

## DIPTEROCARPACEAE

龙脑香科 long nao xiang ke

Li Xiwen (李锡文 Li Hsi-wen)<sup>1</sup>, Li Jie (李捷)<sup>2</sup>; Peter S. Ashton<sup>3</sup>

Trees, evergreen or semievergreen, rarely deciduous in dry season. Xylem with aromatic resin in intercellular resin canals. Branchlets with stipular scars, sometimes annular. Leaves simple, alternate; stipules persistent or caducous, large or small; leaf blade with lateral veins pinnate, margin entire or sinuate-crenate. Inflorescences few- or many-flowered, terminal or axillary racemes or panicles; flowers usually sweetly scented; bracts usually fugacious and minute, rarely persistent and large. Inflorescences, calyces, petals, ovary, and other parts usually with stellate, squamate, fascicled or free-standing hairs. Flowers bisexual, actinomorphic, contorted. Calyx lobes 5, free or united at base, imbricate in bud if not united. Petals 5, adnate or connate at base. Stamens (10–)15 to many, free from or connate to petals; filaments usually dilated at base; anthers 2-celled, with 2 pollen sacs per cell (Chinese species); connective appendages aristate, filiform or stout. Ovary superior, rarely semi-inferior, slightly immersed in torus, usually 3-loculed, each locule 2-, rarely many ovuled; ovules pendulous, lateral or anatropous. Fruit usually nutlike, sometimes capsular and 3-valved, 1(to many)-seeded, with persistent, variously accrescent calyx of which 2 or more lobes are usually developed into lorate wings. Seed exalbuminous; cotyledons fleshy, equal or unequal, applanate or ± folded or cerebriform, entire or laciniate; radicle directed toward hilum, usually included between cotyledons.

About 17 genera and 550 species: tropical Africa, Asia, and South America (in Asia, most species and genera in NW Borneo); five genera and 12 species (one endemic, one introduced) in China.

Tong Shaoquan & Tao Gouda. 1990. Dipterocarpaceae. In: Li Hsiwen, ed., Fl. Reipubl. Popularis Sin. 50(2): 113–131.

- 1a. Calyx in fruit with a distinct tube, free; leaf venation plicate ..... 1. *Dipterocarpus*
- 1b. Calyx in fruit without a tube; leaf venation not plicate.
  - 2a. Fruit sepals without basal thickening; leaf tertiary veins reticulate ..... 5. *Vatica*
  - 2b. Flower sepals with basal thickening appressed to nut; leaf tertiary veins generally scalariform.
    - 3a. Ovary with distinct stylopodium; 2 calyx segments enlarged into wings or all calyx segments not enlarged into wings ..... 2. *Hopea*
    - 3b. Ovary without distinct stylopodium; 3 or all calyx segments enlarged into wings.
      - 4a. Fruit sepals subequal, imbricate; bark, crest of buttresses and bases of fissures prominently pale corky lenticellate ..... 3. *Parashorea*
      - 4b. Fruit sepals unequal, 3 long, aliform; bark, crest of buttresses and bases of fissures scarcely lenticellate ..... 4. *Shorea*

### 1. DIPTEROCARPUS C. F. Gaertner, Suppl. Carp. 50. 1805.

龙脑香属 long nao xiang shu

Trees, lofty, emergent, with grayish brown to orange flaky, prominently lenticellate bark and aromatic oily white resin, with stout buttresses. Stipules large, enclosing terminal bud, finally caducous and leaving an annular scar; leaf blade leathery, plicate in bud and ± corrugate when opened; lateral veins pinnate, straight; tertiary veins subscalariform, conspicuous, margin entire or sinuate-crenate. Raceme 3–9-flowered, hardly branched. Flowers large, sweetly scented. Calyx with urceolate or cup-shaped free basal tube; sepals valvate, unequal. Petals white or with a reddish median stripe, pubescent or stellate pubescent especially on parts exposed in bud. Anthers yellow, linear, equivalved; connective appendages aristate or filiform. Ovary narrowly ovoid, pubescent; style filiform; stigma slightly dilated. Fruit nutlike, enclosed in accrescent calyx tube; winglike calyx lobes 2, erect. Seed adnate to base of pericarp; cotyledons large, thick, unequal; radicle inconspicuous.

About 70 species: Cambodia, China, India, W Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam; two species (one introduced) in China.

*Dipterocarpus gracilis* Blume, which was reported in FRPS (50(2): 114. 1990), is not found in China. It differs in the smaller size of all parts and rufous scabrous tomentum. Its nearest localities are in N Thailand, India (Andaman Islands), and SE Bangladesh.

- 1a. Fruit wings conspicuously 3–5-veined, calyx tube more than 3 cm in diam.; leaf buds obtuse, stout, glabrous, setose or woolly ..... 1. *D. retusus*
- 1b. Fruit wings with only 1 much ramified midvein, calyx tube less than 3 cm in diam.; leaf buds falcate, buds and young twigs densely gray puberulous ..... 2. *D. turbinatus*

<sup>1</sup> Kunming Institute of Botany, Chinese Academy of Sciences, 610 Longquan Road, Heilongtan, Kunming, Yunnan 650204, People's Republic of China.

