The Angiosperm Flora of Singapore Part 5

BURMANNIACEAE

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Major references: Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 1-279; Fl. Males. 1:4 (1948) 13-26; R. Dahlgren et al., Fam. Monocot. (1985) 216-219; Maas et al., Fl. Neotropica, Monogr. 42, Burmanniaceae (1986) 1-189; T. Rübsamen, Diss. Bot. 92 (1986) 1-310, pl. 1-98.

Small saprophytic or autotrophic, annual or perennial herbs, often growing from rhizomes or tubers. *Leaves* simple, exstipulate, usually alternate, lamina entire; autotrophic spp. with basal rosette of linear or lanceolate green leaves; saprophytic spp. with colourless to yellowish or reddish, scale-like leaves. *Flowers* bisexual, usually actinomorphic, solitary or in terminal cymes or racemes; perianth (3-)6-lobed, corolline, tubular or campanulate, tube occasionally 3-angled or 3-winged, outer parts (sepals) valvate, inner parts (petals) generally smaller, induplicate-valvate, occasionally absent, 3 or all 6 of the lobes often each with an elongate, slender, terminal appendage; stamens 3 or 6, if 3, then subsessile in the perianth throat, with anther dehiscence by horizontal slits if 6, then pendant in perianth tube, with anther dehiscence by longitudinal slits; connectives large, often appendiculate; ovary inferior, 1-loculate with parietal placentation, or 3-loculate with axile placentation, ovules numerous, anatropous, bitegmic; style filiform, shortly cylindrical or conical; stigmas 3, sometimes connate. *Fruit* capsular, occasionally fleshy, with either persistent perianth tube and style or persistent basal ring of perianth only, dehiscence irregular or by transverse ventral slits. *Seeds* small, subglobose to linear, numerous, sometimes with a loose reticulate testa; endosperm present. x = 6 or 8 (Rübsamen, 1986).

Distribution - C. 20 genera and 130 spp., with an essentially pantropical distribution but also extending into temperate regions (Jonker, 1938).

Ecology - The Burmanniaceae consist of both saprophytes and autotrophs (semi-saprophytic). The autotrophic spp. generally occur as sparse individuals in open fields and savannahs, whereas the saprophytes occur almost exclusively on decaying leaves, wood and roots in the deep shade of wet tropical forests (Jonker, 1938). The seeds are tiny, with little food reserve, but are produced in very large quantities. Spp. in open grassland habitats therefore presumably disperse their seeds by wind,whereas water may be the primary means of dispersal in spp. of forested areas (Maas et al., 1986).

Uses - The Burmanniaceae are of no known economic importance.

Notes - The phylogenetic relationships of the family are rather unclear, due in part to convergence in evolution of achlorophyllous plants. The Burmanniaceae are clearly isolated, but possess greatest similarities with the Orchidaceae, although not with the subfamily Apostasioideae (Rübsamen,1986), as previously suggested.

The Burmanniaceae have been classified into 3 tribes (Burmannieae, Thismieae and Corsieae) based on the inflorescence type, and stamen number and attachment, although the Corsieae are generally elevated to the segregate family Corsiaceae (e.g., Jonker, 1938; Rübsamen, 1986). The Thismieae have also been isolated as a distinct family (e.g., Dahlgren et al., 1985), although the present account follows most other recent treatments in describing the family Burmanniaceae sensu lato.

Key to the Genera

1a. Perianth tube cylindrical or trigonous. Style of ± equal length as the tube. Stamens 3 2

1b. Perianth tube urceolate, circumscissile. Style very short. Stamens 6 ..... ***Thismia***

2a. Perianth persistent after anthesis, together with ovary often prominently 3-winged, sometimes 3-costate or wingless. Ovary and capsule 3-loculate with axile placentation ..... ***Burmannia***

2b. Perianth caducous after anthesis, together with ovary wingless. Ovary and capsule 1-loculate with parietal placentation. ..... ***Gymnosiphon***

Burmannia L.

