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FIELDIANA

Botany

NEW SERIES, NO. 41

FLORA COSTARICENSIS

William Burger, Editor

Family #193 Scrophulariaceae

Family #193a Schlegeliaceae

Family #194 Bignoniaceae

Family #195 Pedaliaceae

Family #196 Martyniaceae

Family #197 Orobanchaceae

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Index of plant orders known or expected to occur in Costa Rica and adjacent areas, listed alphabetically and numbered according to the sequence of Engler's *Syllabus der Pflanzenfamilien*, edition 11, (H. V. S. J. Dies (1920))

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FLORA COSTARICENSIS

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Family #193 Scrophulariaceae

Kerry Barringer and William Burger

Family #195 Pedaliaceae

William Burger

Family #193a Schlegeliaceae

William Burger and Kerry Barringer

Family #196 Martyniaceae

William Burger

Family #194 Bignoniaceae

William Burger and Alwyn Gentry†

Family #197 Orobanchaceae

Luis D. Gómez and William Burger

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Introduction

This is the eleventh issue in the *Flora Costaricensis* series. The first dealt with the Piperaceae, family number 41 (Fieldiana, Bot. 35, 1971). The second included families numbered 42 through 53, Chloranthaceae through Urticaceae (Fieldiana, Bot. 40, 1977). The third issue covered the Gramineae (Poaceae) and was authored by Richard Pohl (Fieldiana, Bot. n.s. No. 4, 1980). The fourth issue included families numbered 54 through 70, Podostemaceae through Caryophyllaceae (Fieldiana, Bot. n.s. 13, 1983). The fifth issue covered families 200 and 201, the Acanthaceae, authored by L. H. Durkee, and the Plantaginaceae (Fieldiana, Bot. n.s. No. 18, 1986). The sixth issue included families 80 and 81, the Lauraceae and the Hernandiaceae (Fieldiana, Bot. n.s. No. 23, 1990). The seventh issue included families numbered 97 through 103, Krameriaceae through Zygophyllaceae (Fieldiana, Bot. n.s. No. 28, 1991). The eighth issue included family 202, the Rubiaceae (Fieldiana, Bot. n.s. No. 33, 1993). The ninth issue included family 113, the Euphorbiaceae (Fieldiana, Bot. n.s. No. 36, 1995). The tenth issue covered Tribe Maxillarieae of family 39, the Orchidaceae (Fieldiana, Bot. n.s. No. 40, 1999).

Illustrations of leafy or flowering stems are all drawn to the same scale with the exception of Figures 1, 2, and 28. Enlarged flowers, fruits, or seeds are drawn to the same scale on an individual plate unless otherwise noted. Bignoniaceous fruits are drawn to the same scale as the leafy stems. The closed scales represent centimeters and the

open scales represent millimeters. The figures are somewhat diagrammatic and represent a common or characteristic morphology for each species. Figure 28 was done by Luis D. Gómez; the others are by William Burger.

The circumscription of the Scrophulariaceae is difficult because the family is part of a closely related group of families that includes Orobanchaceae, Bignoniaceae, Myoporaceae, Gesneriaceae, Pedaliaceae, Martyniaceae, and Acanthaceae. A few genera have been difficult to place. *Gibsoniothammus* was described by Williams (1970) as a genus of Scrophulariaceae, and he noted its similarity to *Schlegelia*. These genera were placed in the Bignoniaceae by Gentry but are regarded as a separate family here. Reveal has recently (1995) opted for a finer division of the Scrophulariales and proposed segregating families from within Scrophulariaceae. We adhere to a more traditional circumscription of the family because of its long history in providing a useful information retrieval system.

The treatment of the Bignoniaceae presented here is publication No. 2 in the Gentry Invitation Series. This series acknowledges Dr. Gentry's many contributions to our knowledge and understanding of the Bignoniaceae. The late Alwyn Gentry's publications and his many authoritative determinations have served as the foundation for the treatment of the Bignoniaceae presented here. In addition, there are virtually no departures from his taxonomic concepts in this treatment, and he is listed as co-author for that reason.

Acknowledgments

We thank the staff of the Museo Nacional de Costa Rica for their assistance in collecting programs over many years. The National Science Foundation and the National Geographic Society helped support many of these collecting activities. NSF grant DEB-8103184 helped support the work of Kerry Barringer while studying Costa Rica's Scrophulariaceae. We thank Warren Douglas Stevens for making available copies of treatments of Bignoniaceae and Scrophulariaceae prepared for

the *Flora of Nicaragua*. We thank Michael Grayum for providing a copy of the treatment of the Bignoniaceae for the *Manual Flora of Costa Rica*. Noel Holmgren, William D'Arcy, and two anonymous reviewers provided many helpful comments and corrections. The collections of the Field Museum, the Missouri Botanical Garden, Duke University, and the U.S. National Herbarium were consulted in preparing this treatment, and we thank those institutions for the use of their materials.

FLORA COSTARICENSIS

Family #193 Scrophulariaceae

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Family #194 Bignoniaceae

Family #195 Pedaliaceae

Family #196 Martyniaceae

Family #197 Orobanchaceae

SCROPHULARIACEAE

By Kerry Barringer and William Burger

REFERENCES—W. D'Arcy, Scrophulariaceae, in R. Woodson et al., *Flora of Panama*. Ann. Missouri Bot. Gard. 66: 173–272. 1979. F. Pennell, The Scrophulariaceae of eastern temperate North America. Acad. Nat. Sci. Philadelphia Monogr. 1: 1–650. 1935. P. Standley & L. O. Williams, Scrophulariaceae, in *Flora of Guatemala*. Fieldiana, Bot. 24, 9(4): 319–416. 1973. D. Sutton, A Revision of the Tribe Antirrhineae, British Museum (Natural History) & Oxford Univ. Press, London, 576 pp. 1989. D. Sutton & R. Hampshire, Scrophulariaceae, in *Flora of Nicaragua* (unpublished manuscript). 1995. J. Thieret, The tribes and genera of Central American Scrophulariaceae. *Ceiba* 4: 164–184. 1954. J. Thieret, Supraspecific classification of Scrophulariaceae: A review. *Sida* 3: 87–106. 1967.

Herbs or subshrubs (rarely woody shrubs or trees), erect to decumbent or prostrate (rarely climbing), terrestrial to semiaquatic or aquatic, autotrophic or hemiparasitic, bisexual, stems without internal phloem, glabrous or with simple or branched, glandular or eglandular uni- or multicellular hairs; stipules absent. **Leaves** alternate, opposite, or verticillate, simple (rarely deeply pinnately lobed), distal leaves often reduced and intergrading with the floral bracts, leaf blades serrate to entire or deeply pinnately lobed, venation pinnate or less often palmate. **Inflorescences** racemes, spikes, thyrses, or panicles of cymes or of solitary (several) flowers in leaf axils, bracteoles present or absent on the pedicels, pedicels usually well developed. **Flowers** bisexual, small to large, often showy, calyx 4- or 5-lobed, or deeply divided to the base and sepals 4 or 5 (2), imbricate or valvate in bud, persisting

and often enlarging slightly in fruit; **corolla** united and tubular to campanulate, bilaterally symmetric and usually 2-lipped (rarely radially symmetric), lobes 4–5 (8), upper (adaxial) lip 2-lobed to emarginate, sometimes galeate, lower (abaxial) lip usually 3-lobed, tube saccate or spurred in some; **stamens** 2–4 (5), alternating with the lobes, usually of 2 unequal pairs, filaments borne on the tube, free, anthers with 2 (1) equal or unequal thecae, distinct or confluent, rarely awned, a staminode present or absent (rarely 2 or 3), a disc present or absent around the ovary; pistil solitary, ovary superior (or half inferior), 2-locular (rarely 1-locular near the apex or 3-locular), ovules usually many on 2 axile placentas, unitegmic, style 1, terminal, stigmas simple or 2-lobed. **Fruits** usually dry capsules (rarely baccate), dehiscence loculicidal or septicidal or both (rarely indehiscent), placenta often persisting; seeds usually many and small, usually with an ornamented testa or exotesta (sometimes smooth or winged), endosperm usually present, embryo small.

The family Scrophulariaceae includes 285 genera with between 4,000 and 5,000 species. The family is primarily north temperate, but with tropical montane species and cosmopolitan weeds. One of the largest genera, *Calceolaria* (300–400 spp.), is almost exclusively South American and montane. In this treatment we include 36 genera with 72 species, 18 of these being introduced or cultivated (see listing at end of family, p. 69). Costa Rica lies between two major areas of diversity for the family: one in Andean South America and one in Mexico and Guatemala. Among the southern elements are *Alonsoa*, *Calceolaria*, *Scoparia*, and *Stemodia*, while northern elements are *Castilleja*, *Hemichaena*, *Lamourouxia*, and *Russelia*.

Most Scrophulariaceae are recognized by their sympetalous tubular (usually two-lipped) corollas,

two-locular ovaries with many ovules on axile placentas, capsular fruits with many small seeds, and stems lacking internal phloem. Most species are herbs or small shrubs, and the corollas are often showy. There is great diversity in the form of corolla and pollination vectors (see C. M. Kampny, *Pollination and flower diversity in Scrophulariaceae*, Bot. Rev. 61: 35–366, 1995). Iridoid compounds are common in the family. The family includes many species cultivated as ornamentals and an important drug plant (*Digitalis*) but no important food, spice, or fiber plants. Interestingly,

a few of the most colorful genera (e.g., *Castilleja* and *Lamourouxia*) have not been utilized in ornamental horticulture because of difficulty in propagating their hemiparasitic species. Species likely to be mistakenly identified as Scrophulariaceae are found in Lamiaceae, Acanthaceae, and Gesneriaceae, as well as the other families included in this volume. Current molecular studies indicate that the Scrophulariaceae, as traditionally defined, are polyphyletic (Wagstaff & Olmstead, 1997). We retain the traditional circumscriptions of families in this series to facilitate information retrieval.

Key to Genera and Unusual Species of Scrophulariaceae

- 1a. Plants fully aquatic, only the inflorescences held above the water level; leaves submerged or floating, whorled, with pinnatisect filiform divisions [rarely collected] *Benjaminia reflexa*
- 1b. Plants aquatic, partly aquatic, or terrestrial, if aquatic the leaves floating or emergent and not with submerged filiform pinnatisect divisions 2
- 2a. Plants slender-stemmed twining or climbing, usually found in gardens and near habitations; leaves mostly alternate 3
- 2b. Plants erect or creeping on the ground or aquatic, not twining or climbing, found in a great many habitats; leaves alternate or opposite 5
 - 3a. Leaf blades reniform to orbicular, cordate at base, 10–35 mm long, alternate or rarely opposite; corollas 7–9 mm long, with a basal spur *Cymbalaria muralis*
 - 3a. Leaf blades often triangular-subcordate, to 60 mm long, always alternate; corollas 30–80 mm long, without a spur 4
 - 4a. Corollas 60–70 mm long; calyx 15–24 mm long; seeds with lateral wings around much of the seed *Lophospermum erubescens*
 - 4b. Corollas 30–40 mm long; calyx 9–15 mm long; seeds without thin wings *Maurandya*
- 5a. (from 2b) Leaves deeply dissected or compound, the lobes or leaflets > 30% the width of the blade 6
- 5b. Leaves entire to crenate, dentate or lobed, the lobes or teeth < 30% the width of the blade . . . 8
 - 6a. Fruits linear; plants small (40 cm), erect, in open weedy lowland (0–600 m) sites; leaves opposite, to 20 mm long *Schistophragma mexicana*
 - 6b. Fruits broader; plants usually taller, in montane (1100–3800 m) habitats; leaves opposite or alternate, 10–100 mm long 7
 - 7a. Leaves opposite; corolla bright yellow with the lower lip sac-like; calyx 4-lobed, green *Calceolaria*
 - 7b. Leaves alternate; corolla and bracts red, orange, yellow, or green, the lower lip usually narrowed and with acute lobes; calyx 4-parted but usually united to form 2 large lateral lobes, often colored *Castilleja*
- 8a. (from 5b) Lower leaves alternate, plants usually with leaves alternate all along the stem 9
- 8b. Lower leaves opposite or whorled, distal leaves opposite or alternate along the stem or the leaves rosulate from the base 13
 - 9a. Corolla expanded at the base and spurred [yellow or blue, 5–30 mm long; lower leaves linear to lanceolate; cultivated for ornament] *Linaria*
 - 9b. Corolla tubular, not expanded at the base to become saccate or spurred; wild, naturalized, or cultivated species 10
- 10a. Plants repent with creeping stems rooting at most nodes; leaf blades rounded-orbicular [to 25 mm wide]; corolla 4–8-lobed, rotate, 3–5 mm wide *Sibthorpia repens*

- 10b. Plants erect, not rooting at distal nodes; leaf blades not rounded-suborbicular; corolla not rotate 11
- 11a. Corolla with the upper lip galeate, elongate, narrowly 1-lobed and entire, lower lip shorter than the upper, small and often recurved; distal bracts often becoming colorful [not found below 700 m elevation] *Castilleja*
- 11b. Corolla not as above, lobes rounded with the lower lobes usually longer than the upper; bracts not becoming colorful 12
- 12a. Corolla 7–10 mm long, white, campanulate; stamens 5; native plants at 0–500 m elevation. *Capraria biflora*
- 12b. Corolla 20–50 mm long, usually pink marked with purple dots within, tubular; stamens 4; in gardens or naturalized at 1800–3300 m elevation (if at lower elevations and with viscous hairs or slime glands, see Martyniaceae and Pedaliaceae) *Digitalis purpurea*
- 13a. (from 8b) Plants lacking erect stems, < 7 cm tall; found only in wet sites above 3300 m elevation in Central America; leaves linear to oblanceolate, in dense fascicles or rosulate at the nodes; corolla 2–3 mm long, rotate, with 3–5 lobes *Limosella acaulis*
- 13b. Plants with erect stems or without the above combination of characteristics 14
- 14a. Leaf blades linear to linear-lanceolate, often scabrous, larger blades not exceeding 7 mm in width [plants with stiff erect stems but rarely exceeding 0.7 m height; corollas 8–15 mm long] . . . 15
- 14b. Leaf blades narrowly lanceolate to broadly ovate or rounded, scabrous or smooth; larger blades usually > 7 mm in width 18
- 15a. Corolla 20–45 mm long or with spreading lobes to 2 cm wide, magenta, red, blue-violet, or purple to yellowish, glabrous or densely puberulent externally; flowers pedicellate in leaf axils or in distal racemes; plants not wiry or scabrous herbs or subshrubs, 0.4–1.5 m tall 16
- 15b. Corolla 7–15 mm long, lavender to pale purple, glabrous externally; flowers sessile or pedicellate; plants wiry and scabrous, herbs to 0.6 m tall 17
- 16a. Corolla densely minutely puberulent externally, narrowly tubular with small distal lobes *Lamourouxia* spp.
- 16b. Corolla glabrous externally, with short tube and broadly spreading large lobes *Angelonia angustifolia*
- 17a. Flowers borne on pedicels 10–35 mm long; fruits 4–7 mm diam.; erect stems usually with several prominent lateral branches *Anisantherina hispida*
- 17b. Flowers sessile or subsessile on pedicels < 3 mm long; fruits 2–3 mm diam.; erect stems usually with few or no prominent lateral branches *Buchnera weberbaueri*
- 18a. (from 14b) Corollas with the lower lip forming a distal sac and slipper-like, usually bright yellow [10–25 mm long; plants both wild and cultivated for ornament] *Calceolaria*
- 18b. Corollas not slipper-like, the lower lip not forming a distal sac, variously colored, usually with a short or long tube and spreading distal lobes 19
- 19a. Corollas becoming > 15 mm long at anthesis 20
- 19b. Corollas usually < 15 mm long at anthesis 29
- 20a. Corollas 70–120 mm long, white and salverform (with a narrow tube and broad subequal rotate lobes) *Escobedia grandiflora*
- 20b. Corollas 14–45 mm long, variously colored, usually tubular and somewhat 2-lipped with the lobes unequal 21
- 21a. Corolla yellow or yellow and white [flowers in axillary groupings; leaves sessile and auriculate at the base, blades narrowly lanceolate; native wild plants] 22
- 21b. Corolla pink to red or purple, marked with dark spots if white or yellowish (note that *Martynia* and *Sesamum* may key out in this dichotomy; see Martyniaceae and Pedaliaceae, Fig. 27) 24
- 22a. Plants weak-stemmed herbs to 0.4 m tall; leaves petiolate with blades rounded or truncate at the base; flowers solitary in leaf axils [corolla 14–20 mm long] *Mimulus glabratus*
- 22b. Plants erect subshrubs, often to 1 (2) m tall; leaves sessile with blades lanceolate and gradually narrowed to the base; flowers usually several in leaf axils 23

- 23a. Corolla 25–45 mm long, calyx 11–16 mm; fruits dry, brownish, oblong, 13–17 mm long *Hemichaena fruitcosa*
- 23b. Corolla 14–23 mm long, calyx 5–9 mm long; fruits fleshy, white, globose, 7–10 mm long *Leucocarpus perfoliatus*
- 24a. Corolla densely minutely puberulent or glandular puberulent on the exterior 25
- 24b. Corolla glabrous on the exterior 26
- 25a. Corollas densely minutely puberulent externally, the throat not closed by a palate; native wild species *Lamourouxia*
- 25b. Corollas sparsely puberulent, throat usually closed by a palate; cultivated ornamentals *Antirrhinum*
- 26a. Corolla tube ca. 2–4 mm diam., with small distal lobes, deep red; plants shrub-like ornamentals, often without leaves and with many slender green stems *Russelia equisetiformis*
- 26b. Corolla tube 7–10 mm diam., with prominent distal lobes, purple to rose-white or marked with dark coloring; plants not shrub-like, rarely without leaves 27
- 27a. Plants of wet forests; stems usually unbranched and < 30 cm tall; leaf blades oblanceolate, to 31 cm long *Tetranema*
- 27b. Plants of gardens and ornamental plantings; stems usually with a few branches, 0.4–1 m tall; leaf blades not oblanceolate, to 10 cm long 28
- 28a. Plants becoming ca. 1 m tall; calyx united for only a short distance, lobes > half the length of the calyx; staminode prominent; grown as ornamentals in Costa Rica *Penstemon gentianoides*
- 28b. Plants to 0.4 m tall; calyx united for half its length or more, lobes < half the length of the calyx; wild and ornamental species in Costa Rica *Torenia*
- 29a. (from 20b) Calyx united for > half its length at anthesis, a calyx tube clearly present (note that flowers may appear to have separate sepals after anthesis as the fruit develops and the calyx tube splits) 30
- 29b. Calyx with the sepals united only at the base, a calyx tube not evident 35
- 30a. Stems and leaves scabrid or hispid, stems often becoming 1 m tall; flowers sessile or subsessile in distal spike-like inflorescences 31
- 30b. Stems and leaves neither scabrid nor hispid, stems rarely > 40 cm tall; flowers not sessile in spike-like terminal inflorescences (except in *Bacopa sessiliflora*) 32
- 31a. Corolla yellow, campanulate; flowers subtended by large bracts differing little from the leaves; distal leaves narrowly triangular *Alectra aspera*
- 31b. Corolla white or marked with purple or blue, salverform; flowers subtended by bracts much smaller than the leaves; distal leaves narrowly lanceolate ... *Buchnera pusilla*
- 32a. Lower leaves forming a rosette, blades narrowly obovate with long-attenuate base; flowers in lax terminal racemes; rarely encountered introduced weeds *Mazus pumila*
- 32b. Lower leaves not forming dense rosettes, blades narrowly obovate to suborbicular; flowers mostly axillary to distal leaves 33
- 33a. Calyx 4-lobed; stems terete; leaf blades varying from obovate to suborbicular (rarely ovate with truncated base) *Bacopa egensis*
- 33b. Calyx 5-lobed; stems 4-angled or with 2–4 longitudinal ridges; leaf blades mostly ovate-triangular or ovate-ellipsoid with truncated base 34
- 34a. Calyx tube < 4 mm long, usually campanulate; fruits 3–4 mm long, rounded ovoid *Lindernia*
- 34b. Calyx tube usually > 7 mm long, tubular; fruits 8–10 mm long, narrowly ellipsoid-oblong *Torenia thoursii*
- 35a. (From 29b) Fruits usually lenticular in cross-section, truncated or rounded and obcordate at the apex; stamens 2; corolla tube very short, with corolla lobes usually in a single plane (rotate); introduced weeds, 1000–3300 m elevation *Veronica*
- 35b. Fruits usually round in cross-section, never truncated or obcordate at the apex, and without the other combination of characteristics 36
- 36a. Sepals very unequal, the outer usually much broader than the inner and imbricate in bud (note that small linear bracteoles may be present at the base of the calyx) 37

- 36b. Sepals equal or subequal, valvate or less often imbricate in bud 38
 37a. Flowers yellow; bracteoles present at the base of the pedicel; leaf blades broad and abruptly narrowed to a short petiole *Mecardonia procumbens*
 37b. Flowers purple or blue to white (sometimes yellowish in age); bracteoles present in the middle or apex of the pedicel or absent; leaf blades usually gradually narrowed to the base or sessile if rounded at the base *Bacopa*
 38a. Corollas bright red or orange; plants erect herbs or subshrubs to 2 m tall, stems often stiff and longitudinally ridged 39
 38b. Corollas white to blue, purple, or yellowish; plants mostly weak-stemmed herbs 41
 39a. Leaf blades 15–31 cm long; corollas 26–55 mm long; peduncles 9–24 cm long, axillary, slender and flexuous; rarely collected endemic species *Tetranema*
 39b. Leaf blades 1–11 cm long; corollas 5–16 mm long; peduncles less than 2 cm long or the flowers on terminal erect racemes; common and widespread species 40
 40a. Flowers in axillary fascicles of 2–20, corolla deep red, tube 9–12 mm long with small acute lobes; seeds surrounded by hairs within the fruit *Russelia sarmentosa*
 40b. Flowers solitary in bract or leaf axils on a terminal raceme, corolla red to orange, tube < 2 mm long with large rounded spreading-rotate lobes; seeds not associated with hair-like structures *Alonsoa meridionalis*
 41a. Corolla < 4 mm long, rotate or campanulate 42
 41b. Corolla 4–14 mm long, usually tubular and bilabiate 43
 42a. Plants terrestrial, erect, to 1 m tall; leaf blades to 35 mm long, oblanceolate and dentate; fertile stamens 4 *Scoparia*
 42b. Plants floating or prostrate, small; leaves to 8 mm long, rounded and entire; fertile stamens 2 *Micranthemum umbrosum*
 43a. Fertile stamens 2; leaves sessile; stems glabrous *Lindernia dubia*
 43b. Fertile stamens 4; leaves petiolate (sessile and amplexicaul in *Stemodia durantifolia*); stems glabrous or puberulent 44
 44a. Anthers glabrous; stems and leaves puberulent; sepals acute at the apex *Stemodia*
 44b. Anthers with hairs; stems and leaves glabrous; sepals bluntly acute and often thickened at the apex *Darcya*

Agalinis Rafinesque
 Nomen conservandum

Herbs or shrubs, annual or perennial, usually erect and branched, glabrous or pubescent, hemiparasitic on roots, turning dark when dried. **Leaves** opposite or alternate, becoming smaller or bract-like on distal stems, subsessile or sessile, blades usually narrow, entire or lobed, glabrous or puberulent. **Inflorescences** of solitary flowers in axils of reduced distal leaves (often resembling open racemes, spikes, or panicles), peduncles slender, subtended by small bracts, pedicels slender, bibracteolate or ebracteolate. **Flowers** showy, calyx tubular to campanulate or hemispheric, with 5 prominent lobes or teeth, slightly imbricate or open in bud; **corolla** campanulate and often somewhat bilabiate, glabrous or puberulent, pink to purple (yellow or white), tube straight or curved, expanded distally into a broad throat, lobes 5, rounded, subequal or the posterior (upper) smaller; **stamens** 4, of 2 unequal pairs, borne from the

middle of the corolla tube, shorter than the corolla, filaments usually pilose, anthers glabrous or puberulent, 2-thecous with parallel thecae, unequal in some species; ovary glabrous, 2-locular, style straight and slender, deciduous, stigma solitary and linear. **Fruits** rounded capsules, woody to chartaceous or leathery, dehiscence loculicidal (and sometimes septicial); seeds many, oblong to angular, testa reticulate.

A distinctive New World genus with ca. 40, mostly North American, species. Species of this genus were formerly placed in *Gerardia*, but the Linnaean type proved to be a species of *Acanthaceae*. This genus has not been collected in Costa Rica, but ranges southward as far as northern Nicaragua. The following key includes *Anisantherina hispidula*, which occurs in Costa Rica (q.v.), and two species of *Agalinis* known from Nicaragua: *Agalinis albida* Britton & Pennell (? = *Agalinis harperi* Pennell) and *Agalinis peduncularis* (Benth.) Pennell. All three species have linear leaves.

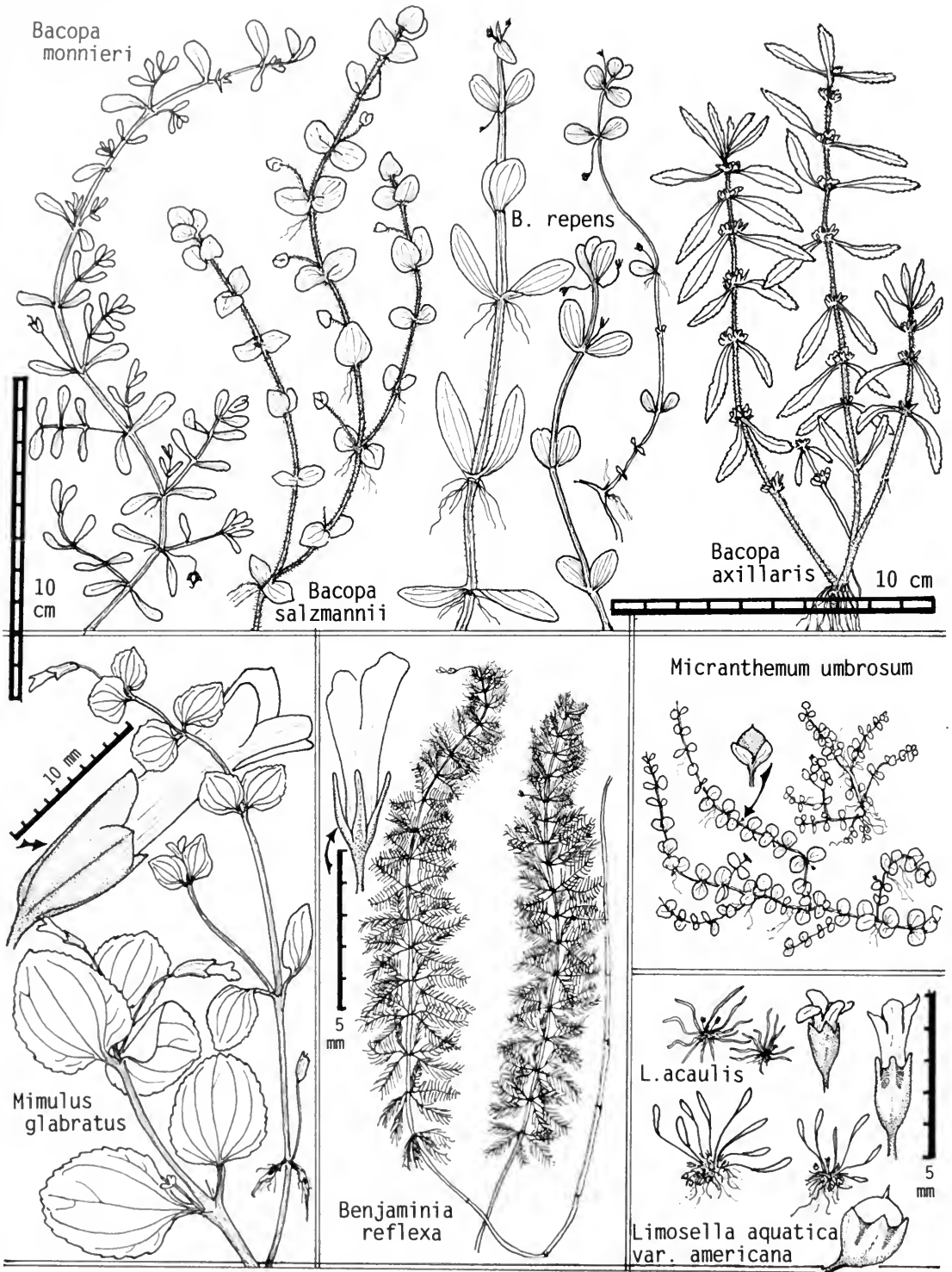


FIG. 1. Scrophulariaceae: aquatic and semiaquatic species.

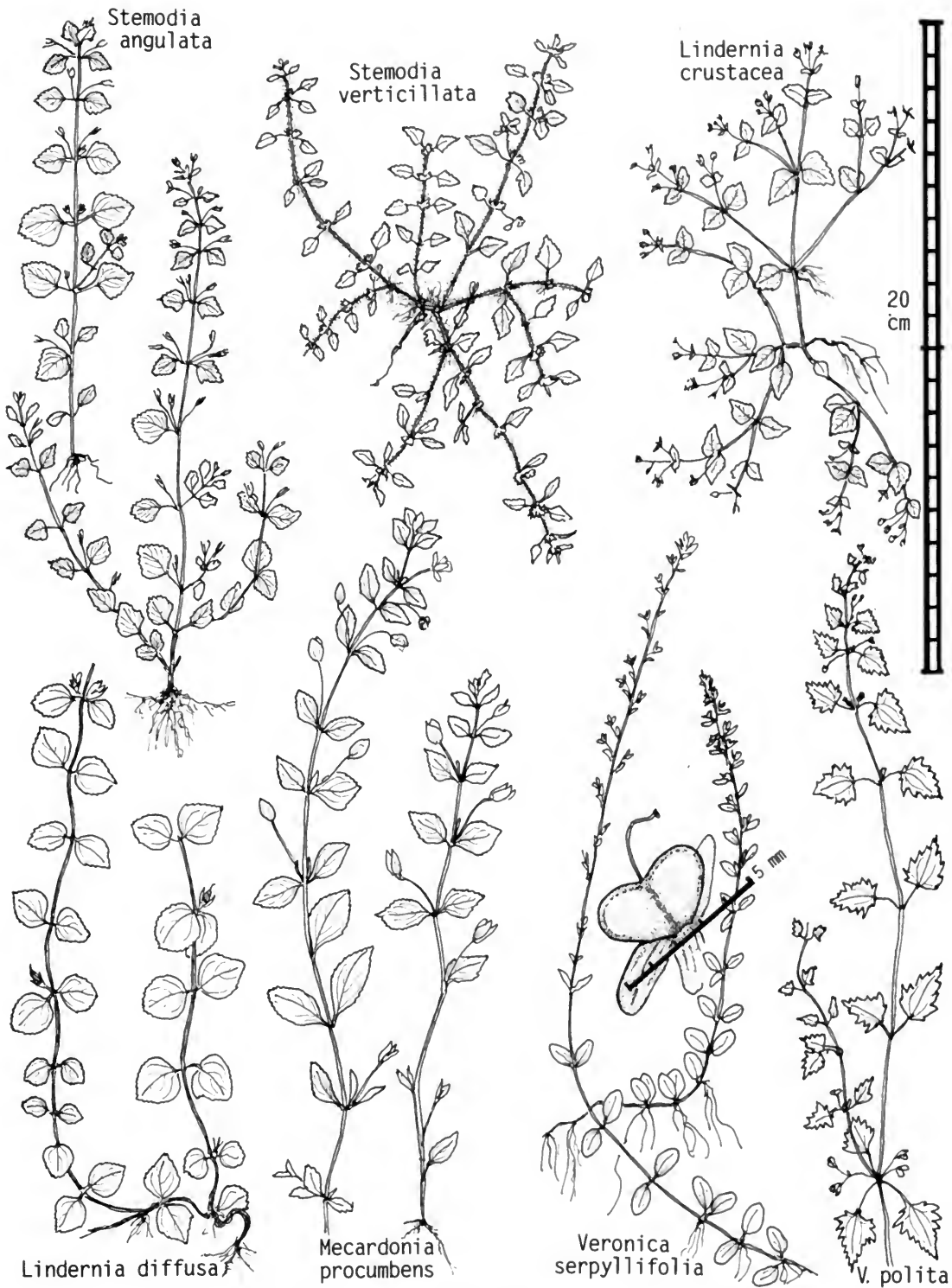


FIG. 2. Scrophulariaceae: small herbs with opposite leaves and broad blades.

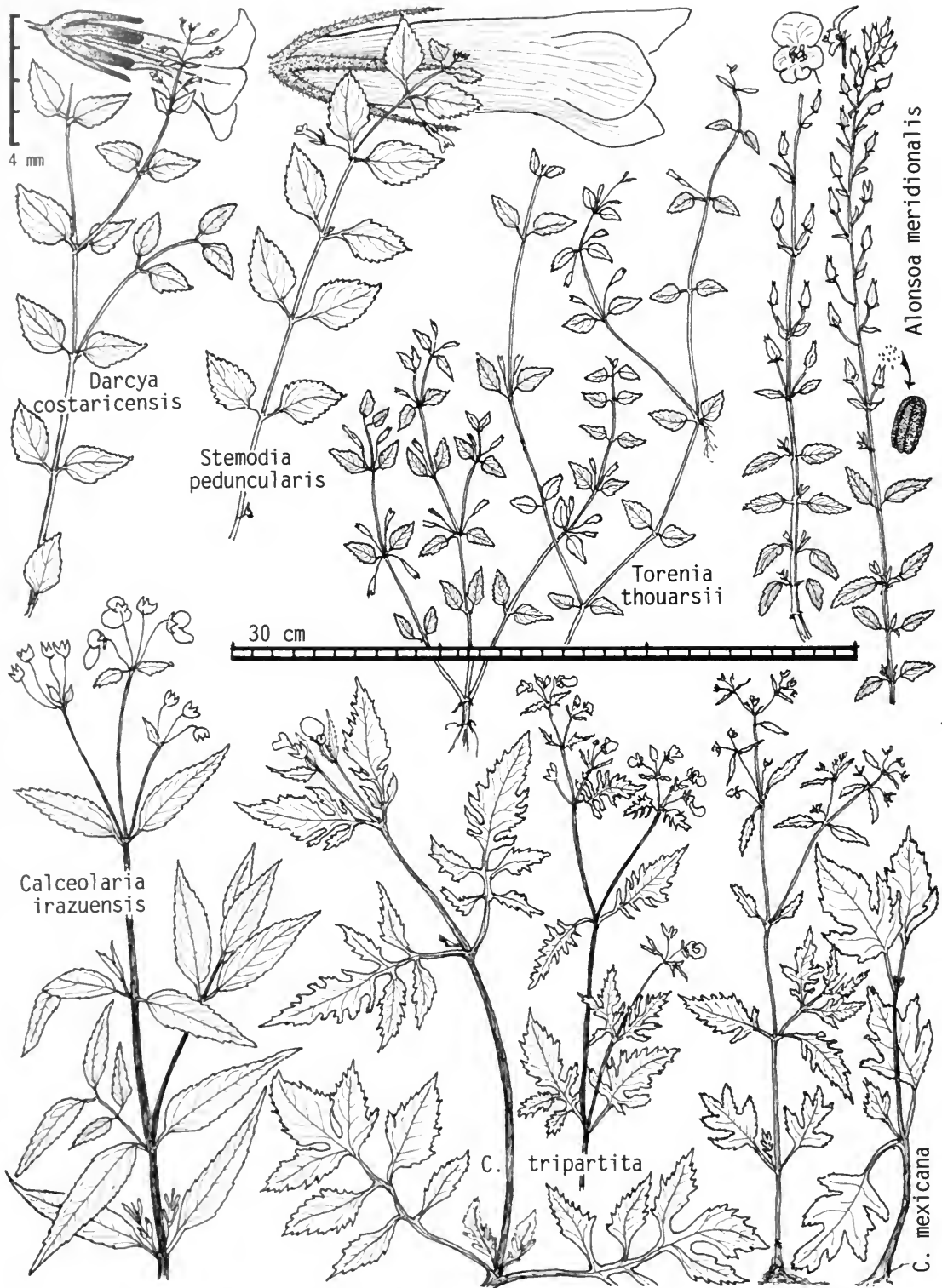


FIG. 3. Scrophulariaceae: herbs with opposite leaves and lanceolate to ovate or dissected blades.

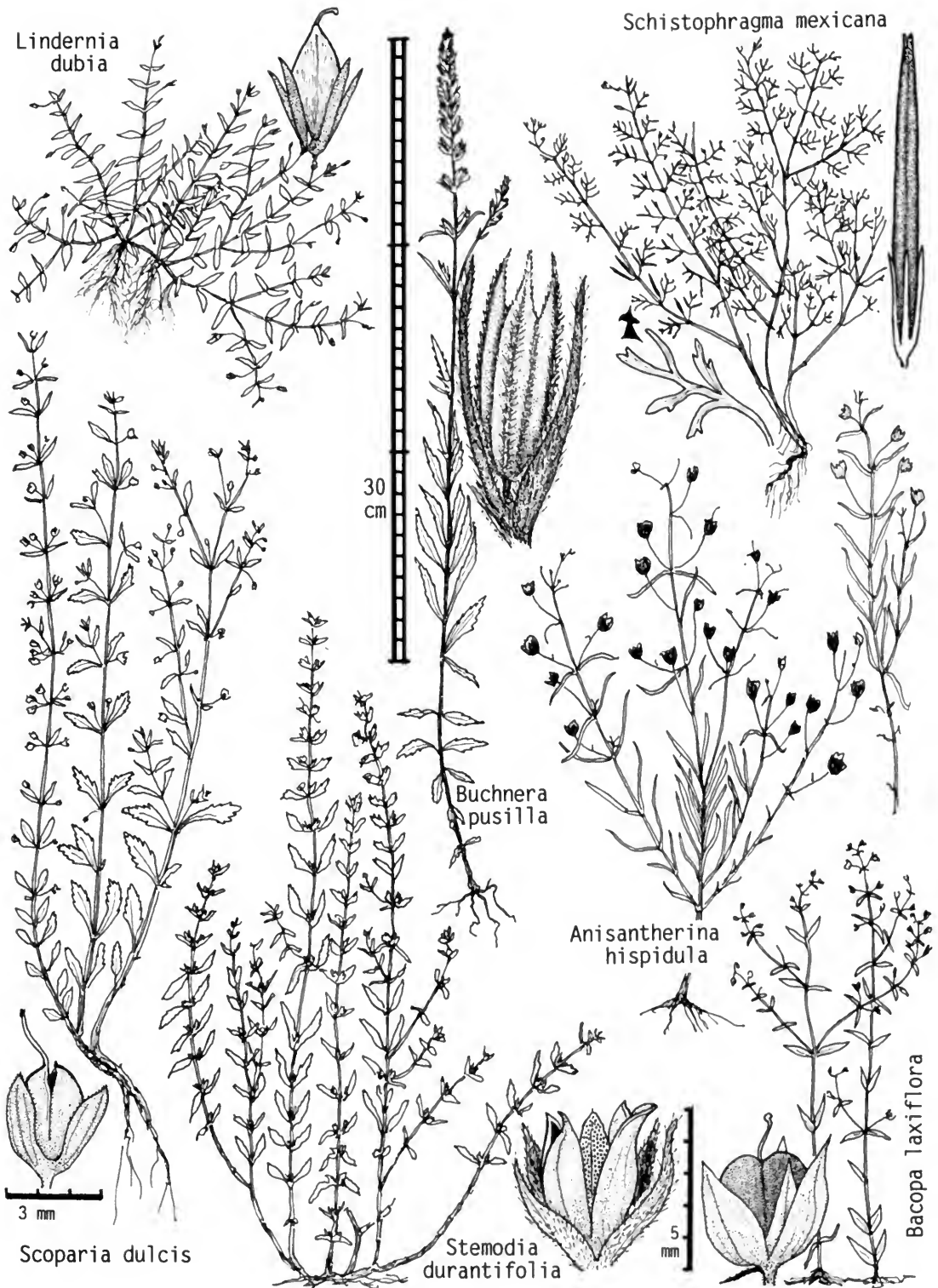


FIG. 4. Scrophulariaceae: herbs with opposite leaves and narrow leaf blades or narrow pinnatifid lobes.

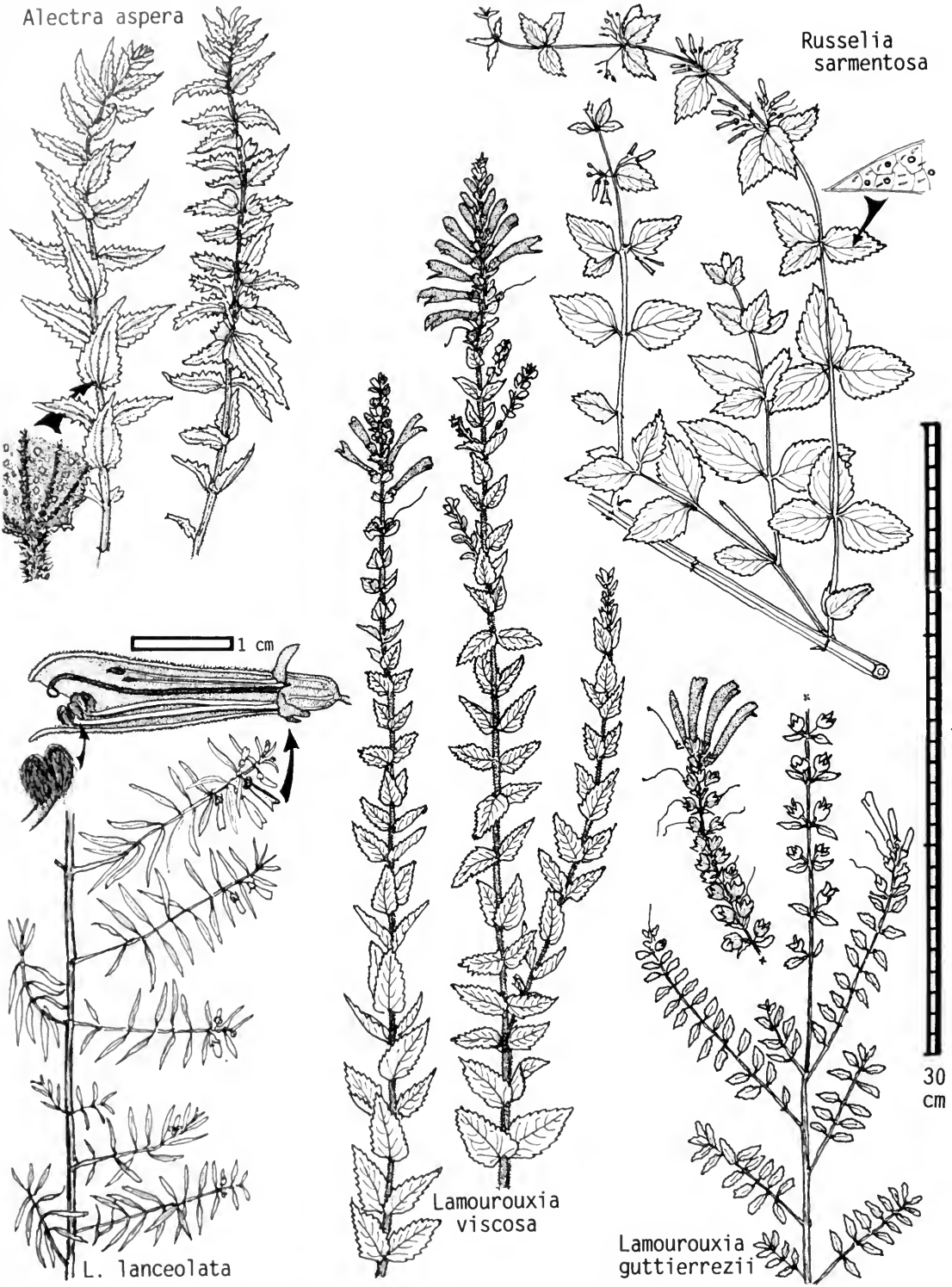


FIG. 5. Scrophulariaceae: herbs with stiff opposite leaves and erect or clambering stems.

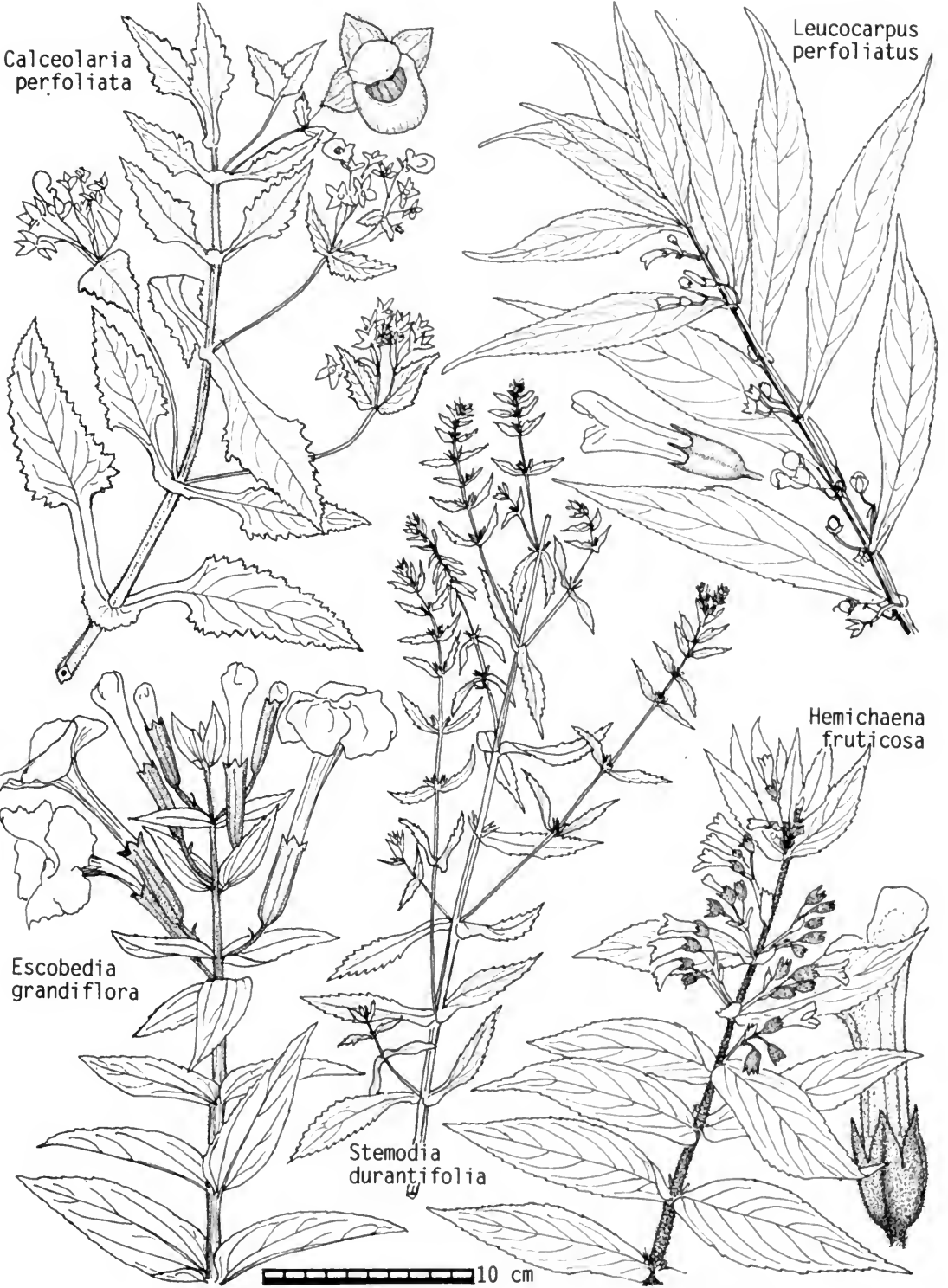


FIG. 6. Scrophulariaceae: erect herbs with larger sessile or perfoliate leaves.

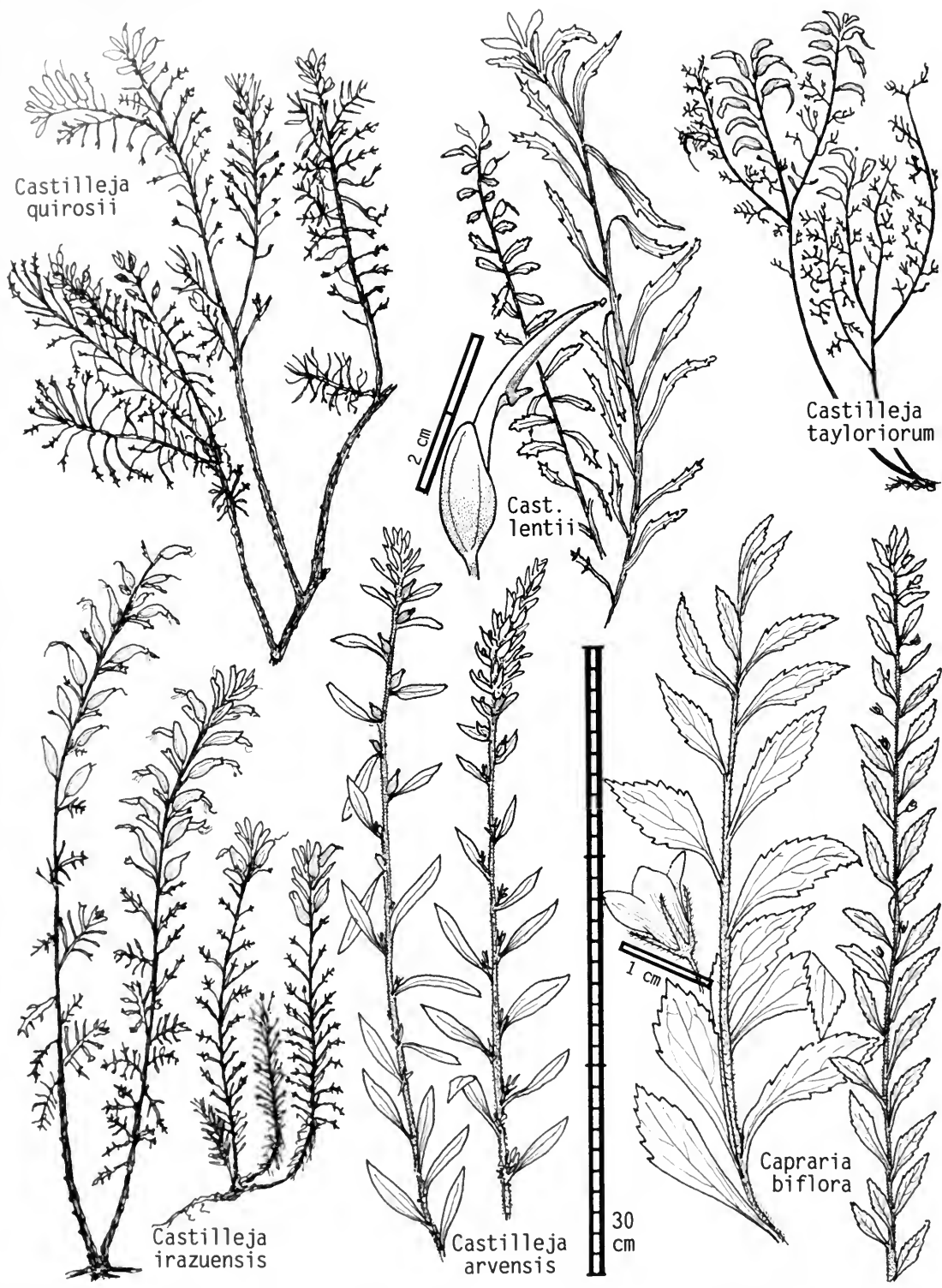


FIG. 7. Scrophulariaceae: erect herbs with consistently alternate leaves and unusual curved flowers (*Castilleja*) or simple, almost regular flowers (*Capraria*).

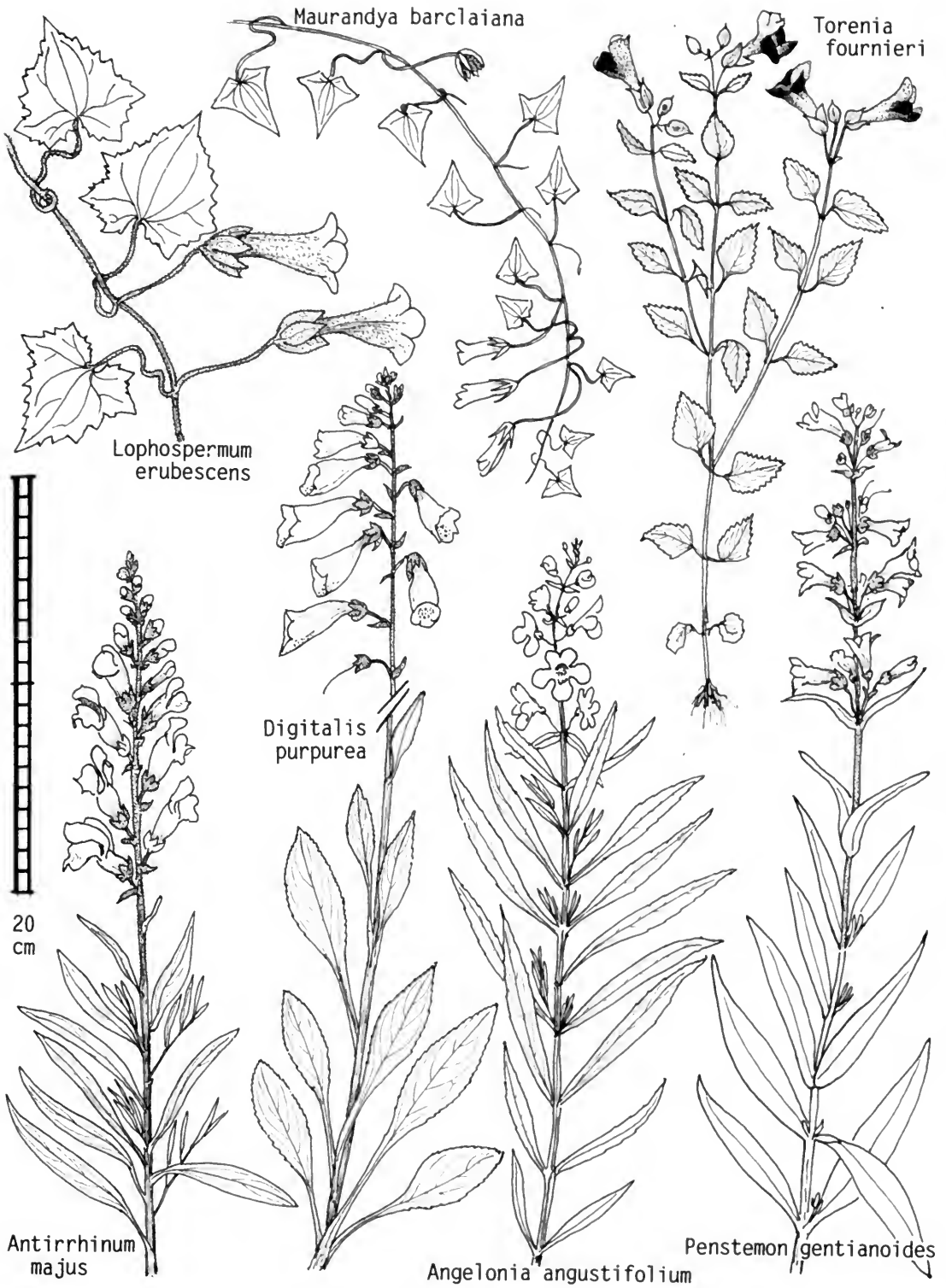


FIG. 8. Scrophulariaceae: wild and cultivated species with large colorful corollas and alternate or opposite leaves.

Key to Species of *Agalinis* and *Anisantherina*

- 1a. Flowers usually 1/node, pedicels shorter than the calyx; distal leaves mostly alternate; stems and leaves smooth to the touch *Agalinis albida*
- 1b. Flowers usually 2/node, pedicels much longer than the calyx; distal leaves mostly opposite or subopposite; stems and leaves slightly scabrous 2
- 2a. Corolla 20–30 mm long, edge of corolla lobes with multicellular hairs; anther thecae equal in size and shape; calyx lobes narrow; pedicels without nodes or bracts *Agalinis peduncularis*
- 2b. Corolla 10–16 mm long, edge of corolla lobes glabrous; anther thecae slightly unequal in size and shape; calyx lobes triangular; pedicels usually with a node or bracts (reduced leaves) near the middle *Anisantherina hispidula*

Alectra Thunberg nomen conservandum

REFERENCE—H. Melchior, Die Gattung *Alectra* Thunb. Notizbl. Bot. Gart. Berlin 15: 423–447. 1941.

Erect annual **herbs**, hemiparasitic, turning dark when dried, unbranched to few-branched, with hispid or scabrous hairs often enlarged at the base. **Leaves** opposite or subopposite (or alternate above), reduced in size distally (rarely absent), simple and sessile or subsessile, margins serrate to dentate (entire), often with 3 prominent veins from the base. **Inflorescences** racemose or spicate, elongate, of solitary flowers in axils of distal leaves, pedicels (peduncles) short, with 2 (1) distal bracts or bracts absent. **Flowers** with campanulate calyx, 10-veined, persisting and enclosing the fruit, with 5 acute to obtuse lobes, valvate in bud, equaling the tube in length; **corolla** usually yellow or orange, personate to subglobose or campanulate, as long or slightly longer than the calyx, 5-lobed and slightly bilabiate, lobes rounded, shorter or equaling the tube; **stamens** of 2 shorter and 2 longer pairs, attached near the base of the corolla, included, filaments glabrous or puberulent, anthers 2-thecous, often barbate abaxially, disc annular and fleshy; **ovary** ovate or compressed, 2-locular with thick fleshy placenta and many seeds, style linear, elongate, and inflexed, stigma entire or bifid, thickened. **Fruits** loculicidal capsules enclosed within the dry calyx, rounded or compressed; seeds very numerous, small, with transparent exotesta often truncated and open at the 2 ends.

A genus of 41 species, according to Melchior (1941, above). Nearly all the species are from Africa and India. The one American species is native to South America and the West Indies; it differs from the Old World species in having divergent

rather than parallel anther thecae. *Alectra* is closely related to *Melasma* in the tribe Buchnereae and was once united with that genus. Few characters reliably distinguish the two. In *Melasma* the corolla is twice as long as the calyx and is more campanulate than that of *Alectra*.

Alectra aspera (Cham. & Schldl.) L. O. Williams, Fieldiana, Bot. 34: 118. 1972. *Pedicularis melampyroides* L. C. Rich., Actes Soc. Hist. Nat. Paris 1: 111. 1792. *Glossostylis aspera* Cham. & Schldl., Linnaea 3: 22. 1828. *Scrophularia fluminensis* Vell., Fl. flumin., 263. 1829. *A. brasiliensis* Benth. in DC., Prodr. 10: 339. 1846. *A. melampyroides* (L. C. Rich.) Kuntze, Rev. Gen. Pl. 2: 458. 1891, non *A. melampyroides* Benth. 1846. *Melasma melampyroides* (L. C. Rich.) Pennell in Britton & Wilson, Bot. Porto Rico 6: 188. 1925. *A. fluminensis* (Vell.) Stearn, J. Arnold Arbor. 52: 636. 1971. Figure 5.

Herbs 0.3–1.5 m tall, stems erect and simple to many-branched, main stems 1.7–6 mm diam., scabrid with straight stiff whitish hairs 0.3–1.5 mm long, short (0.1–0.2 mm) thin hairs also present. **Leaves** becoming gradually smaller distally, opposite, subopposite (rarely alternate distally), subsessile with petioles 0.5–4 mm long; **leaf blades** 1–5(–7) cm long, 4–16(–25) mm wide, narrowly ovate-triangular to ovate-lanceolate or lanceolate, gradually narrowed to the acute or acuminate apex, margin coarsely serrate with teeth 0.3–2.5 mm high, base truncated or obtuse, surfaces scabrous with stiff whitish hairs 0.1–0.9 mm long, venation subpalmate with midvein and 2 prominent ascending basal 2° veins (tripliveined). **Inflorescences** of spike-like or raceme-like distal stems or with solitary flowers in the axils of smaller leaves (1–2 flowers/node), pedicels 1–2(–7) mm long, ca. 0.5 mm diam., bracts linear

or absent, at the base of the calyx, ca. 3 mm long. **Flowers** with campanulate calyx 6–9 mm long (to 12 mm in fruit), 5–8 mm wide at the mouth, calyx lobes 2–6 mm long, triangular and acute, with scabrous hairs along the margins and veins; **corolla** 10–13 mm long, included within the calyx or slightly exerted, campanulate, yellow, glabrous, tube 5–8 mm long, lobes subequal; stamens with pubescent filaments, anthers 1.5 mm long, thecae divergent, without awns; ovary ca. 3 mm long, ovoid, style 6–8 mm long, curved, stigma lanceolate. **Fruits** 5–8 mm long, 4–6 mm diam., oblate-globose, included within the persisting calyx; seeds 1–1.2 mm long, oblong-triangular with truncated ends, translucent yellowish, exotesta reticulate.

Weeds of open sunny sites in lowland Central America. It is a recent introduction and is spreading. It has been collected near Upala and Villa Neilly, at Tarrazu, and on the lower slopes of the Cerros de Puriscal. The species ranges from Guatemala and the West Indies to Brazil, Paraguay, and Bolivia.

Alectra aspera is recognized by its short erect stems, stiff pustulate-hispid leaves, tissues drying dark, solitary flowers in distal leaf axils, corolla tube only as long as the calyx, persisting campanulate-globose calyx, and minute seeds with translucent testa. The corolla of this species is open for a very short time. It soon withers, closing over the anthers and the stigma. The anthers are borne close to the stigma, suggesting that the species is largely self-pollinating.

Alonsoa Ruíz Lopez & Pavón

REFERENCES—J. López Guillén, El Genero *Alonsoa* en el Peru: 1. Revision de las especies endemicas. Raymondiana 3: 155–246, 1970 (1971). Brian Wrigley, A taxonomic revision of *Alonsoa*. Ph.D. diss., Univ. Connecticut, 1968.

Herbs or subshrubs, annual or perennial, often with distal branching, usually woody at the base, stems quadrangular in cross-section, glabrous or sparsely minutely puberulent. **Leaves** opposite or ternate (leaf-like floral bracts alternate), sessile or petiolate, leaf blades ovate to linear, serrate or rarely entire, venation pinnate. **Inflorescences** racemes, terminal or axillary to distal leaves (rarely flowers axillary to distal leaf pairs), floral bracts alternate along the rachis, proximal bracts leaf-like, pedicels solitary, well developed, and becoming twisted, bracteoles absent. **Flowers** small,

resupinate because of pedicel twisting, calyx deeply 5-parted, lobes narrow and slightly unequal, glabrous or sparsely and minutely puberulent, valvate in bud; **corolla** rotate with very short tube, bilaterally symmetric with the 2 lower lobes small and divided nearly to the base, lateral lobes short and broad, upper lobe much larger and usually held erect and convex, reddish to orange or purple; stamens 4, subequal, borne on the base of the corolla, filaments thick or slender, anthers closely positioned around the style, thecae parallel or divergent; ovary 2-locular, style curved upward, stigma capitate. **Fruits** capsules, ovate to oblong, septicidal, 2-valved, valves chartaceous, entire or bifid at the apex; seeds many, punctate-rugose or longitudinally ridged.

Alonsoa is a Neotropical genus of six to fifteen species. The flowers are upside-down (resupinate) because of the twisted pedicel, with the result that the morphologically lower lobe is the upper lobe. The reddish to yellow resupinate flowers with enlarged median lobe are distinctive. The genus is placed in the tribe Hemimeridae, with *Angelonia*, but is probably more closely related to *Scrophularia* and *Verbascum*, with which it shares characters of seed and anther morphology. *Alonsoa warscewiczii* Regel is often used as a potted ornamental plant; only one species is found in the higher mountains of Central America. The genus is currently being studied by Fanny Astholm (GB).

Alonsoa meridionalis (L.f.) Kuntze, Rev. Gen. Pl. 2: 457. 1891.

Scrophularia meridionalis L.f., Suppl. 280. 1781. Figure 3.

REFERENCE—F. Astholm & Y. Nyman, Morphometric variation in the *Alonsoa meridionalis* complex (Scrophulariaceae). Plant Syst. Evol. 193: 53–68. 1994.

Herbs or subshrubs 0.2–1.5 m tall, often woody at the base, usually with lateral branches, leafy stems 0.7–8 mm diam., glabrous or sparsely minutely puberulent (rarely densely puberulent at the node), with 4 prominent longitudinal ridges or wings (from decurrent petiole margins). **Leaves** opposite (sometimes alternate below the flowering nodes), petioles 3–15(–22) mm long, 0.4–1.7 mm diam., glabrous or with few hairs less than 0.3 mm long, with lateral margins continuous with the blade margins; **leaf blades** 1.5–8(–11) cm long,

1–4 cm wide, ovate-lanceolate to oblong-lanceolate or narrowly ovate, apex acute, margin with 4–7 acute teeth/cm, base obtuse to slightly cuneate and decurrent, drying greenish or dark, sparsely puberulent on both surfaces, 2° veins 5–10/side, strongly ascending. **Inflorescences** terminal racemes 3–30 cm long, flowers opposite or distally alternate, subtended by progressively smaller, leaf-like to subulate bracts 4–14 mm long, pedicels 6–18(–25) mm long, glabrous or with few minute (0.2 mm) gland-tipped hairs, upcurved in fruit. **Flowers** resupinate, calyx 3–6 mm long, divided to near the base, lobes 1–1.7 mm wide, subequal or unequal, glabrous or with few minute hairs near the base; **corolla** 5–11 mm long, rotate, yellow to orange, tube ca. 2 mm long, with prominent lobes, median lobe to 15 mm long, larger than the lateral lobes; stamens 3–4 mm long, filaments 0.4–0.6 mm diam., anthers ca. 2 mm long; ovary 1.5–4 mm long, narrowly ovoid, style 1.5–2 mm long, stigma 0.8 mm wide. **Fruits** 7–15 mm long, 3.7–6 mm wide, narrowly ovoid with acute to acuminate apex, smooth, glabrous, pale brown, sulcate along the plane of dehiscence, septicial; seeds many, 1.1–1.4 mm long, 1–1.2 mm diam., oblong, dark, with ca. 6 deep longitudinal sulci.

Plants of open sites in high montane forest formations, 1600–3200 m elevation. Flowering in October–December. In Costa Rica they are found in the Cordillera Central and the Cordillera de Talamanca. The species ranges from southern Mexico to Bolivia.

Alonsoa meridionalis is recognized by its terminal racemes with solitary, usually alternate flowers subtended by bracts gradually diminishing in size, unusual little flowers with red-orange corolla with enlarged median uppermost lobe, short thick filaments, large anthers, and capsules gradually narrowed to the apex. Because the pedicels are twisted 180°, the flowers are upside-down (resupinate). The leaves often have new shoots with small leaves in their axils.

Angelonia Humboldt & Bonpland

REFERENCE—K. Barringer, A Revision of *Angelonia* (Scrophulariaceae). Ph.D. diss. Univ. Connecticut, 1981.

Erect **herbs** or subshrubs, annual or perennial, stems terete to 4-angulate, simple or branching from the base, puberulent with multicellular hairs or glabrous. **Leaves** opposite or rarely alternate distally, petioles short or absent; blades ovate to

linear, serrate or rarely entire, apex acute, venation pinnate. **Inflorescences** racemes, terminal or axillary, bracts leaf-like to rounded, flowers 1–3/axil, pedicels bibracteolate or ebracteolate. **Flowers** showy, calyx of 5 free or partly united sepals, sepals equal, lanceolate, entire, acute to acuminate; **corolla** strongly bilaterally symmetric, cupular-campanulate with short tube and 2 broadly flaring lips, bisaccate at the base of the median lobe, the sacs with a dense mat of glandular hairs within, lobes 5, upper lobes 2, the lower median (abaxial) lip 3-lobed, variously ornamented with a ridge or a crateriform palate and a bifid tooth; **stamens** 4, of 2 unequal pairs, held against the upper part of the corolla tube, filaments short, thecae divaricate, without spurs; ovary ovoid, 2-locular, ovules many, style longer than the ovary, stigma entire and minute. **Fruits** dry capsules, ovoid to broadly ellipsoid, chartaceous or leathery, septicial, often secondarily loculicidal; seeds many, obconical, with a loose reticulate exotesta, endosperm absent.

A genus of 26 species whose major concentration is in the dry caatinga and cerrado formations of Brazil. The Central American and Caribbean species form a distinctive group within the genus. The genus is easily distinguished by the bisaccate corolla and the ornamented median corolla lobe. One species is found in Costa Rica; a second, *Angelonia ciliaris* B. L. Robinson (with puberulent leaves auriculate at the base), ranges from southern Mexico and the Antilles to Nicaragua.

Angelonia angustifolia Benth. *in DC.*, Prodr. 10: 254. 1846. Figure 8.

Herbs 20–120 cm tall, erect, few-branched or unbranched, leafy stems 1.5–5 mm diam., terete or slightly 4-angled, sparsely puberulent with thin multicellular hairs 0.5–2 mm long at the nodes or along longitudinal lines. **Leaves** becoming smaller distally (intergrading with the floral bracts), opposite or subopposite, sessile or subsessile, often clasping the stem; **leaf blades** 2–11 cm long, 4–20 mm wide, linear to narrowly elliptic-oblong or lanceolate, apex acute, margin obscurely serrate with short (0.2–0.6 mm) teeth 1–4/cm, base cuneate to acute, drying chartaceous and brown or dark grayish green, surfaces subglabrous with few thin hairs, 2° veins 3–6/side and strongly ascending. **Inflorescences** 5–40 cm long, flowers solitary in distal leaf/bract axils (usually 2/node), pedicels 4–18 mm long, 0.2–0.4 mm diam., glabrous, ascending, subtended by 2 linear bracteoles 0.5–2 mm long. **Flowers** glabrous, calyx 2–4 mm

long, 1–2 mm wide at the base, narrowly ovoid to campanulate, calyx lobes 2–3.5 mm long, lanceolate to triangular; **corolla** 8–25 mm wide at the mouth, purple to lavender or bluish, minutely punctate, tube white to yellowish or green, often marked with white on the palate (basal entry of the throat), corolla lobes to 9 mm long, rounded; stamens included, filaments glandular-pubescent, anthers 2 mm wide, thecae divergent, equal, glabrous; ovary glabrous. **Fruits** 4–6 mm long, 4–7 mm diam., globose to ovoid-rounded with truncated base, glabrous; seeds 1.3–1.5 mm long, conic to oblong, exotesta strongly reticulated with prominent thin walls.

Native to southern Mexico, this species has spread into much of Central America, where it is a favorite garden ornamental. In Costa Rica it has been collected in both the deciduous and evergreen lowlands and from gardens in the Meseta Central; it flowers throughout the year. The species is now cultivated throughout the world.

Angelonia angustifolia is recognized by its small stature, narrow subglabrous opposite leaves, showy corolla with prominent spreading rounded lobes, and unusual seed surface. This species is probably pollinated by *Centris* bees, which collect a thick oil from the corolla sacs with specialized combs on their front legs. Common names used for this species are *boca de la vieja* (Guatemala), *porto bello* (Nicaragua), and *angelón* (Colombia).

Anisantherina Pennell

Herbs, annual, erect with ascending branches, hispidulous with multicellular hairs with dark cross-walls, hemiparasitic on roots, turning dark when dried. **Leaves** opposite or subopposite distally, becoming smaller or bract-like on distal stems, sessile, blades linear and entire, scabrous. **Inflorescences** of solitary flowers in the axils of reduced distal leaves (raceme-like with well-separated flowers), pedicels often longer than the calyx, bibracteolate. **Flowers** showy, calyx campanulate with 5 prominent equal lobes; corolla tubular-campanulate, slightly bilabiate, glabrous, pink to purple, tube straight or curved, expanded distally into a broad throat, 2-lipped, upper lip 2-lobed, lower lip 3-lobed, lobes rounded, subequal, spreading; **stamens** 4, of 2 unequal pairs, inserted near the mouth of the corolla tube, shorter than the corolla, anterior filaments longer than the posterior, pilose above, anthers 2-theccous with unequal divergent thecae, glabrous; ovary ovoid, glabrous, 2-locular, style longer than the ovary,

straight and slender, stigmas linear and lateral on the liguliform style apex. **Fruits** globose capsules, chartaceous, loculicidal, style base persistent, placenta persistent; seeds many, linear, exotesta reticulate.

Anisantherina is a monotypic Neotropical genus related to African genera in the tribe Buchnereae. Pennell distinguished *Anisantherina* from *Agalinis* by its bibracteolate pedicels, unequal anther thecae, and narrow oblong-linear seeds. Canne (1980) showed that the structure and ornamentation of *Anisantherina* seeds are also distinctive. This species was once placed in *Gerardia*, but that name is no longer valid; see the discussion under *Agalinis*.

Anisantherina hispidula (Mart.) Pennell, Mem. Torrey Bot. Club 16: 106. 1920. *Gerardia hispidula* Mart., Nov. Gen. Sp. Pl. 3: 13. 1829. *Agalinis hispidula* (Mart.) D'Arcy, Ann. Missouri Bot. Gard. 65: 4. 1978 (1979). Figure 4.

Annual **herbs**, 30–50 cm tall, unbranched or with few branches arising in the lower half, leafy internodes 0.5–1.5 mm diam., with few short (0.2–0.4 mm) stiff hispidulous hairs; usually drying dark. **Leaves** opposite or subopposite (rarely alternate distally), sessile or subsessile, sometimes clasping the stem; **leaf blades** 8–80 mm long, 0.5–4 mm wide, linear, entire, scabrous with short (ca. 0.2 mm) whitish hairs above and along the margin, 2° veins obscure. **Inflorescences** of solitary flowers in axils of reduced distal leaves, raceme-like with 8–14 flowers, pedicels 10–35 mm long, 0.3–0.4 mm diam., glabrous, usually with a node or a pair of small (0–2 mm) bracts near the middle. **Flowers** glabrous, drying dark, calyx tube 4–6 mm long, 3–5 mm diam., campanulate-tubular, abruptly rounded and truncated at the base, calyx lobes 1.2–2.5 mm long, triangular and acute; **corolla** 10–15 mm long, campanulate, pink to light purple with darker spots within, tube 8–10 mm long, lobes 2–3 mm long, glabrous, rounded; filaments 2–3 mm long, anther thecae unequal, divergent. **Fruits** 5–9 mm long, 4–7 mm diam., abruptly rounded at apex and base (short-cupulate), glabrous, drying black, slightly exserted beyond the thin persisting calyx; seeds 0.6–0.8 mm long, 0.2–0.3 mm diam., linear, dark brown.

