35, 30–35 and 25–30, 12–17 and 30–50 μm in vertical and radial diameters respectively; rarely with perforated ray cells with simple perforations. Prismatic crystals absent. Silica bodies absent.

Macaranga denticulata (Blume) Müll.Arg.

[Plate 105]

Small trees in the tropical to subtropical zones.

SPECIMEN. No. 9455083, dbh=22 cm, h=4 m, alt. 830 m: Gandaki Zone, Gorkha Distr., Macha Khola (850 m) — Kholabesi (890 m) — Tatopani (930 m) — Dovan (990 m) — Syaule Bhatti (1070 m), M. Suzuki et al., July 22, 1994.

DESCRIPTION. Wood diffuse porous with medium-sized vessels often in radial multiples. Growth rings usually distinct or occasionally indistinct, marked by smaller vessels and flattened fibers at the end of growth rings; false growth rings occasional; growth ring width 0.9–4.75 mm; growth ring boundaries undulating.

Vessels evenly distributed, $8.2/\text{mm}^2$, reduced in size within the final 100–500 μm of growth rings; solitary or in radial multiples of up to 6; round, (16–)60–121(–154) and (23–)59–136(–175) μm in radial and tangential diameters respectively, walls medium in thickness (about 4 μm).

Vessel elements medium in length, (200–)400–750(–960) μm ; perforation plates simple with thick borders; intervessel pits densely alternate, round or slightly polygonal, about 6 μm in diameter; vessel-ray pits with reduced borders, opposite to scalariform, occasionally palisade, 5–25 and 5–28 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses common, thin-walled, sparsely pitted.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; medium in length, (825–)980–1450(–1600) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 7–20 and 5–32 μm in radial and tangential diameters respectively; walls thin (about 2 μm); spiral thickenings absent; non-septate.

Axial parenchyma vasicentric and diffuse-in-aggregates to in short lines; diffuse-in-aggregates parenchyma consisting of slender cells 80–180 μm tall; vasicentric parenchyma consisting of broad cells 25–130 μm tall; mostly 4–6 per strand; prismatic crystals, 20–40 μm in longest axis, or druses, about 30 μm in diameter, occasionally in short non-chambered cells.

Rays heterocellular, 1–9 cells and 15–95 μm wide, up to 1.1 mm tall, 14–16.5 rays/mm in tangential section; multiseriate body consisting of procumbent and square cells with an incomplete sheath of upright cells, uniseriate wings and uniseriate rays mostly of upright cells; upright, square, and procumbent cells 45–125 and 15–30, 25–45 and 30–40, 12–20 and 40–75 μm in vertical and radial diameters respectively. Perforated ray cell with simple or scalariform perforations occasional. Prismatic crystals, 25–40 μm in longest axis, in short enlarged cells frequent in uniseriate wings and uniseriate rays, occasional in marginal cells of multiseriate ray body. Silica bodies absent.

Mallotus nepalensis Müll.Arg.

[Plate 106]

Small trees in the temperate zone.

SPECIMENS. No. 9755148, dbh=14 cm, h=6.5 m, alt. 1930 m: Koshi Zone, Sankhuwasawa Distr., Nurbu Gaon (2120 m) — Dungameti (1900 m) — Isuwa Khola bridge (1650 m) — Nurbu Chaur (2050 m), S. Noshiro et al., Aug. 21, 1997. No. 9840113*, dbh=15 cm, h=7 m, alt. 2180 m: Koshi Zone, Sankhuwasawa Distr., Below Chamtang (2070 m) — Deurali (2350 m) — Chumsur (2380 m) — Deurali (2450 m) — Chyangrima (2170 m), S. Noshiro et al., Aug. 20, 1998.

DESCRIPTION. Wood ring porous with gradual reduction in vessel size from medium to small vessels. Growth rings distinct, marked by difference in vessel size across growth ring boundaries and flattened fibers at the end of growth rings; growth ring width 2.3–6.8 mm; pith flecks occasional.

Earlywood vessels round, solitary or in radial multiples of up to 3; 6.1–10.9/mm², (65–)110–164(–183) and (78–)151–259(–303) µm in radial and tangential diameters respectively, walls rather thick (6–8 µm). Latewood vessels round or slightly polygonal, mostly solitary or occasionally in radial multiples or clusters of 2(–4); 8.2–9.1/mm², (25–)28–72(–110) and (18–)30–104(–142) µm in radial and tangential diameters respectively, walls rather thick (about 6 µm).

Vessel elements medium in length, (370–)600–810(–880) µm; perforation plates simple, rarely scalariform with one bar, with rather thick borders; intervessel pits densely alternate, polygonal, 10 µm in diameter; vessel-ray pits with reduced borders, dense alternate to opposite, 4–8 and 4–12 µm in vertical and radial diameters respectively, occasionally unilaterally compound. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 5 µm in diameter; medium in length, (850–)960–1280(–1375) µm. Fibers constituting ground mass of wood, rectangular or polygonal in outline, 7–28 and 7–45 µm in radial and tangential diameters respectively; walls thin (about 3 µm); spiral thickenings absent; non-septate.

Axial parenchyma vasicentric with narrow sheath and diffuse, or occasionally diffuse-in-aggregates in the latewood; diffuse parenchyma consisting of slender cells 110–200 µm tall, mostly 4–8 cells per strand; vasicentric parenchyma consisting of broad cells 20–120 µm tall, mostly 10–16 cells per strand; prismatic crystals absent.

Rays heterocellular, uniseriate or partly biseriate, often merging with upper or lower rays, forming chains over 5 mm long, 14–16 rays/mm in tangential section; consisting of a mixture of upright, square, and procumbent cells; upright, square, and procumbent cells 55–80 and 25–45, 30–45 and 30–50, 15–25 and 60–100 µm in vertical and radial diameters respectively. Prismatic crystals rarely in upright or square cells. Silica bodies absent.

Mallotus philippensis (Lam.) Müll.Arg.

[Plate 107]

Evergreen small trees in the tropical to subtropical zones

SPECIMENS. No. 9194052*, d=40 cm, h=9 m, alt. 690 m: Bheri Zone, Dailekh Distr., Dungsar (720 m) — Belpata (700 m) — Chupra (750 m) — Shrithan (790 m), M. Suzuki et al., Aug. 1, 1991. No. 9194123, d=24.5 cm, h=6.5 m, alt. 780 m: Karnali Zone, Kalikot Distr., Kota (810 m) — Sangligad (860 m) — Phukgad (930 m), M. Suzuki et al., Aug. 7, 1991. No. 9455048, dbh=20 cm, h=6 m, alt. 630 m: Gandaki Zone, Gorkha Distr., Arkhet

Bazar (570 m) — Soti (630 m) — Almara (700 m) — Khorsanedanda (830 m), M. Suzuki et al., July 20, 1994.

DESCRIPTION. Wood diffuse porous with medium sized vessels. Growth rings distinct or indistinct, usually marked by difference in vessel diameter across growth ring boundaries and flattened fibers at the end of growth rings; false growth rings common.

Vessels evenly distributed, $10.0\text{--}18.5/\text{mm}^2$, reduced in size over $100\ \mu\text{m}$ across growth ring boundaries; solitary or in radial multiples of up to 6 or more; round, (14–)35–108(–129) and (15–)31–135(–178) μm in radial and tangential diameters respectively, walls rather thick (6–8 μm).

Vessel elements rather short, (260–)330–620(–770) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, round or slightly polygonal, 8–12 μm in diameter; vessel-ray pits with reduced borders, dense alternate to opposite, or scalariform to palisade, 4–12 and 7–15 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses occasional, thin-walled, sparsely pitted, with large prismatic crystals of 15–50 μm in longest axis.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; short, (510–)670–1090(–1150) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 5–16 and 7–25 μm in radial and tangential diameters respectively; walls thin, about 1.5 μm ; spiral thickenings absent; non-septate.

Axial parenchyma vasicentric with narrow sheath and in wavy lines; banded parenchyma consisting of slender cells 100–190 μm tall, mostly 4(–8) cells per strand; vasicentric parenchyma consisting of broad cells 25–130 μm tall, mostly 8–12 cells per strand; prismatic crystals, 10–30 μm in longest axis, occasionally in chambered cells.

Rays heterocellular, 1–3 cells and 12–40 μm wide, often merging with upper or lower rays, forming chains up to 3.2 mm long, 19–22 rays/mm in tangential section; multiseriate body consisting of procumbent cells, uniseriate wings and uniseriate rays of upright and square cells; upright, square, and procumbent cells 45–90 and 25–40, 25–40 and 30–40, 10–20 and 30–60 μm in vertical and radial diameters respectively. Prismatic crystals, 15–35 μm in longest axis, common in chambered upright cells and square and procumbent cells; usually one, occasionally two per cell. Silica bodies absent.

Mallotus tetracoccus (Roxb.) Kurz

[Plate 108]

Small trees in the tropical to subtropical zones.

SPECIMENS. No. 9154233, d=25 cm, h=6 m, alt. 930 m: Koshi Zone, Sankhuwasawa Distr., Baidep (960 m) — Arun River (780 m) — Num (1520 m), H. Ohba et al., Aug. 13, 1991. No. 9840031*, dbh=17 cm, h=7 m, alt. 1300 m: Koshi Zone, Sankhuwasawa Distr., Semma (1420 m) — Pathibhara Danda (1520 m) — Yekuwa (1310 m) — Deurali (1260 m) — Gola (1120 m), S. Noshiro et al., Aug. 14, 1998.

DESCRIPTION. Wood diffuse porous with large vessels often in radial multiples. Growth rings distinct, weakly marked by difference in vessel diameter across growth ring boundaries and flattened fibers at the end of growth rings; growth rings 2.8–6 mm wide.

Vessels evenly and rather sparsely distributed, $6.9\text{--}8.3/\text{mm}^2$, reduced in size over $100\text{--}400\ \mu\text{m}$ across growth ring boundaries; solitary or in radial multiples of up to 5(–7); round, (22–)57–163(–237) and (16–)44–177(–256) μm in radial and tangential diameters respec-

tively, walls rather thick (5–8 μm).

Vessel elements long, (440–)620–1270(–1370) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, round or slightly polygonal, 11–13 μm in diameter; vessel-ray pits with reduced borders, densely alternate to opposite, or scalariform to palisade, 7–27 and 7–33 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 5 μm in diameter; rather long, (1100–)1330–1950(–2225) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 10–30 and 7–35 μm in radial and tangential diameters respectively; walls thin (about 3 μm); spiral thickenings absent; non-septate; prismatic crystals, 22–30 μm in longest axis, occasionally in chambered cells.

Axial parenchyma vasicentric with narrow sheath and in wavy lines; banded parenchyma consisting of slender cells 120–270 μm tall, mostly 6–8 cells per strand; vasicentric parenchyma consisting of broad cells 50–130 μm tall, mostly 12–16 cells per strand; prismatic crystals, 10–30 μm in longest axis, occasionally in chambered cells.

Rays heterocellular, uniseriate or biseriate, occasionally merging with upper or lower rays, forming chains over 5 mm long, 12–19 rays/mm in tangential section; consisting of a mixture of upright, square, and procumbent cells; upright, square, and procumbent cells 65–200 and 20–40, 30–50 and 30–50, 20–30 and 50–100 μm in vertical and radial diameters respectively. Perforated ray cells with simple perforations occasional. Prismatic crystals, 20–50 μm in longest axis, often in chambered upright to square cells and non-chambered square to procumbent cells. Silica bodies absent.

Ostodes paniculata Blume

[Plate 109]

Deciduous small trees in the tropical to subtropical zones.

SPECIMENS. No. 8840382, d=24 cm, h=13 m, alt. 890 m: Koshi Zone, Sankhuwasawa Distr., Sedua – Vedghari (Runruma) – Arun Nadi – Dhadkhet (Runbaun) – Num, M. Suzuki et al., Aug. 2, 1988. No. 9455010*, dbh=27 cm, h=3.5 m, alt. 1170 m: Bagmati Zone, Nuwakot Distr., Trisuli Bazar (630 m) — Ragsinge Bazar (610 m) — Horagaru (880 m) — Chilaune Bas (1030 m) — Kabhre Bas (1110 m) — Samre Bhanjyang (1280 m), M. Suzuki et al., July 14, 1994. No. 9840195, dbh=23 cm, h=7.5 m, alt. 850 m: Koshi Zone, Sankhuwasawa Distr., Gadhi Danda (1180 m) — Arun Bridge (820 m) — Num (1540 m) — Mude (2000 m), S. Noshiro et al., Aug. 28, 1998.

DESCRIPTION. Wood diffuse porous with medium-sized vessels often in radial multiples. Growth rings indistinct, faintly marked by flattened fibers.

Vessels evenly and rather sparsely distributed, slightly reduced in size across seeming growth ring boundaries, 4.9–8.3/mm²; solitary or in radial multiples of up to 5(–7); round, (21–)43–127(–180) and (23–)48–189(–218) μm in radial and tangential diameters respectively, walls medium in thickness (about 5 μm).

Vessel elements medium in length, (460–)610–1010(–1240) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, polygonal, 10–16 μm in horizontal diameter; vessel-ray pits with reduced borders, opposite to scalariform, or slanting, often unilaterally compound, 6–12 and 8–25 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses occasional, thin-walled, pitted, with pris-

matic crystals 30–90 μm in longest axis.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; medium in length, (950–)1240–1830(–2075) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 10–28 and 10–35 μm in radial and tangential diameters respectively; walls thin (about 2.5 μm); spiral thickenings absent; non-septate.

Axial parenchyma scanty paratracheal and in dense wavy lines; banded parenchyma consisting of slender cells 80–185 μm tall, mostly 6–8 cells per strand; scanty paratracheal parenchyma consisting of broad cells 30–120 μm tall, 8–12(–18) cells per strand; prismatic crystals rare, 30 μm in longest axis.

Rays heterocellular, uniseriate and multiseriate, 15–18 rays/mm in tangential section. Uniseriate rays consisting mostly of tall upright cells, 1–23 cells and 100–1500 μm tall. Multiseriate rays 2–3(–4) cells and 30–65 μm wide and up to 1000 μm tall; often merging with upper or lower rays, forming chains up to 5 mm long; multiseriate body mostly made up of procumbent cells with occasional upright cells; uniseriate wings made up of upright cells; upright, square, and procumbent cells 50–100 and 25–50, 35–50 and 30–50, 20–30 and 50–115 μm in vertical and radial diameters respectively. Perforated ray cells occasional, mostly with simple perforations, rarely with scalariform to reticulate perforations. Prismatic crystals, 25–50 μm in longest axis, common in chambered upright cells. Silica bodies absent.

Phyllanthus emblica L.

[Plate 110]

Deciduous small trees in the tropical to warm temperate zones

SPECIMENS. No. 9194124*, d=14 cm, h=4.5 m, alt. 800 m: Karnali Zone, Kalikot Distr., Kota (810 m) — Sangligad (860 m) — Phukgad (930 m), M. Suzuki et al., Aug. 7, 1991. No. 9755249, dbh=15 cm, h=7 m, alt. 780 m: Koshi Zone, Sankhuwasawa Distr., Nurbu Chaur (2080 m) — Yangluwa (1880 m) — Tenggaug (1750 m) — Thanke (1620 m) — Tallo Wollung (1340 m) — Apsuwa Doban (660 m), S. Noshiro et al., Aug. 30, 1997.

DESCRIPTION. Wood diffuse porous with medium-sized vessels often in radial multiples. Growth rings usually distinct, marked by small vessel flattened fibers in the end of growth rings; growth ring width 1.1–2.6 mm; pith flecks occasional.

Vessels evenly distributed, 17.8–20.4/mm², reduced in size within the final 100–200 μm of growth rings; solitary or in radial multiples of up to 4; round, (15–)46–121(–149) and (15–)42–133(–187) μm in radial and tangential diameters respectively, walls medium in thickness (about 5 μm).

Vessel elements medium in length, (370–)620–970(–1080) μm ; perforation plates simple; intervessel pits densely alternate, round or slightly polygonal, 8–10 μm in diameter; vessel-ray pits with reduced borders, opposite or scalariform to palisade, 5–25 and 5–25 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses rare, thin-walled, unpitted.

Non-perforated tracheal elements fibers with dense, distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; rather long, (1025–)1320–2070(–2250) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 8–32 and 8–30 μm in radial and tangential diameters respectively; walls thin, about 3 μm); spiral thickenings absent; septate.

Axial parenchyma scanty paratracheal, mostly 6–8 cells per strand; prismatic crystals absent.

Rays heterocellular, uniseriate and multiseriate. Uniseriate rays consisting mostly of tall upright cells, 1–6(–14) cells and 100–550(–1150) μm tall, 0.5–2.5 rays/mm in tangential section. Multiseriate rays (3–)5–9 cells and (60–)100–200 μm wide and up to 1500 μm tall, 3.5–5.5 rays/mm in tangential section; multiseriate bodies mostly made up of procumbent and square cells with upright cells forming an incomplete sheath; uniseriate wings made up of upright cells; upright, square, and procumbent cells 70–200 and 20–50, 50–70 and 40–60, 20–50 and 60–140 μm in vertical and radial diameters respectively. Perforated rays cells with simple perforations occasional. Slender prismatic crystal, 40–90 μm in longest axis, often throughout rays, 1(–2) per cell. Silica bodies absent.

Phyllanthus parvifolius Buch.-Ham. ex D. Don

[Plate 111]

Deciduous shrubs in the tropical to warm temperate zones.

SPECIMEN. No. 8840615, d=2 cm, h=2 m, alt. 1670 m: Bagmati Zone, Kathmandu Valley, Forest Office – Chhap – Shiwapuri Summit, M. Suzuki et al., Sept. 13, 1988.

DESCRIPTION. Wood diffuse porous with small vessels often in radial multiples. Growth rings distinct, marked by flattened fibers at the end of growth rings and one discontinuous row of earlywood vessels at the beginning of growth rings; growth ring width 0.2–0.6 mm.

Vessels evenly distributed, 204.7/mm², reduced in size within the final 50–200 μm of growth rings; solitary or in radial multiples of 2–4; polygonal, (10–)16–27(–41) and (11–)21–38(–50) μm in radial and tangential diameters respectively, walls thin (about 2.5 μm).

Vessel elements medium in length, (480–)540–790(–900) μm ; perforation plates simple or scalariform with 2–8 bars, often with distinct borders; intervessel pits densely alternate, round, 3 μm in diameter; vessel-ray pits bordered, densely opposite to alternate, round to elliptic, 3–5 μm in diameter. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; medium in length, (640–)810–1120(–1340) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 8–27 and 7–25 μm in radial and tangential diameters respectively; walls thin (about 3.5 μm); spiral thickenings absent; septate.

Axial parenchyma absent.

Rays heterocellular, of two distinct sizes; smaller rays 1–2 cells wide, forming long chains up to 3 mm or more, consisting of upright cells, 21–23 rays/mm in tangential section; larger rays 4–10 cells and 45–200 μm wide, up to 5 m tall, body consisting of square and short upright cells and occasional procumbent cells with tall upright cells forming incomplete sheath, wings consisting of tall upright cells; upright, square, and procumbent cells 30–120 and 15–25, 20–30 and 20–25, 20–30 and 30–50 μm in vertical and radial diameters respectively. Perforated ray cells with simple or scalariform perforations occasional. Prismatic crystals, 15–25 μm in longest axis, frequent in non-chambered cells. Silica bodies absent.

Phyllanthus reticulatus Poir.

[Plate 112]

Shrubs in the tropical zone.

SPECIMENS. No. 9455054, d=7 cm, h=1.2 m, alt. 620 m: Gandaki Zone, Gorkha Distr.,

Arkhet Bazar (570 m) — Soti (630 m) — Almara (700 m) — Khorsanedanda (830 m), M. Suzuki et al., July 20, 1994. No. 9455084*, d = - cm, h = 1.8 m, alt. 830 m: Gandaki Zone, Gorkha Distr., Macha Khola (850 m) — Kholabesi (890 m) — Tatopani (930 m) — Dovan (990 m) — Syaule Bhatti (1070 m), M. Suzuki et al., July 22, 1994.

DESCRIPTION. Wood diffuse porous with large vessels often in radial multiples. Growth rings usually distinct marked by difference in vessel diameter across growth ring boundaries and flattened fibers at the end of growth rings; growth ring width 0.5–3.7 mm; false growth rings only with small vessels occasional.

Vessels densely and evenly distributed, 27.7–30.2/mm²; some vessels reduced in size within the final 300 µm of growth rings; solitary, in radial multiples of 2–7, or in radially elongated clusters up to 15; round, (17–)53–143(–210) and (12–)44–191(–296) µm in radial and tangential diameters respectively, walls rather thick (about 5 µm).

Vessel elements medium in length, (300–)410–910(–1140) µm; perforation plates simple with rather thick borders; intervessel pits densely alternate, polygonal, 8 µm in diameter; vessel-ray pits with reduced borders, opposite to scalariform, occasionally slanting, 7–15 and 10–32 µm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses occasional, thin-walled, unpitted, with starch.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3–6 µm in diameter; medium in length, (580–)730–1420(–1500) µm. Fibers constituting ground mass of wood, rectangular or polygonal in outline, 7–38 and 7–45 µm in radial and tangential diameters respectively; walls medium in thickness (about 3.5 µm); spiral thickenings absent; septate.

Axial parenchyma scanty paratracheal, mostly 6–8 cells per strand; prismatic crystals, 15–30 µm in longest axis, occasional in chambered cells.

Rays heterocellular, uniseriate or multiseriate, 10–17 rays/mm in tangential section; uniseriate rays consisting of upright cell, up to 26 cells and 1.2 mm tall; multiseriate ray body consisting of short upright to square cells with occasional short procumbent cells, wings of upright cells, 2–7 cells and 20–90 µm wide, up to 1.3 mm tall; upright, square, and procumbent cells 45–105 and 15–35, 30–45 and 30–50, 20–25 and 45–85 µm in vertical and radial diameters respectively. Perforated ray cells with simple perforations occasional. Prismatic crystals, 10–35 µm in longest axis, frequent in chambered upright cells and non-chambered upright to square cells; mostly one, occasionally 2–3, per cell. Silica bodies absent.

Phyllanthus sikkimensis Müll.Arg.

[Plate 113]

Shrubs in the subtropical zone.

SPECIMEN. No. 9263119, d = 3 cm, h = 2 m, alt. 1240 m: Mechi Zone, Taplejung Distr., Bhirkuna (1980 m) — Manangkhe (1620 m) — Sapcho (deurali) (1620 m) — Chiruwa (1210 m), M. Suzuki et al., May 21, 1992.