Sp. pl., ed. 1 (1753) 287; Ridl., Mat. fl. Malay. Penins. 2 (1907) 69; Fl. Malay Penins. 4 (1924) 303; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 18, 57; Fl. Males. 1:4 (1948) 15; M.R. Hend., Malay. Wild Flowers, Monocot. (1954) 170; Backer & Bahk. f., Fl. Java 3 (1968) 213.

Achlorophyllous saprophytic or green autotrophic, annual or perennial herbs; autotrophs with basal rosette of green leaves, and smaller green leaves appressed to the stem; saprophytes with only small bract-like, achlorophyllous, stem leaves. *Flowers* solitary or in terminal cymes; perianth persistent after anthesis, often 3-winged, occasionally wingless, tube generally 6-lobed, cylindrical to trigonous, outer segments relatively large, inner segments often minute, occasionally lacking; stamens 3, sessile or subsessile on perianth tube, connective occasionally with (1-) 2 apical glandular crests and/or a central, pendant, basal spur; ovary trigonous, 3-loculate, placentation axile; styles fused, branched towards the stigmas; stigmas 3, occasionally sessile, funnel-shaped. *Capsule* with persistent perianth, dehiscence generally irregular. *Seeds* numerous, oblong or ellipsoidal.

Distribution - C. 60 spp., throughout the range of the whole family (Jonker, 1938) although with an Asian centre of diversity. Only *B. championii*, *B. coelestis* and *B. wallichii* have been recorded in Singapore.

Ecology - As with the family, most spp. of *Burmannia* are either autotrophs of wet areas of open savannahs, or saprophytes of wet tropical forests (Jonker, 1938), although 1 neotropical sp. is known to be epiphytic (Maas et al., 1986). Although the brightly coloured perianth, septal nectaries and glandular staminal crests are indicative of entomophily, no such system has ever been observed. Protandry has been demonstrated for some *Burmannia* spp. (Malme, 1896), and it has been suggested that the lower lip of the stigmatic lobes may be a means of avoiding autogamy. The stigmas and anthers are, nonetheless, located at the same height in the perianth tube, often almost occluding the throat of the tube, and Schoh (1920) believed that *Burmannia* must be autogamous since the stigmatic lobes prevent the dispersal of pollen from the thecae.

Notes - The distinction between autotrophic and saprophytic habits was previously believed to be of some taxonomic significance, but is now considered of little value due to the occurrence of pairs of closely related saprophytic and autotrophic spp. (Jonker, 1938), suggesting that saprophytism is polyphyletic in the genus. The pollen is mono- or biporate (Chakrapani & Raj, 1971).

Key to the Species

1a. Leaves in a basal rosette, green ..... ***B. coelestis***

1b. Leaves not in a basal rosette, achlorophyllous 2

2a. Inflorescences (2-)3-9(-14)-flowered. Perianth tube without lateral wings ..... ***B. championii***

2b. Flowers generally solitary. Perianth tube with 3 lateral wings.... ***B. wallichii***

1. *B. championii* Thwaites

Enum. pl. Zeyl. 5 (1864) 325; Ridl., Mat. fl. Malay. Penins. 2 (1907) 72; A. Ernst & C. Bernard, Annls Jard. bot. Buitenz. 24 (1911) 81-82; Ridl., Fl. Malay Penins. 4 (1924) 306; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 138; Fl. Males., 1:4 (1948) 17; M.R. Hend., Malay. Wild Flowers Monocot. (1954) 172; Backer & Bakh. f., Fl. Java 3 (1968) 213; H. Keng, Gdns' Bull., Singapore 40 (1987) 123; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 63; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 47.