Rarely collected plants of open sunny seasonal pools and moist savannas in deciduous or evergreen forest areas, 0–600 m elevation. We have seen only two collections from Costa Rica, both from near La Cruz in northern Guanacaste (*L. D. Gomez 18965* & *J. Gomez-Laurito 9097*); flow-

ering and fruiting in November. The species ranges from southern Mexico and Cuba to Brazil.

Anisantherina hispidula is recognized by its short wiry habit, parts drying dark, linear scarious leaves, glabrous distant upright pink flowers, and rounded fruits. It is confined to wet habitats in open sunny savannas. See the key and discussion under *Agalinis*.

Antirrhinum Linnaeus

REFERENCE—D. Sutton, A Revision of the Tribe Antirrhineae. British Museum (Natural History) & Oxford Univ. Press, 1988.

Herbs, annual or perennial, erect or procumbent, usually few-branched, stems terete, often glandular pubescent. **Leaves** opposite to subopposite, sometimes alternate on distal stems, sessile or short-petiolate, leaf blades lanceolate to ovate, usually narrow, entire to denticulate. **Inflorescences** usually showy terminal racemes or with solitary flowers in axils of distal bracts or reduced leaves, pedicels ebracteolate. **Flowers** with calyx united at the base, sepals 5, imbricate in bud; **corolla** bilaterally symmetric, 2-lipped and very irregular, corolla tube gibbous or saccate at the base (not spurred), broader than high, upper lip erect and 2-lobed, lower lip spreading and 3-lobed, base of the lower lobe forming a palate and pressing against the front of the throat (closing off easy entrance to the tube); **stamens** 4, of 2 unequal pairs, included in the corolla tube, filaments slender and slightly dilated at the apex, anther cells divergent, staminode absent; ovary ovoid, 2-locular, many-ovulate, style filiform, longer than the ovary, stigma bilobed. **Fruits** ovoid or globose capsules, opening below the apex by pores or slits (septicidal); seeds many, oblong, truncated, exotesta smooth or rugose (without wings).

A genus of about 42 species from the western United States, northwestern Mexico, Europe, and the Mediterranean region of Eurasia. The genus is a member of tribe Antirrhineae, with *Cymbalaria* and *Linaria*. A number of species and many varieties have been developed as garden ornamentals with bright red, purple, yellow, or white forms. The mouth of the corolla is closed by the curved palate of the lower lip, which is held against the base of the upper lip. Thus, bees must force their way into the interior of the corolla to gain access to nectar. The following species is commonly cultivated in cool highland gardens throughout Central America.

Antirrhinum majus L., Sp. Pl. 617. 1753. Figure 8.

Herbs, erect, 0.4–1 m tall, leafy stems 2–8 mm diam., glabrous and terete. **Leaves** opposite or ternate below, alternate or rarely ternate distally, petioles 1–14 mm long but poorly differentiated from the blade; **leaf blades** 2–9 cm long, 3–16 mm wide, lanceolate to ovate-lanceolate or linear, apex acute, margin entire, base gradually narrowed, drying stiffly chartaceous and greenish. **Inflorescences** to 30 cm long, racemes of alternate flowers, rachis usually densely puberulent with gland-tipped hairs ca. 0.3 mm long, bracts ovate, 2–10 mm long, acute, pedicels 2–10 mm long. **Flowers** showy, calyx glandular puberulent, sepals 5, 6–8 mm long, ovate to rounded; **corolla** 2.5–4 cm long, pink to red or purple, externally glandular hairy, the palate closing the throat, yellow within. **Fruits** 1–1.5 cm long, oblong capsules with unequal valves, opening near the apex, glandular pubescent to glabrous; seeds light brown, reticulate-tuberculate.

Antirrhinum majus is a native of the Pyrenees of northern Spain and southern France. It is widely cultivated in temperate and subtropical regions. It can be recognized by its showy racemes and slightly saccate corolla with an enlarged palate that “closes” the throat. In some horticultural forms the throat is open or the flowers are highly modified. Common names are “snapdragon,” *boca de león*, and *boca de dragón*.

Bacopa Aublet

REFERENCE—F. W. Pennell, Reconsideration of the *Bacopa-Herpestis* problem of the Scrophulariaceae. Proc. Acad. Nat. Sci. Philadelphia 98: 83–98. 1946.

Herbs, erect to decumbent or procumbent, usually growing in moist soil or in standing water, stems simple or profusely branched, glabrous or pubescent, often glandular punctate. **Leaves** opposite, sessile or petiolate, leaf blades often slightly succulent, entire to dentate (or dissected), venation pinnate or palmate, the minor venation usually obscure. **Inflorescences** of 1–6 flowers in leaf axils, less often the distal flowering stems racemose or spicate (cymose, paniculate), pedicels short or absent, bracteoles present or absent at the base of the calyx. **Flowers** usually with 5-parted calyx, sepals subequal to strongly unequal with the 3 adaxial sepals usually much wider than the

abaxial, imbricate in bud (if 4-parted, the calyx tube equaling the lobes); **corolla** tubular, strongly or weakly bilabiate, blue-violet to white, tube cylindrical, the lips spreading, with 3, 4, or 5 lobes, the upper lip exterior in bud and 2-lobed or emarginate (1-lobed), the lower lip 2- or 3-lobed; stamens (5) 4 (2, 3), usually in 2 unequal pairs, inserted on the upper half of the corolla tube, included, anthers approximate or distant, thecae contiguous, parallel or divergent, staminode absent; ovary 2-locular, style usually straight, stigma terminal, bilobed or entire. **Fruits** dry capsules, globose to ovoid, bisulcate, loculicidal, often secondarily septicidal into 4 valves; seeds many, small, oblong, longitudinally reticulate.

Bacopa is a genus of about 50 to 60 species, widespread in warm temperate and tropical areas

throughout the world. It is most diverse in South America. The species are varied but they can usually be recognized by their small opposite leaves, strongly unequal sepals, and preference for wet habitats. They are often found in open sunny sites in shallow standing water of seasonal pools, along the edges of watercourses, and in moist savannas. Most of the species described below are rarely collected in Costa Rica, perhaps because of their seasonally inundated habitats. Because the sepals differ so much in size, they may appear to be bracts enclosing the flower. The inner sepals are usually much narrower than the outer. The bracteoles are borne at the apex of the pedicel when present. The synonymy of this genus is very large; D'Arcy (1979, p. 183) provides a long list of generic synonyms.

Key to the Species of *Bacopa*

- 1a. Flowers sessile or subsessile, pedicels up to 2 mm long; plants erect; rarely collected in Costa Rica 2
- 1b. Flowers borne on conspicuous pedicels > 2 mm long; plants erect, prostrate or floating; rare or common 4
 - 2a. Stems densely puberulent with hairs to 1.3 mm long; [flowers often in dense verticels of 3–12 flowers/node in the axils of leaves; outer calyx lobes 3–4 mm long] *B. axillaris*
 - 2b. Stems glabrous or minutely puberulent, the hairs < 0.5 mm long 3
 - 3a. Stems puberulent; fruits with smooth surfaces; outer sepals 1–2 mm long; flowers in distal fascicles separated by conspicuous slender internodes; leaves subtire ... *B. monnierioides*
 - 3b. Stems glabrous; fruits with pitted-reticulated surfaces; outer sepals 2–3.5 mm long; flowers often in distal crowded fascicles and spike-like with obscure internodes; leaves serrate *B. sessiliflora*
- 4a. Plants mostly erect with few to many distal branches, rooting only at the base, stems glabrous, leaves serrate, sessile and auriculate at the base (petiolate in *B. lacertosa*), opposing leaves not united and usually without an interpetiolar line 5
- 4b. Plants usually prostrate, floating or creeping, with few or no distal branches, rooting at base and lower nodes, stems glabrous or puberulent; leaves serrate or entire, sessile or petiolate, opposing leaves slightly united across the stem to form an interpetiolar line or ridge or the node pubescent 7
 - 5a. Outer sepals to 5 mm long, sepals usually narrowed at the base, rarely covering the fruits, the venation not conspicuously raised; distal flowers subtended by greatly reduced leaves (ca. 8 mm long) and easily seen [distal internodes usually longer than the adjacent leaves] *B. laxiflora*
 - 5b. Outer sepals to 8 mm long, rounded at the base, usually covering the fruits, venation often conspicuous on the outer surface; distal flowers subtended by normal-size or reduced leaves, usually easily visible 6
 - 6a. Outer sepals not developing a lustrous surface, venation only slightly elevated; plants to 40 (–50) cm tall; distal stems glabrous or glandular puberulent *B. bacopoides*
 - 6b. Outer sepals with smooth lustrous surface and conspicuous elevated venation; plants to 70 cm tall; distal stems glabrous [Belize to Nicaragua] *B. lacertosa*
- 7a. Internodes densely villous with hairs to 1.5 mm long; leaves often suborbicular [outer sepals 4–6 mm long, ciliate; commonly collected in Costa Rica] *B. salzmanii*
- 7b. Internodes glabrous or with thin hairs < 0.5 mm long; leaves broadly to narrowly obovate (rarely suborbicular) 8

- 8a. Bracteoles 2, slender, below the calyx; outer sepals 5–7 mm long; fruits 4–7 mm long; flowers usually 1/node; pedicels to 30 mm long; internodes glabrous *B. monnieri*
- 8b. Bracteoles none; outer sepals 2.5–4 mm long; fruits 2.3–4 mm long; flowers 1–4/node; pedicels to 18 mm long; internodes glabrous or puberulent 9
- 9a. Sepals (4) 5, unequal and united only at the base; leaves usually cuneate or rounded at the base, sessile; widespread *B. repens*
- 9b. Sepals 4, subequal and united in the lower half; leaves cuneate with a narrowed petiole-like base; rarely collected *B. egensis*

Bacopa axillaris (Benth.) Standl., J. Wash. Acad. Sci. 15: 460. 1925. *Herpestis axillaris* Benth. in DC., Prodr. 10: 396. 1846. *Monniera axillaris* (Benth.) O. Kuntze, Rev. Gen. Pl. 463. 1891. *Caconapea axillaris* (Benth.) Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 152. 1920. Figure 1.

Erect **herbs** 10–30 cm tall, aquatic or paludal, rooting mostly at the base, leafy stems 1.3–4 mm diam., spongy, villous with thin multicellular hairs to 1.3 mm long. **Leaves** opposite, sessile with opposing leaves slightly united at the base and forming a line or ridge across the stem (clasping the stem); **leaf blades** 1.2–4.8 cm long, 2–12 mm wide, oblanceolate to narrowly obovate or narrowly elliptic-oblong, apex bluntly obtuse to acute, distal $\frac{2}{3}$ of the margin serrate, teeth 0.2–0.5 mm high, 1–2.3 mm wide, base gradually narrowed and cuneate, drying yellowish brown or olive green, glabrous, conspicuously pellucid punctate beneath, venation pinnate. **Inflorescences** verticillate, of dense axillary fascicles with 3–12 flowers/node, pedicels 0.2–1.5 mm long, expanded at the apex and with 2 small (0.4–0.7 mm) slender bracteoles. **Flowers** glabrous externally, outer sepals 3–4 mm long, 1.5–3 mm wide, ovate with rounded to obtuse apex, palmately veined, punctate, glabrous or ciliate; **corolla** 3–4 mm long, white, slightly exerted, the upper lip 1-lobed; stamens 4, inserted in the upper half of the tube; ovary ca. 1 mm long, style 1.5–2 mm long. **Fruits** 2–3 mm long, ca. 1.4 mm diam., very narrowly ovoid or conical, 4-valved; seeds 0.5–0.6 mm long, 0.2–0.3 mm wide, oblong or somewhat curved, brown, reticulate with parallel longitudinal ridges.

Plants of swamps and the muddy edges of standing water in seasonally deciduous and evergreen forest areas, 0–500 m elevation (to 1500 m in Guatemala). Rarely found north of Panama, the species has been collected near Bagaces and along the Río Grande de Tárcoles in Costa Rica; it flowers in September. The species ranges from Guatemala to Colombia.

Bacopa axillaris is recognized by the pubescent stems, sessile oblanceolate serrate leaves, verticillate flower clusters with small subsessile flowers, and wet habitat. The outer sepals are often flat, translucent, and conspicuously punctate.

Bacopa bacopoides (Benth.) Pulle, Enum. Pl. Surinam. 415. 1906. *Herpestis bacopoides* Benth. in DC., Prodr. 10: 399. 1846. *B. bracteolata* Pennell ex Standl., Contrib. U.S. Natl. Herb. 27: 336. 1927.

Erect **herbs** to 50 cm tall, aquatic or paludal, leafy stems 1.4–4.5 mm diam., glabrous, terete or slightly 4-angled, with minute sessile glands, node lacking interpetiolar lines. **Leaves** sessile, clasping the stem, opposing leaves not united at the base; **leaf blades** 1.5–3.8 cm long, 2.5–7 mm wide, linear-oblanceolate to linear-oblong or ovate-elliptic, gradually narrowed in the lower half but slightly expanded and subauriculate at the base, apex acute, margin serrate with short (0.2–0.3 mm) broad (1–3 mm) teeth, drying dark brown, glabrous, minutely punctate, venation pinnate, obscure. **Inflorescences** of 1–2 axillary flowers (2–4 flowers/node), pedicels 2–7 mm long, 0.2–0.3 mm diam., minutely papillate-puberulent with whitish hairs, slightly expanded at the apex, paired bracteoles 1–2 mm long or absent, linear. **Flowers** glabrous externally or the outer sepals sometimes puberulent, outer 3 sepals 4–8 mm long, 3–5 mm wide, broadly ovate, rounded but obtuse at the base, with raised venation; **corolla** 4–7 mm long, white, stamens 4, inserted near the middle of the corolla tube, anthers ca. 0.6 mm long; ovary glabrous, style ca. 2 mm long. **Fruits** ca. 3 mm long, globose, enclosed within the enlarged (to 15 mm) wing-like sepals.

Partly aquatic plants of marshes and wet areas at low elevations. The species has not been collected in Costa Rica but is common in central Panama and flowers in December–January in Nicaragua. This species ranges from Guatemala to Brazil.

Bacopa bacopoides is recognized by its erect habit, sessile narrow serrate leaves, one or two pedicellate flowers in leaf axils, large rounded outer sepals enclosing the fruits, and wet habitat.

Bacopa egensis (Poepp.) Pennell, Proc. Acad. Nat. Sci. Philadelphia 98: 96. 1946. *Hydranthelium egense* Poepp. in Poepp. & Endl., Nov. Gen. Sp. Pl. 3: 75, tab. 287. 1845.

Aquatic or terrestrial **herbs**, floating or prostrate on wet soil, with short erect flowering stems, rooting at proximal nodes, leafy stems terete, puberulent on the upper surfaces. **Leaves** opposite, larger in aquatic plants, petioles not clearly distinguished from the cuneate base; **leaf blades** 7–23 mm long, 3–14 mm wide, obovate to spatulate, rhombic or suborbicular, apex obtuse to rounded, margin serrate distally, base cuneate from the middle of the blade, puberulent beneath, venation palmate with 5–7 1° veins. **Inflorescences** of solitary axillary flowers (usually 2/node), pedicels 3–6 mm long, slender, glabrous or puberulent, bracteoles absent. **Flowers** with 4-parted calyx 2–4 mm long, lobes united below the middle, subequal, obtuse, subglabrous or the outer surface minutely puberulent; **corolla** 3–5 mm long, funnel-form, white, with 3 unequal lobes rounded distally; fertile stamens 3; ovary with many ovules, stigma bilobed. **Fruits** 3–4 mm long, ovoid, bivalved with membranaceous walls; seeds many, cylindrical-curved, rugulose.

Rarely collected plants of standing water and wet depressions in southern Nicaragua and north-eastern Costa Rica, 0–200 m elevation. Flowering and fruiting in September. The species is also found in Colombia and Brazil.

Bacopa egensis is recognized by its unusual palmately veined leaves with cuneate or attenuate base, flowers with four equal sepals, three-lobed white corollas, and curved cylindrical seeds. The terrestrial plants of this species have smaller leaves with more puberulence than their aquatic conspecifics. We have not seen Costa Rican material and follow the report in *Flora of Nicaragua*.

Bacopa lacertosa Standley is found along the Caribbean coast, from Belize to Nicaragua. It has erect stems to 70 cm tall, lanceolate leaves to 70 × 15 mm, axillary flowers on short pedicels, and broadly ovate outer sepals (to 8 mm long) with a parchment-like texture and lustrous surface on which the venation is conspicuously elevated. Sutton and Hampshire (*Flora of Nicaragua*, 1995) suggested that this species may be conspecific

with the African *B. decumbens* (Fernald) F. N. Williams.

Bacopa laxiflora (Benth.) Wettst. ex Edwall, Bol. Commiss. Geogr. Estado São Paulo 13: 180. 1897. *Herpestis laxiflora* Benth. in DC., Prodr. 10: 396. 1846. *H. auriculata* Robinson, Proc. Am. Acad. Arts 26: 172. 1891. *B. auriculata* (Robinson) Greenman, Publ. Field Mus. Nat. Hist. Bot. Ser. 2: 262. 1907. *Caconapea auriculata* (Robinson) Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 150. 1920. *Mella laxiflora* (Benth.) Pennell, Notul. Nat. Acad. Nat. Sci. Philadelphia 46: 1. 1940.

Erect **herbs** 10–40 cm high, aquatic or paludal, rooting only at the base, main stem simple or with few lateral branches, leafy stems 0.5–3 mm diam., glabrous, 4-angled with longitudinal ridges. **Leaves** sessile, smaller and bract-like at distal flowering nodes, often appearing perfoliate but the opposing leaves not united across the stem; **leaf blades** 6–30 mm long, 2–10 mm wide, lanceolate to lanceolate-oblong or ovate-lanceolate, apex acute, margin serrate, teeth ca. 0.3 mm high and 1–2 mm wide, base rounded to auriculate, drying grayish green, glabrous and punctate, venation pinnate. **Inflorescences** of solitary axillary flowers (1–2/node) or racemose and terminal (resembling panicles in some collections), pedicels 3–8 mm long, minutely papillate puberulent, ebracteolate at base of calyx or with 2 slender bracteoles 1–1.5 mm long. **Flowers** glabrous, outer sepals 3–5 mm long, 1–3.3 mm wide, ovate, usually narrowed at the base, acute, palmately veined, inner sepals linear; **corolla** 7–10 mm long, lilac to purple, bilabiate, tube ca. 5 × 1.7 mm, lobes 2–3 mm long; stamens 4, inserted on the upper half of the tube, anthers 0.5 mm long; style 2.5 mm long. **Fruits** 2.5–4 mm long, subglobose, surface slightly reticulate with minute pits; seeds ca. 0.4 × 0.2 mm, oblong with 1 or 2 truncated ends, longitudinally ridged/reticulate, brown.

Plants of wet sites and shallow standing water, in lowland deciduous and evergreen formations, 0–300 m. The species has been collected near La Cruz, Guanacaste Province; it flowers in December–January. The species ranges from Mexico to Brazil but is rarely collected in Central America.

Bacopa laxiflora is recognized by its short erect habit, wet habitat, sessile serrate leaves appearing to clasp the stem, solitary axillary flowers forming distal racemes, and globose or ovoid fruits.

Stems and leaves are usually glabrous, but the pedicels are minutely papillate puberulent.

Bacopa monnieri (L.) Pennell, Proc. Acad. Nat. Sci. Philadelphia 98: 94. 1946. *Lysimachia monnieri* L., Sp. Pl. Cent. 2: tab. 9. 1756. Figure 1.

Prostrate to procumbent **herbs** to 30 cm tall, rooting from the lower nodes, leafy stems 0.7–2.5 mm diam., glabrous, nodes marked by interpetiolar lines. **Leaves** slightly succulent, subsessile or with poorly defined petioles 0.5–2 mm long, clasping the stem at the base; **leaf blades** 3–18 mm long, 1.5–7 mm wide, obovate to oblong-obovate, oblanceolate, or spatulate, apex rounded, margin entire, base gradually narrowed and cuneate, drying yellowish green, glabrous, often punctate, venation pinnate but obscure (sometimes appearing tripliveined). **Inflorescences** of solitary axillary flowers, usually with only 1 flower/node, pedicels 7–30 mm long, 0.3–0.6 mm diam., glabrous, bracteoles 2, opposite, 1.5–3 mm long, 0.4–0.7 mm wide, near the apex of the pedicel and resembling the larger sepals in texture. **Flowers** glabrous, the 2 outer sepals 5–7 mm long, 2–3 mm wide, 3 inner sepals narrower, acute; **corolla** 6–10 mm long, white to lavender, blue or pale purple, lobes rotate and essentially regular, ca. 2 cm wide, tube 3–5 mm long; stamens 4, filaments arising near the apex of the tube, glabrous, anthers ca. 1.5 mm long; ovary ca. 4 mm long, ovate-oblong, style ca. 4 mm long, stigma flattened, ca. 0.8 mm wide. **Fruits** 4–7 mm long, ovoid, enclosed within the persisting sepals; seeds ca. 0.5 mm long, reddish brown, longitudinally reticulate.

Plants of open sunny sites in marshes, sandy stream edges, and standing water, often creeping on wet mud and tolerant of some salinity, 0–1000 m elevation. The species has rarely been collected in Costa Rica, where it is usually found near the coasts. It probably flowers throughout the year. We have seen a single sterile collection (*Crow 9465* INBIO) from 820 m in Alajuela. The species ranges from the southeastern United States to Argentina.

Bacopa monnieri is recognized by its small entire obovate or spatulate leaves, glabrous parts, narrow bracteoles beneath the sepals, somewhat larger flowers, and ability to survive in slightly salty water. The species has been called *verdolaga* in Nicaragua.

Bacopa monnierioides (Cham.) Robinson, Proc. Am. Acad. Arts 44: 614. 1909. *Ranaria monnierioides* Cham., Linnaea 8: 31. 1833. *Herpeticis ranaria* Benth. in J. D. Hook., Companion Bot. Mag. 2: 57. 1836, based on *R. monnierioides* Cham. *B. ranaria* (Benth.) Chod. & Hassl., Bull. Herb. Boissier ser. 2, 4: 288. 1904. *Caconapea parviflora* Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 152. 1920. *B. parviflora* (Pennell) Pennell ex Standl., Contrib. U.S. Natl. Herb. 27: 336. 1928. *B. parviflora* (Pennell) Standl. ex L. O. Williams, Fieldiana Bot. 34: 118. 1972.

Erect **herbs** to 40 cm tall, aquatic or in wet soil, with much distal branching, rooting mostly at the base, leafy stems 0.5–2.5 mm diam., minutely puberulent with slender crooked hairs 0.1–0.4 mm long on upper surfaces. **Leaves** sessile, opposing leaves not united across the stem but sometimes producing a line across the stem, distal leaves conspicuously smaller than leaves of the main stem; **leaf blades** 8–30 mm long, 2–7 mm wide, oblong-lanceolate to narrowly oblong, apex obtuse, margin subentire or obscurely dentate with teeth 1–2 mm wide, drying yellowish brown or dark grayish, glabrous, glandular punctate on both surfaces, venation subpalmate or tripliveined. **Inflorescences** mostly fasciculate, of (1)2–4 axillary flowers, 2–8 flowers/node, pedicels ca. 0.5 mm long, bracteoles minute (0.3 mm) at apex of pedicel. **Flowers** glabrous, outer sepals 1–2 mm long, 0.5–1 mm wide, narrowly ovate-oblong, with an unusual glandular-pitted surface; **corolla** 1.5–2.5 mm long, tubular, white or bluish white, upper lobe entire, lower lip 3-lobed; stamens 4, inserted near the apex of the tube; ovary glabrous. **Fruits** ca. 1.5 mm long, smooth, enclosed within the stiff persisting sepals (to 2.5 mm long); seeds 0.6–0.7 mm long, 0.2–0.3 mm thick, oblong-ellipsoid, longitudinally ridged, reddish brown.

Plants of inundated areas, the margins of water bodies, and wet savannas, 0–1500 m in Central America. In Costa Rica, this species has been collected only in lowland Guanacaste. The species ranges from Guatemala to Paraguay.

Bacopa monnierioides is recognized by its erect branching habit, sessile lanceolate-oblong leaves with subserrate margins, small fasciculate flowers, and smooth fruit. The glandular pit at the base of the outer sepal is unusual but difficult to see. Compare *B. axillaris* and *B. sessiliflora*.

Bacopa repens (Sw.) Wettst. in Engl. & Prantl, Nat. Pflanzenfam. 4(3b): 76. 1895. *Gratiola repens* Sw., Prodr. 14. 1788. *Herpestis repens* (Sw.) Schldl. & Cham., Linnaea 5: 107. 1830. *Macuillamia limosa* Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 158. 1920. *Bacopa limosa* (Pennell) Standl., Contrib. U.S. Natl. Herb. 27: 336. 1928. *M. repens* (Sw.) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1: 60. 1935. *B. curtipes* Standl. & L. O. Williams, Ceiba 3: 129. 1952. Figure 1.

Herbs, aquatic or terrestrial, floating to prostrate or repent, to 40 cm long, rooting from lower nodes, stems 0.4–3 mm diam., glabrous or with short (0.1–0.3 mm) thin hairs distally. **Leaves** sessile, bases of opposing leaves partly united and obscuring the node; **leaf blades** 6–20(–30) mm long, 3–15(–20) mm wide, obovate to obovate-oblong or suborbicular, apex rounded or obtuse, margin entire, base cuneate, drying yellowish green to dark green or blackish, glabrous except near the base, venation palmate with 3–11 major veins. **Inflorescences** of axillary flowers, 2–4 flowers/node, pedicels 6–18 mm long, 0.2–0.3 mm diam., glabrous or minutely puberulent, bracteoles absent or minute. **Flowers** with 4 or 5 sepals, outer sepals 2.5–4 mm long, 0.7–1.5 mm wide, narrowly oblong, rounded to obtuse at the apex, margin often ciliolate, inner sepals narrower; **corolla** 3–4 mm long, white or pale violet, campanulate and regular or nearly so, throat sometimes marked with yellow, 2-lipped, the upper lip 2-lobed; stamens 4, filaments inserted near the apex of the tube, anthers ca. 0.7 mm long; ovary ca. 1.3 mm long, style 1–3 mm long, slender, stigma capitate, slightly 2-lobed. **Fruits** 2.3–4 mm long, ca. 2 mm diam., glabrous, enclosed within the persisting (3–4 mm long) sepals; seeds ca. 0.4 mm long, oblong, dull whitish to brown, surface reticulate.

Aquatic plants of lake edges and marshes, in both evergreen and deciduous forest areas, 0–1000 m elevation. Rarely collected in Costa Rica, this species is found in the Caribbean lowlands and on the Pacific coast in seasonal ponds at Bagaces and Palo Verde National Park. Flowering in August–October. The species ranges from southern Mexico and the West Indies to Argentina.

Bacopa repens is recognized by its aquatic habitat, glabrous or sparsely puberulent stems, obovate sessile leaves slightly united (across the stem) at the base, and small flowers. The distal leaves and stems are often floating and can become a floating mat. This species may be vege-

tatively very similar to *B. monnieri*, but that species has larger flowers and fruits and lacks bracteoles. Compare *B. salzmännii*, which occurs in similar habitats but has villous stems, larger flowers, and separate leaf bases.

Two collections from water 1.5 m deep at Palo Verde National Park (*G. Crow* 5977 & 60603) are provisionally placed here. These collections have larger (20–40 mm) leaves, longer fruits (3–5 mm), and linear-oblong seeds to 0.7 mm long. They conform to the description of *B. valerii* Standl. & L. O. Williams (Ceiba 1: 163, 1950) based on material from 20 m elevation in western Honduras. Although quite distinctive, it seems likely that all these plants represent no more than an unusually robust form of *B. repens*.

Bacopa salzmännii (Benth.) Wettst. ex Edwall, Bol. Commiss. Geogr. Estado São Paulo 13: 176, 181. 1897. *Scrophularia procumbens* Vell., Fl. flumin. Ic. 6, tab. 85. 1827, non *B. procumbens* (Miller) Greenman. *Herpestis salzmännii* Benth. in J. D. Hook., Companion Bot. Mag. 2: 58. 1836. *B. salzmännii* (Benth.) Chod. & Hassl. Bull. Herb. Boissier Ser 2.4: 290. 1904. *Monocardia humilis* Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 157. 1920. *M. violacea* Pennell, loc. cit. 156. 1920. *B. humilis* (Pennell) Standl., J. Wash. Acad. Sci. 15: 460. 1925. *B. violacea* (Pennell) Standl., loc. cit. 460. 1925. *Herpestis ciliata* Pennell, Notul. Nat. Acad. Sci. Philadelphia 46: 2. 1940. Figure 1.

Herbs, aquatic or terrestrial, prostrate or decumbent, sometimes floating or forming mats, rooting from lower nodes, stems succulent, 1–2 mm diam., densely hirsute with thin multicellular hairs 0.7–1.5 mm long. **Leaves** sessile and decussate, opposing leaves not united at the base, often subtended by a tuft of hairs; **leaf blades** 6–20 mm long, 5–18 mm wide, ovate to broadly ovate-elliptic or ovate-orbicular, apex rounded or bluntly obtuse, sometimes slightly notched, margin entire, base rounded and truncate to subcordate or auriculate, drying greenish to yellowish, glabrous or hirsute near the base beneath, venation palmate with 3–7 poorly defined primary veins. **Inflorescences** of solitary axillary flowers, 1–2/node, pedicels 8–23 mm long, 0.2–0.4 mm diam., hirsutulous with slender hairs 0.2–0.5 mm long, ebracteolate (but the outer sepals resembling bracts). **Flowers** with strongly unequal sepals, outer 3 sepals 4–6 mm long, 2.5–5 mm wide, ovate with truncated or subcordate bases and resembling the leaves, ciliolate along the margin, inner sepals

narrowly triangular; **corolla** 6–9 mm long, pale blue to lavender or violet (white), slightly exerted beyond the sepals, 4-lobed with the upper lobe emerginate; stamens 4, included, filaments 1–2 mm long, glabrous, larger anthers 1.2–1.5 mm long; ovary ca. 1 mm long, narrowly ovoid, glabrous, style 2–5 mm long, stigma 0.3 mm wide. **Fruits** ca. 3 mm long and 1 mm wide, narrowly ovoid-oblong; seeds many, small, reddish brown, reticulate.

Plants of shallow water and moist open sunny sites at the edges of water in both evergreen and deciduous forest areas, 40–1700 m elevation. This is a common species of marshes, swamps, and wet depressions, growing both as a partly submerged aquatic, prostrate and mat-forming on wet mud, or erect among other wetland plants, flowering throughout the year. This species ranges from Mexico and the West Indies to southern Brazil.

Bacopa salzmannii is the most commonly collected species of *Bacopa* in Costa Rica. It is recognized by its often aquatic or repent habit in wet sites, the villous stems, sessile rounded leaves, and leaf-like (bract-like) outer sepals. The rounded bases of the leaf blades may obscure the stem but they are not joined (interpitiolar, cf. *B. repens*) nor are they decurrent on the stem.

Bacopa sessiliflora (Benth.) Pulle, Enum. Pl. Surinam 415. 1906. *Herpestis sessiliflora* Benth. in J. D. Hook., Companion Bot. Mag. 2: 58. 1836. *B. sessiliflora* (Benth.) Edwall, Bol. Commiss. Geogr. Estado São Paulo 13: 176, 181. 1897, incomplete combination fide D'Arcy 1979. *Caconapea conferta* Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 153. 1920. *C. sessiliflora* (Benth.) Pennell, loc. cit. 75: 11. 1923.

Erect **herbs** to 40 cm tall, with short lateral branches, rooting only at the base, leafy stems 0.8–3 mm diam., glabrous, with 2 opposite longitudinal ridges. **Leaves** sessile, separate at the base and not forming an interpitiolar line, decurrent on the stem, distal leaves smaller (5 mm) and bract-like; **leaf blades** 10–35 mm long, 2–5 mm wide, oblanceolate to linear-oblanceolate or narrowly elliptic-oblanceolate, apex acute, distal half of the margin with prominent teeth ca. 0.5 mm high, 1–2 mm long, cuneate to the base, drying yellowish brown, glabrous, punctate on both surfaces, venation pinnate. **Inflorescences** fasciculate in distal spiciform arrangements or 1–4 flowers in leaf axils, distal spikes 1–3 cm long, ca. 1 cm diam., flowers sessile or subsessile on pedicels less than 1.5 mm long, bracteoles 1–2 mm long

at apex of pedicel or absent. **Flowers** glabrous externally, calyx united at base, outer calyx lobes 3–3.5 mm long, 1.3–2 mm wide, ovate, thin with 3 prominent parallel veins; **corolla** 3–4 mm long, tubular-campanulate, exerted, bluish or white, lobes ca. 0.5 mm long; stamens 4, attached near middle of tube; ovary ca. 1.5 mm long, style ca. 1 mm long. **Fruits** 3–4 mm long, 1.5–2 mm diam., narrowly ovoid, surface with minute (0.1 mm) capitate hairs; seeds ca. 0.3 × 0.2 mm, rectangular with truncated ends, brown, longitudinally reticulate/ridged.

Rarely collected plants of open sunny sites in wet marshes and depressions. The plants are tolerant of brackish water and can be found near the seashore. The species has not been collected in Costa Rica but is known from Bluefields, Nicaragua, and is found in central Panama. The species ranges from Guatemala and Belize to Ecuador and the West Indies.

Bacopa sessiliflora is distinguished by its erect habit, general lack of pubescence, sessile oblanceolate leaves serrulate along their distal margins, and sessile flowers often in axillary fascicles that may be arranged in terminal spike-like inflorescences. Compare *B. monnieroides*.

Benjaminia Martius

REFERENCE—L. B. Smith & J. M. Pires, An evaluation of *Benjaminia* Martius ex Benjamin. J. Wash. Acad. Sci. 46: 86. 1956.

Herbs, aquatic and submerged, rooting at lower nodes, glabrous or puberulent, glandular punctate on vegetative parts. **Leaves** verticillate, united at the base, petiole, the blades pinnatifid with slender linear segments. **Inflorescences** of solitary axillary flowers, bracts absent, pedicels elongating slightly in fruit, bracteoles absent at the base of the calyx. **Flowers** with calyx lobes united near the base, calyx lobes (sepals) 5 and subequal, narrow, valvate in bud; **corolla** tubular and 2-lipped, upper lip slightly 2-lipped, lower lip 3-lobed; stamens 4, of 2 unequal pairs, included, anthers equal, thecae similar; ovary subtended by a ring of filaments, 2-locular, ovules many, style simple, stigma flat and slightly curved. **Fruits** thin-walled capsules, loculicidal, surface smooth; seeds many, oblong, surface longitudinally reticulate.

A monotypic genus of unusual aquatic plants, this taxon is closely related to *Bacopa* but differs in having nearly equal sepals, unusual pinnatifid leaves, and ovary subtended by staminodial fila-

ments (present in some *Bacopa* species). This genus has been confused with the Old World *Limnophila*, but *Benjaminia* is distinct because of its estipitate anther-thecae and its two-lobed stigma. Also, *Limnophila* species usually have emergent leaves that are broad and dentate, whereas emergent leaves are never found in *Benjaminia*. For a short discussion of the complex nomenclature of the genus, see D'Arcy (1979, p. 194).

Benjaminia reflexa (Benth.) D'Arcy, Ann. Missouri Bot. Gard. 66: 194. 1979. *Herpestis reflexa* Benth. in DC., Prodr. 10: 399. 1846. *Beutriculariaeformis* Mart., Fl. Bras. 10: 256. 1847. *Quinquelobulus utriculariaeoides* Benj., Linnaea 20: 316. 1847. *Monnierea reflexa* (Benth.) Kuntze, Rev. Gen. Pl. 2: 463. 1891. *Bacopa reflexa* (Benth.) Edwall, Bol. Commiss. Geogr. Estado São Paulo 13: 176. 1897. *Naiadothrix longipes* Pennell, Mem. Torrey Bot. Club 16: 105. 1920. *Bacopa naias* Standl., Field Mus. Bot. Ser. 11: 141. 1932. *Limnophila costaricensis* Suesseng., Bot. Jahrb. Syst. 72: 284. 1942. *L. costaricensis* forma *aquatica* Suesseng., loc. cit. *L. costaricensis* forma *semiterrestris* Suesseng., loc. cit. Figure 1.

Submerged **herbs**, only the flowers and fruits extending above the water surface, branched, rooting at lower nodes, internodes 2–60 mm long, 0.5–2 mm diam., glabrous or minutely and sparsely puberulent, vegetative parts glandular punctate. **Leaves** in verticels of 6 or 8/node (rarely 2 or 4), glabrous or sparsely puberulent, petioles 2–6 mm long (to the first pinna), 0.2–0.4 mm wide; **leaf blades** 4–35 mm long, 5–25 mm wide, with slender filiform pinnate lobes, lobes 4–15/side and in a single plane, central rachis 0.2–0.4 mm wide, lobes 0.05–0.15 mm wide, often with small (0.1–0.2 mm) punctate glands. **Inflorescences** of solitary axillary flowers, 1 flower/node, pedicels 5–9(–18) mm long, 0.2–0.4 mm diam., glabrous or sparsely and minutely puberulent. **Flowers** with sepals 2–4 mm long, 0.4–0.7 mm wide, linear-lanceolate to linear-oblong, apex usually slightly rounded; **corolla** 4–6 mm long, bluish white or purple, yellowish within the throat; anthers versatile and similar; ovary ca. 2 × 1 mm, narrowly ovoid, style ca. 1 mm long, slender. **Fruits** 2–3 mm long, narrowly ovoid, smooth, with a persisting style ca. 1 mm long; seeds ca. 0.6 mm long, oblong-fusiform, reticulate.

Submerged aquatic plants of shallow ponds and lakes, 0–800 m elevation. Only three collections from Costa Rica have been seen, all from the

General Valley (near Buenos Aires and between San Isidro and Rivas), flowering and fruiting in November (*Crow* 6176 & 6239), December (Nicaragua), and February (*Kupper* 597). The species (in a wide sense) ranges from Mexico and Cuba to Brazil.

Benjaminia reflexa is an unusual aquatic plant distinguished by being almost entirely submerged, having whorls of feather-like leaves with slender pinnate lobes, solitary little flowers with five nearly equal narrow sepals, and sympetalous two lipped corollas. The flowers and fruits are borne above the water surface on stiff pedicels. The leaves can also be interpreted as being opposite, with each leaf having three or four primary axes and each of these having deeply divided pinnatifid divisions. These plants resemble the submerged portions of species of *Cabomba* (Nymphaeaceae) as well as aquatic *Utricularia* species (Lentibulariaceae). The only similar Neotropical species of Scrophulariaceae is *Bacopa myriophylloides* (Benth.) Pennell, which has palmately dissected leaves and differing flowers. This species was treated as *Bacopa naias* in the *Flora of Guatemala*. Suessenguth's *Limnophila costaricensis* lacks a species description but has Latin descriptions of two forms, all based on a single collection number (*Kupper* 597, fragments at ♀).

Buchnera Linnaeus

REFERENCE—D. Philcox, Revision of the New World species of *Buchnera* L. Kew Bull. 18: 275–316. 1965.

Herbs, annual (in ours) or perennial, hemiparasitic, erect, simple or branched, hairs with a broad base and stiff straight tip, often scabrous, drying dark. **Leaves** opposite or subopposite, sometimes alternate distally, sessile to short-petiolate, leaf blades narrow, dentate or entire, margins often revolute, usually scabrous, venation pinnate or palmate, with 1 or 3 (5) major veins. **Inflorescences** terminal compact or lax spikes, flowers sessile or subsessile, subtended by a bract, with 2 slender lateral bracteoles beneath the calyx. **Flowers** with a tubular calyx, slightly enlarging in fruit, with 5 or 10 prominent longitudinal veins, lobes 4 or 5, shorter than the tube, acute; **corolla** radially symmetric and usually salverform, tube longer than the calyx, cylindric and straight or slightly curved, blue to white or purple, glabrous (in ours) or puberulent externally, lobes 5 and

subequal, rotate-spreading, shorter than the tube, apex of the tube often with moniliform hairs; stamens 4, of 2 unequal pairs, inserted in the proximal half of the tube, sessile or with short filaments, anthers ovoid, versatile, 1-theccous; ovary ellipsoid to ovoid, 2-locular with many ovules, style slender and included, stigma clavate. **Fruits** dry capsules partly enclosed by the persisting calyx, splitting loculicidal into 2 equal parts; seeds many, oblong or ellipsoid, curved or angled, longitudinally reticulate.

A genus of ca. 100 species in tropical and tem-

perate climates throughout the world. Most of the species are found in the Old World tropics; there are about 16 species in the New World. The genus is distinguished by its slender few-branched habit, stiff, narrow, usually scabrous leaves, spicate inflorescences, tubular calyx, and one-theccous anthers, all parts drying dark or black. All species are believed to be hemiparasites, attaching by haustoria to the roots of the host plants. The genus is placed in the tribe Buchnerae, along with many Old World genera. Its closest Neotropical relatives are *Alectra* and *Escobedia*.

Key to the Species of *Buchnera*

- 1a. Stems hispid-scabrid, rough to the touch; larger leaves with prominent teeth; calyx pubescent, becoming slightly thickened in fruit, but the areas between the longitudinal veins usually remaining flat and the minor venation not visible *B. pusilla*
- 1b. Stems usually smooth to the touch at distal internodes; larger distal leaves entire and linear; calyx glabrous, becoming conspicuously thickened and with raised minor venation between the longitudinal veins in fruiting stages *B. weberbaueri*

Buchnera pusilla Kunth in H.B.K., Nov. Gen. Sp. 2: ed. quarto 340. 1818. *B. tinctoria* Bertol., Fl. Guatemala 26. 1840. *B. major* Polak., Linnaea 41: 588. 1877. *B. mexicana* Hemsl., Biol. Centr. Am. Bot. 2: 457. 1881. Figure 4.

Stiff erect **herbs** (6-)10-70(-150) cm tall, annual, unbranched or with 2-7 distal branches, drying dark, stems 0.4-3 mm diam., terete, hispid with stiff whitish hairs 0.3-1.3 mm long. **Leaves** opposite or subopposite, sessile or with poorly differentiated petioles to 8 mm long; **leaf blades** 15-50 mm long, 1-8 mm wide, linear to linear-oblong or linear-oblancheolate (oblong near the base), apex acute, margin with 1-5 prominent teeth (0.2-1 mm) or entire, gradually narrowed to the cuneate base, subcoriaceous, with scattered short scabrid hairs above, larger (0.2-0.5 mm) stiff hairs along the margin and veins beneath, with 1 or 3 major veins. **Inflorescences** 3-15 cm long, bracts 4-9 mm long, ovate to lanceolate, pedicels 0-1 mm long, with 2 shorter linear bracteoles beneath the calyx, bracts and bracteoles scabrid and ciliate. **Flowers** with calyx 4-5 mm long, enlarging (to 8 mm) and becoming more scabrid in fruit, with 10 longitudinal veins, hispid only along the veins, lobes 1-2.5 mm long, equal or unequal, acute; **corolla** 8-14 mm long, salverform, white to purplish white or lilac, tube 0.4-0.8 mm diam., lobes 1-5 mm long, obovate with narrowed base and broadly rounded apex; stamens

inserted near the middle of the tube. **Fruits** 4-6 mm long, ca. 2 mm wide, oblong, smooth, partly enclosed in the scabrid calyx; seeds 0.4-0.5 mm long, oblong or curved.

Plants of open sunny sites in fields and savannas in deciduous and evergreen forest areas of the Pacific slope and central highlands, 10-1700 m elevation. Flowering and fruiting from October to early March. The species ranges from Mexico to Ecuador and Brazil.

Buchnera pusilla is distinguished by its short, stiff, erect (usually few-branched) habit, hispid to scabrous vesture, spicate inflorescences, and salverform white to pinkish corollas, all parts turning dark when dried. This is a frequently collected species in Central America. We have included *Herrera 801* within our concept of this species, which has been identified as *B. longifolia* Kunth by Wilcox (1965, see above). *Buchnera pusilla* and *B. longifolia* form a variable species complex, widely distributed in the lowland Neotropics. They are distinguished by the amount and type of pubescence on the calyx, but that character can vary with the age of the flower, the fruits becoming more scabrid as they mature. See the illustration in *Flora of Guatemala* (Standley & Williams, 1973, p. 337).

Buchnera weberbaueri Diels, Bot. Jahrb. Syst. 37: 430. 1906. *B. leiantha* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 22: 105. 1940.

Stiff erect **herbs** 30–70 cm tall, annual, usually without lateral branches, leafy stems 1–2.5 mm diam., glabrous or with minute (0.1–0.2 mm) scabrid hairs in longitudinal files or at lower internodes, usually smooth to the touch. **Leaves** opposite or subopposite, sessile and slightly clasping the stem, a petiole not differentiated; **leaf blades** 2–7 cm long, 0.5–4 mm wide, linear to linear-lanceolate, apex acute, margins entire (except rarely on basal leaves), base gradually narrowed, drying black or brown, glabrous, with 1 central vein or tripliveined. **Inflorescences** 4–14 cm long, flowers separate or closely congested into a dense spike, abaxial bracts 2–3 mm long, acute, enlarging to 5 × 3 mm in fruit, ciliolate along the margin, pedicels 0–1 mm long. **Flowers** with calyx 5–7 mm long, to 10 mm in fruit, sparsely puberulent with few white hairs, sepal lobes ca. 1.5 mm long, acute, minor venation between the main veins not apparent until fruiting; **corolla** 7–13 mm long, salverform, lilac to pink-purple or white, tube ca. 0.6 mm diam., lobes 1.5–2 mm long, equal. **Fruits** 5–7 mm long, ca. 3 mm diam., surface smooth and glabrous, included within the stiff thickened calyx.

Rarely collected plants of open sunny sites, 200–1300 m elevation. In Costa Rica this species has only been collected in Guanacaste Province, flowering in January and September–October, with old fruit in February. The species has been collected in Belize, in Izabal (Guatemala), and on the Cerro de Espíritu Santo near Naranjo in Costa Rica; it ranges southward to Trinidad and Peru.

Buchnera weberbaueri is recognized by its short, usually unbranched stems, very sparse pubescence, linear entire leaves, and sepals that become indurated and with many elevated veins in fruiting stages. Two rather different specimens are provisionally placed here: *Herrera 801*, with young flowers, and *Williams & Williams 24514*, with old fruits. Standley and Williams (1973) confused *B. weberbaueri* with the larger-flowered *B. palustris* (Aubl.) Spreng., which is found in lowland South America in wet areas. In addition to its larger flowers, *B. palustris* has longer pedicels and narrowly lanceolate bracts and bracteoles.

Calceolaria Linnaeus

REFERENCES—U. Molau, Scrophulariaceae, Part 1. Calceolariae. Fl. Neotropica, Monogr. 47: 1–326. 1988. L. R. Landrum & R. McVaugh, *Calceolaria mexicana* and *C. tripartita* in Mexico. Contrib. Univ. Michigan Herb. 11: 273–309. 1978.

Shrubs, vines or herbs, annual or perennial, usually confined to high-elevation habitats, stems terete, hairs simple. **Leaves** opposite (ternate in some Andean species), sessile or petiolate, leaf blades simple and without prominent lobes or becoming deeply lobed or pinnatifid, margins usually serrate, pinnately veined. **Inflorescences** terminal or axillary, often a compound thyrses of cymes with 3 or 4 flowers or of 1–3 axillary flowers, often subtended by smaller leaves, bracteoles absent at the base of the calyx. **Flowers** small to large, calyx deeply 4-parted, sepal lobes equal or unequal, valvate in bud, usually persisting in fruit; **corolla** strongly bilabiate with the lower lip usually developed into a globose or slipper-like saccate form, the upper lip usually much smaller and arched or hooded and enclosing style and stamens, yellow to red or purple, sometimes spotted or mottled, glabrous on the exterior; stamens 2, attached near the base of the tube, filaments short, anther with 2 contiguous thecae opening by a longitudinal slit, staminodes absent; ovary superior and conical (partly inferior in the temperate subgenera *Cheiloncos* and *Rosula*), somewhat 2-lobed, 2-locular, ovules many, style short and often recurved, stigma simple or capitate. **Fruits** dry capsules, septicidal and loculicidal, the 4 valves opening from the apex; seeds many, small (0.3–1 mm), usually with longitudinal and transverse ridges or minute tubercles.

A pantropical genus of ca. 300 species with a majority of the species found above 1000 m elevation in the Andes. A number of species range into the lowlands of temperate Chile and Argentina. The genus is classified with *Jovellana* and *Porodittia* in the tribe Calceolarieae. This tribe exhibits links between southern South America and New Zealand, duplicating the disjunction found in the tribe Veroniceae. Molau (1988) provided a fine treatment of this complex and fascinating group in the Neotropics; his discussions of biology, distribution, speciation, and phylogeny are especially noteworthy. *Calceolaria* is immediately recognizable because of its bright yellow bilabiate corollas with small upper lip and rounded saccate or inflated slipper-like lower lip. The four-parted calyx, only two stamens, and restriction to moist high-elevation habitat (in Central America) are further distinctions. Some South American species have corollas that are somewhat S-shaped in lateral view. A number of hybrids are popular as potted ornamentals, called “slipper-worts” or “slipper flowers.”

Key to the Species of *Calceolaria*

- 1a. Petioles broadly winged to the base and united across the node, the leaves perfoliate [larger blades triangular to sagittate, never pinnatifid; anther cells contiguous, dark brown; uncommon] *C. perfoliata*
- 1b. Petioles not broadly winged to the base, the leaves not perfoliate 2
- 2a. Larger leaves lanceolate, without pinnate lobes or deep sinuses; anther-thecae contiguous, not separated by an expanded connective; stems slightly woody and plants clambering to 2 m high (note that these 2 species are very similar) 3
- 2b. Larger leaves usually with prominent pinnate lobes separated by deep sinuses; anther-thecae separated by the slender expanded connective; stems mostly herbaceous and semisucculent, plants to 1 m high 4
 - 3a. Fruits puberulent; 2° veins of leaves not loop-connected in the distal half of the blade, usually strongly ascending, upper surface of the blade with very short hairs and glands, lower surface often with brown punctations; stems usually puberulent; seeds with prominent longitudinal ridges and smaller transverse ribs; common high-montane plants *C. irazuensis*
 - 3b. Fruits glabrous; 2° veins of leaves usually loop-connected in the distal half of the blade, upper surface lacking very short hairs or glands, lower surface not punctate; stems usually glabrous (rarely with a few hairs at nodes and petioles); seeds with prominent longitudinal ridges but no transverse ribs; rarely collected in Costa Rica *C. microbefaria*
- 4a. Corolla 5–15 mm long, mouth open; fruits 3–7 mm long, oblate; seeds 0.4–0.5 mm long; sinuses of larger leaves rarely reaching the midvein; lower anther-theca fertile *C. mexicana*
- 4b. Corolla 10–20 mm long, mouth closed; fruits 6–9 mm long, ovoid; seeds 0.6–0.8 mm long; sinuses of larger leaves sometimes reaching the midvein; lower anther-theca sterile *C. tripartita*

Calceolaria irazuensis J. D. Smith, Bot. Gaz. 20: 292. 1895. *C. costaricensis* Kränzl., Ann. K. K. Naturhist. Hofmus. 22: 192. 1907. Figure 3.

Subshrubs, erect or scandent, 0.2–1(–2) m tall, leafy stems 1.2–5 mm diam., densely puberulent with slightly viscous hairs 0.05–0.3 mm long, older stems glabrescent. **Leaves** forming a line across the stem at their base, petioles 2–8(–15) mm long, 0.5–1.8 mm diam., puberulent with longer hairs adaxially; **leaf blades** 1.8–9(–12) cm long, 6–35(–45) mm wide, lanceolate to ovate-lanceolate or elliptic-lanceolate, gradually narrowed to the acute apex, margin serrate with teeth 0.3–1 mm high, 2–5 teeth/cm, base acute to obtuse or slightly rounded, asymmetric, drying much paler beneath than above, minutely (0.1–0.2 mm) puberulent above, glabrous between the veins beneath, 2° veins 4–9/side and strongly ascending. **Inflorescences** mostly of 2–4 long-pedunculate cymes subtended by a pair of smaller leaves (bracts) or with 2–4 flowers terminal on the distal leafy node, minutely viscid puberulent, peduncles 1.5–12 cm long, 1–2 mm diam., usually bearing 3 or 4 pedicellate flowers, pedicels 1–4 cm long, 0.4–0.6 mm diam. **Flowers** with calyx 6–9 mm long, calyx lobes 4–9 mm long, broadly ovate-triangular, minutely puberulent along the margin; **corolla**

12–24 mm long, minutely glandular-papillose on the exterior, upper lip 6–8 mm long, lower lip 15–25 mm long, 12–18 mm wide, bright yellow; filaments ca. 1.5 mm long, anthers with divaricate thecae to 3.5 mm wide; style 2–3 mm long, curved. **Fruits** 6–9 mm long, 5–8 mm wide, ovate with truncated base, minutely papillate-puberulent; seeds 0.4–0.7 mm long, 0.2–0.3 mm wide, oblong-ellipsoid, dark brown, with prominent longitudinal ridges and minute transverse ribs (×50).

Plants of evergreen high-montane forest formations, (1800–)2400–3500 m elevation. Flowering and fruiting throughout the year but with most collections made between November and May. The species ranges from Volcán Barva southward to the Chiriquí highlands of Panama.

Calceolaria irazuensis is recognized by it mostly lanceolate leaves, slightly viscid hairs, inflorescences often with long peduncles and/or pedicels, and slipper-shaped yellow flowers. This species is frequently encountered in open sites at higher elevations. Compare the closely similar but rarely collected *C. microbefaria*. Common names are *botón de oro* and *gallitos*.

Calceolaria mexicana Benth., Pl. Hartw. 47. 1840. *C. trachelifolia* Martens & Galeotii, Acad. R. Sci. Bruxelles 12: 16. 1845. *C. urti-*

cina Kränzl., Feddes Repert. Spec. Nov. Regni Veg. 1: 82. 1905. Figure 3.

Annual **herbs**, erect to decumbent, 10–60(–100) cm tall, leafy stems 0.6–3 mm diam., slightly succulent, often reddish in color, sparsely to densely puberulent with simple or viscid gland-tipped hairs 0.3–0.6 mm long. **Leaves** slightly clasping the stem and forming an interpetiolar ridge, petioles 2–40(–160) mm long, 0.4–1.4 mm diam., pubescence similar to that of the stem; **leaf blades** 1–12 cm long, 0.4–8(–13) cm wide, varying from narrowly ovate-triangular in smaller blades to broadly ovate-triangular in outline with 2–4 prominent pinnatifid lobes separated by deep sinuses in larger blades, apex acute, margins strongly dentate-serrate with intermixed larger (2–4 mm) and smaller (0.3–2 mm) teeth, base obtuse to subcordate, drying yellowish green to grayish green, upper surface with slender hairs 0.2–0.4 mm long, lower surface with few thin hairs to 1 mm long on the major veins, 2° veins 6–12/side. **Inflorescences** of solitary axillary flowers (2/ node) or resembling terminal cymes when subtended by reduced bract-like distal leaves, pedicels 4–14 mm long, elongating in fruit, 0.15–0.25 mm diam., minutely puberulent with gland-tipped hairs. **Flowers** with calyx 4–6 mm long, calyx lobes 2–5 mm long, 1–3 mm wide at the base, acute, with glandular hairs at the base; **corolla** 5–15 mm long, 3–10 mm wide, the upper lip 1–3 mm long, lower lip 5–14 mm long, 3–6 mm wide, slipper-shaped, yellow; anthers 2–3.5 mm wide, the 2 small thecae fertile, separated by the longer narrow connective; ovary 2.5 mm diam., papillate-puberulent. **Fruits** 3–7 mm long, 3–6 mm wide, oblate or globose, thin-walled; seeds 0.4–0.5 mm long, ca. 0.3 mm thick, oblong, dark.

Plants of wet sites near streams, moist depressions, and wet cliffsides, 1500–3200 m elevation. Flowering throughout the year, but with most Costa Rican collections made in April–August. This species is the commonest *Calceolaria* in Mexico and Central America; it ranges to Bolivia.

Calceolaria mexicana is recognized by its preference for wet montane habitats, diverse foliage with the large leaves having prominent pinnate lobes, small slipper-shaped yellow corollas, and stamens with two small but functional thecae. This species can be found growing together with the very similar *C. tripartita*, and the two are easily confused. Both species have a strongly developed connective separating the thecae. In *C. mexicana* the corollas are open and the lower lip is

slightly three-lobed. In addition, the larger leaves do not have the deep sinuses of *C. tripartita* leaves.

Calceolaria microbefaria Kränzl., Ann. K. K. Natur. Hofmus. Wien 22: 193. 1907. *C. storkii* Standl., Publ. Field Mus. Nat. Hist. Bot. Ser. 18: 1103. 1938.

Shrubs or subshrubs 0.3–3 m tall, erect or clambering, much branched, stems glabrous or with a few hairs at the nodes. **Leaves** with petioles 3–11 mm long, glabrous or with a few hairs along the adaxial margins; **leaf blades** 4–9(–13) cm long, 1–2.3(–2.8) cm wide, lanceolate to narrowly oblong-lanceolate, apex acute, margin serrate with 5–7 gland-tipped mucronulate teeth/cm, base acute, upper surface glabrous or minutely papillate, lower surface often drying pale grayish or reddish, 2° veins 5–11/side, loop-connected distally. **Inflorescences** 3–12 cm long, usually with 2 or 3 pairs of 4–8 flowered cymes, peduncles 1–5 cm long, bracts often lacking at the base of the cymes, pedicels 0.5–3.4 cm long, glabrous to minutely papillate-puberulent (to tomentose in South America). **Flowers** with sepals 3.3–6 mm long, 2.8–4 mm wide at anthesis, minutely puberulent along the margins; **corolla** 10–20 mm long, bright yellow, the upper lip hooded or flattened and sub-circular, the lower lip projecting or pendant, saccate; anthers 2–3.7 mm wide. **Fruits** 5–9 mm long, 5–9 mm wide, broadly ovoid with truncated base, glabrous; seeds 0.7–0.9 mm long, ca. 0.3 mm thick, with prominent longitudinal ridges, surface smooth.

Plants of subparamo formations near the highest point along the Interamerican Highway in the western part of the Talamanca range, 3100–3500 m elevation. Flowering in March–August; fruiting in August. This species is known from only four collections in Costa Rica (*Barringer et al.* 2913, *Grayum & Affolter* 8190, *Skutch* 5188, and *Stork* 3048, type of *C. storkii*). The species ranges from Venezuela to central Ecuador in the Andes, with a small disjunct population in Costa Rica.

Calceolaria microbefaria is recognized by its lanceolate leaves, generally glabrous vegetative parts and fruits, bright yellow slipper-shaped corollas, and very limited range in our area. Molau (1988) divides this species into three geographically and morphologically distinct subspecies, with the Costa Rican collections placed in subsp. *microbefaria*. In Costa Rica, this species is easily mistaken for the much more common *C. irazuensis*.

sis; the characteristics used in the key to separate the two species usually allow confident identification.

Calceolaria perfoliata L.f., Suppl. 86. 1781. *Fa-gelia perfoliata* (L.f.) Kuntze, Rev. Gen. Pl. 2: 460. 1891. *C. sciadephora* J. D. Smith, Bot. Gaz. 25: 151. 1898. Figure 6.

Herbs or weak-stemmed subshrubs 0.5–1.5 m high (to 5 m long), often scandent on other plants, leafy stems 1.5–6 mm diam., often with 4 prominent longitudinal ridges, slightly succulent, with slender crooked multicellular hairs 0.3–1 mm long. **Leaves** sessile and perfoliate, opposing leaves united at the base with lateral tissue to 6 mm wide, leaves subtending the inflorescences not perfoliate, petioles broadly winged and blade like, 0.5–6 cm long, 3–12 mm wide and expanded near the stem; **leaf blades** 2–11 cm long (beyond the blade-like petiole), 2–7 cm wide, narrowly triangular or sagittate, apex acute, margins serrate-dentate with larger (2–4 mm) and smaller (1–2 mm) teeth intermixed, base truncated to the winged petiole-like part, drying yellowish brown, often silvery below (in life), upper surface with short (0.2 mm) scattered hairs, lower surface with thin hairs to 1 mm long, 2° veins 5–7/side. **Inflorescences** with 8–12 (4–24) flowers, borne on axillary peduncles 6–15 cm long, 1–1.5 mm diam., terminated by a pair of asymmetric leaves/bracts 2–5 cm long, pedicels 1.5–5 cm long, densely puberulent. **Flowers** with calyx 8–12 mm long, lobes 6–8 mm long, puberulent, broadly ovate, rounded at base, apex obtuse, enlarging slightly in fruit; **corolla** to 22 mm long, bright yellow, upper lip 4–9 mm long, lower lip 15–20 mm long, 8–18 mm wide, anthers U- or C-shaped, 2–4 mm wide; ovary pubescent, style 3–5 mm long. **Fruits** 5–7 mm long, ca. 5 mm diam., ovoid with truncated base, pubescent; seeds 0.5–0.7 mm long, 0.1–0.2 mm wide.

Infrequently collected plants of evergreen montane forest formations, 2700–3300 m elevation (as low as 1800 m in Chiriquí). Flowering and fruiting appear to be restricted to January–February in Costa Rica. This species ranges from the Cordillera de Talamanca and the Chiriquí highlands to southern Ecuador.

Calceolaria perfoliata is distinguished by its perfoliate leaves with broadly winged petioles and distal narrowly triangular or sagittate blades. The anthers are attached at the center and decurved laterally to produce a rounded C-shaped or horse-

shoe-shaped form. The restricted flowering period may account for the relatively few Costa Rican collections. A related species, *C. trilobata* Hem-sley, is native to Mexico–Guatemala and Venezuela–Bolivia but is not known from southern Central America. That species has a more definitely contracted petiole between the distal blade and the expanded perfoliate base, and the anthers are not horseshoe-shaped.

Calceolaria tripartita R. & P., Fl. Peruv. Prodr. 1: 14, tab. 22. 1798. *C. heterophylla* Wild., Enum. Pl. 1: 29. 1809 (non *C. heterophylla* R. & P.). Figure 3.

Herbs, erect or decumbent, 9–90 cm tall, stems 1–4 mm diam., slightly succulent, puberulent with multicellular, often gland-tipped hairs 0.2–0.7 mm long. **Leaves** simple and serrate to deeply pinnatifid, slightly clasping the stem and forming a ridge across the node, petioles 1–5 cm long, 0.5–1.5 mm wide, glandular puberulent; **leaf blades** 1–16 cm long, 0.3–11 cm wide, ovate-lanceolate in smaller leaves to broadly ovate-triangular, larger blades with deep proximal sinuses separating 1–3 pairs of subopposite lobes, apex acute, margin with larger (3–10 mm) and smaller (0.3–3 mm) teeth, base truncated in larger leaves, drying greenish or brown, upper surface with transparent multicellular hairs to 1 mm long. **Inflorescences** of terminal or axillary flowers, 2–4/node (if small distal leaves are interpreted as bracts, the subtending internodes can be interpreted as peduncles of thyrses-like inflorescences), pedicels 4–45 mm long, 0.2–0.4 mm diam., puberulent with simple or glandular hairs 0.2–0.4 mm long. **Flowers** with calyx 5–7 mm long, lobes ca. 4 mm long, with small glandular hairs; **corolla** 10–20 mm long, bright yellow, upper lip 2–5 mm long, lower lip 10–25 mm long, 6–15 mm wide, slipper-shaped, unlobed; anthers 2–5 mm long, one theca sterile, reduced to a nub, connective slender. **Fruits** 6–9 mm long, ovoid, rounded at the apex; seeds 0.6–0.8 mm long, ca. 0.4 mm diam., reddish brown, with longitudinal ridges.

Plants of wet or moist open sites in evergreen montane forest formations, 1000–3200 m elevation. Flowering throughout the year, but with most collections made between October and December. This species ranges from Mexico to Peru.

Calceolaria tripartita is recognized by its highland habitats, glandular viscid pubescence, larger leaves deeply pinnatisect (almost pinnately compound), yellow slipper-shaped corollas, and un-

usual stamens. This species is similar to *C. mexicana* (q.v.), and the two have often been confused, as in the *Flora of Guatemala*. In addition to the differences used in the key, the pedicels of *C. tripartita* usually have more conspicuous gland-tipped hairs.

Capraria Linnaeus

REFERENCES—T. A. Sprague, A revision of the genus *Capraria*. Kew Bull. 1921: 205–212. 1921. C. Niezgodna & S. Tomb, Systematic palynology of the tribe Leucophylleae (Scrophulariaceae) and selected Myoporaceae. Pollen et Spores 17: 497–516. 1975.

Herbs or subshrubs, annual or perennial, branches usually slender and terete, pubescent or glabrous. **Leaves** alternate, sessile or petiolate, blades usually serrate, glandular punctate (viewed by transmitted light). **Inflorescences** of 1–3 axillary flowers borne on slender pedicels at distal nodes (racemose when distal leaves are reduced and bract-like), bracteoles absent beneath the calyx. **Flowers** radially symmetric, calyx united only near the base, sepals 5, equal or subequal, narrow, valvate in bud; **corolla** funnellform or campanulate, white, purple, or greenish yellow, glabrous externally, tube as long as the lobes or slightly shorter, lobes 5, throat sometimes bearded within; stamens 4 or 5, equal or subequal, included, borne proximally or distally within the tube, filaments glabrous, anthers sagittate, basifixed, versatile, introrse, thecae divergent but basal parts confluent; ovary 2-locular, ovules many, style slender, apically flattened with stigmas on the lateral faces. **Fruits** capsules, ellipsoid to ovoid, glandular-punctate, dehiscent loculicidally and secondarily septicial, 4-valved, placenta remaining as a conspicuous column with pitted-reticulate surface; seeds many, small, yellow to brown.

Capraria is a genus of five species ranging from the southern United States to Peru; one species is adventive in West Africa. The narrow alternate leaves, flowers that are radially symmetric, and fruit with persisting reticulated column (placenta) make these plants distinctive. The campanulate five-lobed corolla and five stamens are unusual in the Scrophulariaceae, so that the genus has never been satisfactorily classified within the family. Niezgodna and Tomb (reference above) showed that the pollen of *Capraria* is diorate and more closely related to types found in the My-

oporaceae than to the pollen of other Scrophulariaceae.

Capraria biflora L., Sp. Pl. 628. 1753. *C. biflora* var. *pilosa* Griseb., Fl. Brit. W.I. 427. 1861. *C. biflora* form *hirta* Loes., Bull. Herb. Boissier 2, 3: 284. 1903. Figure 7.

Herbs or **subshrubs**, perennial, erect or climbing, 0.5–2 m tall, distal stems usually few-branched, leafy stems 0.7–5 mm diam., densely puberulent to glabrescent with thin erect whitish hairs 0.2–0.7 mm long. **Leaves** alternate, gradually becoming smaller on distal stems, petioles to 8 mm long but usually not clearly differentiated; **leaf blades** 1.5–11 cm long, 6–30 mm wide, elliptic to elliptic-oblongate or oblongate, apex acute and sharp-tipped, distal half of the margin with sharp-pointed teeth 0.5–3 mm high, 1–6 teeth/cm, gradually narrowed to the cuneate base, drying grayish green, both surfaces with thin white hairs 0.1–0.4 mm long, 2° veins 3 or 4/side, strongly ascending. **Inflorescences** of 2 or 3 flowers in distal leaf axils, pedicels 4–12 mm long, ca. 0.2 mm diam., minutely puberulent, not articulated at the base of the calyx. **Flowers** with calyx 4–6 mm long, sepals 1–1.5 mm wide at the base, narrowly triangular to linear, to 7 mm long in fruit, with short (0.3 mm) thin whitish hairs; **corolla** 7–10 mm long, 4–7 mm wide at the mouth, tubular-campanulate, white, lobes 3–5 mm long, 2.5–3.5 mm wide at base, triangular; filaments attached at the base of the tube, 3–4 mm long, anthers ca. 3 mm long. **Fruits** 4–6 mm long, 2.5–4 mm wide, ovoid-ellipsoid and bisulcate, surface smooth, yellowish brown and punctate; seeds 0.3–0.4 mm long, oblong or angular.

Plants of open sunny sites in lowland situations in both the Caribbean (evergreen) and northern Pacific (deciduous) areas of Costa Rica, 0–500 m elevation (to 1000 m in Nicaragua). Flowering and fruiting throughout the year but collected primarily in July–January. The species ranges from Florida, Mexico, and the West Indies to Argentina; it is found on Cocos Island and has become naturalized in West Africa.

Capraria biflora is recognized by its long slender stems, alternate leaves that are smaller distally, oblongate leaf blades serrate in the distal half, flowering nodes with two or three flowers on slender pedicels, and flowers with narrow sepals and radially symmetric campanulate white corolla. The glandular punctations of the leaves can best be seen by transmitted light. This species is

uncommon in Central America. In Panama it is used to make a tea that may be a dangerous depressant in large quantities (D'Arcy, 1979).

Castilleja Mutis ex Linnaeus filius

REFERENCE—N. H. Holmgren, *Castilleja* (Scrophulariaceae) in Costa Rica and Panama. *Brittonia* 30: 182–194. 1978.

Herbs or subshrubs, annual or perennial, erect, branching mostly from the base, hemiparasitic on roots of hosts, drying dark. **Leaves** alternate, cauline, sessile or the petioles poorly differentiated, leaf blades entire to deeply dissected or pinnately lobed. **Inflorescences** terminal spikes or racemes, spikes usually with flowers hidden by colorful bracts, the racemes often with conspicuous flowers arranged along one side (secund), subtending leaves intergrading with bracts, distal bracts often more conspicuous than the flowers, bracteoles absent at the base of the calyx. **Flowers** bilaterally symmetric, calyx tubular with 4 equal or unequal lobes or united into 2 entire lateral lobes, slightly enlarging in fruit; **corolla** bilaterally symmetric and strongly 2-lipped, greenish yellow to brightly colored, tube usually elongate and narrow, upper (adaxial) lip entire with united lobes hooded and forming a beak-like galea, enclosing the anthers, lower lip slightly 3-saccate, with 3 rudimentary

teeth or petaloid lobes; stamens 4, of 2 unequal pairs, attached near or above the middle of the corolla tube, anther sacs (thecae) unequally placed on the connective, the outer longer and attached near the center, the inner theca smaller and borne on the apex of the connective; ovary 2-locular, ovules many, style slender, stigma capitate or slightly 2-lobed. **Fruits** dry capsules, usually asymmetric, ovate to globose, opening loculicidally; seeds many, with a loose reticulate exotesta.

A genus of ca. 200 species, ranging from North America into higher elevation Central America and the Andes, and with a few northern Asian and European species. These plants are easily recognized because of their colorful inflorescences in which bracts, sepals, and petals may all be variously colored and showy. The calyx tube is somewhat gibbous at the base (abaxially) and often with only two large lateral lobes; the narrow, curved corolla has a beaked upper lip that is usually much longer than the lower lip. In many species all parts become blackish on drying. Many species of *Castilleja* have the reputation of being very variable and difficult to distinguish, making the delimitation of some species quite arbitrary. This problem manifests itself in Costa Rica, where *C. irasuensis*, *C. quirosii*, and *C. talaman-censis* form a closely related complex that deserves further study. Our treatment is based on the publication (1978, cited above) and determinations of Noel Holmgren.

Key to the Species of *Castilleja*

- 1a. Calyx 9–12 mm long, corolla 9–12 mm long; flowers sessile and difficult to see within the densely congested distal portion of the spicate inflorescence; specimens drying pale grayish green to dark gray; 700–2500 m elevation in Costa Rica *C. arvensis*
- 1b. Calyx 13–24 mm long, corolla 18–34 mm long; flowers short- to long-pedicellate and usually easily seen among the bracts; specimens drying grayish to blackish; 1000–3800 m in Costa Rica 2
- 2a. Leaves to 2 cm long and nearly as wide, pinnatifid with narrow (1–2 mm) central rachis and slender filiform (1 mm) pinnate lobes; clefts of the calyx tube more nearly the same (adaxial 4–6.5 mm deep, abaxial 8–12 mm deep); rarely collected, 1100–1600 m *C. tayloriorum*
- 2b. Leaves much longer than wide, usually lanceolate to linear, the pinnatifid lobes short or > 1 mm wide when present; clefts of the calyx tube differing greatly in length (adaxial 1–4 mm deep, abaxial 9–17 mm deep); rare to common, 1400–3500 m 3
- 3a. Leaves lanceolate, mostly 3–6 cm long; upper galeate lip equal to the corolla tube or up to 1.5 times as long; rarely encountered at 1400–1700 m elevation *C. lentii*
- 3b. Leaves mostly linear or pinnatifid, 1–4 cm long; upper galeate lip 2–3 times as long as the corolla tube; not collected from below 1600 m elevation [the following three species are part of a closely related complex] 4
- 4a. Plants usually densely puberulent with stiff slender whitish hairs in most parts, the stems terete or with poorly defined longitudinal ridges, parts drying dark grayish; corolla tube 7–10 mm long; uncommon in Costa Rica, 1600–3500 m *C. quirosii*

- 4b. Plants glabrous to sparsely puberulent with slender whitish hairs, the stems usually with well-defined longitudinal ridges continuous with the leaf bases, parts usually drying black; corolla tubes 7–16 mm long; commonly collected in Costa Rica, 2600–3800 m 5
- 5a. Leaves mostly entire, with short lobes near the apex; calyx red to brownish purple with yellow distal tips; 2600–3800 m in the Cordillera de Talamanca *C. talamancensis*
- 5b. Leaves usually with prominent pinnate lobes in the distal half; calyx reddish throughout; 3000–3700 m on Volcan Irazu, Volcan Turrialba, and rarely collected in the Cordillera de Talamanca ..
..... *C. irasuensis*

Castilleja arvensis Schldl. & Cham., *Linnaea* 5: 103. 1830. *C. communis* Benth. in DC., *Prodr.* 10: 529. 1846. *C. agrestis* Pennell, *Fieldiana*, *Bot.* 28: 519. 1953. Figure 7.