DESCRIPTION. Wood diffuse porous with small vessels usually in radial multiples. Growth rings barely distinct, marked by slight change in vessel diameter across growth ring boundaries and flattened fibers at the end of growth rings, or indistinct. Growth rings 0.6–1.4 mm.

Vessels evenly distributed, 149.1/mm²; solitary or in radial multiples of 2–7, solitary vessels and multiples often aligned radially; round, (13–)23–37(–49) and (14–)24–44(–58)

μm in radial and tangential diameters respectively, walls rather thick (about $4 \mu\text{m}$).

Vessel elements medium in length, (450–)530–670(–740) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, round, slightly polygonal, 4–5 μm in diameter; vessel-ray pits with distinct borders, opposite to alternate, dense and round, 4–5 μm in diameter. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 2 μm in diameter; rather short, (675–)730–1040(–1300) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 6–20 and 6–25 μm in radial and tangential diameters respectively; walls thin (about 2.5 μm); spiral thickenings absent; septate.

Axial parenchyma rarely diffuse or scanty paratracheal.

Rays heterocellular, 1–3 cells and 13–50 μm wide, up to 2 mm tall, 18–20 rays/mm in tangential section; uniseriate rays consisting of upright cells; multiseriate rays consisting mostly of upright and square cells with occasional procumbent cells; upright, square, and procumbent cells 35–120 and 15–45, 30–35 and 30–40, 15–20 and 45–85 μm in vertical and radial diameters respectively. Perforated ray cells with simple perforations or scalariform perforations with a few bars occasional. Prismatic crystals absent. Silica bodies absent.

Sauropus quadrangularis (Willd.) Müll. Arg.

[Plate 114]

Shrubs in the tropical to warm temperate zones.

SPECIMENS. No. 8840433, d=2.5 cm, h=1.8 m, alt. 1670 m: Gandaki Zone, Kaski Distr., Tolka (Thorika) – Landrung – Kyomi – Namjung – Ghandruk Lumle – Ghandruk (Ghandrung), M. Suzuki et al., Aug. 21, 1988. No. 9455239*, d=3 cm, h=1.7 m, alt. 1530 m: Gandaki Zone, Gorkha Distr., Ekle Ghar (1620 m) — Luktar (1600 m) — Deng (1790 m), M. Suzuki et al., Aug. 2, 1994.

DESCRIPTION. Wood diffuse porous with small vessels often in radial multiples. Growth rings distinct, marked by smaller vessels and flattened fibers at the end of growth rings, or indistinct; growth ring width 0.4–4.4 mm.

Vessels evenly distributed, 55.7–75.0/mm², reduced in size within the final 100 μm of growth rings; solitary or in radial multiples of 2–6; polygonal, (11–)20–43(–58) and (16–)25–61(–90) μm in radial and tangential diameters respectively, walls thin to rather thick (2.5–3.5 μm).

Vessel elements medium in length, (370–)460–690(–800) μm ; perforation plates simple or rarely reticulate with distinct borders; intervessel pits densely alternate, round, 5 μm in diameter; vessel-ray pits bordered, opposite to alternate, round to elliptic, 4–8 μm in radial diameter. Helical thickenings absent. Tyloses absent.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; rather short, (570–)770–1130(–1250) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 8–20 and 8–35 μm in radial and tangential diameters respectively; walls thin (about 3 μm); spiral thickenings absent; septate.

Axial parenchyma rarely scanty paratracheal or diffuse.

Rays heterocellular, 1–5 cells and 10–60 μm wide, up to 1.4 mm, about 25 rays/mm in tangential section; multiseriate body consisting a mixture of tall and short upright cells with occasional square and procumbent cells, wings and uniseriate rays mostly of tall up-

right cells; upright, square, and procumbent cells 30–110 and 15–35, 15–30 and 20–35, 15–25 and 30–55 μm in vertical and radial diameters respectively. Perforated ray cells with simple perforations occasional. Prismatic crystals absent. Druses, 12 μm in diameter, rarely in radially elongated cells among tall upright cells. Silica bodies absent.

Trewia nudiflora L.

[Plate 115]

Deciduous small trees in the tropical zone.

SPECIMENS. No. 9555005*, d=24 cm, h=10 m, alt. 80 m: Koshi Zone, Sunsari Distr., Kushaha, Koshi Tappu Wildlife Reserve, SW of Headquarter Office (60–65 m), M. Mikage et al., Oct. 21, 1995. No. 9840212, dbh=42 cm, h=9 m, alt. 440 m: Koshi Zone, Sankhuwasawa Distr., Tumlingtar (440 m) — Katle Bhanjyang (410 m) — Sabha Khola (310 m) — Khahare (410 m) — Pikuwa Khola (320 m) — Surtibari (320 m) — Baireni Bagar (320 m), S. Noshiro et al., Aug. 31, 1998.

DESCRIPTION. Wood diffuse porous with sparse large vessels often in radial multiples. Growth rings barely distinct, marked by reduction in vessel diameter across growth ring boundaries and flattened fibers at the end of growth ring, or indistinct. Pith flecks occasional.

Vessels evenly and sparsely distributed, 3.6–5.5/mm², reduced in size over 200–300 μm across growth ring boundaries; solitary or in radial multiples of 2–7, rarely in clusters formed by merging multiples; round, (26–)83–193(–245) and (17–)65–206(–266) μm in radial and tangential diameters respectively, walls rather thick (5–6 μm).

Vessel elements medium in length, (360–)490–740(–800) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, polygonal, about 12–15 μm in diameter; vessel-ray pits with reduced, but distinct borders, opposite to scalariform, occasionally slanting, round to rectangular, 10–25 and 6–13 μm in vertical and radial diameters respectively. Helical thickenings absent. Tyloses common, thin-walled, unpitted, with prismatic crystals or rare druses 15–80 μm long.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 3 μm in diameter; medium in length, (950–)1060–1430(–1600) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 7–40 and 7–45 μm in radial and tangential diameters respectively; walls thin (about 1.5 μm); spiral thickenings absent; non-septate.

Axial parenchyma scanty paratracheal and in dense lines; banded parenchyma consisting of slender cells 80–140 μm tall, mostly 4–6 cells per strand; scanty paratracheal parenchyma consisting of broad cells 25–85 μm tall, mostly 4–12 cells per strand; prismatic crystals absent.

Rays heterocellular, uniseriate and multiseriate, 13–16 rays/mm in tangential section; uniseriate rays, up to 15 cells and 800 μm tall consisting of upright and square cells; multiseriate rays up to 5 cells and 80 μm wide, up to 870 μm tall, wings consisting of upright and square cells, body of procumbent cells; upright, square, and procumbent cells 40–120 and 15–60, 30–70 and 30–70, 15–25 and 50–140 μm in vertical and radial diameters respectively. Prismatic crystals, 25–65 μm in longest axis, or druses, 25–45 μm in diameter, common in chambered upright and non-chambered upright to square cells, or rarely in procumbent cells; mostly one, occasionally 2, per cell. Silica bodies absent.

Triadica cochinchinensis Lour.

[Plate 116]

Deciduous small trees in the tropical zone.

SPECIMENS. No. 9455389, dbh=20 cm, h=11 m, alt. 1130 m: Gandaki Zone, Kaski Distr., Ghorepani (2760 m) — Banthati (2180 m) — Ulleri (1950 m) — Tikhe Dhunga (1470 m) — Ramghai (1200 m) — Birethanti Bazar (1030 m), M. Mikage et al., Aug. 28, 1994. No. 9840211*, dbh=25 cm, h=12 m, alt. 540 m: Koshi Zone, Sankhuwasawa Distr., Bhotebas (pass) (1840 m) — Mane Bhanjyang (1140 m) — Khandbari (1040 m) — Dunge Danda (920 m) — Tumlingtar Shiran (530 m) — Tumlingtar (440 m), S. Noshiro et al., Aug. 30, 1998.

DESCRIPTION. Wood diffuse porous with sparse large vessels often in radial multiples. Growth rings distinct, marked by reduction in vessel diameter across growth ring boundaries and flattened fibers at the end of growth ring, or indistinct. Pith flecks occasional.

Vessels evenly and sparsely distributed, $2.2\text{--}7.1/\text{mm}^2$, reduced in size in the final 0.5–1 mm of growth rings; solitary or in radial multiples of 2–5, rarely in clusters formed by merging multiples; round, (23–)51–241(–261) and (10–)50–301(–345) μm in radial and tangential diameters respectively, walls rather thin (3–4 μm).

Vessel elements medium in length, (440–)660–910(–1070) μm ; perforation plates simple with rather thick borders; intervessel pits densely alternate, polygonal, about 10–12 μm in diameter; vessel-ray pits with reduced borders, opposite to alternate, rarely scalariform, round to rectangular, 8–12(–25) μm in radial diameter. Helical thickenings absent. Tyloses occasional, thin-walled, pitted.

Non-perforated tracheal elements fibers with distinctly bordered pits mostly on radial walls with chambers of about 4 μm in diameter; medium in length, (800–)1000–1380(–1550) μm . Fibers constituting ground mass of wood, rectangular or polygonal in outline, 12–45 and 12–60 μm in radial and tangential diameters respectively; walls thin (about 1.5–3 μm); spiral thickenings absent; non-septate.

Axial parenchyma scanty paratracheal and in dense lines; banded parenchyma consisting of slender cells 75–200 μm tall, mostly 4–8 cells per strand; scanty paratracheal parenchyma consisting of broad cells 45–130 μm tall, mostly 8–12 cells per strand; prismatic crystals, 15–30 μm in longest axis, occasionally in chambered cells.

Rays heterocellular, 1–2(–3) cells and 10–30(–45) μm wide, up to 1.1 mm tall, 10–13 rays/mm in tangential section, consisting of upright, square, and procumbent cells; upright, square, and procumbent cells 45–110 and 30–50, 40–80 and 35–80, 20–50 and 50–230 μm in vertical and radial diameters respectively. Prismatic crystals, 20–25 μm in longest axis, occasionally in chambered upright cells, mostly one per cell. Druses, about 20 μm in diameter, rarely in procumbent cells. Silica bodies absent.

References

- Suzuki, M. and Yoda, K. 1986. Comparative wood anatomy of Coriaria of East Asia 1. Journ. Jap. Bot. **61**: 289–296.
 Suzuki, M. and Yoda, K. 1986. Comparative wood anatomy of Coriaria of East Asia 2. Journ. Jap. Bot. **61**: 333–342.
 Yoda, K. and Suzuki, M. 1992. Comparative wood anatomy of Coriaria. Bot. Mag. Tokyo **105**: 235–246.

INDEX OF LATIN NAMES

Names in italics are synonyms.

| | | | |
|--|----------|---------------------------------|-----|
| <i>Alchornea mollis</i> | 358 | <i>Sauropus quadrangularis</i> | 373 |
| <i>Antidesma acidum</i> | 359 | | |
| <i>bunius</i> | 360 | <i>Trewia nodiflorum</i> | 374 |
| | | <i>Triadica cochinchinensis</i> | 375 |
| <i>Balakata baccata</i> | 360 | | |
| Berberidaceae | 347 | | |
| <i>Berberis angulosa</i> | 347 | | |
| <i>asiatica</i> | 348 | | |
| <i>ceratophylla</i> | 349 | | |
| <i>concinna</i> var. <i>extensiflora</i> | 350 | | |
| <i>hookeri</i> | 350 | | |
| <i>koehneana</i> | 351 | | |
| <i>mucrifolia</i> | 352 | | |
| <i>sikkimensis</i> var. <i>baileyi</i> | 353 | | |
| <i>tsarica</i> | 354 | | |
| <i>umbellata</i> | 355 | | |
| <i>zebeliana</i> | 356 | | |
| <i>Bridelia retusa</i> | 361 | | |
| <i>stipularis</i> | 362 | | |
| <i>Coriaria napalensis</i> | 356 | | |
| <i>tenrminalis</i> | 357 | | |
| Coriariaceae | 347, 356 | | |
| Euphorbiaceae | 347, 358 | | |
| <i>Excoecaria acerifolia</i> | 363 | | |
| <i>Glochidion ellipticum</i> | 363 | | |
| <i>heyneanum</i> | 364 | | |
| <i>Leptopus cordifolius</i> | 365 | | |
| <i>Macaranga denticulate</i> | 366 | | |
| <i>Mallotus nepalensis</i> | 367 | | |
| <i>philippensis</i> | 367 | | |
| <i>tetracoccus</i> | 368 | | |
| <i>Ostodes paniculata</i> | 369 | | |
| <i>Phyllanthus emblica</i> | 370 | | |
| <i>parvifolius</i> | 371 | | |
| <i>reticulatus</i> | 371 | | |
| <i>sikkimensis</i> | 372 | | |

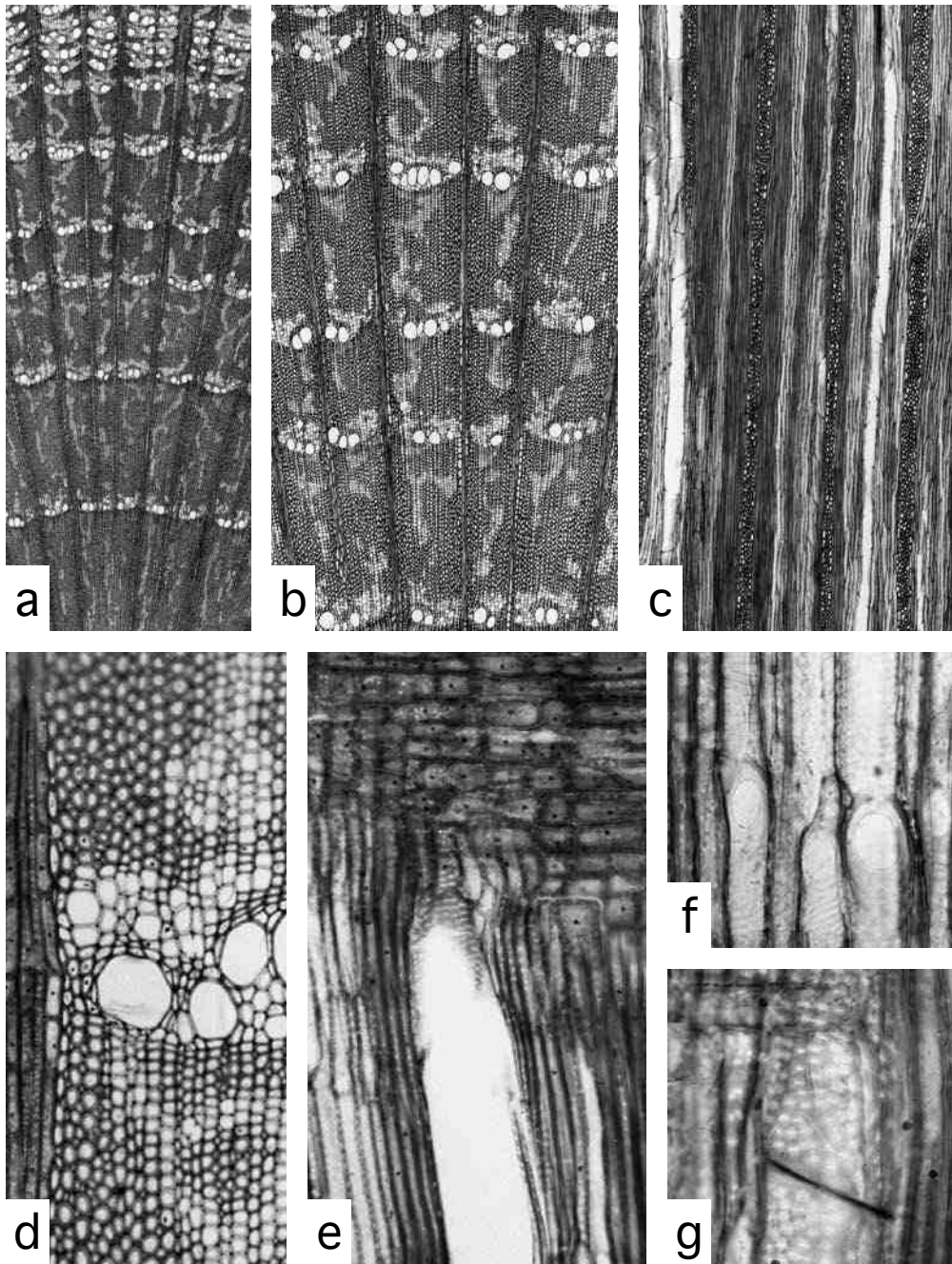


Plate 82. *Berberis angulosa* Wall. ex Hook. f. et Thoms. (No. 9684253). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing small vessel elements with simple perforations and helical thickenings. g: Radial section ($\times 400$) showing alternate intervessel pits and vessel-ray pits.

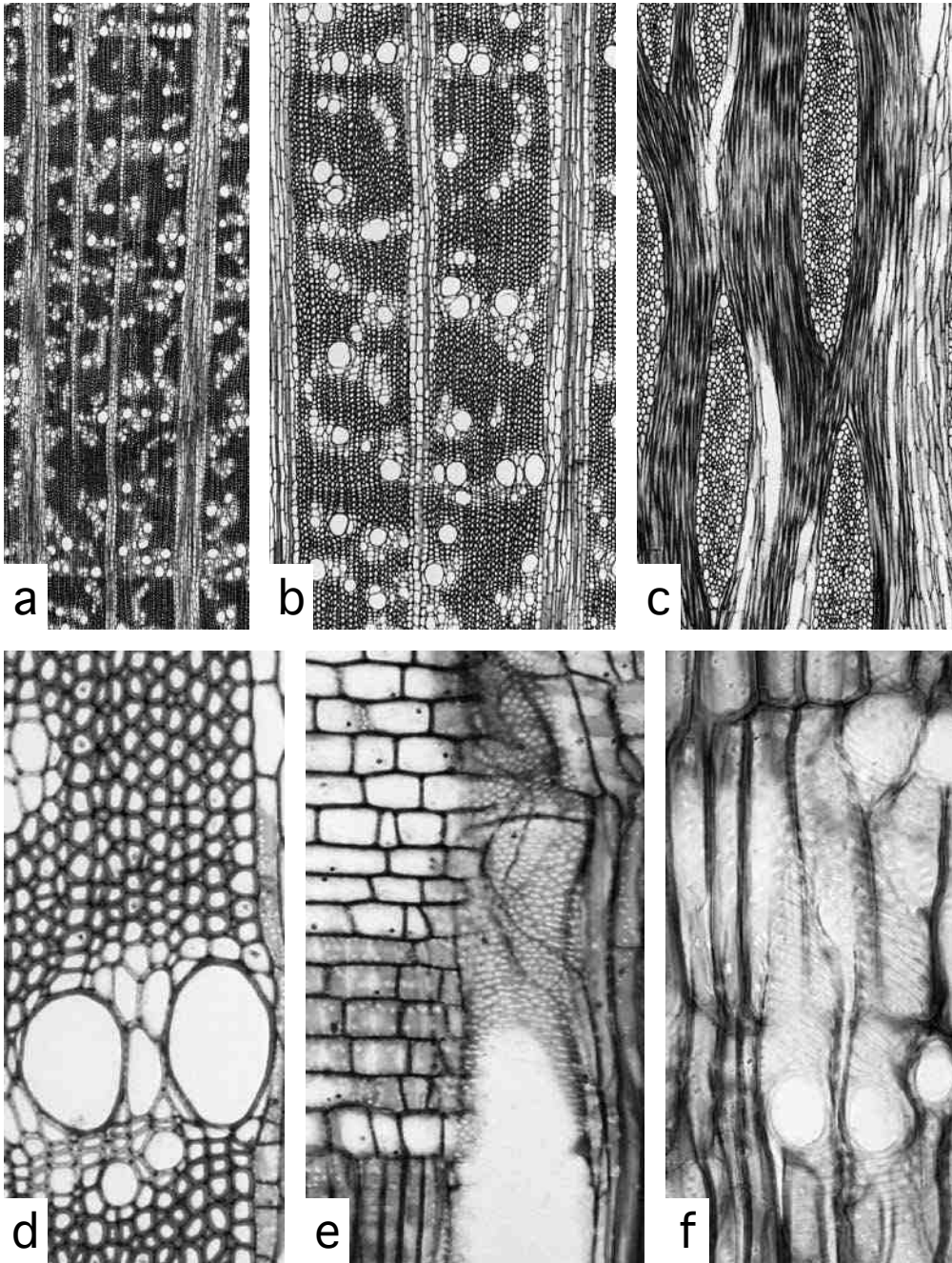


Plate 83. *Berberis asiatica* Roxb. ex DC. (No. 9551040). a: Cross section ($\times 20$) showing semi-ring porous wood. b: Cross section ($\times 40$) showing irregular clusters of large and small pores in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing small vessel elements with simple perforations, helical thickenings and vessel-ray pits.