<sup>2</sup> Xishuangbanna Tropical Botanical Garden, Kunming, Yunnan 650223, People's Republic of China.

<sup>3</sup> Harvard University Herbaria, 22 Divinity Avenue, Cambridge, Massachusetts 02138–2094, U.S.A.

**1. *Dipterocarpus retusus*** Blume, Catalogus, 77. 1823.

东京龙脑香 dong jing long nao xiang

Trees, lofty, to 45 m tall. Bark gray or brown, shallowly flaky, not longitudinally fissured or only at base. Branchlets glabrous or persistently buff pubescent; leaf buds obtuse, stout, glabrous, setose, or woolly. Stipules green or red, lanceolate, to 15 cm, glabrous or pubescent outside (always stellate pubescent on young trees); petiole glabrous; leaf blade broadly ovate, 16–28 × 10–15 cm, leathery, abaxially sparsely or densely golden-buff stellate pubescent, adaxially initially white strigose, sometimes glabrescent, lateral veins 16–19 pairs conspicuously raised abaxially, base rounded or somewhat cordate, margin entire or sinuate-crenate in distal half, apex acute. Racemes axillary, 8–10 cm, 2–5-flowered. Calyx segments: 2 rather long and linear, 3 shorter and triangular. Petals reddish, sweetly scented, narrowly elliptic, 5–6 cm, with dense squamate hairs, margin slightly reflexed, apex obtuse. Stamens (25–)30; anthers linear to lanceolate, ca. 5 mm, sagittate at base, coherent; connective appendages aristate; filaments filiform, dilated at base. Ovary narrowly ovoid, sericeous-tomentose, 3-loculed, with 2 ovules per locule; style finely terete, with long silky hairs on lower half. Nut ovoid, densely yellowish gray tomentellate; calyx tube to 3.5 cm in diam.; wing-like calyx segments red, linear-lanceolate, to 19–23 × 3–4 cm, leathery, stellate-tomentellate, 3–5-veined, apex rounded. Fl. May–Jun, fr. Dec–Jan of following year.

Humid valley rain forests, dense forests on limestone; below 1000 m. SE Xizang, SE and W Yunnan [India, Indonesia, Laos, Malaysia, Myanmar, Thailand, Vietnam].

Still locally abundant in the E Himalayan foothills, this species is now rare in Yunnan, its distribution affected by habitat loss. The wood is heavy and is used for building houses. The tree is a source of a balsam used for caulking boats.

This species is very variable at the extremes of its range: China, N Vietnam, and Indonesia (Java). *Dipterocarpus macrocarpus* was recognized on account of its dense tomentum on twigs, leaf buds, and leaf abaxial surface, and *D. mannii* on account of its somewhat smaller parts and ca. 25 stamens. Two varieties of *D. retusus* can be recognized in China, and they may co-occur in the same stand.

- 1a. Parts glabrescent ..... 1a. var. *retusus*  
 1b. Parts persistently tomentose ..... 1b. var. *macrocarpus*

**1a. *Dipterocarpus retusus* var. *retusus***

东京龙脑香(原变种) dong jing long nao xiang (yuan bian zhong)

*Dipterocarpus mannii* King ex Kanjilal et al.; *D. occidentoyunnanensis* Y. K. Yang & J. K. Wu; *D. pubescens* Koorders & Valetton; *D. retusus* subsp. *tonkinensis* (A. Chevalier) Y. K. Yang & J. K. Wu; *D. retusus* var. *yingjiangensis* Y.

K. Yang & J. K. Wu; *D. spanoghei* Blume; *D. tonkinensis* A. Chevalier; *D. trinervis* Blume.

Parts glabrescent.

Humid valley rain forests, dense forests on limestone; below 1000 m. SE Xizang, SE and W Yunnan [India, Indonesia, Laos, Malaysia, Myanmar, Thailand, Vietnam].

**1b. *Dipterocarpus retusus* var. *macrocarpus*** (Vesque) P. S. Ashton, stat. nov.

多毛东京龙脑香 duo mao dong jing long nao xiang

Basionym: *Dipterocarpus macrocarpus* Vesque, Compt. Rend. Hebd. Séances Acad. Sci. 78: 627. 1874; *D. austroyunnanicus* Y. K. Yang & J. K. Wu; *D. luchunensis* Y. K. Yang & J. K. Wu; *D. retusus* subsp. *macrocarpus* (Vesque) Y. K. Yang & J. K. Wu.

Parts persistently tomentose.

Humid valley rain forests, dense forests on limestone; below 1000 m. SE Xizang, SE and W Yunnan [India, Indonesia, Laos, Malaysia, Myanmar, Thailand, Vietnam].