B. capitata Makino; *B. chionantha* Schltr.; *B. dalzieli* Rendle; *B. japonica* Maxim. ex Makino; *B. tuberosa* Becc.

Saprophytic annual herbs, flowering at 9-27 cm tall; stem unbranched, filiform, growing from a tuberous rhizome, covered with hair-like roots, giving rise to small adventitious tubers. Stem *leaves* appressed, achlorophyllous, bract-like, linear to subulate, 2-8 mm long. *Inflorescence* of (2-)3-9(-14) flowers; bracts lanceolate, 2-6 mm long, apex acute. *Flowers* 3-11 mm long; perianth yellow-white to bright yellow, tube 3-costate, without lateral wings, outer lobes triangular, c. 1-2.5 mm

long, apex acute involute, inner lobes spathulate, to c. 0.75 mm long, apex rounded; staminal connective with single, central crest at apex, basal spur absent; gynoecium c. 3 mm long; ovary c. 2-3 mm long; flowers pedicellate or subsessile. *Capsule* dehiscing by fragmentation of the wall between costae. n = 6, 2n = 12 (Ernst and Bernard, 1912).

Distribution - Japan, southern China, Sri Lanka and Malesia (Malay Peninsula, Bangka, Java, Borneo and Papua New Guinea) (Jonker, 1938).

Ecology - Grows in wet lowland forests.

Notes - The pollen is monoporate (Chakrapani and Raj, 1971).

2. *B. coelestis* D. Don

Prodr. fl. Nepal. (1825) 44; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1900) 152; Mat. fl. Malay. Penins. 2 (1907) 71; Fl. Malay Penins. 4 (1924) 304; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 120; Fl. Males., 1:4 (1948) 17; M.R. Hend., Malay. Wild Flowers Monocot. (1954) 171; Backer & Bakh. f., Fl. Java 3 (1968) 213; H. Keng, Gdns' Bull., Singapore 40 (1987) 123; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 63; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 47.

B. azurea Griff; *B. borneensis* Gand.; *B. javanica* Blume; *B. malaccensis* Gand; *B. selebica* Becc.; *B. triflora* Roxb.

Autotrophic annual herbs, flowering at 7-40 cm tall; stem usually unbranched, robust. *Leaves* with basal rosette and stem forms; basal rosette leaves linear or lanceolate, 3-26 × 0.5-3.5 mm; stem leaves appressed, sometimes imbricate towards the base, linear to subulate, 3-30 mm long, apex acute. *Inflorescence* a solitary flower or cluster of 2-4(-6) flowers; bracts linear to subulate, 1-9 mm long, apex acute. *Flowers* 6-17 mm long; perianth blue, purple or white, often with yellow lobes, tube cylindrical-trigonous with lateral wings, c. 5 mm long, lateral wings half-elliptical to half-obovate, c. 10 × 2.5 mm, outer lobes ovate, to c. 1.5 mm long, double margined, apex apiculate, inner lobes lanceolate, to c. 0.5 mm long, double margined, apex apiculate; staminal connectives with 2 apical crests and a basal pendant spur; gynoecium c. 4 mm long; ovary c. 5 mm long; flowers subsessile. *Capsule* dehiscing ± irregularly, by transverse splits. n = c. 16 (Sarkar et al., 1973). - **Fig. 1**.

Distribution - Singapore: currently in MacRitchie Reservoir, Poyan Reservoir, Kent Ridge Park, etc. India, Nepal, southern China, Burma, Thailand, Indochina, and throughout Malesia (Jonker, 1938).

Ecology - Grows in wet areas of open grassland.

Notes - The pollen is monoporate (Chakrapani and Raj, 1971). Larsen (1963) reported a chromosome count of 2n = c.32 for '*B. coelestis*'; examination of the voucher specimen resulted in its redetermination as *B. chinensis* Gand.