Erect **herbs**, annual, 15–80 cm tall, unbranched or with few lateral branches, leafy stems 0.7–4 mm diam., sparsely to densely hirsutulous with thin whitish hairs 0.2–1.5 mm long, gland-tipped hairs also present. **Leaves** sessile and lacking a clearly defined petiole, gradually smaller distally and intergrading with the floral bracts; **leaf blades** 15–60(–90) mm long, 4–14(–22) mm wide, oblanceolate to narrowly elliptic-obovate or elliptic, apex bluntly acute, margin entire, gradually narrowed to the cuneate base, drying greenish gray or dark gray, with thin hairs 0.2–0.5 mm long on both surfaces, tripliveined. **Inflorescences** 4–15 cm long, 2–3 cm diam., flowers subsessile and densely congested (becoming more distant in fruit), pubescent throughout with villous and glandular hairs, bracts 12–20 mm long, leaf-like to ovate-oblong, often green tipped with red or yellow, enlarging slightly in fruit, pedicels 0–1 mm long. **Flowers** hidden within the bracts, calyx 9–12 mm long, ovate-oblong and slightly curved, viscid-villous, adaxial and abaxial clefts subequal, 3–5 mm deep; **corolla** 9–12 mm long, greenish yellow, usually hidden within the calyx, tube 6–8.5 mm long, galeate upper lip 2.5–5 mm long, lower lip reduced, with 3 lanceolate lobes; ovary glabrous. **Fruits** 6–8 mm long, 3.5–5 mm wide, ovoid-oblong, dark brown, producing many seeds; seeds 0.6–1.2 mm long, 0.2–0.3 mm wide, wedge-shaped to narrowly rectangular with translucent truncated ends.

Weedy plants of moist open sunny sites in evergreen or partly deciduous forest areas, 700–2500 m elevation (to 3000 m in Guatemala). Flowering and fruiting throughout the year, but collected most often in November–March. The species ranges from central and northeastern Mexico to Paraguay; it is adventive in Hispaniola and Hawaii.

Castilleja arvensis is distinguished by its annual growth, alternate grayish leaves (when dried), densely congested spikes in which the corollas are difficult to see, green bracts often reddish at the tips, and the subsessile fruit producing numerous wedge-shaped seeds. The entire, narrowly elliptic leaves give this species a quite different appearance from Costa Rica's other *Castilleja* species. Small (3 mm) fleshy tubercle-like leaves may be present at the base of the stems near ground level. This is a well-defined species and the widest ranging of the genus; it belongs to section *Epichroma*.

Castilleja irasuensis Oersted, *Vidensk. Meddel. Dansk Naturhist. Foren. Kjobenhavn* 1853: 27. 1854. Figure 7.

Herbs or shrubs, 10–50 cm tall, branching mostly from the woody base, lateral branches usually short, leafy stems 1–2 mm diam., mostly glabrous, with longitudinal ridges. **Leaves** sessile, articulated at the base, with fewer lobes distally and becoming bract-like in the inflorescence; **leaf blades** 6–30 mm long, the central portion 1–2.5 mm wide, linear and entire to pinnatifid with 1–3 pairs of lobes 0.5–8 mm long and ca. 0.8 mm wide (the longest pair often also pinnately lobed), apex bluntly acute, margin usually revolute, base with parallel margins to the stem, drying black, minutely papillate puberulent above, with larger (0.1–0.2 mm) hairs beneath, venation obscure.

Inflorescences 3–15 cm long, racemose and 1-sided, rachis hispid-villous, proximal bracts little differentiated from the leaves, distal bracts oblanceolate, ca. 2 cm long, bright red, pedicels 2–6(–11) mm long, ca. 0.3 mm diam., pubescent. **Flowers** with calyx 14–20 mm long, 4–6 mm wide, ovoid-tubular, adaxial cleft 1–4 mm deep, abaxial cleft 9–15 mm deep, lobes rounded and entire, becoming red, puberulent; **corolla** 22–30 mm long, tube 8–12 mm long, galeate upper lip 12–19 mm long, puberulent and green above, red along the mar-

gins; anthers ca. 2 mm long. **Fruits** 7–12 mm long.

Plants of open habitats in high-montane forest and paramo formations, 3000–3700 m elevation. Flowering and fruiting throughout the year. The species is endemic to the eastern volcanoes (Irazú, Turrialba) and the western part of the Cordillera de Talamanca.

Castilleja irasuensis is recognized by its restriction to high-elevation habitats, alternate pinnatifid leaves, and colorful racemes. Plants often differ because they grow on volcanic ash, open disturbed sites, or moist depressions, and the species exhibits considerable variation. More important, the characters used to separate this species from *C. talmanensis* vary greatly within and between populations. Also, the two species may hybridize in the Talamanca Mountains, and it appears that the separation of the two species may be an arbitrary distinction. This problem is worthy of careful study in the field. The name *gallito* has been recorded for this species.

Castilleja lentii N. Holmgren, Brittonia 30: 191. 1978. Figure 7.

Erect **herbs**, 20–60 cm tall, simple or branched, leafy stems 0.7–3 mm diam., with thin whitish hairs to 0.8 mm long or glabrescent, terete and with longitudinal ridges. **Leaves** sessile, often slightly thickened (articulated) at the base; **leaf blades** (1.4–)3–6 cm long, 2–7 mm wide, linear-oblong to narrowly elliptic, apex acute or slightly rounded, distal half of the margin with 1–4 short (0.7–3 mm) pairs of lateral lobes, gradually narrowed to the cuneate base, drying black, mostly glabrous above, with thin whitish hairs beneath, tripliveined from near the base. **Inflorescences** 4–9 cm long, terminal 1-sided racemes, proximal bracts leaf-like and green, distal bracts oblanceolate to obovate and distally reddish, pedicels 3–12 mm long, glabrous or pubescent. **Flowers** with calyx 12–24 mm long, 4–6 mm wide, glabrous, adaxial cleft 2–4 mm deep, abaxial cleft 12–17 mm deep, lobes usually entire, pale green below, yellow or reddish distally; **corolla** 27–33 mm long, tube 11–15 mm long, curved, galeate upper lip 12–18 mm long, 1–2 mm wide, green above and reddish along the sides, lower lip with short (1 mm) teeth. **Fruits** 9–12 mm long, 4–5 mm diam., narrowly obovoid; seeds not seen.

Plants of open sunny wet sites or moist cliff-sides in wet evergreen cloud forest formations,

1400–1700 m elevation. Flowering material has been collected in April, August, and November. The species is only known from near Cachí (Cartago Prov.) and the Río Cascajal (San José Prov.). The species is endemic to the Caribbean slope of central Costa Rica.

Castilleja lentii is recognized by its lower elevation habitat (among our species of *Castilleja*), the alternate oblanceolate leaves with short pinnate distal lobes, glabrous sepals, and long slender upper corolla lip reddish along the lateral margins.

Castilleja quirosii Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1104. 1938. *C. aurantiaca* Pennell, Ann. Missouri Bot. Gard. 27: 338. 1940. *C. chiriquiensis* Pennell, loc. cit. 338. 1940. *C. seibertii* Pennell, loc. cit. 339. 1940. *C. bicolor* Pennell, loc. cit. 340. 1940. Figure 7.

Herbs or subshrubs, 30–90 cm tall, main stems with few to many branches, leafy stems 0.7–3 mm diam., terete or with poorly defined longitudinal ridges, densely hirsutulous with straight or curved hairs 0.2–0.5 mm long. **Leaves** sessile, a petiole not clearly differentiated, slightly thickened at the base (abaxially); **leaf blades** 6–30(–40) mm long, 0.7–3 mm wide (not including the lobes), linear to linear-oblong, rounded at the apex, margin entire or with 1 or 2 pairs of short (1–2 mm) narrow (0.3–0.7 mm) lobes distally, base parallel-cuneate, drying dark grayish green, densely to sparsely pubescent with stiff hairs ca. 0.2 mm long, often scabrous, venation obscure. **Inflorescences** 4–12 cm long, 1-sided racemes, rachis and bracts minutely (0.3 mm) puberulent, bracts ca. 25 mm long, 1–2 mm wide, proximal bracts leaf-like, marked with red or orange, pedicels 2–12 mm long, puberulent (sometimes with gland-tipped hairs). **Flowers** with calyx 17–20 mm long, 3–5 mm wide, minutely puberulent, red to orange or yellowish at the tip, adaxial cleft 1–3 mm deep, abaxial cleft 11–16 mm deep; **corolla** (18–)22–28(–32) mm long, yellow to yellowish green with red margin, tube 7–10 mm long, curved, galeate upper lip 15–23 mm long, ca. 1.5 mm wide, densely puberulent on the dorsal (adaxial) margin; anthers ca. 1.7 mm long. **Fruits** 8–13 mm long, 3–6 mm diam., ovoid-oblong, terminated by the persisting style base.

Plants of open sunny sites or partly shaded sites in evergreen montane and open paramo formations, 1600–3500 m elevation. The species appears to do best in volcanic soils and burnt areas. Flowering and fruiting throughout the year. The

species ranges from Volcan Irazú eastward to the Chiriquí highlands of Panama.

Castilleja quirosii is recognized by its generally dense short pubescence, small alternate linear leaves with few short distal lobes, colorful flowers in one-sided racemes, and unusual corollas. Among our species of *Castilleja*, this species has the widest altitudinal range within Costa Rica, although it is not frequently collected. This species and its close congeners should be studied in the field; it seems possible that *C. quirosii* might be included within a more broadly defined *C. irasuensis*.

Castilleja talamancensis N. Holmgren, Brittonia 30: 187. 1978.

Herbs and shrubs, erect or clambering, 0.1–1.5(–2) m tall, simple or with many distal branches, woody at the base, stems 0.8–3.5 mm diam., glabrous or minutely (0.1 mm) puberulent, with prominent longitudinal ridges. **Leaves** sessile or subsessile, slightly articulated at the base, bract-like at the base of the inflorescence; **leaf blades** 5–18(–25) mm long, 0.5–2 mm wide, linear to linear-oblong, often with short distal lateral lobes 0.5–1.5 mm long, apex rounded, margins entire or with small lobes near the apex, base decurrent on the stem, drying black, glabrous or minutely (0.05 mm) puberulent beneath, venation obscure. **Inflorescences** 2–8 cm long, 1-sided racemes, rachis minutely hispidulous, proximal bracts leaf-like, distal bracts obovate with rounded apex, marked with red, purple, or green, pedicels 2–11 mm long, 0.2–0.4 mm diam., with erect thin hairs 0.1–0.2 mm long. **Flowers** with calyx 14–20 mm long, 3–4 mm diam., adaxial cleft 1–3.5 mm deep, abaxial cleft 9–17 mm deep, rounded at the apices, minutely puberulent along the veins, red to brownish purple with yellow distal margin; **corolla** 20–32 mm long, tube 7–12 mm long, hooded upper lip 13–22 mm long, green above, margins red to orange, lower lip reduced with 3 narrow teeth ca. 1 mm long. **Fruits** 6–9 mm long, 4–5 mm diam., dark brown and smooth; seeds ca. 2 mm long, C-shaped.

Plants of open or partly shaded sites in highmontane forest and paramo formations, 2600–3800 m elevation. Flowering and fruiting throughout the year. The species is endemic to the Cordillera de Talamanca of Costa Rica.

Castilleja talamancensis is recognized by its restriction to higher elevations, narrow linear-oblong leaves that may have three small lobes at the

apex, and the colorful inflorescences. The distal bracts subtending undeveloped flowers are often bright red. Plants in protected sites become large and shrubby, while those on exposed ridges or open sites are small and have few branches. This species is particularly successful along the disturbed margins of the Carretera Interamericana. However, there is so much variation in this species, and within *C. irasuensis* and *C. quirosii* as well, that there is the strong possibility that all three would be better considered a single variable species, with *C. irasuensis* having priority. Careful field work with the living populations should help resolve this problem. The name *flor de Indio* has been used for this species.

Castilleja tayloriorum N. Holmgren, Brittonia 30: 193. 1978.

Slender herbs, annual or short-lived perennials, erect, 25–150 cm high, stems 0.4–1.5 mm diam., glabrous or with few minute (0.1 mm) appressed whitish hairs. **Leaves** sessile or appearing to have winged petioles (to the first lobes), deeply pinnatisect from a narrow (0.7–2 mm) rachis; **leaf blades** 5–20 mm long, 3–14 mm wide, with a slender (petiole-like) proximal half and the distal rachis bearing 2 or 3 pairs of narrow (1–2 mm) lateral lobes, the proximal lobes often with smaller distal lobes, apices rounded, margin entire and revolute, drying dark grayish, glabrous, venation obscure. **Inflorescences** 3–7 cm long, racemes (often 1-sided), lower bracts leaf-like and green, distal bracts shorter and reddish, often deciduous, pedicels 3–8 mm long, ca. 0.4 mm diam., minutely puberulent. **Flowers** with calyx 13–17 mm long, glabrous, adaxial cleft 4–6.5 mm deep, abaxial cleft 8–12 mm deep, major lobes usually rounded and yellowish; **corolla** 22–25 mm long, curved, tube 8–12 mm long, ca. 1 mm diam., curved, galeate upper lip 13–15 mm long, finely puberulent and green dorsally, margins reddish, lower lip short. **Fruits** 7–10 mm long, ca. 4 mm wide, obovoid or oblong with abruptly truncated apex.

Plants of open sites or cliffsides in wet evergreen cloud forest formations, 1100–1600 m elevation. Flowers were collected in August and October, fruiting in October. The species is known from only two collections: *Gómez-Laurito 10180*, from near the highway tunnel at Zurquí, and *J. Taylor & C. Taylor 11901*, from below Bajo La Hondura. Presently the species is only known from the upper Río Zurquí drainage in Braulio

Carrillo National Park on the Caribbean slope of central Costa Rica.

Castilleja tayloriorum is recognized by its lower elevation habitat, small pinnatifid leaves with slender lateral lobes, glabrous calyx, slender curved corolla tube, and long narrow upper lip. *Castilleja tayloriorum* is probably most closely related to species of section *Epichroma* from south-central Mexico.

Cymbalaria Hill

REFERENCES—G. Cufodontis, Die Gattung *Cymbalaria* Hill. Nachtrage und Zusammenfassung. Bot. Not. 1947: 135–156. 1947. D. Sutton, A Revision of the Tribe Antirrhineae. British Museum (Natural History) & Oxford Univ. Press. 1988.

Weak-stemmed **herbs**, creeping or twining, perennials, simple or much-branched. **Leaves** opposite or alternate, simple, long-petiolate, leaf blades reniform to suborbicular, palmately lobed or toothed, venation palmate. **Inflorescences** racemes, cymes, or solitary flowers in leaf axils, pedicels well developed, elongating in fruit, bracteoles absent at the base of the calyx. **Flowers** small, calyx united only at the base, sepals 5, imbricate (valvate) in bud, enlarging slightly in fruit; **corolla** strongly bilabiate, usually blue or purple, tube with a short, backward-pointing abaxial spur at the base, upper lip with 2 lobes, lower lip with 3 lobes and elevated transverse ridge (upper palate) restricting access to the throat; stamens 4, of 2 unequal pairs, included, thecae separate and parallel; ovary 2-locular, ovules many, stigma 2-lobed. **Fruits** dry capsules, opening by 2 pore-like slits, the 2 valves often splitting into 3; seeds ellipsoid or crested, rugulose.

A genus of nine species native to western European and the Mediterranean. It is classified in the tribe Antirrhineae, and its species were once placed in *Linaria*, but they differ in having solitary axillary flowers and leaves with palmate venation. Several species are used in ornamental horticulture as groundcover and in hanging baskets. One adventive species is sometimes found on moist walls in Mexico and Central America.

Cymbalaria muralis P. Gaertn., B. Meyer & J. Sherb., Oekon. Fl. Wetterau 2: 397. 1800. *Antirrhinum cymbalaria* L., Sp. Pl., 612. 1753.

Linaria cymbalaria (L.) Miller, Gard. Dict., ed. 8, #17. 1768.

Herbs with slender creeping or pendent stems, often rooting from the nodes, internodes 0.5–1.0 cm long, 0.5–1.7 mm diam., glabrous. **Leaves** mostly alternate, glabrous, petioles 10–45 mm long, 0.3–0.5 mm diam.; **leaf blades** 10–35 mm long, 9–40 mm wide, orbicular-oblate to reniform in outline, apex obtuse to rounded with apiculate tip, margins entire with usually 5 (3, 7) rounded lobes separated by short narrow sinuses, base subcordate to deeply cordate, drying dark greenish or grayish, with usually 3 major veins. **Inflorescences** of solitary axillary flowers, pedicels 12–40 mm long, 0.4–0.7 mm diam., glabrous, elongating to 6 cm and negatively phototropic after anthesis. **Flowers** glabrous externally, sepals 0.8–1.5 mm long, 0.5–0.8 mm wide, lanceolate to narrowly oblong, elongating to 2.5 mm long in fruit; **corolla** 7–9 mm long, lilac or pale violet to blue with yellow interior, tube 3.5–4 mm long (including the spur to 2 mm long), lower lip ca. 3 mm long. **Fruits** 2.7–4 mm long, 3–4 mm wide, globose or rounded-oblong, thin-walled.

Cymbalaria muralis, as its Latin epithet implies, is usually found on damp shaded walls. A native of Europe, this species has only been collected in San José and Tres Ríos (1100–1300 m) in Costa Rica. The slender stems, small thin-textured five-lobed cordate leaves, and solitary flowers with strongly bilabiate bluish corolla and backward-oriented spur make these plants quite distinctive. In addition, the pedicels are negatively phototropic after anthesis, moving the capsules into dark corners as they elongate. They are sometimes planted as cover plants in gardens and are called Kenilworth ivy, Coliseum ivy, and pennywort.

Darcya Turner & Cowan

REFERENCE—B. Turner & C. Cowan, *Darcya* (Scrophulariaceae), a new genus from Central and South America. Phytologia 74: 267–270. 1993.

Herbs or weak-stemmed subshrubs to 1 m tall, annual or perennial, glabrous or puberulent, drying greenish to dark brown. **Leaves** opposite, simple, petiolate, blades with serrulate margins, venation pinnate or subpalmate with 3–5 major veins from near the base. **Inflorescences** terminal racemes with 2 flowers/node separated by well-

developed internodes (flowers solitary in axils of distal leaves or bracts), pedicels slender, bracteoles absent at the base of the calyx. **Flowers** with calyx deeply 5-parted, calyx lobes equal or subequal, valvate in bud, enlarging slightly in fruit; **corolla** tubular and strongly 2-lipped (bilaterally symmetric), white to blue or purple, tube shorter than the lips, lower (abaxial) lip 3-lobed and larger, upper (adaxial) lip 2-lobed; stamens 4, subequal or unequal, filaments borne at 2 levels on the corolla tube, anthers with straight white hairs on dorsal side; ovary ovoid, style short. **Fruits** thin-walled capsules, dehiscence loculicidal and sep-

tidal producing 4 valves (or irregular); seeds small, oblong to trapezoidal, testa reticulate.

Darcya is a genus of three narrowly endemic species, restricted (respectively) to Costa Rica, Panama, and Colombia. These plants resemble species of *Stemodia* but differ in having pubescent anthers, very short styles, more clearly racemose inflorescences, three or five prominent veins from the base of the blade, and oblong trapezoidal seeds. The decurrent leaf bases merge with the longitudinal ridges (angles) of the stem in a distinctive manner. This genus also resembles the Asiatic genus *Linnophila*, which has become an invasive weed in some areas.

Key to the Species of *Darcya*

- 1a. Calyx and pedicels glabrous; leaf blades 15–45 mm long, ovate-triangular to ovate-elliptic; stamens 4, subequal; plants of the wet Caribbean slope in central Costa Rica *D. costaricensis*
- 1b. Calyx and pedicels puberulent; leaf blades 17–60 mm long, ovate-lanceolate; stamens 4 in 2 unequal pairs; collected in the area of Boquete, Chiriquí, Panama *D. reliquiarum*

Darcya costaricensis (B. L. Turner) B. L. Turner, *Phytologia* 74: 268. 1993. *Stemodia costaricensis* B. L. Turner, *Phytologia* 73: 253. 1992. Figure 3.

Erect or sprawling **herbs** to 1 m tall with many internodes 3–6 cm long, leafy stems 0.7–2.5 mm diam., glabrous, terete but with 4 longitudinal ridges, nodes without an interpetiolar ridge. **Leaves** opposite, petioles 2–10 mm long, 0.4–1.2 mm wide, lateral margins decurrent on the stem and continuous with the stem ridges; **leaf blades** 15–45 mm long, 10–25 mm wide, ovate-triangular to ovate-elliptic, apex acute, margin with 4–6 teeth/cm, often revolute (dried), base obtuse to truncate, minutely punctate, glabrous or with few minute (0.1 mm) hairs beneath, subpalmate with 3 prominent basal veins, 2° veins 2 or 3/side. **Inflorescences** 5–10 cm long, glabrous racemes, basal flower pair subtended by reduced leaves (12–16 mm long), distal flowers subtended by sessile lanceolate or linear bracts 2–6 mm long, pedicels 6–16 mm long, glabrous. **Flowers** glabrous externally, calyx lobes 2.5–3 mm long, to 4 mm in fruit, 0.3–0.5 mm wide, narrowly oblong, apex truncated and thickened, with 3 prominent parallel veins; **corolla** 4–7 mm long, blue or purple, tube 3–4 mm long, puberulent internally near the mouth, central lobe of lower lip 3–6 mm long; stamens 4, subequal, anthers similar; stigma in-

cluded. **Fruits** 3–4 mm long, 1.5–2 mm wide, narrowly ovate to oblong, persisting style 0.4–0.8 mm long; seeds 0.5–0.7 mm long, yellowish brown, reticulate with longitudinal ridges separated by rounded pits.

Plants of open sites and along stream edges in very wet lower montane forest formations of the Caribbean slope, 1400–1600 m elevation. Flowering and fruiting throughout the year. This species is known only from along the upper Río Grande de Orosí, Tapantí Refuge, Cartago Province, central Costa Rica.

Darcya costaricensis is recognized by its weak-stemmed herbaceous habit, opposite leaves with broad serrulate blades, racemose inflorescences, narrow calyx lobes, two-lipped blue or purple corollas with short tube, and restricted geographical range. This material had earlier been placed in *Stemodia reliquiarum* (see the following species).

Darcya reliquiarum (D'Arcy) B. L. Turner & C. C. Cowan, *Phytologia* 74: 269. 1993. *Stemodia reliquiarum* D'Arcy, *Ann. Missouri Bot. Gard.* 66: 258. 1979.

Herbs with sprawling stems to 40 cm tall, leafy stems 0.7–3 mm diam., with 2 prominent ridges, glabrous except near the nodes with erect 5-celled hairs, glabrescent, drying brown. **Leaves** opposite, petioles 0–4(–8) mm long, with narrow lat-

eral margins decurrent on the stem and poorly differentiated from the blade; **leaf blades** 1.7–6 cm long, 10–26 mm wide, ovate-lanceolate to narrowly ovate, apex acute, margins serrulate distally with 10–15 teeth/side, base obtuse or truncate, punctate on both surfaces, glabrous, subpalmate with 3 major veins from the base, midvein with 2 or 3 lateral veins/side. **Inflorescences** terminal open racemes, rachis 0.5–0.8 mm diam., bracts leaf-like to scale-like, mostly linear (ca. 3 × 1 mm), ciliolate along the edge with multicellular gland-tipped hairs 0.1–0.3 mm long, pedicels 4–12 mm long, puberulent. **Flowers** small, calyx lobes 2–4 mm long, ca. 0.5 mm wide, minutely puberulent externally, with 3 longitudinal veins, drying brown; **corolla** 4–6 mm long, salverform, blue to lavender or purple, tube 3–4 mm long, slightly exceeding the calyx, subglabrous externally, lobes 2–3 mm long, subequal, minutely puberulent at the base within; stamens 4, the lower 2 filaments ca. 0.5 mm long and with reduced thecae, the upper filaments 0.7–1 mm long, inserted near the middle of the tube, one theca sessile on the connective with the other on a stipe-like arm of the connective; ovary conical, style 0.5 mm long, stigma club-like. **Fruits** 4–5 mm long, 2.4–3 mm wide, dehiscent apically into 4 valves, placenta broad, unwinged; seeds many, 0.4–0.6 mm long, oblong to trapezoidal, longitudinally reticulate, dark brown.

Plants of evergreen montane cloud forests around Boquete, 1500–2500 m elevation. Probably flowering throughout the year. Endemic to the Chiriquí highlands of western Panama.

Darcya reliquiarum is recognized by its herbaceous sprawling habit, opposite serrulate leaves with subpalmate venation, racemose puberulent inflorescences, narrow calyx lobes, strongly 2-lipped blue or purple corolla, pubescent anthers, and restricted geographical range.

Digitalis Linnaeus

REFERENCE—K. Werner, Zur Nomenclature und Taxonomie von *Digitalis* L. Bot. Jahrb. Syst. 79: 218–254. 1960.

Erect **herbs** or rarely shrubs, biennial or perennial, stems simple or branched from the base. **Leaves** alternate, sessile or petiolate, entire to dentate, pinnately veined, drying greenish or grayish. **Inflorescences** terminal racemes, the flowers often aligned along one side, bracts sub-

tending the pedicels, lacking bracteoles at the base of the calyx. **Flowers** large and colorful, calyx with 5 sepals united only near the base, imbricate in bud, enlarging slightly in fruit; **corolla** tubular to campanulate, longer than the calyx, purple to yellow or white, bilaterally symmetric with the lower lip slightly longer than the upper, upper lip entire or 2-cleft, lower lip 3-lobed, lateral lobes exterior in bud; stamens 4 in 2 similar pairs, included within the tube, anthers with 2 divergent thecae; ovary 2-locular, ovules many, style simple, stigma 2-lobed. **Fruits** dry capsules, dehiscent septically; seeds many, minute, rugulose.

Digitalis is a genus of about 20 species ranging from western Europe into central Asia. They are classified in the subtribe Digitalieae of the tribe Veroniceae and are distinguished by their erect habit, one-sided racemes, and large tubular corollas. The common foxglove is found in gardens and as an escape in the cooler highlands of Central America.

Digitalis purpurea L., Sp. Pl. 621. 1753. Figure 8.

Stout **herbs**, 0.5–1.8 m tall, biennial, leafy stems 2–8 mm diam., minutely puberulent with thin hairs 0.1–0.3 mm long. **Leaves** becoming progressively shorter from base to inflorescence, petioles 1–11 cm long but not well differentiated from the blade, 2–12 mm wide with winged margins; **leaf blades** 2.5–20 cm long, 1–8 cm wide, narrowly elliptic to ovate-elliptic or elliptic-obovate, apex acute to obtuse, margin serrate with 5–10 teeth/cm, gradually narrowed to the cuneate base, minutely puberulent on both surfaces, 2° veins 3–5/side, strongly ascending. **Inflorescences** 15–40 cm long, flowers mostly along 1 side, bracts 8–18 mm long, lanceolate, sessile, pedicels 5–10 mm long, 0.4–0.7 mm diam., puberulent. **Flowers** with calyx 8–16 mm long, sepals separate to the base, 4–7 mm wide, broadly ovate to ovate-oblong, ciliolate along the edge; **corolla** 20–50 mm long, tube 1.3–2 cm wide, tubular-campanulate, pink to purple (white), lower lip extending 3–8 mm beyond the upper lip, usually with dark spots within the throat; thecae divergent and equal, ca. 3 mm long. **Fruits** 9–11 mm long, 9–10 mm diam., ovoid with broadly truncated base, minutely puberulent; seeds 0.4–0.7 mm long, narrowly rectangular.

Digitalis purpurea, native to Europe, occurs as a garden plant and in small naturalized populations in high-montane areas, 1800–3300 m elevation. This species is distinctive, with its alter-

nate leaves gradually narrowed into the long petiole, conspicuous (often one-sided) racemes of large colorful flowers, and the open corolla tubes marked with dark spots within. Many varieties are used in ornamental horticulture. The plants are poisonous to livestock and contain a number of potent compounds. This species is the principal source of digitalin, an important drug in treating some kinds of heart ailments. Common names are *digital*, *manga de la Señora*, and foxglove.

Escobedia Ruiz & Pavón

REFERENCES—F. Pennell, *Escobedia*, a Neotropical genus of Scrophulariaceae. Proc. Acad. Nat. Sci. Philadelphia 83: 411–426. 1931. J. Thieret, The Scrophulariaceae—Buchnereae of Central America. Ceiba 8: 92–101. 1961.

Perennial **herbs**, stems simple or branched, glabrous or puberulent, striate or angled, roots yellow to orange. **Leaves** opposite, sessile or subsessile, base cuneate to clasping, coriaceous, entire to serrulate, venation pinnate to subpalmate, often scabrous. **Inflorescences** racemose or with solitary flowers in axils of distal leaves, pedicels (peduncles) with 2 bracteoles distally or lacking bracteoles. **Flowers** large, calyx tubular to funnelform, with 5–10 longitudinal veins, lobes 3–6, shorter than the tube, triangulate to rounded; **corolla** salverform with a long slender tube, usually white, externally glabrous or puberulent, lobes 5, small to large, equal and rounded; stamens 4, subequal, inserted in the middle of the tube, filaments ciliate or glabrous, anthers glabrous and aristate; ovary 2-locular, ovules many, style elongate, stigmas linear on the side of the style apex. **Fruits** dry capsules, ellipsoid, hard, included within the persisting calyx; seeds many, narrowly conical to linear-oblong, surface reticulate.

Escobedia is a genus of six to eight species ranging from Mexico to Bolivia and Brazil. The genus is classified in the tribe Buchnereae, subtribe Melasmineae. These plants are distinctive among Neotropical Scrophulariaceae because of their large salverform white corollas with long narrow tubes. The roots have been used by indigenous peoples as a source of a yellow dye for food coloring. Three species are found in northern Central America (Standley & Williams, 1973), but only one of these has been found in Costa Rica. *Escobedia laevis* Schldl. & Cham. (with long linear leaves and calyx 4–7 cm long with narrow

calyx lobes) ranges from southern Mexico to central Nicaragua.

Escobedia grandiflora (L.f.) O. Kuntze, Rev. Gen. Pl. 3: 231. 1893. *Buchnera grandiflora* L.f., Suppl. Pl. 287. 1781. *E. scabrifolia* Ruiz & Pavón, Syst. Veg. Peruv. Chil. 159. 1798. *Micalia grandiflora* (L.f.) Raf., Fl. Tell. 2: 104. 1837. *E. curialis* Pennell, Proc. Acad. Nat. Sci. Philadelphia 83: 417. 1931. *E. longiflora* Pennell, loc. cit. 423. 1931. *E. reticulata* Pennell, loc. cit. 420. 1931. Figure 6.

Erect perennial **herbs**, 0.6–1.5(–2) m tall, leafy stems 1.5–7 mm diam., with stiff whitish hairs 0.1–0.3 mm long, smooth or scabrous, roots bright yellow-orange. **Leaves** opposite or subopposite, gradually becoming smaller distally, subsessile with petioles 1–4 mm long, ca. 2 mm wide; **leaf blades** 5–12 cm long, 1.5–3 cm wide, lanceolate to narrowly triangular or ovate-elliptic, apex acute, margin serrate with 1–3 teeth/cm, base rounded and truncate to auriculate, drying pale to dark gray and coriaceous, scabrous above and below with short (0.1–0.2 mm) hairs, tripliveined from the base or palmately 5-veined. **Inflorescences** of solitary flowers (2/node) in axils of smaller distal leaves (or the inflorescences racemose if the smaller leaves are interpreted as bracts), pedicels 11–35 mm long, 0.7–2 mm diam., slightly curved, often with linear bracteoles to 4 mm long in the upper third. **Flowers** with calyx 34–44 mm long, 6–10 mm diam., scabrous, lobes 2–5 mm long, triangular; **corolla** 7–12 cm long, 6–8 cm wide at the mouth, salverform with a long narrow tube to 10 cm long, 3–8 mm diam., lobes 1–3 cm long and broadly rounded, white, minutely puberulent; stamens inserted on the middle of the tube; ovary glabrous, style 5–8 cm long. **Fruits** 20–28 mm long, ca. 10 mm wide, smooth; seeds 3–4 mm long, 0.3–0.5 mm wide, linear-rectangular, translucent except for the center.

Uncommon plants of open sites, in marshy or wet situations of lower montane evergreen forest formations, 1000–1500 m elevation. Collected in flower in July–February. The species ranges from Mexico to Brazil.

Escobedia grandiflora is recognized by its opposite scabrous coriaceous subsessile leaves with three (five) major veins, distal nodes with two large opposite flowers, and large white corollas with long narrow tubes and widely flaring limb. The color, form, and size of the corolla suggest nocturnal pollination by hawkmoths. *Escobedia*

reticulata (from near Canas Gordas, Pittier 11118 holotype US) was distinguished by Pennell and Thieret on the basis of a pustulate calyx and the size and position of the bracteoles. This is most likely a local variation and not deserving of species rank (D'Arcy, 1979, p. 220).

Gerardia species are now placed in *Agalinis* (q.v.).

Gibsoniothamnus is now placed in the Schlegeliaceae.

Hemichaena Bentham

REFERENCE—J. Thieret, Synopsis of *Hemichaena*, including *Berendtiella* (Scrophulariaceae). Fieldiana, Bot. 34: 89–99. 1972.

Herbs or shrubs, simple or branched, glabrous or viscid-pubescent, drying brownish. **Leaves** opposite or fasciculate, sessile or subsessile, margins dentate, surface often rugose, venation pinnate. **Inflorescences** axillary, of solitary flowers or 1 or 2 cymes/axil, usually pedunculate with bracts subtending the well-developed pedicels, bracteoles absent at the base of the calyx. **Flowers** showy, calyx campanulate to tubular, with 5 prominent longitudinal costae, 5-lobed or 5-toothed, lobes unequal, shorter than the tube; **corolla** funnelliform to tubular-campanulate, 2-lipped, bright yellow to orange or red, tube exceeding the calyx, lobes equal to or shorter than the tube, upper lip 2-lobed or emarginate, lower lip 3-lobed; stamens 4, subequal or of 2 unequal pairs, included or exserted, inserted at the middle or on the lower half of the tube, anthers 2-theous, parallel but becoming divergent, staminode absent; ovary 2-locular, placentas bilamellate, ovules many, style slender, with 2 flattened stigmatic areas or lobes at the apex. **Fruits** dry capsules, ovoid to oblong, loculicidally dehiscent and secondarily septicidal; seeds very many, minute, linear-oblong to fusiform, testa reticulate with thin translucent walls.

A genus of five species, ranging from northern Mexico to the Talamanca mountains of Costa Rica. *Hemichaena* is classified in the tribe Dodartieae, with *Mimulus*, *Mazus*, *Leucocarpus*, and *Berendtiella*. The genus was monotypic, but Thieret (1972, cited above) broadened the concept to include the four species of *Berendtiella*. Generic delimitations within the tribe are problematic. If characters of the fruit are emphasized, then

Hemichaena and *Berendtiella* appear closely related, but *Hemichaena* can be distinguished by its amplified corolla tube, included stamens that are attached near the base of the corolla, and cordate-amplexicaul leaves. The generic classification of the tribe Dodartieae will remain obscure until *Mimulus* is revised and the classification of the entire group is compared. Only the following disjunct species is found south of northern Nicaragua.

Hemichaena fruticosa Benth., Pl. Hartw. 78. 1841. *Leucocarpus fruticosus* (Benth.) Benth. in DC., Prodr. 10: 336. 1846.

Herbs or shrubs to 2 m tall, distal stems with few or no lateral branches, leafy stems 2–11 mm diam., terete or slightly quadrangular, densely pubescent with gland-tipped hairs 0.5–1.3 mm long. **Leaves** opposite, sessile, of similar size along the stems, equal or subequal at the node; **leaf blades** 5–17 cm long, 2–5 cm wide, lanceolate to narrowly elliptic-lanceolate or oblanceolate, apex acute or acuminate, margin serrate with 3–6 small or prominent teeth/cm, base rounded and auriculate to cordate-amplexicaul, drying dark above and paler beneath, minutely glandular puberulent with hairs 0.2–0.6 mm long, 2° veins 4–9/side. **Inflorescences** 3–8 cm long, usually of 1 or 2 axillary cymes (1–4/node), peduncles 10–28 mm long, bracts 6–22 mm long, 1–5 mm wide, lanceolate, viscid puberulent with hairs ca. 0.5 mm long, pedicels 5–18 mm long. **Flowers** with calyx 11–16 mm long, 4–6 mm diam., densely puberulent with gland-tipped hairs, lobes 3–8 mm long, narrowly triangular and acute; **corolla** 25–45 mm long, 14–28 mm wide at the mouth, tubular-campanulate, tube 6–11 mm wide at the mouth, minutely puberulent externally, lobes 5–9 mm long; stamens subequal, inserted in the lower ¼ of the tube, filaments 12–15 mm long, glabrous, anthers 3.3–3.8 mm long; style 15 mm long, stigmas flattened. **Fruits** 13–17 mm long, 4–6 mm diam., oblong, becoming brown; seeds 0.6–1 mm long, 0.3–0.4 mm wide, narrowed at each end.

Plants of open moist to wet sunny sites along streams, on steep slopes, and in disturbed sites in montane evergreen forest formations, 1600–3100 m elevation. Probably flowering and fruiting throughout the year, but collected most often in December–March. The species is found in southern Mexico and Guatemala and in the western portion of the Cordillera de Talamanca.

Hemichaena fruticosa is recognized by its stout viscid puberulent stems, sessile opposite serrate

leaves, axillary cymes, bright yellow corollas that are only slightly bilabiate, and its restricted geographical range (in Costa Rica). It is surprising that this species, which is so common in the western half of the Cordillera de Talamanca, has not been collected elsewhere in Costa Rica. D'Arcy (1979) placed this species in synonymy under *Leucocarpus perfoliatus* (H.B.K.) Benth., but that species has smaller flowers, smaller leaves, and baccate white fruits.

Lamourouxia Kunth in H.B.K.
Nomen conservandum

REFERENCE—W. Ernst, Floral morphology and systematics of *Lamourouxia* (Scrophulariaceae: Rhinanthoideae). *Smithson. Contrib. Bot.* 6: 1–63. 1972.

Perennial **herbs** or subshrubs, usually woody at the base, stems erect or scandent, distal stems often few-branched and arched, glabrous or pubescent, gland-tipped hairs often present, probably hemiparasitic on roots. **Leaves** opposite (verticillate), sessile or short-petiolate, often smaller and bract-like distally, blades serrate to deeply dissected, drying brownish or black, pubescent with simple, branched, or gland-tipped hairs. **Inflorescences** of solitary flowers in distal leaf axils (1 or 2/node) or appearing racemose (paniculate or corymb-like) when distal leaves are bract-like, pedicels ebracteolate at the apex. **Flowers** large and showy, calyx tubular-campanulate, 4-lobed, lobes subequal or of 2 unequal pairs (rarely cleft to

base), obtuse to deltoid or linear, with 10 prominent longitudinal veins; **corolla** tubular and bilabiate, red to orange or white, usually puberulent on the exterior, upper lip often erect (rarely hood-like), entire or bilobed, lower lip usually shorter, narrow, 3-lobed, biplicate within below the apex; **stamens** 4 in 2 subequal pairs or with 2 fertile stamens and 2 staminodes, attached near base of corolla tube, filaments swollen and puberulent at the base, included in the upper lip, fertile anthers basifixed and pilose; ovary 2-locular, ovules many, stigma terminal, exerted and 2-lipped. **Fruits** dry capsules, ovoid to ellipsoid with persisting style-base, opening loculicidally into 2 entire valves; seeds many, ellipsoid to oblong, minutely bullate to reticulate.

Lamourouxia is a genus of ca. 24 species found in Neotropical highlands from Mexico to Peru. The center of species richness is in Mexico, with only three species found in southern Central America and two species in the Andes. Although a very distinctive genus, the individual species can be difficult to separate from each other. In Costa Rica the plants are restricted in distribution and not often collected. The large showy flowers with bright red or orange narrowly tubular corollas, spicate or racemose inflorescences, four-lobed calyx, subsessile leaves, and preference for open habitats at mid-elevations help distinguish this genus. Our species belong to section *Hemispadon*, according to Ernst's fine monograph (1972, cited above). *Lamourouxia* is in the subfamily Rhinanthoideae. Every member of this subfamily that has been tested is hemiparasitic, perhaps explaining why these lovely plants are not seen in gardens.

Key to the Species of *Lamourouxia*

- 1a. Calyx glabrous; young stems glabrous except for longitudinal lines of minute hairs; leaves linear-lanceolate; 1600–2800 m elevation *L. lanceolata*
- 1b. Calyx puberulent externally; young stems pubescent; leaves narrowly elliptic to ovate-triangular; 900–1800 m elevation 2
- 2a. Stems and flowers with simple (non-gland-tipped) hairs, leaves 7–24 mm long; flowering mostly November–February *L. gutierrezii*
- 2b. Stems and flowers with gland-tipped hairs; leaves 10–110 mm long; flowering in July–December *L. viscosa*

Lamourouxia gutierrezii Oerst. in Benth. & Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjobenhavn 1853: 29. 1853. *L. scabra* Seemann, Bot. Voy. Herald 177: pl. 33. 1854. Figure 5.

Herbs or subshrubs, 0.5–1.3(–2) m tall, distal branches arched and often with short lateral branching, leafy stems 1–4 mm diam., sparsely to densely puberulent with thin straight or retrorse hairs 0.2–0.5 mm long. **Leaves** opposite (verticillate), sessile or subsessile with poorly differentiated petioles to 2 mm long; **leaf blades** 7–24 mm long, 2–10 mm wide, elliptic to elliptic-oblong or ovate-elliptic, apex obtuse or rounded, margin with 4–6 rounded teeth/cm, base cuneate, drying dark grayish green, slightly scabrous above and below with short stiff hairs ca. 0.2 mm long, 2° veins 3–5/side. **Inflorescences** 5–20 cm long, spicate or racemose, bracts 8–12 mm long, 5–6 mm wide, leaf-like and lanceolate to ovate, sometimes caducous and the flowers appearing ebracteate, pedicels 2–5 mm long, ca. 0.7 mm diam., puberulent. **Flowers** with calyx 6–9 mm long, enlarging to 12 mm in fruit, 2–4 mm diam., cupulate, 5-lobed, lobes 2–4 mm long, triangular to lanceolate; **corolla** 30–44 mm long, 4–6 mm diam., tubular, bright red to orange-red, densely puberulent externally, upper lip ca. 14 mm long; functional stamens 2, anthers connivent and positioned against the upper lobe, 3–4 mm long with hairs 1–2 mm long; ovary glabrous, style 2–4 cm long. **Fruits** 8–13 mm long, 4–8 mm diam., ovoid, short-beaked, dark and smooth; seeds 0.8–1 mm long, 0.3–0.4 mm thick.

Infrequently collected plants of open sites in lower montane evergreen forest formations, 900–1900 m elevation. Probably flowering throughout the year, with most collections made in November–February and June–July. The species ranges from the western part of the Meseta Central in Costa Rica to the Chiriquí highlands in Panama.

Lamourouxia gutierrezii is recognized by its smaller narrow scabrous leaves, simple pubescence, and puberulent calyx. The structure and position of the staminodes suggest that they may function as a barrier to keep visiting insects from the ovary. This is the only species of the genus endemic to southern Central America.

Lamourouxia lanceolata Benth. in DC., Prodr. 10: 542. 1846. *L. longiflora* var. *lanceolata* (Benth.) L. O. Williams, Fieldiana, Bot. 34: 121. 1972. Figure 5.

Herbs or subshrubs to 1.5(–3) m tall, erect or scandent, stems often arching and with multiple branching, leafy stems 1–3 mm diam., with minute (0.2 mm) crooked hairs in 2 opposing longitudinal lines along the stems. **Leaves** sessile or subsessile with poorly defined petioles to 2 mm long, not conspicuously smaller distally; **leaf blades** 11–48(–57) mm long, 2–8(–14) mm wide, narrowly lanceolate to narrowly linear-lanceolate or narrowly elliptic-oblong, apex acute, margin with 4–6 teeth/cm, base narrowly cuneate, drying brownish to blackish, glabrous or with minute (0.1 mm) papillate-puberulent hairs on the midvein above, 2° veins 4–7/side. **Inflorescences** 3–15 cm long or of flowers axillary to distal leaves, flowers subtended by leaves very similar to those lower on the stems, pedicels 3–9(–14) mm long, 0.4–0.8 mm diam., glabrous or with a line of hairs along one side. **Flowers** with calyx 7–18 mm long, 3–5 mm diam., glabrous externally, veins elevated, lobes 6–15 mm long and becoming reflexed; **corolla** 25–47 mm long, 4–7 mm diam., tubular, bright red to red-orange, densely puberulent externally, upper lip 14–18 mm long; stamens 2, with larger pubescent anthers often coherent, staminodes 2, borne above the fertile stamens, thickened at the apex. **Fruits** 8–14 mm long, 5–8 mm diam., ovoid-rounded, beaks 1–2 mm long; seeds 1–1.3 mm long, oblong to wedge shaped, surface reticulate.

Infrequently collected plants of open sites in evergreen montane forest formations, 1600–2800(–3200) m elevations. Flowering in December–March. In Costa Rica this species is known only from the western portion of the Cordillera de Talamanca. The species ranges from central Mexico to Costa Rica.

Lamourouxia lanceolata is recognized by its narrow opposite leaves, glabrous calyx with reflexed lobes, narrow bright red corolla tubes, androecium of two stamens with pubescent anthers and two staminodes, and higher elevation habitats. This species has been confused with *L. longiflora* Benth. (Williams, 1972; Standley & Williams, 1973), but *L. longiflora* has four fertile stamens and the calyx is puberulent on the exterior.

Lamourouxia viscosa Kunth in H.B.K., Nov. Gen. Sp. 2 ed., folio 272. 1817; ed. quarto 338. 1818. *L. vejizensis* Oerst. in Benth. & Oerst., Vidensk. Meddel. Dansk. Naturhist. Foren. Kjobenhavn 1853: 28. 1853.

Erect perennial **herbs** 0.5–1.3(–3) m tall, leafy stems 1.5–7 mm diam., terete, densely puberulent with gland-tipped hairs 0.2–0.7 mm long. **Leaves** gradually diminishing in size distally, sessile or subsessile with petioles ca. 1 mm long, appearing amplexicaul; **leaf blades** 1–7(–11) cm long, 6–28(–53) mm wide, ovate-triangular to narrowly triangular-oblong, apex acute, margin serrate with 2–6 teeth/cm, base truncate to cordate-auriculate and amplexicaul, drying dark grayish to dark brown and coriaceous, with short (0.3 mm) hairs above and more densely puberulent beneath, 2° veins 3–7/side. **Inflorescences** 10–20 cm long, racemes or spicate, glandular puberulent, flowers crowded or separated by internodes to 12 mm long, **bracts** 5–16 mm long, 3–11 mm wide at the base, ovate to lanceolate, sessile, **pedicels** 1–3(–6) mm long. **Flowers** glandular-puberulent externally, calyx 4–8 mm long, 3–5 mm diam., lobes 2–4 mm long, triangular and acute; **corolla** 14–38(–60) mm long, 3.5–6(–10) mm diam., tubular, dark red to red-orange (pink or purple), upper lip 6–12 mm long, lower lobes ca. 2 mm long; functional stamens 2; thecae glabrous. **Fruits** 6–12 mm long, 4–7 mm diam., ovoid, dark; seeds 0.8–1.2 mm long, 0.4–0.6 mm thick, wedge shaped, with a deeply reticulated surface.

Plants of open sites in lower montane evergreen or partly deciduous formations, 1000–1800 m elevation (500–2800 m in Mexico). Flowering primarily in July–December in Costa Rica (flowering and fruiting throughout the year in Nicaragua). In Costa Rica this species has been collected only at the eastern and western edges of the Meseta Central and in the region between Paraiso and Orosí. This species ranges from northern Mexico to Panama.

Lamourouxia viscosa is recognized by its minute gland-tipped hairs on stems and flowers, stiff sessile opposite leaves that often surround the stem at their cordate bases, and lower montane habitats. This species is most closely related to the Mexican species *L. smithii* Pringle and *L. rhinanthifolia* Kunth in H.B.K. Costa Rican collections of *L. viscosa* do not possess leaves and flowers as large as some found in Mexico.

Leucocarpus D. Don in Sweet

Herbs, stems erect, quadrangular in cross-section and often with 4 longitudinal wings, glabrous or sparsely puberulent. **Leaves** opposite, sessile, narrow and serrulate, cordate-amplexicaul at the

base, venation pinnate, drying yellowish brown. **Inflorescences** cymose, solitary in distal leaf axils, peduncles with bracteoles subtending the pedicels or secondary inflorescence branches, bracteoles absent at the base of the calyx. **Flowers** with cupulate thin-walled calyx, 5-veined, persisting in fruit, calyx lobes narrow and tooth-like; **corolla** tubular or tubular-campanulate, somewhat bilaterally symmetrical with subequal upper and lower lips, glabrous externally, upper lip exterior in bud, 2-lobed, lower lip 3-lobed, puberulent at the mouth within; stamens 4 in 2 unequal pairs (or with only 2 fertile stamens), anthers with 2 slightly diverging thecae, staminodes rarely present; ovary conical, 2-locular, ovules many, style thickened at the apex, stigma 2-lobed. **Fruits** fleshy indehiscent berries, white, pericarp thin, style base forming a small beak; seeds immersed in pulp, minutely reticulate.

Leucocarpus is a monotypic genus, ranging from Mexico to Bolivia. It is included in the tribe Dodartieae, with *Hemichaena*, *Minulus*, and *Mazus*. At one time, Bentham included *Hemichaena* in *Leucocarpus*, but the genera are now considered distinct.

Leucocarpus perfoliatus (Kunth in H.B.K.)

Benth. in DC., Prodr. 10: 335. 1846. *Minulus perfoliatus* Kunth in H.B.K., Nov. Gen. Sp. 2: 371. 1817. *Conobea alata* Graham, Edinburgh New. Philos. J. 10: 168. 1830. *L. alatus* (Graham) D. Don in Sweet, Brit. Fl. Gard. 2: tab. 124. 1833. Figure 6.

Erect **herbs** or shrubs 0.5–2.5 m tall, flowering stems usually unbranched, leafy stems 3–8 mm wide, with 4 prominent longitudinal wings (ridges), wings 0.3–2 mm wide, usually glabrous. **Leaves** of the same node slightly united at the base to form a short interpetiolar ridge, sessile and amplexicaul; **leaf blades** 8–23(–28) cm long, 1–4.5(–6) cm wide, narrowly lanceolate to very narrowly elliptic-oblong, tapering gradually to the acute or acuminate apex, margin serrulate with 3–5 teeth/cm, cuneate in the lower ¼ but slightly expanded at the rounded-auriculate base, drying thin-chartaceous, usually glabrous, 2° veins 10–14/side. **Inflorescences** 2–6 cm long, axillary cymes or with 2° branching, with 2–12 flowers, peduncles 1–3 cm long, 0.7–1.3 mm diam., glabrous or minutely puberulent with thin hairs 0.1–0.2 mm long, bracts 3–8 mm long, lanceolate, pedicels 4–14 mm long, minutely puberulent. **Flowers** with calyx 5–9 mm long, 2.5–3.5 mm

diam., campanulate, with narrow acute lobes 1–3 mm long, sparsely minutely puberulent; **corolla** (12–)14–17(–23) mm long, tubular with slightly expanded lobes, yellow to white, marked with yellow and barbate within, tube 2–5 mm diam., lobes slightly unequal; filaments 5–10 mm long; style 5–7 mm long. **Fruits** globose, 7–10 mm diam., white, fleshy; seeds 0.4–0.5 mm long, 0.2–0.3 mm wide, ellipsoid-oblong, yellowish brown, reticulation minute (visible at 50×).

Plants of open moist to wet sites in lower montane evergreen forest formations, 800–2200 m elevation. Probably flowering and fruiting throughout the year, but with most Costa Rican collections made in December–January and April–June. The species ranges from Veracruz, Mexico, to the highlands of western Panama and Bolivia.

Leucocarpus perfoliatus is recognized by the unbranched flowering stems with winged margins, sessile leaves with auriculate bases clasping the stems, axillary inflorescences, always shorter than the leaves, smaller tubular yellow corollas, and baccate fruit. Superficially, these plants are similar to *Hemichaena fruticosa* (q.v.), but that species has larger flowers and dry dehiscent fruits.

Limosella Linnaeus

REFERENCE—H. Glück, *Limosella* studien. Beitrage zur Systematik, Morphologie, und Biologie der Gattung *Limosella*. Bot. Jahrb. Syst. 66: 490–563. 1934. A. Lourtieg, Étude sur *Limosella*. Comité National Français des Recherches Antarcitiques: Biologie 1(10): 165–173. 1964.

Very small **herbs**, annual or perennial, growing in shallow water or on moist soil, caespitose or with short stolon-like stems rooting from the nodes, glabrous or puberulent. **Leaves** from the apex of the rootstock or fasciculate at the nodes, densely clustered, sessile or with poorly differentiated petioles, blades linear to obovate, entire, flat or cylindrical, drying brown or yellowish, glabrous, venation obscure or with a midvein. **Inflorescences** of 1 to several flowers from the leaf axils, glabrous, bracts absent, pedicels usually shorter than the leaves, bracteoles absent at the base of the calyx. **Flowers** very small, glabrous externally, calyx campanulate, usually thin-walled, equal to or slightly shorter than the corolla tube, lobes 5 (4) with the posterior lobe exterior; **corolla** funnellform to campanulate, white to bluish or pinkish, tube short, lobes 3–5, subequal and

imbricate in bud, equal to or shorter than the corolla tube; stamens 4 (2, 5), included, filaments simple, borne near the middle of the tube, filaments of lower stamens crossing over the filaments of upper stamens, anther thecae confluent (1-thecous), not mucronate; ovary ovoid to ellipsoid, 2-locular near the base, style short, stigma capitate. **Fruits** capsules or indehiscent, usually bivalvate; seeds small, numerous, ovoid, striate and reticulate.

A genus of ca. 11 species distributed widely over temperate and tropical montane regions but most diverse in the Southern Hemisphere. The very small size of the plants, their small flowers, and their aquatic or moist habitats help distinguish the genus. The genus is classified in the tribe Gratiolaeae and is often placed in the subtribe Limosellinae.

Limosella acaulis Sesse & Mociño, Fl. Mex. ed. 2: 143. 1894. *L. americana* Glück, Notizbl. Bot. Gart. Berlin Dahlem 12: 75. 1934. *L. americana* f. *submersa* Glück, loc. cit. 75. 1934. *L. americana* f. *natans* Glück, loc. cit. 76. 1934. *L. americana* f. *terrestris* Glück, loc. cit. 1934. Figure 1.

Small **herbs** to 5 cm tall, stems to 6 cm long or little developed (and plants acaulescent), rooting at the nodes, glabrous. **Leaves** rosulate or fasciculate, sessile or with poorly differentiated petioles to 4 cm long, clasping the stem at their base, glabrous throughout; **leaf blades** 4–15 mm long (–11 cm when linear), 0.7–4 mm wide, linear to narrowly oblong to spatulate or oblanceolate, apex usually rounded, margins entire, gradually narrowed at the base, drying brown or yellowish, midvein usually visible only near the base. **Inflorescences** of 1–3 flowers in leaf axils (but difficult to see among the crowded leaf bases), pedicels 10–30 mm long, ca. 0.4 mm wide, glabrous. **Flowers** glabrous externally, calyx 1.5–2 mm long, lobes 5, 0.3–0.7 mm long, narrowly triangular to oblong, dark coloring sometimes present between the lobes distally; **corolla** ca. 4 mm long, campanulate or subrotate, slightly zygomorphic (bilaterally symmetric), white, tube ca. 2.5 mm long, ca. 1.3 mm diam., lobes 3–5, 1–1.5 mm long, rotate; stamens 4 in 2 opposing pairs. **Fruits** 1.5–4 mm long, 1–3 mm diam., ovoid-ellipsoid, glabrous; seeds 0.5–1 mm long, 0.2–0.5 mm wide, striate.

Rarely collected plants in shallow water or wet soils, found only above 3300 m elevation in Cen-

tral America. Probably flowering and fruiting throughout the year. Known in Costa Rica from a single collection made in the Valle de los Conejos on Chirripo Grande (3400 m) in February (*Weston 12360*). The species ranges disjunctly from Mexico to Venezuela and Bolivia.

Limosella acaulis is distinguished by its moist and very high altitude habitat, the small size of the plants, mostly fasciculate linear sedge-like leaves, and very small flowers with white corollas that have three to five lobes. When seen from above, the flowers may be reminiscent of *Houstonia* (Rubiaceae), with four corolla lobes held in a single horizontal plane. Species are variable and individual populations are often isolated, so local variation is common. Also, the plant's habit changes with water depth and length of immersion. When submersed, leaves develop to be longer and more linear than spatulate; flowers remain closed and are cleistogamous. The Costa Rican collection describes the plants as forming small mats in a creek bed. Lourtieg (1964, cited above) placed most taxa as synonyms of *L. australis* R. Br., but we follow the decisions of Louis Williams regarding the circumscription of this species (Fiediana, Bot. 34: 121, 1972).

Linaria Miller

REFERENCE—D. Sutton, A. Revision of the Tribe Antirrhineae. British Museum (Natural History) & Oxford Univ. Press, 1988.

Herbs or subshrubs, annual, biennial or peren-

Key to the Species of *Linaria*

- 1a. Flowers yellow, corollas 20–30 mm long; planted in gardens and rarely escaping . . . *L. vulgaris*
- 1b. Flowers blue to purple, corollas 5–15 (20) mm long; weedy plants of cooler climates *L. canadensis*

Linaria canadensis (L.) Dumort., Bot. Cult. 2: 96. 1802. *Antirrhinum canadensis* L., Sp. Pl. 618. 1753. *L. texana* Scheele, Linnæa 21: 761. 1848.

Herbs, annual or biennial, flowering stems erect from a basal rosette of leafy stems, 15–50 cm tall, branching from the base, leafy stems 0.5–2.5 mm diam., glabrous. **Leaves** opposite or whorled near the base, alternate on erect stems,

erect, branching, mostly from the base, glabrous or less often glandular-puberulent, drying grayish to dark brown. **Leaves** alternate, sometimes opposite or verticillate near the base, leaf blades usually sessile, entire, linear to reniform, pinnately veined. **Inflorescences** colorful racemes or spikes (rarely flowers solitary in leaf axils), alternate along the rachis, bracts usually small, bracteoles absent at base of calyx. **Flowers** usually glabrous, calyx campanulate, with 5 sepals or 5 calyx lobes, equal or subequal, imbricate in bud, persisting in fruit; **corolla** tubular and strongly bilabiate, tube with a backward-pointing abaxial spur, upper (adaxial) lip bilobed and exterior in bud, lower (abaxial) lip 3-lobed and with a prominent raised palate near the entrance to the tube; stamens 4 in 2 pairs, included, filaments attached near the base of the tube, anthers with 2 parallel or divergent thecae, a staminode sometimes present; ovary 2-locular, ovules many, style slender, stigma small, 2-lobed or capitate. **Fruits** thin-walled capsules, ovoid to globose, dehiscent loculicidally into 2 valves or forming distal pores; seeds ovoid to discoid or C-shaped, testa thin, smooth to rugose.

Linaria is a genus of ca. 100 species, native to north temperate regions and the Mediterranean area. They are often grown in gardens for their colorful and complex flowers or their foliage. The corollas with backward-pointing spur and strongly two-lipped lobes are distinctive. The genus is classified in the tribe Antirrhineae and is closely related to *Cymbalaria* (q.v.). Although not known to be naturalized in Costa Rica, the following two species are likely to be present.

sessile; **leaf blades** of erect stems 5–20 mm long, 1–2 mm wide, linear, apex acute to bluntly acute, margin entire, base cuneate, venation obscure. **Inflorescences** racemes (or appearing spicate), usually making up the distal half of erect stems, glabrous, bracts ca. 2 mm long, pedicels 1–4 mm long. **Flowers** glabrous externally, calyx 2–3.5 mm long, sepals 5, 0.5–1 mm wide; **corolla** 5–15(–20) mm long, blue to purple, spur 2–9 mm long, tube strongly 2-lipped, the throat open,

white; stamens 2–3 mm long; ovary 1–2 mm long, ovoid, style 1–2 mm long. **Fruits** 2–3.5 mm long, subglobose to rounded oblong, with persisting style 0.5 mm long; seeds 0.3–0.5 mm long, angled, smooth.

Linaria canadensis, native from southern Canada to northern Mexico, is a weed of open sunny sandy sites in cooler temperate or montane tropical climates (ca. 2000 m elevation in Mexico). Although not yet recorded for Central America, it is naturalized in South America and is likely to become established in our area. The unbranched erect stems, linear leaves, slender racemes, and blue corolla with spur help to distinguish this species.

Linaria vulgaris Miller, Gard. Dict. ed. 8. 1768.
Antirrhinum linaria L., Sp. Pl. 616. 1753.

Erect perennial **herbs** 0.2–0.8 m tall, spreading by underground stems to form persisting clumps, erect stems usually unbranched, 1–3 mm diam., usually glabrous. **Leaves** alternate and numerous along the stem, glabrous, sessile; **leaf blades** 3–5 cm long, 1–6 mm wide, linear to linear-lanceolate, secondary veins obscure. **Inflorescences** spicate racemes with crowded flowers, bracts ca. 1 cm long, similar to the leaves, pedicels 1–4 mm long, pedicels and flower oriented upward at an acute angle to the stem. **Flowers** with glabrous calyx, sepals 2–3.5 mm long, narrowly ovate, acute; **corolla** 2–3 cm long, yellow with orange near the mouth, tube with a spur equaling the tube and lobes in length, mouth of the corolla strongly bilabiate, upper (adaxial) lip 8–12 mm long, lower (abaxial) lip 6–9 mm long, with a puberulent rounded palate. **Fruits** 5–10 mm long, glabrous; seeds ca. 2 mm long, discoid and winged.

Linaria vulgaris, a native of Eurasia, is occasionally grown in gardens for its unusual yellow flowers, but it is more likely to be seen as a weed in cooler climates of the world. It is recognized by its often linear alternate leaves and the unusual two-lipped yellow corolla with basal spur. This species has not been recorded as naturalized in Central America. These plants sometimes produce abnormal flowers that are radially symmetric (not two-lipped) and have five spurs or none. Linnaeus mistakenly erected the genus *Peloria* for such plants, and the word *peloria* is now used to describe abnormal radially symmetric forms of flowers that are normally strongly bilaterally symmetric (zygomorphic).

Lindernia Allioni

REFERENCES—D. Miranda, Flavonoid and morphological studies of *Lindernia* Allioni (Scrophulariaceae) in South America. Bot. J. Linn. Soc. 75: 47–67. 1977. D. Philcox, Revision of the Malaysian species of *Lindernia* All. (Scrophulariaceae). Kew Bull. 22: 1–72. 1968. T. Yamazaki, Revision of the Indo-Chinese species of *Lindernia* All. J. Fac. Sci. Univ. Tokyo, Bot. 13: 1–64. 1981.

Small annual **herbs**, terrestrial or semiaquatic, erect to prostrate or creeping and rooting at the nodes, stems simple or branched, glabrous or puberulent, usually 4-angled, drying yellowish or brown. **Leaves** opposite, simple, small, sessile or petiolate, blades entire or denticulate, base often truncated to cordate, often glandular-punctate, venation pinnate or 3–5-veined from the base. **Inflorescences** of solitary flowers in the axils of distal leaves, less often terminal or axillary racemes or umbel-like clusters, bracts and bracteoles absent, pedicels slender, usually longer than the calyx. **Flowers** small, calyx tubular with 5 short spreading lobes or deeply parted to the base with 5 sepals, the sepals or lobes subequal, glabrous or puberulent externally, tube with 5 longitudinal ridges (sometimes winged); **corolla** tubular to campanulate, longer than the calyx (equaling the calyx and not opening in cleistogamous flowers), blue to purple or white, bilabiate, upper lip usually shorter and erect, entire or 2-lobed, lower lip 3-lobed and spreading; stamens 4 or with 2 fertile and 2 staminodes present, filaments often inserted at 2 levels in the distal half of the tube, anterior filaments often with a distinct spur near the base, upper filaments often bent just near the apex, anthers free or united in pairs, 2-theous, thecae often widely divergent and X-shaped; ovary glabrous, 2-locular, ovules many, style slender, stigmas 2-lobed. **Fruits** dry capsules, ovoid to ellipsoid, globose or cylindric, dehiscent septically and 2-valved, the placentae winged; seeds many, oblong-elliptic, smooth to reticulate or alveolate with prominent transverse or longitudinal raised ridges.

A genus of 50 to 70 species widespread in tropical and temperate areas throughout the world, with the majority of species in tropical parts of Africa, Asia, and Australia. The genus is classified in the tribe Gratiroleae and placed in subtribe Lindernieae with *Torenia*. It seems likely that *L. crustacea* is indigenous to Costa Rica and that the

other two species have been introduced. These plants are generally found in marshes, at the edges of standing water, or in moist depressions, in open sunny or partly shaded sites. The preference for

moist soils, the short slender stems, small opposite leaves, small bluish flowers, tubular bilabiate corollas, four or two fertile stamens, and appendaged anther filaments help distinguish the genus.

Key to the Species of *Lindernia*

- 1a. Flowers subsessile, pedicels < 3 mm long, flowers solitary in leaf axils; corollas white or yellowish to pale lilac; leafy stems usually with puberulent longitudinal ridges; fruits 6–10 mm long *L. diffusa*
- 1b. Flowers borne on pedicels 3–23 mm long (longer pedicels at distal nodes), flowers often in terminal cyme-like groupings; corollas bluish to lilac, rose, or white marked with yellow; leafy stems glabrous or puberulent; fruits 3–4 mm long 2
- 2a. Calyx 5-lobed, united ca. 50% to form a tube (but splitting after anthesis and appearing as separate sepals in fruit); fruits ovoid, seeds 0.4–0.5 mm long; leaves petiolate *L. crustacea*
- 2b. Calyx with 5 sepals united only at the base; fruits ellipsoid, seeds 0.3–0.4 mm long; leaves sessile *L. dubia*

Lindernia crustacea (L.) F. v. Muell., Syst. Census Aust. Pl. 1: 97. 1882. *Capraria crustacea* L., Mant. Pl. 1: 87. 1767. *Torenia crustacea* (L.) Cham. & Schldl., Linnaea 2: 570. 1827. *Vandelila crustacea* (L.) Benth., Scroph. In. 35: 1835. *Pyxidaria crustacea* (L.) Kuntze, Rev. Gen. Pl. 2: 464. 1891. Figure 2.

Prostrate or procumbent **herbs** to 15 cm tall, rarely rooting at distal nodes, leafy stems 0.2–1.3 mm diam., longitudinally ribbed, glabrous or with thin crooked hairs 0.1–1 mm long. **Leaves** opposite, petioles 1–7 mm long, 0.4–0.7 mm wide, glabrous or sparsely puberulent, leaf bases not united across the stem; **leaf blades** 6–16 mm long, 4–15 mm wide, ovate to ovate-rounded or ovate-triangular, apex obtuse or rounded, margin serrate with 4–6 teeth/cm, base truncate to rounded-subcordate, drying membranaceous and yellowish green, minutely punctate, glabrous or very sparsely puberulent beneath and along margin, 2° veins 3–5/side. **Inflorescences** solitary axillary flowers or terminal cymes, pedicels 4–18(–25) mm long, 0.1–0.2 mm diam., glabrous or with few thin hairs to 0.4 mm long. **Flowers** with calyx 2–4 mm long, 1–1.8 mm diam., lobes 0.7–1.5 mm long, triangular and acute, glabrous or very sparsely puberulent; **corolla** 4–7 mm long, blue to violet or blue-purple (white), tube ca. 5 mm long, 1–1.5 mm diam.; fertile stamens 4 in 2 pairs, anthers connivent; ovary glabrous. **Fruits** 3–4 mm long, 2–2.5 mm wide, rounded-ovoid, central column (placenta) to 2 mm wide with smooth lateral wings and central reticulated area; seeds 0.4–0.5

mm long, 0.3–0.4 mm diam., oblong, yellowish, obscurely reticulate.

Uncommon plants of moist open sunny or partly shaded sites in lowland evergreen forest formations, 0–300(–1000) m elevation. It is also found along stream edges in seasonally dry areas. Flowering and fruiting throughout the year. This species is a widespread weed, now found in tropical and warm-temperate climates throughout the world.

Lindernia crustacea is recognized by its small, mostly prostrate habit, mostly glabrous parts, small ovate-serrate leaves, small blue flowers on prominent slender pedicels, calyx lobes united for half their length, small rounded fruit, and unusual persisting placenta with smooth lateral wings. In addition, the lower pair of anthers is inserted on the lower corolla lip. The persisting and expanded calyx often splits along the thin intercostal areas to produce separate sepals, appearing very different from the calyx in anthesis.

Lindernia diffusa (L.) Wettst. in Engl. & Prantl, Natürlichen Pflanzenfam. 4, 3b: 79. 1891. *Vandelila diffusa* L., Mant. Pl. 1: 89. 1767. *Pyxidaria diffusa* (L.) Kuntze, Rev. Gen. Pl. 2: 464. 1891. Figure 2.

Prostrate or decumbent **herbs** 2–15 cm tall, sometimes forming small mats to 25 cm wide, often rooting at the nodes, leafy stems 0.4–1.3 mm diam., quadrangular with 4 puberulent longitudinal ribs, the thin whitish hairs 0.2–0.3 mm long. **Leaves** opposite, united at the base to form

an interpetiolar line or ridge, subsessile or with petioles to 4 mm long; **leaf blades** 6–25 mm long, 4–24 mm wide, ovate to broadly ovate or rhombic, apex obtuse to rounded, margin serrate with 6–10 teeth/cm, base broadly obtuse to rounded and truncate, minutely punctate, glabrous above, with minute (0.1–0.2 mm) hairs along the veins beneath, venation subpalmate with 2–3 2° veins/side. **Inflorescences** of solitary axillary flowers, usually 2/node, pedicels 1–3 mm long, ca. 0.3 mm diam., minutely puberulent. **Flowers** with calyx 4–7 mm long, 1–1.5 mm diam., lobes 2–4 mm long, linear-lanceolate, glabrous or minutely puberulent on the major veins and margins of lobes; **corolla** 6–9 mm long, white, yellowish, or pale lilac with yellow interior; fertile stamens 4; ovary glabrous, style ca. 3 mm long. **Fruits** 6–10 mm long (including the 1–2 mm beak), 2.3–4 mm diam., ellipsoid or narrowly ovoid-ellipsoid; seeds 0.5–0.6 mm long ca. 0.3 mm diam., oblong, with minute spines and a reticulate-pitted surface.

Plants of open sunny sites in evergreen forest formations, 10–1200 m elevation. Probably flowering and fruiting throughout the year. Probably originating in the Old World, this species is now widespread in warmer climates.

Lindernia diffusa is recognized by its small size, stems with usually four puberulent ridges, small subsessile serrate leaves with broad blades, solitary axillary flowers on very short pedicels, and white corollas marked with yellow.

Lindernia dubia (L.) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1: 141. 1935. *Gratiola dubia* L., Sp. Pl. 17. 1753. *Capraria gratiolooides* L., Syst. Veg. ed. 10: 1117. 1759. *G. inaequalis* Walt., Fl. Carol. 61. 1788. *G. anagallidea* Michx., Fl. Bor. Am. 1: 6. 1803. *Ilysanthes gratiolooides* (L.) Benth. in DC., Prodr. 10: 419. 1846. *L. gratiolooides* (L.) Lloyd & Fouc., Fl. Ouest Fr. ed. 4: 246. 1886. *L. inaequalis* (Walt.) Pennell, Torrey 19: 149. 1919. *I. dubia* (L.) Barnhart, Bull. Torrey Bot. Club. 26: 376. 1899. *L. anagallidea* (Michx.) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1: 152. 1935. Figure 4.

Herbs, stems procumbent or erect, 5–30 cm tall, simple or much-branched, rooting mostly at the base, leafy stems 0.2–1 mm diam., usually with 4 longitudinal ridges, glabrous. **Leaves** opposite, sessile, free or united at the base and forming an interpetiolar line; **leaf blades** 4–14(–25) mm long, 3–8(–10) mm wide, narrowly ovate to

narrowly ovate-triangular or lanceolate, apex acute to obtuse, margin entire or with 2 or 3 teeth/side, base acute to somewhat rounded, drying membranaceous, glabrous, venation usually palmate with 3 major veins. **Inflorescences** of solitary axillary flowers or cymes subtended by leaf-like bracts, pedicels 3–23 mm long, ca. 0.2 mm diam., glabrous, distal pedicels much longer than those at lower nodes. **Flowers** with calyx deeply 5-parted, sepals 1.8–2.5 mm long, 0.3–0.4 mm wide, linear-oblong, becoming 3–5 mm long in fruit but remaining narrow; **corolla** 5–10 mm long, blue or white with purplish throat or lilac to rose; fertile stamens 2, staminodes 2 and bifid at the apex; ovary glabrous, style 3 mm long. **Fruits** 3–6 mm long, ca. 2 mm wide, narrowly ovoid-oblong to oblong-ellipsoid; seeds 0.3–0.4 mm long, 0.2–0.3 mm diam., oblong, with longitudinal rows of pits.

Plants of open wet sites and marshes in evergreen or seasonally deciduous areas, 5–1100 m elevation. Probably flowering primarily at the end of the rainy season (November–January). Rarely encountered in Costa Rica, this species ranges from southern Canada and the eastern United States to southern South America and the West Indies.

Lindernia dubia is recognized by its small stature, moist habitats, lack of pubescence, opposite sessile leaves, distal flowers on longer pedicels, white and blue two-lipped corollas, and separate sepals. There is considerable diversity of leaf form, with some plants having narrowly ovate leaves (var. *anagallidea* (Michx.) Cooper) and other plants with more elongate narrow leaves (var. *dubia*). Holmgren (*Flora of the Great Plains*, 1986, p. 769) found that *L. anagallidea* cannot be effectively separated from *L. dubia*. Likewise, in 1984 D. A. Qualls annotated many North American collections as *L. dubia*. We follow their decision to consider the two as elements of the same species. *Lindernia microcalyx* Pennell & Stehle is very similar but has corollas 9–14 mm long; it has been collected along the Caribbean shore of Guatemala and Honduras (determinations by D. A. Qualls, 1984).

Lophospermum D. Don

REFERENCES—W. Elisens, Monograph of the Maurandyinae (Scrophulariaceae—Antirrhineae). Syst. Bot. Monogr. 5: 1–97. 1985. D. Sutton, A Revision of the Tribe Antirrhineae. British Mu-

seum (Natural History) & Oxford Univ. Press, 1988.