**2. *Dipterocarpus turbinatus*** C. F. Gaertner, Suppl. Carp. 51. 1805.

羯布罗香 jie bu luo xiang

*Dipterocarpus jourdainii* Pierre; *D. laevis* Buchanan-Hamilton; *D. turbinatus* C. F. Gaertner var. *ramipiliferus* Y. K. Yang & J. K. Wu.

Trees, lofty, ca. 35 m tall. Bark gray or dark brown, shallowly longitudinally fissured and flaky. Branchlets glabrescent; leaf buds falcate, buds and young twigs densely gray puberulous. Stipules 2–6 cm, densely, shortly dark grayish or dark yellow puberulous; petiole 2–3 cm, densely gray puberulous or glabrescent; leaf blade ovate-oblong, 20–30 × 8–13 cm, leathery, glabrous or sparsely stellate pubescent, lateral veins 15–20 pairs conspicuously raised abaxially, base rounded or somewhat cordate, margin entire or sometimes sinuate, apex acuminate or acute. Racemes axillary, 3–6-flowered. Calyx segments: 2 linear, 3 shorter, all glabrous, outside glaucous. Stamens ca. 30; anthers linear-lanceolate; connective appendages filiform. Ovary densely pubescent; style terete, silvery gray tomentose on lower half. Nut ovoid or narrowly ovoid, densely appressed tomentose; calyx tube to 2.8 cm in diam., glabrous, glaucous; winglike calyx segments linear-lanceolate, 12–15 × ca. 3 cm, glabrous, minutely papillate near much-ramified solitary midvein. Fl. Mar–Apr, fr. Jun–Jul.

S and W Yunnan (cultivated) [native to Bangladesh, Cambodia, India, Laos, Myanmar, Thailand, Vietnam].

This tree provides a source of balsam.

**2. HOPEA** Roxburgh, Pl. Coromandel 3: 7. 1811, nom. cons., not Garden ex Linnaeus (1767).

坡垒属 po lei shu

*Balanocarpus* Beddome; *Dioticarpus* Dunn; *Hancea* Pierre (1891), not Seman (1857), nor Hemsley (1890); *Peirrea* F. Heim (1891), nom. cons., not Hance (1877); *Petalandra* Hasskarl (1858), not F. Mueller (1856).

Trees evergreen, of main canopy or understory, white resinous. Stipules caducous, small; leaf blade thinly leathery; lateral veins

pinnate; tertiary veins scalariform (in Chinese species) [or subreticulate], margin entire. Flowers sessile or shortly pedicellate, in lax panicles of unilateral racemes; bracts early caducuous, linear. Calyx segments imbricate. Exposed parts of petals usually pubescent in bud. Stamens (10–)15, slightly connate and adnate to petals; anthers ovoid, small, subequal; connectival appendages aristate or filiform. Ovary ovoid, with prominent filiform style, or hourglass-shaped, with short tapering style. Fruit ovoid or globose; pericarp usually thin, waxy; 1-seeded, closely surrounded by thickened base of calyx segments; 2 fruit sepals winglike, linear, or all orbicular or ovate, subequal.

About 100 species: Cambodia, China, S India, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Thailand, Vietnam; four species (one endemic) in China.

These trees are a source of a damar resin used in varnishes. The wood is finely grained, very durable, and used for making boats, bridges, and furniture.

1a. Ovary globose to ovoid, style columnar; flaky barked trees: (Section, subsection *Hopea*).

2a. Two fruit sepals winglike; leaf base obtuse, subequal, lateral veins 9–12 pairs ..... 2. *H. hainanensis*

2b. Fruit sepals subequal, suborbicular; leaf base strongly unequal, subcordate; lateral veins 3–5 pairs ..... 3. *H. reticulata*

1b. Ovary hourglass-shaped; style short, tapering; smooth-barked trees: (Subsection *Pierrea*).

3a. Fruit sepals unequal, two winglike; leaf lateral veins 8–12 pairs ..... 1. *H. chinensis*

3b. Fruit sepals unequal, suborbicular-ovate; leaf lateral veins 7–9 pairs ..... 4. *H. shingkeng*

**1. *Hopea chinensis*** (Merrill) Handel-Mazzetti, *Sinensia* 2: 131. 1932.

狭叶坡垒 xia ye po lei

*Shorea chinensis* Merrill, *Philipp. J. Sci.* 21: 503. 1922, not (H. Wang) H. Zhu (1992); *Hopea austroyunnanica* Y. K. Yang & J. K. Wu; *H. boreovietnamica* Y. K. Yang & J. K. Wu; *H. daweshanica* Y. K. Yang & J. K. Wu; *H. guangxiensis* Y. K. Yang & J. K. Wu; *H. hongayensis* Tardieu; *H. jianshu* Y. K. Yang et al.; *H. mollissima* C. Y. Wu; *H. pingbianica* Y. K. Yang & J. K. Wu; *H. yunnanensis* Y. K. Yang & J. K. Wu.