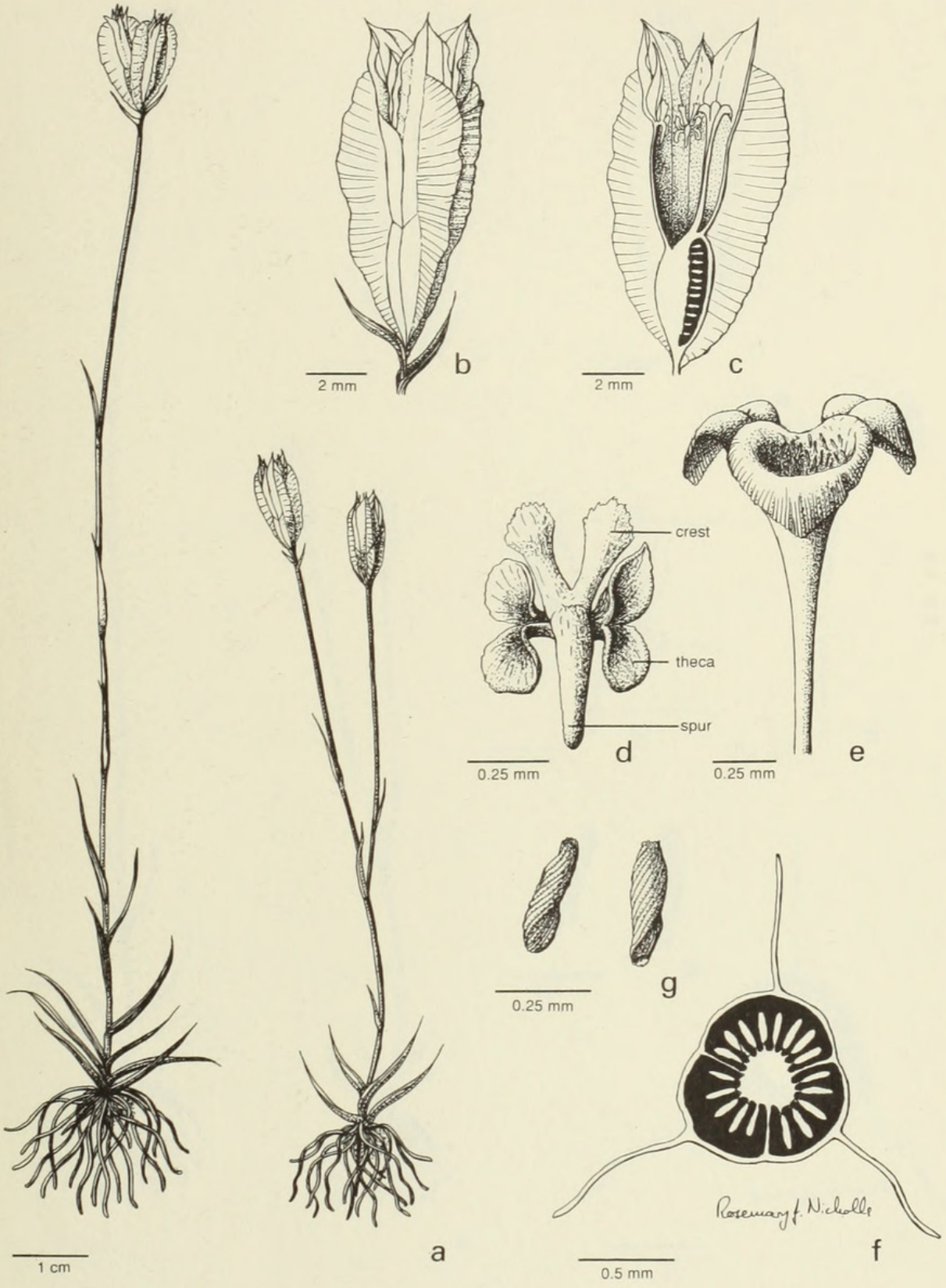

Fig. 1. *Burmannia coelestis* D. Don. a. Habit. b. Complete flower. c. Half flower. d. Stamen, with lateral thecae and connective consisting of 2 apical crests and a pendant basal spur. e. 3 stigmas with united style. f. Ovary (TS), showing axile placentation. g. Seeds, with spirally striate testa. [a.-f. K.S. Chua & H.T.W. Tan 281 (Herbarium, The University of Hong Kong); g. Z. Teruya 2210 (SING)]. Del. R.J. Nicholls.

3. *B. wallichii* (Miers) Hook. f.

Fl. Brit. India 5 (1888) 666; Ridl., Mat. fl. Malay. Penins. 2 (1907) 71; Fl. Malay Penins. 4 (1924) 305; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 145; R.M.K. Saunders, Blumea 41 (1996) 336.