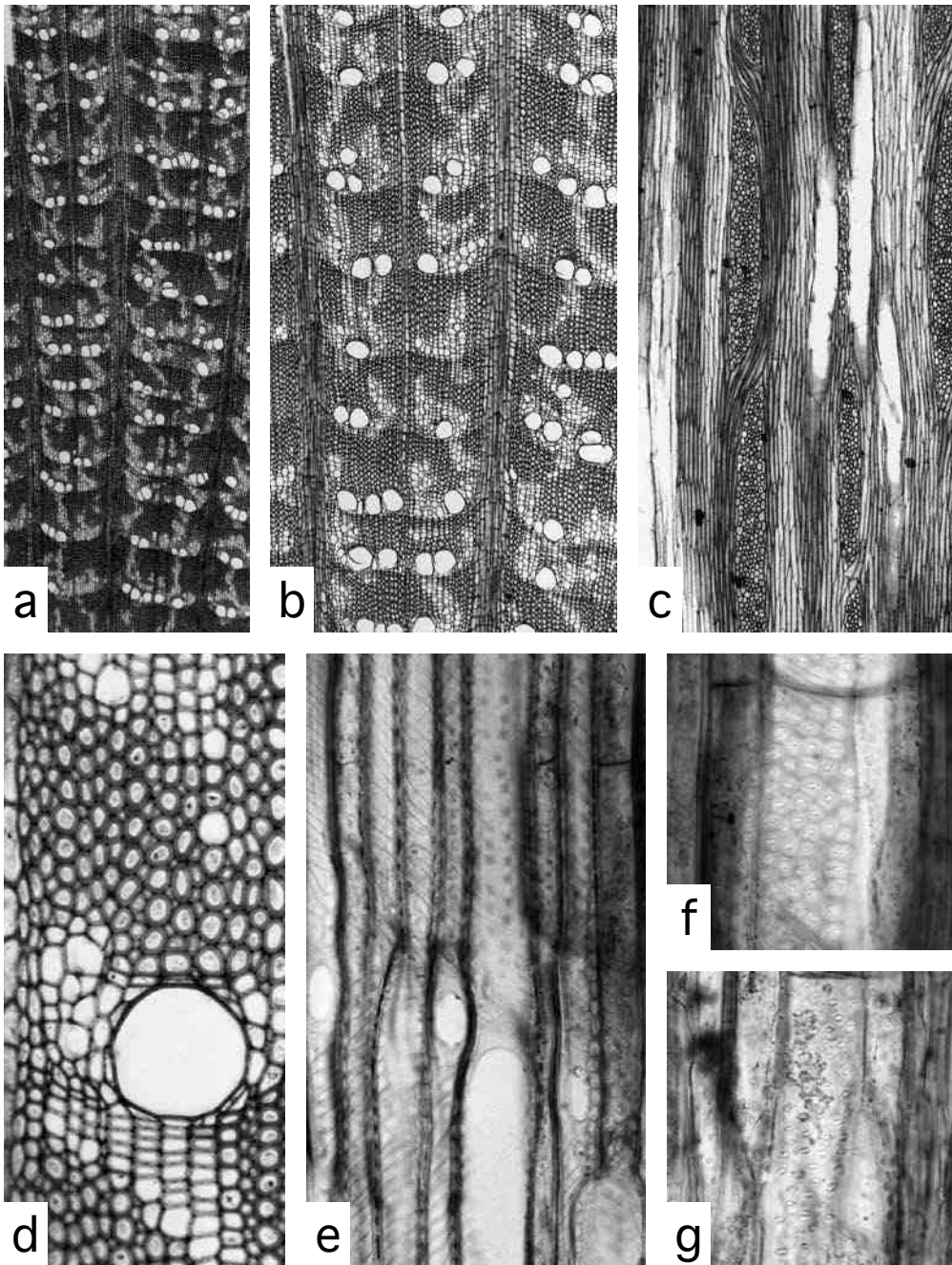


Plate 84. *Berberis ceratophylla* G. Don (No. 9686116). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing small vessel elements and a septate fiber. f: Radial section ($\times 400$) showing alternate intervessel pits. g: Radial section ($\times 400$) showing vessel-ray pits.

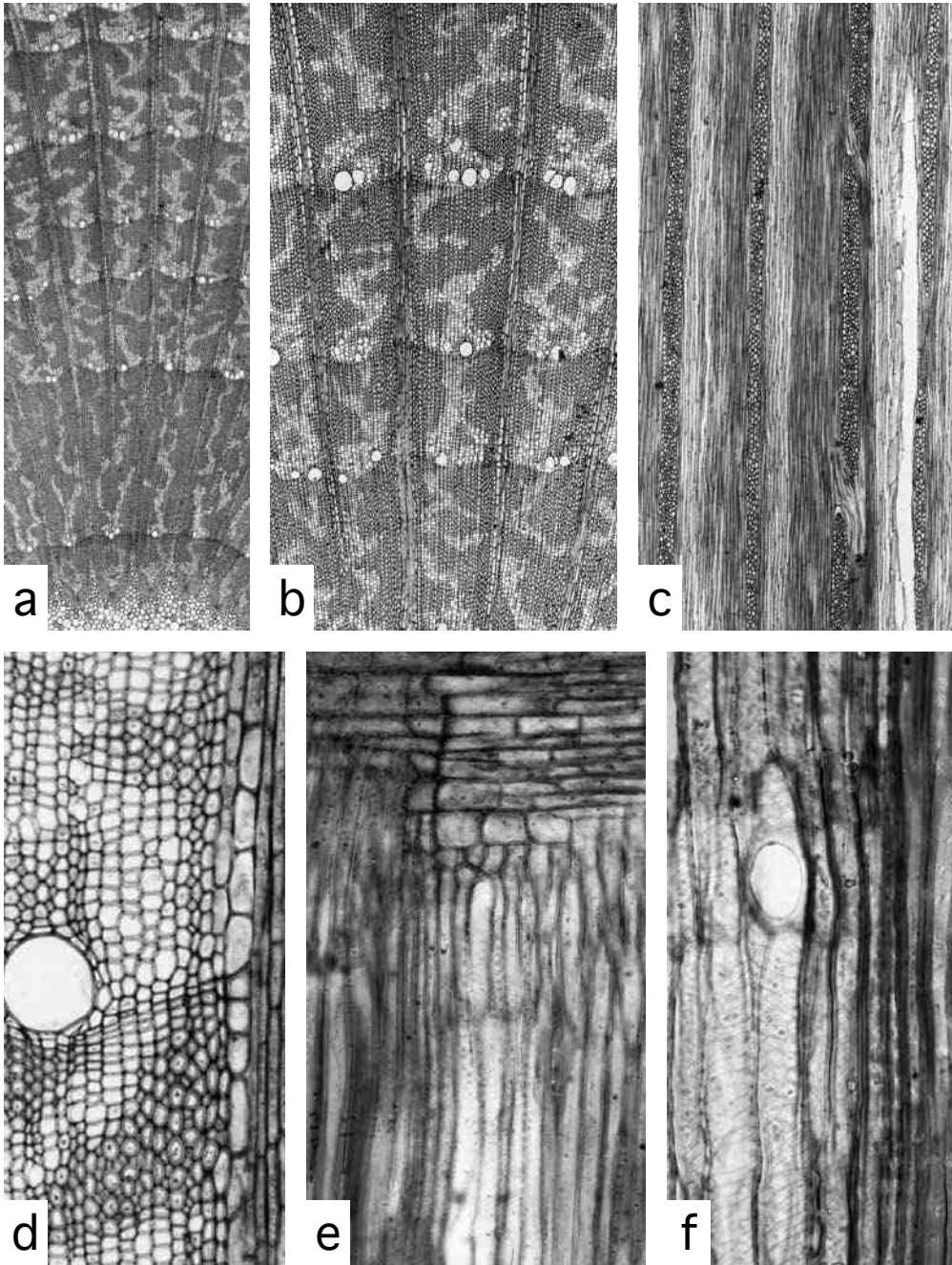


Plate 85. *Berberis concinna* Hook. f. et Thoms. var. *extensiflora* Ahrendt (No. 9684190). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing small vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing fiber pits and small vessel elements with simple perforations and helical thickenings.

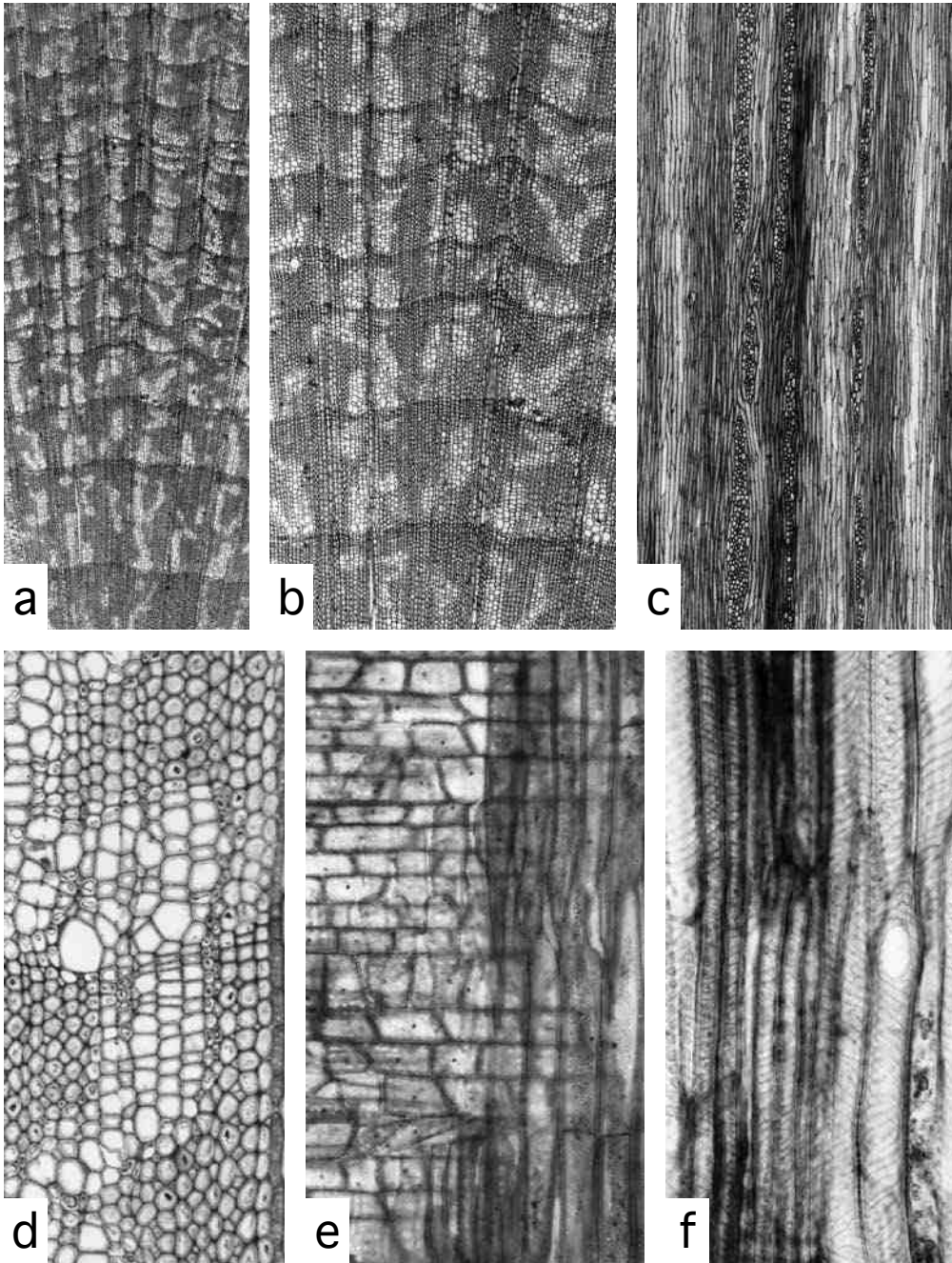


Plate 86. *Berberis hookeri* Lamaire (No. 9460308). a: Cross section ($\times 20$) showing semi-ring porous wood. b: Cross section ($\times 40$) showing pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing heterocellular ray cells. f: Radial section ($\times 400$) showing vessel elements with a simple perforation and helical thickenings.

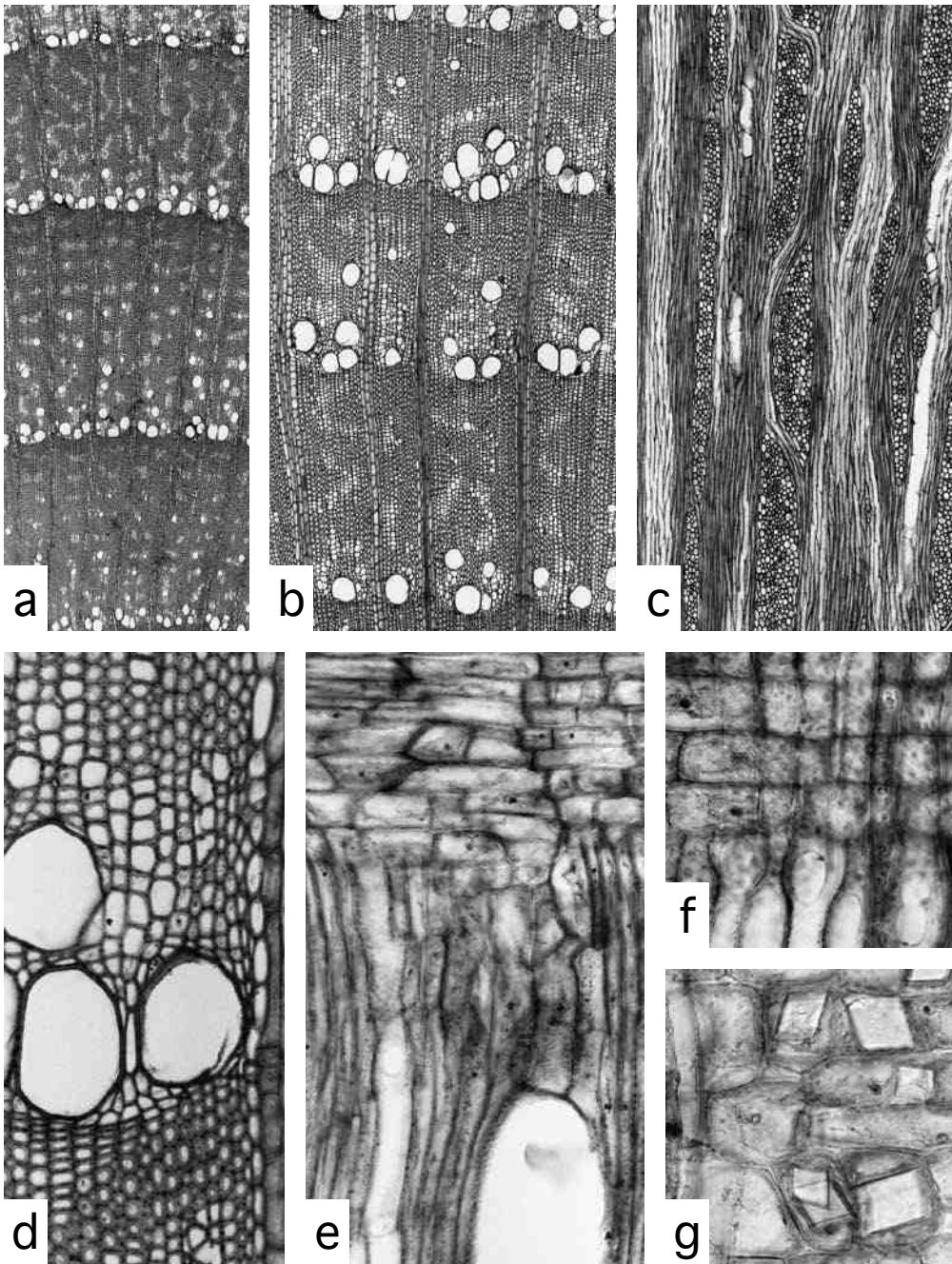


Plate 87. *Berberis koehneana* Schneid. (No. 9460361). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing vessel-ray pits. g: Radial section ($\times 400$) showing prismatic crystals.

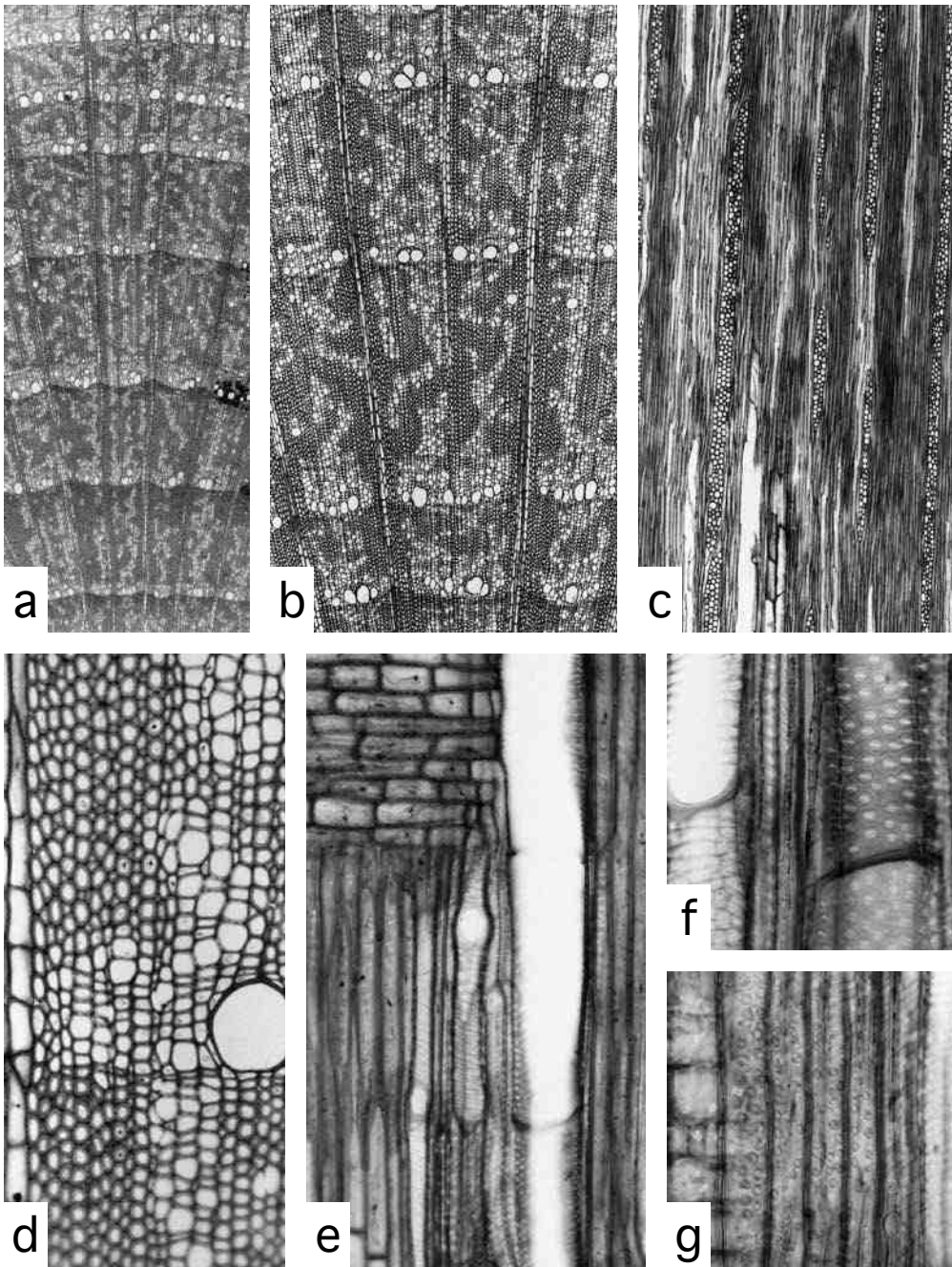


Plate 88. *Berberis mucrifolia* Ahrendt (No. 9551061). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements, heterocellular ray cells and septate fibers. f: Radial section ($\times 400$) showing alternate intervessel pits and helical thickenings. g: Radial section ($\times 400$) showing vessel-ray pits.

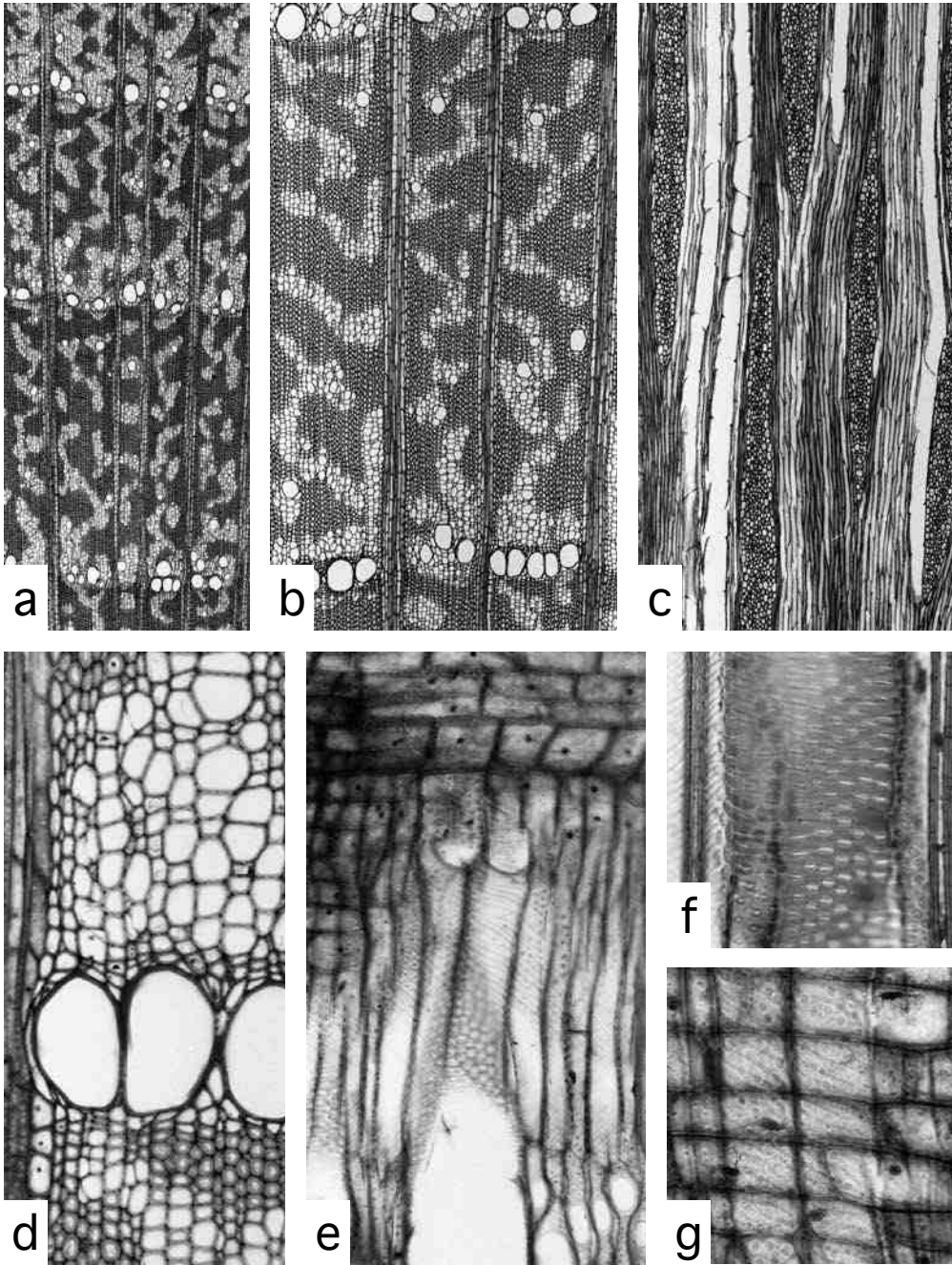


Plate 89. *Berberis sikkimensis* (Schneid.) Ahrendt var. *baileyi* Ahrendt (No. 9460454). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements, heterocellular ray cells and septate fibers. f: Radial section ($\times 400$) showing alternate intervessel pits. g: Radial section ($\times 400$) showing vessel-ray pits .