Trees 15–20 m tall, with aromatic white resin. Bark grayish black, smooth. Branchlets reddish brown, white lenticellate, gray stellate-pubescent, gray tomentellate, or glabrous. Petiole dark brown, ca. 1 cm, glabrous or sparsely or densely yellowish pubescent; leaf blade 7–26 × 2–8 cm, oblong to oblong-lanceolate, leathery, abaxially sparsely pubescent or glabrous, adaxially glabrous or both densely stellate-pubescent, lateral veins 8–12 pairs, conspicuously raised abaxially, base rounded or cuneate, slightly asymmetric, margin entire, apex acuminate or caudate-acuminate. Panicle axillary, few flowered, 4–18 cm, slender, sparsely or densely pubescent, with ciliate margin. Sepals imbricate, ovate, glabrous or pubescent. Petals reddish, elliptic, 3–4 mm, yellow tomentose on parts exposed in bud. Stamens (10–)15; anthers ovoid, subequal; connective appendages aristate, ca. 3 × as long as anther. Ovary ovoid; stylopodium cylindrical, slightly swollen, glabrous, ca. 2 × as long as ovary; style short, tapering. Fruit dark brown, ovoid, apiculate; winglike calyx segments oblong-lanceolate or oblong, 8–12 × ca. 2.5 cm, longitudinally 12-veined, glabrous, apex rounded. Fl. Jun–Jul, fr. Oct–Dec.

Valley forests, forests on mountain slopes, hills; 300–600 m. S and SW Guangxi, S and SE Yunnan (Jiangcheng, Lüchun, Pingbian) [N Vietnam].

This is an endangered species threatened by timber exploitation. The durable wood is used for making boats, furniture, and building bridges.

**2. *Hopea hainanensis*** Merrill & Chun, *Sunyatsenia* 5: 134. 1940.

坡垒 po lei

Trees ca. 20 m tall, with aromatic white resin. Bark gray or brown, flaky, white lenticellate. Petiole robust, ca. 2 cm, glabrous or farinose-scurfy; leaf blade oblong to oblong-ovate, 4–8 × 5–8 cm, thinly leathery, both surfaces glabrous or farinose-scurfy, lateral veins 9–12 pairs conspicuously raised abaxially, base rounded, margin entire, apex slightly obtuse or acuminate. Flowers arranged in lax panicle of unilateral racemes. Sepals ovate, ca. 2.5 mm, apex rounded, outer 2 pubescent on entire surface. Petals oblong or oblong-elliptic, ca. 6 mm. Stamens 15; anthers ovoid; connective appendages filiform, ca. 1 mm. Ovary and stylopodium ovoid, pubescent; style short, glabrous; stigma conspicuous. Fruit ovoid, waxy, apiculate; winglike calyx segments oblong or oblanceolate, 5–7 × ca. 2.5 cm, longitudinally 9–11-veined, sparsely stellate pubescent. Fl. Jun–Jul, fr. Nov–Dec.

Dense forests; ca. 700 m. Hainan [N Vietnam].

This is an endangered species of scattered occurrence. The durable wood is used for making boats and building bridges and houses.

**3. *Hopea reticulata*** Tardieu, *Notul. Syst.* (Paris) 10: 123. 1942.

铁凌 tie ling

*Hopea exalata* W. T. Lin et al.; *H. reticulata* Tardieu subsp. *exalata* (W. T. Lin et al.) Y. K. Yang & J. K. Wu.

Trees ca. 15 m tall, with dark brown smooth bark, later becoming flaky, with aromatic white resin. Branchlets initially densely grayish yellow tomentose, soon sparsely so. Petiole 6–8 mm, gray tomentose; leaf blade ovate to ovate-lanceolate, 5–12 × 3–6 cm, leathery, basal veins 5 or 6, lateral veins 3–5 pairs slightly raised abaxially, base oblique or cordate, sometimes rounded, margin entire, apex acuminate. Panicles axillary or terminal, few flowered, 6–11 cm, slender, sparsely pubescent or subglabrous. Calyx segments imbricate, suborbicular, glabrous. Petals reddish, obovate-elliptic, ca. 5 mm, outside tomentose, ciliate at margin. Stamens (10–)15; anthers ellipsoid; connective appendages filiform. Ovary and stylopodium pyriform, with median constriction, glabrous; style short. Fruit ovoid; peri-

carp thin, glabrous; calyx lobes subequal, short, to  $8 \times 7$  mm. Fl. Mar–Apr, fr. May–Jun.

Forests on mountain slopes, hills; ca. 400 m. Hainan (mountain range between Yaxian and Baoting) [Vietnam].

This is a rare species vulnerable to extirpation. The wood is durable and is used for building houses and bridges and making furniture.

*Hopea exalata* was earlier separated from *H. reticulata* by having 15 as opposed to 10 stamens, but we find that both numbers are found in each entity and accordingly treat them as conspecific.

**4. *Hopea shingkeng* (Dunn) Bor, Indian Forest Rec., Bot. 2: 227. 1941.**

西藏坡垒 xi zang po lei

*Vatica shingkeng* Dunn, Bull. Misc. Inform. Kew 1920: 108. 1920.