Saprophytic annual herbs, flowering at 4.5-11 cm tall; stem unbranched, filiform. Stem *leaves* ± appressed, achlorophyllous, bract-like, subulate-triangular, sometimes keeled, 1-2.8 mm long, apex acute. *Inflorescence* a solitary flower or occasionally a pair; bracts lanceolate, c. 2.5-4 mm long. *Flowers* 6-9.5 mm long; perianth white or bluish; tube cylindrical, c. 3 mm long, lateral wings narrow, ± linear, c. 4.5 × 0.5 mm; outer lobes obtuse-triangular, to c. 1 mm long, inner lobes orbiculate, apex rounded; staminal connectives without apical crests, but with a short basal spur; gynoecium c. 3 mm long, ovary c. 2.5 mm long; flowers subsessile. *Capsule* dehiscing ± irregularly by transverse splits. n = 16 (Larsen, 1963).

Distribution - India, Burma, Thailand, Indo-China, southern China and the Malay Peninsula (Jonker, 1938).

Ecology - *B. wallichii* is clearly saprophytic; otherwise little is known of its ecology.

Notes - *B. wallichii* has only been recorded from Singapore once, last century (Ridley's collector s.n., Kranji [SING 074436]); as it has not been collected since, it is now probably extinct in Singapore.

Gymnosiphon Blume

Enum. pl. Javae 1 (1827) 29; Ridl., Mat. fl. Malay. Penins. 2 (1907) 73; Fl. Malay Penins. 4 (1924) 306; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 27, 168; Fl. Males., 1:4 (1948) 20; Backer & Bakh. f., Fl. Java 3 (1968) 214.

Saprophytic annual herbs. *Leaves* achlorophyllous, bract-like, small. *Flowers* borne in 3 to many-flowered racemes, rarely solitary; perianth tube 6-lobed, without lateral wings, tube from below point of insertion of stamens deciduous after anthesis, lower part persistent, outer lobes larger than the inner ones, slightly 3-lobed; anthers 3, sessile in the tube throat, dehiscing horizontally, connectives rather broad, inappendiculate or mucronulate at the top; ovary ovoid to globose, with 3 parietal placentas, placentas each with a large globose gland at both sides of the apex; style filiform, branching; stigmas 3, often appendiculate. *Capsule* with persistent perianth tube base, dehiscence generally irregular or by longitudinal slits. *Seeds* ovoid to globose, with a reticulate testa.

Distribution - C. 25 spp., occurring in the neotropics, tropical Africa and Madagascar and South-east Asia (Jonker, 1938). Only *G. aphyllus* has been recorded in Singapore.

Ecology - All spp. of *Gymnosiphon* are saprophytes of wet tropical forests.

Although cross-pollination has never been demonstrated for the genus, several floral structures are indicative of entomophily: coloured perianths; septal nectaries (Maas et al., 1986); stigmatic appendages that exceed the floral tube; putative protandry (Rübsamen, 1980); and reports of scented flowers in 2 spp. (Bentham, 1855; Vogel 1962, cited in Maas et al., 1986). Rübsamen (1986) has furthermore observed insect larvae within *Gymnosiphon* flowers. Autogamy is also possible, however, as the stigmas and anthers are located at the same height in the perianth tube, and are often intimately associated.

Notes - The upper region of the perianth tube (including the sessile anthers) is deciduous after anthesis, and so the identification of post-anthesis and fruiting specimens is therefore often impossible.

1. *G. aphyllus* Blume

Enum. pl. Javae 1 (1827) 29 ('*G. aphyllum*'); Ridl., Mat. fl. Malay. Penins. 2 (1907) 73; Fl. Malay Penins. 4 (1924) 306; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 30, 170; Fl. Males., 1:4 (1948) 20; Backer & Bakh. f., Fl. Java 3 (1968) 214; H. Keng, Gdns' Bull., Singapore 40 (1987) 123; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 63; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 47.