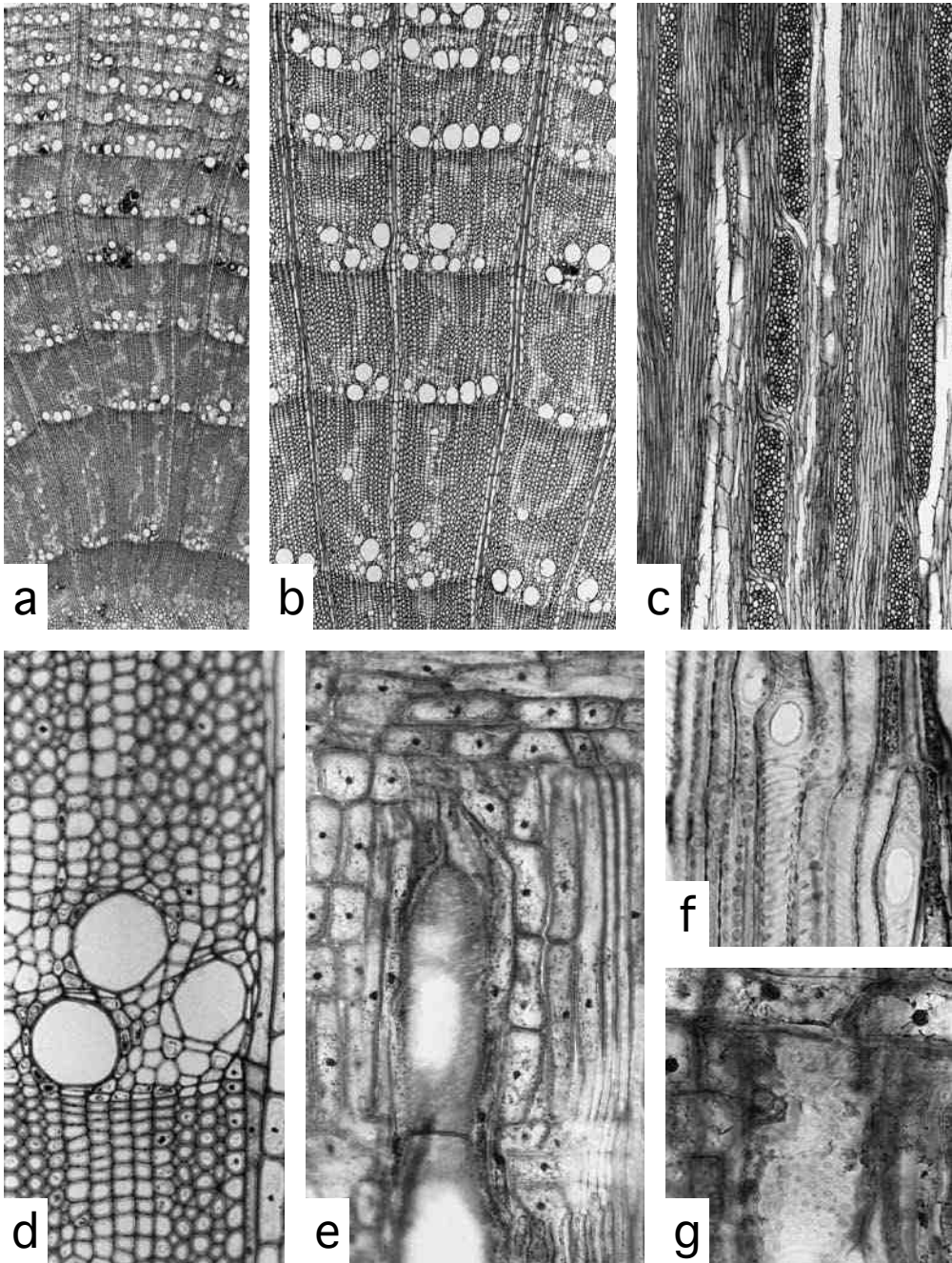


Plate 90. *Berberis tsarica* Ahrendt (No. 9460389). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing small vessel elements with simple perforations and helical thickenings. g: Radial section ($\times 400$) showing vessel-ray pits.

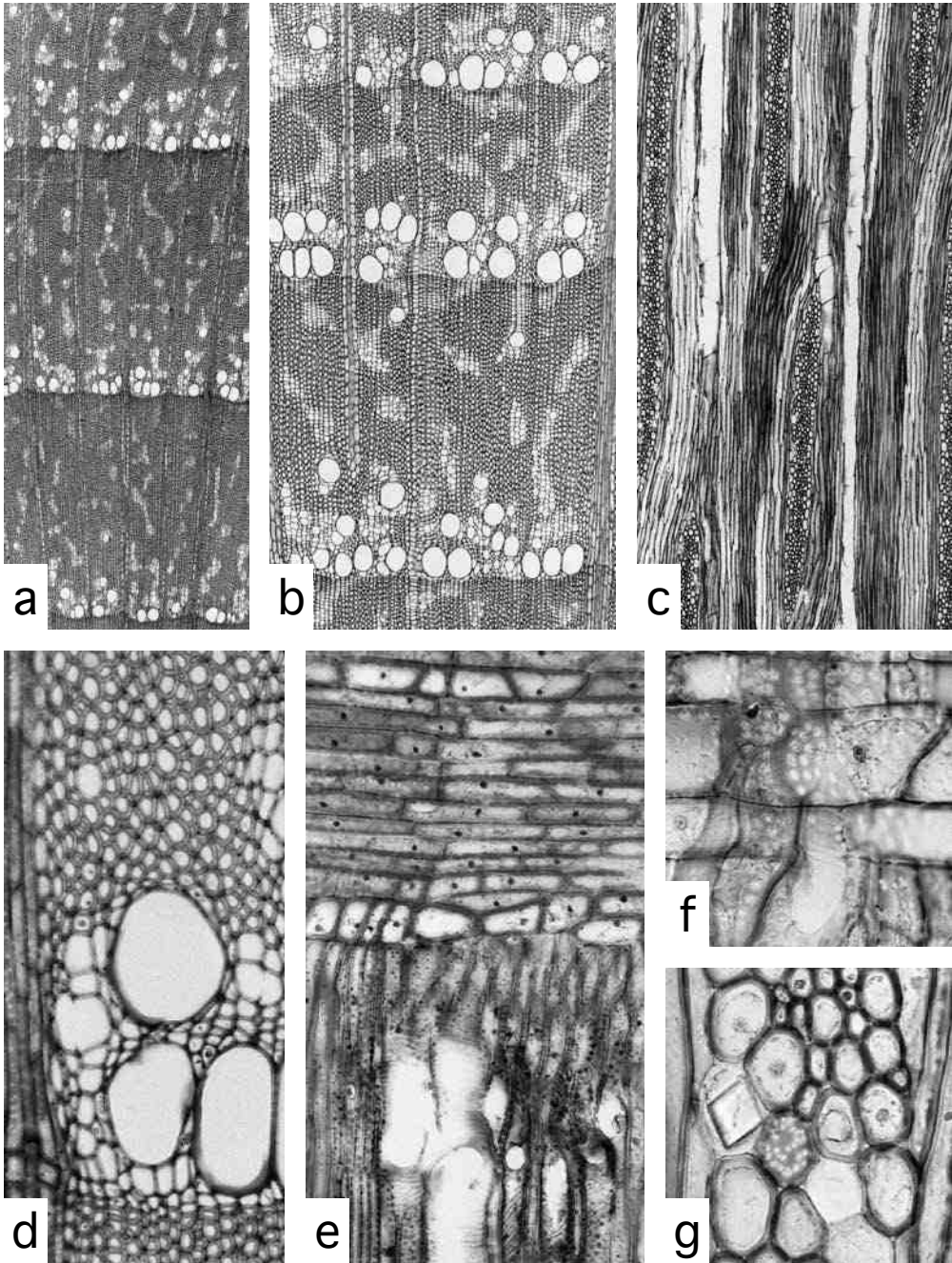


Plate 91. *Berberis umbellata* Wall. ex G. Don (No. 9460298). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in dendritic pattern in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing vessel-ray pits. g: Tangential section ($\times 400$) showing prismatic crystals.

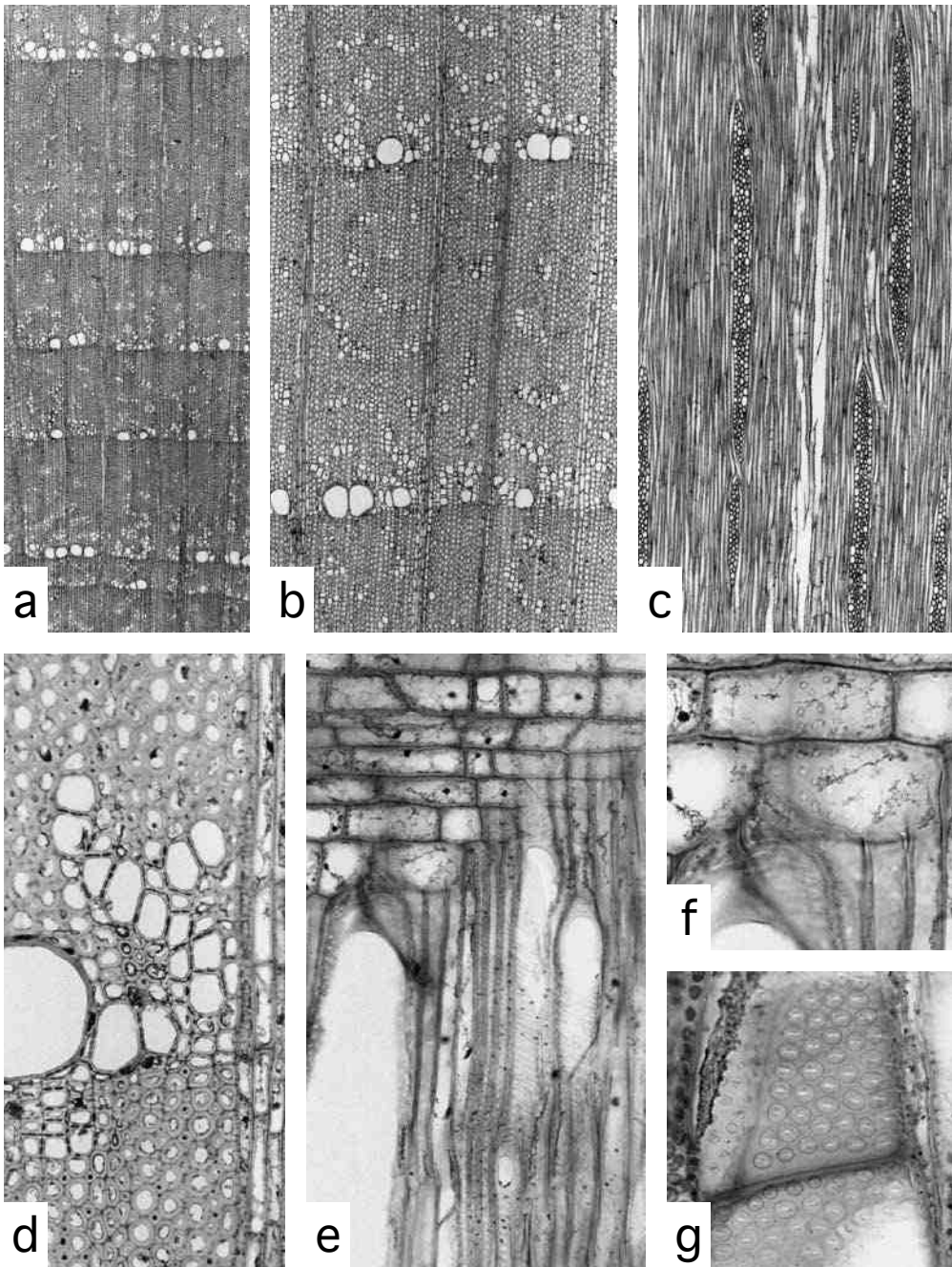


Plate 92. *Berberis zebeliana* Schneid. (No. 9460344). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing small pores in irregular clusters in late wood. c: Tangential section ($\times 40$) showing heterocellular rays. d: Cross section ($\times 200$) showing growth ring boundary. e: Radial section ($\times 200$) showing large and small vessel elements and heterocellular ray cells. f: Radial section ($\times 400$) showing vessel-ray pits. g: Radial section ($\times 400$) showing alternate intervessel pits.

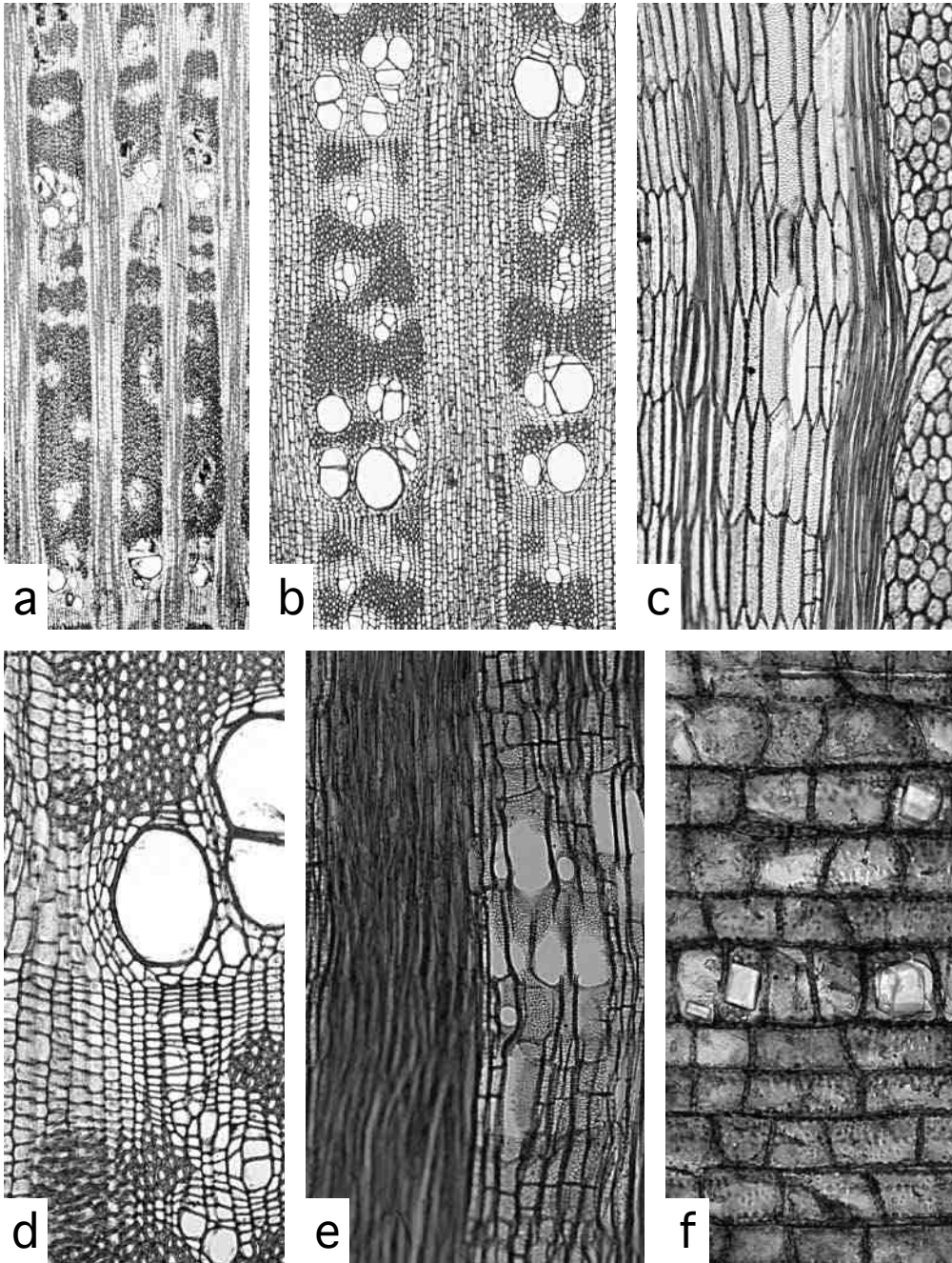


Plate 93. *Coriaria napalensis* Wall. (No. 8340287). a ($\times 20$) & b ($\times 40$): Cross sections showing semi-ring porous vessel arrangement, vascentric and confluent axial parenchyma and wide rays. c: Tangential section ($\times 100$) showing parts of large rays and storied structure of narrow vessel elements and axial parenchyma. d: Magnified cross section ($\times 100$) showing an annual ring boundary, a part of a large ray, wide vessels in earlywood and narrow vessels with vascentric and confluent axial parenchyma in latewood. e: Radial section ($\times 100$) showing a part of ray, narrow vessels with simple perforation plates and axial parenchyma. f: magnified radial section ($\times 200$) showing narrow vessels with simple perforation plates and axial parenchyma. g: Radial section ($\times 200$) showing procumbent and square ray cells. Single crystals are often present in the square cells.

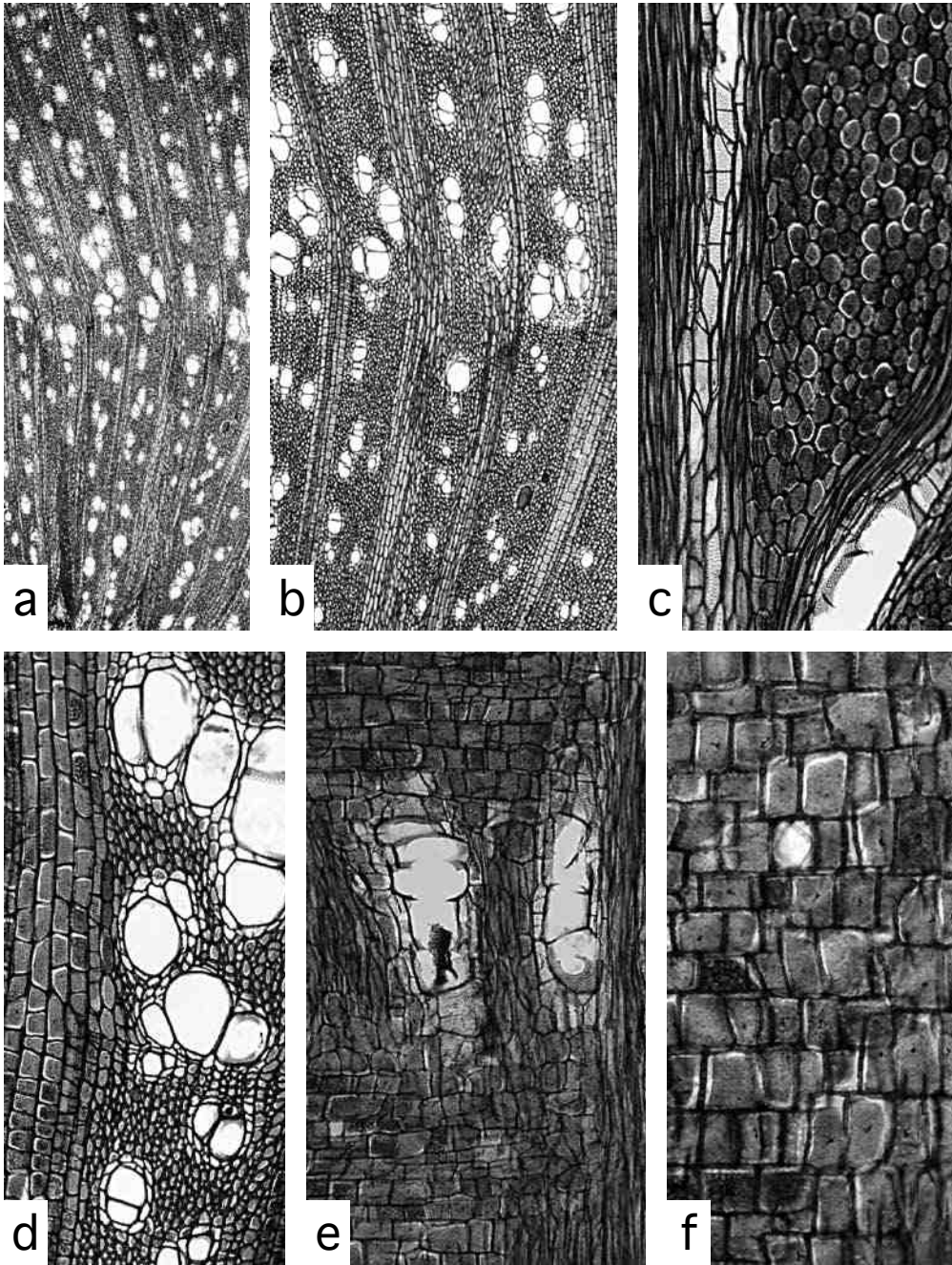


Plate 94. *Coriaria terminalis* Hems. (No. 12316). a ($\times 20$) & b ($\times 40$): Cross sections showing diffuse to semi-ring porous vessel arrangement, vasicentric axial parenchyma and wide rays. c: Tangential section ($\times 100$) showing parts of large rays and weekly storied structure of narrow vessel elements and axial parenchyma. d: Magnified cross section ($\times 100$) showing an annual ring boundary and wider vessels in earlywood and narrower vessels with vasicentric axial parenchyma in latewood. e: Radial section ($\times 100$) showing the narrower vessels with simple perforation plates and vasicentric axial parenchyma. f: Radial section ($\times 200$) showing procumbent and square ray cells. Single crystals are rarely present in the square cells.