Trees evergreen, to 18 m tall, glabrous; bark smooth, brown mottled. Twigs slender. Stipules fugacious; petiole ca. 1 cm; leaf blade  $9\text{--}15 \times 2.5\text{--}5$  cm, elliptic-oblong to lanceolate, herbaceous, lateral veins 7 or 8 pairs slender but prominent abaxially and impressed adaxially, tertiary veins laxly scalariform, base broadly cuneate, apex caudate. Panicles to 15 cm, lax, slender; flowers buds ca. 8 mm, narrowly ovoid, secund. Sepals broadly ovate, subequal. Petals ca.  $8 \times 4$  mm, lanceolate, pubescent on parts exposed in bud. Stamens 15; anthers oblong; connective appendages ca.  $3 \times$  as long as anthers, slender. Ovary and stylopodium hourglass-shaped, with short tapering style. Fruit sepals unequal, 2 outer lobes to  $3 \times 2$  cm, ovate, obtuse; 3 inner lobes to 1.5 cm, narrowly ovate; nut to 1.5 cm, ovoid-globose, apex apiculate.

• Moist evergreen forests; 300–600 m. SE Xizang.

### 3. PARASHOREA Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39(2): 65. 1870.

柳安属 liu an shu

Trees evergreen, large, with stout buttresses. Bark fissured, shallowly flaky, grayish mauve-brown, with small but prominent white lenticels at base of fissures and on buttress crowns. Stipules lanceolate, persisting in juveniles; leaf blade oblong to lanceolate. Inflorescence racemose. Flowers and fruit as in *Shorea*, but flower sepals narrowly lanceolate, imbricate at base only; petals falling separately. Stamens 15; filaments short, dilated; pollen sacs narrowly oblong, glabrous; connective appendages short or columnar, relatively stout. Ovary ovoid, small, pubescent; style filiform, long. Fruit sepals subequal, with narrow thickened base often becoming valvate in fully ripe fruit, narrowly winglike, long; nut globose or ellipsoid.

Fourteen species: Cambodia, China, W Indonesia, Laos, Malaysia, S Myanmar, Philippines, Thailand, Vietnam; one species in China.

The Chinese species differs from others in *Parashorea* in that the seedlings do not have a silvery abaxial leaf surface and the pubescence on the nut obscures the normally distinct pale lenticels; but this species is otherwise typical of the genus. *Parashorea* has wood-anatomical similarities to the red meranti group of *Shorea*; molecular phylogenetic evidence suggests that it is basal to them. Formal review of the status of genera in tribe Shoreae must await further molecular evidence.

**1. *Parashorea chinensis* H. Wang, Acta Phytotax. Sin. 15(2): 11. 1977.**

望天树 wang tian shu

*Parashorea chinensis* var. *kwangsiensis* Lin Chi; *Shorea chinensis* (H. Wang) H. Zhu (1992), not Merrill (1922); *S. wangtianshuae* Y. K. Yang & J. K. Wu; *S. wangtianshuae* var. *chuanbanshuae* Y. K. Yang & J. K. Wu; *S. wangtianshuae* subsp. *kwangsiensis* (Lin Chi) Y. K. Yang & J. K. Wu; *S. wangtianshuae* subsp. *vietnamensis* Y. K. Yang & J. K. Wu.

Trees evergreen, lofty emergents, 40(–60) m tall, 0.6–1.5 m in diam., with large stout straight buttresses. Bark gray or brown, shallowly longitudinally fissured on upper part, but exfoliating in masses on lower part, with prominent lines of lenticels on buttress ridges and in fresh fissures. Branchlets gray to yellowish brown scurfy pubescent or tomentose, lenticels orbicular. Stipules caducous, ovate, to  $15 \times 5$  mm in juveniles, papery, scurfy pubescent or tomentose, longitudinally 5-veined, leaving short scars; petiole 1–3 cm, densely pubescent; leaf blade elliptic-lanceolate,  $6\text{--}20 \times 3\text{--}8$  cm, leathery, both surfaces scurfy pubescent or tomentose, lateral veins pinnate in 14–19 pairs conspicuously raised abaxially, tertiary veins conspicuous and subreticulate, base rounded, margin entire, apex acuminate. Inflorescences axillary or terminal cymose panicles 5–12 cm,

densely grayish yellow scurfy-pubescent or tomentose, flowers sweetly scented; cymes 2-bracteate at base, 3–8-flowered. Pedicel 2-bracteolate; bracts and bracteoles ovate or ovate-elliptic,  $6\text{--}13 \times 4\text{--}7$  mm, longitudinally 6–9-veined. Sepals narrowly lanceolate, outside pubescent. Petals yellowish white,  $6\text{--}11 \times 3\text{--}7$  mm, 10–14-veined. Stamens 15; anthers linear-lanceolate, outer cells apiculate, inner cells much smaller than outer; connective appendages acicular, nearly as long as outer cells. Ovary narrowly ovoid, densely white silky-pubescent; style columnar, ca. twice as long as ovary, glabrous; stigma small, slightly 3-lobed. Fruit (when mature) ellipsoid, densely silvery silky-pubescent; calyx segments subequal, winglike,  $6\text{--}8 \text{ cm} \times 6\text{--}10$  mm, longitudinally 5–7-veined, bases narrow, not completely enveloping fruit, often becoming valvate. Fl. May–Jun, fr. Aug–Sep.