G. borneense Becc.; *G. pedicellatum* Schltr.

Herbs, flowering at 8-17 cm tall; stem often branched. *Leaves* appressed, bract-like, narrowly ovate-triangular, 1-2.8(-4.5) mm long, apex acute. *Inflorescence* racemose, branched or not, many-flowered; bracts appressed, ovate-triangular, 1.2-3.5(-5) mm long, apex acute. *Flowers* with white to violet perianth, tube to 4 mm long, outer lobes ovate, c. 2-2.5 mm long, apex obtuse, with narrow, crenate lateral lobes, inner lobes linear-lanceolate, minute; anthers inserted immediately below the inner perianth lobes; stigmas curved, funnel-shaped, inappendiculate; pedicel 1.5-4.0 mm long. *Capsule* c. 3 mm long, dehiscing by perforation of the wall between costae. *Seeds* ovoid, with striate testa.

Distribution - Singapore: formerly collected from Bukit Timah, but now probably extinct in Singapore (Keng, 1987). Thailand and Malesia (Malay Peninsula, Java, Borneo, Sulawesi and New Guinea) (Jonker, 1938).

Ecology - Grows on decaying vegetation and humus, in wet shaded forests below 1500 m in its range.

Thismia Griff.

Proc. Linn. Soc. Lond. 1 (1844) 221; Ridl., Mat. fl. Malay. Penins. 2 (1907) 73; Fl. Malay Penins. 4 (1924) 307; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 42, 227; Fl. Males., 1:4 (1948) 21; Backer & Bakh. f., Fl. Java 3 (1968) 214.

Saprophytic, fleshy, annual herbs with generally tuberous, coralliform or vermiform and creeping subterranean parts, stem usually short, rarely branched. *Leaves* achlorophyllous, bract-like, small. *Flowers* actinomorphic (occasionally zygomorphic); subtending bracts sometimes forming an involucre; perianth 6-merous, segments either free and of equal length, or else with very small outer lobes and larger inner lobes connivent or connate at the apex, forming an erect mitre with 3 holes; tube urceolate to campanulate, longitudinally striate, with a prominent annulus at the tube mouth; stamens 6, generally laterally connate, forming an anther tube, hanging from the annulus, occasionally free, filaments filiform or taeniform, short; ovary 1-loculate, with 3 parietal placentas, obconical or obovoid; style cylindrical or conical, short, thick; stigmas 3, simple or bilabiate. *Fruit* fleshy, cupulate, crowned by the persistent, fleshy, basal ring of the perianth tube and the style and stigmas, dehiscing by abscission of the apical lid. *Seeds* numerous, oblong, with reticulate testa.

Distribution - C. 30 spp., distributed in tropical regions of America and Indo-Malesia and temperate Australasia (Tasmania and New Zealand) (Jonker, 1938); 1 further sp., now extinct, was endemic to Illinois, U.S.A. Only *T. aseroe* and *T. fumida* have been recorded in Singapore.

Ecology - All *Thismia* spp. are saprophytic, predominantly occurring among leaf litter of the tropical forest floor. As with other genera in the Burmanniaceae, *Thismia* possesses several floral characteristics typical of entomophily: some spp. have a brightly coloured annulus with nectar guides directed towards the perianth tube; others have tentacle-like extensions of the perianth, which may act as access routes for insects of the forest floor; the stamens often form a guide, leading the pollinator to the stigma; many have specialized or restricted exit routes for pollinators, ensuring that they brush past the anthers; and some spp. have glandular swellings at the tip of the perianth segments, presumably acting as osmophores, or glands at the base of the perianth (Vogel, 1962, cited in Maas et al., 1986). Stone (1980) suggested that pollination of some spp. may be effected by flies, and cited the mitriform perianth apex with its openings as evidence of the myophilous syndrome. Self-pollination has also been demonstrated in many spp. (Maas et al., 1986). Abscission of the perianth tube following anthesis and the fragility of the membrane covering the ovarian chambers are indicative of seed dispersal by rain-splash (Stone, 1980).