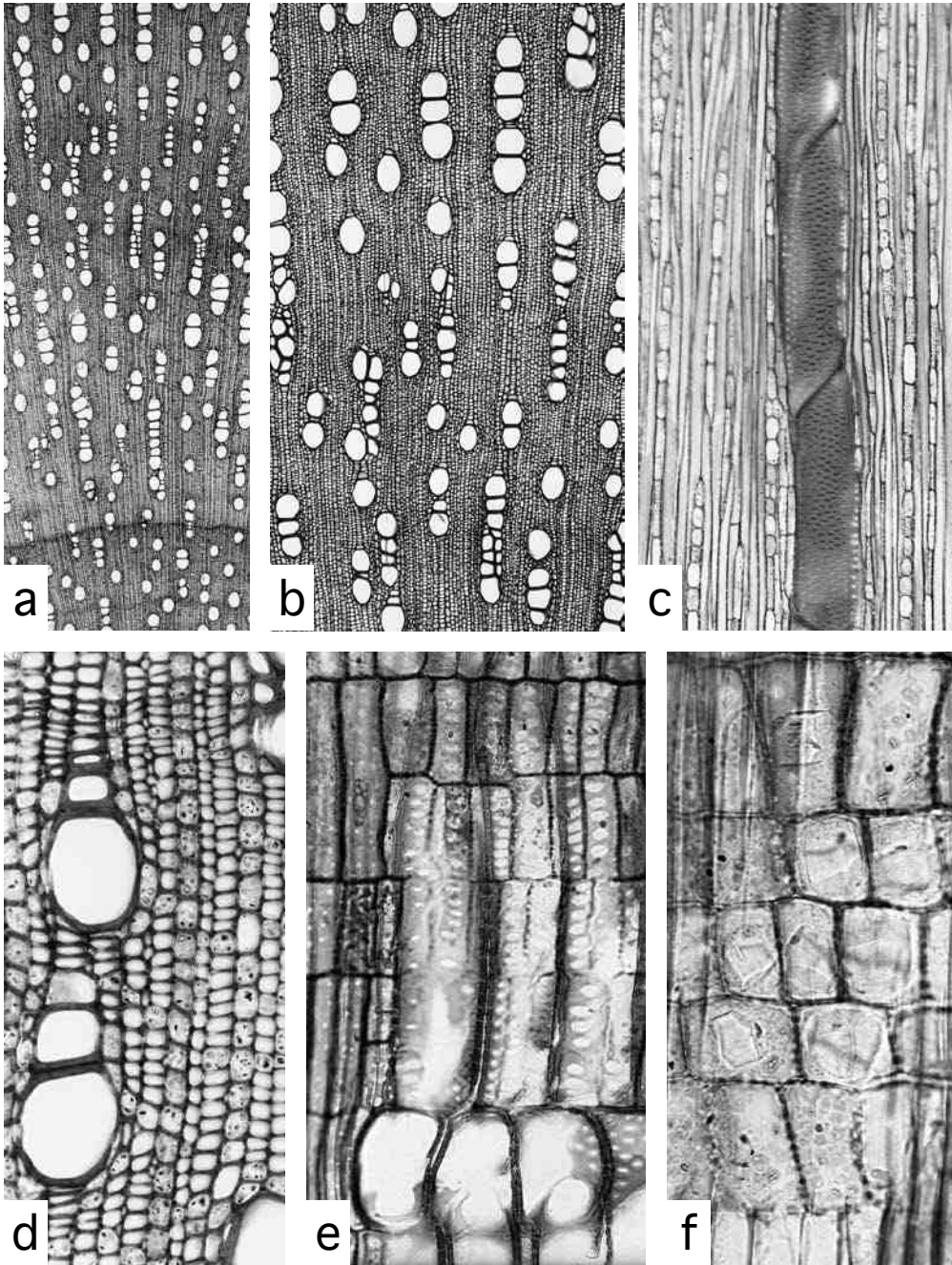


Plate 95. *Alchornea mollis* (Benth.) Müll.Arg. (No. 9840040). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels mostly in radial multiples or clusters. c: Tangential section ($\times 100$) showing narrow heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessel multiples and scanty paratracheal and banded parenchyma. e: Radial section ($\times 200$) showing simple perforations and scalariform vessel-ray pits. f: Radial section ($\times 400$) showing prismatic crystals in ray cells.

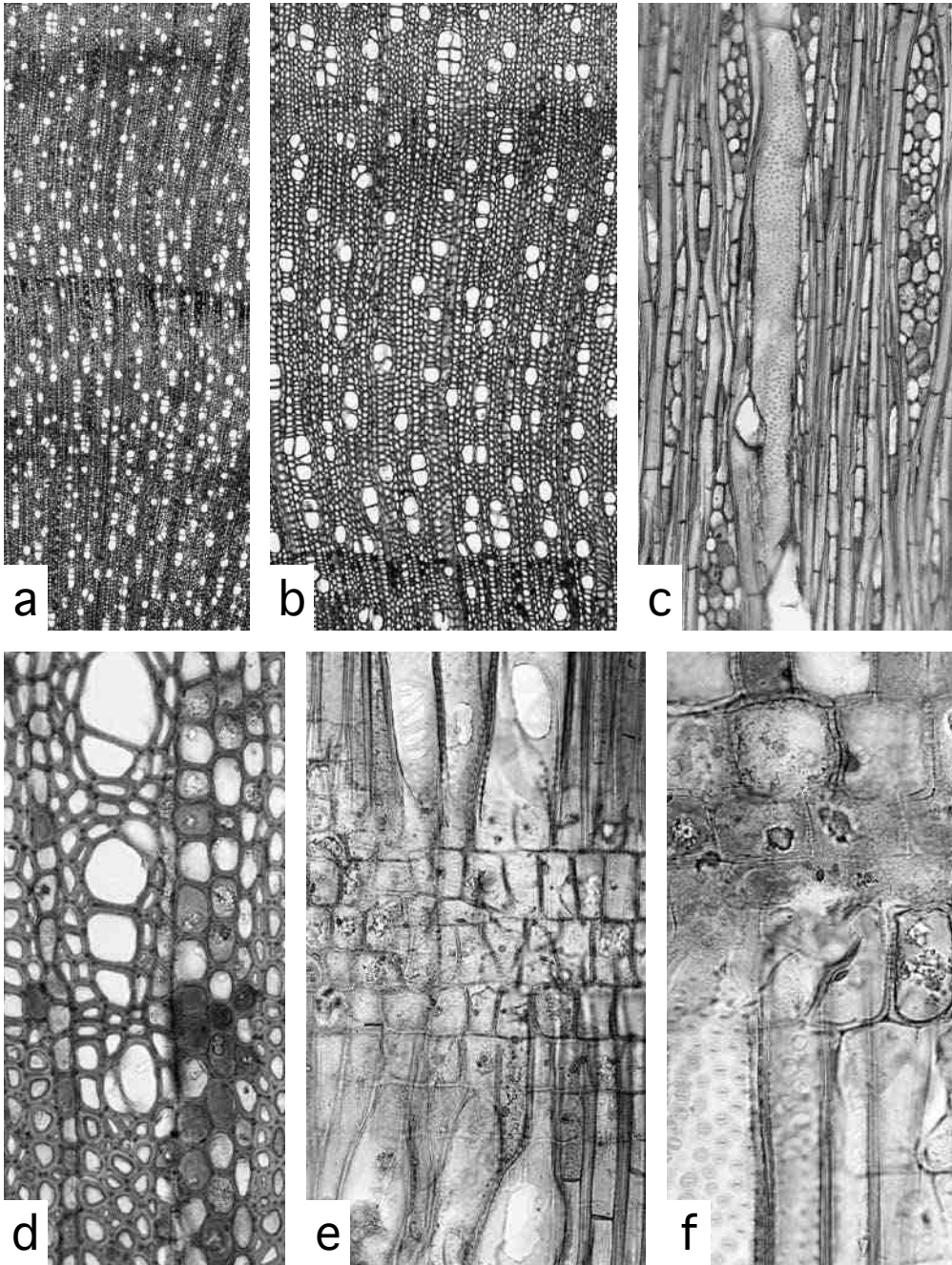


Plate 96. *Antidesma acidum* Retz. (No. 9455031). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing rather sparse small vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessel multiples and silica bodies in ray cells. e: Radial section ($\times 200$) showing simple and scalariform perforations, septate fibers, and scalariform vessel-ray pits. f: Radial section ($\times 400$) showing silica bodies in ray cells.

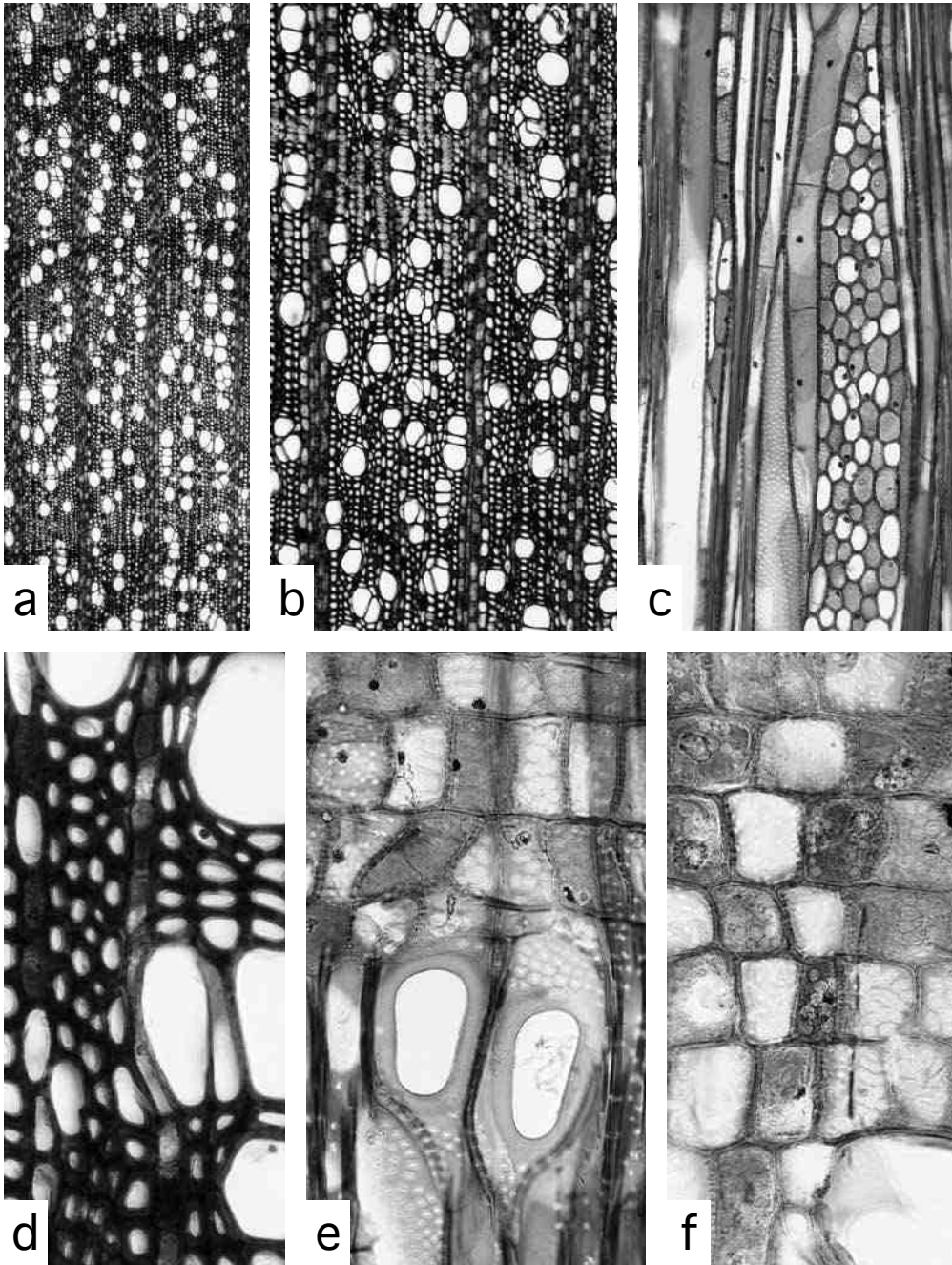


Plate 97. *Antidesma bunius* (L.) Spreng. (No. 9455034). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing round vessels often in radial multiples. c: Tangential section ($\times 100$) showing large heterocellular rays and dense intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing simple perforations and opposite to scalariform vessel-ray pits. f: Radial section ($\times 200$) showing a perforated ray cell with a simple perforation and silica bodies in ray cells.

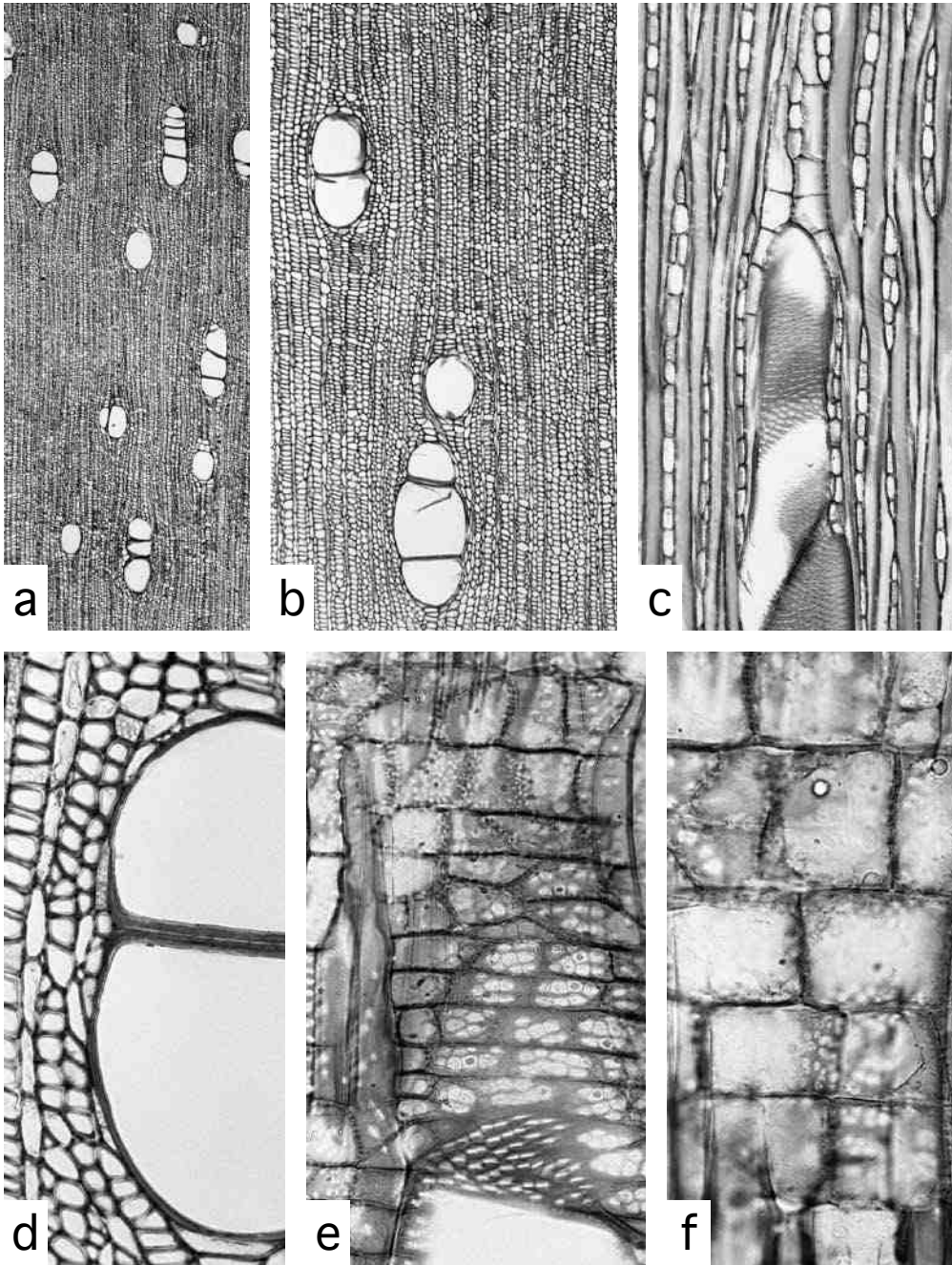


Plate 98. *Balakata baccata* (Roxb.) Esser (No. 9455056). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing sparse large vessels and axial parenchyma in dense lines. c: Tangential section ($\times 100$) showing narrow heterocellular rays, paratracheal parenchyma, and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing vessel-ray pits with reduced borders. f: Radial section ($\times 400$) showing small silica bodies in ray cells.

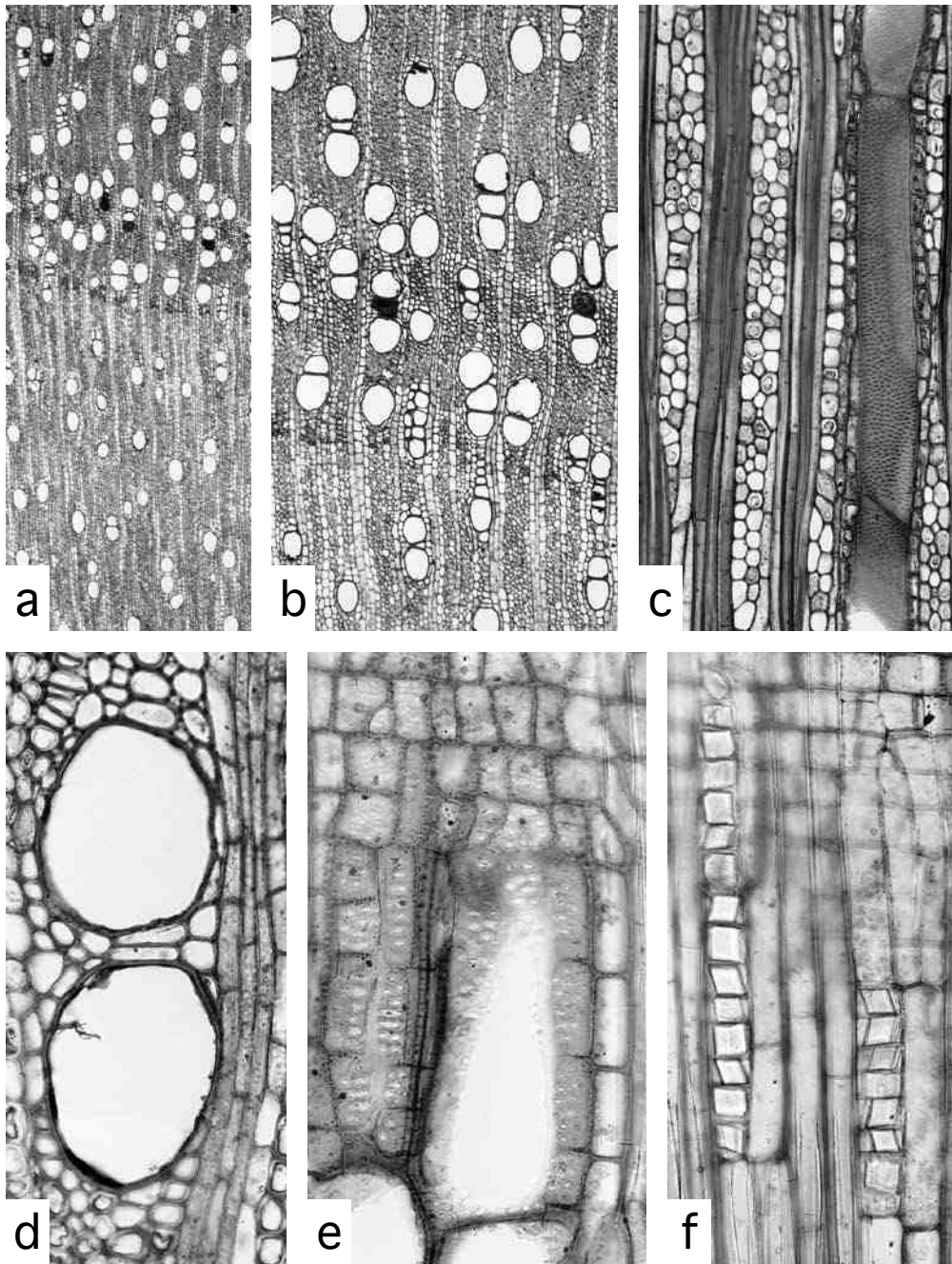


Plate 99. *Bridelia retusa* (L.) A. Juss. (No. 9755271). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing round vessels often in radial multiples and marginal parenchyma. c: Tangential section ($\times 100$) showing tall heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric parenchyma. e: Radial section ($\times 200$) showing opposite to scalariform vessel-ray pits and similar pits in axial parenchyma cells. f: Radial section ($\times 200$) showing prismatic crystals in chambered axial parenchyma cells.

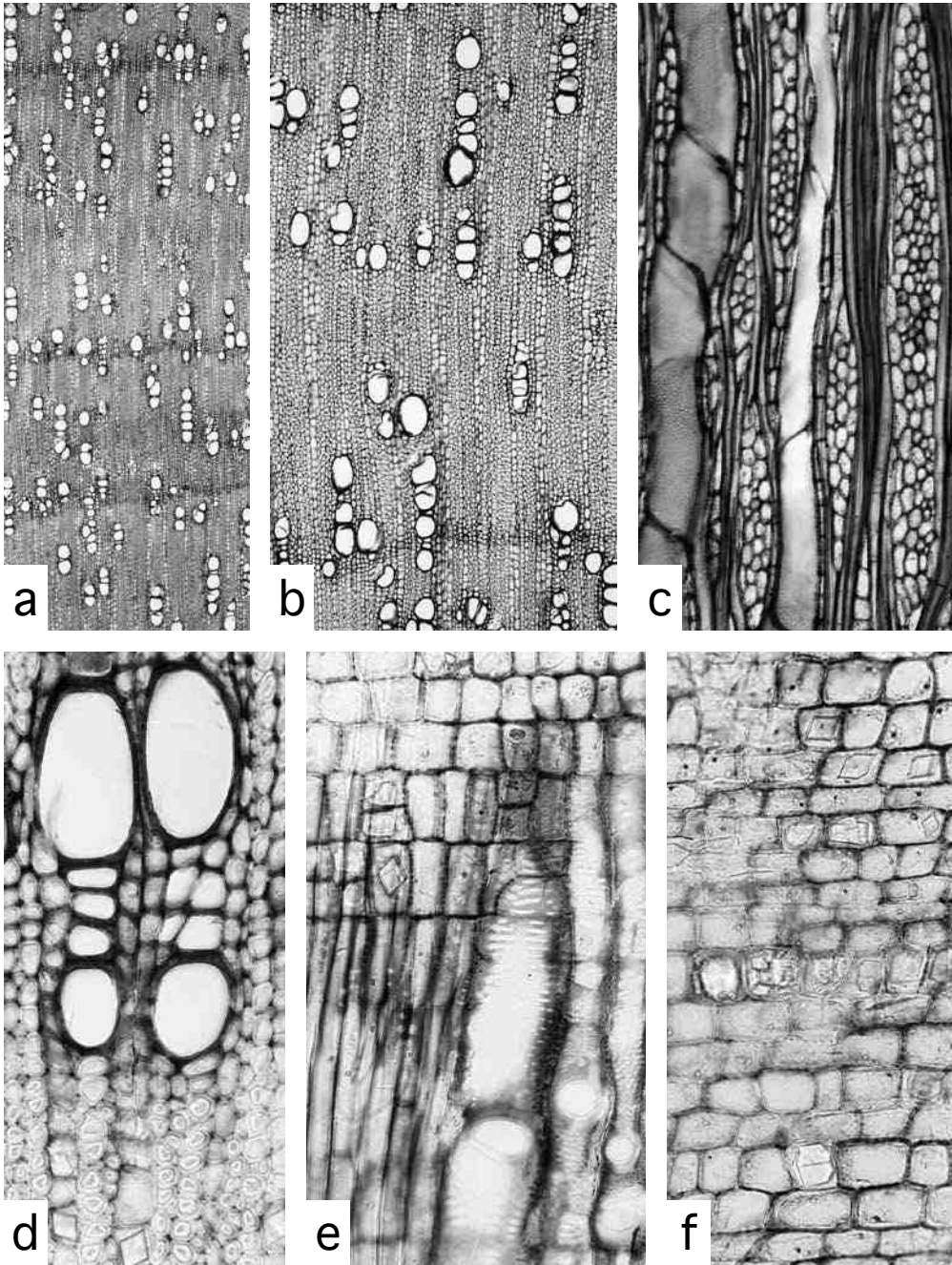


Plate 100. *Bridelia stipularis* (L.) Blume (No. 9194191). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and marginal parenchyma. e: Radial section ($\times 200$) showing simple perforations, scalariform vessel-ray pits, and prismatic crystals in ray cells. f: Radial section ($\times 200$) showing prismatic crystals in ray cells.