Perennial **herbs** or climbers, stems often scandent or clambering, branches often arising from a woody base, sparsely puberulent to glandular-villose, drying grayish or greenish. **Leaves** alternate, petioles well developed and often bending to facilitate climbing; leaf blades deltoid to reniform, apex acute to mucronate, margins dentate to broadly crenate, venation palmate. **Inflorescences** of solitary flowers in axils of leaves, pedicels horizontal to ascending, bracts and bracteoles absent. **Flowers** large, calyx urceolate or campanulate and expanded, sepals free or united at the base, narrowly to broadly ovate, glandular puberulent, often enlarging in fruit; **corolla** tubular-campanulate, somewhat bilabiate and open-throated, reddish to violet or purple distally (whitish or pale near the base), 5-lobed, upper 2 lobes recurved, lower 3 lobes projecting forward; stamens 4, subequal or in 2 pairs, included, connective often expanded, a staminode usually present; ovary glabrous or glandular puberulent, 2-locular, ovules many, stigma recurved or straight, forked and divergent (rarely conical and lobed). **Fruits** dry capsules, ovoid to globose, symmetric or asymmetric, dehiscent irregularly or poricidal, bivalved; seeds rounded with a wing around the margin.

A genus of 6 or 20 species, depending on whether the Mexican genus *Rhodochiton* Zucc. is included (following Elisens, 1985) or excluded (following Sutton, 1988). Species range from north-central Mexico to Guatemala; a few species are planted as ornamental climbers. These plants are characterized by the scandent or clambering habit, alternate leaves, twining petioles, deltate to cordiform blades, large corollas, and round seeds with thin peripheral wing. The one species found in Costa Rica was formerly placed in the genus *Maurandya*; both are placed in the tribe Antirrhineae.

Lophospermum erubescens D. Don in Sweet, Brit. Fl. Gard. ser. 2, 1: tab. 68 and after tab. 75. 1830. *Maurandya erubescens* (D. Don) Gray, Proc. Am. Acad. Arts 7: 377. 1868. *Asarina erubescens* (D. Don) Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 174. 1947. Figure 8.

Climbing **herbs**, leafy stems 1–4 mm diam., pubescent with thin straight or crooked multicellular hairs 0.3–0.8 mm long, some hairs with

gland tips. **Leaves** alternate, petioles 3–6 cm long, 0.6–1.2 mm diam., often bent or curving (sometimes helping to support the stem), pubescent; **leaf blades** 3–7(–15) cm long, 2–6.5(–15) cm wide, triangular to triangular-rhombic or sagittate, apex acute, margin prominently crenate-serrate with teeth 0.5–6 mm high and 1–8 mm wide, base cordate, with thin whitish hairs 0.3–0.5 mm long above and below, major veins 3 or 5. **Inflorescences** of solitary axillary flowers, pedicels 2–7(–11) cm long, 0.7–1.4 mm diam., puberulent, not bent or twining. **Flowers** puberulent externally, calyx 15–24 mm long, sepals subequal, 10–14 mm wide, broadly ovate; **corolla** 6–7 cm long, tubular-campanulate, bright pink to red distally, tube constricted above the base, whitish within and with yellow hairs in the throat, ca. 2 cm wide at the mouth, lobes 10–14 mm long, 12–16 mm wide, rounded distally. **Fruits** 15–20 mm long, subtended by persisting sepals, surface with thin multicellular hairs; seeds ca. 2.5 × 2.5 mm, wings lateral with a narrow notch at apex and truncated base, body of the seed ca. 1.5 × 0.8 mm, tuberculate.

Lophospermum erubescens is characterized by its vining habit, twisted petioles, triangular and coarsely dentate leaf blades, broad sepals, and large, tubular, slightly asymmetric pink corollas. This species is native to the oak forests of the Sierra Madre Oriental of Mexico and is now commonly grown in gardens as a climbing ornamental. It has been collected as an escape at Monteverde, where it was flowering in January and September at ca. 1400 m, and north of San Isidro del General at 1500 m elevation, where it was flowering in April. Compare *Maurandya barclaiana* and *M. scandens*.

Maurandya Ortega

REFERENCES—W. Elisens, Monograph of the Maurandyinae (Scrophulariaceae—Antirrhineae), Syst. Bot. Monogr. 5: 1–97. 1985. D. Sutton, A Revision of the Tribe Antirrhineae. British Museum (Natural History) & Oxford Univ. Press, 1988.

Scandent **herbs**, annual or perennial, with thin flexible stems from a fibrous base or taproot, glabrous. **Leaves** alternate, petioles long and often twisting to support the twining habit; leaf blades hastate to sagittate or rarely cordiform, margins usually entire, glabrous, venation palmate. **Inflo-**

rescences of solitary flowers in leaf axils, pedicels long, terete or winged near the base, glabrous or glandular-puberulent distally, bracts and bracteoles absent. **Flowers** with 5 sepals united only at the base, equal, lanceolate, imbricate near the base (urceolate), margins entire, glabrous or glandular-pubescent; **corolla** tubular and prominently 2-lipped, with open or closed throat, pink to red, violet, or blue, often whitish near the base, glabrous to glandular-puberulent externally, upper lip with 2 recurved lobes, lower lip with 3 recurved or projecting lobes, often closing the mouth with the well-developed palate; stamens 4 in 2 pairs, included, inserted near the base of the tube, filaments villous at the base; ovary 2-locular, locules subequal or unequal, glabrous or with glandular trichomes, ovules many, stigma conical and recurved. **Fruits** dry 2-valved capsules, ovoid to

globose, dehiscence irregular, irregular-transverse or poricidal; seeds rectangular with tuberculate-cristate surface (ovoid with a peripheral wing and minute tuberculate surface sculpturing in *M. wislizeni*), dark brown.

As revised by Elisens (1985, cited above), *Maurandya* is a genus of four species ranging from the southwestern United States to central Mexico. Sutton (1988, cited above) recognizes only two species in the genus, transferring two species found in the southwestern United States to splinter genera. The genus is closely related to *Lophospermum*, and they are placed in the tribe Antirrhineae. Two species are likely to be found as garden ornamentals in Central America, and one has recently been collected as an escape. These plants have also been placed in the genus *Asarina*.

Key to the Species of *Maurandya*

- 1a. Seeds with lateral wings; corolla to 6 cm long (see *Lophospermum erubescens*)
- 1b. Seeds without wings; corolla to 4 cm long 2
- 2a. Calyx covered with short gland-tipped hairs; corolla usually blue-violet *M. barclaiana*
- 2b. Calyx glabrous or with few gland-tipped hairs; corolla usually pink *M. scandens*

Maurandya barclaiana Lindley, Bot. Reg. 13, tab. 1108. 1827. Figure 8.

Vines with slender herbaceous climbing stems and twisting petioles, leafy stems 0.6–1 mm diam., glabrous or minutely papillate-puberulent at the nodes. **Leaves** alternate, petioles 12–32 mm long, 0.3–0.5 mm diam., glabrous, often coiling around objects for support; **leaf blades** 16–24(–35) mm long, 14–35 mm wide, triangular-hastate or sagittate, apex acute, usually with 2 basal lobes, glabrous, venation subpalmate with 3 (5) major veins from the base. **Inflorescences** of solitary flowers in leaf axils, pedicels 15–55 mm, ca. 0.5 mm diam., straight or curved, glabrous except near the calyx. **Flowers** with calyx 8–16 mm long, 2–3 mm wide at base, lobes triangular with long narrow apex, covered with gland-tipped hairs 0.3–0.5 mm long; **corolla** 2.5–4 cm long, ca. 15 mm wide, blue-violet, lobes 6–10 mm long, filaments ca. 18 and 14 mm long. **Fruits** 11–17 mm long, ovoid; seeds with angular projections.

Maurandya barclaiana is a vining ornamental often planted in tropical gardens. It is recognized by its colorful tubular two-lipped corollas, glandular-puberulent calyx, often sagittate leaves, and twisting petioles.

Maurandya scandens (Cav.) Pers., Syn. Pl. 2: 160. 1806. *Usteria scandens* Cav., Icon. 2: 15, tab. 116. 1793. *Maurandya semperflorens* Ortega, Nov. Pl. Descr. Dec. 21. 1797. *Reichardia scandens* (Cav.) Roth, Catal. bot. 2: 65. 1800. *Asarina scandens* (Cav.) Pennell, Proc. Acad. Nat. Sci. Philadelphia 99: 175. 1947. Figure 8.

Herbaceous climbers with slender twining stems, often with adventitious roots, leafy stems 0.5–2 mm diam., glabrous. **Leaves** alternate, petioles 8–35(–42) mm long, 0.4–0.8 mm diam., glabrous, often bent or twisted along their length; **leaf blades** 2–5(–6) cm long, 1–3.5(–4.5) cm wide, sagittate to hastate or triangular, apex acute, margin entire, base cordate and usually with prominent lateral lobes, drying membranaceous, glabrous or minutely papillate-puberulent near the petiole attachment, major veins 5 or 7, the 3 central veins reaching the middle of the blade. **Inflorescences** of solitary axillary flowers, pedicels 2–6(–8.5) cm long, 0.4–1 mm diam., slightly thickened near the base, glabrous. **Flowers** with calyx 9–15 mm long, sepals 2–4 mm wide near the base, lanceolate, glabrous (rarely sparsely glandular puberulent); **corolla** to 4 cm long, tubular-

campanulate, pink to pale purple, tube 2–3 cm long, lobes 6–10 mm long, rounded; filaments 16 and 12 mm long, lower filaments shorter; ovary glabrous or with glandular hairs near apex. **Fruits** 9–12 mm long, ovoid to oblong, locules subequal; seeds with rounded projections.

Maurandya scandens, a native of central Mexico, is planted as an ornamental climber in Central America. The thin twining stems, lack of pubescence, often twisted petioles, sagittate-triangular leaves, solitary axillary flowers, and tubular two-lipped pinkish corollas make the plants distinctive.

Mazus Loureiro

Small annual **herbs**, diffusely branched from a basal rosette, stems with longitudinal ridges, pubescent or subglabrous. **Leaves** opposite and crowded near the base, alternate distally, petioles poorly differentiated; **leaf blades** obovate with crenulate or coarsely dentate margins, venation pinnate. **Inflorescences** terminal racemes, flowers alternate and solitary along the rachis (often on 1 side), bracts minute or absent, pedicels well developed, lacking bracteoles. **Flowers** with campanulate or tubular calyx, 5-lobed, tube usually equaling the lobes in length, lobes equal in size and shape, glabrous or puberulent, slightly expanded and enclosing the fruit; **corolla** 2-lipped, light blue to white or lavender, tube short, upper lip 2-lobed, lower lip 3-lobed, larger than the upper and spreading; stamens 4 in 2 pairs, filaments inserted at the base of the tube, anthers divaricate, thecae contiguous, a staminode absent; ovary 2-locular, ovules many, style longer than the ovary, stigma broadly bilabiate. **Fruits** capsules, globose or slightly compressed, loculicidal, producing 2 entire valves; seeds, ovoid to oblong or angled, rugulose or reticulate, black.

Mazus is an Asian-Australian genus of 30 to 40 species that is placed in the tribe Dodartieae with *Mimulus* and *Leucocarpus*. The following species is now an occasional weed in temperate and tropical montane climates.

Mazus pumilus (Burm.f.) Steenis, *Nova Guinea* N.S. 9: 31. 1958. *Lobelia pumila* Burm.f., *Fl. Ind.* 186, t. 60, f. 3. 1768. *M. japonicus* (Thunb.) Kuntze, *Rev. Gen. Pl.* 1: 462. 1891. *Lindernia japonica* Thunb., *Fl. Jap.* 253. 1784. *M. rugosus* Lour., *Fl. Cochinch.* 385. 1790.

Annual **herbs** 3–15 cm tall, ascending or decumbent, sometimes forming small mats, stems to 20 cm long, leafy stems 0.8–1.5 mm diam., sparsely puberulent with hairs to 0.5 mm long. **Leaves** rosulate or crowded at the base, opposite leaf bases united across the stem, distal leaves smaller and alternate, petioles 2–15 mm long, with lateral margins not clearly differentiated from the blades; **leaf blades** 6–60 mm long, 4–20 mm wide, obovate to cuneate-oblong or oblanceolate, apex obtuse or rounded, margins of larger leaves with prominent lobes 0.5–3 mm long (separated by wide sinuses), base cuneate and decurrent, sparsely puberulent with hairs to 0.4 mm long, 2° veins 2 or 3/side. **Inflorescences** 3–8 cm long, racemes with 3–13 flowers separated by internodes to 12 mm long, bracts 1–2 mm long, linear-filiform, pedicels 2–6(–11) mm long, sparsely to densely papillate puberulent. **Flowers** with calyx 4–7 mm long, with 5 prominent veins, tube 1–2 mm diam., lobes 2–3 mm long, narrowly triangular or oblong, with 5 prominent longitudinal veins, glabrous or minutely papillate puberulent; **corolla** 7–10 mm long, pale violet and white, tubular, upper lobes erect, lower lip ca. 2 mm long with 2 raised longitudinal ridges adaxially, palate yellow or whitish; stamens included; stigma lobes closing after pollination. **Fruits** 2–4 mm long, 2–3 mm diam., obovoid and bisulcate, surface glabrous, smooth, enclosed within the persisting calyx cup; seeds oblong, minutely reticulate.

Mazus pumilus, native to eastern Asia, is rarely collected in the Neotropics. It is often found as a weed in gardens and open places (1000–2000 m). The species is recognized by its small size, narrowly obovate opposite leaves with crenulate margins and long-decurrent blades, few-flowered racemes with long pedicels, partly united calyx, and blue or pink two-lipped corolla. These plants may resemble species of *Veronica*, but that genus lacks the strongly two-lipped flowers and four stamens.

Mecardonia Ruiz & Pavón

REFERENCE—F. Pennell, Reconsideration of the *Bacopa*–*Herpestis* problem. *Proc. Acad. Nat. Sci. Philadelphia* 98: 83–98. 1946. R. Rossow, Revisión del género *Mecardonia* (Scrophulariaceae). *Candollea* 42: 431–474. 1987.

Erect or prostrate **herbs**, annual or perennial, stems with few to many branches, mostly glabrous, drying brown or blackish. **Leaves** opposite,

sessile or short-petiolate, blades with serrate margins, usually glabrous, glandular-punctate, venation pinnate with most veins diverging in the proximal half of the blade. **Inflorescences** of solitary axillary flowers (2/node), 2 small linear bracts subtending the pedicel, bracteoles absent at the base of the calyx, pedicels slender. **Flowers** with deeply 5-parted calyx, sepals unequal in width with 3 broad outer ones; **corolla** tubular-campanulate, slightly 2-lipped and sometimes with a prominent palate (personate), yellow or white, upper lip slightly 2-lobed, lower lip 3-lobed; stamens 4 in 2 pairs, inserted near the base of the tube, thecae stipitate on short arms of the connective, a short staminode sometimes present; ovary 2-locular, ovules many, stigma flattened, 2-lobed, slightly bent. **Fruits** thin-walled capsules, dehiscence loculicidal; seeds oblong, surface reticulate and ridged.

A tropical and warm-temperate American genus of ca. 15 species, the majority in South American. The species have sometimes been united with those of *Bacopa*, but Pennell (1946) separated them because of the stipitate anther-thecae and the yellow pigmentation of the corolla. The anthers, the gland-dotted foliage, the slightly bilobed deflexed stigma, and the loculicidal capsule strengthen the distinction and indicate a close relationship with *Stemodia*. In Costa Rica, *Mecardonia* differs from *Stemodia* in having yellow corollas and pedicels with small bracts at the base. However, these distinctions do not hold over the entire range of all species, and it may be necessary to reevaluate the genera.

Mecardonia procumbens (Mill.) Small, Fl. S.E. U.S. 1065 & 1338. 1903. *Erinus procumbens* Mill., Gard. Dict. ed. 8. 1768. *Lindernia dianthera* Sw., Prodr. 92. 1788. *Herpestis caparioides* Kunth in H.B.K., Nov. Gen. Sp. 2: 368. 1818. *H. peduncularis* Benth., Bot. Mag. 2: 56. 1836. *Bacopa procumbens* (Mill.) Greenman, Publ. Field Columb. Mus. Bot. Ser. 2: 261. 1907. Figure 2.

Herbs, prostrate to procumbent, stems to 40 cm long, distal stems few-branched, sometimes rooting at the proximal nodes, leafy stems 0.4–2 mm diam., glabrous, with 4 longitudinal ridges. **Leaves** opposite, subsessile or with poorly defined petioles to 4 mm long; **leaf blades** 6–24 mm long, 4–16 mm wide, ovate-elliptic to broadly or narrowly elliptic, apex obtuse, margin with 6–9 teeth/cm, base obtuse to cuneate, drying charta-

ceous and often blackish, glabrous, 2° veins 2 or 3/side. **Inflorescences** of solitary axillary flowers, linear bracts ca. 2 mm long at base of pedicel, pedicels 2–16(–24) mm long, 0.2–0.4 mm diam., glabrous. **Flowers** glabrous externally, calyx 5–9 mm long, outer 3 sepals 2.7–4 mm wide, ovate to lanceolate; **corolla** 8–10 mm long, tube ca. 7 mm long, yellow, purplish in the throat, barbate in the mouth, lobes 1–2 mm long; stamens 4, filaments borne on the lower half of the tube, a staminode sometimes present. **Fruits** 4–6 mm long, ovoid, dehiscent from the apex, placenta spongy; seeds 0.4–0.5 mm long, ca. 0.2 mm diam., oblong or ovoid, minutely reticulate, light brown.

Plants of open sunny or partly shaded sites on wet soils or wet sand in evergreen or deciduous areas, 0–1200(–2400) m elevation. Flowering and fruiting throughout the year. The species is particularly common in areas supporting evergreen lowland rain forest formations. The species ranges from Mexico to Uruguay and Argentina.

Mecardonia procumbens is recognized by its short herbaceous stems, general lack of pubescence, subsessile opposite serrate leaves, solitary axillary flowers on prominent pedicels, calyx with wide outer sepals and narrow inner sepals, and yellow tubular two-lipped corolla. These plants resemble species of *Bacopa*, *Lindernia*, and *Stemodia*, both in growth habit and in preference for moist open sites. This species can be separated from those in the other genera by the bright yellow corolla, glabrous gland-dotted foliage and bracteolate pedicels. This species is very closely related to *M. montevidensis* (Spreng.) Kuntze of southern South America.

Micranthemum Michaux

REFERENCE—L. O. Williams, Tropical American plants XII. Fieldiana, Bot. 34: 101–132. 1972 (*Micranthemum* pp. 122–124).

Small slender stemmed **herbs**, aquatic or growing in wet places, diffuse and much-branched, nodes often with adventitious roots. **Leaves** opposite, sessile, small, blades with entire margins, thin, usually glabrous, venation palmate. **Inflorescences** of solitary (rarely 2) axillary flowers, usually with 1 flower/node, bracts and bracteoles absent, pedicels short. **Flowers** minute, calyx with 4 or 5 lobes or 4 or 5 sepals, lobes equal, tube short or absent, glabrous or sparsely puberulent; **corolla** 2-lipped, tube very short, adaxial lip short

and 2-lobed, abaxial lip prominent and 3-lobed; stamens 2, filaments inserted at the mouth of the tube abaxially, anthers 2-theous, staminodes absent; ovary 1- or 2-locular, ovules many, style short, stigma 2-lobed. **Fruits** dry capsules, globose or ovoid, splitting irregularly; seeds oblong, with longitudinal ridges.

Micranthemum is a genus of perhaps 10 to 12 species, ranging from the southeastern United States to southern South America. It is most diverse in Cuba. The genus is recognized by its small slender-stemmed aquatic or semiaquatic habit, small sessile rounded leaves, minute solitary flowers, and small two-lipped corolla with two distal stamens. These delicate little plants are sometimes grown in freshwater aquaria. Although rarely collected in Central America, it is represented by the following species in Costa Rica.

Micranthemum umbrosum (J. F. Gmelin) Blake, *Rhodora* 17: 131. 1915. *Anonymous umbrosa* Walter, *Fl. Carol.* 63. 1788. *Globifera umbrosum* (Walter) J. F. Gmelin, *Syst. Nat.* 32. 1791. Figure 1.

Herbs, aquatic or in wet sites, creeping or often forming small mats, stems to ca. 12 cm long, leafy stems 0.2–0.8 mm diam., glabrous, with 2 longitudinal ridges. **Leaves** sessile, base of opposing leaves often forming a line or ridge across the stem; **leaf blades** 3–8 mm long, 2–7 mm wide, ovate-orbicular to rounded-obovate, apex obtuse to rounded, margins entire, obtuse or rounded at the contracted base, drying greenish and translucent, glabrous, with 3 major veins and 2 lateral veins. **Inflorescences** of solitary axillary flowers, usually with 1 flower/node, pedicels 0.5–1 mm long, 0.2–0.4 mm diam., glabrous. **Flowers** with calyx 0.8–1.3 mm long, sepals 4, equal and separate nearly to the base, narrowly oblong, with few minute hairs or glabrous; **corolla** ca. 1.5 mm long, white, tube very short; stamens 2, attached at the base of the abaxial sinuses. **Fruits** ca. 1 mm diam., globose, thin-walled, 1-locular; seeds 0.3–0.4 mm long, ca. 0.2 mm diam., oblong, yellowish, with minutely ribbed longitudinal ridges (50×).

Micranthemum umbrosum, ranging from the southeastern United States to South America, is rarely collected in Central America, but the very small size of the plants and their aquatic or wet habitats may have resulted in the species being overlooked. The species has been collected in Honduras, Nicaragua, and the Tortuguero region of northeastern Costa Rica. The slender glabrous

stems, small opposite sessile rounded leaves, minute solitary flowers, white two-lipped corolla with two stamens, and thin-walled capsules with one locule help distinguish these plants. *Micranthemum standleyi* Williams, an endemic of Guatemala, has smaller flowers, ovoid fruits, and pilose calyx lobes. *Micranthemum pilosum* Ernst, from Venezuela, is also similar, but it is possible that these are only variants of *M. umbrosum* in a broad sense.

Mimulus Linnaeus

REFERENCE—A. Grant, A monograph of the genus *Mimulus*. *Ann. Missouri Bot. Gard.* 11: 98–388. 1924.

Annual or perennial **herbs** (rarely shrubs), often preferring moist sites, decumbent or erect, with viscid pubescence or glabrous. **Leaves** opposite, simple, sessile or petiolate, blades entire or dentate, venation pinnate or palmate. **Inflorescences** of solitary flowers in leaf axils or forming terminal racemes, bracts absent or leaf-like, pedicels without bracteoles at the apex. **Flowers** showy, calyx tubular to campanulate, almost as long as the corolla, with 5 prominent veins, tube longer than the 5 short lobes or teeth, lobes usually unequal; **corolla** tubular or narrowly campanulate, 2-lipped, lips shorter than the tube, adaxial lip 2-lobed, abaxial lip 3-lobed, lobes subequal, usually with 2 yellowish protuberances in the throat; stamens 4 in 2 unequal pairs, included or exerted, filaments attached near the base of the tube, linear, anthers 2-theous with the thecae divaricate and confluent at the apex; ovary 2-locular, ovules many, style included, stigma flattened and 2-lobed. **Fruits** capsules, oblong to linear, thin- or thick-walled, dehiscence loculicidal, enclosed within the persisting and enlarged calyx tube; seeds small, smooth or reticulate.

Mimulus is a genus of ca. 150 species ranging from the Americas to Africa and Asia but with most of the species in western North America. Colorful species (monkey flowers) are grown in temperate gardens. No specimens of this genus have been collected in Costa Rica, but the following species may occur.

Mimulus glabratus Kunth *in* H.B.K., *Nov. Gen. Sp.* 2: ed. quarto 370. 1818. Figure 1.

Perennial **herbs**, procumbent or prostrate, 4–40 cm long, rooting at many lower nodes, leafy stems

0.3–4 mm diam. (dried), succulent in life, glabrous, nodes with an interpetiolar line formed by the clasping leaf bases, rooting at lower nodes. **Leaves** opposite, subsessile near the apex of stems or with petioles 2–18 mm long, 0.4–2 mm wide, with lateral margins continuous with the blade margins; **leaf blades** 8–45 mm long, 4–35 mm wide, ovate to ovate-oblong or ovate-orbicular, apex obtuse to rounded, margins with 3–5 prominent teeth/cm, base obtuse or truncated, drying grayish green, glabrous, venation palmate with 3–5 major veins. **Inflorescences** of solitary flowers axillary to foliage leaves (2/node), pedicels 12–42 mm long, 0.4–0.8 mm diam., glabrous. **Flowers** with calyx 5–10 mm long (14 mm in fruit), 2.5–4 mm diam., tubular, upper lobe larger (ca. 4 mm) than lower lobes (ca. 2 mm), glabrous; **corolla** 7–18 mm long, yellow with red spots within the throat, tube 2.5–4 mm diam., lobes 1–2 mm long. **Fruits** 6–10 mm long, 5–6 mm diam., included within the calyx tube; seeds 0.4–0.5 mm long, ca. 0.3 mm diam., oblong, brown, with poorly defined longitudinal ridges.

Mimulus glabratus ranges from the southern United States and Mexico to Nicaragua and from Colombia to Chile. In tropical environments it grows in wet sites at 100–2200 m elevation. These plants are recognized by their wet habitat, creeping stems with adventitious roots, lack of pubescence, opposite petiolate leaves, solitary axillary flowers on slender pedicels, tubular-plicate calyx with unequal lobes, and yellow two-lipped corolla with short lobes. Although not collected between Nicaragua and Colombia, this species may occur in our area.

Penstemon Mitchell

REFERENCE—R. Straw, The penstemons of Mexico. II. *Penstemon hartwegii*, *Penstemon gentianoides*, and their allies. Bol. Soc. Bot. Mexico 27: 1–25. 1962.

Perennial **herbs** or subshrubs, mostly erect, stems simple or branching from near the base, glabrous or pubescent. **Leaves** opposite, the lower leaves often petiolate, distal leaves often sessile and clasping the stem or bract-like; leaf blades serrate or entire, acute to rounded, venation pinnate. **Inflorescences** terminal panicles or thyrses (often racemiform), the partial inflorescences usually cymose, pedunculate with dichotomous branching, subtended by leaf-like or small bracts,

glabrous or puberulent, bracteoles present or absent. **Flowers** small or large, calyx deeply 5-parted, sepals imbricate in bud, equal or subequal; **corolla** tubular to tubular-campanulate, often narrowed at the base and abruptly expanded, 2-lipped, mostly blue to purple, sometimes red or white, upper (adaxial) lip 2-lobed and often erect, lower (abaxial) lip spreading or reflexed and 3-lobed; stamens 4 in 2 pairs, shorter than the corolla, bases glandular and nectariferous, filaments attached near the base of the tube, anthers glabrous or villous, thecae distinct or confluent, a staminode present and conspicuous; ovary ovoid, 2-locular, ovules many, style slender, stigma slightly 2-lobed or subcapitate. **Fruits** dry capsules, ovoid to globose, dehiscence septicidal and often loculicidal, valves entire or bifid; seeds many, dark, angular, rugulose to smooth, rarely winged along the margins.

Penstemon is one of the largest genera of Scrophulariaceae, with ca. 300 species ranging from temperate North America into the mountains of Mexico and Guatemala. The greatest number of species are found in the mountains of the western United States. The genus is identified by the tubular to campanulate flowers with a conspicuous staminode oriented on the lower (abaxial) side of the tube. Several species are colorful ornamentals, grown widely in temperate or tropical montane gardens. The following species is likely to be seen in Costa Rican gardens.

Penstemon gentianoides (Kunth in H.B.K.) Poir-et, Dict. Sci. Nat. 38: 385. 1825. *Chelone gentianoides* Kunth in H.B.K., Nov. Gen. Sp. 2: 363, tab. 172. 1818. *P. skutchii* Straw, Bol. Soc. Bot. Mexico 27: 13. 1962. Figure 8.

Erect perennial **herbs** or subshrubs 0.6–1.5 m tall, branched mostly in the lower half, leafy stems 2–6 mm diam., terete, glabrous or with thin straight hairs 0.1–0.2 mm long, nodes with interpetiolar ridges. **Leaves** opposite (but often with axillary short-shoots and giving a verticillate appearance), sessile or subsessile; **leaf blades** 4–12 cm long, 5–20 mm wide, lanceolate to linear-lanceolate, apex acute, margin entire, base cuneate to rounded, drying stiffly chartaceous, usually glabrous (except at the base), punctate above and below, 2° veins often obscure. **Inflorescences** 10–35 cm long, racemiform thyrses with axillary groups of (1–)3–9 flowers, bracts (reduced leaves) 12–30 mm long, usually lanceolate, peduncles 4–12 mm long, often terminated by opposite brac-

teoles 3–8 mm long, pedicels 3–12 mm long, minutely puberulent or subglabrous. **Flowers** with calyx 6–10 mm long, sepals 3–5 mm wide, broadly imbricate, glabrous or puberulent; **corolla** 2.5–4 cm long, tube 7–10 mm diam., narrowed near the base, deep purple to rose, red, or white, glabrous or minutely puberulent, lobes 6–10 mm long, throat white; filaments glabrous, anthers included, staminode ca. 22 mm long; ovary 5–7 mm long. **Fruits** 8–12 mm long, 5–6 mm wide, ovoid, style base persisting, septicial and loculicidal; seeds black, angular, rugulose.

Penstemon gentianoides, native to the higher (2400–4000 m) mountains of Mexico and Guatemala, is sometimes cultivated in gardens of the Meseta Central and at higher elevations. The spicate or racemiform arrangement of verticillate groups of large colorful flowers, with tubular corollas slightly expanded above the base, and the prominent staminode help to distinguish these plants.

Russelia Jacquin

REFERENCE—M. Carlson, Monograph of the genus *Russelia*. Fieldiana, Bot. 29: 231–292, 1957.

Perennial **shrubs** or herbaceous subshrubs from a woody base, erect or with pendent or scandent stems, distal branches few to many, stems angular or terete, puberulent or glabrous. **Leaves** opposite or whorled (caducous in *R. equisetiformis*), sub-

sessile or short-petiolate, blades usually ovate to lanceolate, margin entire or dentate to deeply incised, glandular (resinous) peltate scales (dots) often present, venation pinnate. **Inflorescences** dichotomous cymes, 1–3 in leaf axils or subtended by reduced bract-like leaves, often verticillate, subsessile to long pedunculate, linear bracts subtending the slender pedicels, bracteoles absent at the base of the calyx. **Flowers** mostly small (1–2 cm), calyx deeply 5-lobed or with 5 sepals, ovate to lanceolate, imbricate in bud, with or without peltate glands; **corolla** tubular to funnelliform, slightly 2-lipped, red to pink (white), the 5 lobes slightly unequal, the 2 (upper) adaxial lobes outside in bud, lower lip 3-lobed; stamens 4 in 2 unequal pairs, included, filaments borne in the lower half of the tube, thecae divaricate and confluent, a short staminode usually present; ovary 2-locular, ovules many, style slender, stigma slightly thickened. **Fruits** dry capsules, ovoid to subglobose, glabrous, dehiscence septicial (secondarily loculicidal); seeds small, slightly rugulose, developing among translucent fragmenting hairs (elaters) produced by the placenta.

Russelia is a genus of 51 species centered in Mexico and Guatemala, with one species reaching Cuba and Colombia. The genus has been placed in its own tribe because of the unusual hair-like fragments in the capsule. The small tubular red flowers (only slightly two-lipped) in axillary cymes and the peltate glands (when present) also help to distinguish members of this genus. Two species are found in Costa Rica.

Key to the Species of *Russelia*

- 1a. Common wild plants of seasonally dry habitats; leaves ovate, subsessile, 1–9 cm long; stems with opposite branches; inflorescences > 2-flowered; corollas 10–16 mm long *R. sarmentosa*
- 1b. Plants grown in gardens; leaves falling off early and stems and verticillate branches leafless; inflorescences 2-flowered; corollas 15–30 mm long *R. equisetiformis*

Russelia equisetiformis Schldl. & Cham., Linnaea 6: 377. 1831. *R. juncea* Zucc., Flora 15, Beibl. 2: 99. 1832.

Erect **subshrubs** to 1 m tall, much-branched, lower nodes with whorls of 4–8 branches, distal nodes with 2 branches or peduncles at each node, longitudinal ridges 2, 4, or 6, distal stems usually leafless, 0.7–6 mm diam., glabrous or minutely puberulent near the nodes with thin hairs 0.1–0.3 mm long. **Leaves** opposite or verticillate, usually

caducous, and absent at distal stems, petioles 3–4 mm long and often remaining appressed to the stems when blades fall; lower larger leaf blades 8–15 mm long, 6–9 mm wide, ovate to elliptic. **Inflorescences** 2–16 cm long, often resembling open racemose panicles, usually with 2–4 peduncles/node, each peduncle with 1 or 2 flowers, basal peduncles 0.5–1.5 mm diam., glabrous, with 2 or 4 prominent longitudinal ridges, bracteoles 1–2 mm long, linear, pedicels 6–15 mm long, 0.2–0.3 mm diam. **Flowers** glabrous externally, calyx

2–3 mm long, imbricate, acute or acuminate, glabrous; corolla 15–30 mm long, 2–4 mm diam., tubular-funnelform, bright red, glabrous within; stamens 18 and 20 mm long, anthers near mouth of the tube, staminode present; ovary 2 mm long, ovoid, style 15 mm long, stigma minute. **Fruits** 3–6 mm diam., globose; seeds light brown, among white hairs within the capsule.

Russelia equisetiformis is a popular garden plant because of its slender green leafless stems and bright red flowers. It is distinctive because of the ridged stems and verticillate arching branches, which resemble those of *Equisetum*. Common names in Central America are *coral* and *lluvia de coral*. The species is native to Mexico and is an occasional roadside escape in the Meseta Central.

Russelia sarmentosa Jacq., Enum. Pl. Syst. 6: 25. 1760. *R. colombiana* Pennell, Proc. Acad. Nat. Sci. Philadelphia 72: 186. 1920. *R. flavoviridis* Blake, Contrib. U.S. Natl. Herb. 24: 22. 1922. *R. tabacensis* Lundell, Contrib. Univ. Michigan Herb. 6: 59. 1941. *R. oxyphylla* Lundell, loc. cit. 7: 51. 1942. Figure 5.

Herbs or weak-stemmed **shrubs** 0.5–2 m tall, erect or spreading, base woody, distal flowering stems usually unbranched, leafy stems 1–5 mm diam., strongly 4- or 6-angled with raised longitudinal ridges, puberulent with thin whitish hairs 0.1–0.3 mm long or glabrous (except at the nodes). **Leaves** 2 or 3 at each node, subsessile with petioles 0.5–4 mm long, often forming an interpetiolar line across the stem, lateral margins puberulent; **leaf blades** 1–7(–9) cm long, 1–5(–6) cm wide, ovate to broadly ovate or ovate-triangular, apex acute, margin with 2–5 teeth/cm, teeth 0.5–2 mm long, obtuse or truncated at the base, drying dark or grayish, glabrous or puberulent above, usually more pubescent beneath with hairs 0.2–0.4 mm long, peltate glands (ca. 0.2 mm diam.) often present on both surfaces, 2° veins 3–5/side and strongly ascending. **Inflorescences** 2–3 cm long, congested verticels of cymes in distal leaf axils, 12–20 flowers/cyme, peduncles 2–18 mm long, resembling the stems, bracts 3–4 mm long, linear, pedicels 5–8 mm long. **Flowers** with calyx 3–4 mm long, ca. 1.3 mm diam., lobes 2–3 mm long, with thin lateral margins and acuminate apex, often with peltate glands; **corolla** 10–14(–16) mm long, 1.5–3 mm diam., tubular, deep red, puberulent within, lobes subequal, 1.3–3 mm long; stamens ca. 8 and 6 mm long, inserted near the middle of the tube, anthers white; ovary 1–2

mm long, style 4–8 mm long. **Fruits** 4–5 mm long (not including the 0.5–4 mm style base), 4–5 mm diam., rounded-ovoid to subglobose, drying dark; seeds 0.4–0.5 mm long, ca. 0.2 mm wide, dark, among yellowish hairs.

Common plants of open weedy sites and forest edges in deciduous and partly deciduous (rarely evergreen) forest formations, 0–1300 m elevation. Flowering and fruiting throughout the year but collected most often in July–August and December–January. The species ranges from Mexico to Cuba and Colombia.

Russelia sarmentosa is recognized by the often shrub-like habit, stiff few-branched distal stems with two or three subsessile leaves at each node, short cymes often forming compact verticels of flowers and fruits, and bright red tubular corollas. The prominent longitudinal ridges on stems, peltate glands on leaf surfaces and calyx (when present), and sepals broadly overlapping at the base are also helpful in recognizing this common species. We agree with Margery Carlson's delimitation (1957, cited above) of this wide-ranging and variable species, but we do not believe that the recognition of forms and varieties is useful. The common name is *coralillo*.

Schistophragma Bentham ex Endlicher

Small annual **herbs**, erect or procumbent, stems quadrangular and with longitudinal ridges, glabrous or sparsely minutely puberulent, drying yellowish brown. **Leaves** opposite, petiolate, blades deeply pinnatisect with few opposite or alternate narrow lobes (smaller leaves sometimes linear-oblanceolate), margins entire or with a few distal teeth, venation pinnate. **Inflorescences** of solitary flowers axillary to distal leaves, bracts and bracteoles absent, pedicels slender. **Flowers** small, calyx divided to near the base, sepals or calyx lobes 5, narrow, acute, subequal; **corolla** tubular and slightly 2-lipped, upper (adaxial) lip with 1 emarginate lobe, lower (abaxial) lip 3-lobed; stamens 4, in 2 subequal pairs, included; ovary narrowly ellipsoid, 2-locular, ovules many, style slender, dilated at apex. **Fruits** linear capsules, somewhat compressed and bisulcate, septicidal; seeds oblong, surface with compressed spiral ridges.

The delimitation of *Schistophragma* and its distinction from *Leucospora* Nuttall and *Conochea* Aubl. is the subject of disagreement. B. L. Turner (Turner & Cowan, Phytologia 74: 61–103, 1993) recognizes three species of *Schistophragma* and

includes *Leucospora* within *Stemodia*. D. Keil (pers. comm.) includes the species of *Schistophragma* in his concept of *Leucospora*, which he retains as distinct from *Stemodia*. *Schistophragma* is placed in the tribe Gratioloae, subtribe Stemodiinae. The spirally striate seeds are very unusual in the Scrophulariaceae, but seeds of this type are sometimes found in the Gesneriaceae. The small size of the plants, narrow or pinnatisect leaves, small tubular flowers, and very narrow capsules make these plants distinctive. The linear fruits resemble those of some Brassicaceae. Among American Scrophulariaceae, only *Mabrya* Elisens, from Mexico, has similar linear fruits.

Schistophragma mexicana Benth. ex D. Dietr., Syn. Pl. 3: 513. 1842. *S. pusilla* Benth. in DC., Prodr. 10: 392. 1846. *Conobea pusilla* (Benth.) Benth. & Hook. ex Jackson, Index Kew 1, fasc. 1: 596. 1893. *Stemodia siligiosa* Sessé & Moçino, Pl. Nov. Hisp. ed. 1: 98. 1887–1890, ed. 2: 91. 1893. Figure 4.

Erect to decumbent annual **herbs** 6–25 cm tall, with few or many branches, leafy stems 0.3–1 mm diam., with 4 longitudinal ridges (quadrangular in cross-section), glabrous or with few minute hairs, nodes lacking interpetiolar lines. **Leaves** opposite, deeply pinnatifid, petioles 2–7 mm long (to first lobe), undifferentiated from the narrow rachis, 0.2–0.5 mm wide, sulcate adaxially; **leaf blades** 4–18 mm long, to 12 mm wide, deeply pinnatisect with 3–7 narrow lobes (including the distal extension of the rachis), lobes 0.3–2 mm wide, entire or the larger with 1 or 2 lateral teeth, glabrous or minutely puberulent on the veins beneath, proximal lobes rarely with 1 or 2° lobes (bipinnatifid). **Inflorescences** of solitary axillary flowers, usually 2/ node, pedicels 3–5 mm long, ca. 0.15 mm diam., glabrous or subglabrous. **Flowers** with calyx 2–4 mm long, sepals united only at the base, ca. 0.3 mm wide, glabrous; **corolla** 5–6.5 mm long, violet to purple or bluish purple, tube ca. 4 mm long, 1.5 mm diam.; ovary glabrous, style 2–3 mm long. **Fruits** 8–12 mm long, 0.9–1.2 mm wide, linear, smooth and bisulcate, drying blackish, apex acute, style deciduous or sometimes persisting; seeds 0.7–0.9 mm long, 0.3–0.4 mm diam., cylindrical with truncated ends, brown, the closely spaced ridges forming spirals around the surface.

Rarely collected plants of moist areas in open sunny sites, 0–1100 m elevation in Central Amer-

ica. Probably flowering primarily in the wet season, June–December. Only two Costa Rican collections have been seen: *A. Jimenez 984*, from near Playa Coco, Guanacaste, and *Tonduz 13790*, from Nicoya, Puntarenas. The species ranges from Mexico to northwestern Costa Rica and has been collected in Colombia.

Schistophragma mexicana is very distinctive because of its small stature, small opposite pinnatifid leaves with narrow lobes, small flowers with tubular purple or violet corollas, and dark linear fruits. This is the only Costa Rican species of Scrophulariaceae with linear fruits and one of the few with pinnatifid leaves (compare *Benjaminia* and *Castilleja*).

Scoparia Linnaeus

Herbs or subshrubs, annual or perennial, profusely branched, leafy stems slender, 4- to 6-angled. **Leaves** opposite or verticillate, 2–4/node, sometimes caducous or reduced to scales, petioles little differentiated from the blade, blades dentate to pinnatifid or entire, base cuneate, often glandular-punctate, venation pinnate. **Inflorescences** of 1 or 2 flowers in leaf axils (1–8/node), bracts and bracteoles absent, pedicels filiform. **Flowers** small, calyx 4- or 5-parted, sepals ovate to lanceolate, 1 often larger than the others; **corolla** subrotate with very short tube and 4 spreading or reflexed lobes (upper lip emarginate), white to blue, rose, or yellow, with a ring of hairs at the mouth of the tube; stamens 4, subequal or equal, inserted at the base of the tube, anthers sagittate with parallel or subequal thecae; ovary 2-locular, ovules many, style short, stigma subcapitate, exerted. **Fruits** thin-walled capsules, globose to ovoid, dehiscence septicial; seeds small, reticulate with pitted surface.

Scoparia is a Neotropical genus of ca. 17 species with centers of diversity in Mexico and southern South America. The plants are native to dry scrub and grasslands, and some species have become successful weeds. *Scoparia* is distinctive within the family because of its usually four-lobed corolla with very short tube and conspicuous hairs. Unfortunately, the corollas are fugaceous, and the characters of erect habit, solitary or paired flowers, four calyx lobes, and crenate or pinnatifid leaves must be used for identification. One species occurs in Costa Rica, and a second is likely to be found here.

Key to the Species of *Scoparia*

- 1a. Corolla white or pale lilac; sepals 4, obtuse or rounded at the apex; leaf blades to 35 mm long; plants usually becoming >40 cm tall; Mexico to Costa Rica *S. dulcis*
1b. Corolla yellow; sepals 4 or 5, acute at the apex; leaf blades to 20 mm long; plants <30 cm tall; Mexico to Nicaragua *S. annua*

Scoparia annua Schldl. & Cham., *Linnaea* 6: 375. 1831.

Small erect annual **herbs** 10–20(–30) cm tall, much-branched from the base or lower half, leafy stems 0.4–1.5 mm diam., glabrous, with 4 prominent longitudinal ridges. **Leaves** opposite, petioles not clearly differentiated from the blades, glabrous; **leaf blades** 5–20 mm long (including the narrowed base), lower blades ovate to rhombic and pinnatifid with rounded lobes to 4 mm long, distal blades linear-oblong and entire or with a few distal teeth, glandular punctate beneath. **Inflorescences** of solitary flowers in leaf axils (2/ node), pedicels 6–18 mm long, filiform, glabrous. **Flowers** with calyx 2 mm long, sepals 4- or 5-parted, lanceolate-oblong with acute apices, glabrous; **corolla** to 3 mm long, rotate, yellow, fugaceous, lobes 2 mm long, rounded; stamens equal, filaments glabrous; ovary ellipsoid, style shorter than the ovary, stigma minute. **Fruits** 2.5–3 mm long, 1.5–2 mm wide, ovoid, subtended by sepals ca. 3 mm long; seeds reticulate.

Scoparia annua ranges from Mexico to central Nicaragua in open sunny habitats from sea level to 1000 m elevation; it is also found in South America. These small weedy plants are likely to be overlooked, and it is possible that they will be found in northwestern Costa Rica.

Scoparia dulcis L., *Sp. Pl.* 116. 1753. Figure 4.

Herbs or subshrubs 0.3–1 m tall, woody at the base, often with many lateral branches, leafy stems 0.5–4 mm diam., 4- or 6-angled with 4 or 6 longitudinal ridges, glabrous or puberulent at the nodes, nodes with interpetiolar line. **Leaves** 2 or 3 (4) at each node, petioles 1–8 mm long (poorly differentiated), 0.3–0.9 mm wide; **leaf blades** 6–35 mm long, 2–15 mm wide, narrowly elliptic to oblanceolate (basal leaves ovate to ovate-rhombic), apex obtuse to acute, with 5–8 teeth/side distally, teeth 0.3–3 mm long, base obtuse to cuneate, drying grayish green, glabrous, glandular punctate on both surfaces, 2° veins 2 or 3/side.

Inflorescences of 1–3 flowers axillary to distal leaves (leaves often reduced to 6 mm long and bract-like), nodes with 2–6 flowers, pedicels 3–9 mm long, 0.1–0.2 mm diam., glabrous or minutely puberulent. **Flowers** with 4-parted calyx, 2 mm long (–3 mm in fruit), lobes ca. 1.3 mm long, elliptic to oblong, apex obtuse or rounded; **corolla** rotate and 3–4 mm wide distally, pale lilac or white, white-barbate within the throat; stamens ca. 1.5 mm long, anthers 0.7 mm long. **Fruits** 3 mm long, 2–3 mm diam., broadly ovoid, smooth, yellowish gray; seeds 0.3–0.4 mm long, 0.2–0.3 mm diam., oblong or irregularly angled, pale brown, pits in longitudinal rows.

Common plants of open sunny sites in deciduous, partly deciduous, and wet evergreen forest formations, 0–1300 m elevation. Flowering and fruiting throughout the year but collected most often in the wet season, June–December. The species ranges from the southeastern United States to southern South America and is a pantropical weed.

Scoparia dulcis is recognized by its short, much-branched herbaceous habit, nodes with usually two or three leaves, dentate leaf blades, small flower with white rotate corollas, and thin-walled fruits with pitted seeds. This species is a common weed in the lowlands of Central America. The bushy stems have been used to make small brooms and are believed to repel fleas (Standley & Williams, 1973). The plants have an aromatic odor and are called sweet broom; *culantrillo*, *escoba amarga*, *escobeta*, and *escobilla amarga* are Spanish names.

Sibthorpia Linnaeus

REFERENCE—O. Hedberg, A taxonomic revision of the genus *Sibthorpia*. *Bot. Not.* 108: 161–183. 1955.

Prostrate or creeping **herbs** rooting at many nodes, perennial, internodes often elongated, stems terete, with multicellular hairs, plants drying greenish or brown. **Leaves** alternate or crowd-

ed, petioles often long, slender, blades orbicular to reniform, margin crenate with broad rounded or truncated lobes, base cordate, villous to glabrous, venation palmate. **Inflorescences** of 1–3 flowers in axils of leaves, bracts and bracteoles absent, pedicels long and slender. **Flowers** very small, almost radially symmetric, calyx campanulate, united in the basal half with 5 (4–8) lobes, lobes subequal, acute, persisting in fruit; **corolla** subrotate with very short tube and 5 (4–8) spreading lobes, white, yellow, pink, or reddish purple, lobes rounded; stamens 2–8, as many as the corolla lobes or 1 or 2 fewer, borne near the apex of the tube, filaments slender, subequal, anthers slightly sagittate, thecae parallel or slightly divergent, confluent near the apex, staminodes absent; ovary pubescent, ovules few, style short, stigma simple or capitate. **Fruits** thin-walled capsules, dehiscence loculicidal; seeds few, oblong to ovate, convex on 1 surface, reticulate or smooth.

Sibthorpia is a genus of six species found in Europe, the high mountains of Africa, and higher elevations in the Neotropics. The creeping growth form, small alternate cordate reniform or orbicular leaves with crenate margins, very small axillary flowers, almost radially symmetric corolla, short corolla tube, and few-seeded capsules distinguish this genus. Seed morphology indicates that this genus is related to *Veronica*.

Sibthorpia repens (Mutis ex L.) Kuntze, Rev. Gen. Pl. 3: 239. 1898. *Willichia repens* Mutis ex L., Mant. Pl. 2: 558. 1771. *S. pichinchensis* Kunth in H.B.K., Nov. Gen. Sp. 2: 390, tab. 176. 1817. *S. triandra* Suesseng., Repert. Sp. Nov. Regni Veg. 39: 18. 1935.

Creeping **herbs**, usually with long internodes and few lateral branches, rooting at most nodes, leafy stems 0.5–1 mm diam., with slender translucent multicellular hairs 0.2–0.8 mm long, older stems usually glabrescent. **Leaves** alternate, petioles 2–22(–30) mm long, 0.3–0.8 mm diam., with translucent hairs to 0.8 mm long; **leaf blades** 6–22 mm long, 6.5–25 mm wide, ovate-suborbicular to rounded-reniform, apex a rounded lobe, margin crenate with 5–9 rounded or truncated lobes/side, lobes 0.5–4.5 mm wide, base cordate with sinus 1–7 mm deep, drying membranaceous, translucent hairs sparse to dense on both surfaces, major veins 3 or 5. **Inflorescences** of 1 (2) flowers in axils of leaves, pedicels 3–12 cm long (to 4 cm long in Mexico), filiform, puberulent. **Flowers** with calyx 1.7–2 mm long, united and campanu-

late, lobes 4 or 5, 0.5–1 mm long, acute; **corolla** 2–3 mm long, 3.5–5 mm wide, subrotate, pale lilac to dull purple to brown-purple or dark wine-red (white in Ecuador), tube very short, lobes 0.7–1.3 mm wide; stamens 2–4; style 2 mm long, stigma capitate. **Fruits** ca. 2 mm long, subglobose, lower part enclosed within the calyx cup, surface with straight ascending hairs 0.1–0.2 mm long, persisting style ca. 0.8 mm long; seeds ca. 0.7 mm long, oblong, dark with a whitish reticulum.

Rarely collected herbs of partly shaded to deeply shaded sites in evergreen montane forest formations, 1600–3100 m elevation. Collected with flowers in April–June (flowering primarily in December–March in northern Central America). These plants are locally common in open high-elevation forests of Guatemala, but we have seen only five collections from Costa Rica. This species ranges from central Mexico to Costa Rica and is found in the Andes.

Sibthorpia repens is recognized by the creeping habit, slender stems with many adventitious roots, small suborbicular leaves with lobed crenate margins, small axillary flowers, subrotate corollas with two epipetalous stamens, and few-seeded capsules enclosed at their base by the campanulate calyx. This species is quite variable in a number of significant taxonomic features. Despite this variability, it seems probable that, as Hedberg (1955, cited above) and Williams (1972) have suggested, the Neotropical material represents a single species. These plants are easily mistaken for species of *Hydrocotyle* (Apiaceae) or *Dichondra* (Convolvulaceae) with similar growth form.

Stemodia Linnaeus

Nomen conservandum

REFERENCES—B. Turner & C. Cowan, Taxonomic overview of *Stemodia* (Scrophulariaceae) for North America and the West Indies. *Phytologia* 74: 61–103. 1993. Taxonomic overview of *Stemodia* (Scrophulariaceae) for South America. *Phytologia* 75: 281–324. 1993.

Erect or procumbent **herbs** or shrubs to 3 m tall, annual or perennial, stems terete or angular, often much-branched, usually puberulent, often with gland-tipped hairs, drying greenish or brown. **Leaves** opposite, subopposite, or verticillate, simple, sessile or petiolate, blades serrulate to pinnately lobed (rarely subentire), pinnately veined or subpalmate, often glandular-punctate. **Inflorescences** of 1–3 flowers in axils of leaves or bracts (1–6/node), sometimes forming distal racemes, thyrses, or panicles, bracts absent when

flowers are subtended by leaves, pedicels slender, bracteoles present or absent at the base of the calyx. **Flowers** with deeply 5-parted calyx, sepals narrow and acute, equal or more often slightly unequal (adaxial sepal often larger), valvate in bud, persisting and enlarging slightly in fruit; **corolla** tubular to narrowly campanulate, 2-lipped, white to blue, lilac, or purple (yellowish when faded), 4- or 5-lobed, bilabiate, upper (adaxial) lip 2-lobed or entire, lower lip 3-lobed, often bearded at the base of the lobes; stamens 4, equal or of 2 unequal pairs, included, borne on the tube, filaments glabrous or puberulent, anthers glabrous, with an enlarged connective separating the 2 parallel or divergent thecae, a staminode sometimes present; ovary ovoid, style terete, stigma ligulate, often minutely 2-lobed or capitate and reflexed. **Fruits** dry capsules, often bisulcate, dehiscent loculicidally and partly septucidally from the apex (2- or 4-valved), placenta drying to form a peg that is free from the apex of the locule; seeds many, small, oblong to pyriform or irregular, often longitudinally sulcate or ridged, usually with a short stipe at one end.

According to Turner and Cowan (1993) *Stemodia* is a genus of 29 Neotropical and 20 Old World species, including several widespread weeds. They are placed in subfamily Antirrhinoideae, tribe Gratioleae, subtribe Stemodiinae. Because of the variability of important taxonomic characteristics within the genus, it is likely that *Stemodia* may be broken up into smaller genera (see *Darcya*). Minod (1918) split the genus into a number of genera that have generally not been accepted. His characters were often variable and his nomenclature was flawed, which, as much as his splitting, accounts for the lack of interest in his classification. We follow Turner and Cowan's treatment and their annotations. These generally short, weedy plants are recognized by their opposite or ternate leaves, one- to six-flowered nodes, calyx with narrow sepals united only near the base, tubular two-lipped bluish to purple or white corollas, and style often curved at the terminal stigma. Other important characters are the anthers with thecae slightly separated by an expanded connective, and the seeds often with longitudinal ridges or sulci.

Key to the Species of *Stemodia*

- 1a. Flowers and fruits borne on slender pedicels 6–19 mm long; corollas white to pink or yellowish (if flowers have a prominent calyx tube, see *Torenia*) 2
- 1b. Flowers and fruits subsessile or on pedicels < 4 mm long; corollas blue to purple 3
 - 2a. Flowers 7–9 mm long; fruits 4–5 mm long; plants to 20 cm tall *S. angulata*
 - 2b. Flowers 12–15 mm long; fruits 5–7 mm long; plants to 80 cm tall *S. peduncularis*
- 3a. Fruits at least 3 mm long; calyx 4–6 mm long; flowers on spike-like axes; leaves subsessile, larger leaves to 6 cm long and oblanceolate *S. durantifolia*
- 3b. Fruits 1.8–2.5 mm long; calyx 2–4 mm long; flowers in leaf axils; leaves petiolate, larger leaves to 2 cm long and ovate-triangular *S. verticillata*

Stemodia angulata Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjobenhavn 1853: 22. 1854. *Stemodiakra angulata* (Oerst.) Kuntze, Rev. Gen. Pl. 2: 466. 1891. *Stemodia jorullensis* subsp. *reptans* Minod, Bull. Soc. Bot. Genève, ser 2, 10: 190. 1918. Figure 2.

Small **herbs** 5–20 cm tall, stems to 40 cm long, often much-branched, leafy stems 0.3–1.7 mm diam., pubescence of thin multicellular translucent hairs 0.2–1.2 mm long, slightly viscid. **Leaves** opposite, petioles 2–9 mm long, 0.2–0.5 mm wide, puberulent with thin whitish hairs; **leaf blades** 6–20 mm long, 3–18 mm wide, ovate to ovate-triangular or ovate-rhombic, apex obtuse or round-

ed, margin with 7–11 teeth/side, base broadly obtuse or truncate, glandular punctate and sparsely puberulent above and below, 2° veins 3–5/side, ascending. **Inflorescences** of 1 (2 or 3) flowers in leaf axils, pedicels 4–12 mm long (–19 mm in fruit), 0.1–0.2 mm diam., puberulent, bracteoles absent. **Flowers** with calyx 4–6 mm long, sepals 3–5 mm long, ca. 0.8 mm wide at the base, puberulent; **corolla** 7–9 mm long, white with purple lines within (yellowish in age), tube to 7 mm long, 1.4–2 mm diam., lobes to 2 mm long; stamen pairs very unequal, 2 borne at the base and 2 in the upper part of the tube. **Fruits** 4–5 mm long, ca. 2 mm diam., oblong, pale yellowish brown, glabrous; seeds 0.3–0.4 mm long, 0.2–0.3 mm

diam., variously shaped, brown to black, longitudinally sulcate with 6–8 ridges.

Plants of open sunny sites in both seasonally dry and wet evergreen forest areas, 10–1400 m elevation. Probably flowering and fruiting throughout the year, but collected most often in August–March. The species ranges from Mexico and the West Indies to northwestern South America.

Stemodia angulata is recognized by its short stature, opposite ovate-triangular leaves, solitary axillary flowers on slender pedicels, nearly separate sepals, and small white to rose corollas. Standley (1938) included this species under *S. peduncularis*, but that species, although similar, is larger in almost all its dimensions. In the *Flora of Panama*, specimens of this species were placed under *S. jorullensis* Kunth in H.B.K., a species of western Mexico.

Stemodia durantifolia (L.) Swartz, Obs. Bot. 240. 1791. *Capraria durantifolia* L., Syst. Nat. ed. 10: 1116. 1759. Figures 4 and 6.

Herbs 0.2–0.9(–1.5) m tall, annual or becoming woody at the base, usually with many branches, leafy stems 0.5–4.5 mm diam., pubescent with crooked translucent multicellular viscid glandular hairs 0.1–0.5 mm long, stems 4-angled with 4 longitudinal ridges. **Leaves** 2–3/node, diminishing in size distally and intergrading with the bracts, sessile and clasping the stem; **leaf blades** 1.4–7 cm long, 4–18 mm wide, smaller leaves narrowly elliptic-oblong to narrowly ovate, larger leaves oblanceolate, apex acute, margin with 3–12 teeth/side, base auriculate in larger leaves, both surfaces with minute (0.1 mm) glandular hairs and longer thin hairs, 2° veins 2–5/side. **Inflorescences** 4–17 cm long, spicate or paniculate to 50 cm long with opposite spicate branches and internodes 5–15 mm long, puberulent like the stems, bracts (reduced leaves) 5–16 mm long, 2–5 mm wide, pedicels 0–3 mm long, bracteoles 1 or 2, subtending the calyx, linear, 2–5 mm long. **Flowers** with calyx 4–6 mm long, ca. 1 mm diam., lobes 2–4 mm long, linear-lanceolate, densely glandular-puberulent; **corolla** 5–7 mm long, blue to purple, glandular-puberulent, tube ca. 1 mm diam., yellow within the throat, lower lobes ca. 1.5 mm long; stamens inserted at the same level near the mouth of the tube, connective globose; style 3–4 mm long. **Fruits** 3–4 mm long, 2 mm diam., narrowly ovoid, smooth, yellowish brown; seeds 0.2–0.3 mm long, 0.15 mm diam., narrowly oblong or nar-

rowed at one end, dark brown, with longitudinal rows of rounded tubercles (50×).

Weedy plants of open sunny moist sites or partly shaded woodland in seasonally dry vegetation of the Pacific slope (rarely collected on the Caribbean slope), 0–900 m elevation. Flowering and fruiting throughout the year, but collected most often in November–March. The species ranges from the southwestern United States, Mexico, and the West Indies to Chile and Brazil.

Stemodia durantifolia is recognized by the erect, much-branched, weedy habit, viscid pubescence, sessile leaves with basal blades oblanceolate, long distal spikes with short internodes, small flowers, and blue or purple corollas. The flowers are usually two per node but may be as many as six per node. Distal bracts may be alternate or tightly congested on flowering stems. The bracteoles are difficult to distinguish from the sepals but are an unusual character. These plants resemble species of *Hyptis* (Lamiaceae).

Stemodia peduncularis Benth. in DC., Prodr. 10: 382. 1846. *Stemodiocris peduncularis* (Benth.) Kuntze, Rev. Gen. Pl. 2: 466. 1891. Figure 3.

Erect or decumbent **herbs** 10–80 cm tall, usually with few or no lateral branches on distal stems, leafy stems 0.5–2 mm diam., pubescence of thin white or viscid hairs 0.2–0.5 mm long, glabrescent. **Leaves** opposite, petioles 4–14 mm long, 0.3–0.9 mm wide, puberulent with thin whitish hairs, leaf base decurrent on the petiole; **leaf blades** 8–40(–50) mm long, 6–25(–35) mm wide, ovate to ovate-triangular or ovate-oblong, apex acute, margin with 8–12 teeth/side, base obtuse to truncate, punctate and minutely (0.1–0.2 mm) puberulent on both sides, 2° veins 3 or 4/side, strongly ascending. **Inflorescences** of 1 or 2 flowers in leaf axils (1–4/node), pedicels 6–18 mm long (–50 mm in fruit), 0.1–0.2 mm diam., with thin whitish hairs 0.1–0.2 mm long. **Flowers** with sepals 4–7 mm long, 0.7–1 mm wide at the base, linear to linear-triangular, minutely puberulent (sometimes glandular punctate); **corolla** 11–15 mm long, white or red-veined (yellowish), tube 8–10 mm long, 2–3 mm diam., externally glabrous, lobes 2–3 mm long; stamens borne near the base of the tube; style 4–7 mm long. **Fruits** 5–7 mm long, narrowly ovoid; seeds 0.5–1 mm long, irregular in shape, black.

Inrequently encountered plants of shaded sites in moist evergreen montane forest formations along the Continental Divide and Pacific slope in

the central volcanic highlands and Cordillera de Talamanca, 1300–2400 m elevation. Flowering and fruiting throughout the year, but collected mostly in December–March. The species ranges from western Mexico to western Panama.

Stemodia peduncularis is recognized by its short, erect, few-branched habit, opposite serrate leaves, mostly solitary flowers on long slender pedicels, separate linear sepals, and white tubular corollas. Standley (1938) incorrectly included *S. angulata* under this species. This species resembles our species of *Darcya* in general appearance.

Stemodia verticillata (Miller) Hassler, Trab. Mus. Farmacol. 21: 110. 1909. *Erinus verticillatus* Miller, Gard. Dict. ed. 8. 1768. *S. parviflora* W. T. Aiton, Hortus Kew., ed. 2, 4: 52. 1812. *S. arenaria* Kunth in H.B.K., Nov. Gen. Sp. 2: 357. 1817. *Lindernia verticillata* (Miller) Britton in Britton & Wilson, Bot. Porto Rico 6: 184. 1925. Figure 2.

Small **herbs** 5–15(–25) cm tall, prostrate to ascending, rooting only near the base, internodes mostly 4–14 mm long, leafy stems 0.5–1 mm diam., densely puberulent with straight or curved (often glandular) hairs 0.2–0.8 mm long. **Leaves** usually 2 or 3 (4) per node, petioles 2–11 mm long, 0.2–0.5 mm wide, puberulent, leaf base decurrent on the petiole; **leaf blades** 5–12(–18) mm long, 3–10(–14) mm wide, ovate to ovate-triangular or ovate-oblong, apex obtuse, margin with 5–9 teeth/side, teeth ca. 0.5 mm long, base obtuse or truncated, both surfaces with hairs 0.1–0.5 mm long, 2° veins 3–5/side. **Inflorescences** of usually 2 subsessile axillary flowers (2–6/node), pedicels 0.5–2 mm long, minutely puberulent, bracteoles absent. **Flowers** with calyx 2–4 mm long, sepals equal or subequal, 0.5 mm wide near the base, with thin whitish and glandular hairs; **corolla** 3–5 mm long, blue-violet or purple with white throat, tube 1 mm diam., lobes 1–2 mm long; stamens borne in the lower half of the tube, anther thecae 0.3 mm long; style 1–1.5 mm long with recurved stigma. **Fruits** 1.8–2.5 mm long, 1.4–2 mm wide, ovoid-subglobose, glabrous, pale yellow-brown; seeds ca. 0.5 mm long, 0.2–0.3 mm diam., narrowly ovoid, yellowish, with dark tip 0.05 mm long, surface with longitudinal ridges and sulci.

Uncommon weeds of open sunny or shaded sites (often on sand or wet gravel) in evergreen or deciduous vegetation, 0–1600 m elevation. Probably flowering and fruiting throughout the

year, but collected in Costa Rica primarily in July–August. The species ranges from Mexico and the West Indies to Argentina.

Stemodia verticillata is recognized by its small, often prostrate habit, mixture of both glandular and eglandular hairs, small petiolate leaves subtending solitary subsessile flowers, narrow sepals, and bluish or purple corollas. Plants with three or four leaves per node are distinctive. The glandular punctations of the leaf surfaces are often obscure. These plants have been called *hierba santa* (Costa Rica) and *corrimiento* (El Salvador).

Tetranema Benthham ex Lindley

REFERENCES—M. Grayum & B. Hammel, The genus *Tetranema* (Scrophulariaceae) in Costa Rica, with two new species. *Phytologia* 79: 269–280. 1995 (1996). T. Méndez-Larios & J. Villaseñor. Revisión taxonómica del genero *Tetranema* (Scrophulariaceae). *Acta Bot. Mexico* 32: 53–68. 1995.

Herbs, erect or decumbent, perennial, sometimes woody at the base but the stems usually short, glabrous or pubescent. **Leaves** opposite and often crowded near the base, equal or unequal at a node, subsessile and clasping the stem or petiolate, blades dentate to subentire, venation pinnate. **Inflorescences** axillary, cymose to subumbellate or congested, long-pedunculate, bracteate, pedicels short but often elongating in fruit. **Flowers** with the calyx deeply 5-parted, campanulate, lobes narrow and attenuate-acuminate, with prominent longitudinal ribs; **corolla** tubular to campanulate, 2-lipped, glabrous, white to rose, purple or less often red, tube longer than the lobes, upper lip emarginate (1-lobed), lower lip with 3 spreading lobes, imbricate in bud; stamens 4 (rarely 3), filaments of 2 longer and 2 shorter pairs, anthers 2-theous, a staminode very small (in ours) or absent; ovary 2-locular, style slender or thick, stigma capitate or bilobed. **Fruits** capsules, ovoid to globose, glabrous, dehiscence loculicidal; seeds many, angled or tetrahedral, surface reticulate or foveolate.

Tetranema is a genus of six species from Mexico and Central America. It is distinguished by its opposite leaves, axillary and cymose inflorescences, separate sepals, four-lobed and two-lipped corolla, and loculicidal capsules. Our recently discovered species are unusual in having red (probably hummingbird-pollinated) flowers. These distinctive plants (Fig. 27) may resemble *Razisea*

spicata Oerst. and *Odontonema tubaeforme* (Bertol.) Kuntze of the Acanthaceae. The Costa Rican species are similar to *T. megaphyllum* (Brandege) L. O. Williams, but that species has smaller (2–4 mm) corolla lobes and larger (6–10 mm) floral bracts and is endemic to Mexico. Species of *Tetranema* are sometimes cultivated as ornamen-

tals, especially *T. roseum* (M. Martens & Galeoti) Standl. & Steyerl. The new species come from the Pacific slope of central Costa Rica and both slopes of southern Costa Rica. The dichotomy in *Flora of Guatemala* separating *Tetranema* from *Penstemon* and *Uroskinnera* is inverted (Standley & Williams, 1973, p. 321).

Key to the Species of *Tetranema*

- 1a. Inflorescences with 14–30 flowers, peduncle purple; corollas 26–35 mm long, pubescent internally with a band of flat yellow hairs along the entire ventral (abaxial) surface and onto the lower lobe; leaf apex rounded to short-acuminate; 1200–1600 m on Cerro Turrubares *T. floribundum*
 1b. Inflorescences with 2–12 flowers, peduncle green; corollas 44–55 mm long, glabrous throughout or rarely pubescent on the lower lobe and mouth; leaf apex long-acuminate; 500–1200 m elevation on both Caribbean and Pacific slopes *T. gamboanum*

Tetranema floribundum B. Hammel & M. Grayum, *Phytologia* 79: 269–280. 1995 (1996). Figure 27.

Erect **herbs** (0.3–)0.8–2 m tall, decumbent near the base and often rooting at the lower nodes, internodes to 5 cm long, arachnoid or wooly-pubescent when young, leafy stems 1.5–5 mm thick, glabrescent. **Leaves** opposite, sessile with petioles 0–6 mm long, ca. 2 mm thick; **leaf blades** 14–24 cm long, 7–13 cm wide, broadly elliptic to oblanceolate or spatulate, apex abruptly acute or short-acuminate, margins coarsely serrate or undulate-toothed with teeth ca. 1 mm high, base gradually cuneate, mostly glabrous above, minutely puberulent on the major veins beneath, lustrous beneath when dry, 2° veins 8–11/side, ascending. **Inflorescences** 15–30 cm long, 14–30-flowered, peduncles 13–23 cm long, purple, with 4 longitudinal ridges, bracts 1–5 mm long, narrowly triangular, margins ciliate (often only at the base), pedicels 10–20 mm long, glabrous. **Flowers** with calyx ca. 3 mm long (–5 mm in fruit), divided nearly to base, striate and glabrous (except along margins), with a short apical projection; **corolla** 26–35 mm long, 5–6 mm diam., tubular and slightly expanded distally and curved upward, red-orange, lobes 4, ca. 13 mm long, 2.5–5.5 mm wide, the 3 lower rounded apically and reflexed-spreading, puberulent internally abaxially; stamens slightly exerted, anthers 0.8–0.9 mm long, staminode ca. 0.5 mm long; ovary ca. 3.5 mm long. **Fruits** not seen at maturity, ca. 8 mm long, ovoid, borne on pedicels ca. 20 mm long.

Plants of evergreen lower montane forest for-

mations at 1200–1600 m elevation on Cerro Turrubares. Flowering in December–January and March. This species is known only from an isolated peak on the Pacific slope of the southeastern part of the central plateau in the province of San José.

Tetranema floribundum is recognized by its larger subsessile elliptic to obovate leaves with many ascending secondary veins, inflorescences with long purple peduncles, five separate acute sepals, curved-tubular red corollas, and isolated habitat. Cerro Turrubares is also the location of a recently discovered and unusual species of *Psychotria* (Burger & Jiménez, 1994).

Tetranema gamboanum M. Grayum & B. Hammel, *Phytologia* 79: 269–280. 1995 (1996). Figure 27.

Erect **herbs** 1–2 m tall, internodes to 11 cm (or more) long, at first minutely strigulose, 1.7–5 mm thick, glabrous but with a puberulent interpetiolar line. **Leaves** opposite, sessile to subsessile or with petioles to 1 cm long, canaliculate above, margins ciliate at the base; **leaf blades** 14–31 cm long, 5–11 cm wide, elliptic to elliptic-obovate, apex long-acuminate, margin coarsely serrate with teeth 1–2 mm high, base cuneate and abruptly narrowed at the base, glabrous above or with few hairs along midvein and major veins, minutely puberulent along the veins beneath, 2° veins 9–13/side. **Inflorescences** axillary cymes with 2–13 flowers, peduncles 9–24 cm long, green, quadrangular with 4-winged ribs, bracts 0.5–2 mm long, subulate to narrowly triangular, ciliate along the margins, pedicels 9–12 mm long (–20 mm in fruit),

glabrous. **Flowers** with 5-parted calyx, sepals 3–5 mm long (–6 mm in fruit), inner 2 sepals slightly smaller than the outer, narrowly to broadly ovate, imbricate in bud, minutely ciliolate along the margin, apex acute, venation parallel; **corolla** 44–55 mm long, ca. 5 mm diam., narrowly tubular, gradually expanded distally and slightly curved, bright red, glabrous throughout or with hairs at throat and lower lobes, lobes 8–14 mm long, 3–4 mm wide, lanceolate or oblong, the 3 lower lobes obtuse to rounded at the apex and spreading-reflexed; stamens slightly exserted, filaments dilated near base, glabrous, anthers 0.8–1 mm long, with divergent thecae confluent at the base, staminode 1.5–2 mm long; ovary 3–4 mm long, narrowly ovoid, style exserted, stigma capitate. **Fruits** capsules, 6–9 mm long (not including the 1–2 mm style base), subglobose-apiculate, glabrous; seeds 0.5–0.7 mm long, 0.4–0.5 mm diam., rectangular or oblong-rounded, surface with prominent pits (foveolate), dark yellow to brown or blackish.

Newly discovered plants of evergreen rain forest formations on the Caribbean slope of the Cordillera de Talamanca and on the southern Pacific slope, 500–1200 m elevation. Flowering and fruiting in December–May. This species has been collected only from between 83°W and 84°W in the southern half of Costa Rica.

Tetranema gamboanum is distinguished by its erect stems with larger ellipsoid leaves with many lateral veins, axillary cymes on long peduncles, five-parted calyx, and bright red, slightly curved corolla tubes.

Torenia Linnaeus

Annual or perennial **herbs**, erect or procumbent, branching from both basal and distal nodes,

Key to the Species of *Torenia*

- 1a. Corolla 30–40 mm long, lower lobes dark purple or blue-violet; calyx broadly winged and 5–10 mm wide; leaves 16–50 mm long, often truncate at the base *T. fournieri*
- 1b. Corolla 7–12 mm long, lower lobes pale purple or pale blue-violet; calyx not winged, 2–3 mm diam.; leaf blades 8–22 mm long, obtuse to rounded at the base *T. thouarsii*

Torenia fournieri Linden in Fourn., *Illustr. Hort.* 23: 129, tab. 249. 1876. Figure 8.