Key to the Species

1a. Perianth tube brown to grey-yellow below and bright orange-yellow above, with bright orange-yellow lobes which are red basally; short extensions present between the lobes ..... ***T. aseroe***

1b. Perianth tube white with pink stripes, and grey-green lobes; extensions between lobes absent ..... ***T. fumida***

1. *T. aseroe* Becc.

Malesia 1 (1878) 252; Ridl., J. Straits Brch R. Asiat. Soc. 22 (1890) 336; J. Straits Brch R. Asiat. Soc. 33 (1900) 153; Mat. fl. Malay. Penins. 2 (1907) 74; Fl. Malay Penins. 4 (1924) 308; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 240; Fl. Males., 1:4 (1948) 23; H. Keng, Gdns' Bull., Singapore 40 (1987) 123; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 63; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 47.

Herbs, flowering at up to c. 9 cm tall; stem usually unbranched, ± succulent, growing from the creeping white rhizome. *Leaves* appressed, lanceolate, c. 4 mm long, apex obtuse. *Flowers* solitary, terminal on branches; bracts lanceolate, forming an involucre at the flower base, apex acute; perianth tube brown to grey-yellow below bright orange-yellow above, obconic-campanulate, flaring into a narrow rim, c. 10-12 mm long, with a prominent raised annulus at the mouth, basal 5 mm of tube with transverse bars internally; perianth lobes bright orange-yellow with bright yellow or orange tentacles, red at base, triangular, equal-sized, c. 10 mm long, with short extensions of the tube present between the lobes; anthers pendulous from the annulus, with filaments near the top, laterally connate, forming a staminal tube, connective extensions forming broad, dorsal quadrangular wings on the outer margin, with 2 nectaries located in the furrows between extensions, the staminal tube base with several pendulous lobes; ovary obovoid, c. 3 mm long; style short; stigmas 3. *Capsule* c. 5 mm long, ribbed, with persistent style, pedicel lengthening c. 5-7 mm above the involucre. *Seeds* ellipsoid.

Distribution - Singapore: currently there is only 1 known population, in Fern Valley at the Bukit Timah Nature Reserve. Only known from the Malay Peninsula (Singapore and Perak) (Jonker, 1938).

Ecology - Grows in the leaf litter of dense forests.

Notes - The complex floral anatomy is described in detail and illustrated by Groom (1895).

2. *T. fumida* Ridl.

J. Straits Brch R. Asiat. Soc. 22 (1890) 338; J. Straits Brch R. Asiat. Soc. 33 (1900) 153; Mat. fl. Malay. Penins. 2 (1907) 74; Fl. Malay Penins. 4 (1924) 307; Jonker, Meded. bot. Mus. Rijks-Univ. Utrecht 51 (1938) 240; Fl. Males., 1:4 (1948) 23; H. Keng, Gdns' Bull., Singapore 40 (1987) 123; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 63; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 47.

Herbs, flowering at up to c. 10 tall; stem usually unbranched, ± succulent, growing from a brownish rhizome. *Leaves* appressed, lanceolate, apex acute to acuminate. *Flowers* solitary, terminal on branches, c. 5-10 mm long, bracts not

observed; perianth tube white with pink stripes, ± cylindrical, constricted above the ovary and broadened below the limb, without a noticeable apical ring, annulus prominent; perianth lobes grey-green, spreading, lanceolate, apex acute, extensions between lobes absent; anthers not observed; ovary obconical; style very short; stigmas 3, recurved. *Capsules* cupulate, ribbed, scabrid, crowned by the crenulate basal ring of the perianth. *Seeds* not observed.

Distribution - *T. fumida* has only ever been recorded from Petaling in Selangor, Malaysia and Chan Chu Kang in Singapore (Saunders, 1996a).

Ecology - Grows on rotting logs in dense forests.

Notes - The scarcity of collections and their poor quality prevents descriptions of some structures, including the bracts, anthers and seeds. The above description is consequently largely based on that of Ridley (1890) and his drawings, now held in the library of the Royal Botanic Gardens at Kew (published in Saunders, 1996a). As both collections were made in the last century, the sp. is now believed to be extinct in Singapore (Keng, 1987).

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