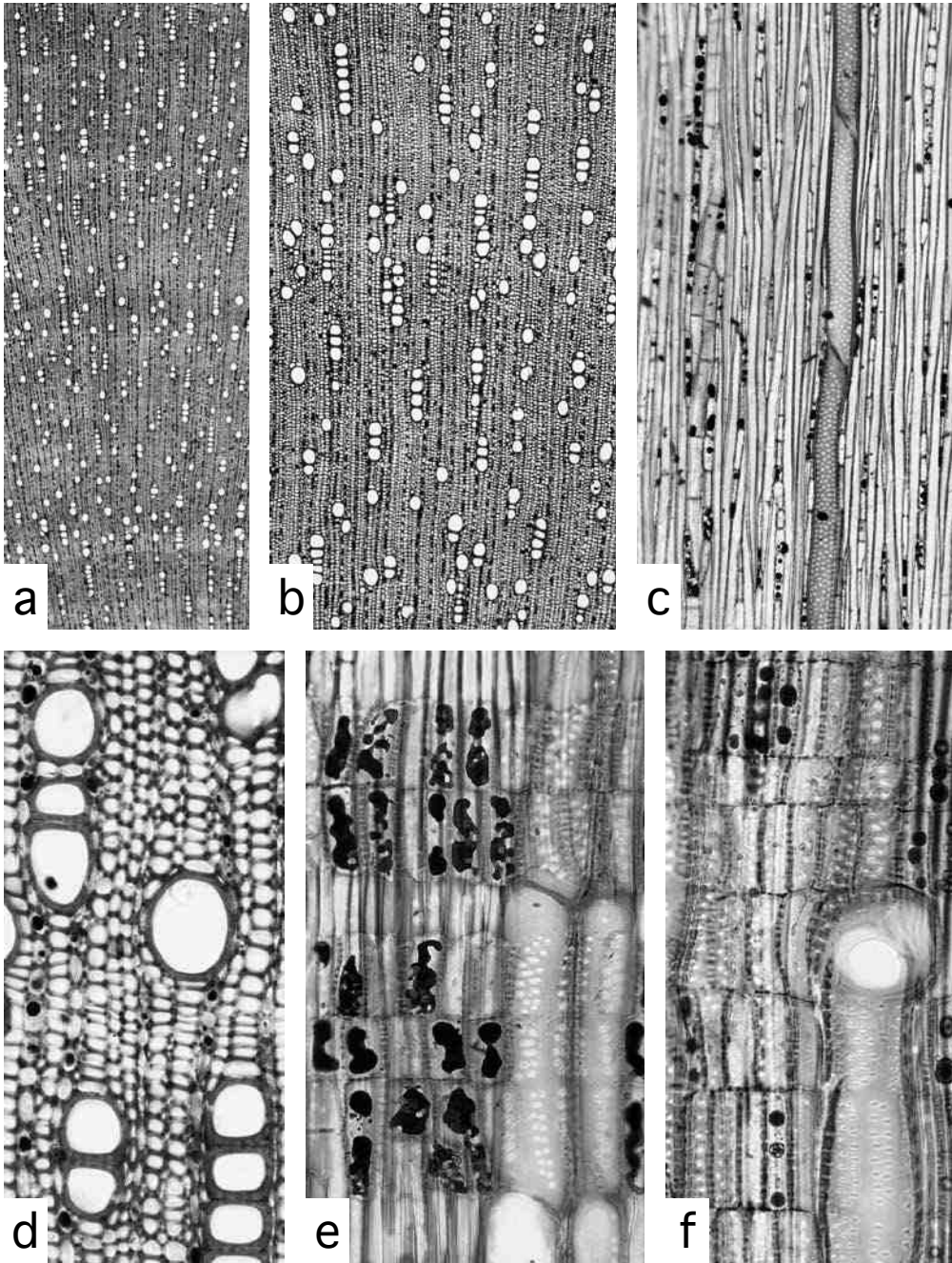


Plate 101. *Excoecaria acerifolia* Didr. (No. 8840516). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing small vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular uniseriate rays and intervessel pits. d: Cross section ($\times 200$) showing thick-walled vessels and scanty paratracheal and marginal parenchyma. e: Radial section ($\times 200$) showing opposite vessel-ray pits with distinct borders. f: Radial section ($\times 200$) showing a perforated ray cell with a simple perforation.

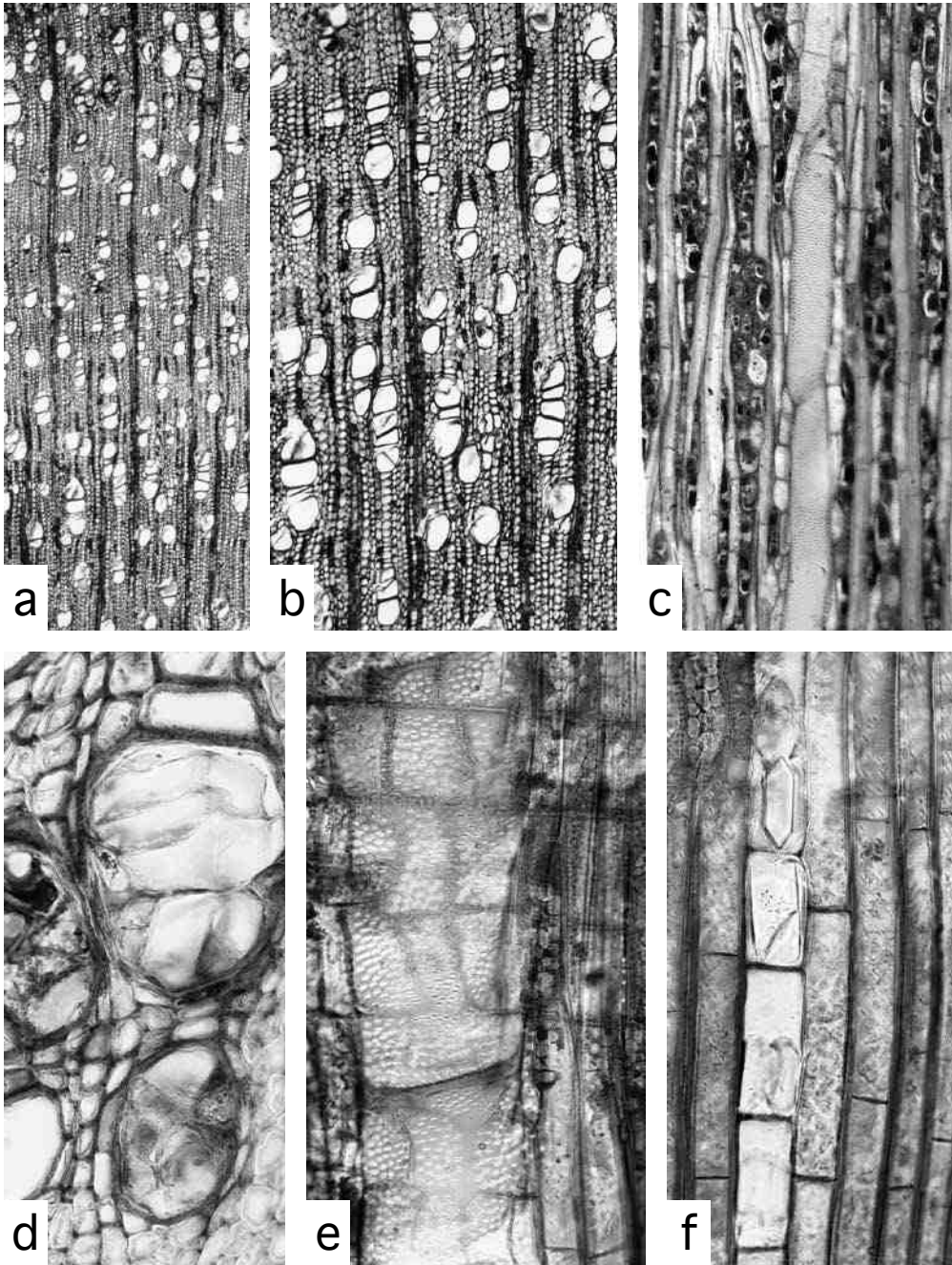


Plate 102. *Glochidion ellipticum* Wight (No. 9840197). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays, paratracheal parenchyma, and intervessel pits. d: Cross section ($\times 200$) showing vessels with thin-walled tyloses and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing densely alternate vessel-ray pits. f: Radial section ($\times 200$) showing prismatic crystals in axial parenchyma and septate fibers.

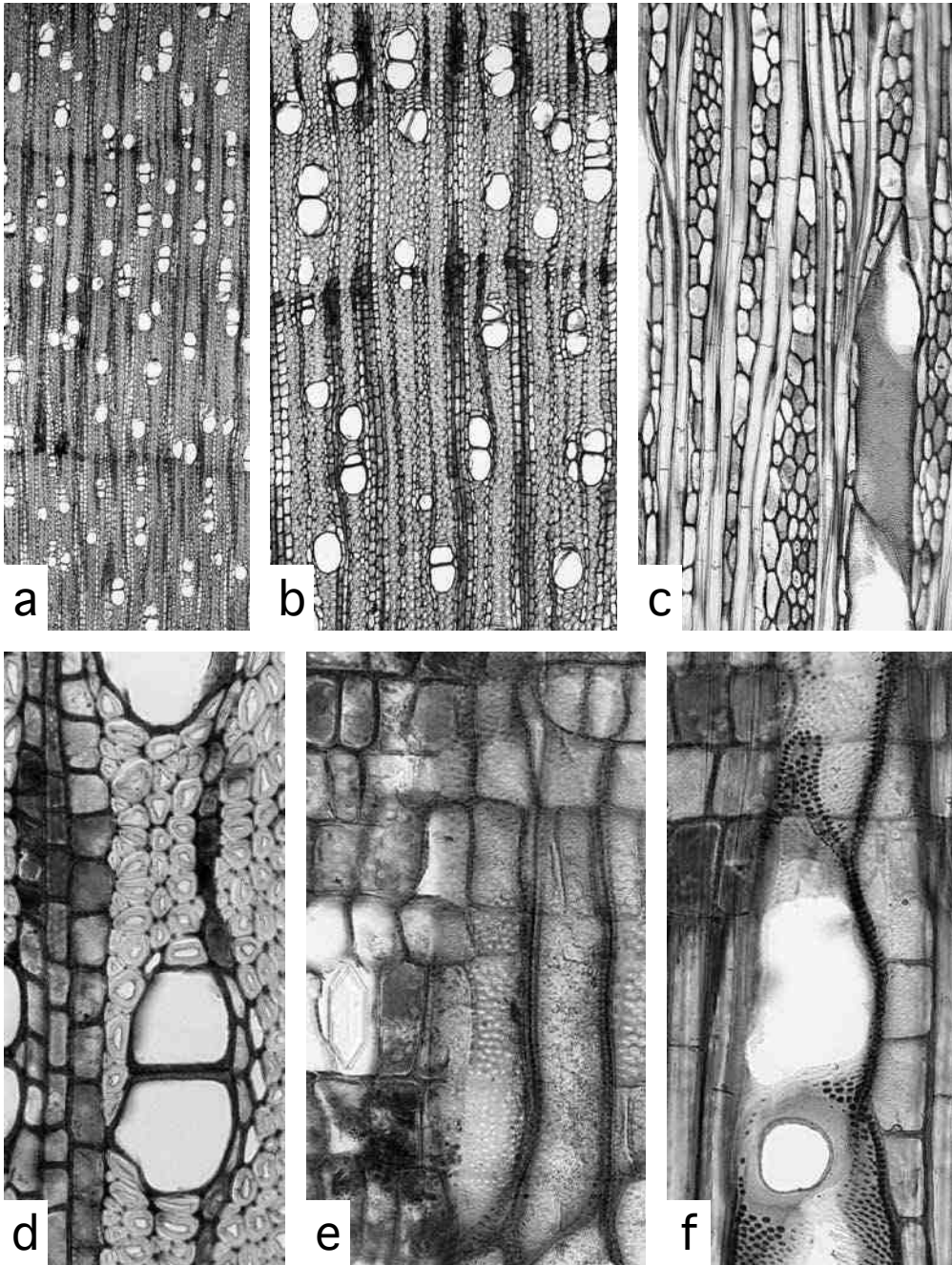


Plate 103. *Glochidion heyneanum* (Wight & Arn.) Wight (No. 9455063). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing rather sparse vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric parenchyma. e: Radial section ($\times 200$) showing dense vessel-ray pits and a prismatic crystal in a ray cell. f: Radial section ($\times 200$) showing a simple perforation, axial parenchyma, and septate fibers.

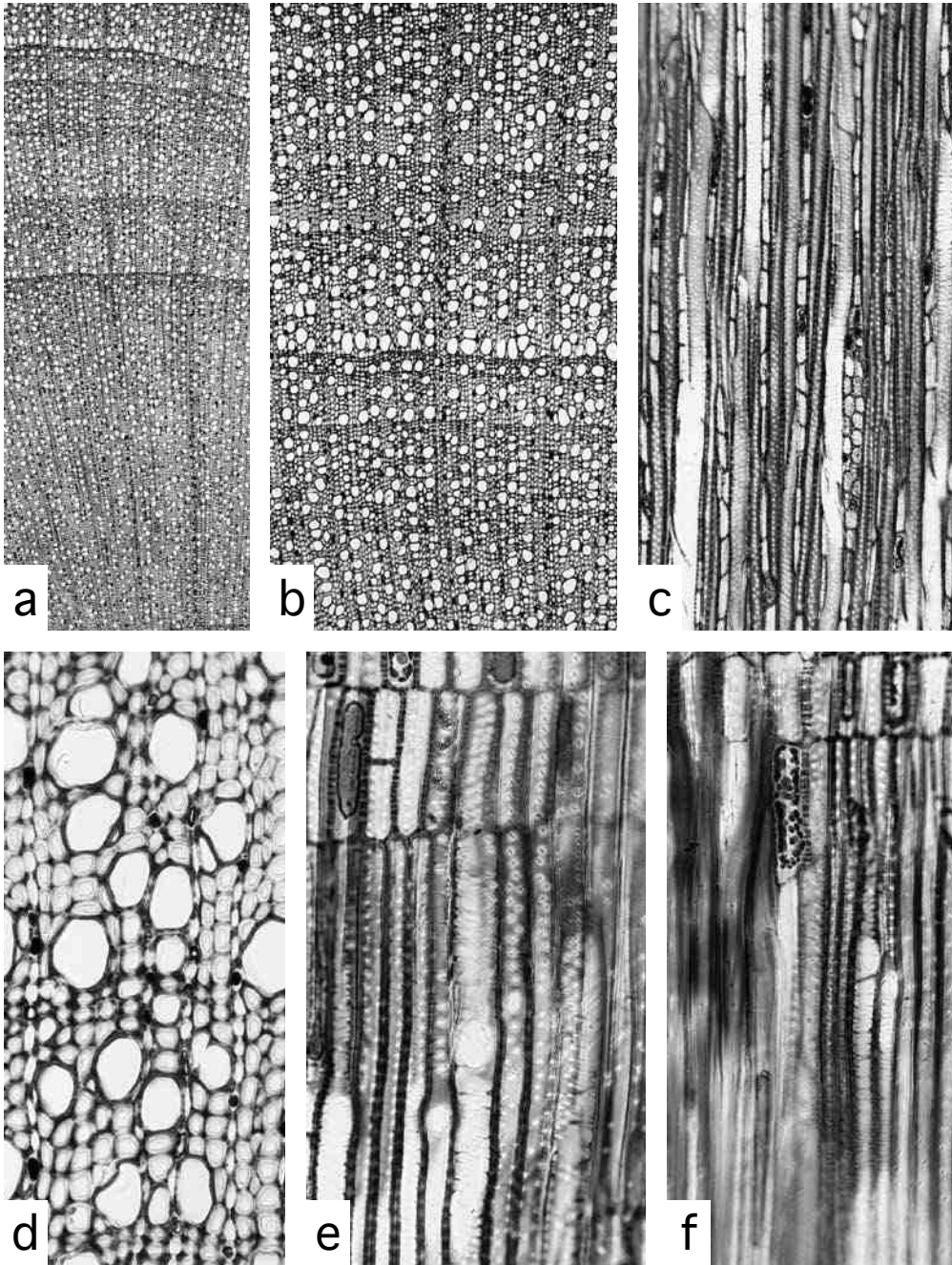


Plate 104. *Leptopus cordifolius* Wall. ex Decne. (No. 9194111). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing mostly solitary small vessels. c: Tangential section ($\times 100$) showing heterocellular rays and lax intervessel pits. d: Cross section ($\times 200$) showing polygonal vessels and terminal vascular tracheids. e: Radial section ($\times 200$) showing simple perforations and vessel-ray pits with distinct borders. f: Radial section ($\times 200$) showing terminal vessels and vascular tracheids with distinct helical thickenings.

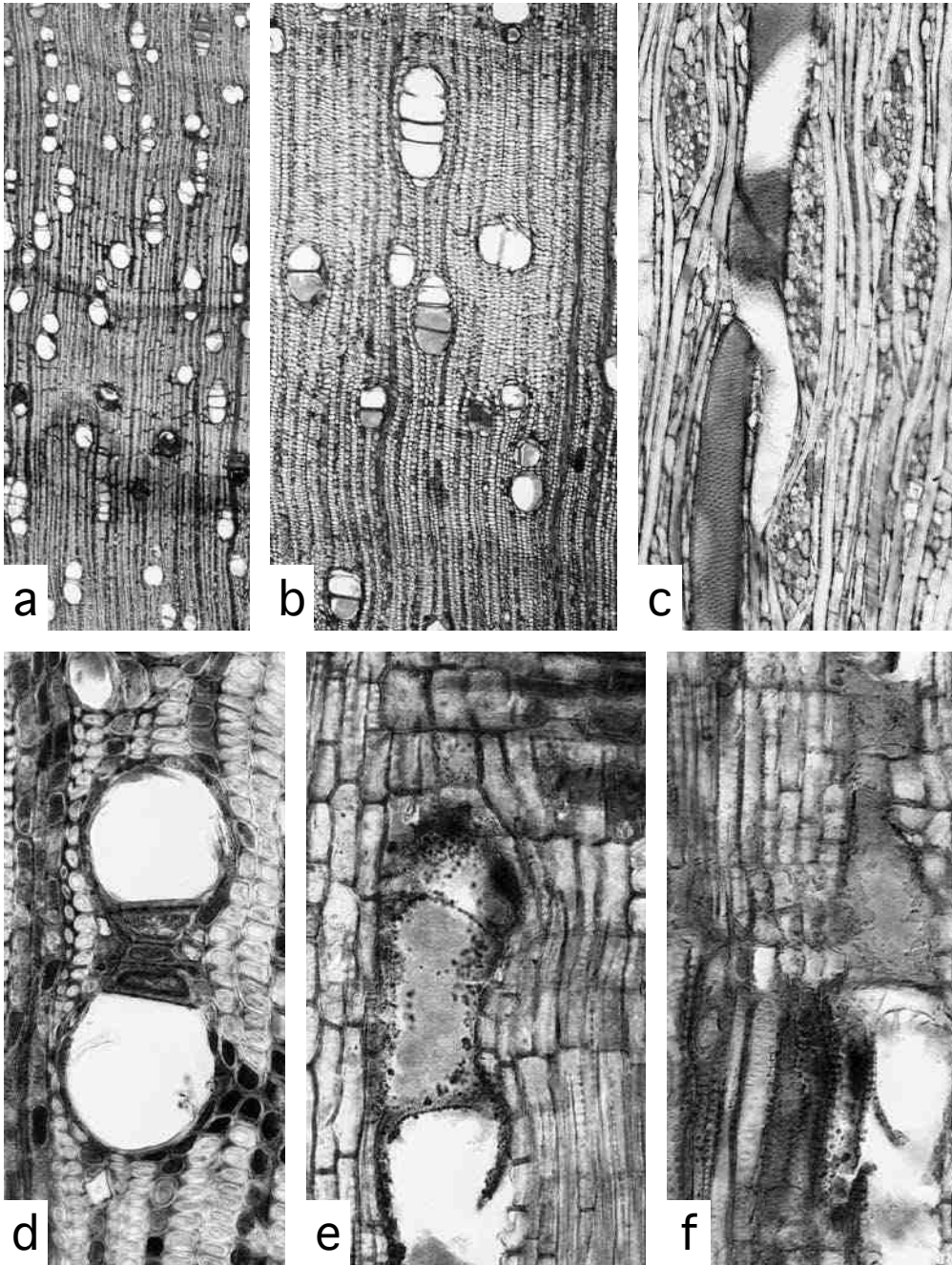


Plate 105. *Macaranga denticulata* (Blume) Müll.Arg. (No. 9455083). a: Cross section ($\times 20$) showing diffuse porous wood with axial parenchyma diffuse to in lines. b: Cross section ($\times 40$) showing sparse vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric parenchyma. e: Radial section ($\times 200$) showing a simple perforation and prismatic crystal in chambered ray cells. f: Radial section ($\times 200$) showing a perforated ray cell with a scalariform perforation.