Weak-stemmed erect **herbs** 15–50 cm tall, often reddish near the base, main stems with 2–5 branching nodes, leafy stems 1–3 mm diam., 4-

stems 4-angled with longitudinal ridges, puberulent to hirsute or glabrous. **Leaves** opposite, petiolate, blade margins entire to serrate or crenulate, venation pinnate. **Inflorescences** of 1–3 flowers in axils of distal leaves or in short terminal or axillary few-flowered racemes, linear bracts sometimes present, pedicels usually held at a 45° angle to the stem. **Flowers** showy or small, calyx usually somewhat shorter than the corolla tube, united to form a long tube with 3–5 short lobes (or 2-lipped), with 3–5 longitudinal ribs or broad wings, persisting and enlarging in fruit; **corolla** campanulate to tubular or salverform, bilabiate with the upper lip erect and 2-lobed, lower lip with 3 lobes, tube usually widened distally, bearded in the throat; stamens 4, in 2 unequal pairs, filaments inserted near the top of the tube and usually with a tooth-like appendage at the base, anterior 2 arching upward over the stigma (with anthers connivent or reduced), thecae oblong to linear, divaricate by the enlarged connective; disc prominent and saucer-shaped or cupulate; ovary oblong, style straight, stigma slightly 2-lobed. **Fruits** capsules, usually enclosed within the persisting perianth tube, oblong-ellipsoid, dehiscent septically to the base, placenta linear with septum forming wings; seeds globose to variously angled, tuberculate or reticulate.

Torenia is a genus of 40 to 80 species of tropical Africa and Asia. A few species are cultivated ornamentals that have become naturalized in the Americas. *Torenia* is closely related to *Lindernia*, sharing the curved appendaged filaments often found in that genus. Species of *Torenia* in the New World can be distinguished from *Lindernia* by their larger flowers, tubular calyx, elongate fruits, and globose pitted seeds.

angled with prominent longitudinal ridges, nodes with thin whitish hairs 0.2–0.5 mm long (internodes often glabrous). **Leaves** opposite throughout, petioles 3–17 mm long, 0.7–1.4 mm wide, with thin whitish hairs along the adaxial margins; **leaf blades** 16–50 mm long, 6–25 mm wide, tri-

angular to ovate-triangular or ovate-elliptic, apex acute, margin with prominent teeth, base truncate to obtuse, upper surface with few thin straight hairs 0.2–0.5 mm long, 2° veins 3–6/side, strongly ascending. **Inflorescences** of solitary flowers in distal leaf axils (2/node) or more often in short terminal racemes with 4–8 flowers, bracts 2–5(–12) mm long, linear, pedicels 4–18 mm long, 0.6–1 mm wide, glabrous or very sparsely puberulent. **Flowers** with calyx 13–22 mm long, 5–10 mm wide, tube more than half the calyx length, broadly winged to produce an ovate form with acute or acuminate apices, ciliolate; **corolla** 3–4 cm long, 2–3 cm wide distally, tube 7–9 mm diam. in the center, whitish near the base, upper lip often pale blue with the lower lobes very dark blue-violet, a yellow patch present within at the base of the central lobe. **Fruits** 1–2 cm long, included within the slightly enlarged calyx.

Torenia fournieri, a native of southeastern Asia, is widely planted as an ornamental. This species may become naturalized in lowland and mid-elevation areas of Central America, but it seems doubtful that the populations persist for long. These plants are easily distinguished by their small size, opposite (often triangular) leaves, few-flowered racemes, broadly winged calyx, and relatively large corollas with dramatic dark purple-violet coloring. This species is unusual within the genus in having broadly winged sepals and in lacking basal appendages on the lower filaments. *Torenia asiatica* L. is similar but has prostrate stems. The large colorful corollas make these plants especially attractive. They can be mistaken for members of the Gesneriaceae.

Torenia thouarsii (Cham. & Schldl.) Kuntze, Rev. Gen. Pl. 2: 468. 1891. *Nortenia thouarsii* Cham. & Schldl., Linnaea 3: 18. 1828. *Lindernia thouarsii* (Cham. & Schldl.) Edwin, Phytologia 19: 361. 1970. Figure 3.

Procumbent or erect **herbs** 10–30 cm tall, leafy stems 0.6–1.3 mm diam., quadrangular, internodes glabrous or with thin whitish hairs 0.2–0.5 mm long, nodes usually with thin hairs. **Leaves** opposite throughout, petioles 1–7 mm long, ca. 1 mm wide with thin lateral margins, sparsely puberulent; **leaf blades** 8–22 mm long, 5–12 mm wide, ovate-elliptic to ovate-triangular, apex acute, margins with 4 or 5 prominent teeth/cm, base obtuse to rounded, surfaces glabrous or sparsely puberulent, 2° veins 3–5/side, arcuate ascending. **Inflorescences** of 1 or 2 flowers axillary

to foliage leaves (1–4/node), bracts ca. 2 mm long, linear, pedicels 2–15 mm long, ca. 0.5 mm diam., glabrous or sparsely puberulent. **Flowers** with calyx 4–12 mm long, 1.3–2 mm diam. (to 18 × 3 mm in fruit), narrowly tubular to tubular-ellipsoid, glabrous, lobes 2–3 mm long, acute; **corolla** 7–12 mm long, bluish, purple, or white, lobes crenate; filaments with a linear appendage at base, staminode with a rounded tip. **Fruits** 8–10 mm long, 2–3 mm wide, narrowly oblong-ellipsoid, included within the enlarged calyx tube or the tube splitting.

Torenia thouarsii, a native of India, is naturalized in parts of Central and South America. In Costa Rica it is occasionally found in wet sites at 10–2000 m elevation, from the Caribbean lowlands to the central highlands. These plants resemble species of *Lindernia* and *Stemodia* but differ in the tubular calyx and narrowly oblong fruits.

Veronica Linnaeus

Annual or perennial **herbs** (rarely shrubs), prostrate or ascending to erect, often branching from the base, stems terete or with longitudinal ridges, glabrous or puberulent. **Leaves** opposite near the base and usually alternate distally, sometimes intergrading with smaller floral bracts, sessile or petiolate, blades subtire to dentate, crenate or divided, pubescence of simple multicellular or glandular hairs, venation usually palmate or subpalmate. **Inflorescences** of solitary flowers in leaf axils or of elongate racemes (or spike-like) with flowers solitary in the axils of bracts, usually terminal, pedicels very short to long and slender. **Flowers** mostly small, calyx deeply 4-lobed (rarely 5-lobed), the lobes (sepals) subequal to unequal, slightly overlapping in bud, usually persisting and slightly enlarged in fruit, glabrous or puberulent; **corolla** rotate (rarely campanulate), tube very short, corolla lobes 4 (5), unequal, with the lower lobe the smallest, lateral lobes exterior in bud, blue to purple or white (rarely reddish); stamens 2, borne at either side of the upper lobe, exerted, filaments attached at the base of the tube and free, anthers 2-theous, thecae confluent at the apex; ovary rounded, 2-locular, ovules few to many, style simple, persisting in fruit but not enlarging, stigma capitate. **Fruits** capsules, flattened at right angles to the plane of the septum, obovoid or 2-lobed (obcordate) with a depressed or emarginate apex, dehiscence loculicidal (also sometimes septical); seeds few to many, ovate to or-

bicular, surfaces smooth to rugulose, often with the inner face concave, embryo often U-shaped.

Veronica is a genus of 150 to 250 species confined to cool climates. The great majority of species are found in Europe and Asia, but a number have become widespread weeds; it seems likely that none are native to Central America. The genus is distinguished (in our area) by its small herbaceous growth form, small leaves becoming alternate distally, small flowers with prominent calyx lobes (sepals), bluish to lilac or white corollas with the four lobes usually held in a single plane (rotate), two stamens, and unusual fruits. The cap-

sules are flattened perpendicular to the plane of the septum and often have an emarginate or deeply notched apex. The rounded lateral lobes of the fruits (carpels) can be lenticular or rounded. The genus is placed in the tribe Veroniceae and is closely related to *Sibthorpia* and the Australasian *Hebe*. Unfortunately, some species of *Veronica* are very similar, and a number of Central American collections have been misidentified in the past. In Costa Rica the genus has not been found below 1200 m elevation, and only two species (*V. polita* and *V. serpyllifolia*) are commonly collected.

Key to the Species of *Veronica*

- 1a. Flowers borne on conspicuous pedicels, the pedicels much longer than the calyx lobes, flowers arising from the axils of leaves or from short axillary racemes; leaves with prominent teeth along the margins; styles 1.3–3 mm long 2
- 1b. Flowers borne on short pedicels, the pedicels much shorter to slightly longer than the calyx lobes, flowers arising from the axils of leaves or from the axils of floral bracts differing greatly in size and form from the basal leaves; leaves with small or inconspicuous teeth along the margin (except in *V. arvensis*); styles 0.5–2.5 mm long 3
 - 2a. Corolla < 8 mm wide; fruits about as broad as long, ca. 4 mm wide, venation obscure; fruiting sepals ca. 5 mm long; leaf blades often triangular-ovate; styles 1.3–1.6 mm long; occasional at 1400–3300 m elevation *V. polita*
 - 2b. Corolla 8–13 mm wide; fruits distinctly broader than long, 5–9 mm wide, venation prominent; fruiting sepals ca. 6 mm long; leaf blades usually ovate-oblong; styles 1.8–3 mm long; rarely collected in Costa Rica *V. persica*
- 3a. Lower leaf blades 8–28 mm long, narrowly oblanceolate, leaves gradually intergrading into the smaller distal floral bracts; erect stems to 45 cm tall; corolla white with purple lines [pedicels ca. 1 mm long; styles ca. 0.5 mm long; rarely collected in southern Central America] .. *V. peregrina*
- 3b. Lower leaf blades up to 12 mm long, usually broadly ovate; leaves usually clearly differentiated from the smaller floral bracts; erect stems rarely exceeding 20 cm in height; corolla usually bluish 4
- 4a. Pedicels becoming 6 mm long; styles 1.8–2.5 mm long; margins of leaf blades subentire to slightly crenate; frequent in Costa Rica *V. serpyllifolia*
- 4b. Pedicels 0.5–1.2 mm long; styles ca. 0.6 mm long; margins of leaf blades minutely to conspicuously dentate-crenate; rarely collected in Costa Rica *V. arvensis*

***Veronica arvensis* L., Sp. Pl. 13. 1753.**

Annual herbs, 5–20(–40) cm tall, stems usually branching only near the base, leafy stems 0.4–1.3 mm diam., puberulent with thin curved whitish hairs 0.2–0.7 mm long. **Leaves** opposite (but bracts of the inflorescences alternate), sessile or the basal leaves with petioles 1–4 mm long; **leaf blades** 4–12 mm long, 3–10 mm wide, broadly ovate to ovate-oblong, apex obtuse or rounded, margin crenate-dentate with 2–6 teeth 0.3–0.8 mm high, base obtuse or truncate, with thin hairs

ca. 0.5 mm long on both surfaces, venation palmate with 3 or 5 major veins. **Inflorescences** erect spike-like racemes, 2–15 cm long, bracts 4–7 mm long, 1–2 mm wide, narrowly oblong to narrowly ovate, narrowed at the base, rachis 0.5–1.2 mm diam., puberulent, pedicels 0.5–1.2 mm long. **Flowers** with unequal calyx lobes 2.5–4 mm long (becoming 5 mm long in fruit), ca. 1 mm wide, narrowly oblong to narrowly elliptic-oblong, puberulent with short thin hairs; **corolla** blue, upper lobe ca. 2 mm long; anthers ca. 0.4 mm long; styles ca. 0.6 mm long. **Fruits** 3.5–4 mm long,

ca. 3.5 mm wide, lenticular-obovoid, distally bilobed with an apical notch 0.5–1 mm deep, puberulent along the margin.

Veronica arvensis is found on the slopes of Volcán Turrialba (Khan *et al.* 1977), but it is rarely collected in Central America. This species is recognized by its short stature, leaves with subentire margins, very short pedicels, and blue corollas. The closely clustered bracts and calyx lobes give the inflorescences of this species a spike-like appearance. Also, there are few intermediate leaves along the stem between the lower foliage leaves and the much narrower floral bracts in this species.

Veronica peregrina L., Sp. Pl. 14. 1753. *V. xalapensis* Kunth in H.B.K., Nov. Gen. Sp. 2: 389. 1817. *V. peregrina* var. *xalapensis* (Kunth in H.B.K.) Pennell, Torreya 19: 167. 1919.

Erect or spreading **herbs** 5–45 cm tall, branching mostly near the base, leafy stems 0.3–3 mm diam., glabrous (in var. *peregrina*) or with minute (0.2 mm) gland-tipped hairs (in var. *xalapensis*). **Leaves** opposite near the base and alternate distally, gradually becoming smaller and bract-like distally, narrowed at the base but a petiole not clearly differentiated; **leaf blades** 8–28 mm long, 1–8 mm wide, narrowly oblong to narrowly elliptic-oblong or oblanceolate (spatulate), apex bluntly acute or rounded, margin entire or with few small teeth, base gradually narrowed and cuneate, surfaces glabrous, venation subpalmate with a prominent midvein. **Inflorescences** of solitary flowers in leaf axils or flowers in the axils of reduced bract-like distal leaves, spike-like with pedicels ca. 1 mm long, rachis sparsely puberulent. **Flowers** with subequal or strongly unequal calyx lobes ca. 4 × 1 mm (–6 mm long in fruit), narrowly oblong, sparsely puberulent; **corolla** 2–3 mm wide, white marked with purple lines; stamens 2–3 mm long; style ca. 0.5 mm long. **Fruits** 2.8–4 mm long, 4–5 mm wide, obovoid-triangular with a slight indentation at the apex, compressed-lenticular, glabrous or puberulent.

Plants of open moist sites, often along riverbeds, 1000–3000 m elevation. Probably flowering throughout the year in northern Central America, but rarely collected in southern Central America. This species is native to southern Europe and is now widely naturalized in temperate climates.

Veronica peregrina is recognized by its white flowers, longer erect spicate stems, and narrowly oblong subentire leaves. Although glabrous in Eu-

rope, plants in the Americas range from glabrous to glandular puberulent (var. *xalapensis*). The typical glabrous variety is more common in the eastern United States, whereas var. *xalapensis* is most common in the western United States, Mexico, and Central America, but they intergrade, and both varieties can be found in a broad band across the central United States. The longer distal stems are unusual in that there is a gradual change from flowers subtended by narrow leaves (to 3 cm long) to flowers subtended by linear bracts only 6 mm long.

Veronica persica Poirlet in Lam., Encycl. 8: 542. 1808. *V. rotundifolia* Sesse & Mociño, Fl. Mex. 5. 1892.

Creeping **herbs**, stems 5–30(–50) cm long (–15 cm tall), leafy stems 0.5–2 mm diam., puberulent with thin whitish hairs 0.1–0.5 mm long, often in longitudinal rows. **Leaves** opposite near the base and alternate throughout the distal stems, petioles 1–7 mm long, puberulent; **leaf blades** ovate to ovate-orbicular, 6–24 mm long, 4–16 mm wide, apex obtuse to rounded, margin with 3–6 prominent (0.5–2 mm) serrate lobes/side, base obtuse or truncate, surfaces with whitish hairs to 0.7 mm long, venation palmate with 3 or 5 major veins. **Inflorescences** of solitary flowers in leaf axils (bracts absent), pedicels 10–35 mm long, 0.2–0.3 mm diam., puberulent. **Flowers** with 4-parted calyx, sepals 4–5 mm long, subequal, to 6 mm long in fruit, 1–1.5 mm wide at the base, lanceolate, surfaces glabrous but the margin ciliolate; **corolla** 8–13 mm wide, upper lobe ca. 4 mm wide, pale blue or lilac with darker blue lines; filaments 2–3 mm long, anthers 0.9 mm long; style 1.8–3 mm long. **Fruits** 3.5–5 mm long, 5–9 mm wide, broadly obovate with apical notch and divergent lateral sides, surface glabrous or with thin hairs, the veins becoming prominent; seeds ovoid, flattened, rugulose.

Veronica persica, probably a native of the Caucasus and southwestern Asia, is now naturalized over much of northern North America and is rarely found at higher elevations in Mexico and Central America. Standley reported this species as growing on the slopes of Volcán Irazú in Costa Rica. This species is recognized by its creeping habit, solitary flowers in leaf axils, and larger obovate capsules that are distinctly broader than long. The broad fruit causes the persisting sepals to spread wide as the fruit matures. This species has often been confused with *V. polita*, but that

species has smaller flowers and different fruits. Material cited as *V. polita* in *Flora of Guatemala* and *Flora of Panama* is actually *V. persica*.

Veronica polita Fries, Novit. Fl. Succ. 63. 1819. Figure 2.

Creeping or vining **herbs**, stems 5–70(–120) cm long, branching at both distal and basal nodes, leafy stems 0.4–1.5 mm diam., appressed puberulent with thin whitish hairs 0.1–0.2 mm long. **Leaves** opposite, petioles 4–18 mm long, 0.3–0.6 mm wide and expanding at the blade, appressed puberulent; **leaf blades** 6–22 mm long, 6–22 mm wide, triangular to ovate-triangular, apex acute to obtuse, margins with 4–8 prominent teeth 0.3–3 mm high, base truncate to subcordate, surfaces with scattered stiff sharp hairs 0.1–0.7 mm long, venation palmate with 3 major veins. **Inflorescences** of solitary flowers in axils of leaves or of short (2–4 cm) axillary racemes with narrowly elliptic bracts 2–4 mm long, pedicels 3–15 mm long, 0.2–0.3 mm diam., puberulent. **Flowers** with calyx lobes (sepals) 4, subequal or with 1 distinctly smaller, lobes 3–4 mm long (–5 mm in fruit), 1.5–2 mm wide, narrowly obovate or obovate, surfaces subglabrous but margins with stiff curved hairs; **corolla** 4–5 mm long, less than 8 mm wide at anthesis, blue with linear darker markings, filaments ca. 1.3 mm long, anthers 0.4 mm long; styles 1.3–1.6 mm long. **Fruits** ca. 3 mm long, 3–4 mm wide, obovate-triangular or slightly obcordate, veins usually indistinct; seeds obovoid, with one flattened face, rugulose to ridged.

Plants of open moist slopes, damp disturbed sites, and partly shaded forest floor, 1400–3000 m elevation. Flowering and fruiting throughout the year. This species is a native of Europe that is now widely naturalized in North America and montane areas in Central America.

Veronica polita is distinguished by its often triangular leaves with prominent teeth, flowers in axils of leaves or on short axillary racemes, well-developed pedicels, and blue corollas not extending much beyond the obovate sepals. In addition, the stems are often long and much-branched, and many parts have short sharp hairs. There has been a controversy over the correct name for this species. An earlier name, *V. didyma* Tenore, has been used for this species, but many European authors consider that name a nomen ambiguum and reject it in favor of *V. polita*. This species is closely related to *V. persica*.

Veronica serpyllifolia L., Sp. Pl. 12. 1753. *V. tenella* All., Fl. Pedemont. 1: 75. 1785. *V. humifusa* Dickson, Trans. Linn. Soc. 2: 228. 1794. *V. serpyllifolia* var. *humifusa* (Dickson) Vahl, Enum. Pl. 1: 65. 1805. *V. crenulata* Sesse & Mociño, Fl. Mex. 5. 1892, non Ruiz & Pavón 1798. Figure 2.

Small **herbs** 5–20 cm tall, erect stems unbranched, sometimes with repent sterile leafy branches forming small mats, leafy stems 0.5–0.9 mm diam., puberulent with thin ascending whitish hairs 0.1–0.2 mm long. **Leaves** opposite in the lower half of the stem, alternate and smaller below the flowering nodes, petioles 0.5–2 mm long or the leaves sessile; **leaf blades** 3.5–12 mm long, 1.5–9 mm wide, broadly ovate to broadly oblong, becoming narrower distally (6 × 3 mm), apex rounded to obtuse, margin subentire to obscurely crenate with teeth 0.1–0.2 mm high, obtuse to rounded at the base, glabrous above and below, venation subpalmate. **Inflorescences** 4–15 cm long, erect, racemes or spike-like, rachis appressed puberulent, flowers distant or closely spaced, bracts 2–6 mm long, 1–3 mm wide, narrowly elliptic-oblong to narrowly ovate-elliptic, sessile, glabrous, pedicels 2–4 mm long (–6 mm in fruit), glabrous or puberulent. **Flowers** usually puberulent at the base, calyx lobes 4, subequal, 2–4 mm long, ca. 0.9 mm wide, lanceolate, glabrous or minutely puberulent; **corolla** ca. 4 mm long, lobes 2–4 mm wide, pale blue to blue-purple and with darker lines; styles 1.8–2.5 mm long. **Fruits** 2.3–4 mm long, 3–4.5 mm wide, obovoid with slightly or moderately depressed apex (obcordate), glabrous or minutely puberulent along the distal margins; seeds ovoid, flattened on 1 face, smooth.

Plants of damp open or partly shaded sites in montane forest formations, 2400–3300 m elevation. Probably flowering throughout the year; it is common along the Carretera Interamericana in the Cordillera de Talamanca. This species, a native of western Eurasia, is now widely naturalized in North America and higher elevations in Mexico and Central America.

Veronica serpyllifolia is recognized by its narrow unbranched erect stems, small subentire leaves, short-pedicellate flowers, and subequal oblong calyx lobes. This species is the second most commonly collected species of *Veronica* in Costa Rica.

List of Accepted Species of Scrophulariaceae

Key: END-CR = endemic to continental Costa Rica; END-CR&WP = endemic to Costa Rica and western Panama; END-WP = endemic to western Panama; INTRO = introduced weed; ORNAM = cultivated ornamental; ORNAM & NAT = cultivated and naturalized; ?? = not collected in Costa Rica but known from nearby areas. Total number of species covered is 72; the number of documented native species is 48.

Alectra aspera INTRO
Alonsoa meridionalis
Angelonia angustifolia ORNAM
Anisantherina hispidula
Antirrhinum majus ORNAM

Bacopa axillaris
Bacopa bacopoides ??
Bacopa egensis
Bacopa laxiflora
Bacopa monnieri
Bacopa monnierioides
Bacopa repens
Bacopa salzmännii
Bacopa sessiliflora
Benjaminia reflexa
Buchnera pusilla
Buchnera weberbaueri

Calceolaria irazuensis END-CR
Calceolaria mexicana
Calceolaria microbefaria
Calceolaria perfoliata
Calceolaria tripartita
Capraria biflora
Castilleja arvensis
Castilleja irasensis END-CR
Castilleja lentii END-CR
Castilleja quirosii END-CR&WP
Castilleja talamancensis END-CR
Castilleja tayloriorum END-CR
Cymbalaria muralis INTRO

Darcya costaricensis END-CR
Darcya reliquiarum END-WP
Digitalis purpurea ORNAM & NAT

Escobedia grandiflora
Hemichaena fruticosa

Lamaronia gutierrezii END-CR&WP
Lamaronia lanceolata
Lamaronia viscosa
Lencocarpus perfoliatus
Limosella acaulis
Linaria canadensis ??
Linaria vulgaris ORNAM
Lindernia crustacea
Lindernia diffusa
Lindernia dubia
Lophospermum erubescens ORNAM & NAT

Maurandya barclaiana ORNAM
Maurandya scandens ORNAM

Mazus pumila INTRO
Mecardonia procumbens
Micranthemum umbrosam ??
Mimulus glabratus ??

Penstemon gentianoides ORNAM

Russelia equisetiformis ORNAM & NAT
Russelia sarmentosa

Schistophragma mexicana
Scoparia annua
Scoparia dulcis
Sibthorpia repens
Stemodia angulata
Stemodia durantifolia
Stemodia peduncularis
Stemodia verticillata

Tetranema floribundum END-CR
Tetranema gamboamun END-CR
Torenia fournieri ORNAM
Torenia thouarsii INTRO

Veronica arvensis INTRO
Veronica peregrina INTRO
Veronica persica INTRO
Veronica polita INTRO
Veronica serpyllifolia INTRO

SCHLEGELIACEAE Reveal

By William Burger and Kerry Barringer

REFERENCES—W. D'Arcy, Scrophulariaceae, *in* Flora of Panama. Ann. Missouri Bot. Gard. 66: 173–272, 1979. R. Olmstead & P. Reeves, Evidence for the polyphyly of the Scrophulariaceae based on chloroplast *rbcL* and *udhF* sequences. Ann. Missouri Bot. Gard. 82: 176–191, 1995. J. Reveal, Newly required suprageneric names in vascular plants. Phytologia 79: 68–76, 1996.

Shrubs, subshrubs or lianas, erect or climbing, terrestrial or epiphytic, autotrophic, bisexual, stems without internal phloem, glabrous or with simple, eglandular or glandular, unicellular or multicellular hairs, nodes lacking interpetiolar lines or glandular fields; stipules absent. **Leaves** opposite or subopposite, simple, entire (serrulate in *Synapsis*), usually coriaceous to subcoriaceous, glabrous or puberulent, pinnately veined. **Inflorescences** racemes, cymes, or of solitary flowers in leaf axils, sometimes in dense fascicles, bracteoles present, pedicels well developed. **Flowers** bisexual, small to large, often showy, calyx irregularly lobed, 5-lobed or split, persistent and usually accrescent in fruit; **corolla** tubular to funnel-form, bilaterally symmetric or almost radially

symmetric, 5-lobed, the tube straight (not saccate or spurred); **stamens** 4, borne on the corolla tube, filaments free, alternating with the corolla lobes, anthers 2-theecous, thecae equal, distinct, a staminode present, disc absent; **pistil** solitary, ovary superior, 2-locular, ovules many, unitegmic, borne on 2 large axile placentas, the style 1, terminal, stigmas simple. **Fruits** baccate, indehiscent; seeds many, with reticulate exotesta, the embryo small, straight.

Schlegeliaceae is a family of four Neotropical genera and about 30 species. The genera *Gibsoniothamnus* and *Schlegelia* are found in Costa Rica, and they are closely related. Until recently the genera of this family were included in either the Scrophulariaceae or Bignoniaceae but were atyp-

ical for either family. Evidence from chloroplast DNA sequences (Olmstead & Reeves, 1995, cited above) indicates that the family is not closely related to either of these families but is a distinct group, probably most closely related to the basal Verbenaceae, such as *Callicarpa*. In recognition of their distinctiveness, Reveal (1996, cited above) established the family Schlegeliaceae for this group. Our representatives are distinguished from most Bignoniaceae by their simple entire leaves and baccate fruits. The family also differs from many bignons in lacking tendrils, interpetiolar lines, and interpetiolar gland fields on the stems. The Schlegeliaceae are distinguished from most Scrophulariaceae by their woody habit and baccate-indehiscent fruits.

Key to the Genera of Schlegeliaceae in Costa Rica

- 1a. Epiphytic shrubs; corollas usually reddish to purple (less often white), tubular and almost radially symmetric; staminodes < 5 mm long; fruits with fleshy covering; leaves usually 4–8 cm long *Gibsoniothamnus*
- 1b. Lianas or rarely small trees or epiphytic shrubs; corollas white to pinkish (in Costa Rica), tubular-campanulate and usually clearly bilaterally symmetric; staminodes usually > 5 mm long; fruits with a hard outer covering; larger leaves usually > 10 cm long (except in *S. brachyantha*) *Schlegelia*

Gibsoniothamnus L. O. Williams

REFERENCES—W. D'Arcy, *Gibsoniothamnus* (Scrophulariaceae) in Flora of Panama, Part 9. Ann. Missouri Bot. Gard. 66: 220–227. 1979. A. Gentry, Note on *Gibsoniothamnus*. Fieldiana, Bot. 34: 55. 1971. A. Gentry, *Gibsoniothamnus* (Scrophulariaceae) in Panama. Ann. Missouri Bot. Gard. 61: 533–537. 1974. A. Gentry, New or noteworthy species of middle American Bignoniaceae. Wrightia 7: 83–89. 1982. P. C. Standley & L. O. Williams, *Gibsoniothamnus* (Scrophulariaceae) in Flora of Guatemala. Fieldiana, Bot. 24: 356–359. 1973. L. O. Williams, An overlooked genus of the Scrophulariaceae. Fieldiana, Bot. 32: 211–214. 1970.

Shrubs or small trees, epiphytic or rarely terrestrial, to 6 m tall, young stems terete or angular, glabrous or pubescent, leaf base persistent and becoming conspicuously raised, older stems with a light-colored bark. **Leaves** opposite or subopposite, equal or unequal (anisophyllous) at a node, clearly articulated at the base, petioles usually short, merging with the base of the blade, blades simple and entire, often elliptic, coriaceous or

subcoriaceous (rarely chartaceous), glabrous or puberulent, usually with glandular pits scattered on the underside, domatia often present in the axils of veins and midvein below. **Inflorescences** of solitary axillary flowers or flowers in terminal cymes, panicles, racemes, or condensed and fasciculate, peduncles present or absent, pedicels elongate, merging with the calyx and often the same color as the calyx, usually bracteate. **Flowers** usually colorful throughout, calyx cupulate or campanulate, glabrous or puberulent, lobes usually 5, narrow and tooth-like to elongated and laterally compressed or winged, persistent and often accrescent in fruit; **corolla** tubular to narrowly funnelliform, often brightly colored in purples and reds, radially symmetric or slightly 2-lipped, glabrous externally or ciliolate along the distal edges, lobes 5, rounded and subequal, much shorter than the tube, tube interior with hairs near the stamen insertion; stamens 4, included, equal or in 2 subequal pairs, inserted above the base of the tube, filaments filiform, bent near the apex, anthers with a broad connective and 2 separate parallel or slightly divaricate thecae, staminode 1, usually shorter than the stamens; disc lacking; ovary 2-

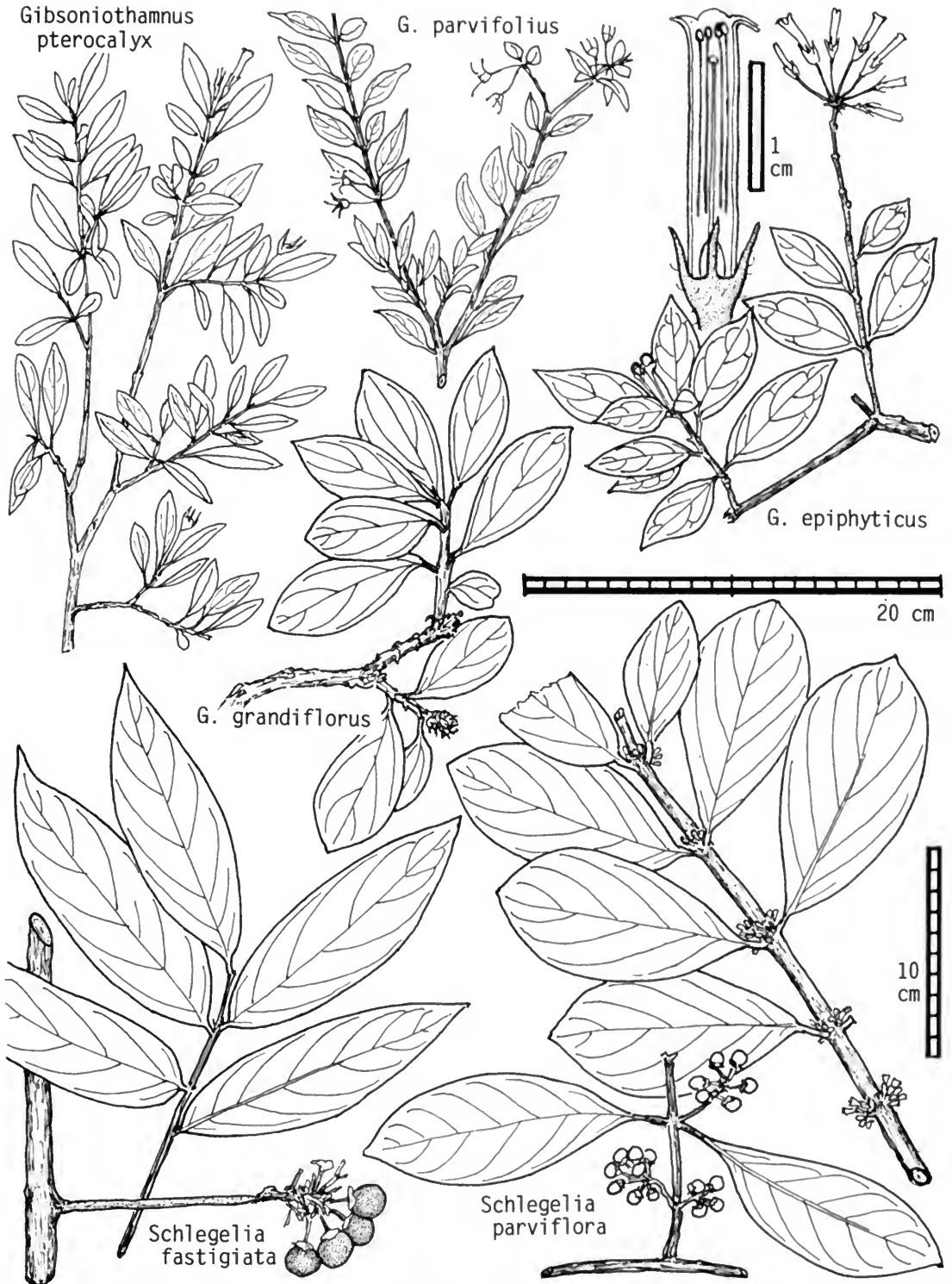


FIG. 9. Schlegeliaceae: epiphytic shrubs, vines, or trees with berry-like fruits; species of *Gibsoniothamnus* and *Schlegelia*.

locular, ovules many, style slender, longer than the stamens, stigma capitate. **Fruits** fleshy berries, globose to subglobose, juicy or mucilaginous; seeds many, seed coat reticulate, the margins of the reticulae bearing elongate filaments that are sticky or mucilaginous; endosperm absent in mature seeds, embryo straight.

Gibsoniothamnus is a genus of 12 species native to southern Mexico, Central America, and adjacent Colombia. The paucity of earlier collections resulted in D'Arcy's broad specific concepts

(1979), but additional collecting appears to justify the recognition of a larger number of geographically isolated species. The domatia vary from tufts of hairs in vein axils to well-defined pits or pockets in the lower leaf surface; they may be lacking in some species. Our species are less pubescent and have more prominent calyx lobes than does *G. cornutus* (J. D. Smith) A. Gentry, which is restricted to Mexico and Guatemala and probably includes *G. pithecobius* (Standl. & Steyererm.) L. O. Williams.

Key to the Species of *Gibsoniothamnus*

- 1a. Flowers usually borne in distal fascicles of 5–25 flowers; leaf blades elliptic-oblong to obovate, to 5 cm wide 2
- 1b. Flowers 1–3 in the axils of leaves or terminal; leaf blades narrowly elliptic to ovate or oblanceolate, to 3 cm wide 3
 - 2a. Leaf blades to 8 cm long and to 3 cm wide, the major veins deeply impressed above when dried; young stems usually with stiff straight hairs; flowers in fascicles of 5–11 *G. epiphyticus*
 - 2b. Leaf blades to 15 cm long and to 6 cm wide, the major veins not deeply impressed when dried; young stems glabrous or with few hairs; flower in fascicles of 10–25 *G. parvifolius*
- 3a. Corolla red or purple; sepal lobes and veins not expanded laterally to form winged margins, calyx drying blackish or yellowish; 1000–1500 m elevation in evergreen (rarely, deciduous) forests of the Pacific slope *G. parvifolius*
- 3b. Corolla lavender, rose, or white, sepal lobes expanded laterally from the veins and somewhat winged, often drying yellowish; 300–1400 m elevation in evergreen forests on the Caribbean slope and along the Continental Divide 4
- 4a. Corolla lilac or rose; calyx lobes only slightly expanded along the veins, leaves to 70 mm long; 400–900 m elevation on the Caribbean slope *G. pterocalyx*
- 4b. Corolla white, calyx lobes expanded laterally along the midveins and conspicuously winged, leaves to 25 mm long; 1200–1400 m elevation on Cerro Colorado, Panama *G. stellatus*

Gibsoniothamnus epiphyticus (Standl.) L. O. Williams, Fieldiana, Bot. 34: 120. 1972. *Clerodendrum epiphyticum* Standl., Publ. Field Mus. Nat. Hist. Bot. Ser. 22: 168. 1940. Figure 9.

Epiphytic shrubs to ca. 1 m tall, leafy branches 2–4 mm thick, terete to slightly angulate below the raised leaf bases, with stiff straight hairs 0.3–1 mm long but glabrescent. **Leaves** opposite or subopposite, usually of 2 different sizes at each node (anisophyllous), petioles 4–9 mm long, 0.8–1.7 mm thick, puberulent or glabrous; **leaf blades** 2–8 cm long, 1.2–3 cm wide, elliptic to elliptic-oblong or ovate-elliptic, apex acuminate to acute or rounded, margin entire and reflexed, base cuneate to acute, subcoriaceous, lustrous above, glabrous or with few straight hairs to 1 mm long, midvein impressed above, 2° veins 2 or 3/side,

domatia in vein axils beneath. **Inflorescences** of 5–11 flowers in short axillary panicles or from a fasciculate base near the apex of a branchlet, 1° peduncles to 7 mm long, bracts 2–4 mm long, narrowly triangular, pedicels 15–20 mm long, merging gradually with the calyx, glabrous or with straight hairs to 0.8 mm long. **Flowers** with calyx 8–11 mm long, 3–4 mm diam., glabrous or slightly puberulent on the angles, lobes 4–6 mm long, 1–1.5 mm wide at the base; **corolla** 14–21 mm long, 3–4 mm diam., tubular, glabrous, red-violet or purple, lobes 1.5–2.5 mm long; stamens attached 3–4 mm from base of tube, filaments 18–20 mm long; staminode 4–5 mm long; pistil glabrous, style 19–22 mm long. Mature **fruits** to 1 cm diam., becoming white.

Rarely collected plants of evergreen montane cloud forest formations of the Caribbean slope,

600–1500 m elevation. Flowering in April–July. This species is known only from central Costa Rica.

Gibsoniothamnus epiphyticus is recognized by its epiphytic habit, stiff leaves with deeply impressed venation, fasciculate flowers, prominent winged calyx lobes, and red or purple tubular corollas. The stiff multicellular hairs are distinctive when present, but the pubescence is often deciduous. This species is similar to *G. pterocalyx* but differs from that species in having narrower, subcoriaceous leaves with veins impressed above, red-violet corollas, and shorter, more triangular calyx lobes. *G. mirificus* A. Gentry of central Panama is also similar but that species has solitary flowers, longer calyx lobes, and thinner leaves.

***Gibsoniothamnus parvifolius* Barringer** (Novon 9: 476. 1999). Figure 9.

Epiphytic **shrubs** to 2 m tall, leafy stems 1–7 mm thick, glabrous to sparsely pubescent with hairs 0.2–0.6 mm long, winged or angled in early stages but soon terete and glabrescent. **Leaves** equal or sometimes strongly unequal at a node (with the smaller leaves more rounded), petioles 2–15 mm long, 0.4–2 mm thick, glabrous; **leaf blades** 1.6–12 cm long, 0.6–5 cm wide, blades lanceolate to narrowly elliptic or obovate-elliptic, apex acuminate, margin entire and reflexed on drying, base acute or cuneate and decurrent on the petiole, drying subcoriaceous, lustrous and dark olive-green above, glabrous above, glabrous or with thin hairs beneath, 2° veins usually 2–5/side, impressed above, pit domatia often present near the vein axils beneath. **Inflorescences** of solitary flowers in distal leaf axils (2/node), bracteoles ca. 1 mm long, linear, pedicels 4–30 mm long, 0.3–1.5 mm thick, glabrous or with few glandular hairs in early stages, bracteolate at base. **Flowers** glabrous externally, calyx campanulate, tube ca. 4 mm long with truncated distal margin, lobes 4–10 mm long, 0.5–1 mm wide, narrowly triangular, glabrous, spreading, drying dark; **corolla** 18–38 mm long, 1.5–5 mm diam., tubular, reddish violet to wine-red or red, lobes 2–4 mm long, upper lobes broadly ovate, lateral and median lobes ovate, usually more darkly colored than the tube; filaments 15–26 mm long, staminode 1.7–5 mm long; pistil glabrous, style elongate, ca. 18 mm long. **Fruits** becoming 10 mm in diam., globose or oblate, fleshy, white at maturity.

Plants of evergreen cloud forest formations in the Chiriquí highlands and in the Cordillera de

Guanacaste and Cordillera de Tilarán, at 500–1500 m elevation. Flowering in February and August; fruiting in August. This species is known only from Costa Rica and adjacent Panama.

Gibsoniothamnus parvifolius is distinguished by its often small glabrous leaves, solitary axillary flowers, narrow calyx lobes, slender tubular purplish or reddish corollas, and white fleshy fruits. The specimens from northern Costa Rica tend to have more angled stems and shorter stamens than the Panamanian specimens. This species can be distinguished from *G. epiphyticus* of central Costa Rica by its small obovate or lanceolate leaves, its calyx lobes more than 5 mm long, and its one- or two-flowered inflorescences. The larger-leaved collections resemble *G. grandiflorus* A. Gentry & Barringer of central Panama (see Fig. 9). Two Costa Rican collections were provisionally placed under *G. grandiflorus*, but they are now placed under an expanded circumscription of *G. parvifolius*; they are *G. Herrera* 3473 (MO) and *J. D. Smith* 6730 (US).

***Gibsoniothamnus pterocalyx* A. Gentry**; Ann. Missouri Bot. Gard. 61: 535. 1974. Figure 9.

Epiphytic **shrubs** to 2 m tall, leafy stems 0.7–3 mm thick, glabrous, at first slightly angled but soon terete and pale grayish. **Leaves** opposite or subopposite, unequal or subequal at a node, articulated at the base, petioles 2–13 mm long, 0.4–0.8 mm thick, glabrous; **leaf blades** 1.7–7 cm long, 1.5–3.4 cm wide, narrowly elliptic to narrowly obovate or oblanceolate, apex bluntly acute or rounded and slightly emarginate, margin entire and slightly revolute, base acute to cuneate, drying subcoriaceous to chartaceous, dark olive green and lustrous above, glabrous, 2° veins 2 or 3/side, strongly ascending; pit domatia often present near vein axils beneath. **Inflorescences** of solitary axillary flowers or few flowers in condensed axillary panicles, 1° peduncles to 1 cm long, bracts 2–3 mm long, narrowly triangular, sparsely villous, pedicels 7–25 mm long, 0.4–0.8 mm thick, glabrous, merging gradually with the base of the calyx. **Flowers** pale lilac or rose, glabrous externally, calyx 8–12 mm long, 2–4 mm diam., calyx lobes 5–9 mm long, 0.4–1.3 mm wide, linear and slightly winged at the base; **corolla** 18–25 mm long, lilac or pink, glabrous, tube 3–5 mm diam., lobes 2–3 mm long, rounded; filaments 15–20 mm long, staminode 5–6 mm long, filiform; ovary glabrous, style 16–19 mm long.

Fruits becoming up to 10 mm diam., obovoid to oblong with truncated apex, white.

Infrequently collected plants of evergreen lower montane rain forest formations on the Caribbean slope, 400–900 m elevation (intensive collecting over many years at Monteverde indicates that the upper altitudinal limit of 900 m is real, and not an artifact of insufficient collecting). Flowering in April–July and October. This species ranges along the Caribbean escarpment from northern Costa Rica to western Panama.

Gibsoniothamnus pterocalyx is recognized by its epiphytic habit, glabrous parts, small narrow lustrous leaves, usually only one to three pink or lilac (white) flowers at a node, and prominent sepal lobes. The leaf undersides are often purplish, especially along the veins. This species is superficially similar to *G. parvifolius* (q.v.).

Gibsoniothamnus stellatus A. Gentry & Barringer, *Novon* 5: 121–122, 1995.

Epiphytic **shrubs**, stems angled and with raised leaf bases, leafy stems ca. 2 mm thick, glabrous, becoming grayish. **Leaves** of the same node unequal or subequal, petioles 3–5 mm long, glabrous, without lateral wings; **leaf blades** 5–25 mm long, 4–16 mm wide (larger blades 15–25 × 9–16 mm), ovate-lanceolate to elliptic, apex acute, base cuneate, drying coriaceous, glabrous, punctate; 2° veins 2 or 3/side, domatia sometimes present near the base beneath. **Inflorescences** of solitary flowers axillary to distal leaves, bracteate at the base, pedicels 10–12 mm long, expanded distally, glabrous. **Flowers** with campanulate purplish calyx, glabrous, tube 6–8 mm long, lobes 8–9 mm long, triangular with wings 3–4 mm wide; **corolla** 20–25 mm long, 4–5 mm diam., tubular, white, upper and lateral lobes 3–4 mm long and wide, ciliolate along the edge; filaments 17–18 mm long, staminode 5–6 mm long; pistil glabrous. **Fruits** not seen at maturity.

Gibsoniothamnus stellatus is distinguished by its shrubby epiphytic habit, small leaves, flowers with winged calyx lobes (giving a star-like form), and white corollas. This species is known only from two collections from 1200–1400 m elevation on Cerro Colorado in the provinces of Bocas del Toro and Chiriquí in western Panama. They were flowering in April and July. This species is closely

related to *G. alatus* of eastern Panama and adjacent Chocó, which also has white corollas and winged calyx lobes but has much larger leaves.

Schlegelia Miquel

REFERENCES—A. Gentry, *Schlegelia* (Bignoniaceae) in *Flora of Panama*. *Ann. Missouri Bot. Gard.* 60: 923–930, 1973. P. Standley & L. O. Williams, *Schlegelia* (Scrophulariaceae) in *Flora of Guatemala*. *Fieldiana Bot.* 24, pt. 9: 396–400, 1973.

Shrubs, woody vines, lianas or small trees, terrestrial or epiphytic, wood without anomalous vasculature, stems usually terete; pseudostipules small, usually appressed against the branchlets. **Leaves** opposite, simple, with thick terete petioles, usually becoming articulated at the base, blades often coriaceous, margins entire, venation pinnate. **Inflorescences** terminal or axillary panicles, fascicles or axillary racemes, peduncles usually woody, often with conspicuous small bracts beneath the pedicels. **Flowers** with a subcoriaceous tubular or cupulate calyx, entire or splitting irregularly into small lobes, persisting and splitting in fruit; **corolla** campanulate to narrowly tubular, white to pink or red (yellow), glabrous externally but glandular lepidote on the lobes within, lobes 5, rounded; **stamens** 4, in 2 unequal pairs, borne on the lower half of the corolla tube, included, anthers glabrous, thecae divaricate, a small staminode usually present; **ovary** 2-locular (sometimes 1-locular near the apex), placenta central on the septum in each locule, ovules many, style simple, stigma bifid (trifid). **Fruits** berries with hard crustaceous indehiscent pericarp, usually globose; seeds narrow and angular, wingless, small, embedded in pulp.

Schlegelia is a genus of ca. 15 species, ranging from eastern Mexico and the West Indies to Brazil. The simple, opposite, usually stiff leaves, shrubby, often epiphytic or vining habit, usual lack of conspicuous pubescence, woody inflorescence branches, calyx tubes with poorly developed lobes, and round berry-like fruits with stiff rind help distinguish this genus. Dr. William D'Arcy (MO) is currently studying this genus.

Key to the Species of *Schlegelia*

- 1a. Corollas usually < 20 mm long; calyx tube 4–6 mm long at anthesis; fruits up to 12 mm diam.; leaves usually drying stiffly coriaceous and with the minor venation usually not evident on the upper surface; plants often epiphytic; 2–2100 m elevation 2
- 1b. Corollas 20–43 mm long; calyx 5–12 mm long; fruits 12–40 mm diam.; leaves drying stiffly chartaceous to subcoriaceous, the minor veins often elevated on the upper surface; plants usually vines or lianas; 10–900(–1500) m elevation 3
 - 2a. Corollas mostly 8–11 mm long; leaf blade acute to obtuse or rounded at apex; commonly collected *S. parviflora*
 - 2b. Corollas usually 15–20 mm long; leaf blade obtuse to rounded at apex; rarely collected *S. brachyantha*
- 3a. Corolla 20–28 mm long, narrowly tubular with short (1–3 mm) lobes; fruits 12–16 mm diam.; inflorescences of many (> 15) flowers in dense woody fascicles or panicles, peduncles 1–20 cm long *S. fastigiata*
- 3b. Corolla 30–43 mm long, tubular-campanulate with prominent (to 10 mm) lobes; fruits 30–40 mm diam.; inflorescences of few (1–5) flowers in racemose arrangements, peduncles usually < 1 cm long *S. nicaraguensis*

Schlegelia brachyantha Griseb., Cat. Pl. Cub. 191. 1866.

Lianas or vine-like shrubs to 6 m high, leafy stems 1–8 mm thick, glabrous or sparsely puberulent near the apex and on the new growth, drying grayish or dark, terete or slightly quadrangular. **Leaves** with petioles 3–9 mm long, 1–2.5 mm thick, becoming articulated and thicker at the base, glabrous or with few minute (0.1–0.2 mm) hairs; **leaf blades** 4–12 cm long, 1.5–8 cm wide, broadly elliptic to broadly oblong or oblong-obovate, apex bluntly obtuse to rounded or short-acuminate, base obtuse to rounded and subtruncate, drying subcoriaceous and slightly lustrous above with margin often recurved, glabrous above and below, punctate beneath, major 2° veins 3–5/side, loop-connected distally. **Inflorescences** axillary to leaves or leafless nodes, apparently sessile fascicles with few (2–5) flowers, peduncles very short with bracts ca. 2 mm long on congested nodes, pedicels 2–8 mm long, glabrous and drying black. **Flowers** not seen at anthesis, flower buds 3–5 mm long, with few minute hairs, drying dark; **corolla** 15–20 mm long, white or pink, 5–6 mm wide at throat, lobes ca. 5 mm long. **Fruits** 6–10 mm diam., green turning red.

Rarely collected plants of evergreen forest formations, 20–1800 m elevation. In Costa Rica it is only known from the high plateau southeast of Chatham Bay, Cocos Island, flowering and fruiting in April (*R. Foster 4125 F*). Also known from the Chiriquí highlands in Panama, Venezuela, and the West Indies.

Schlegelia brachyantha is distinguished by its smaller, often rounded leaves, few-flowered, sessile inflorescences, and few collections from widely separated geographical areas.

Schlegelia costaricensis Standl. described in the *Flora of Costa Rica*, part 3 (Publ. Field Mus. Nat. Hist. Bot. Ser. 18: 1128, 1938) has been transferred to the Boraginaceae as *Bourreria costaricensis* (Standl.) A. Gentry (see *Phytologia* 26: 67–68, 1973).

Schlegelia fastigiata Schery, Ann. Missouri Bot. Gard. 29: 367. 1942. Figure 9.

Lianas or vines, climbing stems ca. 15 mm diam., leafy stems 1.8–6 mm thick, terete or somewhat flattened, glabrous (minutely puberulent). **Leaves** with petioles 3–8 mm long, 1.5–3.5 mm thick, glabrous, usually drying dark and articulated at the base; **leaf blades** 10–26(–33) cm long, 3–9(–13) cm wide, narrowly elliptic-oblong to narrowly ovate-oblong, apex acuminate or acute, base obtuse, drying stiffly chartaceous to subcoriaceous, glabrous above and below, the minor venation slightly elevated on the upper surface (dried), 2° veins 8–16/side. **Inflorescences** congested woody panicles borne on short (1–2 cm) peduncles or longer (8–14 cm) leafless stems, usually with more than 15 flowers, woody panicles (fascicles) 2–8 cm long, 2–10 cm wide, woody branches short and grayish, pedicels 4–8 mm long, ca. 0.4 mm thick, minutely puberulent, drying black, subtended by a pair of small (1 mm) bracts on a slender 2° peduncle 2–4 mm long.

Flowers with truncated calyx tube 5–8 mm long, cupular with entire or slightly lobed distal margin, 5–7 mm diam. at apex, purple to red-violet or pink, usually glabrous, splitting in fruit and to 14 mm wide; **corolla** 20–28 mm long, tubular, glabrous externally, 4–6 mm diam., 4–8 mm wide at the spreading lobes, white, lobes 2–5 mm long, rounded, pink to pale violet; filaments 8–12 mm long, anthers 1–1.5 mm long, divaricate, ca. 2 mm wide; ovary lepidote (Gentry, 1973b). **Fruits** 12–16 mm long, subglobose, yellow to orange or purple, surface somewhat muriculate, glabrous; seeds ca. 2 × 0.5 mm, narrowly triangular or curved.

Plants of the evergreen rain forest formations of the Caribbean lowlands and slopes, 10–900 m elevation. Probably flowering and fruiting throughout the year, but our collections were collected between July and March. The species ranges from Guatemala to Ecuador.

Schlegelia fastigiata is recognized by its vining habit, thinner leaves with more 2° veins than our other species of *Schlegelia*, flowers borne in densely branched, woody fascicles on slender bracteate pedicels, calyx cup with entire margin, and narrowly tubular white corolla with pink lobes. The minor venation is usually clearly elevated on the upper leaf surface of the dried leaves, a helpful characteristic in making specific determinations. This species was incorrectly placed under *S. sulphurea* Diels in *Flora of Panama*, misspelled as *S. sulfurea* (Gentry, 1973b); that species has yellow corollas and is endemic to eastern Ecuador.

Schlegelia nicaraguensis Standl., Trop. Woods 16: 44. 1928. *S. silvicola* L. O. Williams, Fieldiana, Bot. 34: 126, tab. 3. 1972.

Lianas or woody vines (rarely trees or epiphytic shrubs), climbing stems ca. 15 mm diam., leafy stems 2–6 mm thick, terete or 4-angled, minutely puberulent in early stages, glabrescent, grayish and with prominent lenticels; pseudostipules to 3 mm long. **Leaves** with petioles 3–14 mm long, 1.5–4.2 mm thick, rounded but with 2 adaxial ridges, glabrous, drying grayish or yellowish; **leaf blades** (4–)8–22 cm long, (2–)3.5–10 cm wide, elliptic to elliptic-oblong, elliptic-obovate or elliptic-ovate, apex acuminate to acute or rounded, base obtuse to acute, drying subcoriaceous and grayish, glabrous above and below or with a few hairs along the midvein beneath, minor venation flat or slightly elevated above, 2° veins 5–8/side. **Inflorescences** with 1–5 flowers, ter-

minal, axillary, or borne on older stems, racemose, peduncles 6–10 mm long from a short (1–6 mm) woody base, rachis with small (1–2 mm) bracts, pedicels 8–20 mm long, ca. 0.8 mm thick, minutely (0.1–0.2 mm) puberulent. **Flowers** with cupulate or campanulate calyx 9–12 mm long, 7–10 mm diam., margin entire or with short (1–2 mm) rounded lobes, glabrous or with few minute hairs near the base, purple or violet with white spots in life; **corolla** 33–42 mm long, tubular-campanulate and bilabiate, yellowish white or white, with rose or purplish lobes, tube 3–4 mm diam. at base and widening to the mouth, lobes 6–10 mm long, with rounded apices; stamens 16–23 mm and 14–18 mm long, anthers divaricate, thecae ca. 3 mm long, staminode 3–5 mm long; ovary unilocular near the apex. **Fruits** 4–5 cm long, 3–4 cm diam., obovoid to globose with narrowed base, surface lustrous and slightly muriculate, drying brown; seeds ca. 3 mm long, 0.8–1 mm wide in the center.

Uncommon vines of evergreen rain forest formations along the Caribbean slope, 100–600 m elevation (to 1500 m in Nicaragua). Probably fruiting throughout the year (Costa Rican flowering collections have been made only in October and December–February). This species ranges from Veracruz, Mexico, to Panama.

Schlegelia nicaraguensis is recognized by its woody vining habit, subcoriaceous leaves, few-flowered inflorescences, large bilabiate corollas, and large fruits. This species is similar to *S. parasitica* Sw. of Jamaica (Gentry, 1973b).

Schlegelia parviflora (Oerst.) Monachino, Phytologia 3: 103. 1949. *Dermatocalyx parviflorus* Oerst., Vidensk. Meddel. Dansk Naturhis. Foren. Kjobenhavn 1855: 29. 1856. *S. fuscata* A. Gentry, Ann. Missouri Bot. Gard. 60: 925. 1973 (1974). Figure 9.

Epiphytic shrubs or less often (in Costa Rica) woody vines, lianas, or small trees, stems slightly quadrangular or terete, leafy stems 2–7 mm thick, glabrous or sparsely puberulent at the shoot apex; pseudostipules 2–3 mm long. **Leaves** with petioles 6–30 mm long, 0.7–3 mm thick, becoming articulated at the base and thickened, glabrous; **leaf blades** (4–)6–18 cm long, (2–)3–13 cm wide, broadly elliptic to ovate-elliptic or ovate-oblong, apex bluntly acute to obtuse or rounded, base obtuse to cuneate and often slightly decurrent on the petiole, drying coriaceous and yellowish gray, glabrous above and below, minutely punctate be-

neath, 2° veins 4–8/side, minor venation usually obscure above. **Inflorescences** axillary to leaves or from older leafless nodes, fascicles of 5–40 flowers in racemose or paniculate arrangements, 2–5 cm long (to 8 cm in fruit), 1° peduncles 1–10 mm long, 1–2 mm thick, glabrous, usually drying yellowish, bracts 1–2 mm long, subulate, pedicels 1–4 mm long (measured from the subtending bracteoles), becoming 1.5 mm thick in fruit. **Flowers** with calyx 4–6 mm long, 3–4 mm wide, cupulate to campanulate, glabrous, lobes 0.5–1.5 mm long, rounded distally; **corolla** 8–11 mm long, to 10 mm wide across the lobes, white with pink-tinged lobes, glabrous externally, lobes 2–4 mm long, with purple lines within; filaments ca. 4 mm long, thecae 1.3 mm long, lilac; style ca. 6 mm long. **Fruits** 8–12 mm diam., globose or somewhat oblate, becoming purple or wine-red, surface lustrous and slightly muriculate, subtending calyx to 10 mm wide, pale green; seeds 2–3 mm long, 0.5–1 mm thick, usually wider at one end, drying black.

Common woody plants in wet evergreen forest formations on both the Caribbean and Pacific slopes, 4–2200 m elevation. Probably flowering and fruiting in all months, but with lowland plants usually flowering in December–February and highland plants with peak flowering in June–August. This species ranges from Belize to Brazil.

Schlegelia parviflora is recognized by its usually epiphytic habit (also vines or trees), stiffly coriaceous leaves, lack of pubescence, fascicles of flowers on few-branched axes, cupulate or campanulate calyx, white corolla with pink and purple coloring, and subglobose purplish fruits. The lower elevation collections tend to have larger leaves, but there is great variation in leaf size, and a cline is not evident. The flowers and fruits of this species are distinctly smaller than those of its sympatric congeners. A very few Costa Rican collections fit the description of *S. fuscata*, with smaller flowers drying black on consistently racemose axes. However, such collections seem to be no more than extreme variants (perhaps plants of exposed windy sites) in a species that exhibits a broad range of variation in leaf and inflorescence morphology.

BIGNONIACEAE

By William Burger and Alwyn Gentry (†)

REFERENCES—A. Gentry, Bignoniaceae in Flora of Panama. Ann. Missouri Bot. Gard. 60: 781–

9771. 1973 (1974). A. Gentry, Co-evolutionary patterns in Central American Bignoniaceae. Ann. Missouri Bot. Gard. 61: 728–759. 1974. A. Gentry, Bignoniaceae of southern Central America; distribution and ecological specificity. Biotropica 8: 117–131. 1976. A. Gentry, Bignoniaceae, Part I (Crescentiaceae and Tourrettiae). Fl. Neotrop. Monogr. 25(I): 1–130. 1980. A. Gentry, Evolutionary patterns in Neotropical Bignoniaceae. Mem. New York Bot. Gard. 55: 118–129. 1990. A. Gentry, Bignoniaceae—Part II (tribe Tecomeae). Fl. Neotrop. Monogr. 25(II): 1–370. 1992. P. C. Standley & L. O. Williams, Bignoniaceae in Flora of Guatemala. Fieldiana, Bot. 24(10): 153–232. 1974.

Trees, shrubs, or more often **lianas** (rarely herbs or twining herbs), often climbing with the aid of twisting stems or tendrils, the tendrils simple or distally trifid (with sticky pads in *Mansoa parvifolia*), often becoming woody, stems terete or angulate, glabrous or pubescent, often with interpetiolar ridges or gland fields at the nodes; stipules absent, pseudostipules present or absent. **Leaves** opposite or whorled (alternate in a few genera), simple, 2-foliolate, 3-foliolate, pinnately compound or palmately compound (occasionally twice compound as in *Jacaranda*, *Pleonotoma*, and *Tourrettia*), petiolate, the distal leaflet often replaced by a tendril in climbing species, blades usually entire, sometimes serrate (not lobed), glabrous to densely puberulent, venation palmate or pinnate, domatia rarely present. **Inflorescences** terminal, axillary, or cauliflorous, cymose, paniculate, racemose, fasciculate, or of solitary flowers in leaf axils, bracts and bracteoles often present, small and caducous, pedicels usually well developed. **Flowers** bisexual, nearly always large and showy, calyx united and tubular to campanulate, usually with 5 lobes or teeth (rarely entire, bilabiate, calyptrate, or spathe-like); **corolla** united and funnelform to campanulate with a basal tube, usually 2-lipped and bilaterally symmetrical (rarely radially symmetric), the 5 lobes imbricate in bud (rarely valvate) and usually rounded distally; **stamens** usually 4 (rarely 5 or 2), alternate with corolla lobes, filaments usually of 2 unequal pairs, borne on the lower half of the tube and free, anthers 2-theccous (1-theccous), free, a staminode usually present, an annular disc usually present; ovary superior, 2-locular with 2 axile placentas or unilocular with 2–4 intruded parietal placentas (rarely 4-locular as in *Tourrettia*), style simple, stigma 2-lobed, rounded. **Fruits** mostly 2-valved

capsules with septicidal or loculicidal dehiscence (fruits fleshy or hard and indehiscent in a few genera); seeds mostly flat and winged in capsular fruits, often embedded in pulp or mucilage in indehiscent fruits, lacking endosperm, cotyledons leaf-like.

The Bignoniaceae are a family of about 112 genera with over 800 species in tropical and temperate areas of the world but with the greatest concentration of genera and species (ca. 600) in the Neotropics. The family is often easy to identify because of its woody stems, large showy five-lobed and two-lipped corollas, androecium of usually four functional stamens with filaments of two lengths, superior ovary with many ovules, and usually capsular fruits with thin-winged seeds. Gland fields are sometimes present at the nodes, on the petioles, or at the base of the leaf blade. The stems are woody (except in *Touretia*) and often climbing; many species have opposite compound leaves with entire margins. *Gibsoniothamnus* and *Schlegelia*, often assigned to Bignoniaceae, have now been placed in the family Schlegeliaceae (q.v.). On the basis of floral morphology the Bignoniaceae were thought to be closely related to the Gesneriaceae, Pedaliaceae, and Scrophulariaceae. However, recent DNA studies also suggest relationships with Buddlejaceae and Verbenaceae (Olmstead & Reeves, 1995).

This is publication No. 2 in the *Gentry Invitation Series*, based on data and annotations left by the late Dr. Alwyn H. Gentry, who died in an airplane crash in Ecuador on 3 August 1993. The series acknowledges the many contributions made by Dr. Gentry to our understanding of the Bignoniaceae. A summary of his life and a complete bibliography were published by James Miller (Ann. Missouri Bot. Gard. 83 pt. 4). For information on the computerized databases left by Gentry, contact the Missouri Botanical Garden. It has been a privilege to work on Costa Rica's Bignoniaceae using the many annotations and publications that Alwyn Gentry left us. The Bignoniaceae had been a very difficult family on which to work. Many genera and species were described from material that included only flowers or only fruits. The resulting number of monotypic genera and genera with disimilar species created considerable confusion. An additional problem was that tropical trees, and especially lianas, had been poorly sampled (Standley & Williams, 1974). Al Gentry stepped into this situation and

attacked the problem with intelligence and vigor, both in the field and in herbaria. He made order where there had been considerable chaos, and we are deeply indebted to him for this work. His efforts in understanding tropical forests and their diversity, together with his work on behalf of conservation, inspired many of his students and colleagues. Al Gentry's untimely death cut short what was already a rich and productive botanical career.

Thanks to Gentry's work, most of the species of New World Bignoniaceae are well characterized and their taxonomy has been put into good order. The percentage of Costa Rican bignon species that range from Mexico far into South America greatly exceeds that for most plant families in our flora. There appear to be two reasons for this. The first is that we now have sound biological species concepts recognizing considerable variation within each binomial, thanks to Al Gentry's extensive field work. The second and more fundamental reason is related to the thin membranous-winged seeds, which have proved to be very successful dispersal agents in many of the genera. As Al Gentry pointed out (1983), genera and species lacking such seeds usually have much more limited geographical ranges (cf. *Amphitecna* and *Parmentiera*). Interestingly, although a few genera of Bignoniaceae can tolerate the cold winters of the northeastern United States, no indigenous member of the family is found above 2300 m elevation in Costa Rica. This treatment has also benefited from comparison with a draft of the family for the *Manual Flora of Costa Rica* project by Quirico Jiménez and J. F. Morales. Our independent work on these plants resulted in almost identical treatments, thanks to the earlier annotations by Al Gentry.

The Bignoniaceae appear to be a modern lineage in which recent diversification has produced a great number of species differing in a variety of minor morphological traits. Some of these minor variations have been the basis for erecting what appeared to be an excessive number of genera. Gentry (1973a, 1979) addressed this issue and made important advances in creating better generic concepts. Although further "lumping" would seem to be desirable, current generic concepts have provided a useful information retrieval system that should not be radically altered until the evidence for doing so becomes substantial.