Valleys, mountain slopes, hills, dense forests on limestone and other rocks; 300–1100 m. W Guangxi (Bama, Longzhou, Napo), S and SE Yunnan (Hekou, Mengla) [N Vietnam].

The wood is brownish yellow, fine-grained, hard, and durable. It is used for various purposes.

The homogeneity of genetic structure of *Parashorea chinensis* in different populations supported reducing *P. chinensis* var. *kwangsiensis* into synonymy (Li and Xu, Acta Bot. Yunnan. 23: 313–320. 2001).

#### 4. *SHOREA* Roxburgh ex C. F. Gaertner, Suppl. Carp. 47. 1805.

娑罗双属 suo luo shuang shu

*Pentacme* A. Candolle.

Trees usually large, prominently buttressed. Bark usually fissured, flaky. Stipules caducous, large or small; leaf blade ± leathery, tertiary veins parallel, margin entire. Flowers in axillary or terminal lax cymose panicles; bracts persistent, caducous, or absent. Sepals with 3 outer larger than 2 inner. Petals white, yellow, or pink, usually pubescent. Stamens (12–)15 or 20–100; anthers ovoid, oblong, or panduriform; connective subulate-cuspidate or stout, club-shaped; valves equal or outer one slightly larger. Ovary ovoid, pubescent; style subulate; stigma entire or 3-toothed. Fruit usually 1-seeded, closely surrounded by thickened bases of accrescent calyx segments; sepals developed into lorate wings, outer 3 much larger than 2 inner.

About 200 species: Bhutan, Cambodia, China, NE India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam; two species in China.

- 1a. Trees evergreen with laminated inner bark; anthers ellipsoid, glabrous, connective appendages filiform, glabrous; stamens (*S.* sect. *Anthoshorea* (Pierre) F. Heim) ..... 1. *S. assamica*  
 1b. Trees deciduous without laminated inner bark; anthers panduriform, setose toward apex, connective appendages short, stout, sparsely setose (*S.* sect. *Shorea*) ..... 2. *S. robusta*

1. *Shorea assamica* Dyer in J. D. Hooker, Fl. Brit. India 1: 307. 1874.

云南娑罗双 yun nan suo luo shuang

*Shorea assamica* Dyer subsp. *yingjiangensis* Y. K. Yang & J. K. Wu; *S. siamensis* Miquel var. *borealis* Y. K. Yang & J. K. Wu.

Trees evergreen, emergent, to 50 m tall, with aromatic white resin smears. Bark dark brown or grayish brown, irregularly exfoliating in scales; inner bark laminated; wood pale, not hard. Branchlets densely grayish yellow tomentose, orbicular lenticellate. Stipules oblong or falcate-ovate, ca. 2 cm, longitudinally 10- or 11-veined, densely grayish yellow tomentose, persistent on juveniles; petiole ca. 1 cm, densely yellow tomentose; leaf blade ovate-elliptic, 6–12 × 3–6 cm, thinly leathery, midvein raised abaxially and conspicuously impressed adaxially, lateral veins 12–19 pairs, pinnate, slender, tertiary veins loosely scalariform and conspicuous, abaxially stellate pubescent, adaxially tomentose along midvein, base rounded or slightly cordate, margin entire, apex acuminate. Flowers in axillary or terminal cymose panicles; bracts caducous. Sepals: outer 3 elliptic and ca. 8 mm, inner 2 lanceolate and ca. 6 mm, all grayish yellow tomentose. Petals yellowish white, contorted, narrowly oblong, longitudinally 11-veined, appressed tomentose outside. Stamens 15; anthers ellipsoid, glabrous; connective appendages filiform, ca. 3 mm glabrous. Ovary ovoid, sparsely pubescent; nut to 1.5 × 1.5 cm; style narrowly cylindrical; stigma 3-lobed. Sepal lobes winglike; long wings linear-oblong, 8–10 × ca. 1.5 cm, longitudinally 10–14-veined, short wings linear-lanceolate, 3–5 cm; all tomentellate. Fl. Jun–Jul, fr. Dec–Jan of following year.

Tropical valley forests; below 1000 m. SE Xizang, W Yunnan

[India, Indonesia (Sumatra), Malaysia, Myanmar, Philippines, Thailand].

This is a rare species in China, threatened by habitat loss. *Shorea assamica* subsp. *globifera* (Ridley) Symington accounts for the extra-Chinese distribution.

2. *Shorea robusta* C. F. Gaertner, Suppl. Carp. 48. 1805.