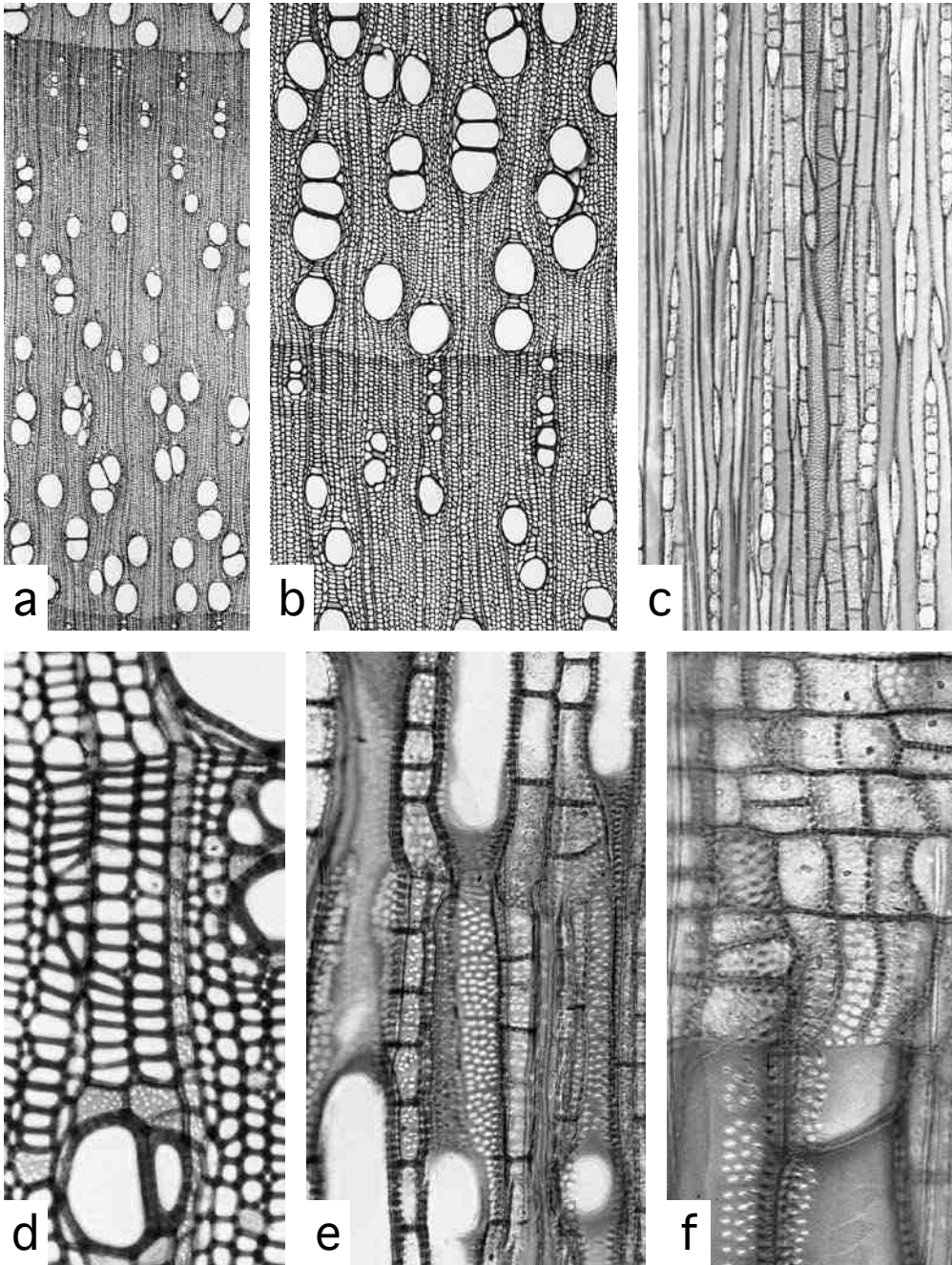


Plate 106. *Mallotus nepalensis* Müll.Arg. (No. 9840113). a: Cross section ($\times 20$) showing ring porous wood. b: Cross section ($\times 40$) showing vessels occasionally in radial multiples. c: Tangential section ($\times 100$) showing narrow heterocellular rays, vasicentric parenchyma, and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric and diffuse-in-aggregate parenchyma. e: Radial section ($\times 200$) showing vessels with simple perforations and alternating axial parenchyma. f: Radial section ($\times 200$) showing dense vessel-ray pits.

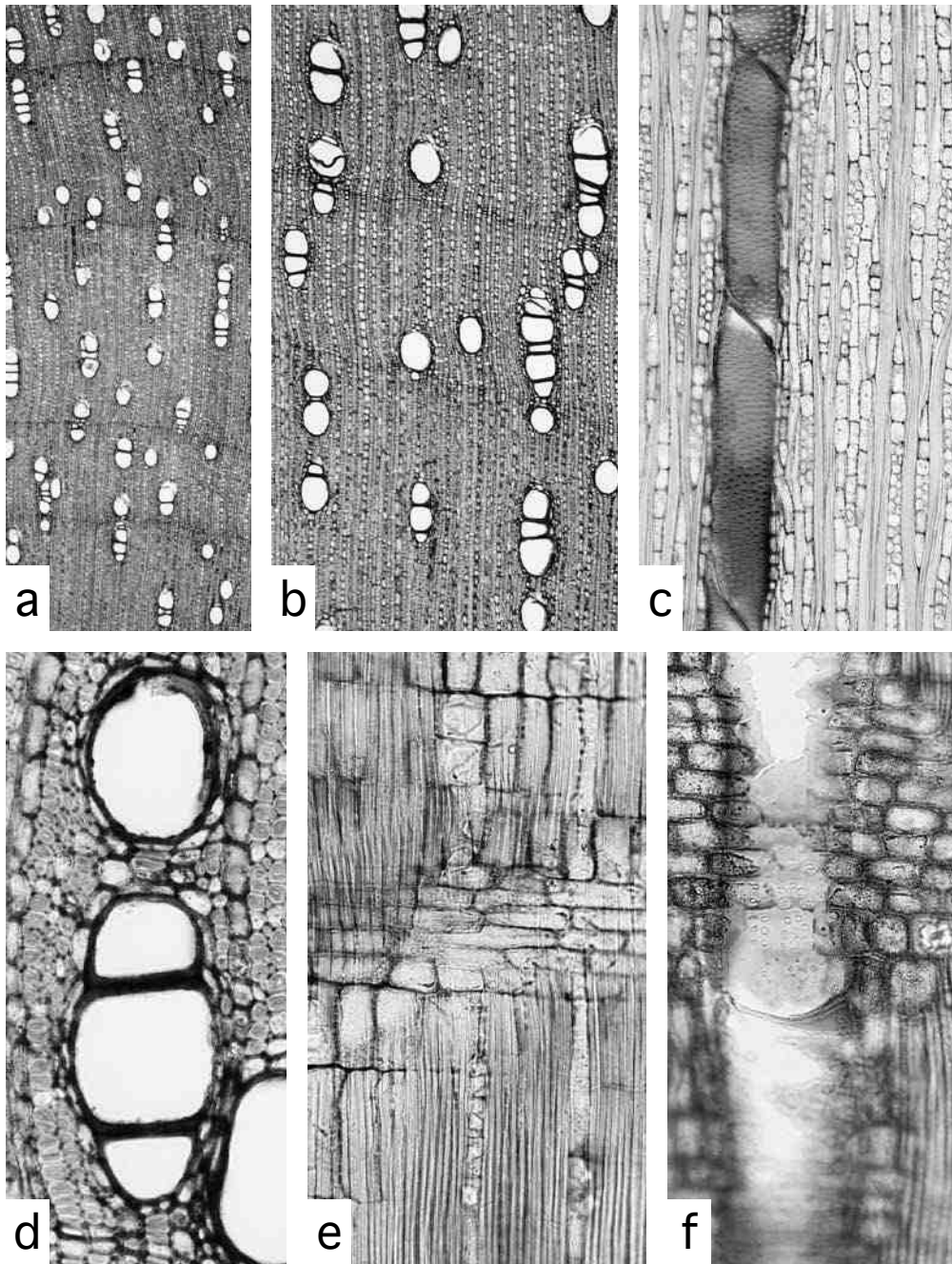


Plate 107. *Mallotus philippensis* (Lam.) Müll.Arg. (No. 9194052). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels often in radial multiples and axial parenchyma in wavy lines. c: Tangential section ($\times 100$) showing narrow heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric parenchyma. e: Radial section ($\times 200$) showing prismatic crystals in chambered ray and axial parenchyma cells. f: Radial section ($\times 200$) showing a simple perforation and opposite to alternate vessel-ray pits.

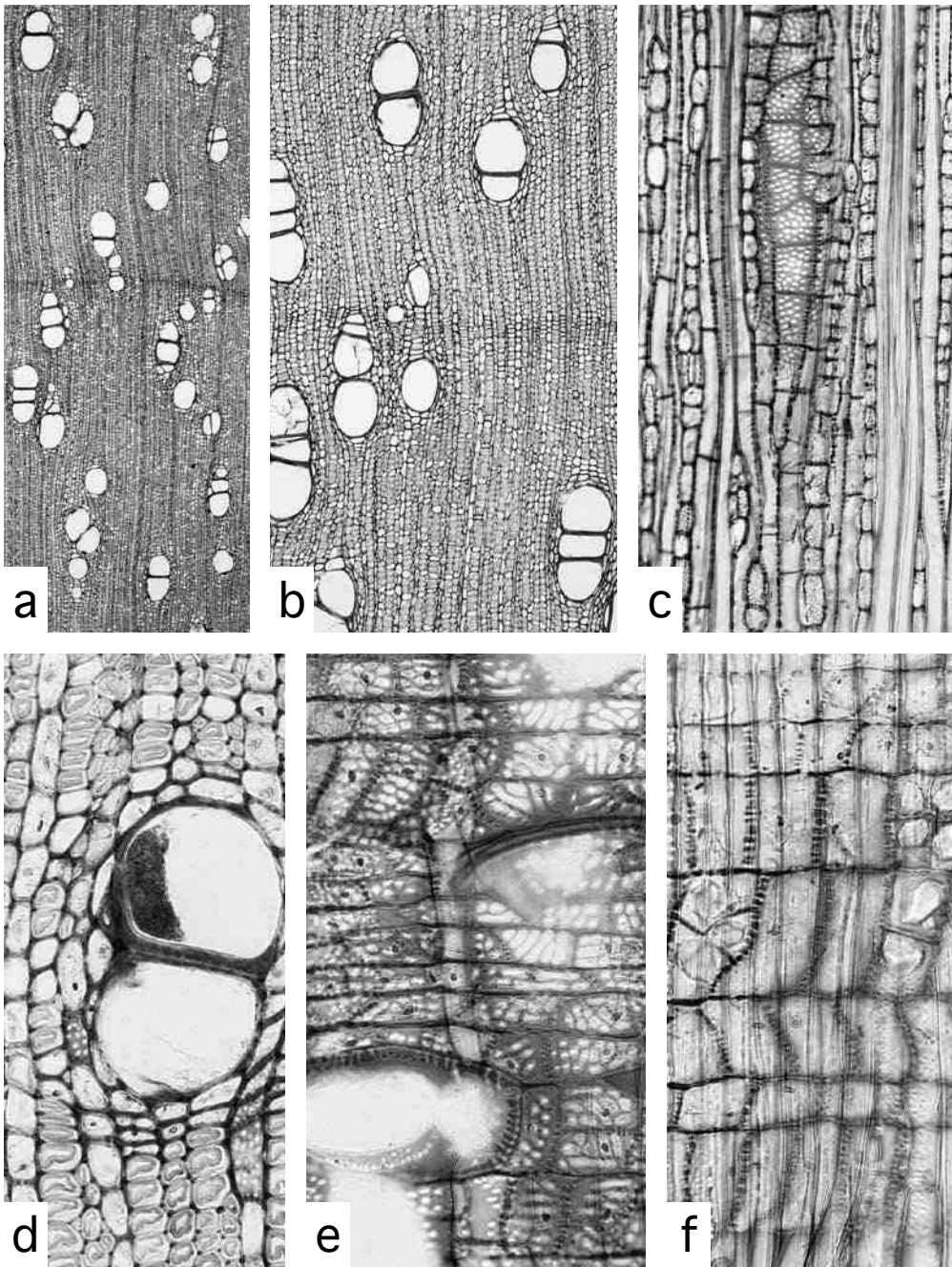


Plate 108. *Mallotus tetracoccus* (Roxb.) Kurz (No. 9840031). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels often in radial multiples and axial parenchyma in wavy lines. c: Tangential section ($\times 100$) showing narrow heterocellular rays, vasicentric parenchyma, and intervessel pits. d: Cross section ($\times 200$) showing vessels and vasicentric parenchyma. e: Radial section ($\times 200$) showing scalariform to palisade vessel-ray pits and a perforated ray cell with a simple perforation. f: Radial section ($\times 200$) showing prismatic crystals in chambered ray cells.

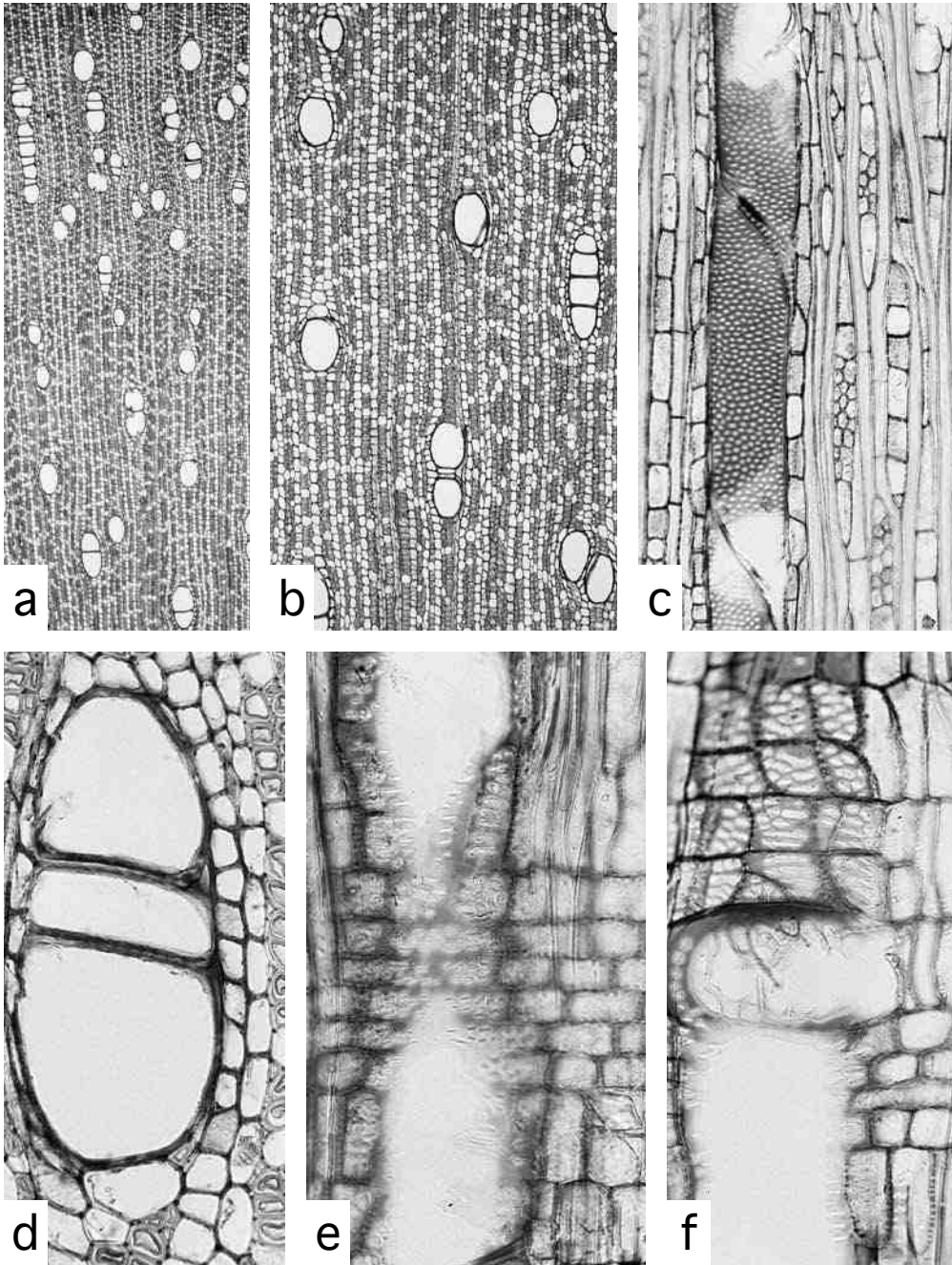


Plate 109. *Ostodes paniculata* Blume (No. 9455010). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing sparse vessels and axial parenchyma in dense wavy lines. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing vessel-ray pits and a prismatic crystal in a chambered ray cell. f: Radial section ($\times 200$) showing opposite to scalariform vessel-ray pits and a perforated ray cell with a scalariform perforation.

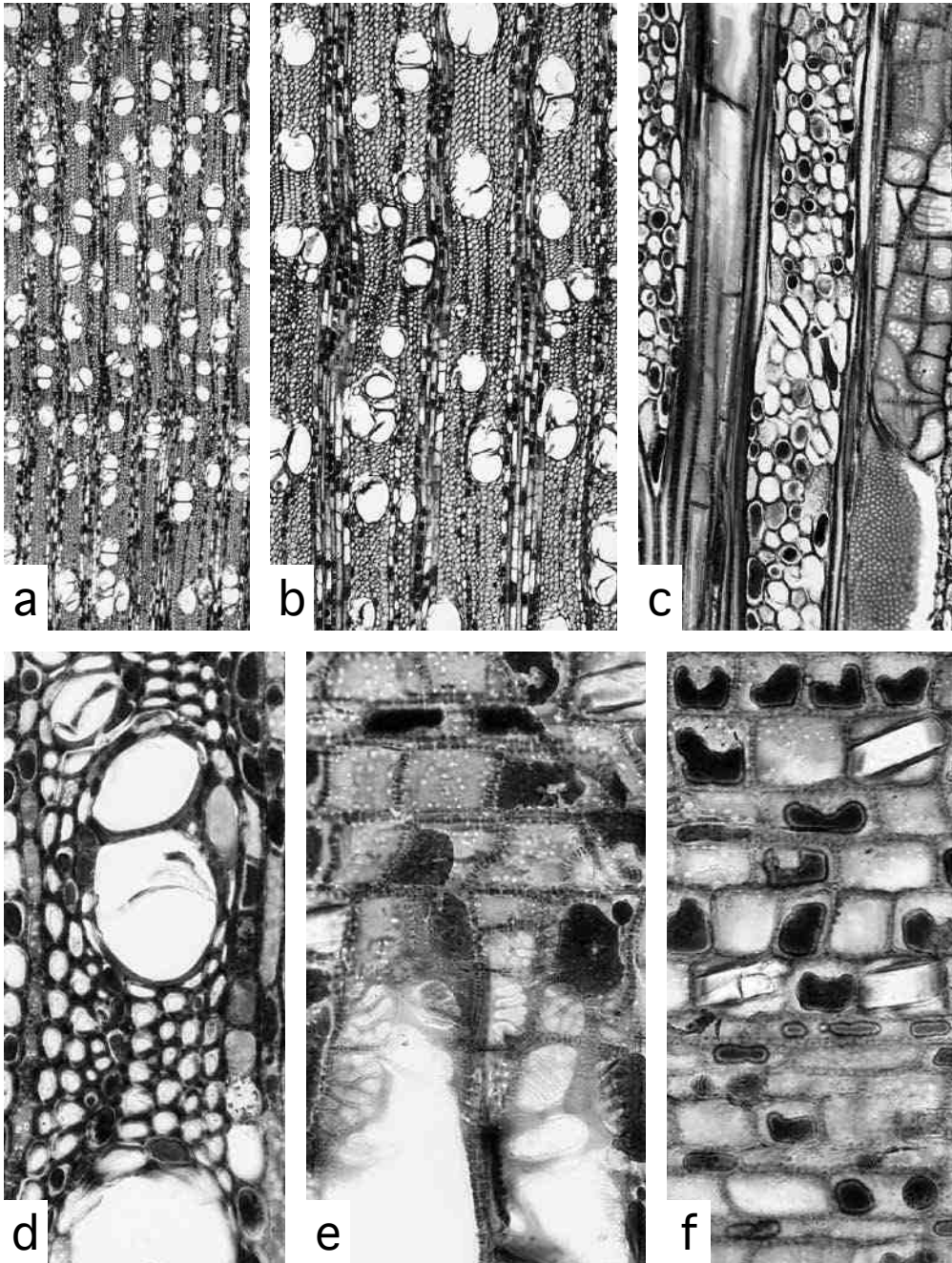


Plate 110. *Phyllanthus emblica* L. (No. 9194124). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing vessels often in radial multiples. c: Tangential section ($\times 100$) showing large heterocellular rays, paratracheal parenchyma, and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing scalariform to palisade vessel-ray pits. f: Radial section ($\times 200$) showing large prismatic crystals in ray cells.

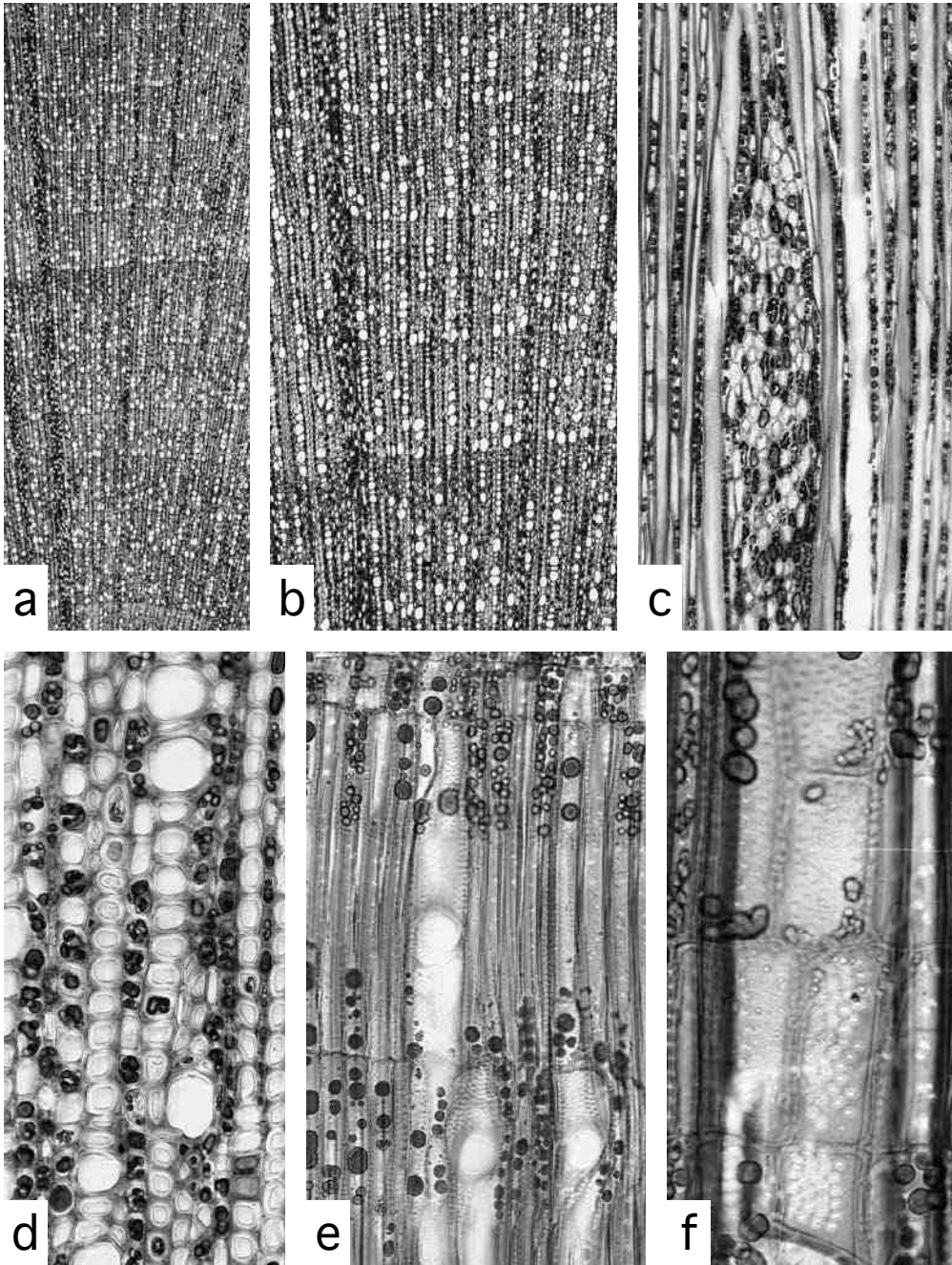


Plate 111. *Phyllanthus parvifolius* Buch.-Ham. ex D. Don (No. 8840615). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing evenly distributed small vessels forming a discontinuous row at the beginning of growth rings. c: Tangential section ($\times 100$) showing heterocellular rays in two sizes with prismatic crystals and intervessel pits. d: Cross section ($\times 200$) showing round vessels. e: Radial section ($\times 200$) showing simple or scalariform perforations and septate fibers. f: Radial section ($\times 400$) showing dense small vessel-ray pits.