Key to the Genera and Unusual Species of Bignoniaceae

- 1a. Trees and shrubs, stems woody and erect or spreading, tendrils absent [native and ornamental species] 2
- 1b. Lianas or vines, stems woody or herbaceous, stems climbing or clambering, tendrils often present 16
- 2a. Leaves pinnately compound, the central rachis with > 1 pair of lateral leaflets or bipinnately compound 3
- 2b. Leaves simple, trifoliolate or palmately compound (with all leaflets arising from the apex of the petiole) 8
- 3a. Leaves bipinnate (twice compound), the central rachis with opposing lateral 2° rachises on which the leaflets are borne; flowers lavender to bluish purple, staminode larger than the stamens and resembling a style [both native and planted ornamental species] *Jacaranda*
- 3b. Leaves pinnate, the central rachis bearing the usually opposite leaflets; flowers not lavender or bluish, staminode much smaller than the stamens, not resembling a style 4
- 4a. Corollas 3.5–6 cm long, yellow or orange to red-orange; native and introduced trees .. 5
- 4b. Corollas 6–12 cm long, yellow, red or dark purple to maroon; introduced ornamental trees 6
- 5a. Stamens included; flowers usually yellow; leaflets 2–15 cm long; native small trees often planted for ornament *Tecoma stans*
- 5b. Stamens exserted; flowers usually orange-red; leaflets 1–3.5 cm long; introduced ornamental shrubs with clambering branches *Tecoma capensis*
- 6a. Corollas 8–12 cm long, red or red-orange, curved and opening upward, glabrous externally; calyx split down 1 side and spathe-like; commonly planted in lower elevation evergreen areas *Spathodea campanulata*
- 6b. Corollas 6–9 cm long, yellow or dark purple to maroon, not usually opening upward, glabrous or puberulent externally; calyx not split down 1 side (not spathe-like); rarely planted in Central America 7
- 7a. Corolla dark purple or maroon, glabrous externally; leaves 7–9-foliolate; fruits pendulous, ellipsoid-oblong *Kigelia pinnata*
- 7b. Corolla yellow, puberulent externally; leaves 5–7-foliolate; fruits not ellipsoid [plants not recorded from Costa Rica and not included in text] *Haplophragma adenophyllum*
- 8a. (from 2b) Epiphytic shrubs; leaves simple, opposite, usually coriaceous; corollas radially symmetric or only slightly 2-lipped (note that these plants have now been transferred to Schlegeliaceae) 9
- 8b. Terrestrial trees (not epiphytic); corollas usually clearly bilaterally symmetric and 2-lipped [neither red nor narrowly tubular] 10
- 9a. Corollas usually red or purple, narrowly tubular and radially symmetric; fruit with fleshy covering; leaves usually < 10 cm long *Gibsoniothamnus*
- 9b. Flowers white or pinkish, tubular-campanulate; fruit with hard outer covering; leaves to 18 cm long *Schlegelia*
- 10a. Leaves opposite, usually 2–9-foliolate; corolla thin and without a transverse fold on the lower (abaxial) side, white to yellow, rose, or magenta; flowers usually borne in racemose panicles on distal stems; fruits dehiscent capsules with thin flat overlapping seeds 11
- 10b. Leaves fasciculate, alternate or opposite, simple or 3-foliolate; corolla thick and stiff with a transverse fold on the lower side, white to greenish white; flowers usually 1 to few and borne on thicker branches or trunk; fruits indehiscent with fibrous-fleshy or hard outer shells, seed angular and embedded in white fleshy pulp 14
- 11a. Flowers < 18 mm long; anthers pilose; fruits spirally twisted; leaflets 7–9 [often cuneate at base] *Godmannia*
- 11b. Flowers > 20 mm long; anthers glabrous; fruits usually straight; leaflets (1–)2–7 .. 12
- 12a. Corolla deeply split down the sides and strongly 2-lipped; rarely collected small trees of the Caribbean slope *Tynanthus macranthus*

- 12b. Corolla not deeply split down the side, slightly 2-lipped; rare and common species of many habitats 13
- 13a. Fruits usually held erect and 6–18 cm long; inflorescences with < 11 purple flowers; leaves simple and 3-foliolate on the same branches; small trees and shrubs of seasonally very dry Guanacaste *Arrabidaea costaricensis*
- 13b. Fruits usually pendant and > 15 cm long; inflorescences usually with > 10 pink flowers or the corollas yellow or white; leaves rarely simple, 3–7-foliolate; small to large trees found in many habitats and often planted as ornamentals *Tabebuia*
- 14a. (from 10b) Leaves opposite; 3-foliolate (often cruciform); calyx split on 1 side; fruits with fibrous exocarp (not a hard shell) *Parmentiera*
- 14b. Leaves alternate or fasciculate; simple or 3-foliolate; calyx not split on 1 side; fruits with a hard exocarp 15
- 15a. Leaves alternate; ovules on 2 parietal placentas or axile near base; seeds large (> 13 mm) *Amphitecna*
- 15b. Leaves fasciculate; ovules on 4 parietal placentas; seeds small (< 8 mm) *Crescentia*
- 16a. (from 1b) Leaves simple; tendrils absent; fruits spherical and indehiscent, seeds angular and wingless; stems lacking 4–8 phloem areas in cross-section; with 1 axile placenta in each locule (now transferred to Schlegeliaceae) *Schlegelia*
- 16b. Leaves usually compound (simple leaves sometimes present on young growth or the base of new shoots); tendrils often present; fruits usually elongate or flattened, dehiscent to release flat, usually winged seeds; stems with 4–8 phloem areas; with usually 2 axile placentas in each locule .. 17
- 17a. Leaflets 3–15 mm long on young climbing stems, becoming 30 mm long on distal stems [4 leaflets/node]; tendrils ending with small disc-like adhesive pads *Mansoa parvifolia*
- 17b. Leaflets not so small on young climbing stems, becoming more than 3 cm long on distal stems; tendrils not ending in disc-like pads 18
- 18a. Some leaves twice compound, some petioles bearing 2 or 3 petiolules with 3 or 5 leaflets each 19
- 18b. Leaves never twice compound, simple or with petioles bearing 2 or 3 leaflets [plants with woody stems; inflorescences never with sterile and fertile dimorphic flowers] 21
- 19a. Herbaceous vines; inflorescence subspicate with 2 different kinds of flowers (distal flowers sterile); corolla greenish to purple; fruits ellipsoid and covered with prominent hooked spines *Tourrettia lappacea*
- 19b. Woody vines and lianas; inflorescence racemose or paniculate, with 1 kind of flower; fruits linear, without spines 20
- 20a. Corollas white or yellowish white, glabrous externally; tendrils tri-fid at the apex *Pleonotoma variabilis*
- 20b. Corollas magenta or purple, puberulent externally; tendrils simple [plants not known from between Belize and Colombia and not included in the text] *Arrabidaea inaequalis*
- 21a. Each tendril terminating with usually 3 sharp stiff claw-like tips or hooks [corolla glabrous externally] 22
- 21b. Each tendril terminating with 1–3 slender tips, not hard and claw-like or hooked 24
- 22a. Corolla deep purple or magenta; calyx 4- or 5-lobed; Golfo Dulce area in Central America [capsules usually linear] *Parabignonia steyermarkii*
- 22b. Corolla yellow; calyx subtruncate to spathe-like; widely ranging in Central America ... 23
- 23a. Capsules linear, 1.5–2 cm wide, > 15 cm long, valves not splitting in half (2/fruit); thin flexible *Macfadyena*
- 23b. Capsules oblong, 2.5–4 cm wide, to 15 cm long, valves splitting longitudinally in half at maturity (4/fruit), thick woody *Melloa quadrialvis*
- 24a. Corolla orange, long-tubular and slightly curved (6–9 cm long, 3–12 mm diam.), lobes valvate in bud; planted for ornament in parks and gardens *Pyrostegia venusta*
- 24b. Corolla not orange, without a long narrow slightly curved tube, lobes imbricate in bud; planted for ornament and/or native wild species 25
- 25a. Branchlets 6-sided, hexagonal in cross-section, with 6 prominent longitudinal ribs along the young stems [fruits ellipsoid to oblong, 2.5–7 cm wide, surface smooth to tuberculate] 26

- 25b. Branchlets 2- or 4-sided to terete or subterete in cross-section, with 0–4 longitudinal ribs along the young stems 28
- 26a. Calyx double, with an inner and outer whorl of distal lobes; leaves with dendroid (stellate or branched) hairs; tendrils usually with 3 distal tips; corolla strongly 2-lipped with the upper and lower lobes connate at anthesis *Amphilophium*
- 26b. Calyx simple, with 1 distal whorl of lobes; leaves with simple hairs; tendrils with 3–15 distal divisions; corolla weakly 2-lipped, lobes free and reflexed at anthesis 27
- 27a. Corolla white, tube strongly curved near the base; fruit oblong with a covering of short spines; widely ranging *Pithecoctenium crucigerum*
- 27b. Corolla rose-purple, tube not curved; fruits without spines; not known from between central Nicaragua and Colombia and not included in the descriptions *Distictis*
- 28a. Leaves with minute (0.1 mm) pellucid flat glands on both surfaces; branchlets with a hollow center; capsules < 9 mm wide, linear and 24–45 cm long, surface minutely puberulent [corolla puberulent externally, white or greenish yellow with purple lobes] *Stizophyllum*
- 28b. Leaf surfaces without pellucid-punctate glands; branchlets without a hollow center (sometimes hollow in *Paragonia*); capsule > 10 mm wide, linear to oblong or rounded, surfaces glabrous to puberulent, smooth to spiny or muricate 29
- 29a. Leaves with branched or irregular dendroid hairs (at least in the vein axils beneath); capsules oblong (3–10 cm wide, ca. 5–10 mm thick), valves woody and flattened, surface smooth [seeds thin with broad lateral wings] 30
- 29b. Leaves with slender simple or flat rounded-peltate hairs or glabrous; capsules without the above combination of characters 31
- 30a. Interpetiolar glandular fields absent at the nodes; calyx > 20 mm long; corolla yellow; seeds 6–12 cm wide, wings gland brown and opaque *Callichlamys latifolia*
- 30b. Interpetiolar gland fields present at the nodes; calyx < 9 mm long; corolla lavender or rose; seeds 3–5 cm wide, wings translucent *Xylophragma seemannianum*
- 31a. Corolla 15–20 cm long with long narrow tube and distal rotate lobes (tubular-slaverform), white and puberulent externally; fruits oblong-cylindric, 9–22 cm long, 6–11 cm wide and 5–8 cm thick *Tanaecium jaroba*
- 31b. Corolla < 15 cm long (mostly tubular-campanulate) and without the combination of characters listed above 32
- 32a. Lower surface of leaf with gland fields in axils of basal veins or with gland field at apex of the petiole [corolla pink to magenta or white] 33
- 32b. Lower surface of leaf lacking gland fields, apex of petiole lacking a gland field 35
- 33a. Leaf axils with a conical structure made up of 3 imbricate series of scale-like pseudostipules or vegetative parts with the strong odor of onion or garlic [fruits with verrucose or smooth surface] *Mansoa*
- 33b. Leaf axils lacking a conical structure of imbricate scale-like pseudostipules **and** vegetative parts lacking an onion-like odor 34
- 34a. Native wild plants; young stems lacking conspicuous pseudostipules (rounded leaf-like pseudostipules present in *C. diversifolia*); corolla pink or lavender to purple, glabrous or puberulent externally; fruits oblong or linear *Cydista*
- 34b. Vines planted for ornament (rarely collected in Costa Rica); young stems with broadly ovate leaf-like pseudostipules; corolla magenta to violet, glabrous externally; fruits linear *Saritea magnifica*
- 35a. Corolla strongly bilabiate, split down the sides beyond the middle, usually white; rarely collected *Tynanthus*
- 35b. Corolla not strongly bilabiate, not split down the sides to the middle, colors various; common to rare species 36
- 36a. Flowers yellow or white (sometimes with reddish markings in *Mussaia*); disc present beneath the ovary; valves of the fruits usually woody, > 25 mm wide, never echinate 37
- 36b. Flowers rose to magenta or lavender (white in species of *Arrabidaea*, *Cydista*, and *Lundia*); disc present or absent; valves of the fruits not woody unless echinate or tuberculate, usually < 25 mm wide 41

- 37a. Corolla < 20 mm long, calyx < 2 mm long, widely campanulate; young stems strongly tetragonal in cross-section, with 4 prominent longitudinal ridges *Mussatia*
- 37b. Corolla > 25 mm long, calyx > 4 mm long, cupular to tubular-campanulate; young stems terete or weakly tetragonal in cross-section, without 4 prominent ridges 38
- 38a. Young stems with interpetiolar gland fields at the nodes; fruits tetragonal (square) in cross-section, ca. 2 cm thick, narrowly oblong [corolla glabrous externally] *Ceratophytum tetragonolobum*
- 38b. Young stems lacking interpetiolar gland fields; fruits flattened and broadly oblong to elliptic or suborbicular 39
- 39a. Corolla glabrous externally or with minute flat peltate hairs; capsules narrowed at the base and somewhat stipitate, flattened and elliptic to oblong or suborbicular . . . *Anemopaegma*
- 39b. Corolla minutely puberulent externally; capsules not stipitate, flattened and elliptic to oblong 40
- 40a. Inflorescences 10–20 cm long; calyx entire; tendrils trifid at the apex *Distictella magnoliifolia*
- 40b. Inflorescence 2–6 cm long; calyx usually split 1–2 mm along 2 sides; tendrils simple *Adenocalymma inundatum*
- 41a. (from 36b) Pseudostipules (cataphylls) forming small bromeliad-like clusters in distal leaf axils (especially below the inflorescence); fruits ellipsoid to suborbicular and echinate, 5–9 cm long with spines to 8 mm long [disc absent, venation pinnate] *Clytostoma binatum*
- 41b. Pseudostipules not forming small bromeliad-like clusters in leaf axils; fruits mostly linear and smooth to verrucose 42
- 42a. Calyx split down 1 side and spathe-like, apex thickened and curved; fruit surface with minute hairs that often give a grayish metallic luster [disc absent; fruits linear-oblong or ellipsoid; gland fields absent at the nodes] *Phyrganocydia*
- 42b. Calyx not split down 1 side, not spathe-like or with curved thickened tip; fruit surface not grayish lustrous 43
- 43a. Anthers pubescent; flower buds with narrow conical tip, the apex splitting off to produce an entire margin on the calyx cup at anthesis (also splitting as growth progresses) [corollas white to rose or magenta, minutely puberulent externally; disc absent; fruits 20–60 cm long, 1.5–2 cm wide margin and midvein prominent, surface densely puberulent] *Lundia*
- 43b. Anthers glabrous; flower buds and calyx not calyprate (sometimes coming off as a conical cap in *Paragonia*) 44
- 44a. Tendrils ending in 3 short tips; corolla dark purple to deep maroon, glabrous or subglabrous externally; fruits (30–)50–110 cm long, linear, surfaces flat and glabrous [disc present] *Martinella obovata*
- 44b. Tendrils simple or bifid at apex; corolla whitish or rose to purple, usually minutely puberulent externally; fruits < 60 cm long, surface with raised edges or raised midrib, glabrous or puberulent 45
- 45a. Calyx > 15 mm long, 2-lipped or lobed; fruits becoming black, with tuberculate or verrucose surface [disc present] *Arrabidaea verrucosa*
- 45b. Calyx > 10 mm long, usually truncate at the apex; fruits not becoming dark with tuberculate or verrucose surface 46
- 46a. Disc absent beneath the ovary; young stems terete or tetragonal, lacking interpetiolar gland fields; stems with 8–16 phloem areas in cross-section *Cydista*
- 46b. Disc present beneath the ovary; young stems terete, often with interpetiolar gland fields; stems with 4 phloem areas in cross-section 47
- 47a. Capsule valves flat and smooth (except in *A. verrucosa*), seeds usually with translucent wings differentiated from the brown center; tendrils simple at the apex; interpetiolar gland fields often present; leaflets lacking a faint sweet odor when crushed; deciduous to evergreen wet forests *Arrabidaea*
- 47b. Capsule valves convex and slightly rough-surfaced, seeds uniformly brownish; tendrils simple or minutely bifid at the apex; interpetiolar gland fields rarely present; leaflets with faint sweet odor when crushed; evergreen lowland rain forests *Paragonia pyramidata*

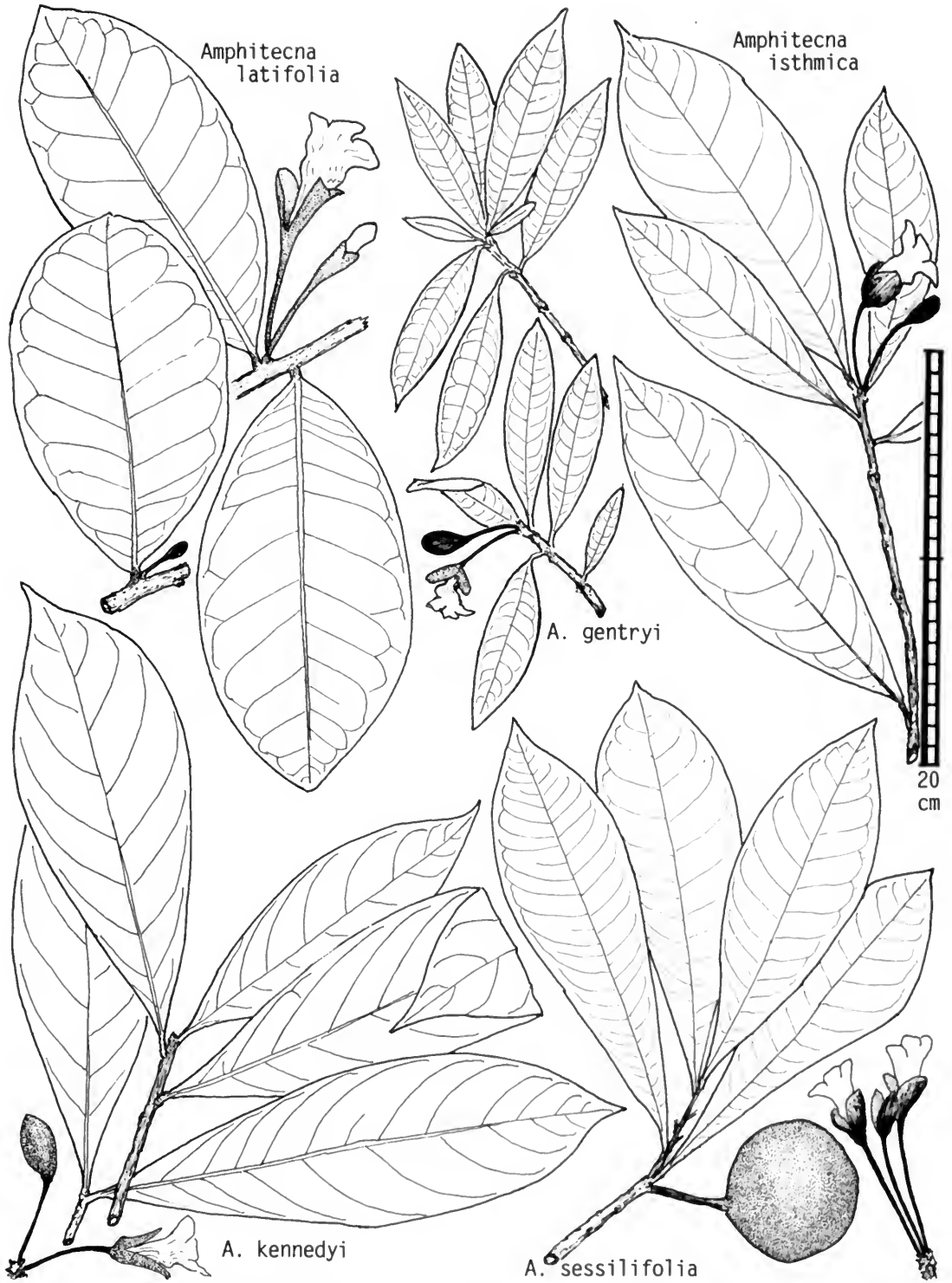


FIG. 10. Bignoniaceae: trees with simple leaves, fruit a calabash or pepo; species of *Amphitecna*.



FIG. 11. Bignoniaceae: trees with simple or compound leaves, fruit a calabash or pepo: species of *Crescentia* and *Parmentiera*.

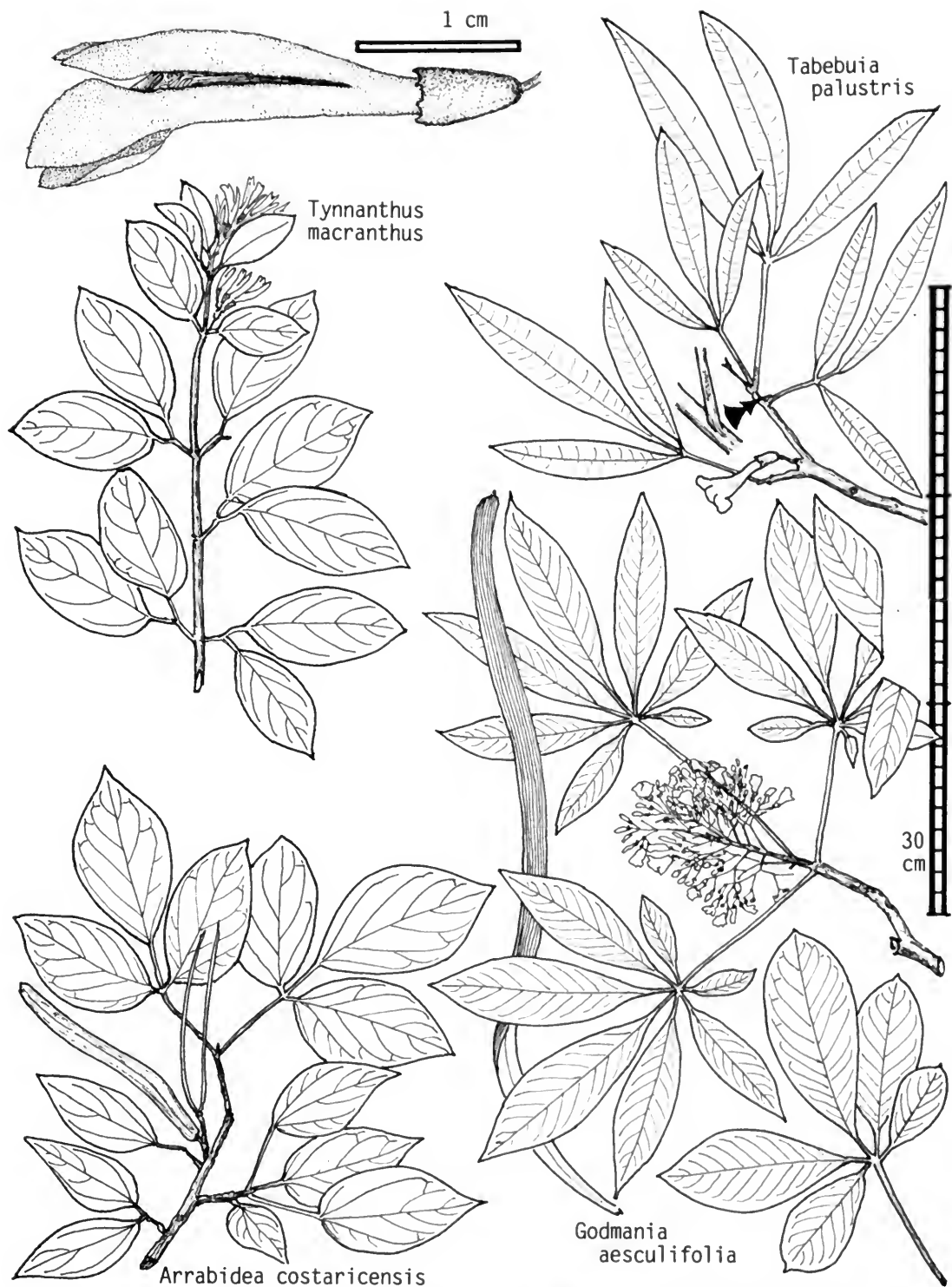


FIG. 12. Bignoniaceae: trees and shrubs with 2- to 7-foliolate leaves, fruits long narrow capsules.

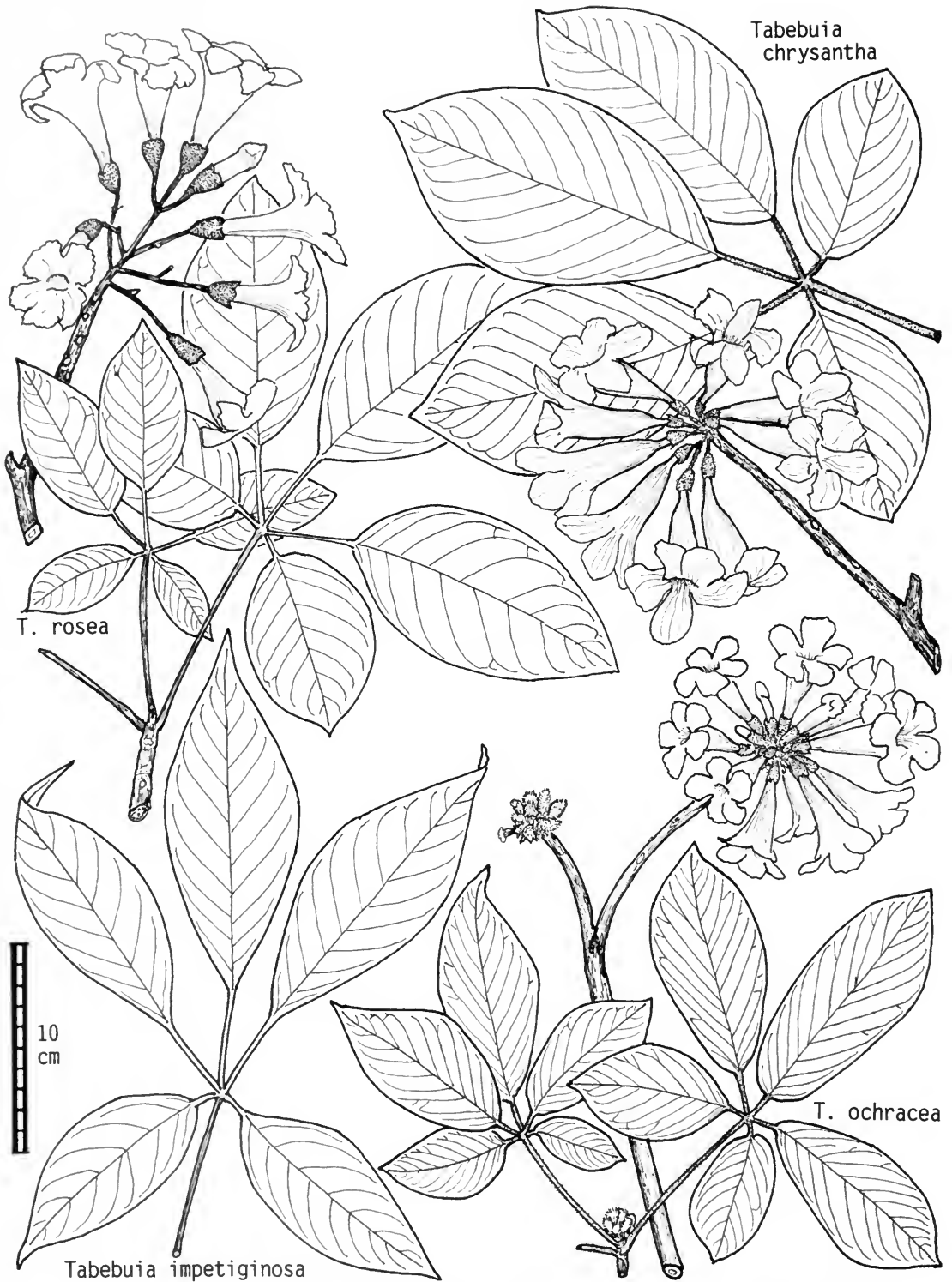


FIG. 13. Bignoniaceae: trees with palmately compound leaves and showy flowers; species of *Tabebuia*.

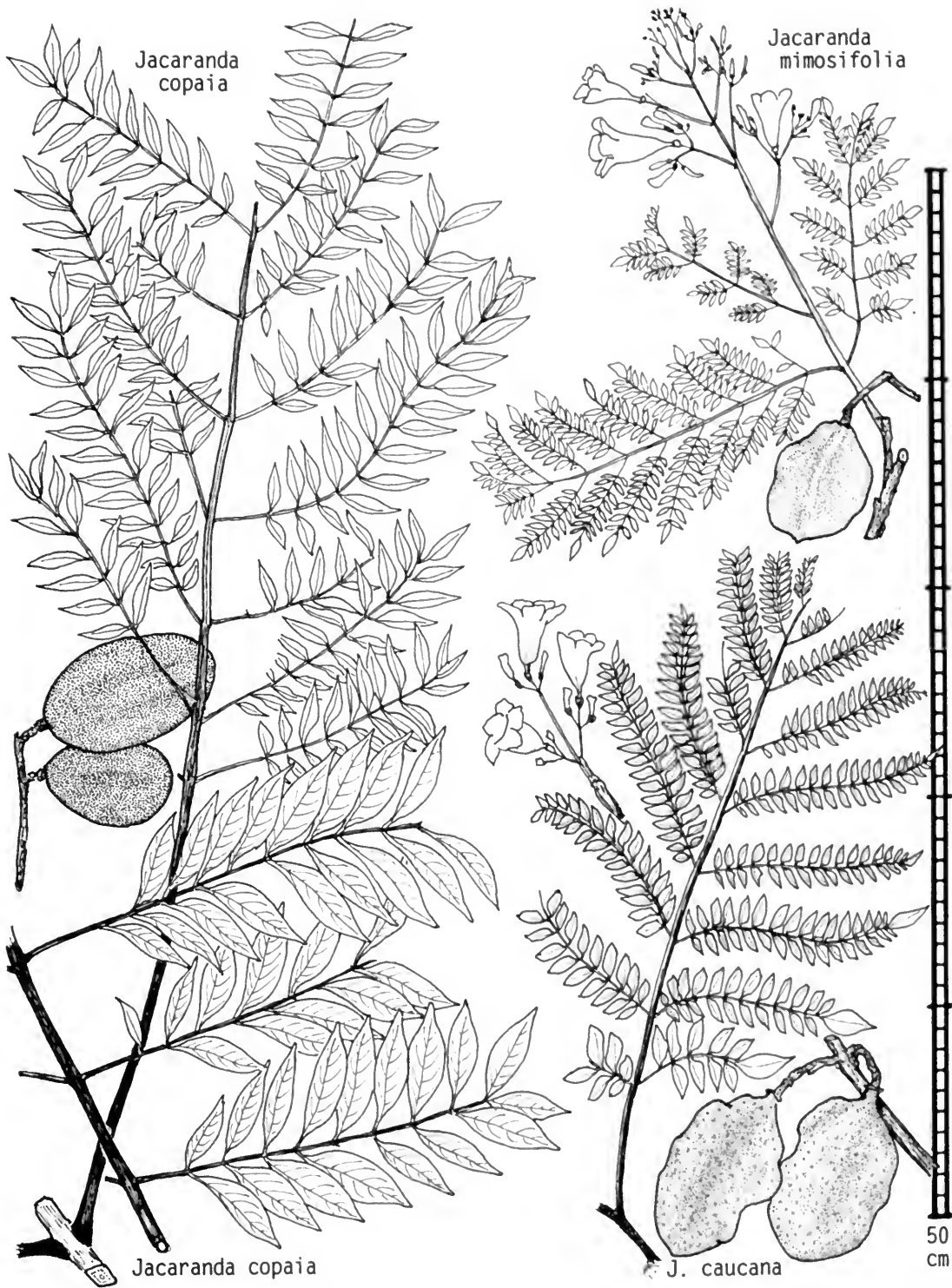


FIG. 14. Bignoniaceae: trees with bipinnately compound leaves and lavender or bluish flowers; species of *Jacaranda*.

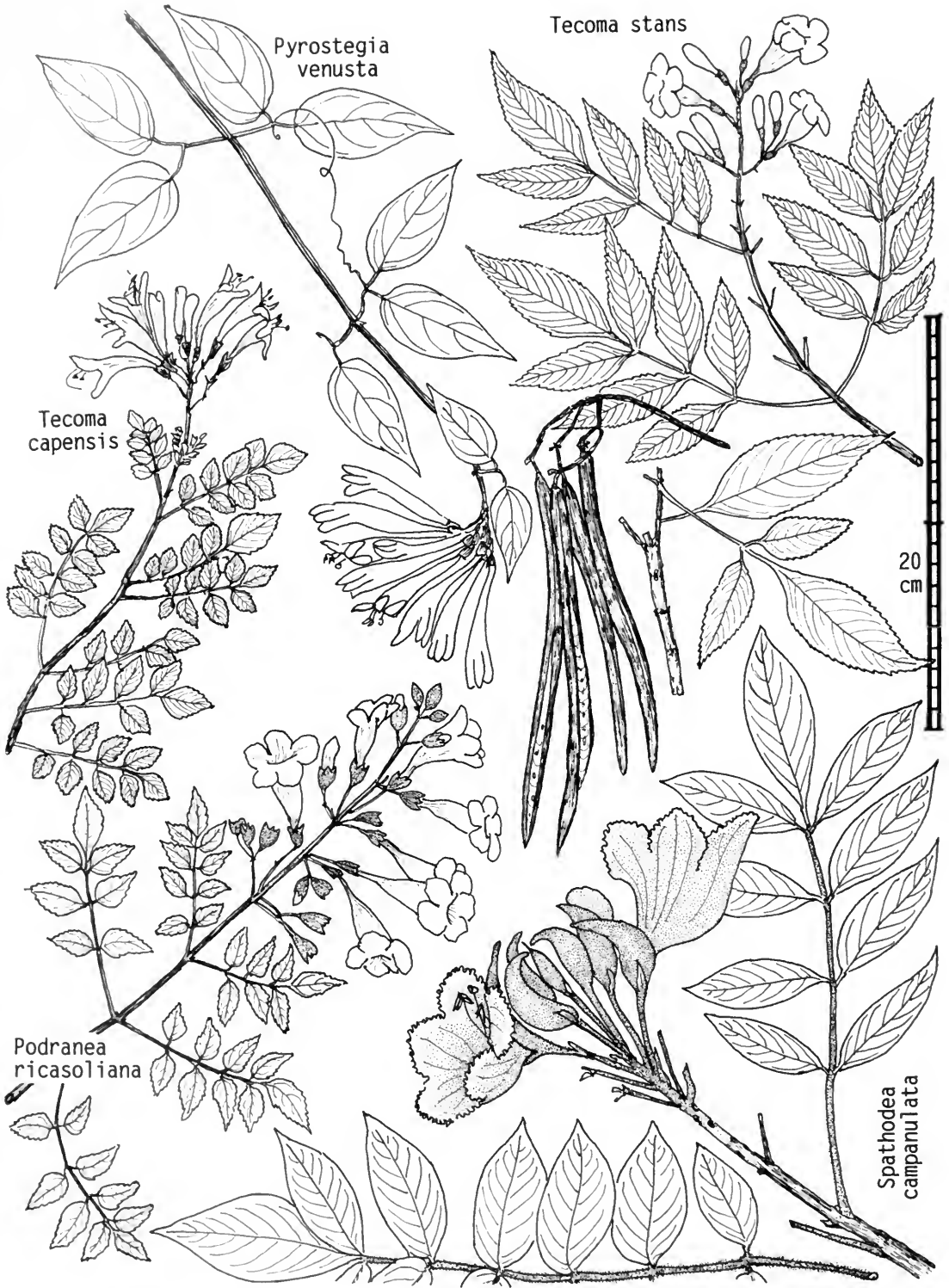


FIG. 15. Bignoniaceae: ornamental trees and shrubs and an ornamental vine.

30
cm

Tourrettia
lappacea

Mansoa
parvifolia



Pleonotoma *variabilis*

Tanaecium *jaroba*

FIG. 16. Bignoniaceae: unusual vines with twice-compound leaves, with very small leaves, or with a very long narrow corolla tube.

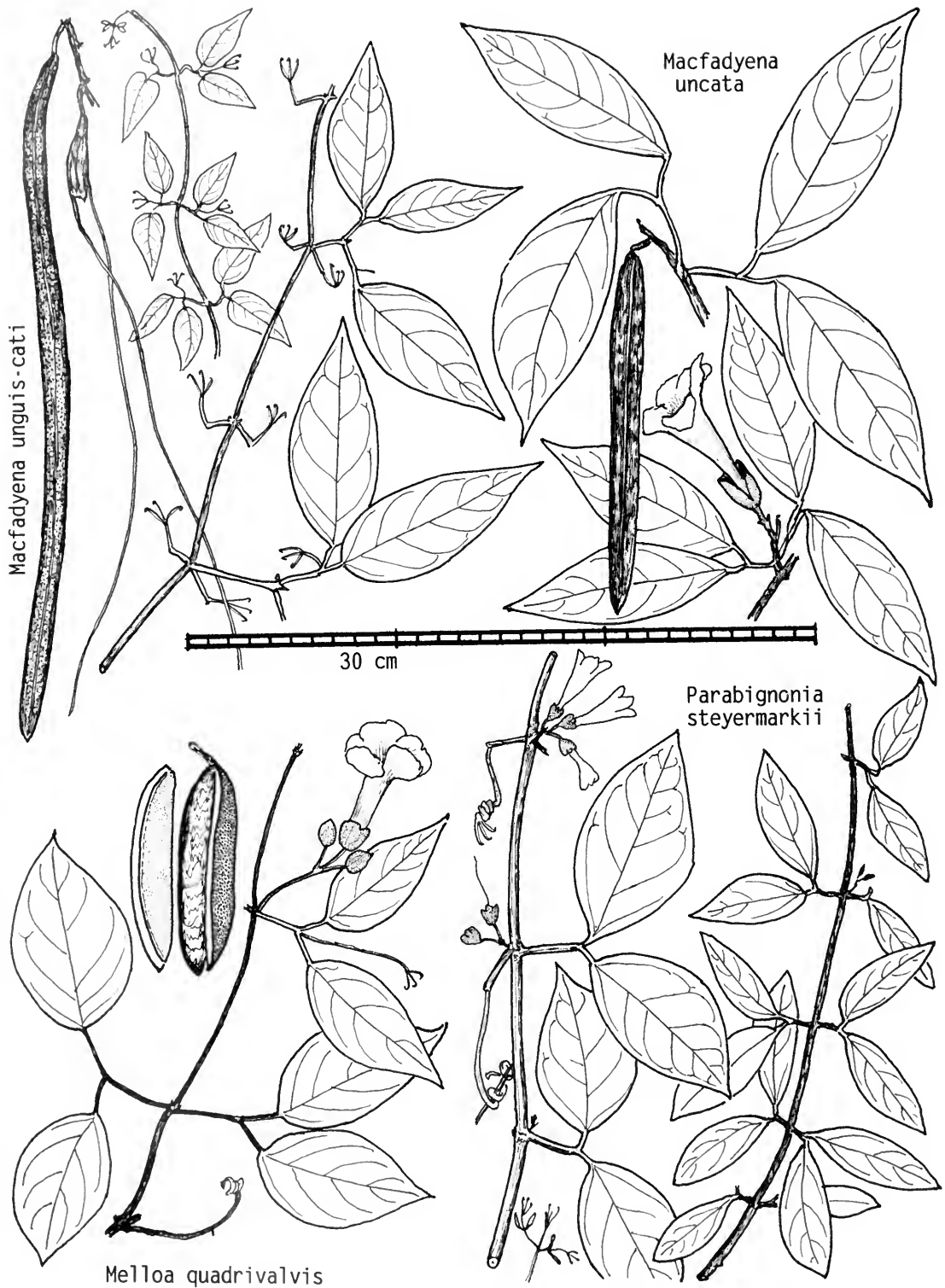


FIG. 17. Bignoniaceae: vines climbing with tendrils ending in 3 sharp hard claws.

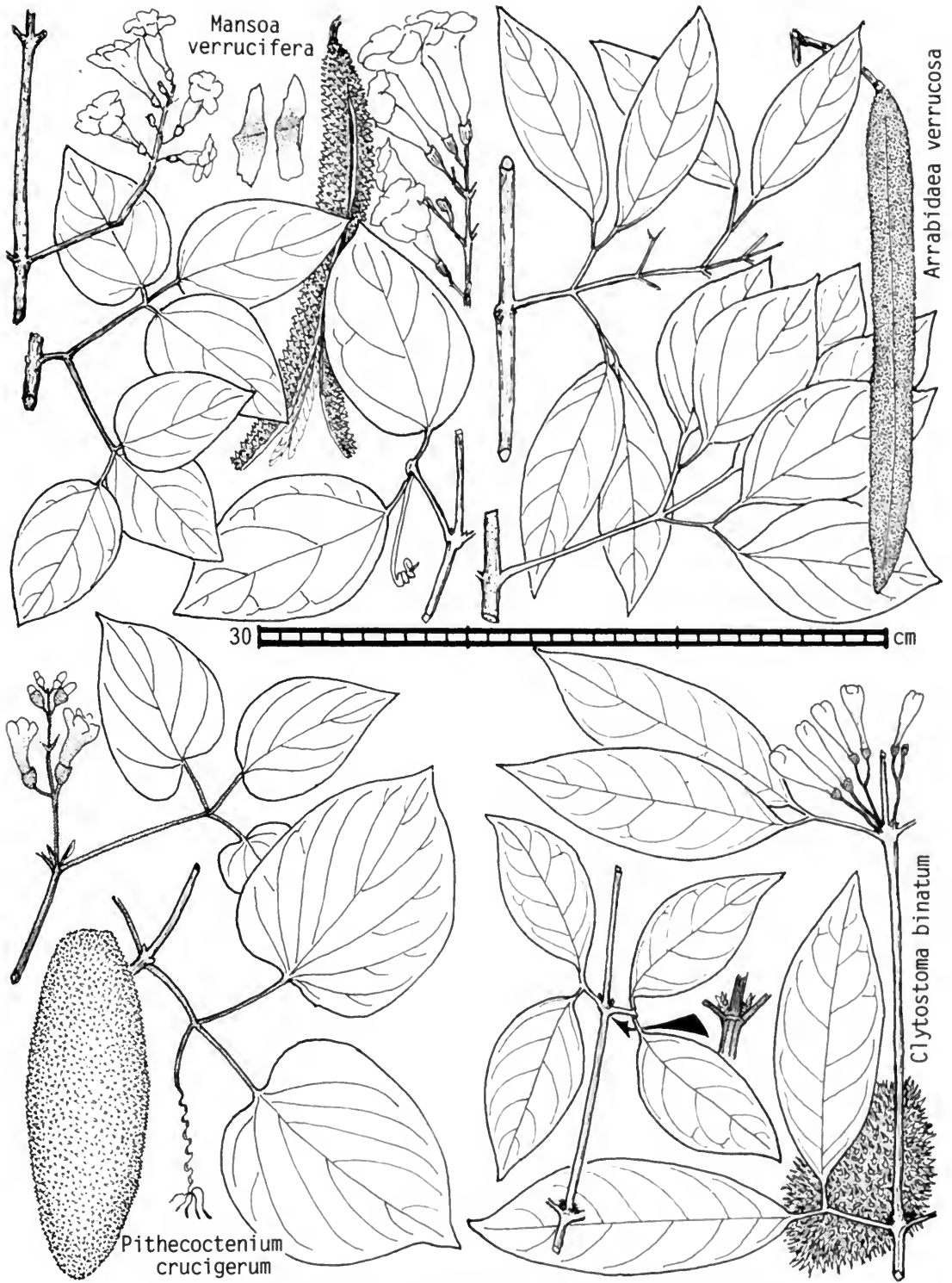


FIG. 18. Bignoniaceae: vines with echinate or prominently tuberculate fruits.

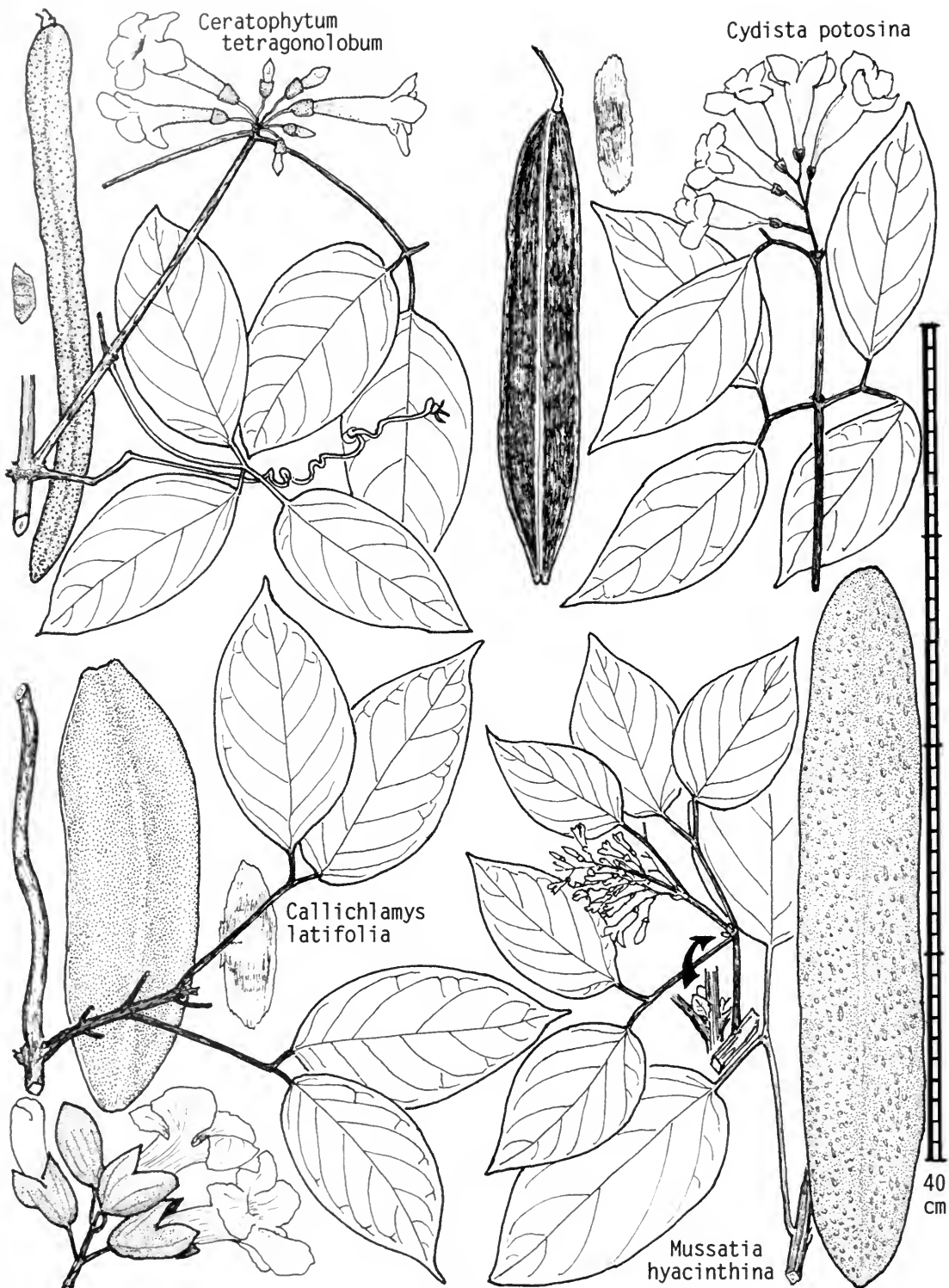


FIG. 19. Bignoniaceae: vines with broad or thick elongate fruits.

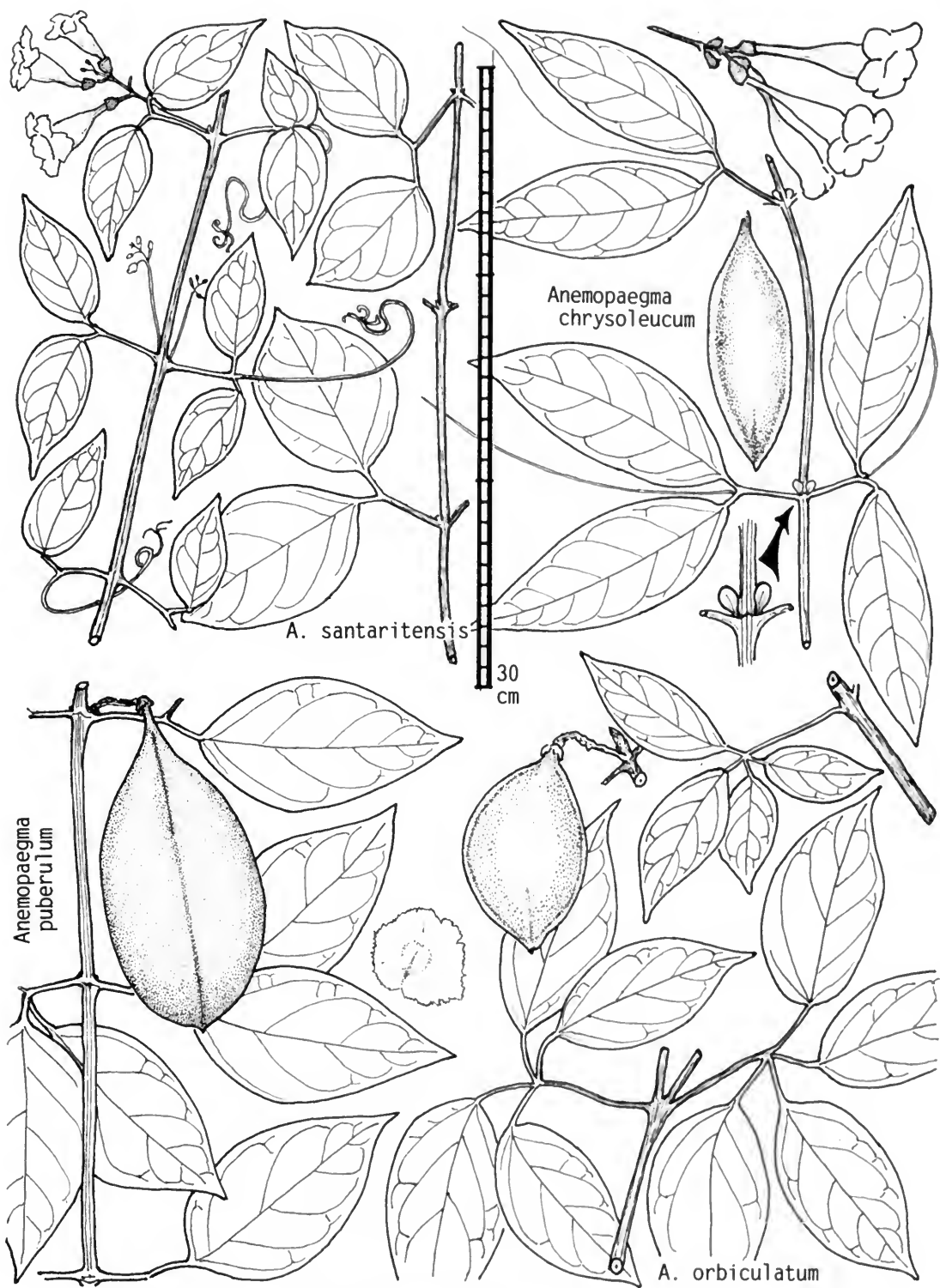


FIG. 20. Bignoniaceae: vines with ellipsoid or rounded fruits; species of *Anemopaegma*.



FIG. 21. Bignoniaceae: vines with flattened ellipsoid or oblong fruits.

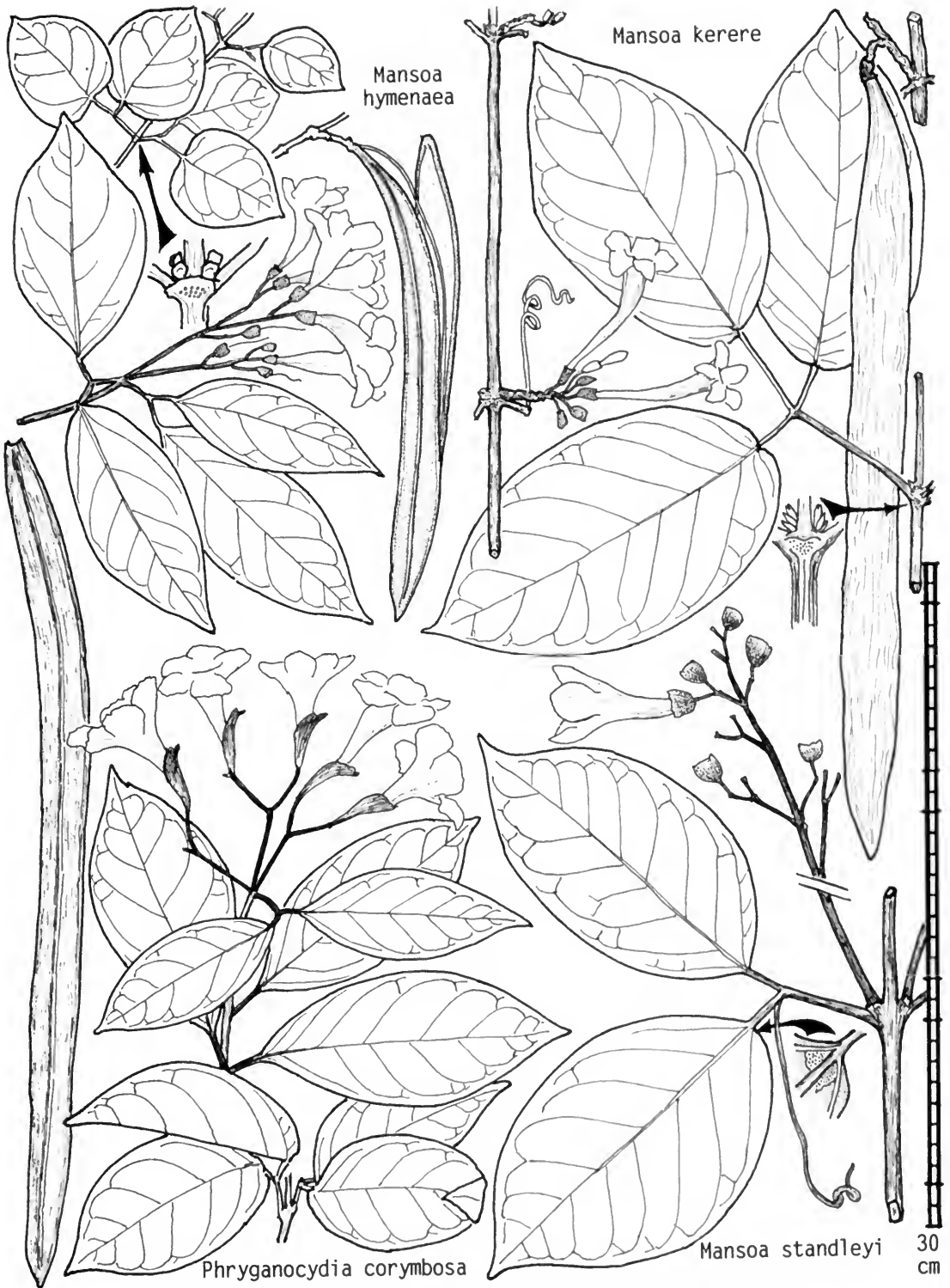


FIG. 22. Bignoniaceae: vines with flattened elongate fruits more than 2 cm wide.

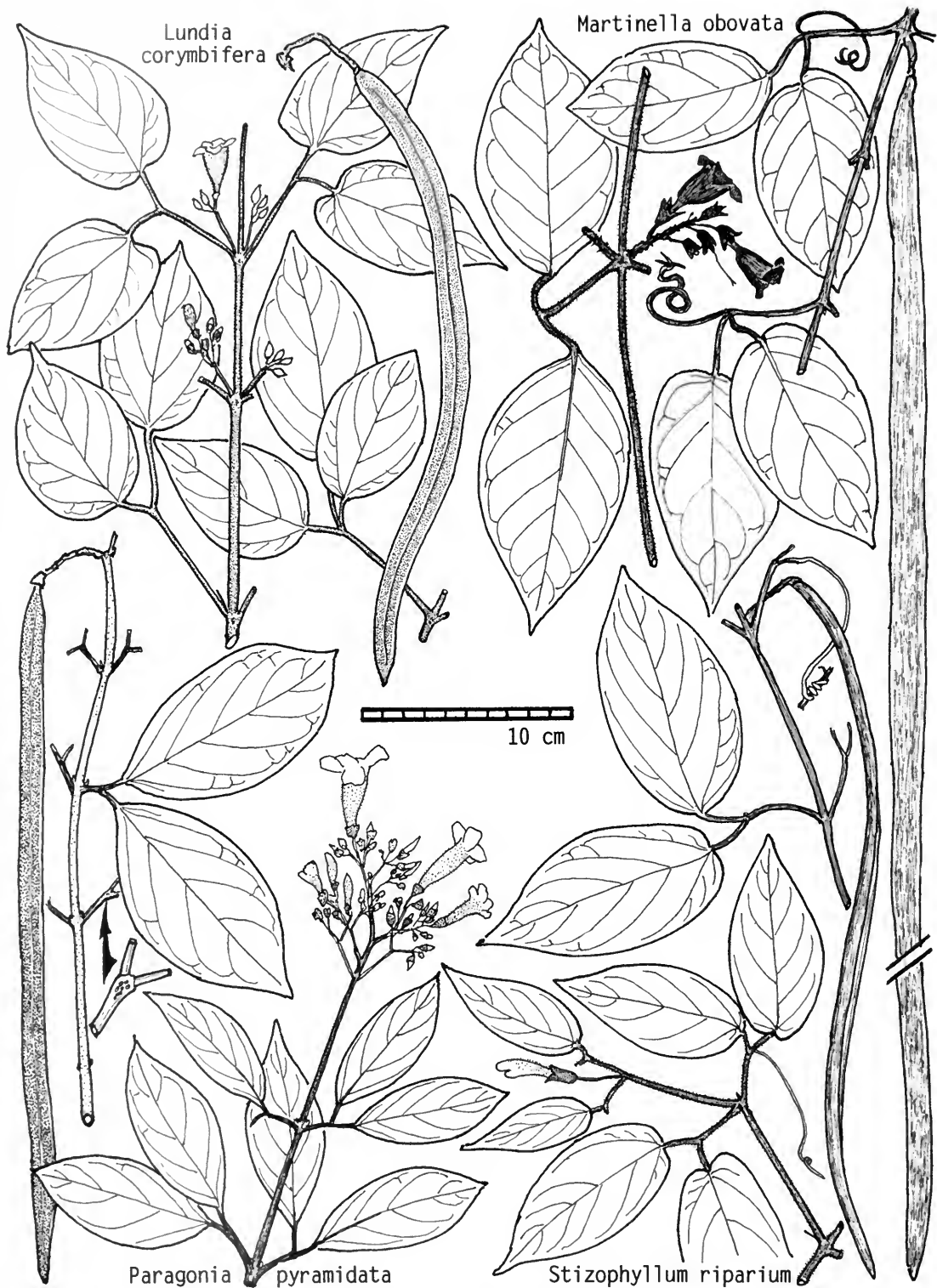


FIG. 23. Bignoniaceae: vines with very long linear flattened fruits.



FIG. 24. Bignoniaceae: vines with elongate narrow fruits; species of *Cydista*.



FIG. 25. Bignoniaceae: vines with elongate flattened narrow fruits; species of *Arrabidaea*.

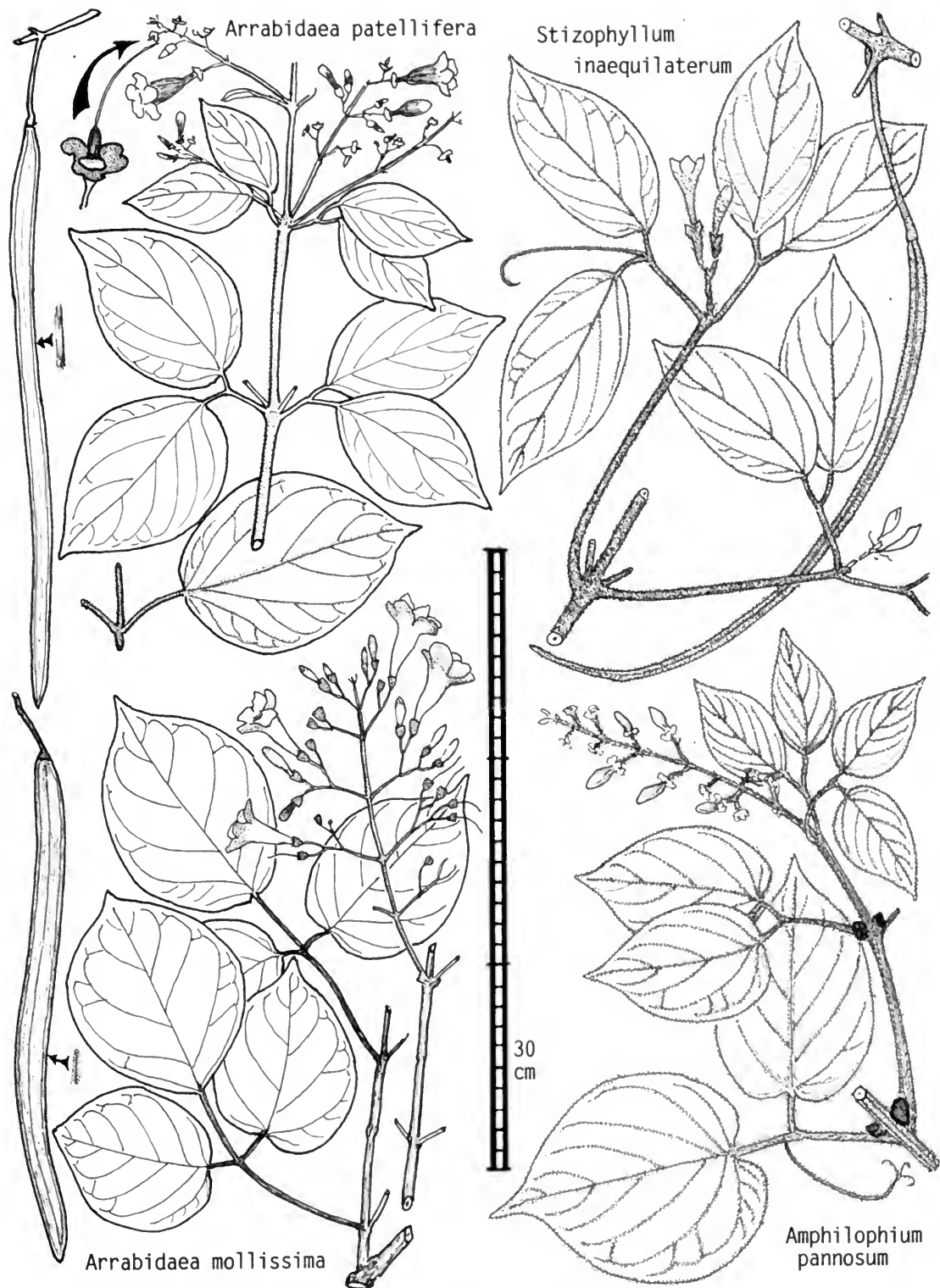


FIG. 26. Bignoniaceae: vines with elongate narrow fruits and usually puberulent leaves.

Adenocalymma Martius ex Meissner

Lianas, climbing with tendrils, stem terete, with 4 phloem areas in cross-section, glandular fields absent at the nodes; pseudostipules small, subulate. **Leaves** opposite, 3-foliolate or 2-foliolate with terminal tendril, petiolate, leaflets with petiolules, margins entire, venation pinnate. **Inflorescences** terminal or axillary, narrow racemes, flower buds subtended by caducous bracts. **Flowers** with cupular calyx, 5-lobed and 2-lipped or truncated, usually with peltate glands near the rim; **corolla** tubular-funnelform to tubular-campanulate, yellow, usually puberulent on the exterior; stamens 4, filaments of 2 lengths, included, anthers glabrous, thecae straight and divaricate to slightly divergent, a staminode present; disc pulvinate, ovary puberulent or with peltate hairs, 2-locular, ovules in 2 series on each placenta. **Fruits** oblong woody capsules, valves parallel to the septum, rounded or slightly compressed, median vein not elevated; seeds almost wingless or with 2 lateral wings poorly differentiated from the central body, brownish or translucent distally.

Adenocalymma is a Neotropical genus of about 36 species ranging from Mexico to Argentina, with most of the species in eastern Brazil. One species is endemic to mangroves in eastern Mexico, two species are found in eastern Panama-Chocó, and the following wide-ranging species occurs in Central America.

Adenocalymma inundatum Mart. ex DC., Prodr. 9: 201. 1845. *Tabebuia calderonii* Standl., J. Washington Acad. Sci. 14: 244. 1924. *A. hintonii* Sandw. Kew Bull. 1936: 10. 1936. *A. calderonii* (Standl.) Seibert, Carnegie Inst. Washington Publ. 522: 428. 1940. Figure 21.

Lianas, stems 1–15 cm diam., tendrils to 20 cm long, leafy stems 1.7–8 mm diam., essentially glabrous, terete, drying dark with whitish lenticels but becoming grayish in age, interpetiolar line often present; pseudostipules 2–3 mm long. **Leaves** with petioles 2–8 cm long, 0.8–2 mm diam., glabrous or minutely puberulent at the apex, petiolules of lateral leaflets 7–27 mm long, often thickened below the blade; **leaflet blades** 3.5–16 cm long, 2.5–7 cm wide, ovate to broadly elliptic-ovate or elliptic-oblong, apex acuminate, tips to 15 mm long, base obtuse or slightly rounded and truncated, drying stiffly chartaceous and lustrous above, glabrous except for few minute (0.05–0.1 mm) peltate hairs beneath, 2° veins 5–8/side, 3°

veins often elevated on the dried upper surface. **Inflorescences** 2–8 cm long, peduncles 6–22 mm long, minutely papillate-puberulent, bracts 6–12 mm long, 4–7 mm wide, early caducous, pedicels 2–7 mm long. **Flowers** with calyx 4–8 mm long, 4–6 mm diam., minutely papillate-puberulent, lobes 1–2 mm or margin irregularly split; **corolla** 3.5–6.5 cm long, funnelform-campanulate, yellow, tube 5–18 mm diam., minutely puberulent with crooked hairs externally, lobes 10–20 mm long, narrowed below and rounded distally, becoming reflexed; filaments 15–20 and 10–16 mm long, thecae 2–3 mm long. **Fruits** 9–18(–27) cm long, 2–3.5 cm wide, 13–22 mm thick, oblong, rounded at both ends, valves convex or flattened, pale grayish and rugulose-lenticellate; seeds 16–19(–21) mm long, 44–64(–76) mm wide, central area 17–20 mm wide, lateral wings membranaceous.

Evergreen lianas in deciduous and partly deciduous forests of the Pacific lowlands (in Costa Rica) and often found in riverine gallery forests, 2–400 m elevation (to 900 m in Chiapas). Flowering primarily March–August in Central America, fruiting December–February. This species ranges from Mexico to Brazil and occurs on Grenada.

Adenocalymma inundatum is recognized by its woody climbing habit and simple tendrils, opposite two- or three-foliolate leaves, short inflorescences, papillate-puberulent yellow corollas, narrowly oblong woody fruit, and thick-bodied, winged seeds. The generally glabrous parts and large floral bracts that leave conspicuous scars are also distinctive characteristics. The floral bracts have the same texture as the calyx but are present for only a short time. Gentry used the name *A. apurense* (Kunth in H.B.K.) Sandw. for this material but later decided that *A. apurense* was restricted to South America.

Amphilophium Kunth

Lianas, climbing with trifid tendrils, stems terete, with 4 (5) phloem areas in cross-section, nodes with interpetiolar ridges, lacking gland fields; pseudostipules leaf-like, early deciduous. **Leaves** opposite, 3-foliolate or 2-foliolate and often with a tendril, petiolate; leaflets with entire margins and pinnate venation. **Inflorescences** terminal, often on short lateral branches, racemose panicles with short lateral branches, bracts subtending the pedicels. **Flowers** with a cupulate-

campanulate calyx with thick inner 2–3-lobed calyx and thinner 5-lobed spreading exterior; **corolla** tubular and bilabiate, thick, whitish at first but becoming purple at anthesis, glabrous or puberulent externally, upper lip with 2 united lobes, lower lip with 3 united lobes, lobes triangular; stamens 4, filaments of 2 lengths, anthers glabrous, thecae thick and divaricate, staminode present; disc annular; ovary 2-locular, ovules multiseriate in each locule. **Fruits** woody capsules, valves somewhat compressed, parallel to the septum, smooth to tuberculate; seeds thin, with 2 lateral

membranous wings not clearly differentiated from the body of the seed.

Amphilophium is a genus of about eight South American species, with two wider ranging species present in Costa Rica. Unusual features are a thick two-layered calyx and the stiff, closed corolla, split almost halfway into two lobes that must be forced open by pollinators. The rough-surfaced fruits and corollas that are white but turn purple at anthesis are also unusual. *Distictis laxiflora* (DC.) Greenm. of Mexico and central Nicaragua also has six-angled stems, but that species has larger corollas and smooth elliptic fruits.

Key to the Species of *Amphilophium*

- 1a. Fruit surface muriculate; pseudostipules 3–10 mm long and caducous; stems and petioles sparsely to densely puberulent with simple to dendroid hairs 0.05–0.4 mm long and usually drying grayish to yellowish gray; common plants in deciduous, partly deciduous, and evergreen forest formations *A. paniculatum*
- 1b. Fruit surface verrucose; pseudostipules 5–18 mm long and often persisting; stems and petioles villous with simple or branched hairs 1–3 mm long and drying yellowish to yellowish brown; uncommon plants of evergreen rain forest formations *A. pannosum*

***Amphilophium paniculatum* (L.) Kunth** in H.B.K., Nov. Gen. Sp. 3: 116. 1819. *Bignonia paniculata* L., Sp. Pl. 623. 1753. *A. molle* (Schldl. & Cham.) Linnaea 5: 120. 1830. *A. paniculatum* var. *molle* (Schldl. & Cham.) Standl., Publ. Field Mus. Nat. Hist. Bot. Ser. 18: 1114. 1938. Figure 21.

Lianas to ca. 15 m high, stems to 10 cm diam., tendrils to 17 cm long, leafy stems 1.8–5 mm diam., with 6 prominent longitudinal ridges (hexagonal in cross-section), sparsely to densely puberulent with short (0.1–0.4 mm) scurfy-stellate and minute (0.05 mm) peltate hairs; pseudostipules 3–10 mm long, usually rounded, caducous. **Leaves** usually 2-foliolate, petioles 3–7 cm long, puberulent in longitudinal lines, petiolules 1–4.5 cm long; **leaflet blades** 3–16 cm long, 2–11 cm wide, broadly ovate to ovate-oblong or ovate-elliptic, apex acuminate to caudate-acuminate, base rounded and cordate to subcordate or truncate, often minutely scurfy puberulent beneath, larger (0.2 mm) peltate rounded hairs beneath near the base, venation subpalmate, 2° veins 5–7/side, distal veins strongly ascending. **Inflorescences** terminal, often on short lateral shoots and apparently axillary, 7–30 cm long, racemiform panicles with short lateral branches, 1° peduncle ca. 3 cm long,

puberulent like the stems, bracts caducous, pedicels 1–9 mm long. **Flowers** with calyx 7–12 mm long, 5–7 mm diam., cupulate, minutely puberulent, with usually reflexed outer lobes 3–4 mm long, inner calyx 2- or 3-lobed; **corolla** 20–35 mm long, 5–14 mm diam., white in early stages and becoming purple at anthesis, glabrous or with few hairs externally, lobes 11–20 mm long, narrowly triangular and not opening; filaments ca. 17 and 14 mm long, thecae ca. 2 mm long; ovary puberulent, style ca. 24 mm long. **Fruits** 5–15 cm long, 2.8–5 cm wide, 13–30 mm thick, oblong or oblong-ellipsoid, surface muriculate and with minute peltate hairs; seeds 11–15 mm long, 27–42 mm wide, central area ca. 10 mm wide, brownish or transparent distally.

Common and widespread plants of both seasonally deciduous forests and evergreen rain forest formations, 5–1800 m elevation. Flowering in the wet season and early dry season (Gentry, 1973b), but Costa Rican collections were made primarily in May–July and October–January. Probably fruiting throughout the year. This species ranges from Veracruz, Mexico, to northern Argentina.

Amphilophium paniculatum is recognized by its unusual calyx with inner and outer layers, corollas that are thick and held shut at anthesis, and the

woody oblong fruits with muriculate surface. Stems with six prominent longitudinal ridges, dendritic hairs (when present), and ovate blades with palmate venation are useful vegetative characteristics. The thick corolla lobes are united and the two lips remain connivent until forced open by large bees. The flowers are full size and white or yellowish a day before anthesis; they then become purple. The thick two-layered calyx may be protection against nectar-robbing animals. A great range of variation makes separation of this species into two varieties based on pubescence impractical. Because of its foliage and hexagonal stems, this species can be confused with *Pithecoctenium echinatum*, but that species has simple hairs and tendrils with as many as 15 distal segments.

Amphilophium pannosum (DC.) Bur. & K. Schumann in Mart., Fl. Bras. 8 (2): 209. 1896. *Bignonia pannosa* DC., Prodr. 9: 148. 1845. *A. oxylophium* J. D. Smith, Bot. Gaz. 31: 119: 1901. Figure 26.

Lianas or slender vines to 3 cm diam., tendrils to 18 cm long, leafy stems 1.5–5 mm diam., with 6 longitudinal ridges, densely villous with hairs 0.5–3.7 mm long yellowish brown when dried; pseudostipules 5–18 mm long, equally broad, sessile. **Leaves** usually 2-foliolate, petioles 2–7 cm long, 1.3–2 mm diam., densely villous, petiolules 1–4 cm long; **leaflet blades** 6–14 cm long, 3.5–10 cm wide, ovate to ovate-elliptic, apex acuminate, base rounded and truncate to cordate, upper surface with simple hairs 0.5–2 mm long, lower surface densely villous with branched hairs to 2 mm long, venation subpalmate, 2° veins 4–6/ side. **Inflorescences** 5–18 cm long, 1° peduncles 2–4 cm long, densely villous, 2° peduncles 5–12 cm long, bracts 1–1.5 mm, linear lanceolate, caducous, 2 bracteoles present below the calyx. **Flowers** with outer calyx 8–14 mm long, densely villous, lobes to 6 mm long, rounded, recurved or rotate, to 24 mm wide; **corolla** 22–30 mm long, tubular, 6–9 mm diam., at first yellowish white but turning purple, subglabrous externally, lip 11–14 mm long; filaments ca. 15 and 12 mm long, thecae ca. 2 mm long; style ca. 2 cm long. **Fruits** 5–10 cm long, 3–5.5 cm wide, elliptic-oblong, compressed, surfaces prominently verrucose with tubercles ca. 2 mm long, a central vein prominent or not, yellowish pubescent; seeds ca. 12 × 48 mm.

Uncommon plants of wet evergreen forest formations on both the Caribbean and southern Pa-

cific slopes, 5–1400 m elevation (but note that nearly all our collections come from the southern Pacific slope). Flowering in January, May, and July–September. The species ranges from central Costa Rica to northern Argentina.

Amphilophium pannosum is recognized by its climbing habit, six-angled stems, tendrils with usually trifid tips, densely villous yellow-brown pubescence, rounded pseudostipules, usually two-foliolate leaves, double-margined calyx, and verrucose fruit. Specimens of *A. pilosum* Standl. (1000–1400 m, in central Honduras) will key here because of similar pubescence and often retaining their pseudostipules, but that species may be an unusual variant of *A. paniculatum*.

Amphitecna Miers
Nomen conservandum

REFERENCE—A. Gentry, *Amphitecna* in Bignoniaceae—Part I (Crescentieae and Tourrettieae). Flora Neotropica Monogr. 25(1): 1–130. 1980.

Small to medium-sized **trees**, stems without distinct phloem fields in cross-section, glabrous, becoming terete; pseudostipules and glandular fields absent at the nodes. **Leaves** alternate (subopposite), simple, sessile to short-petiolate, blades entire, subglabrous or glabrous (domatia absent), venation pinnate. **Inflorescences** terminal, axillary or on short-shoots borne on older branchlets or trunks (cauliflorous), flowers solitary or fasciculate, subtended by small bracts, pedicels well developed and drying black, with or without bracteoles, glabrous. **Flowers** drying black, calyx large, cupular or tubular, splitting along 1 or 2 sides or opening irregularly, usually glabrous; **corolla** tubular-campanulate to funnelliform, usually bent upward above a contracted region below the middle of the tube, greenish white to yellowish white, thick-textured, 5-(4-) lobed and slightly 2-lipped; stamens 4, slightly exerted, filaments equal or of 2 lengths, anthers glabrous, thecae thick and somewhat divergent; a staminode present; ovary 1- or 2-locular, ovules many on axile placentas (when 2-locular) or on 2 parietal placentas (where unilocular). **Fruits** pendulous, an indehiscent hard-surfaced and thin-walled pepo (calabash), globose to ellipsoid, usually subtended by a circular perianth scar, the outer shell easily broken; seeds more than 10 mm diam., embedded in a soft or fleshy white pulp, surfaces smooth and without wings.

Amphitecna (formerly called *Dendrosicus* and

including *Enallagma*) is a genus of 20 species ranging from Mexico, Central America, and the West Indies to northern South America. There are two centers of species diversity: southern Mexico to Belize and Guatemala, and Costa Rica to Panama. The tree habit, lack of conspicuous hairs, simple large alternate leaves, large flowers with thick tissues that dry black, and pepo-like fruit with rounded seeds are unusual traits among Bignoniaceae and are characteristic of the tribe Crescentieae. The perianth usually forms a circumscissile abscission scar around the base of the fruit. The corolla often has an abaxial transverse indentation just distal to the constricted section of the corolla tube, where the distal portion of the widening corolla tube bends upward. The large size,

strong odor (usually unpleasant), large amount of nectar, and thick texture of the flowers are characteristic of flowers pollinated by bats. The flowers often vary significantly in size within a single species; leaf sizes and shapes also vary greatly within species. More important, herbarium material suggests that there may be populations intermediate between generally recognized species in this genus. Whether this variation is due to hybridization, overly narrow species concepts, or inherent variability is difficult to determine at this time because many species are represented by only a few collections. Gentry (1990) interpreted the greater number of localized endemic species in this genus as being a result of mammal-dispersed seeds, in contrast to genera with wind-dispersed seeds.

Key to the Species of *Amphitecna*

- 1a. Plants of ocean shores and low-elevation swamp forests; fruits subglobose and rounded distally; leaf blades often rounded distally, coriaceous *A. latifolia*
- 1b. Plants of well-drained soils, 5–2200 m elevation; fruits usually oblong to ellipsoid with a narrowed apex (sometimes globose in *A. gentryi*); leaf blades usually acute to acuminate at the apex, chartaceous to subcoriaceous 2
- 2a. Flowers borne on older leafless stems and trunks; leaf blades to 50 cm long [calyx 20–34 mm long, corolla 38–50 mm long; 10–600 m elevation] *A. kennedyi*
- 2b. Flowers terminal on leafy shoots or on short-shoots near the leaves; leaf blades to 30 cm long 3
- 3a. Flowers usually in clusters or 2–8, pedicels often with linear bracteoles 1–4 mm long 2–5 mm above the pedicel base; leaves often drying dark; (1200–)1500–2200 m elevation [calyx 22–32 mm long, corolla 33–53 mm long; fruits 13–17 cm long] *A. sessilifolia*
- 3b. Flowers usually 1 or 2, pedicels lacking linear bracteoles near the base; leaves often drying brown or grayish; 5–1400 m elevation 4
- 4a. Calyx 22–28 mm long, corolla 44–60 mm long; fruits 10–14 cm long; 5–800 m elevation, Pacific slope *A. isthmica*
- 4b. Calyx 15–20 mm long, corolla 25–40 mm long; fruits 5–8 cm long; 600–1400 m elevation, Caribbean slope *A. gentryi*

Amphitecna gentryi W. Burger, sp. nov. Figure 10.

Arbor parva. Folia alternata, glabra, anguste obovata-elliptica vel elliptica-oblonga, acuminata. Inflorescencia terminalia, floribus 1–2, pediculis glabris. Calyx 15–20 mm longus, bipartitus, lobis rotundatis, glabris. Corolla 22–28 mm longa, campanulata, alba. Fructus globosus vel ellipsoideus, seminibus in pulpa inclusis. TYPUS: Costa Rica, Puntarenas, Monteverde, in lower community, alt. 1350 m. March 1981. *Haber 478* (holotypus MO 3162341, isotypus CR).

Small trees 5–10 m tall, trunks to 18 cm diam.,

leafy stems 2–6 mm diam., terete, glabrous, yellowish or pale gray, expanded below the leaf base. **Leaves** alternate, petioles 0–8 mm long, 0.7–1.8 mm diam., glabrous, often with lustrous hard yellowish tissue at the base; **leaf blades** 6–16.5 cm long, 2–6.5 cm wide, elliptic-obovate, obovate or narrowly elliptic-oblong, apex acute to caudate-acuminate, gradually narrowed to the cuneate or acute base, drying chartaceous and grayish or grayish brown, glabrous above and below, 2° veins 7–12/side. **Inflorescences** terminal, of 1 flower (rarely 2) on leafy shoots or subterminal on short lateral shoots, subtended by hard yellowish subulate bracts 1–2 mm long, pedicels 30–42

mm long, glabrous, sometimes with very small (1 mm) yellowish bracteoles 1–5 mm above the base. **Flowers** with calyx 15–20 mm long, ca. 10 mm diam., glabrous, splitting near the base into 2 broad lobes, rounded distally; **corolla** 25–40 mm long, white or cream-green, tube 6–11 mm diam., papillate-puberulent in the distal half, lobes ca. 3 × 10 mm; filaments 20–23 mm long, thecae ca. 5 mm long; ovary not examined. **Fruits** 5–8 cm long, 4–5 cm diam., oblong to subglobose, with a slightly narrowed apex, surface smooth, green drying brown; seeds 11–14 mm long, 14–17 mm wide, 6–9 mm thick.

Plants of lower montane rain forest formations of the Caribbean slope, 600–1400 m elevation. Flowering in February–March and July; fruiting in March, June–July, and September. As presently known, this species ranges from Volcán Cacao eastward to Braulio Carillo National Park in northern and central Costa Rica.

Amphitecna gentryi is recognized by its small tree habit, smaller subsessile leaves turning grayish when dried, usually solitary terminal flower, smaller corollas, and globose or oblong fruit. Specimens placed here include *Gómez et al. 21603*, *Hammel & Chavarría 17533A*, and the following collections by William Haber and associates: 478, 5841, 6673, 7473, 8235, and 9272.

Gentry recognized these plants as distinct and designated these plants as *Amphitecna sp. aff. A. donnell-smithii* (Sprague) L. O. Williams, a lowland species of Belize and Guatemala with oblanceolate leaves of similar length. This species also resembles two highland species of northern Central America described by L. O. Williams: *A. molinae*, of Honduras, and *A. silvicola*, of the border between Guatemala and Mexico. More important, it should be noted that there are collections that appear to be intermediate between this species and *A. isthmica* at elevations of 300–600 m (*Herrera 1966, 2118*), implying that the plants placed here could also be considered a subspecific highland element of *A. isthmica*. Nevertheless, the characteristics used in the key seem to separate the two taxa effectively, and only further collecting can determine whether the intermediates are unusual individuals or are parts of a cline.

Amphitecna isthmica (A. Gentry) A. Gentry, Taxon 25: 108. 1976. *Dendrosicos isthmicus* A. Gentry, Phytologia 26: 442. 1973. Figure 10.