娑罗双 suo luo shuang

Trees to 40 m tall, ± tardily deciduous; trunk to 2 m in diam.; crown spreading. Bark gray to dark reddish brown, becoming fissured and flaky; inner bark not laminated; wood hard; heartwood dark brown. Branchlets densely buff scabrous-pubescent. Stipules fugacious, lanceolate, small, lepidote; petiole 2–2.5 cm, buff scabrous-pubescent; leaf blade 10–40 × 5–24 cm, ovate to oblong, thinly leathery, midvein prominent abaxially and conspicuous adaxially, lateral veins ca. 12 pairs prominent abaxially, tertiary veins densely scalariform, glabrous, base obtuse to cordate, apex acuminate. Flowers subsessile, on panicles to 25 cm; branches racemose, secund; bracts caducous, minute. Petals strongly contorted, creamy-yellow or sometimes with a medium pink stripe, 1–1.5 cm × ca. 5 mm, linear. Sepals ovate, to 2 mm in bud, subequal, densely buff pubescent. Stamens many; anthers panduriform, setose toward apex; connective appendages short, stout, exceeding anther apex, sparsely setose. Ovary ovoid, densely buff pubescent. Fruit sepals unequal, spatulate, sparsely pubescent, 3 longer to 8 × 1.5 cm, 2 smaller to 3.5 × 0.5 cm; nut ovoid, ca. 5 × 12 mm. Fl. Feb–May, fr. May–Jul.

Gregarious in savanna woodlands; below 800 m. SE Xizang [Bhutan, India, Nepal].

This is a rare species in China.

#### 5. *VATICA* Linnaeus, Mant. Pl. 2: 152, 242. 1771.

青梅属 qing mei shu

*Pachynocarpus* J. D. Hooker; *Retinodendron* Korthals (1840), not Zenker (1833) [Fossil]; *Sunaptea* Griffith.

Trees of main canopy and understory, unbuttressed, white resinous. Bark gray, smooth, often with annular striations. Stipules caducous, small; leaf blade ± leathery, pinnately veined, tertiary reticulate veins conspicuous, margin entire. Flowers in axillary or

terminal cymose panicles, usually stellate pubescent. Calyx tube short; sepals narrowly imbricate, equal or subequal. Petals white, often with a mauve suffusion, lorate, large, falling separately. Stamens 15; filaments unequal, stout; anthers ellipsoid; connective appendages short, obtuse. Ovary ovoid, pubescent; style cylindrical, short; stigma capitate or conic, prominent, entire or dentate. Nut globose or ellipsoid, 1- or 2-seeded; calyx segments equal or unequal, with 2 developed into long wings.

About 65 species: Cambodia, China, E and S India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam; three species (one endemic) in China.

*Vatica cordata* Hu is a synonym of *Tridynamia sinensis* (Hemsley) Staples var. *sinensis* in the Convolvulaceae (see Fl. China 16: 282. 1995).

- 1a. Fruit sepals short, subequal; leaf abaxially glaucous ..... 2. *V. lanceifolia*  
 1b. Fruit sepals unequal, 2 winglike; leaf not as above.  
 2a. Leaf lateral veins 12 or more pairs ..... 1. *V. guangxiensis*  
 2b. Leaf lateral veins 7–10 pairs ..... 3. *V. mangachapoi*

**1. *Vatica guangxiensis*** X. L. Mo, Acta Phytotax. Sin. 18: 232. 1980.

广西青梅 *guang xi qing mei*

*Vatica guangxiensis* subsp. *xishuangbannaensis* (G. D. Tao & J. H. Zhang) Y. K. Yang & J. K. Wu; *V. xishuangbannaensis* G. D. Tao & J. H. Zhang.

Trees to 40 m tall, ca. 90 cm in diam. Branchlets of current year densely yellowish brown to dark brown stellate-tomentose, old branchlets glabrous. Petiole 1.5–2 cm, densely yellowish brown pubescent; leaf blade narrowly elliptic to elliptic-lanceolate, 6–19 × 1.5–4 cm, thinly leathery, both surfaces with grayish yellow stellate hairs, glabrescent or abaxially sparsely stellate-pubescent and adaxially glabrous, lateral veins 12–18(–20) pairs raised on both surfaces, base cuneate, margin entire, apex acuminate or shortly acuminate. Panicles terminal or axillary, robust, to 12 cm, densely yellowish brown pubescent. Sepals densely pubescent on both surfaces. Petals white or reddish, ca. 15 × 5 mm, pubescent on parts exposed in bud. Stamens 15; filaments triangular, short; anthers oblong; connective appendages short, obtuse. Ovary subglobose, densely grayish yellow pubescent; style glabrous; stigma capitate, 3-lobed. Nut subglobose, pubescent; calyx without basal cup adnate to ovary; fruit sepals: 2 longer oblong-elliptic, to 8 × 2 cm, obtuse, longitudinally 5-veined; 3 shorter linear-lanceolate, to 2 × 0.5 cm, all sparsely stellate-pubescent. Fl. Apr–May, fr. Jul–Aug.