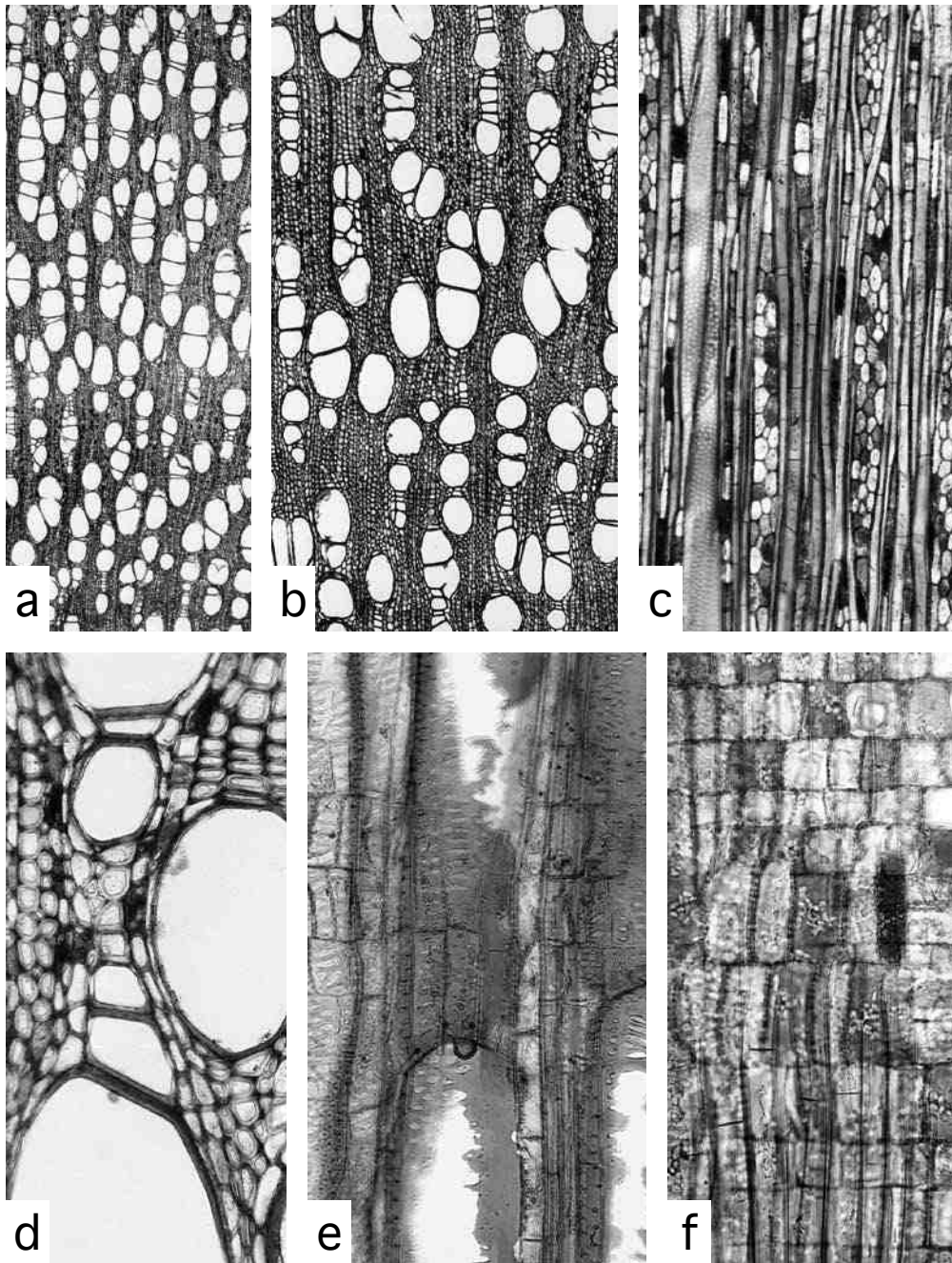


Plate 112. *Phyllanthus reticulatus* Poir. (No. 9455084). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing dense round vessels often in radial multiples c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing scalariform vessel-ray pits. f: Radial section ($\times 200$) showing prismatic crystals in ray cells and septate fibers.

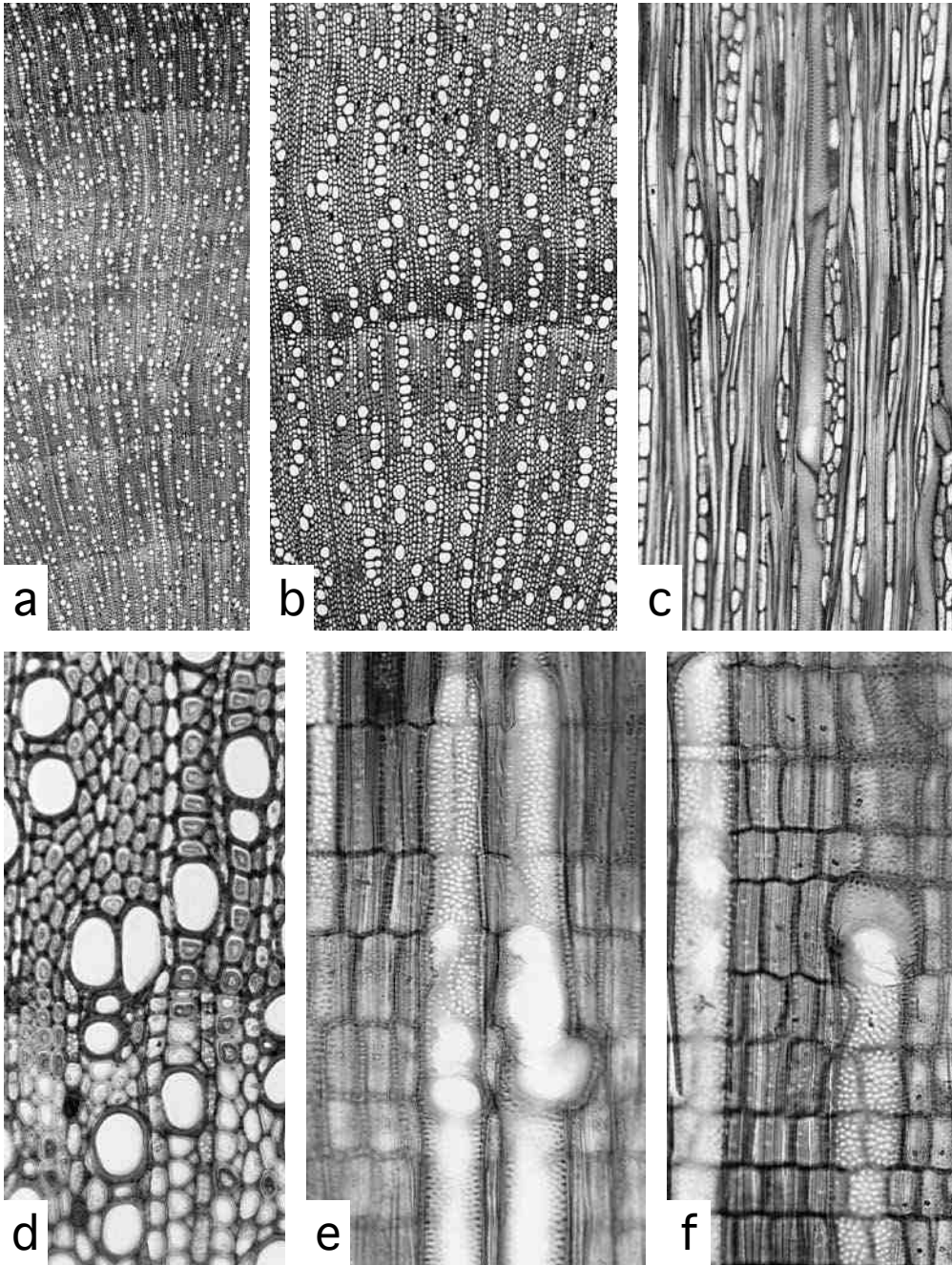


Plate 113. *Phyllanthus sikkimensis* Müll.Arg. (No. 9263119). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing small vessels often in radial multiples. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing rather thick-walled vessels. e: Radial section ($\times 200$) showing simple perforations and dense small vessel-ray pits. f: Radial section ($\times 200$) showing a perforated ray cell with a simple perforation.

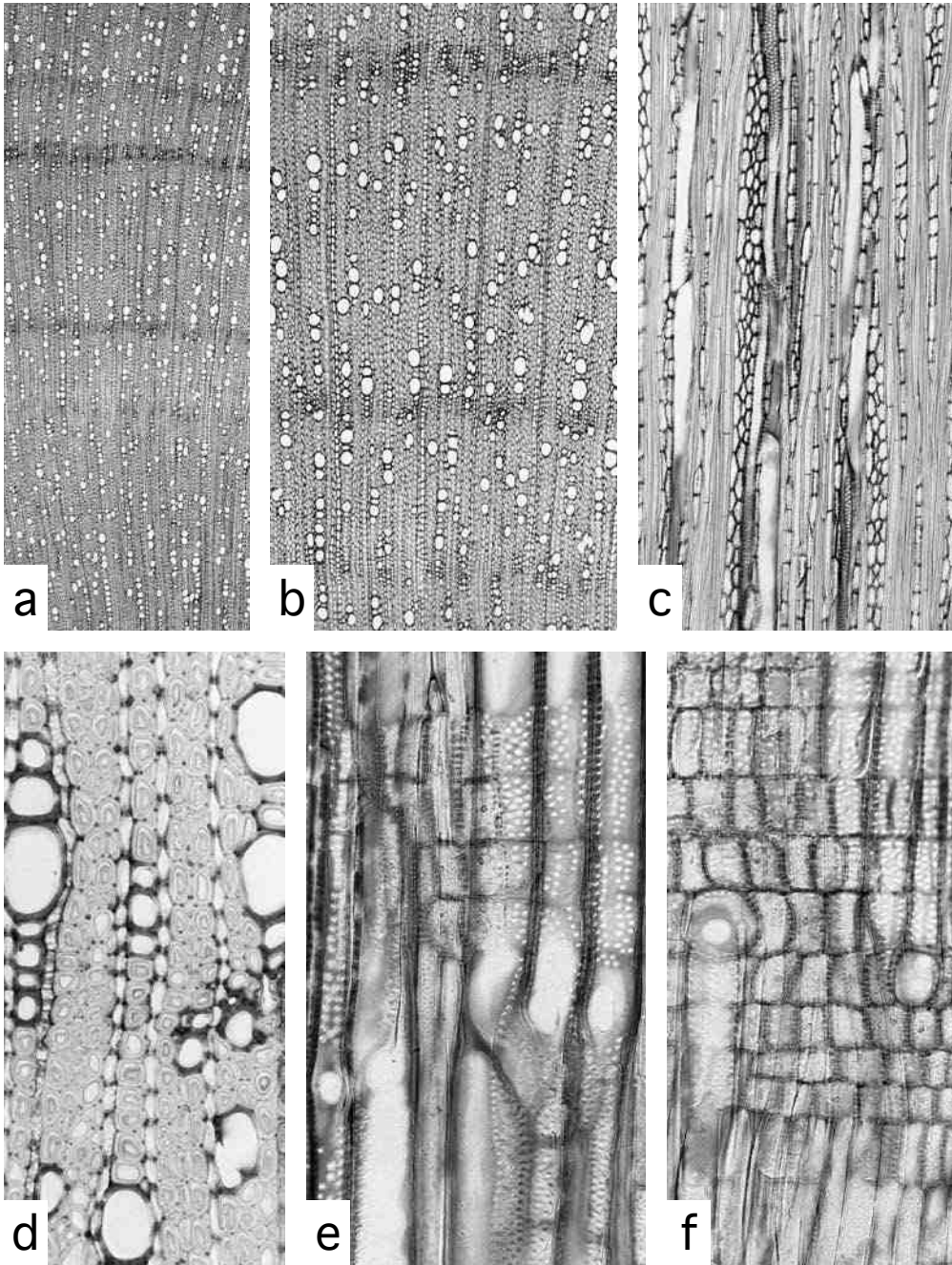


Plate 114. *Sauropus quadrangularis* (Willd.) Müll. Arg. (No. 9455239). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing sparse small vessels. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing rather thick-walled vessels. e: Radial section ($\times 200$) showing simple perforations, bordered vessel-ray pits, and septate fibers. f: Radial section ($\times 200$) showing perforated ray cells with a simple perforation.

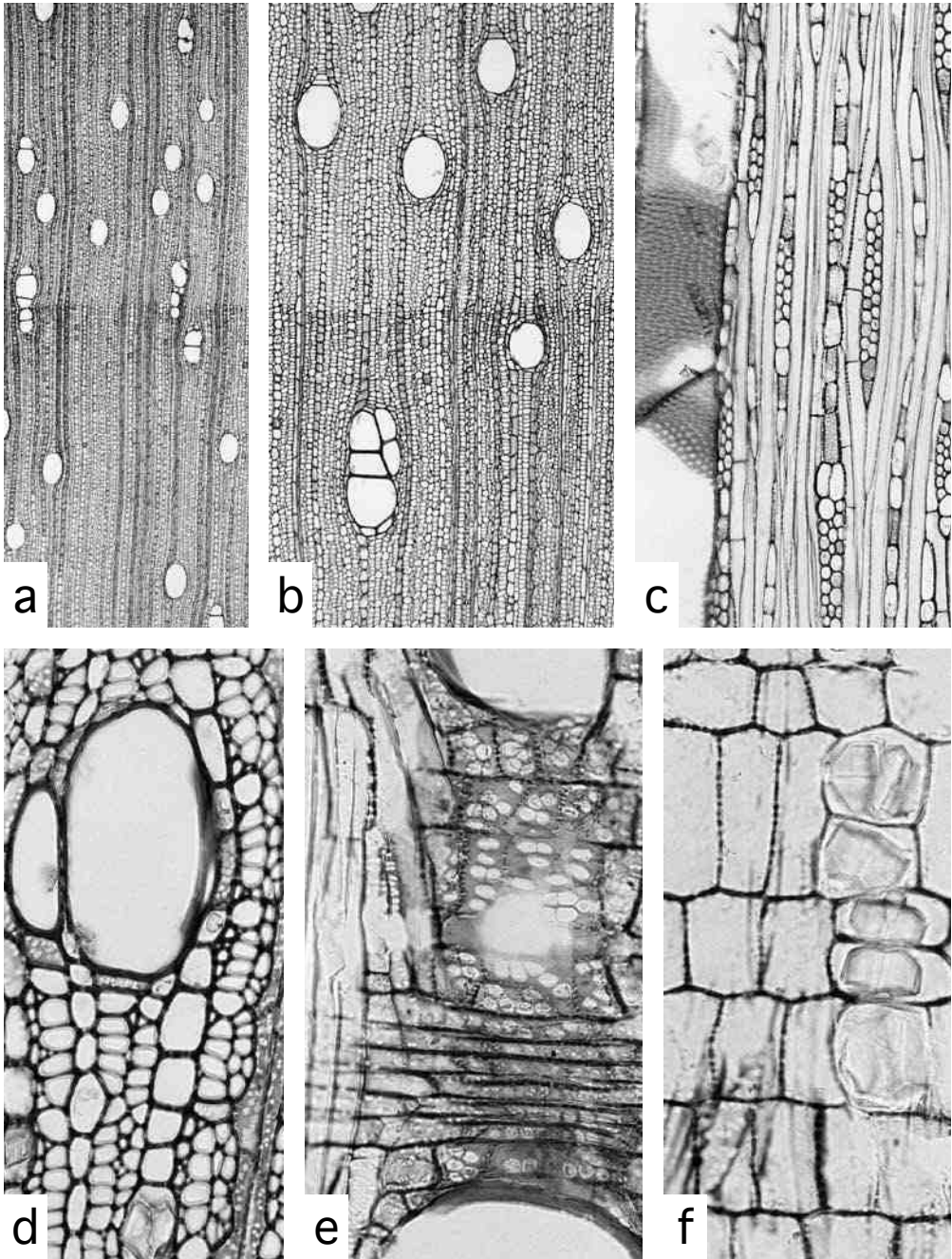


Plate 115. *Trewia nudiflora* L. (No. 9555005). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing sparse large round vessels. c: Tangential section ($\times 100$) showing heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing opposite vessel-ray pits. f: Radial section ($\times 200$) showing prismatic crystals in chambered and non-chambered ray cells.

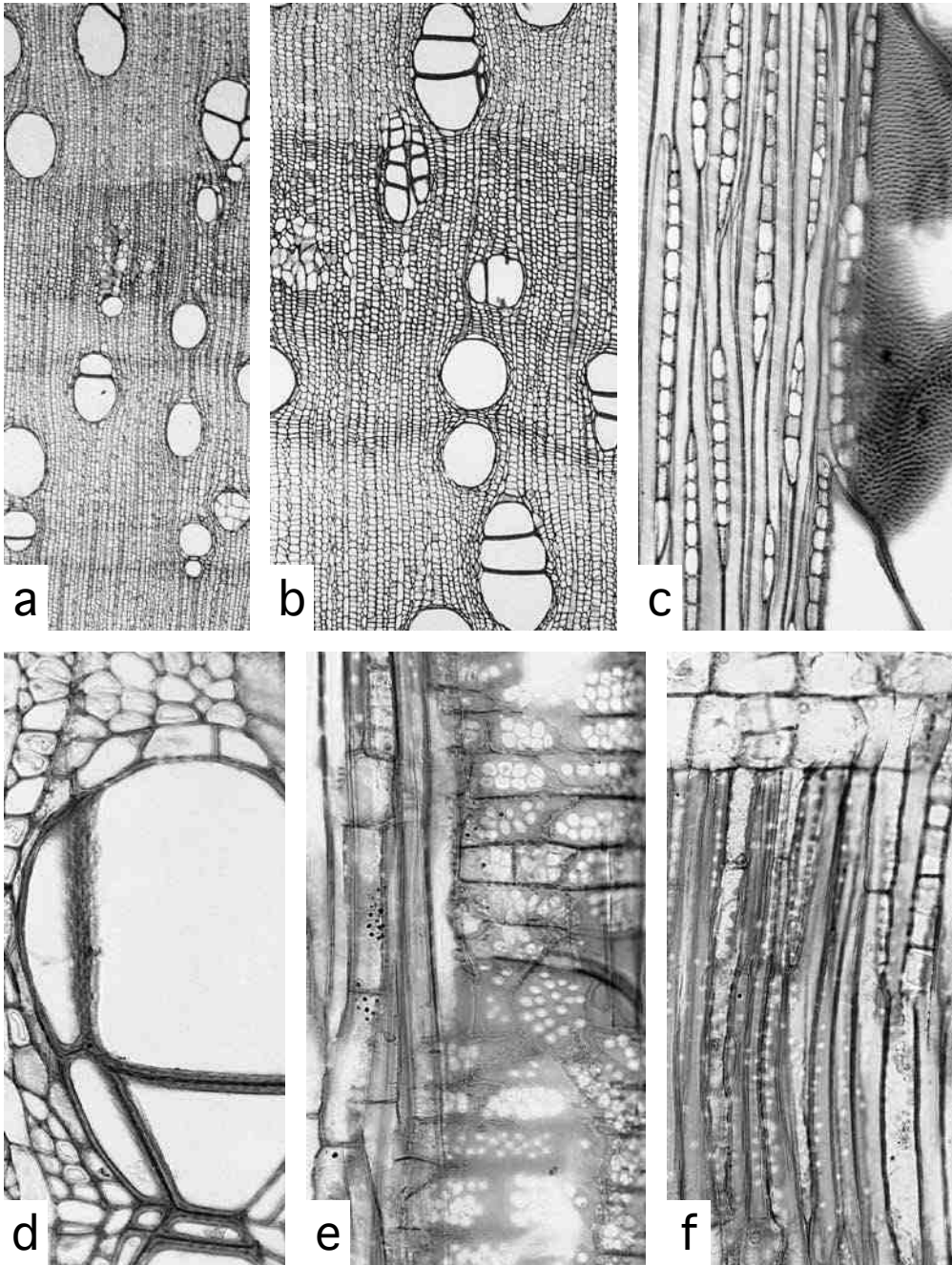


Plate 116. *Triadica cochinchinensis* Lour. (No. 9840211). a: Cross section ($\times 20$) showing diffuse porous wood. b: Cross section ($\times 40$) showing sparse large round vessels and axial parenchyma in dense lines. c: Tangential section ($\times 100$) showing narrow heterocellular rays and intervessel pits. d: Cross section ($\times 200$) showing vessels and scanty paratracheal parenchyma. e: Radial section ($\times 200$) showing opposite to alternate vessel-ray pits. f: Radial section ($\times 200$) showing prismatic crystal in chambered ray and axial parenchyma cells.