Small **trees** 5–10 m tall, trunks to 15 cm diam., leafy stems 1.7–5 mm diam., glabrous, pale yellow

or grayish, terete. **Leaves** subsessile or with petioles to 10 mm long, 1–2.5 mm diam., glabrous, often with hard lustrous yellowish tissue at the base; **leaf blades** 6–22(–32) cm long, 2–8(–10) cm wide, narrowly elliptic-obovate to narrowly elliptic-oblong, apex acuminate, gradually narrowed to the cuneate base, drying stiffly chartaceous and grayish, glabrous, 2° veins 8–17/side. **Inflorescences** terminal (axillary), usually 1 (2) flower on leafy stems, subtended by few hard subulate yellowish bracts 1–2 mm long, pedicel 30–48 mm long, 0.8–1.7 mm diam., glabrous, without bracteoles. **Flowers** drying black or dark brown, calyx 22–30 mm long, 11–18 mm wide, splitting to near the base into 2 broad obtuse lobes, glabrous; **corolla** 44–60 mm long, 30–40 mm wide at the lobes, greenish white, papillate puberulent in the distal half externally, tube 5–14 mm diam., lobes 3–8 mm long, with reflexed rim; filaments 20–30 mm long, thecae 4–5 mm long; ovary bilocular to above the middle. **Fruits** 9–14 cm long, 3–8 cm diam., ellipsoid-cylindric, narrowed at the ends, surfaces smooth and punctate, perianth scar thickened and disc-like at base; seeds ca. 10–14 mm long, 4 mm thick.

Plants of wet evergreen rain forest formations on the Pacific slopes, 5–800 m elevation. Flowering material has been collected in February, May, August, and October–December. The species ranges from northern Costa Rica to Colombia.

Amphitecna isthmica is recognized by its lowland rain forest habitat, small tree habit, narrow alternate leaves that usually dry grayish, usually solitary terminal flowers on long pedicels, calyx splitting into two rounded lobes, and ellipsoid-cylindric fruits. This species lacks the bracteoles on the pedicels seen in *A. gentryi* and *A. sessilifolia* and is separated from *A. kennedyi* by having only terminal flowers. This species appears to be restricted to the evergreen Pacific slope in Costa Rica, which helps distinguish it from the closely related *A. gentryi*.

Amphitecna kennedyi (A. Gentry) A. Gentry, Taxon 25: 108. 1973. *Dendrosicos kennedyi* A. Gentry, Phytologia 26: 441. 1973. Figure 10.

Small **trees** and shrubs 3–15 m tall, leafy stems 1.5–11 mm diam., glabrous, ridged below the leaf base but becoming terete and pale grayish. **Leaves** with petioles 2–12 mm long, 1–4 mm diam., glabrous, often with lustrous hard tissue developed at the base; **leaf blades** 14–35(–50) cm long, 5–

13(–21) cm wide, elliptic-obovate to narrowly obovate or oblanceolate, apex usually short-acuminate, gradually narrowed to the cuneate base, drying chartaceous and brownish or grayish, glabrous above and below, 2° veins 8–17(–22)/side, often weakly loop-connected near the margin. **Inflorescences** cauliflorous, 1–3 flowers on short-shoots borne below leafy nodes on branchlets or on the surface of larger stems, subtended by stiff grayish subulate bracts 2–3 mm long, pedicels 25–45 mm long, 0.6–1.7 mm diam., glabrous. **Flowers** drying black, calyx 20–34 mm long, 9–20 mm diam., split to near the base to form 2 lobes, glabrous; **corolla** 38–56 mm long, tubular-campanulate, 13–19 mm wide at the mouth, greenish white to yellowish green, with peltate or papillate hairs on the distal half externally, lobes forming a reflexed bilabiate rim; filaments 24–28 mm long, thecae 4–5 mm long; ovary lepidote, 1-locular with 2 parietal placentae. **Fruits** 11–16 cm long, 5–7 cm diam., ellipsoid, apiculate at base and apex; seeds 13–15 mm long, embedded in pulp.

Plants of evergreen rain forest formations of both Caribbean and southern Pacific slopes (in Costa Rica), 10–600 m elevation. Flowering collections were made in January–April and July–September. This species ranges from the east coast of Honduras to central Panama.

Amphitecna kennedyi is distinguished by its small tree habit, flowers borne at leafless nodes or on the older stems, corolla with poorly developed lobes forming a reflexed rim, ellipsoid fruits, and lowland rain forest habitat. The lower half of the corolla often has a smoother texture demarcated distally by a transverse ridge.

Amphitecna latifolia (Miller) A. Gentry, *Taxon* 25: 108. 1976. *Crescentia latifolia* Miller, *Gard. Dict.* ed. 8: 306. 1768. *C. obovata* Benth., *Bot. Voy. Sulphur* 130. 1844. *Enallagma latifolia* (Miller) Small, *Fl. Miami* 171. 1913. *A. obovata* (Benth.) L. O. Williams, *Fieldiana*, Bot. 36: 25. 1973. *Dendrosicos latifolius* (Miller) A. Gentry, *Taxon* 22: 644. 1973. Figure 10.

Small trees (2–)4–8(–12) m tall, trunks to 20 cm diam., branches often crooked, leafy stems 2.5–12 cm diam., terete, glabrous, often becoming pale gray, lenticellate. **Leaves** alternate or subopposite, petioles 2–14 mm long but poorly differentiated from the leaf, glabrous; **leaf blades** 10–28 cm long, 4–14 cm wide, narrowly or broadly obovate to obovate-oblong or oblong, apex short-acuminate to rounded, base obtuse to cuneate and

slightly decurrent on the petiole, drying subcoriaceous to coriaceous, glabrous or with minute (0.05 mm) peltate hairs beneath, 2° veins 7–13/side, weakly loop-connected near the margin. **Inflorescences** terminal or below leafless nodes, of 1–3 flowers, subtended by stiff subulate bracts 2–3 mm long, pedicels (22–)40–63 mm long, glabrous. **Flowers** glabrous externally, drying black, calyx 28–38 mm long, tube 7–15 mm diam., splitting along the lateral sides nearly to the base to form 2 divergent lobes; **corolla** 45–65 mm long, tube 12–24 mm diam., 3–4 cm wide at the apex, tubular-campanulate, greenish white or pale yellowish green, lobes 5–15 mm long; filaments ca. 25 mm long, anthers 5–6 mm long; style 5–6 cm long. **Fruits** 7–10 cm long, 6–10 cm wide, globose or subglobose, green, surface smooth and hard, with thickened disc-like perianth scar at base; seeds 13–16 mm long, 14–17 mm wide, 5–8 mm thick, surface smooth.

Small trees growing just inland from coastal mangroves and in low-elevation swamps in evergreen and deciduous areas of both the Pacific and Caribbean coasts, 0–20(–200) m elevation. Flowering and fruiting throughout the year (more abundantly in the wet season). This species ranges from southern Florida, the West Indies, Mexico, and Central America to Venezuela and Ecuador.

Amphitecna latifolia is recognized by the tree habit, stiff simple alternate leaves, glabrous flowers drying black and arising directly from distal stems, globose indehiscent fruit, and rounded seeds embedded in pulp. The flowers have a disagreeable odor. Common names are *calabasillo de playa*, *jicarita*, *jicaró de playa* and swamp calabash (Belize).

Amphitecna sessilifolia (J. D. Smith) L. O. Williams, *Fieldiana*, Bot. 36: 25. April 1973. *Tabebuia sessilifolia* J. D. Smith, *Bot. Gaz.* 25: 156. 1898. *Neotuerckheimia gonoclada* J. D. Smith, *Bot. Gaz.* 47: 259. 1909. *Enallagma sessilifolia* (J. D. Smith) Standl., *Publ. Field Mus. Nat. Hist.*, Bot. Ser. 18: 1120. 1938. *A. sessilifolius* (J. D. Smith) A. Gentry, *Taxon* 22: 646. Nov. 1973. Figure 10.

Trees or shrubs to 12 m tall, trunks 7–25 cm diam., leafy stems 4–11 mm diam., glabrous, with ridges beneath the leaf base, pale gray, becoming terete. **Leaves** alternate, petioles 2–10 mm long, poorly differentiated from the blade, glabrous; **leaf blades** 10–35 cm long, 2–11 cm wide, narrowly obovate to oblanceolate or narrowly oblan-

ceolate, apex acute to acuminate, gradually narrowed to the cuneate base, drying chartaceous, subglabrous with minute (0.05 mm) peltate hairs, 2° veins (8–)11–22/side, often arising at 70–90° from the midvein. **Inflorescences** terminal fascicles of 2–8 flowers, basal bracts to 7 mm long, pedicels 22–65 mm long, 1–2 mm diam., glabrous, drying black, often with 2 small (1–4 mm) linear bracteoles 2–5 mm above the base. **Flowers** with calyx inflated before anthesis, 22–32 mm long, 11–19 mm diam., glabrous, splitting laterally into 2 lobes, margins rounded; **corolla** 33–53 mm long, 25–35 mm wide distally, white with greenish tinge, tube 6–13 mm diam., bent upward near the middle, lobes 3–12 mm long, glabrous proximally but with minute (0.1 mm) peltate hairs on the lobes externally; filaments ca. 26 and 24 mm long, thecae ca. 5 mm long. **Fruits** 12–17 cm long, 6–9 cm diam., subglobose to ellipsoid-oblong with narrowed apex to 1 cm long, surface smooth, glabrous, drying dark; seeds 15–20 mm long, 15–24 mm wide.

Understory trees within evergreen montane rain forests, 1200–2200 m elevation. Flowering throughout the year. This species ranges from the Cordillera de Tilarán to the Chiriquí highlands of western Panama.

Amphitecna sessilifolia is recognized by its tree habit, alternate oblanceolate leaves, large 2-lobed calyx, pale green corollas, smooth oblong-ellipsoid fruits, and restriction to montane forests. Another important distinction is that the thick calyx splits apart, often resulting in a whitish tissue exposed along the edge. A number of specimens from Monteverde have more clearly differentiated petioles and corolla lobes lacking peltate hairs externally; these have been annotated *A. haberi* (an unpublished name) by Gentry. Because they are otherwise identical to *A. sessilifolia* and live in the same kind of habitat, it seems best to consider them no more than a local variant of *A. sessili-*

folia. Common names are *calabacero*, calabash, *quacalillo*, *jicarilla*, *jicaró*.

Anemopaegma Martius ex Meisner
Nomen conservandum

Lianas or vines (in Central America), climbing with simple or distally trifid tendrils, stem with 8 (rarely 4) phloem areas in cross-section, terete; nodes usually with interpetiolar lines, gland fields absent; pseudostipules leaf-like to small or absent. **Leaves** opposite, 2–5-foliolate, petiolate, often bearing a tendril coiled near the tip, blades often drying yellowish or grayish green, margins entire, venation pinnate. **Inflorescences** axillary or terminal, few-flowered racemes or 1 or 2 flowers, bracts small, pedicels short. **Flowers** with cupular or campanulate calyx, truncated and subentire or slightly lobed, often with glands below the margin externally; **corolla** tubular-campanulate or funnel-form, 5-lobed and somewhat 2-lipped, bright yellow to pale yellow or white, externally glabrous or with minute glandular peltate hairs; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae straight and divaricate, staminode present; disc pulviniform; ovary usually stipitate, ellipsoid, puberulent or with peltate hairs, 2-locular with ovules in 2–6 series in each locule. **Fruits** woody or coriaceous capsules, elliptic to orbicular, valves strongly flattened or rounded, smooth; seeds flat, completely surrounded by a membranaceous sub-orbicular wing or wingless and with larger brown corky seed area and thinner distal area.

Anemopaegma is a genus of about 46 species ranging from Mexico to Brazil and Argentina; most of the species are South American. The great variation found within some species has resulted in a large number of names, and it is often difficult to demarcate species. Many of the proposed species probably will have to be brought together into broader species concepts.

Key to the Species of *Anemopaegma*

- 1a. Leaves usually with 4 or 5 leaflets. *A. orbiculatum*
- 1b. Leaves with no more than 2 or 3 leaflets 2
- 2a. Pseudostipules conspicuous (4–9 mm long); tendrils lacking trifid tips; fruits ellipsoid, seeds brown and lacking a translucent outer wing *A. chrysoleucum*
- 2b. Pseudostipules absent or minute; tendrils often trifid near the tip; fruits flattened and oblong, seeds pale yellowish with thin translucent circumferential wing (where known) 3
- 3a. Leaves usually puberulent beneath, leaflet margins not involute [stems terete, lacking corky ridges; corolla tube subglabrous externally]. *A. puberulum*

- 3b. Leaves subglabrous beneath, leaflet margins often involute 4
 4a. Corolla tube with minute peltate hairs externally; stems tetragonal and often with corky ridges; seeds not known *A. santaritensis*
 4b. Corolla tube glabrous; stems subterete and longitudinally striate; seeds suborbicular
 *A. chrysanthum*

Anemopaegma chrysanthum Dugand, *Caldasia* 4: 307. 1947.

Lianas or slender vines, stems to 2 cm diam., tendrils to 13 cm long, trifid at tip, leafy stems 1.2–8 mm diam., glabrous, longitudinally striate, grayish and becoming lenticellate; pseudostipules minute. **Leaves** foliolate, petioles 8–50 mm long, 1–2.5 mm thick, glabrous, petiolules 8–40 mm long; **leaflet blades** 5–17(–20) cm long, 3–9(–12) cm wide, broadly ovate to elliptic, apex acute or short-acuminate, base acute to obtuse, drying stiffly chartaceous and grayish green, subglabrous, 2° veins 3–7/side. **Inflorescences** short axillary racemes with 2–8 flowers, peduncles ca. 10 mm long, pedicels 10–15 mm long. **Flowers** subglabrous, calyx 6–9 mm long, 4–6 mm diam. with distal glands, margin subentire; **corolla** 50–70 mm long, yellow, mouth 12–22 mm wide, lobes 10–15 mm long; filaments 24–32 and 16–23 mm long, thecae 4–5 mm long. **Fruits** 8–20 cm long, 5–8 cm wide, 1 cm thick, oblong-elliptic, flattened, surface smooth, yellow-brown, stipe 1–2 cm long; seeds 40–55 mm diam., suborbicular.

Plants of evergreen forest formations of the northern cordilleras in Costa Rica; 350–1000 m elevation. Flowering in March–April. This species ranges from Mexico to Ecuador.

Anemopaegma chrysanthum is recognized by its three-tipped tendrils, two-foliolate opposite leaves, few-flowered axillary racemes, glabrous yellow corollas, and broad flat fruits with suborbicular seeds. Rarely collected in Central America, this species has only recently been found in Costa Rica.

Anemopaegma chrysoleucum (Kunth in H.B.K.)

Sandw., *Lilloa* 3: 459. 1938. *Bignonia chrysoleucum* Kunth in H.B.K., *Nov. Gen. Sp.* 3: 134. 1819. *A. puncticulatum* Pittier & Standl., *J. Wash. Acad. Sci.* 15: 461. 1925. *A. macrocarpa* Standl., *Publ. Field Columb. Mus., Bot. Ser.* 4: 262. 1929. Figure 20.

Lianas or slender vines, stems to 2 cm diam., tendrils to 17 cm long, simple, leafy stems 1.2–5 mm diam., minutely puberulent at the nodes, lon-

gitudinally striate, interpetiolar lines usually well developed; pseudostipules 4–9 mm long, broadly ovate. **Leaves** 2-(3-) foliolate, petioles 8–34 mm long, 0.8–1.5 mm diam., glabrous or minutely (0.1–0.2 mm) puberulent, petiolules 10–18 mm long; **leaflet blades** 5–13(–18) cm long, 2–6(–8) cm wide, narrowly ovate-elliptic to elliptic, apex acute or acuminate, base acute to obtuse, drying chartaceous and yellowish green or gray-green, minutely punctate, glabrous except for minute hairs on the midvein above, 2° veins 5–8/side. **Inflorescences** of 1 or 2 axillary flowers (1–4/node) or a raceme to 9 cm long with ca. 5 flowers, peduncles 3–15 mm long, 1 mm diam., minutely puberulent, pedicels 6–14 mm long. **Flowers** with calyx 8–11 mm long, 7–9 mm diam., rounded glands and minute peltate hairs or subglabrous, margin entire; **corolla** 58–105 mm long, white to yellowish white, glabrous externally, narrowed base of tube ca. 2 cm long, mouth 12–20 mm wide, lobes 12–25 mm long, 17–24 mm wide; filaments 24–34 and 16–25 mm long, thecae 4–5 mm long. **Fruits** 7–13 cm long, 3–5 cm wide, 2 cm thick, ellipsoid, surface smooth and lustrous, yellow-brown, stipe ca. 1 cm long; seeds ca. 15 × 22 mm, brown throughout, margin thin but not translucent.

Plants of river edges and swampy areas in lowland evergreen rain forest formations on both the Caribbean and Pacific slopes, 0–50 m elevation. Flowering throughout the year. This species ranges from Mexico to Venezuela and Peru.

Anemopaegma chrysoleucum is recognized by its slender climbing stems with simple tendrils, usually bifoliolate opposite leaves, small leaf-like pseudostipules, few-flowered axillary inflorescences, large white to yellowish corollas, and ellipsoid fruits with flat seeds that lack thin translucent membranous wings. This species differs from its congeners by having seeds with stiff cardboard-like texture that are dispersed by water.

Anemopaegma orbiculatum (Jacq.) DC., *Prodr.* 9: 190. 1845. *Bignonia orbiculata* Jacq., *Sel. Stirp. Am. Hist.* 184, tab. 180, fig. 79. 1763. *Pithecoctenium panamense* Benth., *Bot. voy. Sulphur* 129. 1844. Figure 20.

Slender **lianas** to 5 m high, stems to 25 mm diam., longitudinally striate, hollow, tendrils 8–17

cm long, simple or with trifid arms to 5 mm long, leafy stems 1.5–9 mm diam., minutely (0.1–0.2 mm) puberulent with thin hairs, an interpetiolar line present or absent; pseudostipules rarely present. **Leaves** 4- or 5-foliolate, petioles 3–14 cm long, 1.2–2.2 mm diam., minutely puberulent, longitudinally striate, tendril scar ca. 2 mm wide, petiolules 4–40(–55) mm long; **leaflet blades** 5–15(–22) cm long, 3–8(–9.5) cm wide, ovate-elliptic to ovate, apex acuminate, base obtuse to rounded and subcordate, drying chartaceous and greenish, punctate above, minutely and sparsely puberulent beneath, 2° veins 5–7/side. **Inflorescences** axillary, 2–10 cm long, racemes with 1–10 flowers (rarely with a cymose lateral branch at the first node), peduncles 3–30 mm long, ca. 1.2 mm diam., minutely puberulent, pedicels 6–12 mm long. **Flowers** with cupular-campanulate calyx 6–10 mm long, 5–9 mm wide, margin subentire or with 5 irregular minute teeth, minutely (0.1 mm) puberulent; **corolla** 33–70 mm long, tube 14–20 mm wide at the mouth, yellow and often with the lobes paler, glandular puberulent externally (more densely near the base), lobes 8–18 mm long, the lower reflexed; filaments ca. 16 and 23 mm long, thecae ca. 4 mm long, divaricate at 180°. **Fruits** 9–14 cm long, 6–10 cm wide, ca. 2 cm thick at center, suborbicular to broadly elliptic, with a basal stipe 8–15 mm long, valves slightly convex or flattened, surface smooth and lustrous, yellowish brown; seeds 30–38 mm long, 40–47 mm wide, elliptic-orbicular, body ca. 14 mm wide, wings transparent near the periphery.

Plants of forest edges in evergreen lowland rain forest formations of the Caribbean slope and Nicoya peninsula, 5–900 m. Flowering in April–September. Nearly all Costa Rican collections come from near La Selva and the Río Sarapiquí–Río Frio drainage areas; we have no collections of this species from southern Costa Rica. This species ranges from El Salvador to Colombia and Venezuela.

Anemopaegma orbiculatum is recognized by its climbing stems with simple or trifid tendrils, opposite four- or five-foliolate leaves, subentire calyx cups, bright yellow corollas, and suborbicular fruits with orbicular winged seeds. This is the only bignoniaceous vine in Central America with consistently five-foliolate or four-foliolate leaves.

Anemopaegma puberulum (Seibert) Miranda, Anal. Inst. Biol. Mexico 24: 93. 1953. *Chodanthus puberulum* Seibert, Carnegie Inst. Washington Publ. 527: 425. 1940. Figure 20.

Slender **lianas** to 2 cm diam., tendrils 11–27 cm long and trifid at the tip, leafy stems 2–6 mm diam., glabrous or puberulent with thin straight hairs 0.1–0.3 mm long, longitudinally striate when dry, interpetiolar ridge usually present; pseudostipules minute. **Leaves** 2-foliolate with tendril or tendril scar, petioles 18–40 mm long, 1.5–2.3 mm diam., glabrous or minutely puberulent, petiolules 10–45 mm long, 1–2.2 mm diam.; **leaflet blades** 8–21 cm long, 4–12 cm wide, ovate to ovate-elliptic, apex acuminate, base obtuse to truncate or subcordate, drying stiffly chartaceous, usually glabrous above, punctate, minor venation raised above (dried), lower surface glabrous to pubescent with straight thin hairs to 0.1–0.4 mm long, 2° veins 4–7/side, 3° veins prominent on both surfaces. **Inflorescences** axillary, 2–8-flowered racemes to 6 cm long, peduncles 14–20 mm long, ca. 1.5 mm diam., glabrous or puberulent, pedicels ca. 7 mm long. **Flowers** with cupular calyx 6–9 mm long, 5–8 mm diam., distal margin subentire or slightly lobed, puberulent, glabrous or with few minute peltate hairs; **corolla** 50–71 mm long, tubular campanulate, yellow, glabrous or papillate-puberulent externally, tube 12–21 mm diam. at mouth, lobes 10–15 mm long, 10–14 mm wide, rounded, filaments ca. 14 and 20 mm long, thecae 3–4 mm long. **Fruits** 10–21 cm long (including the 11–20 mm stipe), 6–8 cm wide, ca. 13 mm thick, oblong-elliptic, valves flattened, woody, with a median longitudinal line, surface lustrous, yellowish brown; seeds 35–60 mm diam., suborbicular with thin translucent peripheral wing, body 14–18 mm long.

Uncommon plants of evergreen or partly deciduous forest formations on the Caribbean and southern Pacific slopes in Costa Rica, 5–800(–1200) m elevation. Probably flowering throughout the year (mostly in the dry season, January–May). This species ranges from Veracruz, Mexico, to Ecuador.

Anemopaegma puberulum is recognized by its vining habit with trifid tendrils, opposite two-foliolate leaves, few-flowered axillary inflorescences, subentire calyx cups, large yellow subglabrous corollas, flattened oblong-elliptic woody fruit, and seeds with thin suborbicular peripheral wings. The glabrous lustrous upper leaf surface with elevated minor venation, lack of conspicuous pseudostipules, and fruits with a longitudinal line down the middle also help distinguish this uncommon species from its congeners. Specimens with densely puberulent stems and leaves do look quite different from those that are essentially glabrous, but they seem to differ in no other way, and there are

intermediate collections. For this reason, *A. chrysanthum* may prove to be a synonym of *A. puberulum*.

Anemopaegma santaritense A. Gentry, Ann. Missouri Bot. Gard. 58: 93. 1971. Figure 20.

Slender **lianas** climbing with trifold (simple) tendrils 3–12 cm long, leafy stems 1.5–4 mm diam., glabrous or minutely papillate-puberulent, longitudinally ridged or with longitudinal corky ridges, tetragonal, interpetiolar ridge present or absent; pseudostipules absent. **Leaves** 2-foliolate, with a tendril or tendril scar, petioles 15–34 mm long, 0.9–1.3 mm diam., glabrous or minutely papillate-puberulent along the upper (adaxial) surface, petiolules 6–17 mm long; **leaflet blades** 5–11 cm long, 2.5–6.5 cm wide, ovate to narrowly ovate-elliptic or ovate-orbicular, apex acuminate to caudate-acuminate, base obtuse to somewhat rounded, drying chartaceous and greenish, glabrous or with minute papillate hairs along the midvein on both surfaces, 2° veins 3–5/side. **Inflorescences** axillary, flowers 1 or 2 or 2–8 on a raceme to 9 cm long, subglabrous, bracts 0.5–1 mm long, pedicels 5–14 mm long. **Flowers** with cupular calyx 6–10 mm long, 5–8 mm diam., glabrous or with few minute papillate hairs, margin entire; **corolla** 52–75 mm long, tubular-campanulate, 17–20 mm diam. at mouth, pale yellow or white, glabrous or with minute peltate hairs externally, lobes 8–12 mm long; filaments ca. 20 and 18 mm long, thecae 3–4 mm long; ovary stipitate, ca. 2 mm long. **Fruits** not known.

Rarely collected plants of evergreen rain forest formations on the Caribbean slope and Golfo Dulce, 0–1000 m elevation. Flowering collections have been made in March–May and September in Costa Rica and Panama. This species ranges from eastern Costa Rica to Colombia.

Anemopaegma santaritense is recognized by its climbing habit and usually trifold tendrils, tetragonal stems, opposite two-foliolate leaves, few-flowered axillary inflorescences, calyx cups with subentire margins, and larger yellow or white corollas with minute peltate hairs. The upper leaf surfaces are dull green and often reflexed along the margins when dried.

Arrabidaea DeCandolle

Lianas climbing with simple tendrils (rarely small trees or shrubs), stems terete, with 4 phloem areas in cross-section, interpetiolar ridges and

gland fields often present at the nodes; pseudostipules usually small and inconspicuous. **Leaves** opposite, petiolate, 3-foliolate or 2-foliolate with tendril or tendril scar (rarely simple), leaflets petiolulate, margins entire, puberulent to subglabrous, venation pinnate or palmate, domatia rarely present. **Inflorescences** often terminal pyramidal thyrses or panicles, also axillary or from leafless nodes, usually many-flowered, bracts minute, pedicels usually puberulent. **Flowers** small to large, calyx cupulate to tubular or campanulate (rarely patelliform), distally truncated and entire or minutely 5-denticulate, puberulent; **corolla** tubular-campanulate or funnelliform, usually somewhat 2-lipped, pale pink to purple (white), usually densely puberulent externally, lobes 5, unequal, rounded at the apex; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae usually divaricate, staminode present; disc annular; ovary narrowly cylindrical, with peltate hairs, 2-locular, ovules 2-seriate. **Fruits** long-linear capsules, septically dehiscent, valves flattened parallel to the septum, coriaceous and usually with a raised longitudinal median vein, smooth (rarely tuberculate); seeds much wider than long with 2 membranaceous lateral wings (rarely corky), body of the seed usually differentiated from the thin wings.

Arrabidaea is a genus of about 70 species ranging from Mexico and the West Indies to Argentina; the majority of species are South American. *Arrabidaea inaequalis* (DC. ex Spreng.) K. Schum. is disjunct between Belize and Colombia but should be searched for in our flora; it is easily recognized by its twice-compound leaves. Two other species are included in this treatment that have not been collected in Costa Rica: *A. florida* and *A. pubescens* (q.v.). Our species of *Arrabidaea* are mostly lianas with simple tendrils and two- or three-foliolate leaves, usually having paniculate inflorescences, narrowly cupular calyx with entire or minutely dentate margin, purple to lilac or rose corollas that are puberulent externally, long narrow fruits with flattened valves, and flat seeds, often with thin lateral wings transparent at the tips. A number of our species have very short flowering periods, which may account for their poor representation in herbaria. There is great variation within many of the species, which can make determination of specimens lacking flowers very difficult. These plants are easily confused with species of *Cydista* (lacking a disc at the base of the ovary) and *Lundia* (pubescent anthers).

Key to the Species of *Arrabidaea*

- 1a. Shrubs, small trees, or rarely lianas, tendrils usually absent; gland fields absent; simple leaves often present beneath 3-foliolate leaves on distal stems; inflorescences short racemes with < 10 flowers; fruits often held erect [plants of dry deciduous forests, flowering in May–June] *A. costaricensis*
- 1b. Lianas, tendrils usually present, gland field present or absent; simple leaves only found on young plants (except in *A. patellifera*); inflorescences usually paniculate with > 10 flowers; fruits pendulous 2
- 2a. Calyx 14–23 mm long, tubular; fruits with prominently tuberculate valves, becoming black or dark brown; seeds 16–18 mm long [leaves 2-foliolate; flowering in the wet season in evergreen forest formations] *A. verrucosa*
- 2b. Calyx 1–9 mm long, cupulate, short-tubular or flattened and saucer-like; fruits with smooth or slightly muricate valves becoming yellowish brown to dark brown, seeds 6–14 mm long 3
- 3a. Calyx 1–4 mm long, flattened and saucer-like (patelliform), entire and lacking teeth; corolla tube glabrous externally but with the lobes puberulent and whitish [deciduous forests, flowering in July–October] *A. patellifera*
- 3b. Calyx 3–9 mm long, cupulate to short-tubular, entire or with minute teeth; corolla tube puberulent above the narrowed base, lobes pink to purple 4
- 4a. Corolla 8–18 mm long [flowers in dense distal clusters on large inflorescences; leaves usually subglabrous and drying grayish; interpetiolar gland fields usually absent; not known to occur between Nicaragua and central Panama] *A. florida*
- 4b. Corolla 18–55 mm long 5
- 5a. Leaves usually drying reddish brown above and below, usually subglabrous and lustrous with minor venation raised above and below; plants of wet evergreen forests 5–900 m elevation [flowering March–August] *A. chica*
- 5b. Leaves not drying reddish brown and lustrous above and below, usually conspicuously puberulent on the veins or on the lower surface; plants of deciduous and partly deciduous forest formations (also evergreen forests in *A. candicans*), 0–400 m elevation 6
- 6a. Lower leaf surfaces pale grayish with a dense tomentum of minute hairs; flowering in July–December [fruits with the midvein and lateral edges usually prominent; central area of seed clearly demarcated from the translucent wings] 7
- 6b. Lower leaf surface not pale grayish with a dense tomentum, hairs 0.1–1 mm long; flowering in January–August 8
 - 7a. Flowering in November–December; seeds 24–34 mm wide; collected in Costa Rica in partly deciduous and evergreen forests of the Pacific slope *A. candicans*
 - 7b. Flowering in July–September; seeds 17–24 mm wide; not known from Costa Rica *A. pubescens*
- 8a. Surface of fruit puberulent and soft to the touch; calyx 4–6 mm long [margin often with minute teeth and whitish]; flowering in December–early March *A. mollissima*
- 8b. Surface of fruit glabrous or minutely puberulent, not soft to the touch; calyx 4–9 mm long; flowering in April–August 9
- 9a. Calyx cup with small (0.3 mm) distal teeth; stems and leaves with simple and/or branched hairs; fruits with the midvein not elevated; mostly flowering in April–June (in Costa Rica) *A. corallina*
- 9b. Calyx cup with entire distal margin (or sometimes split); stems and leaves with simple hairs; fruits with the midvein usually elevated; mostly flowering in June–August *A. conjugata*

Arrabidaea candicans (L. C. Rich.) DC., Prodr. 9: 185. 1845. *Bignonia candicans* L. C. Rich., Act. Soc. Hist. Nat. Paris 1: 110. 1792. *A. pachycalyx* Sprague, Bull. Herb. Boiss., sér. 2 6: 373. 1906. *A. rhodothyrsus* Kränzl., Fedde Rept. 17: 20. 1921. Figure 25.

Lianas to 7 cm diam., climbing with simple tendrils 11–21 cm long, leafy stems 1–6 mm diam., minutely puberulent, becoming grayish, glandular fields conspicuous, an interpetiolar line usually present. **Leaves** with petioles 45–97 mm long, 1–2.3 mm diam., minutely puberulent, pet-

iolules 11–55 mm long, 0.6–1.4 mm diam.; **leaflet blades** 4.5–20 cm long, 3–12 cm wide, ovate to broadly ovate or ovate-elliptic, apex acute to acuminate, base obtuse to subtruncate or slightly rounded, drying chartaceous, densely and minutely grayish puberulent beneath, 2° veins 4–7/side, strongly ascending. **Inflorescences** terminal or axillary to distal leaves, 20–40 cm long, to 30 cm wide, a pyramidal thyrses, peduncles 2–4 mm diam., densely minutely grayish puberulent, lateral branches 2–7 cm long, pedicels 1–3 mm long. **Flowers** with calyx 3–5 mm long, 2–4 mm diam., tubular-conical, densely minutely puberulent, margin entire; **corolla** 20–38 mm long, 6–9 mm diam. distally, purple or rose (white within), densely puberulent externally, lobes 5–11 mm long, 7–10 mm wide, rounded; filaments ca. 16 and 13 mm long, thecae 2–2.5 mm long. **Fruits** 12–35 cm long, 7–12 mm wide, linear to linear-oblong, valves smooth, midvein and margins slightly elevated; seeds 7–9 mm long, 24–34 mm wide, central dark area 14–18 mm wide, clearly differentiated from the translucent wings.

Plants of evergreen rain forest and partly deciduous forest formations, 5–900 m elevation. Flowering November–December, fruiting February–June. Uncommon in Costa Rica, it is known only from the Pacific slope, from Tacares southward to Golfo Dulce. This species ranges disjunctly from Mexico to Brazil.

Arrabidaea candidans is recognized by the climbing habit, simple tendrils, two- or three-foliate leaves, large inflorescences, puberulent calyx with entire margin, puberulent rose to purple corollas, long linear fruits, and transparent-winged seeds. The leaflets with grayish lower surface and the gland fields conspicuous below the nodes are useful vegetative distinctions.

Arrabidaea chica (Humboldt & Bonpland) Verlot, Rev. Hort. 40: 154. 1868. *Bignonia chica* Humboldt & Bonpland, Pl. Aequin. 1: 107, pl. 31. 1808. Figure 25.

Lianas to 35 m high, stems to 15 cm diam., tendrils to 12 cm long, leafy stems 1.5–5 mm diam., glabrous or sparsely and minutely (0.1 mm) puberulent, longitudinally striate, nodal glandular fields visible on young stems. **Leaves** with petioles 32–85 mm long, 0.8–1.9 mm diam., usually glabrous, petiolules (4–)10–32(–46) mm long; **leaflet blades** (3–)5–16 cm long, 2–8 cm wide, narrowly ovate-elliptic to elliptic-oblong or elliptic, acuminate at the apex, base obtuse or

rounded, drying chartaceous and usually reddish brown, usually glabrous above and below (in Central America), 2° veins 4–7/side, minor venation raised on both surfaces (dried). **Inflorescences** terminal, often 3-parted at a branchlet apex, 8–36 cm long, peduncles 4–8 cm long, ca. 1.7 mm diam., very sparsely puberulent, drying dark, proximal lateral branches to 7 cm long, pedicels 4–7 mm long. **Flowers** with calyx 3–5 mm long, 2–3 mm diam., cupulate, minutely papillate puberulent, grayish green, distally subentire with small (0.2 mm) teeth; **corolla** 18–34 mm long, tube 6–11 mm diam., lavender to purple (white within), densely papillate puberulent externally, lobes 6–12 mm long, to 12 mm wide; filaments ca. 12 and 9 mm long, thecae 1.5–2 mm long. **Fruits** 14–28 cm long, 9–14 mm wide, linear-oblong, valves flat, smooth and light to dark brown, midvein and margins slightly raised; seeds 8–10 mm long, 23–38 mm wide, wings strongly differentiated and transparent.

Uncommon plants of wet evergreen rain forest formations on both Caribbean and Pacific coasts (rarely collected in moist sites in seasonally very dry deciduous formations), 5–900 m elevation. Flowering in late March–August. This species ranges from Mexico to Argentina.

Arrabidaea chica is recognized by its climbing habit with simple tendrils, two- or three-foliate leaves, nearly entire cupular calyx, pale purple corollas densely puberulent externally, and narrow glabrous fruits with winged seeds. The leaves are usually glabrous and usually become reddish brown and lustrous when dried. These plants have been widely used as a source of red dyes; such a use has been reported around Santa Ana (*Echeverría* 32 & 37 f). Gentry (1973b) remarked that puberulent forms of this species intergraded with *A. candidans*, but in Central America it may be better to assign all the puberulent forms to *A. candidans*.

Arrabidaea conjugata (Vell.) Mart., Flora 24 (2), Beibl. 46. 1841. *Bignonia conjugata* Vell., Fl. Flum. 245. 1825; 6: tab. 18. 1827. Figure 25.

Lianas climbing to the tops of medium-size trees, to 5 cm diam., leafy stems 1.5–5 mm diam., sparsely very minutely puberulent, glabrescent, gland fields often conspicuous; pseudostipules ca. 2 mm long, conical. **Leaves** with petioles 2–13 cm long, 0.8–2 mm diam., sparsely minutely puberulent, longitudinally striate, petiolules 8–55 mm long; **leaflet blades** 5–17(–21) cm long, 3.5–

10(–13) cm wide, ovate-elliptic to ovate or elliptic-obovate, apex acuminate, base cuneate to rounded, drying chartaceous to subcoriaceous, glabrous or with minute (0.1 mm) hairs along the veins beneath and usually with longer (0.2–0.5 mm) hairs in vein axils (domatia), 2° veins 4–7/ side, strongly ascending (subpalmate). **Inflorescences** terminal, 14–34 cm long, pyramidal panicles with 3–5 pairs of lateral branches, peduncles to 10 cm long, 2.3 mm diam., pedicels 1–4 mm long, densely puberulent. **Flowers** with tubular calyx 4–7 mm long, 3–5 mm diam., grayish with a dense minute (0.1 mm) puberulence, margin entire or 5-denticulate, submarginal glands present; **corolla** 30–42 mm long, 7–12 mm wide at the mouth, tubular-campanulate, magenta (white within), puberulent with short crooked hairs, lobes 4–11 mm long, 7–9 mm wide; filaments 12–16 and 8–11 mm long, thecae ca. 2 mm long. **Fruits** 12–31 cm long, 8–14 mm wide, linear-oblong, midvein often slightly elevated, surface slightly muricate; seeds 7–11 mm long, 19–27 mm wide, brown throughout except for transparent distal 2–3 mm.

Evergreen lianas of the seasonally dry deciduous forests of northwestern Costa Rica (and in partly deciduous forests elsewhere), 5–150 m elevation. Flowering in June–September; fruiting in the dry season (Gentry, 1973b). The short flowering season may account for a paucity of collections. This species ranges from northwestern Costa Rica to Brazil.

Arrabidaea conjugata is recognized by its climbing habit with simple tendrils, two- or three-foliolate glabrate leaves, terminal pyramidal panicles, densely puberulent grayish calyx with submarginal glands, puberulent magenta corolla, and long linear flattened fruit with two-winged seeds. The conspicuous gland fields below the nodes, leaves with longer hairs in vein axils beneath (when present), and raised minor venation also help to distinguish this species.

Arrabidaea corallina (Jacq.) Sandw., Kew Bull. 1953: 460. 1954. *Bignonia corallina* Jacq., Fragm. Bot. 37, tab. 42, fig. 1. 1800–1809. *B. glabrata* Kunth in H.B.K., Nov. Gen. Sp. 3: 137. 1819. *B. obliqua* Kunth in H.B.K., Nov. Gen. Sp. 3: 135. 1819. Figure 25.

Lianas to 20 m high, stems to 12 cm diam., tendrils to 15 cm long, leafy stems 2–4 mm diam., sparsely to densely puberulent with simple or branched hairs 0.2–0.5 mm long, gland fields pre-

sent or absent at the nodes. **Leaves** mostly trifoliolate, petioles 2–9 cm long, 0.7–2 mm diam., usually densely puberulent with simple or branched hairs, petiolules 3–38 mm long; **leaflet blades** 5–18 cm long, 3–9(–12) cm wide, ovate-elliptic to broadly rounded-elliptic or elliptic-obovate, apex short-acuminate, base narrowed to rounded-truncate, drying thin chartaceous, green or brown, minutely puberulent on the veins above, sparsely to densely puberulent beneath with simple or branched hairs 0.2–0.8 mm long, 2° veins 4–7/side. **Inflorescences** usually short-branched (raceme-like) panicles from the axils of fallen leaves or terminal, 8–30 cm long, peduncles 2–24 mm long, 1.5–2 mm diam., densely puberulent, bracts 1–4 mm long, linear, pedicels 1–12 mm long. **Flowers** with cupulate calyx 5–9 mm long, 4–7 mm diam., sparsely puberulent with multicellular hairs 0.1–0.2 mm long, margin subentire or with narrow apiculate teeth 0.3–1 mm long (sometimes split and appearing lobed); **corolla** 27–46 mm long, 8–12 mm wide at the mouth, magenta to lavender, puberulent externally, lobes 5–14 mm long, to 12 mm wide; filaments ca. 15 and 10 mm long, thecae 2.5–3 mm long. **Fruits** 12–47 cm long, 11–21 mm wide, valves flat and smooth (minutely pitted), midvein apparent or not; seeds 11–14 mm long, 32–50 mm wide, central area ca. 14 mm wide, thin transparent edges ca. 5 mm wide.

Rarely collected deciduous lianas of seasonally dry deciduous forest formations, 1–300 m elevation. Flowering in April–June (July–November in Panama; Gentry, 1973b). The species ranges from Mexico to Argentina.

Arrabidaea corallina is recognized by its climbing habit, simple tendrils, two- or three-foliolate leaves with usually dense pubescence of branched or simple hairs, puberulent magenta or lavender corollas, long narrow fruits, and winged seeds. The calyx tube is usually sparsely puberulent distally and of thin texture with venation drying darker, and narrow teeth (0.3 mm) are usually present along the irregular distal margin.

Arrabidaea costaricensis (Kränzl) A. Gentry, Brittonia 25: 231. 1973. *Saldanhaea costaricensis* Kränzl, Fedde Repert. 17: 124. 1921. *Arrabidaea erecta* Miranda, Anal. Inst. Biol. Mex. 24: 91. 1953. Figure 12.

Shrubs or small trees to 5 m tall (rarely woody vines), tendrils absent or simple, leafy stems 2–5 mm diam., densely puberulent with straight or

curved hairs 0.1–0.3 mm long, soon glabrescent and pale grayish, gland fields absent, interpetiolar lines present or absent. **Leaves** simple to 3-foliolate, petioles 3–55 mm long, 0.8–1.7 mm diam., densely puberulent, petiolules 5–27 mm long with central petiolule much longer than laterals; **leaflet blades** 3–12 cm long, 2.5–7.5 cm wide, ovate-elliptic to broadly ovate, apex acute or short-acuminate, base narrowed and obtuse to rounded, drying chartaceous and grayish green or brown, smooth or slightly scabrous above. With straight hairs ca. 0.2 mm long, lower surface densely puberulent, the soft straight hairs to 0.3 mm long, venation subpalmate, 2° veins 4–6/side, strongly ascending. **Inflorescences** terminal or axillary at leafless nodes, 3–7 cm long, racemes with fewer than 10 flowers, peduncle 5–14 mm long, densely puberulent, bracts caducous or to 4 mm long, pedicels 2–5 mm long. **Flowers** with calyx 3–5 mm long, 3–4 mm diam., cupular, surface grayish with dense minute puberulence, marginal teeth 5, 0.3–0.7 mm long, 0.3–0.5 mm wide at base; **corolla** 24–32 mm long, 5–6 mm wide at the mouth, reddish purple (white), densely puberulent with crooked multicellular hairs externally. **Fruits** 8–21 cm long, 6–14 mm wide, linear-oblong valves flattened, with prominent midrib, brown, smooth or with pits or dots; seeds 6–12 mm long, 18–26 mm wide, central area 13–16 mm wide.

Rarely collected shrubs or vines of seasonally very dry deciduous forest formations in northern Guanacaste, 10–300 m elevation (to 900 m in Honduras). Flowering in May–June; fruiting in June–January. This species ranges from Mexico along the Pacific slope to northwestern Costa Rica.

Arrabidaea costaricensis is distinguished by its often shrubby habit and usual lack of tendrils (sometimes present), grayish indumentum of straight simple hairs, presence of both simple and three-foliolate leaves, few-flowered inflorescences, and linear-oblong fruits with two-winged seeds. The capsules are sometimes held upright, and they may open explosively. The simple leaves are usually borne near the base of a shoot or at the initiation of a new shoot, with the following leaves three-foliolate.

Arrabidaea florida DC., Prodr. 9: 184. 1845. *A. panamensis* Sprague, Bull. Herb. Boiss. séc. 2, 6: 371. 1906.

Lianas, tendrils to 8 cm long (often lacking on specimens), leafy stems 2–5 mm diam., minutely (0.05 mm) puberulent and lenticellate, longitudinally striate, interpetiolar lines usually present, gland fields absent. **Leaves** 2- or 3-foliolate, petioles 10–60 mm long, 0.8–1.5 mm diam., minutely puberulent, petiolules 5–24 mm long; **leaflet blades** 5–14 cm long, 2.5–8 cm wide, ovate-elliptic to ovate-oblong, apex acute to acuminate, base acute to obtuse or rounded, drying stiffly chartaceous and grayish green or brown, lustrous and glabrous above, minutely puberulent beneath, 2° veins 4–7/side. **Inflorescences** terminal or axillary to distal leaves, 9–35 cm long, open panicles to 30 cm wide, 2° peduncles 1.5–7 cm long, distal branches grayish puberulent, flowers crowded in distal clusters, subtended by narrow bracts 1–4 mm long, pedicels 0–3 mm long. **Flower** buds narrowly ellipsoid, calyx 3–4 mm long, 2–3 mm diam., minutely puberulent with grayish hairs, margin entire or with minute teeth 0.1–0.3 mm long; **corolla** 12–18 mm long, campanulate with spreading lobes, pink or lavender (white), throat often white, 5–7 mm wide at the mouth, lobes 3–6 mm long; filaments ca. 8 and 6 mm long, thecae 1.5 mm long. **Fruits** 10–26 cm long, 8–11 mm wide, valves flat, brown with raised midrib, smooth; seeds 6–9 mm long, 17–28(–36) mm wide, dark central area 11–14 mm wide, wings translucent.

Rarely collected plants (in Costa Rica) of moist forest formations, 1–1100 m elevation. Flowering in July–October. The species ranges disjunctly from Mexico to Bolivia and Brazil.

Arrabidaea florida is distinguished by its climbing habit with simple tendrils, generally glabrous two- or three-foliolate leaves, large inflorescences with many distal clusters of small flowers, pink to lavender puberulent corollas, long narrow fruit, and two-winged seeds. Sterile plants of this species resemble *Adenocalymma inundatum* (cartilaginous margins on leaflets) and *Tynnanthus croatianus* A. Gentry of Panama (tendrils with trifid tips).

Arrabidaea mollissima (Kunth in H.B.K.) Bureau & K. Shum. in Mart., Fl. Bras. 8 (2): 46. 1896. *Bignonia mollissima* Kunth in H.B.K., Nov. Gen. Sp. 3: 133. 1819. *B. littoralis* Kunth in H.B.K., Nov. Gen. Sp. 3: 139. 1819. *A. mollicomia* Blake, Cont. Gray Herb. 52: 92. 1917. *A. isthmica* Standl., J. Wash. Acad. Sci. 18: 337. 1925, pro parte. Figure 26.

Lianas (rarely shrub-like), stems to 3 cm diam., tendrils to 12 cm long, leafy stems 2–5 mm diam., minutely puberulent with thin straight hairs, glabrescent, terete, glandular fields rarely present; pseudostipules 2–3 mm long, conical. **Leaves** deciduous in dry season, 2- or 3-foliolate, petioles 25–80 mm long, 1.1–2.8 mm diam., densely puberulent with straight simple or gland-tipped hairs 0.3–0.8 mm long, petiolules 6–35 mm long; **leaflet blades** 4–13 cm long, 2–10 cm wide, broadly ovate to ovate-orbicular, apex caudate-acuminate or short-acuminate, base rounded and truncate to subcordate, drying grayish and chartaceous, upper surface pubescent with straight hairs 0.5–0.8 mm long, lower surface densely puberulent with soft hairs 0.3–0.7 mm long, venation subpalmate, 2° veins 4–6/side. **Inflorescences** terminal or axillary to leafless nodes, 3–25 cm long, to 18 cm wide, densely puberulent throughout, flowers in distal groups of 2–5, pedicels 3–7 mm long. **Flowers** with cupular calyx 4–6 mm long, 3–4 mm diam., densely puberulent, margin subentire or with 5 minute (0.3 mm) teeth; **corolla** 26–54 mm long, pink-lavender to red-purple and white in the throat (rarely white throughout), densely puberulent externally, tube 8–16 mm diam. at mouth, lobes 6–12 mm long; filaments ca. 16 and 12 mm long, thecae 4–5 mm long. **Fruits** 15–28 cm long, 11–15 mm wide, valves flat, yellowish brown with minutely puberulent surface (soft to the touch), midvein apparent or not; seeds 11–13 mm long, 30–45 mm wide, central area ca. 12 mm wide, distal transparent area of wings ca. 6 mm wide.

Common deciduous lianas in seasonally very dry deciduous forest formations and open vegetation, 2–300 m elevation. Flowering in December to early March (with the great majority of flowering collections made in January); fruiting in January–June. This species ranges from Mexico, along the Pacific Coast, to Colombia and Venezuela.

Arrabidaea mollissima is recognized by its densely soft pubescence, broadly ovate or rounded leaf blades, flowering when leafless, puberulent purple or pink corollas, long, narrow, softly puberulent fruits, and two-winged seeds transparent at the lateral margins. Simple tendrils and restriction to areas of deciduous forest are additional distinctions. These plants can be very striking when in full flower, after the leaves have been shed. Compare this species with *A. corallina* (with glabrous fruits).

Arrabidaea patellifera (Schldl.) Sandwith, Kew Bull. 22: 413. 1968. *Bignonia patellifera* Schldl., Linnaea 8: 516. 1833. *Petastoma patelliferum* (Schldl.) Miers, Proc. R. Hort. Soc. 3: 195. 1863. *P. breviflorum* Standl., J. Arnold Arbor. 11: 128. 1930. Figure 26.

Lianas, to over 10 m high and 5 cm diam., tendrils to 16 cm long, leafy stems 2–8 mm diam., densely puberulent with curved hairs ca. 0.2 mm long or subglabrous, terete, an interpetiolar line often present, gland fields absent at the node; pseudostipules rarely present and leaf-like, rounded. **Leaves** simple or 2-foliolate, petioles 12–35 mm long (shorter in compound leaves), 1.2–2.3 mm diam., densely puberulent, petiolules 16–30 mm long; **leaflet blades** (5–)6.5–14(–16) cm long, (3–)4–8(–12) cm wide, ovate to ovate-oblong or ovate-orbicular, apex acuminate, base narrowed or rounded and truncate, drying chartaceous, upper surface with scattered straight hairs 0.2–0.5 mm long, puberulent beneath with thin straight hairs ca. 0.4 mm long, venation pinnate to palmate, 2° veins 3–6/side, ascending. **Inflorescences** axillary or often terminal and 3-parted, 6–28 cm long, to 30 cm wide near base, peduncles to 8 cm long, to 4 mm diam., densely puberulent, pedicels 4–7 mm long. **Flower** buds white apically, calyx broadly spreading (saucer-like), 1–4 mm long, 4–7 mm wide, margin entire and undulate, sparsely puberulent externally; **corolla** 23–40 mm long, red-violet to magenta or lavender (pink-white in the throat), glabrous externally except for the lobes, narrowed (2 mm) base of the tube 6–8 mm long, mouth 8–11 mm wide, lobes 5–11 mm long, ca. 7 mm wide; filaments ca. 12 and 9 mm long, thecae 1.5–2 mm long. **Fruits** 11–39 cm long, 9–14 mm wide, linear, surface of valves flat, smooth, midvein and margins slightly raised; seeds 8–10 mm long, 20–36 mm wide, central area 11 mm wide, wings not clearly differentiated.

Common evergreen lianas in seasonally very dry deciduous and partly deciduous forests of the Pacific slope (rarely collected in evergreen forests of the Caribbean slope), 1–1200 m elevation. Flowering primarily in July–October with the majority of collections made in August; fruiting in January–March. This species ranges from Mexico to Brazil.

Arrabidaea patellifera is recognized by its climbing habit with simple tendrils, simple or bifoliolate puberulent leaves, July–October flowering period, saucer-like (patelliform) calyx, lavender to magenta corollas, and linear flattened fruits

with thin-winged seeds. The frequent presence of simple leaves, strongly ascending secondary veins in a subpalmate pattern, domatia, and the occasional presence of rounded leaf-like little pseudostipules are additional distinctions. The flower buds are unusual with their pubescent distal corolla lobes whitish, in contrast to the glabrous magenta tube.

Arrabidaea pubescens (L.) A. Gentry, *Brittonia* 25: 239. 1973. *Bignonia pubescens* L., *Sp. Pl.*, ed. 2, 2: 870. 1763. *Petastoma pubescens* (L.) Miers, *Proc. R. Hort. Soc.* 3: 195. 1863. *A. lundellii* Standl., *Publ. Field Mus. Bot.* 8: 48. 1930.

Lianas to 20 m high and 5 cm diam., tendrils to 7 cm long, leafy stems 2–7 mm diam., grayish with minute (0.05–0.1 mm) appressed hairs, glandular fields usually present at the nodes; pseudostipules small or absent. **Leaves** 2- or 3-foliolate, petioles 10–22 mm long, 0.9–2.3 mm diam., minutely appressed puberulent, grayish, petiolules 12–23 mm long; **leaflet blades** 4–13 cm long, 2.3–8 cm wide, ovate to ovate-elliptic or narrowly ovate, apex acuminate, base obtuse or rounded and truncated, drying chartaceous and grayish beneath, upper surface subglabrous or with minute (< 0.1 mm) hairs, lower surface with minute or longer (0.4 mm) hairs, 2° veins 4–6 side. **Inflorescences** to 35 cm long, open terminal or axillary panicles, peduncles ca. 6 cm long, densely appressed puberulent, pedicels 3–5 mm long, ca. 0.4 mm diam., grayish puberulent. **Flowers** with calyx 3–5 mm long, 2.5–4 mm diam., tubular-cupulate, margin subentire, grayish puberulent; **corolla** 18–33 mm long, funnellform-campanulate, lavender to lilac, minutely puberulent externally, 5–9 mm wide at mouth, lobes 8–10 mm long; filaments ca. 10 and 8 mm long. **Fruits** (7–)14–27 cm long, 9–11 mm wide, linear-oblong, smooth or slightly pitted, midrib and margins raised; seeds 6–9 mm long, 17–32 mm wide, central area 5–6 mm wide, wings transparent.

Arrabidaea pubescens has not been collected from the region between northeastern Guatemala and central Panama, but it may occur in Costa Rica. This species is distinguished by the simple tendrils, nodes with gland fields, minute dense appressed hairs that give the undersides of the leaves and petioles a grayish appearance, bi- or trifoliolate leaves, and linear fruits. The smaller lilac corollas produced in July–September, truncated grayish calyx tubes, and seeds with central brown area clearly demarcated from the transparent

wings are other noteworthy characteristics. This species prefers seasonally dry lowland forests along the Caribbean coast; it ranges disjunctly from Tamaulipas, Mexico, to Brazil.

Arrabidaea verrucosa (Standl.) A. Gentry, *Selbyana* 2: 43. 1977. *Adenocalymma verrucosa* Standl., *Publ. Field Columb. Mus., Bot. Ser.* 4: 323. 1929. *Martinella verrucosa* (Standl.) Standl., *Contrib. Arnold Arbor.* 5: 138. 1933. *Scobinaria verrucosa* (Standl.) Seibert, *Carnegie Inst. Washington Publ.* 522: 408. 1940. Figure 18.

Lianas to 35 m high, to 10 cm diam., tendrils to 20 cm long, leafy stems 2–7 mm diam., sparsely and minutely (0.1 mm) puberulent (more rarely with hairs to 1 mm long), gland fields and interpetiolar lines present or absent at nodes. **Leaves** 2-foliolate, petioles 14–23(–55) mm long, 0.7–2.3 mm diam., minutely papillate puberulent, petiolules 12–28(–45) mm long; **leaflet blades** 6–17(–22) cm long, 3–9(–11) cm wide, ovate to ovate-elliptic, narrowly elliptic or elliptic-oblong, apex acute to acuminate, base acute to slightly rounded, drying chartaceous and often dark brown, upper surface subglabrous with minute hairs on the midvein, lower surface with small (0.2–0.5 mm) straight hairs or branched along the veins, larger hairs often present *in vein* axils beneath (domatia), venation pinnate or subpalmate, 2° veins 3–5/side, strongly ascending. **Inflorescences** axillary, 5–15 cm long, few-flowered panicles, peduncles 3–5 cm long, sparsely papillate-puberulent, lenticellate, pedicels 6–14 mm long, ca. 0.8 mm diam. **Flowers** with tubular-campanulate calyx, 14–23 mm long, 4–11 mm diam., glabrous or pubescent with hairs to 0.7 mm long near the base, margin 2-lipped or with shallow (1 mm) sinuses separating the rounded lobes; **corolla** 35–60(–79) mm long, tubular-campanulate, lobes magenta to purple with the tube white or pink, puberulent externally, mouth 11–20 mm wide, lobes 8–18 mm long; filaments ca. 18 and 12 mm long, thecae 2–3 mm long. **Fruits** (12–)22–42(–51) cm long, 15–28 mm wide, linear-oblong, valves drying dark and verrucose-tuberculate, tubercles 0.3–2 mm high; seeds 15–20 mm long, 38–57 mm wide, central area poorly delimited.

Plants of evergreen rain forest formations on both the Caribbean and Pacific slopes, 1–700 (–1300) m elevation. Flowering in May–November (with the great majority of collections in July);

fruiting throughout the year. This species ranges from Mexico to Bolivia.

Arrabidaea verrucosa is recognized by the climbing habit with simple tendrils, bifoliolate leaves, small inflorescences, long-tubular calyx, puberulent pink or white and purple corollas, and narrow fruits with dark rasp-like verrucose-tuberculate valves. The wet-season flowering period and wet forest habitats are also characteristic. This material was placed under *Scobinaria japurensis* (DC.) Sandwith by Gentry in *Flora of Panama* (1973b), but he later decided that that name belongs to a species restricted to Amazonian South America (see: Selbyana 2: 45, 1977).

Callichlamys Miquel

Lianas or shrub-like when young, climbing with simple tendrils, stems terete, with 4 phloem arms in cross-section, an interpetiolar line and glandular fields absent at the node, pseudostipules absent (pseudostipule-like structures present at the base of axillary shoots). **Leaves** opposite, 2- or 3-foliolate, terminal leaflet sometimes replaced by a tendril, petiolate, leaflets petiolulate, margins entire, venation pinnate. **Inflorescences** axillary (terminal) racemes, with 2–12 mostly opposite flowers, peduncles becoming woody, bracts subtending the pedicels lanceolate. **Flowers** large, calyx tubular-inflated, with spongy texture, irregularly lobed and bilabiate; **corolla** tubular-campanulate, yellow, glabrous externally, lobes broadly rounded; stamens 4, of 2 lengths, anthers glabrous, thecae divaricate, staminode absent; ovary 2-locular, ovules in 4–8 series on each placenta, stigma simple, flattened. **Fruits** compressed oblong capsules, valves woody and smooth, flattened parallel to the septum; seeds large, the 2 thin lateral wings poorly differentiated from the central area.

Callichlamys includes a single distinctive species ranging from Mexico to Brazil.

Callichlamys latifolia (L. C. Rich.) K. Schum. in Engler & Prantl., Nat. Pflanzenfam. 4 (3b): 223. 1894. *Bignonia latifolia* L. C. Richard, Act. Soc. Hist. Nat. Paris 1: 110. 1792. *Tabebuia latifolia* (L. C. Rich.) DC., Rev. Bign. (Bibl. Univ. Geneve) 15. 1838. *T. speciosa* Standl., Publ. Field Columb. Mus., Bot. Ser. 8: 49. 1930. *C. garnieri* Standl. & L. O. Williams, Ceiba 3: 130. 1952. Figure 19.

Lianas to over 30 m high and 8 cm diam. (rarely shrubs), leafy stems 3–9 mm diam., minutely puberulent at first but soon glabrescent with dark lenticels (0.5–1.5 mm) against a grayish surface. **Leaves** mostly 2-foliolate (also 3-foliolate), petioles 3–17 cm long, 1.7–4.5 mm diam., at first minutely puberulent but later resembling the stems, petiolules 8–35 mm long, sulcate above; **leaflet blades** 7–24(–36) cm long, 4–14(–20) cm wide, broadly elliptic to broadly ovate-elliptic or elliptic-oblong, apex acuminate to caudate-acuminate, narrowed tip to 3 cm long, base obtuse to rounded, drying stiffly chartaceous, glabrescent on both surfaces or with small (0.4–0.5 mm) branched/stellate hairs beneath, often with dense hairs in vein axils beneath (domatia), 2° veins 5–11/side. **Inflorescences** 3–17 cm long, peduncles 4–14 mm long, 2–3 mm diam., minutely puberulent with appressed brownish hairs, bracts to 5 mm long, caducous, pedicels 8–24 mm long, ca. 1 mm diam., drying dark. **Flowers** with calyx 28–48(–65) mm long, 8–30(–42) mm diam., tubular-inflated, rounded at the base, greenish white to yellow, lobes 12–20 mm long; **corolla** 5–9(–11) cm long, bright yellow, tube 15–22(–28) mm wide near the mouth, marked with reddish lines within, lobes 1.5–3 cm long; filaments ca. 15–20 and 25–30 mm long, thecae 2–3 mm long; stigma ca. 4 × 1.8 mm. **Fruits** 12–32 cm long, 6–11 cm wide, ca. 1 cm thick, oblong or elliptic-oblong with rounded ends, flattened, surface smooth; seeds 2.5–4 cm long, 6–11 cm wide, brownish.

Plants of evergreen rain forest formations of both Caribbean and Pacific slopes and also in seasonally very dry deciduous forest areas, 5–600 (–1000) m elevation. Flowering collections have been made in February–August in Costa Rica (flowering primarily in October–November in Panama). The species ranges from Veracruz, Mexico, to Brazil.

Callichlamys latifolia is recognized by its climbing habit with simple tendrils, large spongy calyx, large yellow corolla, and flattened oblong woody fruits with large brown seeds. The grayish stems with dark lenticels, lack of gland fields and interpetiolar lines at nodes, and larger leaf blades often with domatia in vein axils (or with branched hairs beneath) are useful in identifying sterile material. Collections from dryer forests of the Pacific slope tend to have the undersurface of the leaflets covered with conspicuous branched hairs. These collections look quite different from those of the lowland rain forests with subglabrous leaves. The type of *C. garnieri* (*Garnier 130 F*, from the Si-

erra de Managua, Nicaragua) has leaves with branched hairs and unusually large (15 cm) flowers subtended by reduced leaves on a terminal branchlet. However, the fact that no other similar collection has been seen suggests that Gentry (1994) was correct in considering it an aberrant individual of this species.

Ceratophyllum Pittier

Lianas, climbing with tendrils, stems terete, with 4 phloem areas in cross-section, nodes with interpetiolar ridges and glandular fields; pseudostipules of subulate scales. **Leaves** opposite, 3-foliolate or 2-foliolate and the terminal leaflet replaced by a tendril or tendril scar, leaflets petiolulate, margins entire, venation pinnate, webbed tissue (domatia) sometimes present in vein axils. **Inflorescences** terminal, corymbose panicles or condensed fascicles, with 1–20 flowers, peduncles lepidote, bracts small, pedicels well developed. **Flowers** with tubular calyx, coriaceous, apex truncated, with short-linear glandular fields near the rim; **corolla** tubular-funnelform and slightly 2-lipped, yellow to yellowish white, minutely puberulent externally, 5-lobed; stamens 4, of 2 lengths, thecae straight, divaricate, a staminode present; disc cupular; ovary 2-locular, ovules in 6–8 series on each placenta, stigma simple. **Fruits** oblong-linear capsules, tetragonal in cross-section, expanded and rounded at the base, tapering to the apex, valves parallel to the septum (but not flattened), smooth; seeds with 2 lateral papery wings, brownish, not clearly demarcated from the central area.

Ceratophyllum includes a single species ranging from Mexico and the Caribbean to Guyana and Bolivia.

Ceratophyllum tetragonolobum (Jacq.) Sprague & Sandw., Kew Bull. 1934: 222. 1935. *Bignonia tetragonoloba* Jacq., Fragm. Bot. 36, tab. 40, fig. 2. 1800–1806. *Anemopaegma tobagense* Urb., Fedde Repert. 14: 311. 1916. *Adenocalymma heterophyllum* Standl., Publ. Field Columb. Mus., Bot. Ser. 8: 49. 1930, not Kränzl. *C. tobagense* (Urb.) Sprague & Sandw., Kew Bull. 1933: 322. 1933. *Ad. standleyanum* Lundell, Carnegie Inst. Washington Publ. 478. 221. 1937, based on *Ad. heterophyllum* Standl. Figure 19.

Lianas to 20 m high, stems up to 7 cm diam., tendrils 1–3 mm diam., to 22 cm long, often trifid, leafy stems 1.3–7 mm diam., subglabrous, nodes with gland fields; pseudostipules 1–3 mm. **Leaves** 2- or 3-foliolate, petioles 4–11 cm long, 1.2–2 mm diam., subglabrous with minute peltate hairs, petiolules 8–30 mm long; **leaflet blades** 6–18 cm long, 3.5–9(–15) cm wide, elliptic-oblong to broadly elliptic, apex short-acuminate or obtuse, base obtuse to rounded, drying thin-chartaceous, with scattered minute (0.1 mm) peltate hairs beneath, 2° veins 3–7/side, minor venation often prominent above, domatia occasionally present. **Inflorescences** terminal, 1–8 cm long, with 2–20 flowers, peduncles 1–10 mm long, bracts minute, pedicels 8–17 mm long, ca. 0.7 mm diam., with minute peltate hairs. **Flowers** with calyx 8–12 mm long, 5–9 mm wide, tubular with subentire rim, appearing glabrous but with minute peltate hairs and ciliolate rim, with glands near the margin; **corolla** 5–8 cm long, tubular-funnelform with tube gradually expanded to 16–21 mm wide at the mouth, white to yellow, with a dense covering of minute glandular hairs drying pale yellowish brown, lobes 15–22 mm long, rounded or obtuse; filaments 10–16 and 16–24 mm long, thecae 4 × 1 mm; ovary ca. 5 mm long, with peltate hairs. **Fruits** 16–45 cm long, 25–37 mm wide, 15–26 mm thick, linear-oblong, narrowed to the apex, yellowish and lenticellate; seeds 8–13 mm long, 28–45 mm wide, lateral wings brown or gray, not clearly differentiated from central area, translucent.

Uncommon evergreen climbers of deciduous, partly deciduous, or wet evergreen lowland rain forest formations, 1–500 m elevation. Flowering in January–June and October in Central America; fruiting throughout the year. This species ranges from Mexico to Bolivia.

Ceratophyllum tetragonolobum is recognized by its climbing habit, three-tipped tendrils, bi- or trifoliolate opposite leaves, compact terminal inflorescences, truncated calyx tube with distal glands, white or yellowish corolla minutely puberulent on the exterior, thick narrow woody fruits, and seeds with poorly differentiated lateral wings. Young stems with prominent glandular fields and usually four subulate pseudostipules at the nodes and occasional domatia are additional characteristics.

Clytostoma Miers ex Bureau

Lianas climbing with simple tendrils, stems 4-angled or terete, with 8 phloem areas in cross-

section, nodes lacking gland fields; pseudostipules usually a small condensed axis of subulate cataphylls. **Leaves** 2-foliolate (rarely simple), with or without a terminal simple tendril, petiolate, margins entire, venation pinnate. **Inflorescences** terminal or axillary, few-flowered fascicles, cymes, panicles, or the flower solitary, subtended by bracts similar to the cataphylls. **Flowers** with cupular or campanulate calyx truncated distally and minutely 5-denticulate or with 5 linear lobes, subglabrous to minutely lepidote or puberulent; **corolla** tubular-funnelform, white to purple, glandular-puberulent or with minute peltate hairs externally; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae straight and divaricate, a staminode present; disc absent; ovary 2-locular, ovules 2(-4)-seriate in each locule.

Fruits ellipsoid to suborbicular capsules, valves convex or flattened parallel with the septum, woody and echinate with curved spines; seeds transverse-oblong, corky, flattened but not winged.

Clytostoma includes nine South American species and one that ranges from Mexico to Brazil. Echinate woody fruits and flowers lacking a nectariferous disc are distinctive characteristics. *Clytostoma callistegioides* (Cham.) Bureau ex Grisebach of southern South America was collected in a Costa Rican garden in 1935 (*Brenes & Zeledon* 99; Standley, 1938), but we have seen no further evidence of its presence in Central America. It differs from all our other species of Bignoniaceae in Costa Rica by having prominent linear calyx lobes arising from a truncated calyx margin (see key below).

Key to the Species of *Clytostoma*

- 1a. Larger leaf blades > 12 cm long; calyx lobes 0.2–0.6 mm long; native *C. binatum*
 1b. Larger leaf blades < 10 cm long; calyx lobes 1–4 mm long, subulate to linear; garden ornamental (not included in descriptions, see above) *C. callistegioides*

Clytostoma binatum (Thunb.) Sandw., Recueil Trav. Bot. Neerl. 34: 235. 1937. *Bignonia binata* Thunb., Pl. Bras. 3: 35. 1821. *Adenocalymma ocositensis* J. D. Smith, Bot. Gaz. 18: 209. 1893. *C. isthmicum* Pittier, Contrib. U.S. Natl. Herb. 18: 257, pl. 106. 1917. *Petastoma ocositense* (J. D. Smith) Kränzl., Fedde Repert. 17: 61. 1935. Figure 18.

Lianas to 5 cm diam., sometimes forming clumps 1–2 m high, tendrils to 12 cm long, leafy stems 2–7 mm diam., rounded-tetragonal, glabrous or very minutely (0.05 mm) puberulent, lenticellate; pseudostipules forming an axillary cone 3–5 mm long. **Leaves** 2-foliolate, petioles 6–18(-31) mm long, 1–1.5 mm diam., petiolules 4–6(-21) mm long, usually glabrous; **leaflet blades** 7–16(-19) cm long, 2–6(-8) cm wide, elliptic to elliptic-oblong or oblong, apex acuminate, base acute to cuneate, drying chartaceous and with minor venation raised on both surfaces, usually glabrous on both surfaces, 2° veins 5–8/ side. **Inflorescences** mostly axillary, 0.4–8 cm long, peduncle subtended by subulate bracts (similar to the pseudostipules), pedicels 6–32 mm long, 0.4–0.8 mm diam., glabrous. **Flowers** with cupular calyx 4–8 mm long, 3–5 mm diam., glabrous, with many longitudinal veins or smooth,

truncate or with teeth 0.2–0.6 mm long; **corolla** 45–80 mm long, lilac to blue-purple (white), sparsely and minutely (0.05 mm) puberulent externally, tube 12–24 mm diam. at the mouth, throat white internally, lobes 6–16 mm long; filaments ca. 10–16 and 16–20 mm long, thecae ca. 3 mm long; ovary covered by thick rounded hairs. **Fruits** 5–9 cm long, 3–6 cm wide, broadly elliptic to suborbicular, discoid-lenticular, surfaces of the valves covered with echinate spines to 8 mm long, slender-tipped and slightly curved from a broad base; seeds 12–19 mm long, 19–24 mm wide, suborbicular, brown.

Evergreen or deciduous lianas found mostly in swamp forests, river edges, and seasonally inundated areas in both wet evergreen and dry deciduous forest formations, 1–200 m elevation. Flowering throughout the year but most frequently in September–November. This species ranges from Mexico to Brazil.

Clytostoma binatum is recognized by its climbing habit with simple tendrils, bifoliolate leaves, short few-flowered inflorescences, essentially glabrous calyx cups with minute teeth distally, lilac to blue-purple (rarely white) corolla sparsely minutely puberulent on the exterior, short rounded fruit covered with woody echinate projections,

and wingless seeds. The pseudostipule resembles a minute bromeliad plantlet in leaf axils and is helpful in recognizing this species. The seeds are apparently adapted to water dispersal; consequently, the plants are restricted to low elevations.

Crescentia Linnaeus

Small to medium-size **trees**, with many thick twisted branches, leafy stems becoming terete with enlarged nodes, gland fields absent. **Leaves** alternate or more often in fascicles of 3–9 on condensed short-shoots in the axils of fallen leaves, simple or 3-foliolate (1- or 2-foliolate), petioles of compound leaves winged and leaf-like, blades with entire margins, subglabrous or sparsely puberulent, venation pinnate. **Inflorescences** borne on older thick branches or trunks, peduncles absent, flowers 1–3 in sessile fascicles, pedicels short and thick. **Flowers** with large tubular calyx that usually splits into 2 halves at maturity, thick, glabrous or minutely puberulent; **corolla** broadly campanulate and bilabiate, narrowed only at the base, thick textured, usually with minute peltate hairs on the outer surface, tube with a transverse

fold midway across the lower side, distally 5-lobed or variously erose along the margin; **stamens** 4, subexserted, filaments of 2 lengths, disc large, staminode present; ovary lepidote, 1-locular with ovules multiseriate on 4 parietal placentas, stigma flat and expanded. **Fruits** large pepos (a gourd-like calabash) with a hard corky pericarp, subglobose to ovoid, pulpy within; seeds angular, without wings, less than 10 mm long, embedded in the pulp.

Crescentia is a genus of six species in Mexico, the West Indies, Central America, and (one species) Amazonia. The genus is distinguished by the tree habit, mostly fasciculate leaves on alternate short-shoots, few large thick-textured cauliflorous flowers, ovaries with a single locule and parietal placentation, and rounded indehiscent fruits with seeds embedded in pulp. The flowers are foul-smelling and adapted for bat pollination. The pulp-containing fruits are dispersed by mammals. The hard outer shell of the fruits has been used to make cups, ladles, and bowls (see Standley & Williams, 1974). The differentiation of the two Central American species is not complete, and hybrids have been reported. (See Flora Neotropica treatment; Gentry, 1980.)

Key to the Species of *Crescentia*

- 1a. Stems with 3-foliolate leaves, simple leaves may also be present; fruits up to 10 cm diam. and globose; wild plants (rarely cultivated) *C. alata*
- 1b. Stems lacking 3-foliolate leaves, all the leaves simple; fruits > 13 cm diam. and globose to ovoid; plants widely cultivated *C. cujete*

Crescentia alata Kunth in H.B.K., Nov. Gen. Sp. 3: 158. 1819. *Parmentiera alata* (Kunth in H.B.K.) Miers, Trans. Linn. Soc. 26: 166. 1868. *C. ternata* Sessé & Moc., La Naturaleza, ser. 2. 1 (append.); 94. 1889. Figure 11.