Mountain slopes, hills; 800–1000 m. W Guangxi (Napo), S Yunnan (Mengla) [N Vietnam].

This is an endangered species threatened by habitat loss. The durable wood is used for making boats and furniture and building houses.

Zhu and Wang (Acta Bot. Yunnan. 14: 21–24. 1992) thought that it was unreliable to separate *Vatica xishuangbannaensis* from *V. guangxiensis* based on the different number of lateral leaf veins; however, Li and Xu (Acta Bot. Yunnan. 23: 201–208. 2001) supported such a combination based on population genetic data.

*Vatica fleuryana* Tardieu, based on a type in flower from Vietnam but unknown in fruit, was associated by Smitinand et al. (Fl. Cambodge Laos Vietnam 25: 57. 1990) with *V. diospyroides* Symington, but may be the correct name for this species. *Vatica diospyroides* is a swamp species. The fruit will resolve the issue.

**2. *Vatica lanceifolia*** (Roxburgh) Blume, Mus. Bot. 2: 31. 1856.

西藏青梅 *xi zang qing mei*

*Vateria lanceifolia* Roxburgh, Fl. Ind. 2: 601. 1824.

Trees evergreen, to 12 m tall. Bark pale grayish green, mottled, smooth. Twig slender, grayish brown puberulous. Stipules fugacious; petiole ca. 2 cm, puberulous; leaf blade abaxially glaucous, elliptic to lanceolate, 10–23 × 3–8 cm, usually narrow, thinly leathery, midvein raised abaxially, conspicuous adaxially; lateral veins 10–15 pairs, slender, raised abaxially, conspicuous adaxially, base cuneate, acumen slender. Inflorescence irregularly racemose, to 12 cm, lax, or flowers fascicled, scented. Sepals deltoid, ca. 3 mm, outside densely puberulous. Petals lorate, to 2 mm, pubescent on parts exposed in bud. Stamens 15; anthers ovoid-oblong; connective appendage exceeding anther apices, stout. Ovary ovoid, puberulous; style stout, ca. as long as ovary; stigma prominent. Nut pink-brown, ca. 3 × 2.5 cm, globose, with 3 loculicidal sutures, becoming rugulose; fruit sepals ascending, subequal, to 10 × 8 mm, lanceolate, papery, bases cordate.

Relict in evergreen valley forests; below 900 m. SE Xizang [Bhutan, NE India, NW Myanmar].

**3. *Vatica mangachapoi*** Blanco, Fl. Filip. 1: 401. 1837.

青梅 *qing mei*

*Anisoptera mangachapoi* (Blanco) Candolle; *Dipterocarpus mangachapoi* (Blanco) Blanco; *Mocanera mangachapoi* (Blanco) Blanco; *Pteranthera sinensis* Blume; *Shorea mangachapoi* (Blanco) Blume; *Vatica apteranthera* Blanco; *V. hainanensis* H. T. Chang & L. C. Wang; *V. hainanensis* var. *glandipetala* L. C. Wang; *V. hainanensis* var. *parvifolia* H. T. Chang; *V. mangachapoi* subsp. *hainanensis* (H. T. Chang & L. C. Wang) Y. K. Yang & J. K. Wu; *V. mangachapoi* var. *glandipetala* (L. C. Wang) Y. K. Yang & J. K. Wu; *V. mangachapoi* var. *parvifolia* (H. T. Chang) Y. K. Yang & J. K. Wu.

Trees to 20 m tall, white resinous. Branchlets stellate-puberulous. Petiole 1.5–2 cm, densely grayish yellow puberulous; leaf blade oblong to oblong-lanceolate, 5–13 × 2–5 cm, leathery, both surfaces glabrous or sparsely pubescent, lateral veins 7–10 pairs raised on both surfaces, tertiary veins conspicuous, base rounded or truncate, margin entire, apex acuminate or acute. Panicle terminal or axillary, 4–8 cm, slender, silver-gray stellate-pubescent. Calyx grayish yellow pubescent; sepals ovate-lanceolate or oblong, unequal, ca. 3.2 cm. Petals white,

sometimes yellowish or reddish, oblong or linear-spatulate, ca.  $10 \times 4$  mm, outside pubescent, inside glabrous. Stamens 15; filaments short, unequal; anthers oblong; connective appendages short, obtuse. Ovary globose, densely puberulous; style short; stigma capitate. Fruit globose; 2 calyx segments lorate, longer,  $3-4 \times 1-1.5$  cm, longitudinally 5-veined, apex rounded; 3 shorter segments lanceolate, to  $10 \times 4$  mm, apex acute. Fl. May–Jun, fr. Aug–Sep.

Forests on hills, mountain slopes; below 700 m. Hainan [Indonesia, Malaysia (N Borneo), Philippines, Thailand, Vietnam].

This species is vulnerable to extirpation in China due to habitat loss. The durable wood is used for making boats and building bridges and houses.

Records of *Vatica astrotricha* Hance from Hainan are referable to *V. mangachapoi*.