Trees to 10 m tall, trunks to 25 cm diam., leafy stems 3–18 mm diam., glabrous, the alternate nodes becoming enlarged and prominent and subtending the condensed leafy short-shoots. **Leaves** mostly in fascicles of 3–9, simple or 3-foliolate (rarely 1- or 2-foliolate), simple leaves sessile, compound leaves with winged petioles 2.5–11 cm long, 4–11 mm wide, petiolules absent; **leaf blades** 4–15 cm long, 5–35 mm wide, oblanceolate to narrowly obovate (small leaves often rounded), leaflet blades 1.5–10 cm long, 4–23 mm wide, oblanceolate, apex rounded or emarginate,

gradually narrowed to the acute or cuneate base, drying subcoriaceous and grayish green, glabrous. **Inflorescences** of 1–3 flowers borne directly on the surfaces of larger stems and trunks, pedicels 5–10 mm long, 1.3 mm diam., subtended by small (1.5 mm) bracts, glabrous or with minute peltate hairs. **Flowers** with unpleasant aroma, calyx 14–28 mm long, 9–14 mm diam., usually splitting into 2 subequal halves, glabrous or with few minute peltate hairs, greenish; **corolla** 4–6 cm long, tube narrowed only near the base, 22–30 mm diam., greenish purple to reddish white, surface glabrous or with minute peltate glands, 5-lobed or the margin irregularly toothed; filaments ca. 30 and 18 mm long, thecae 5–6 mm long. **Fruits** 7–10 cm diam., globose, greenish, surface smooth; seeds 6–7 mm long, 7–9 mm wide.

Plants of seasonally dry deciduous forest for-

mations of the Pacific lowlands, 5–800 m elevation. Flowering throughout the year (collected mostly in January–September). This species ranges from Mexico along the Pacific slope to northwestern Costa Rica (introduced in Panama).

Crescentia alata is recognized by the mix of simple and trifoliolate leaves with all the larger blades being oblanceolate or narrowly obovate, the few flowers coming directly from the trunk, thick calyx usually splitting in two, and large globose gourd-like fruits borne from large branches and trunks. The trifoliolate leaves, with sessile oblanceolate leaflets and winged petiole, resemble a Christian cross and were mentioned in early Spanish accounts of Mexico (Standley & Williams, 1974, p. 187). The trees are noteworthy for their short compact form and dense branching, often contrasting with the flat, open, grazed land around them. The dense branching is often the habitat for many epiphytes. There may be hybridization between this species and the widely planted *C. cujete*. This species is called *morro* or *jícara*, but *jícara* is also the name of the following species.

***Crescentia cujete* L., Sp. Pl. 2: 626. 1753. Figure 11.**

Trees to 10 m tall, with dense rounded crowns, trunks to 40 cm diam., branches often crooked with mostly thick branchlets, leafy stems 6–30 mm diam., glabrous, nodes becoming thickened and subtending the leafy short-shoots. **Leaves** usually fasciculate on elevated alternate nodes, 1–15 and varying in size at the same node, unifoliolate, sessile, glabrous; **leaf blades** 3–22(–26) cm long, 1–6(–7.5) cm wide, oblanceolate to narrowly obovate, apex acute to acuminate or rounded (emarginate), gradually narrowing to the acute or cuneate base, usually drying subcoriaceous and pale gray, glabrous or with minute simple or branched hairs along the midvein beneath, 2° veins 5–14/side. **Inflorescences** of 1 or 2 flowers borne on older branches and trunks, pedicels 9–30 mm long, 0.7–1.7 mm diam., glabrous or with few minute peltate hairs. **Flowers** with calyx 18–34 mm long, splitting into 2 subequal lips 12–24 mm wide; **corolla** 55–70 mm long, dull white to yellowish white, with purple lines, tube 18–25 mm diam., lobes triangular with narrow tip, subglabrous or with minute peltate hairs externally; filaments ca. 30 and 10 mm long, anthers 6–9 mm long, slightly divergent. **Fruits** 13–25 cm diam. or to 30 cm long, subglobose or ovoid, surface

smooth, subglabrous; seeds 7–8 mm long, 4–6 mm wide.

Widely cultivated plants in regions of both deciduous and wet evergreen forest formations; 1–1200 m elevation. Flowering irregularly throughout the year. This species may have been indigenous to southeastern Mexico, but it is now cultivated throughout tropical America, and its original range is unknown.

Crescentia cujete is recognized by its fascicles of narrow simple leaves from alternate thickened nodes, oblanceolate blades, few flowers borne directly on larger stems and trunks, large calyx usually splitting into two, large thick white to yellowish corolla, and larger globose gourd-like fruit (calabash). The hard shell of the pericarp is often used as a cup, ladle, or other kitchen utensil; the round, dried, empty fruits are often incised or painted for ornament. The pulp of the fruit has been used as a purgative, according to Standley (1938), who reported that the oval fruits are called *guacales* and the globose ones *jícaras*. The wood is hard but not durable. *Jícara*, *calabacero*, calabash, and wild calabash are common names.

Cydista Miers

REFERENCE—W. D. Hauk, A review of the genus *Cydista*. Ann. Missouri Bot. Gard. 84: 815–840. 1997 (1998).

Lianas climbing with simple tendrils, stems terete to tetragonal, with 8–16 phloem areas in cross-section, nodes usually with interpetiolar lines, gland fields absent at the nodes; pseudostipules absent or leaf-like. **Leaves** opposite, simple or 2–(4-) foliolate, petiolate, margins entire, venation pinnate, glands or gland fields often present in basal vein axils beneath. **Inflorescences** terminal or axillary, cymose racemes or panicles (thyrses), often with fewer than 15 flowers, bracts minute or absent, flowers pedicellate. **Flowers** with cupular or campanulate calyx, glabrous to glandular puberulent or with minute peltate hairs, glands present or absent distally, margin truncate and entire to 5-lobed or irregularly split; **corolla** funnelliform to tubular-campanulate, 2-lipped, lavender to purple or white, usually with minute glandular or peltate hairs externally, with 2 upper and 3 lower lobes, broadly rounded; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae divaricate; disc absent; ovary with glandular or peltate hairs on the sur-

face, 2-locular, ovules in 2 series in each locule, stigma 2-lobed. **Fruits** linear to narrowly oblong woody capsules, valves 2, flattened parallel to the septum, septicidally dehiscent, surface usually smooth, glabrate to puberulent; seeds flat and transversely oblong, the central body of the seed not clearly differentiated from the 2 lateral wings.

Cydista is a Neotropical genus of six species, ranging from Mexico and the West Indies to Brazil and Bolivia. Five species have been found in

Costa Rica, but two are known from only single collections. The mix of simple and bifoliolate leaves, presence of glands or gland fields in basal vein axils (on underside of leaf), narrow capsules, and brown two-winged seeds with central area not clearly differentiated help distinguish the genus. The absence of a disc is consistent with reports that the flowers do not produce nectar and deceive pollinators by multiple "big-bang" flowering of a few days. Compare species of *Arrabidaea* and *Clytostoma*.

Key to the Species of *Cydista*

- 1a. Fruits linear or linear-oblong, 10–25 mm wide, to 45 cm long; commonly encountered plants in areas of dry deciduous, partly deciduous, or (less often) evergreen forests 2
- 1b. Fruits narrowly oblong, 27–43 mm wide, to 24 cm long; more rarely encountered plants of evergreen or partly deciduous forests 4
 - 2a. Stems with persisting rounded pseudostipules 3–15 mm long [leaf-venation mostly palmate; flowering mostly in June–August; fruits with thin flat valves] *C. diversifolia*
 - 2b. Pseudostipules usually absent or not broadly ovate 3
 - 3a. Plants usually flowering in April–May while leafless, in dry deciduous forest formations; calyx usually split into 2 or 3 lobes; fruits with 2 longitudinal ridges on the flat valve surface; leaves simple or 2-foliolate, leaf venation mostly palmate-subpalmate, lower leaf surfaces never densely hirtellous *C. heterophylla*
 - 3b. Plants flowering throughout the year with leaves fully expanded, in both deciduous and evergreen habitats; calyx usually entire distally; fruits smooth and flat on the valve surfaces; leaves usually only 2-foliolate, venation pinnate to subpalmate; leaf surfaces densely hirtellous to pilose or subglabrous and lustrous *C. aequinoctialis*
- 4a. Valves of fruit with smooth surface; lower leaf surface without glands or gland fields in basal vein angles; leaflet blades mostly 2–5 cm wide; Mexico to Costa Rica *C. potosina*
- 4b. Valves of fruit with longitudinally wrinkled surface; lower leaf surface usually with glands in basal vein angles; leaflet blades mostly 5–15 cm wide; Costa Rica to Bolivia *C. lilacina*

Cydista aequinoctialis (L.) Miers, Proc. R. Hort. Soc. 3: 191. 1863. *Bignonia aequinoctialis* L., Sp. Pl. 2: 623. 1753. *B. sarmentosa* Bertol., Fl. Guatimal. 25. 1840. *B. sarmentosa* var. *hirtella* Benth., Bot. voy. Sulphur 128. 1845. *C. sarmentosa* (Bertol.) Miers, Proc. R. Hort. Soc. 3: 192. 1863. *Levyia nicaraguensis* Bureau ex Baillon, Hist. Pl. 10: 29. 1888. *Arrabidaea guatemalensis* K. Schum. & Loes., Bot. Jahrb. Syst. 23: 129. 1896. *Arrabidaea pseudochica* Kränzl., Repert. Spec. Nov. Regni Veg. 17: 19. 1921. *Anemopaegma tonduzianum* Kränzl., Fedde Repert. 17: 116. 1921. *Cydista pubescens* Blake, Contrib. U.S. Natl. Herb. 24: 23. 1922. *Arrabidaea isthmica* Standl., J. Wash. Acad. Sci. 15: 461. 1925, pro parte (leaves). *C. aequinoctialis* var. *hirtella* (Benth.) A. Gentry, Ann. Missouri Bot. Gard. 60: 838. 1973. Figure 24.

Lianas to over 20 m high, to 8 cm diam., tendrils 4–21 cm long, leafy stems 2–7 cm diam., glabrous to sparsely or densely pilose with straight hairs to 1 mm long (in var. *hirtella*), young stems tetragonal; pseudostipules usually inconspicuous (leaf-like to 4 mm long), caducous. **Leaves** simple or 2-foliolate, petioles 11–47 mm long, 1.2–2 mm diam., petiolules 9–40 mm long, glabrous to sparsely or densely pilose (var. *hirtella*); **leaflet blades** 6–16 cm long, 3–10 cm wide, ovate-elliptic to elliptic, apex acuminate, base obtuse or rounded and subtruncate, drying stiffly chartaceous, glabrous to sparsely puberulent above, minutely puberulent on the veins to densely pubescent beneath (in var. *hirtella*), 2° veins 4–7/side, basal veins often strongly ascending (subpalmate). **Inflorescences** terminal or axillary, short (3–15 cm) panicles of 3–15 flowers (flowers

rarely solitary), peduncles 1.5–10 cm long, sparsely to densely puberulent, pedicels 5–25 mm long. **Flowers** with calyx 4–9 mm long, 4–7 mm wide, cupular, margin entire or with minute teeth, surface glabrous to densely puberulent (in var. *hirtella*), sometimes with gland fields near the distal margin; **corolla** (25–)35–75 mm long, funnel-form-campanulate, magenta to pink or white, throat often yellowish or with purplish lines within, minutely lepidote externally, tube (6–)11–22 mm diam. at the mouth, lobes 12–24 mm long, 14–25 mm wide; filaments 11–18 and 8–13 mm long, thecae 3–5 mm long. **Fruits** 21–45 cm long, 17–24 mm wide, linear-oblong, ends rounded, valves flat with slightly raised submarginal ridges, drying dark or blackish, smooth; seeds (8–)12–20 mm long, (26–)41–70 mm wide, pale brown throughout, sometimes transparent at the tips.

Common evergreen lianas of lowland wet evergreen forest areas, partly deciduous forests, and seasonally very dry deciduous formations, 0–800 m elevation. Flowering throughout the year but with a peak in April–May; fruiting mostly in the dry season (January–May). This species ranges from Mexico and the West Indies to Brazil, Bolivia, and Paraguay.

Cydista aequinoctialis is recognized by the climbing habit with simple tendrils, opposite simple or bifoliolate leaves, short, few-flowered inflorescences, usually entire calyx cups, pink to magenta or white corollas minutely lepidote on the exterior, long narrow flat fruits, and seeds with uniform brownish coloring. These plants are usually leafless when flowering and fruiting (Gentry, 1973a). An important identifying characteristic is that gland fields are sometimes present in the axils of secondary veins on the lower leaf surface. This species is extremely variable in leaflet form, flower size, and vesture; the more densely pubescent individuals (formerly called *C. sarmentosa* or *C. pubescens*) have been designated var. *hirtella* (Bentham) A. Gentry. The more puberulent variety is usually encountered in dry vegetation, and the glabrous variety is more common in evergreen formations.

Cydista diversifolia (Kunth in H.B.K.) Miers, Proc. R. Hort. Soc. 3: 192. 1863. *Bignonia diversifolia* Kunth in H.B.K., Nov. Gen. Sp. quart. ed. 3: 133, folio ed. 3: 104. 1819. *Pleonotoma diversifolium* (Kunth in H.B.K.) Bureau & K. Schum. in Mart., Fl. Bras. 8(2): 274. 1897. Figure 24.

Lianas to 5 cm diam, to 20 m high, tendrils 11–21 cm long, leafy stems 2–7 mm diam., strongly tetragonal with 4 longitudinal ridges, subglabrous or sparsely pubescent with thin hairs to 0.4 mm long; pseudostipules 3–15 mm long, leaf-like, rounded-ovate. **Leaves** 2-foliolate or sometimes simple, petioles 18–45 mm long, ca. 1 mm diam., surface similar to stems, petiolules 10–31 mm long; **leaflet blades** 4–13 cm long, 2.5–8 cm wide, ovate to broadly ovate, apex acuminate with tip to 13 mm long, base rounded and subcordate to shallow-cordate, drying chartaceous, upper surface subglabrous, lower surface glabrous to sparsely pubescent with thin hairs ca. 0.4 mm long, venation palmate with 3 major veins or subpalmate with 3 or 4 2° veins/side, gland fields often present in the basal vein axils beneath. **Inflorescences** terminal or axillary, 6–20 cm long, panicles with 4–25 flowers, peduncles to 3–9 cm long, ca. 1.5 mm diam., similar to stems, lateral branches 8–25 mm long, bracts 0.4–1 mm long, pedicels 4–12 mm long. **Flowers** with calyx cups 3.5–5 mm long, ca. 4 mm diam., entire or split along the margin, with minute peltate hairs or thin hairs along the margin; **corolla** 22–46 mm long, funnel-form-campanulate, magenta to lavender or bluish purple, subglabrous externally, tube 8–16 mm diam. at the mouth, throat white with purple stripes within, lobes 7–22 mm long, broadly rounded; filaments ca. 16 and 13 mm long, thecae 2–2.5 mm long. **Fruits** 27–41 cm long, 10–16 mm wide, linear, valves flat and smooth, dark brown; seeds 10–13 mm long, 28–57 mm wide, pale yellowish brown throughout, wings thin.

Common evergreen vines in seasonally dry deciduous formations (rarely in evergreen forests), 5–500 m elevation. Flowering throughout the year but most often collected in June–August; fruiting in November–March. This species ranges from Mexico and the West Indies to Colombia and Venezuela.

Cydista diversifolia is recognized by its climbing habit with simple tendrils, usually bifoliolate leaves with rounded subcordate base and palmate venation, open-paniculate inflorescences, wet-season flowering, bright lavender to bluish purple corollas, long narrow flattened fruits, and uniformly colored thin seeds. The persisting rounded pseudostipules (four per node), square stems with prominent ridges and hollow in early stages, and gland fields in the basal vein axils are additional vegetative features.

Cydista heterophylla Seibert, Carnegie Inst. Wash. Publ. 522: 417. 1940. *Bignonia lepidota*

Seem., Bot. voy. Herald 179. 1854, non Kunth in H.B.K. Figure 24.

Lianas to 10 m high, to 10 cm diam., tendrils to 18 cm long, leafy stems 1.8–5 mm diam., terete, glabrescent, nodes with or without interpetiolar lines; pseudostipules 1–2 mm long, conical. **Leaves** simple or 2-foliolate (with or without tendrils), petioles 15–50 mm long, glabrous or sparsely puberulent with minute peltate hairs, longitudinally striate, petiolules 5–50 mm long; **leaflet blades** 5–14(–17) cm long, 3–9(–11) cm wide, broadly to narrowly ovate, apex bluntly obtuse to short-acuminate, base rounded and truncate to subcordate, drying thin-chartaceous, subglabrous on both surfaces, venation palmate with 3 major veins or subpalmate, 2° veins 3–5/side, glandular fields usually present in basal vein axils beneath. **Inflorescences** mostly axillary to fallen leaves, 1.5–7(–14) cm long, racemose, peduncles 8–14 mm long, 0.7–1.8 mm diam., densely covered with peltate (lepidote) hairs, pedicels 6–13 mm long, vesture like the peduncle. **Flowers** with calyx 3.5–6 mm long, 4–5 mm diam., densely covered with peltate hairs (glands sometimes present), margin entire or split into several lobes; **corolla** 47–66 mm long, funnellform-campanulate, lavender to purple-magenta, glabrous or with minute peltate hairs externally, tube 11–17 mm wide at the mouth, lobes 9–20 mm long, to 22 mm wide; filaments ca. 18 and 12 mm long, thecae 4–5 mm long. **Fruits** 18–33 cm long, 14–25 mm wide, linear-oblong, with 2 raised longitudinal ridges and raised edges on each flattened valve, smooth; seeds 8–13 mm long, 34–64 mm long, wings with transparent tips.

Deciduous lianas of the seasonally very dry deciduous forest formations and drier areas within evergreen formations, 5–300 m elevation (to 1000 m in Honduras). Flowering in April–May, fruiting in November–March. This species ranges from Mexico to northern Colombia.

Cydista heterophylla is recognized by its climbing habit with simple tendrils, the simple or bifoliolate opposite leaves, short racemose inflorescences with vesture of minute peltate hairs, lavender or purple corollas, long narrow fruit with two central longitudinal ridges and raised edges, and winged seeds with transparent distal tips. Stem tips of young plants often have four leaves (two pairs of simple leaves). The gland fields in the axils of basal veins may be difficult to see. The short flowering period when leaves are usually absent and restriction to deciduous forest areas are additional characteristics.

Cydista lilacina A. Gentry, Mem. New York Bot. Gard. 29: 277. 1978. Figure 24.

Lianas climbing with simple tendrils (not seen), leafy stems ca. 4 mm diam., terete, glabrous or with few minute hairs, drying black; pseudostipules 1–2 mm long. **Leaves** opposite or subopposite, 2-foliolate or simple, petioles 17–50 mm long, 1.4–3.3 mm diam., subglabrous, drying dark, petiolules 9–23 mm long; **leaflet blades** 5–19(–27) cm long, 3–13(–17) cm wide, ovate to ovate-oblong, apex obtuse with a small acute tip, base obtuse to rounded and often unequal, drying stiffly chartaceous and dark brown, subglabrous above and below, venation pinnate, 2° veins 4–6/side, glands usually present at the basal vein axils beneath. **Inflorescences** terminal, ca. 23 cm long, panicles with well-separated opposite lateral branches to 4 cm long, peduncle 4–9 cm long, 2–3 mm diam., glabrous, drying dark, flowers in distal groups of 2 or 3, pedicels 5–14 mm long. **Flowers** with calyx 4–7 mm long, cupular with 5 prominent (0.5–1.2 mm) teeth or entire, subglabrous but with rounded discoid flat glands; **corolla** 40–55 mm long, tubular-funnelform, lavender with a white throat, tube 10–15 mm diam. at mouth, glabrous or appressed puberulent externally, lobes to 20 mm long; filaments ca. 20 and 13 mm long, thecae 3–4 mm long; ovules 4-seriate. **Fruits** 14–32 cm long, 3–4 cm wide, oblong, valves flattened, margins rounded, midvein flat, surface wrinkled; seeds 15–21 mm long, 35–58 mm wide, brownish.

Plants of lowland evergreen rain forest formations of the Pacific slope, 10–100 m elevation. A collection from Reserva Biológica Carara, flowering in early February (*Zúñiga 90*), is the only record known from Central America. Otherwise, this species ranges from northern South America to Brazil and Bolivia.

Cydista lilacina is recognized by its climbing habit, simple or bifoliolate leaves, terminal panicle, calyx with round flat glands, and oblong fruits with flattened wrinkled surface. The tendency to dry dark (especially stems and inflorescence axes), general lack of puberulence, and lowland wet forest habitat are additional characteristics.

Cydista potosina (Schum. & Loes.) Loes., Rept. Spec. Nov. Regni Veg. 16: 209. 1919. *Arabidaea potosina* Schum. & Loes., Bull. Herb. Boissier 3: 618. *Clytostoma mayanum* Standl., Carnegie Inst. Wash. Publ. 461. 86. 1935. Figure 19.

Lianas. tendrils to 15 cm long, slender, leafy stems 1.7–5 mm diam., glabrous or with minute peltate hairs, tetragonal with 4 prominent longitudinal ridges, interpetiolar ridge usually present; pseudostipules linear or triangular, 1–8 mm. **Leaves** 2-foliolate, petioles 12–37 mm long, 1–1.5 mm diam., sparsely puberulent, striate, petiolules 9–40 mm long; **leaflet blades** 4.5–15 cm long, 2–8 cm wide, ovate to ovate-elliptic or ovate-oblonge, apex acute to acuminate, base obtuse or rounded, drying chartaceous and brown, upper surface glabrous, lower surface glabrous or with short (0.2–0.4 mm) thin hairs along the veins, venation pinnate, 2° veins 3–6/side. **Inflorescences** axillary or terminal, 2–10 cm long, racemes with 2–9 flowers, peduncles 5–85 mm long, glabrous or with minute (0.05 mm) peltate hairs, pedicels 5–18 mm long. **Flowers** with calyx 5–7 mm long, 4–6 mm diam., narrow-cupular, drying dark, subglabrous, sometimes with rounded flat glands distally, margin entire with 5 triangular minute lobes or irregular with pale edge; **corolla** 43–57 mm long, funnellform-campanulate, lavender or white, with minute glandular hairs externally, tube 11–16 mm diam. at the mouth, lobes 9–16 mm long, broadly rounded; filaments ca. 17 and 20 mm long, thecae ca. 3 mm long. **Fruits** 17–24 cm long, 27–43 mm wide, narrowly oblong, narrowed at the apex, valves flat with the margins elevated, midvein flat or elevated, surface smooth and dark; seeds 14–23 mm long, 45–70 mm wide, brownish but transparent at the wing tips.

Plants of wet lowland evergreen and partly deciduous forest formations on both Caribbean and Pacific slopes, 5–400 m elevation (to 800 m in northern Central America). Flowering in May–August. This species ranges from Veracruz, Mexico, to Costa Rica but is rarely collected along the Pacific slope of Central America.

Cydista potosina is recognized by its climbing habit with simple tendrils, bifoliolate leaves, short, few-flowered racemes, lavender or white corollas, and narrowly oblong fruits with winged seeds. The lack of gland fields in the axils of basal veins (lower leaf surface), consistently pinnate venation, and elevated ridges on leafy stems help distinguish this species from some of its congeners.

Dendrosicus species are now placed in *Amphitecna*.

Distictella Kuntze

Lianas (shrubs), climbing with distally coiled and trifid tendrils, stems with 4 phloem areas in cross-section, branchlets terete, nodes lacking interpetiolar lines and glandular fields; pseudostipules short and inconspicuous. **Leaves** opposite, petiolate, 3-foliolate or 2-foliolate with terminal tendril, petiolules well developed, margins entire, venation pinnate, domatia absent, gland fields often present in the basal vein axils beneath. **Inflorescences** terminal or axillary, racemes or racemose panicles with short lateral branches, rachis minutely puberulent, bracts small and caducous. **Flowers** with cupulate calyx, minutely puberulent, margin truncated and subentire, glandular fields often present near the edge; **corolla** tubular-campanulate, white, minutely and densely puberulent externally, lobes 5; stamens 4, of 2 lengths, anthers glabrous, thecae straight and divaricate, a staminode present; disc annular; ovary 2-locular, ovules in 4–8 series on each placenta, stigma simple. **Fruits** laterally compressed or biconvex capsules, the 2 valves flattened parallel to the septum, thick and woody; seeds flat, woody or with thin wings on 2 lateral sides and distally, usually brown.

Distictella is a genus of 13 South American species and one species that ranges from Costa Rica to Brazil.

Distictella magnoliifolia (Kunth in H.B.K.) Sandw., Lilloa 3: 460. 1938. *Bignonia magnoliaefolia* Kunth in H.B.K., Nov. Gen. Sp. 3: 136. 1819. Figure 21.

Lianas to 30 m high and 8 cm diam., tendrils to 18 cm long, 0.6–2.3 mm diam., leafy stems 3–8 mm diam., terete, minutely (0.05–0.1 mm) puberulent with reddish brown hairs. **Leaves** 2-foliolate, petioles 8–55 mm long, 1.3–2.7 mm diam., petiolules 6–23 mm long, often thickened below the blade, minutely puberulent; **leaf blades** 8–27 cm long, 4–12 cm wide, elliptic to elliptic-oblong or ovate-elliptic, apex short-acuminate, base obtuse to cuneate, drying chartaceous, glabrous above, minutely puberulent on the veins beneath, 2° veins 5–8/side, glands often present in basal vein axils. **Inflorescences** terminal or axillary, 10–28 cm long, racemose panicles, rachis densely minutely puberulent, brownish, 2° peduncles (lateral branches) 6–15 mm long, 1.5–2 mm diam., bracts 2–4 mm long, pedicels 4–8 mm long. **Flowers** with calyx 9–13 mm long, 8–11 diam.,

cupular with entire margin, minutely papillate puberulent, longitudinal gland fields 2–3 mm long often present distally; **corolla** 42–65(–73) mm long, 30–45 mm wide at the lobes, white with yellow throat, densely minutely glandular puberulent externally, tube 10–17 mm diam. above the narrowed (3 mm) basal portion, lobes 10–18 mm long, rounded distally and narrowed near the base; filaments ca. 22 and 16 mm long. **Fruits** 7.5–23 cm long, 32–55 mm wide, 15–20 mm thick, narrowly oblong to elliptic-oblong, valves woody, surface smooth; seeds 19–24 mm long, 28–38 mm wide, oblong to suborbicular, brown, body of seed 14–17 mm wide, not differentiated.

Rarely collected plants of lowland Caribbean evergreen rain forest formations ca. 100 m elevation, fruiting in November. The species ranges from northeastern Costa Rica (*Morales et al.* 3212 from La Selva) to Peru and Brazil.

Distictella magnoliifolia is recognized by its climbing habit with distally trifold tendrils, opposite bifoliolate leaves, terminal raceme-like inflorescences, minutely puberulent calyx cups with entire margins and distinct glandular areas, large white corollas, woody oblong fruit, and flat brown seeds in which the opaque wings extend around three sides of the central area. The above description is based on South American material.

Gibsoniothamnus is now placed in the Schlegeliaceae (q.v.).

Godmania Hemsley

Small to medium-size **trees**, bark smooth to longitudinally ridged, interpetiolar line and glandular field absent at the nodes. **Leaves** opposite, long-petiolate, palmately 5–9 foliolate, basal leaflets smaller than distal, leaflets petiolulate, margins entire (serrate on juvenile shoots), venation pinnate. **Inflorescences** terminal, compact many-branched corymbose panicles with many flowers, bracts small, puberulent, pedicels well developed. **Flowers** with small (< 2 mm) broadly campanulate calyx, subentire or with 5 small lobes; **corolla** urceolate-campanulate and slightly 2-lipped, yellow and brownish, puberulent externally, lower lip 3-lobed, lobes valvate in bud and triangular; stamens 4, of 2 lengths, included, filaments and anthers pubescent, thecae divaricate, a staminode present; disc annular-pulvinate; ovary minutely puberulent, 2-locular, ovules multiseriate in each locule. **Fruits** linear-cylindric capsules, twisted,

dehiscing loculicidally (perpendicular to the septum), valves coriaceous; seeds with 2 lateral membranaceous wings.

Godmania is a Neotropical genus of two species characterized by the smaller yellowish flowers with valvate lobes, twisted linear fruits, and palmately compound opposite leaves. A second species occurs in the *caatinga* formations of Brazil. The genus is a member of tribe Tecomeae and related to *Tabebuia* (Gentry, 1992).

Godmania aesculifolia (Kunth in H.B.K.) Standl. in Standl. & Calderón, *Lista Prelim. Pl. El Salvador* 200. 1925. *Bignonia aesculifolia* Kunth in H.B.K., *Nov. Gen. Sp.* 3: 140. 1819. *Tecoma fuscata* Mocino ex DC., *Prodr.* 9: 221. 1845. *Cybistax macrocarpa* Benth. in Benth. & Hook., *Gen. Pl.* 2: 1043. 1876. *G. macrocarpa* (Benth.) Hemsl., *Diag. Pl. Nov. Mex.* 2: 35. 1879. Figure 12.

Trees or shrubs, 3–7(–20) m tall, leafy stems 3–8 mm diam., minutely (0.1–0.2 mm) puberulent, brown, terete, becoming grayish and lenticellate. **Leaves** 11–38 cm long, with 5, 7, or 9 leaflets, petioles 4.5–18 cm long, 2–3 mm diam., petiolules 2–24 mm long, usually densely puberulent; **leaflet blades** 2.5–16 cm long, 1.5–7 cm wide, elliptic-obovate, obovate, narrowly elliptic-oblong or oblanceolate, apex short caudate-acuminate to gradually acuminate, margin entire (with teeth on juvenile shoots), base acute to cuneate, drying stiffly chartaceous, sparsely to densely puberulent with thin straight hairs 0.1–0.3 mm long beneath, punctate on both surfaces, 2° veins 6–13/side, loop-connected distally. **Inflorescences** terminal, 5–10 cm long, 6–10 cm wide, often a flat-topped panicle, 1° peduncle 2–9 mm long, 2° peduncles 12–15 mm long, densely puberulent, bracts ca. 0.7 mm long, pedicels 2–9 mm long, ca. 0.5 mm diam. **Flowers** with calyx 1–2 mm long, 2–3 mm wide, broadly obconic or campanulate, minutely puberulent, subentire or 5-lobed (lobes ca. 0.2 mm and obscure); **corolla** 12–16 mm long, urceolate to campanulate and slightly 2-lipped, yellow with red-brown marking on the upper lobes, tube 5–7 mm diam. for most of its length, densely minutely puberulent externally, lobes 1–5 mm long; filaments ca. 9 and 7 mm long, thecae less than 1 mm long; style ca. 9 mm long. **Fruits** 28–60(–100) cm long, 10–14 mm wide, 8–14 mm thick, long-linear, somewhat flattened and becoming coiled or twisted, with ca. 6 prominent longitudinal ridg-

es on each face; seeds 7–11 mm long, 50–135 mm wide, central area well differentiated, 6–8 mm long, 10–12 mm wide, wings translucent.

Infrequent deciduous trees of deciduous and partly deciduous forests of the Meseta Central and Pacific slope, 5–1200 m elevation. Flowering in February–July; fruiting in November–March. This species ranges from Mexico to Bolivia.

Godmania aesculifolia is recognized by the tree habit, opposite palmately compound leaves with three to nine leaflets, the short, many-branched terminal inflorescences with small crowded flowers, short calyx, and campanulate or urceolate yellow corolla. The long linear spirally coiling fruits and seeds with clearly differentiated translucent membranaceous lateral wings are additional characteristics. The branches often have an unpleasant odor when broken.

Jacaranda Jussieu

Trees (shrubs in Brazil), stems quadrangular or terete, nodes without gland fields or interpetiolar lines; pseudostipules absent. **Leaves** opposite, usually bipinnate (pinnate to simple in Brazilian spp.), often large, petiolate, lateral pinnae opposite or alternate, leaflets sessile or subsessile, often strongly asymmetric with 1 side broader than the other, margin entire or with distal teeth, base usually asymmetric, glabrous or puberulent, venation pinnate. **Inflorescences** terminal, axillary or from older leafless nodes, panicles or thyrses (racemes) with many flowers, pedunculate, lateral branches

usually opposite and not crowded, pedicels subtended by enlarged ebracteate nodes. **Flowers** showy, calyx broadly cupulate to tubular-campanulate, short, 5-lobed to denticulate or subentire; **corolla** tubular-campanulate or campanulate-funneliform above a narrowed base, slightly bilabiate, blue or lavender to magenta (white), densely puberulent to glabrous externally, the tube contracted near the base; stamens 4, filaments of 2 lengths, anthers glabrous, unequal or with only 1 theca, staminode usually exceeding the stamens with glandular hairs along its length and at the apex, pollen 3-colpate; disc pulviniform, ovary glabrous or puberulent, 2-locular, ovules on ca. 8 series in each locule. **Fruits** capsules, oblong or rounded in outline, strongly flattened perpendicular to the septum and dehiscing parallel to the plane of compression, surfaces glabrous or lepidote; seeds thin, flat, with translucent or brown circumferential wings (wider in width than in length), seed area and membranaceous wing differentiated or not.

Jacaranda is a genus of 49 species ranging from Mexico to Argentina (Gentry & Morawetz in Gentry, 1992), belonging to the tribe Tecomeae. The beauty of the trees when in flower has made a few of the species ornamental favorites, now planted throughout the tropics and subtropics. The genus stands out within the family because of its tree habit, opposite bipinnate leaves with usually many small leaflets, bluish or lavender flowers, and flat, rounded woody fruits. The long staminode, often adorned with glandular hairs, is another important generic distinction (it can be mistaken for a style).

Key to the Species of *Jacaranda*

- 1a. Calyx 4–7 mm long and tubular; leaflets 20–80 mm long, 6–25 mm wide [corolla densely puberulent externally; fruits with flat rounded margin; trees to 45 m tall; wet forests of both the Caribbean and Pacific slopes] *J. copaia*
- 1b. Calyx 1–3 mm long and cupular or saucer-like; leaflets 6–24 mm long, 1–10 mm wide 2
- 2a. Corolla mostly glabrous externally; leaflets 3.5–10 mm wide; fruits 5–12 cm long, oblong or rounded with strongly undulating lateral margins; growing wild in evergreen forests of the Pacific slope ..
..... *J. caucana*
- 2b. Corolla minutely puberulent externally; leaflets 1–4 mm wide; fruits 4–7 cm long, suborbicular with flattened or slightly undulating margins, widely planted for ornament in evergreen and partly deciduous areas *J. mimosifolia*

Jacaranda caucana Pittier, Contrib. U.S. Natl. Herb. 18: 258. 1917. *J. ficifolia* D. Don, sec Seem., Bot. Voy. Herald 181. 154, non Don. *J. trianae* Kränzl., Fedde Repert. 17: 226. 1921. *J. caucana* ssp. *sandwithiana* A. Gentry, Ann. Missouri Bot. Gard. 60: 858. 1973 (1974). Figure 14.

Trees 8–28 m tall, trunks up to 1 m diam., leafy stems 3–12 mm diam., glabrous or with few minute peltate hairs, young stems drying dark with narrow whitish lenticles, older stems gray. **Leaves** bipinnate, 20–45 cm long, petioles 4–8 cm long, 1.8–4 mm diam., sparsely minutely puberulent, rachis sulcate above, with lateral wings ca. 0.5 mm wide, lateral pinnae 7–18 pairs, 4–17 cm long, petiolules 3–10 mm long; **leaflet blades** 8–28 mm long, 3.5–10 mm wide (terminal leaflets to 37 × 16 mm), asymmetrically oblong-rhombic, apex obtuse with a small apiculate tip, base with narrowly cuneate and broadly obtuse sides, drying chartaceous, glabrous above with major veins impressed, grayish beneath with thin hairs 0.2–0.4 mm long 2° veins 4–7/side. **Inflorescences** usually borne at distal leafless nodes, 6–15 cm long, paniculate with 3–30 flowers, peduncles 3–25 mm long, 0.7–2 mm diam., glabrous or sparsely puberulent, drying dark, pedicels 0.5–3 mm long (ca. 6 mm including subtending node). **Flowers** with calyx ca. 1.5–3 mm long, 1.8–4 mm wide at the apex, broadly campanulate, sparsely papillate puberulent, bluntly 5-toothed; **corolla** 35–48 mm long, tubular-campanulate and often bent almost 90° near the base, purple-blue, subglabrous externally, tube 10–17 mm diam. near the mouth, lobes ca. 10 × 12 mm; filaments ca. 14 and 13 mm long, thecae 1.5–2 mm long, staminode 22–25 mm long with hairs to 1 mm long. **Fruits** 6–12 cm long, 4–7 cm wide, oblong-elliptic (narrowed at base and apex), 10–17 mm thick, margins thinner and undulating (2 lobes/side); seeds 8–19 mm long, 23–42 mm wide, wings brown or slightly translucent, not clearly differentiated.

Trees of evergreen forest formations of the southern Pacific slope (in Costa Rica), 5–1000 m elevation. Flowering in March–May; fruiting in November–March. The species ranges from southwestern Costa Rica to Venezuela.

Jacaranda caucana is recognized by its tree habit, opposite bipinnate leaves with small asymmetric leaflets, flowers with small, widely flaring calyx cups, purple-blue corollas mostly glabrous on the exterior, and the flat woody fruits with undulating margin. Costa Rican material is placed in

subspecies *sandwithiana*, having shorter or undeveloped calyx lobes and a corolla tube that is glandular-pilose externally. Four subspecies were recognized by Gentry and Morawetz (Gentry, 1992).

Jacaranda copaia (Aublet) D. Don, Edinburg Phil. J. 9: 267. 1823. *Bignonia copaia* Aublet. Hist. Pl. Guiane Fr. 2: 650, tab. 262, fig. 1, tab. 265. 1775. *J. spectabilis* Mart. ex DC., Prodr. 9: 229. 1845. *J. superba* Pittier, Bol. Soc. Venez. Ci. Nat. 6: 19. 1940. *J. copaia* ssp. *spectabilis* (Mart. ex DC.) A. Gentry, Rhodora 79: 441. 1977. Figure 14.

Trees to 45 m tall, trunks to ca. 50 cm diam., with few upright branches forming a plume-like large-leaved crown when young, leafy stems 4–12 mm diam., glabrous, subtetragonal, lenticellate. **Leaves** 30–160 cm long, to 60 cm wide, petioles 4–29 cm long, 2.5–10 mm diam., minutely papillate puberulent or muricate, terete, rachis narrowly sulcate above (without wings), pinnae 7–35 cm long, petiolules 0–3 mm long; **leaflet blades** 20–80 mm long, 6–18(–25) mm wide, asymmetrically rhomboid-elliptic to elliptic-oblong, apex acuminate, base asymmetric with narrowly cuneate and obtuse sides, drying dark and chartaceous, upper surface with minute hairs on the midvein, sparsely minutely puberulent on the veins beneath, 2° veins 3–7/side. **Inflorescences** to 48 cm long, open pyramidal panicles with lateral branches to 30 cm long (sometimes with 3 terminal thyrses), peduncles to 8 cm long, 3–5 mm diam., minutely puberulent or with peltate hairs. **Flowers** with calyx tube 4–7 mm long, 3–5 mm diam, densely minutely (0.1 mm) puberulent, irregularly lobed (0.3 mm) or subentire; **corolla** 23–50 mm long, tubular-campanulate above the narrowed (8–10 mm) base, blue or lavender (white in the throat), densely minutely puberulent externally, tube 8–14 mm diam. distally, lobes 3–13 mm long; filaments ca. 12 and 9 mm long, thecae ca. 2 mm long, staminode 24–27 mm long, pubescent, bifurcate at tip. **Fruits** 4.5–12 cm long, 3–6 cm wide, 5–8 mm thick, oblong-rounded, surface smooth but minutely muricate; seeds 11–14 mm long, 21–30 mm wide, seed ca. 5 mm diam., wings translucent with brown rays.

Trees of rain forests on both Caribbean and Pacific slopes, 10–600 m elevation. Flowering in February–April; fruiting in July–November. This species ranges from southern Mexico to Brazil and Bolivia.

Jacaranda copaia is distinguished by the tall tree habit, opposite bipinnate leaves, strongly asymmetric leaflets, tubular calyx, bluish lavender corolla densely puberulent externally, flat oblong woody fruit, and seeds with brown rays in the otherwise transparent wings. When mature, this is one of the most beautiful trees of southern Central America (Standley, 1938). As a young tree, this species has a slender unbranched trunk with ascending distal branches forming a terminal tuft with very large bipinnate leaves. The mimosoid legume *Schizolobium parahybum* (Vell.) Blake is quite similar in this regard; both species are visually striking and often seen in lowland rain forest secondary growth (Gentry, 1973b). *Gallinazo* is a common name.

Jacaranda mimosifolia D. Don, Bot. Reg. 8: tab. 631. 1822. *J. ovalifolia* R. Br., Bot. Mag. tab. 2327. 1822. Figure 14.

Trees, usually small to medium size (8–15 m tall), stems 4–9 mm diam., usually glabrous, terete, with elongate lenticels. **Leaves** 13–34 cm long, petioles to 4 cm long, 1.8–2.6 mm diam., lateral pinnae 3–10 cm long, with narrow wings 0.3–0.5 mm wide, with 13–41 opposite or alternate, subsessile leaflets; **leaflet blades** 5–14 mm long, 1–4 mm wide (terminal leaflets to 22 × 6 mm), elliptic to elliptic-obovate, apex acute to acuminate, slightly asymmetric at the obtuse/cuneate base, glabrous above, glabrous or puberulent along the edge and major veins beneath, 2° veins 3–7/side. **Inflorescences** terminal, 9–38 cm long, open panicles with well-separated opposite branches, peduncles 34–88 mm long, 1–4 mm diam., pedicels 1–2 mm long (to subtending node), flowers usually in distal cymes. **Flowers** with calyx cup 1–2 mm long, ca. 2 mm wide, sparsely minutely puberulent, margin with 5 triangular or acute teeth 0.2–1 mm long; **corolla** 30–45 mm long, tubular-campanulate, bluish lavender or lavender, densely puberulent near the base with hairs 0.1–0.3 mm long, less densely puberulent distally, tube 9–13 mm diam. near the mouth, lobes 3–8 mm long; filaments ca. 16 and 13 mm long, thecae ca. 2 mm long, staminode 20–25 mm long. **Fruits** 30–70 mm long, 37–60 mm wide, 12–20 mm diam., orbicular to oblong-rounded, lenticular with thinner flattened edges, surface smooth and slightly muricate; seeds 9–13 mm long, 11–19 mm wide, seed ca. 7 × 6 mm, clearly differentiated from the transparent circumferential wing.

Jacaranda mimosifolia, native to northern Ar-

gentina and adjacent Bolivia, is widely planted throughout the tropics and subtropics as an ornamental tree. In Central America it is usually grown between 500 and 1400 m elevation, flowering in January–July, with peak flowering in April–May. Standley and Williams (1974) described the colorful effect of these showy trees in Guatemala. The very small leaflets on opposite bipinnate leaves, bluish lavender flowers blooming in the dry season, and hard, rounded, lens-shaped fruits help distinguish this species. *Jacaranda* and *Jacaranda* are the Spanish and English names.

Kigelia DeCandolle

Medium-size **trees** up to 20 m tall, with broad spreading crowns and inflorescences hanging from the lower branches. **Leaves** opposite, petiolate, imparipinnate with 3–11 leaflets, the terminal leaflet larger than the laterals and borne on a longer petiolule, margin entire to dentate, venation pinnate. **Inflorescences** panicles with few short lateral branches from an elongate central rachis, long-pedunculate and pendulous, bracts small, pedicels well developed. **Flowers** large, calyx campanulate or cupular, splitting into 2–5 lobes, coriaceous, usually glabrous; **corolla** campanulate-funnelform and distally curved, glabrous on the exterior, 5-lobed and somewhat 2-lipped, deep purple to dark wine-red (orange-red); stamens 4, of 2 lengths, subexserted at the mouth of the corolla, thecae slightly divergent; disc annular; ovary lepidote, 1-locular with 2 parietal placentas or bilocular in the lower half, style short, stigma simple. **Fruits** indehiscent, pendulous, cylindrical-oblong, fibrous-woody; seeds many, without wings.

Kigelia is now believed to comprise a single very variable species, native to savannas and forests in central tropical Africa. (In the past some authors recognized as many as ten species.) These trees are occasionally grown as unusual exotics in tropical parks and gardens.

Kigelia pinnata (Jacq.) DC., Rev. Bign. (Bibl. Univ. Geneve) 24. 1838. *Crescentia pinnata* Jacq., Collect. 3: 203, tab. 18. 1791. *K. africana* DC., Fl. Nigr. 463. 1849.

Trees 6–12 m (rarely 20 m) tall, twigs often hollow, leafy stems 6–14 mm diam., glabrous or minutely puberulent, glandular fields absent at the nodes. **Leaves** to 50 cm long, with usually 7 or 9

leaflets, petioles 6–14 cm long, ca. 3 cm diam., petiolules of lateral leaflets 1–4 mm long; **leaf blades** (2–)5–16 cm long, (1.5–)3–7 cm wide, elliptic-oblong to elliptic-obovate, apex obtuse to short-acuminate, margin entire or dentate distally, base asymmetric in lateral leaflets (rounded/cuneate), drying stiffly chartaceous, glabrous or with minute (0.1 mm) straight hairs, 2° veins 7–11/side. **Inflorescences** terminal and pendulous, to 40 cm long, peduncles ca. 20 cm long, 3 mm diam., with lateral branches to 9 cm long and 2.5 mm diam., pedicels 10–14 mm long. **Flowers** held horizontally, calyx 2–3 cm long, 12–20 mm wide at the apex, truncated at the base, lobes to 12 mm long, coriaceous; **corolla** 6–10 cm long, tube ca. 14 mm diam. at base, narrowing to 11 mm and then opening to 4–6 cm wide, dark maroon or wine-red; anthers ca. 8 mm long; ovary 10–11 mm long, 3 mm diam. **Fruits** 25–50(–80) cm long, 5–12 cm diam., tubular-oblong, pendulous, glabrous on the exterior.

Kigelia pinnata is an African tree rarely encountered in Neotropical parks and gardens (our only Costa Rican collections come from Golfito). The pendulous raceme-like inflorescences with large dark wine-red or maroon flowers held horizontally and the large pendulous sausage-like fruits make this a unique species. These plants are adapted for bat pollination, with inflorescences long-pendulous beneath the lower branches, and night-blooming flowers with thick tissues and foul odor.

Lundia DeCandolle
Nomen conservandum

Lianas climbing with tendrils (simple or trifid near the tip), stems with 4 phloem areas in cross-

section, branchlets terete, nodes often wider than the stems, with interpetiolar gland fields; pseudostipules small or absent. **Leaves** opposite, 2- or 3-foliolate, petiolate, blades usually somewhat rounded near the base, margin entire, venation palmate or subpalmate, tufts of hairs (domatia) often present in the proximal vein axils beneath. **Inflorescences** axillary or terminal, usually less than 20 cm long, paniculate, pedunculate, bracts minute or absent, flowers pedicellate. **Flowers** with calyprate-conical calyx buds, calyx margin entire or splitting, puberulent; **corolla** tubular-funnel-form, white to rose or magenta, puberulent externally; stamens 4, included, filaments of 2 lengths, anthers puberulent, thecae divaricate and straight, staminode small; disc absent; ovary densely puberulent, 2-locular, ovules many in 2–6 series in each locule, style puberulent or glabrous. **Fruits** capsules, linear and smooth, valves flattened parallel to the septum, surface densely puberulent, median vein and margins usually elevated, dehiscent septically; seeds flat, thin, transverse-oblong, with 2 lateral membranaceous wings transparent at the tips.

Lundia is a genus of 12 species ranging from Mexico to Brazil and Bolivia. The genus is distinguished by its unusual calyx, externally puberulent white to rose or purple corollas, stamens with divaricate puberulent thecae (often in a straight line), and long narrow fruits with densely puberulent surface. The early flower buds are tubular with narrowly conical tip that is deciduous to produce a calyx with an entire margin, which then may split as growth continues. The calyx remains obconic at the base as opposed to the rounded base in *Paragonia pyramidata*, which may also have calyprate calyces. Costa Rican species of *Lundia* are also vegetatively similar to species of *Arrabidaea* and *Cydista*.

Key to the Species of *Lundia*

- 1a. Flowers white; style glabrous except at the base; calyx drying yellowish, entire or sometimes split; occasional plants of evergreen and partly deciduous forests *L. corymbifera*
- 1b. Flowers pink or magenta; style puberulent near the tip or along its length; calyx drying brownish and often split to form 2 lips; rarely collected in evergreen forests *L. puberula*

Lundia corymbifera (Vahl) Sandw., Recueil Trav. Bot. Néerl. 34: 229. 1937. *Bignonia corymbifera* Vahl, Ecl. Am. 2: 45, pl. 17. 1798. *B. umbrosa* Kunth in H.B.K., Nov. Gen. Sp. 3: 138. 1819. *L. valenzuelae* Dugand, Mutisia 10: 7. 1952. Figure 23.

Lianas to 3 cm diam., tendrils 4–14 cm long, leafy stems 1.7–6 mm diam., minutely puberulent with thin hairs 0.1–0.2 mm long, longitudinally ridged (striate), gland fields prominent; pseudostipules conical. **Leaves** 2- or 3-foliolate, petioles 8–64 mm long, 0.8–1.7 mm diam., minutely pu-

berulent, petiolules 7–42 mm long; **leaflet blades** 5–14 cm long, 2–9 cm wide, ovate-elliptic to broadly ovate, apex caudate-acuminate to long-acuminate (tips ca. 15 mm long), base rounded and truncate to subcordate, slightly or clearly asymmetric, drying thin-chartaceous and brown, minutely puberulent on the midvein above, with whitish hairs 0.1–0.3 mm long beneath and larger hairs sometimes present in the vein axils (domatia), venation palmate or subpalmate, 2° veins 3–7/side. **Inflorescences** axillary or terminal, 5–10 cm long, peduncles 3–4.5 cm long, ca. 1 mm diam., densely puberulent with short (0.1–0.2 mm) yellowish hairs, pedicels 5–8 mm long. **Flowers** with calyx 3–6 mm long, 3–4 mm diam., cupulate-campanulate to obconic, margin entire or split on 1 or 2 sides, minutely puberulent; **corolla** 26–43 mm long, tubular-funnelform, white, densely minutely puberulent externally, with yellow ridges in the throat, lobes 4–12 mm long; filaments ca. 14 and 9 mm long, thecae 2–3 mm long, divaricate. **Fruits** 28–60 cm long, 15–20 mm wide, valves thick, with raised midrib and edges, densely minutely velutinous; seeds 6–14 mm long, 19–40 mm wide, central area ca. 10 mm wide, lateral wings with darker interior and clear distal areas.

Vines often found along stream edges in evergreen and partly deciduous forest formations of the Pacific slope, 10–900 m elevation. Flowering in June–December; fruiting in February–March. This species ranges from central Costa Rica to Brazil and Bolivia.

Lundia corymbifera is distinguished by its vining habit with simple tendrils, opposite bi- or trifoliolate leaves, leaflets rounded at the base, short inflorescences, unusual calyx buds, pubescent anthers, white corolla puberulent on the exterior, and long linear fruits with two-winged seeds. The flower buds are ellipsoid and often have an apiculate apex that usually dehisces as a cap, leaving an entire margin.

Lundia puberula Pittier, Contrib. U.S. Natl. Herb. 18: 258. 15 Sept. 1917. *L. dicheilocalyx* Blake, Contrib. Gray Herb. 52: 94. 28 Sept. 1917. *L. schumanniana* Kränzl., Fedde Repert. 17: 120. 1921. *L. colombiana* Dugand, Caldasia 4: 236. 1946.

Lianas to 5 cm diam., tendrils 5–15 cm long, leafy stems 1.6–6 mm diam., minutely (0.1 mm) puberulent, longitudinally ridged or striate, pseudostipules inconspicuous. **Leaves** 2- or 3-folio-

late, petioles 2.4–6 cm long, petiolules 10–20 mm long, 0.6–1 mm diam., minutely puberulent; **leaf blades** 6–12(–16) cm long, 3.5–7(–9) cm wide, ovate to ovate-oblong, apex long-acuminate (tips ca. 2 cm long), base rounded and truncate to cordate, slightly asymmetric, drying thin-chartaceous and brown, sparsely puberulent above, minutely puberulent beneath and often with longer (0.2–0.6 mm) hairs in the vein axils (domatia), venation palmate or subpalmate, 2° veins 3–5/side. **Inflorescences** axillary or terminal, 3–12 cm long, peduncles 15–55 mm long, 1–2 mm diam., minutely puberulent, bracts ca. 1 mm long, pedicels 3–8 mm long, ca. 0.6 mm diam. **Flowers** with calyx 4–8 mm long, 3–4 mm diam, tubular, entire or split on the margin, minutely puberulent with short (0.1 mm) hairs; **corolla** 30–58 mm long, tubular-campanulate or funnelform, slightly 2-lipped, pale pink to magenta, densely minutely puberulent externally, lobes 8–21 mm long; filaments 14–20 and 9–13 mm long, thecae 2–3 mm long. **Fruits** long linear capsules, 23–48 cm long, 15–17 mm wide, valves flat with raised midvein, surface velutinous; seeds 9–12 mm long, 33–35 mm wide, wings brown to transparent distally.

Rarely collected vines in lowland evergreen rain forests of the Caribbean and Pacific slopes, 0–900 m elevation. Flowering throughout the year. This species ranges from Mexico and Belize to Peru.

Lundia puberula is recognized by its vining habit with simple tendrils, the opposite bi- or trifoliolate leaves with long-acuminate tips and rounded base, the entire or split calyx, pubescent anthers, pink to magenta corollas minutely puberulent externally, and long slender fruits. The usual presence of tufted hairs in vein axils, gland fields at nodes, and lowland rain forest habitat are additional distinctions. This species is easy to confuse with some species of *Arrabidaea* and *Cydista*.

Macfadyena A. DeCandolle

Lianas, tendrils with hardened curved trifid tips, stems terete, cross-section with ca. 8 phloem areas and fissured xylem, roots with swollen tubers, interpetiolar gland fields present or absent; pseudostipules small, lanceolate to ovate. **Leaves** evergreen or deciduous, opposite, 2-foliolate, petiolate, often with a tendril, margin entire, venation pinnate. **Inflorescences** axillary or terminal on short-shoots, 1 or 2 or 3–15 on short cymes or

reduced panicles, pedicels subtended by nodes. **Flowers** with tubular or campanulate calyx, lobed or variously split to spathe-like, usually thin-textured; **corolla** tubular-campanulate or tubular-funnelform, 2-lipped, bright yellow, glabrous externally, with 5 rounded lobes; stamens 4, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, staminode present; disc annular-pulvinate, ovary with minute peltate hairs to puberulent or glabrate, locules 2, ovules in 2-4 series in each locule. **Fruits** elongate linear capsules, valves parallel to the septum, flat, smooth, midvein slightly raised; seeds flat, transversely oblong,

central area not clearly differentiated from the 2 thin lateral wings.

Macfadyena is a genus of four species ranging from Mexico and the West Indies to Argentina. The plants are dimorphic, with the leaf blades of young plants usually smaller and more lanceolate than the blades of more mature stems. In addition, these plants are unusual in that they are able to climb up tree trunks using their short, three-clawed tendrils as grappling hooks; adventitious roots also aid in adhering to their support. The flowers can vary greatly in size, even on the same vine.

Key to the Species of *Macfadyena*

- 1a. Calyx usually split on 1 side (spathe-like) with apical tip curved backward; seeds 20-25 mm wide, brown throughout, fruits to 30 cm long; pseudostipules subulate-lanceolate; plants of lowland swamps below 100 m elevation in evergreen forest formations *M. uncata*
- 1b. Calyx subentire or variously lobed or split (not spathe-like); seeds 40-65 mm wide, translucent near the tips, fruits to 130 cm long; pseudostipules often ovate and striate; plants of well-drained sites in deciduous and partly deciduous or evergreen forest formations, 10-1200 m elevation
 *M. unguis-cati*

Macfadyena uncata (Andr.) Sprague & Sandw., *Recueil Trav. Bot. Néerl.* 34: 215. 1937. *Bignonia uncata* Andr., *Bot. Repos. tab.* 530. 1808. *B. uncinata* G. Meyer, *Prim. Fl. Essequeb.* 210. 1818. *M. uncinata* (G. Meyer) A. DC., *Prodr.* 180. 1845. *M. guatemalensis* Blake, *Contrib. U.S. Natl. Herb.* 24: 24. 1922. Figure 17.

Lianas to 30 m high, tendrils with 3 stiff curved distal tips, leafy twigs 1-4 mm diam., minutely puberulent or glabrous, terete, gland fields usually visible on young stems; pseudostipules ca. 2 mm long, subulate-lanceolate. **Leaves** with petioles 8-36 mm long, 1-1.7 mm diam., glabrous or sparsely puberulent with thin hairs ca. 0.2 mm long, petiolules 4-27 mm long; **leaflet blades** 5-20 cm long, 2-9 cm wide, narrowly ovate to ovate or ovate-elliptic, apex acuminate, often with a long (2 cm) narrow tip, base obtuse or cuneate (rounded), drying chartaceous and often dark, subglabrous or with very minute hairs above, minutely puberulent and with appressed peltate hairs beneath, 2° veins 5-8/side. **Inflorescences** axillary to foliage leaves, flowers 1-3 in reduced cymes or panicles, peduncles 0-9 mm long, ca. 1 mm diam., glabrous, drying black, bracts 1-4 mm long, lanceolate, caducous, pedicels ca. 10 mm

long. **Flowers** with calyx 15-27 mm long, 6-14 mm diam., glabrous or with few minute peltate hairs, usually split on 1 side (spatheaceous) with the narrowed apex recurved; **corolla** 40-85 mm long, tubular-funnelform, yellow, glabrous externally, 8-18 mm diam. at the mouth, lobes 7-17 mm long; filaments ca. 23 and 18 mm long, thecae 2.5 mm long. **Fruits** 16-30 cm long, 15-19 mm wide, valves drying dark brown; seeds 12-14 mm long, 20-25 mm wide, transversely oblong-rectangular with short lateral wings, dark brown throughout.

Plants of swampy sites in evergreen lowland forest formations of both Caribbean and Pacific slopes, 1-110 m elevation. Probably flowering throughout the year. This species, often found in mangrove formations, ranges from Mexico to Brazil.

Macfadyena uncata is recognized by its climbing habit with three-clawed tendrils, bifoliolate leaves with acuminate blades, few-flowered axillary inflorescences, spathe-like calyx, yellow corollas glabrous externally, and narrow fruits with short-winged seeds. It is also unusual in being restricted to swampy habitats at low elevations.

Macfadyena unguis-cati (L.) A. Gentry, *Brittonia* 25: 236. 1973. *Bignonia unguis-cati* L., Sp.

Pl. 2: 623. 1753. *Doxantha unguis-cati* (L.) Miers emend. Rehder, Mitt. Deutsch. Dendrol. Gesel. 1913: 262. 1913. *B. dasyonyx* Blake, Contrib. Gray Herb. 52: 93. 1917. *D. dasyonyx* (Blake) Blake, J. Bot. 61: 192. 1923. Figure 17.

Lianas to 30 m high, to 7 cm diam., tendrils 2–5 cm long with 3 stiff curved terminal “claws” 5–14 mm long, leafy stems 1.3–4 mm diam., glabrescent and grayish, gland fields present or absent at nodes; pseudostipules lanceolate to ovate, often with parallel longitudinal ridges (striate). **Leaves** dimorphic (young vines vs. mature stems), 2-foliolate, petioles 11–27(–47) mm long, 0.8–1.5 mm diam., glabrous or sparsely and minutely puberulent, petiolules 4–16(–25) mm long; **leaf blades** 5–16 cm long, 1–7 cm wide, narrowly ovate-elliptic to narrowly ovate or elliptic, apex acuminate with narrowed tip to 2 cm long, base rounded to acute, drying thinly chartaceous, mostly glabrous except for minute puberulence on the midvein and with peltate hairs beneath, 2° veins 4–8/side. **Inflorescences** terminal on short-shoots or axillary to leafless nodes, panicles of up to 15 flowers, peduncles 8–28 mm long, usually glabrous, pedicels 8–10 mm long. **Flowers** with calyx 6–15 mm long, 7–12 mm wide, cupular to campanulate, thin-textured, distal margin irregularly split or with lobes 0.5–2 mm long, glabrous or with few peltate hairs; **corolla** 42–80 mm long, tubular campanulate or funnelliform, deep yellow or yellow-orange, glabrous externally, tube 12–18 mm wide at mouth, lobes 9–18 mm long; filaments ca. 20 and 14 mm long, thecae ca. 3 mm long, staminode rarely forming a fifth stamen. **Fruits** 24–145 cm long, 11–19 mm wide, linear, tapering at both ends, valves smooth, with minute peltate hairs, drying dark brown; seeds 9–14 mm long, 40–65 mm wide, mostly brown with lateral tips transparent.

Deciduous lianas of seasonally dry deciduous, partly deciduous, and (less often) evergreen forest formations, 10–900(–1300) m elevation. Flowering primarily in February–June. This species ranges from Mexico and the West Indies to Argentina.

Macfadyena unguis-cati is recognized by its climbing habit with short distally three-clawed tendrils, opposite bifoliolate leaves, inflorescences usually flowering before the new leaves are fully flushed, thin calyx with irregular margin, deep yellow corollas glabrous externally, long-linear flattened fruits, and two-winged seeds. The un-

usual dimorphism and climbing habit (see discussion under genus) are additional distinctions. The leaves on very young plants may be only 1 cm long and rounded (Standley, 1938). Gentry (1973b) reported that the seedlings of this species can persist for extended periods in drier areas. *Uña de gato*.

Mansoa DeCandolle

Lianas climbing with distally trifid tendrils or simple tendrils with a terminal peltate disc, stems terete or somewhat quadrangular, with 4–8 phloem areas in cross-section, often with conspicuous glandular fields at the nodes; pseudostipules well developed to inconspicuous. **Leaves** opposite, 2- or 3-foliolate, glabrous or puberulent, petioles sometimes with a glandular field at the apex, margin entire, venation pinnate or subpalmate. **Inflorescences** axillary to distal leaves or leafless nodes (terminal), panicles, racemes or small corymbs, usually few-flowered, pedicels subtended by minute bracts or ebracteate. **Flowers** with cupulate or tubular-campanulate calyx, 5-lobed or the margin truncated, often with plate-shaped glands on the distal surface; **corolla** narrowly tubular at the base, distally tubular-funnelform to tubular-campanulate, white to reddish purple, puberulent externally (tube may be glabrous); stamens 4, filaments of 2 lengths, anthers glabrous or villous, thecae curved or straight, divaricate, a staminode present; disc annular-pulvinate; ovary cylindrical, lepidote to papillate, 2-locular, ovules in 2–4 series in each locule. **Fruits** linear-oblong capsules, valves parallel to the septum, woody, thin and flat to thick and terete, surface smooth or with elevated spines; seeds flat with 2 thin lateral distally membranaceous wings or corky and lacking lateral wings.

Mansoa is a genus of 15 Neotropical species, mostly South American. This generic concept now includes a number of species formerly placed in *Pachyptera* and *Pseudocalymma* (Gentry, 1973b; Standley & Williams, 1974). Five distinctive species are placed here: one with very small leaves (*M. parvifolia*), two whose vegetative parts smell like onions (*M. hymenaea* and *M. standleyi*), one with verrucose-echinate fruits (*M. verrucifera*), and one with large white corollas (*M. kerere*). Except for *M. hymenaea*, the species of this genus have rarely been collected in Costa Rica.

Key to the Species of *Mansoa*

- 1a. Leaflets < 30 mm long; tendrils < 3 cm long, with flat disc-like pad at the apex *M. parvifolia*
- 1b. Leaflets > 40 mm long; tendrils usually > 5 cm long, usually ending in 3 slender tips (disc absent) 2
- 2a. Fruit surfaces covered with spine-like tubercles 1–5 mm long; gland fields absent at the nodes; calyx with well-defined lobes to 4 mm long [leaves without a garlic-like or onion-like odor] *M. verrucifera*
- 2b. Fruits with flat smooth surfaces; gland fields usually present at the nodes; calyx with truncated or irregular margins or rarely with lobes to 2 mm long 3
- 3a. Vegetative parts lacking the odor of onion; pseudostipules usually in a vertical series of 3 in each leaf axil, acute; leaves mostly 3-foliolate; inflorescences racemose; corolla puberulent on tube and lobes externally, white (in Central America) *M. kerere*
- 3b. Vegetative parts with the odor of onion or garlic when crushed; pseudostipules usually inconspicuous, obtuse; leaves 2-foliolate; inflorescences panicles or racemes, corolla puberulent only on the lobes externally, reddish purple 4
- 4a. Calyx 4–7 mm long, green at maturity; fruits 15–25 mm wide, with midvein raised on surface of the valves; plants of deciduous and partly deciduous forests *M. hymenaea*
- 4b. Calyx 9–21 mm long, green to purplish at maturity; fruits with the midvein obscure on the valve surface; plants mostly in evergreen forest formations *M. standleyi*

Mansoa hymenaea (DC.) A. Gentry, Ann. Missouri Bot. Gard. 66: 782. 1979. *Bignonia hymenaea* DC., Prodr. 9: 158. 1845. *Adenocalymma macrocarpum* J. D. Smith, Bot. Gaz., 40: 9. 1915. *A. ciliolatum* Blake, Contrib. Gray Herb. 52: 90. 1917. *A. hosmeca* Pittier, Contrib. U.S. Natl. Herb. 18: 256. 1917. *Petastoma tonduzianum* Kränzl., Fedde Repert. 17: 56. 1921. Figure 22.

Lianas to 5 cm diam., tendrils 10–15 cm long, leafy stems 0.8–7 mm diam., subtetragonal, glabrous (new shoots sparsely minutely puberulent), becoming pale yellowish brown or gray; pseudostipules ca. 3 mm long, ovoid, striate. **Leaves** 2-foliolate, petioles 6–38 mm long, 0.7–2 mm diam., glabrous or very minutely (0.05 mm) puberulent, petiolules 8–26 mm long, thickened at the blade; **leaflet blades** 4–14 cm long, 2–8 cm wide, ovate to ovate-oblong or suborbicular, apex short-acuminate to bluntly obtuse, base obtuse to rounded-truncate (subcordate), drying stiffly chartaceous and grayish or green, glabrous on both surfaces, 2° veins 3–10/side. **Inflorescences** axillary or terminal, 4–10 cm long, panicles, peduncles 1–5 cm long, ca. 2 mm diam., pedicels 5–20 mm long, sparsely to densely puberulent with thin straight hairs. **Flowers** with calyx 4–7 mm long, 4–6 mm diam., cupulate, puberulent to subglabrous, margin subentire or minutely 5-lobed, ciliate; **corolla** 37–65 mm long, tubular-campan-

ulate (slightly 2-lipped), white to lavender or dark pink, glabrous or with the lobes puberulent externally, tube 8–14 mm diam., lobes 9–14 mm long; filaments ca. 18 and 13 mm long, thecae ca. 3 mm long. **Fruits** 15–34 cm long, 15–23 mm wide, linear-oblong, flat, midvein raised, surface smooth; seeds 11–15 mm long, 34–62 mm wide, center ca. 12 mm diam., not clearly differentiated, wings translucent.

Common plants of seasonally dry deciduous and partly deciduous forests of the Pacific slope, 10–1300 m elevation. Flowering primarily in December–March. This species ranges from northern Mexico to southeastern Brazil.

Mansoa hymenaea is recognized by its climbing habit with trifid tendrils, opposite bifoliolate broadly ovate leaves, short inflorescences, white to rose or lilac corollas puberulent distally, flat, narrow fruits tapering at both ends, and thin two-winged seeds. The strong odor of garlic or onions when vegetative parts are crushed is a very distinctive feature. Specimens placed here were called *Pseudocalymma sagotii* (Bur. & K. Schum.) Sandwith by Williams in *Flora of Guatemala* (Standley & Williams, 1974). *Ajillo* and *pedo de padre* are common names.

Mansoa kerere (Aublet) A. Gentry, Ann. Missouri Bot. Gard. 66: 783. 1979. *Bignonia kerere* Aublet, Hist. Pl. Guiane Fr. 2: 644, tab. 260. 1775. *Tanaecium zetekii* Standl., Contrib. Ar-

nold Arbor. 5: 140, tab. 19. 1933. *Pachyptera kerere* (Aublet) Sandw., Recueil Trav. Bot. Néerl. 34: 219. 1937. Figure 22.

Lianas to 5 cm diam., tendrils 6–16 cm long, leafy stems 1.8–6 mm diam., somewhat quadrangular in cross-section, glabrous or minutely puberulent with thin straight hairs ca. 0.1 mm long, gland fields often conspicuous with sunken pits; pseudostipules 2–6 mm long, often 3/axil and the more abaxial progressively shorter, lanceolate. **Leaves** 2- or 3-foliolate, petioles 10–85 mm long, 0.8–2.2 mm diam., minutely puberulent, longitudinally striate, with glandular pits at the apex, petiolules 12–61 mm long; **leaflet blades** 8–18(–24) cm long, 3–9(–11) cm wide, ovate to ovate-oblong or narrowly ovate-elliptic, apex acuminate to acute (rarely rounded or emarginate), base obtuse to rounded and narrowly subcordate, drying thinly chartaceous and brown, surfaces subglabrous with minute hairs along the major veins on both surfaces, 2° veins 5–9/side. **Inflorescences** terminal or axillary, 1.5–4 cm long, racemes, axis 2–3 mm diam., stem-like with many nodes and reflexed bracts 1–3 mm long, pedicels 8–14 mm long. **Flowers** with calyx 9–11 mm long, 5–8 mm diam., deep-cupular, minutely papillate-puberulent to subglabrous with peltate hairs, rounded glands present on distal half, margin with few short (2 mm) broad (3 mm) lobes or irregular; **corolla** 4–7 cm long, narrowly tubular-funnel-form, white or dull white (yellowish within), glabrous proximally or minutely puberulent externally, tube 3–9 mm diam., lobes 5–15 mm long; filaments ca. 20 and 15 mm long, thecae 2–4 mm long. **Fruits** (10–)22–42 cm long, 17–40 mm wide, narrowly oblong with narrowed apex and base, flat or somewhat rounded, midvein elevated or obscure, surface smooth and with round glands; seeds 18–24 mm long, 28–38 mm wide, with corky texture, wings absent.

Rarely collected plants of wet evergreen forests on both the Caribbean and Pacific lowlands, 0–150 m elevation. These plants are usually found along stream margins, lake shores, and coastal marshes (Gentry, 1973b). This species has been collected in the Río Sixaola (Talamanca Valley) and Golfo Dulce areas in Costa Rica. Probably flowering throughout the year. This species ranges from Belize to Brazilian Amazonia.

Mansoa kerere is distinguished by its climbing habit with three-tipped tendrils, opposite two- or three-foliolate leaves, short racemose inflorescences, long white puberulent corollas, pubescent

anthers, and narrowly oblong fruits. Deeply pitted gland fields at the apex of the petiole and the three-seriate pseudostipules in leaf axils are useful vegetative distinctions. The seeds may be corky (the typical variety dispersed by water) or thin and winged, e.g., var. *incarnata* (Aublet) A. Gentry. The Central American collections all have white corollas, but some South American populations have red flowers (var. *erythraea* Dugand).

Mansoa parvifolia (A. Gentry) A. Gentry, Ann. Missouri Bot. Gard. 66: 783. 1979. *Pachyptera parvifolia* A. Gentry, Phytologia 26: 448. 1973. Figure 16.

Woody or herbaceous **vines** with stems to 1 cm diam., climbing with short (2–5 mm) tendrils bearing a flat rounded terminal disc 1–5 mm wide, leafy stems 0.2–0.7 mm diam., glabrous or sparsely puberulent with hairs ca. 0.1 mm long; pseudostipules ca. 0.3 mm long, conical. **Leaves** 2-foliolate and often with a tendril, petioles 1–3(–8) mm long, glabrous abaxially and sparsely to densely minutely puberulent on the adaxial surface, petiolules 0.5–2(–7) mm long; **leaflet blades** (3–)6–18(–30) mm long, 2–9(–17) mm wide, elliptic-oblong to oblong or oblong-obovate, apex obtuse (rounded), base asymmetric with cuneate and slightly rounded sides, drying chartaceous and grayish beneath, surfaces with short (0.1 mm) thin straight hairs, 2° veins 2–4/side, often obscure, loop-connected. **Inflorescences** axillary at leafless nodes, short, 2- or 3-flowered, bracts absent, peduncle 5–6 mm long, pedicels 1–1.5 mm long, subglabrous or with minute peltate hairs. **Flowers** with calyx 4–6 mm long, 5–8 mm wide, campanulate, truncated or slightly 2-lipped, subglabrous; **corolla** 35–50 mm long, tubular-funnel-form, white or pale purple, minutely puberulent externally, tube 8–12 mm diam. at the mouth, lobes 11–13 mm long; filaments 16–25 and 11–18 mm long, thecae 2–4 mm long. **Fruits** 23–43 cm long, 20–25 mm wide, linear-oblong, surface smooth (midvein obscure), pale brown; seeds not seen.

Rarely collected plants of evergreen lowland rain forest formations, 10–700 m elevation. Only sterile trunk-climbing specimens with very small leaves have been collected in Central America. This species ranges from Honduras to Bolivia.

Mansoa parvifolia is one of the most distinctive species of Bignoniaceae. The slender stems clinging to tree trunks by means of short tendrils ending in a peltate disc and the very small opposite

bifoliolate leaves are unique among the species of the family. The few-flowered inflorescences and puberulent white or rose corollas are additional characteristics but are rarely seen. The leaves become 20–30 mm long on distal flowering stems, but these stems have not been collected in Central America. The slender climbing stems with four small leaflets at each node are reminiscent of some *Peperomia* species with whorled leaves.

Mansoa standleyi (Steyermark) A. Gentry, Ann. Missouri Bot. Gard. 66: 783. 1979. *Pseudocalymma standleyi* Steyermark, Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 235. 1947. *Pachyptera standleyi* (Steyermark) A. Gentry, Brittonia 25: 236. 1973. *Ps. alliaceum* var. *macrocalyx* Sandw., Kew Bull. 1953: 468. 1954.

Lianas to 8 cm diam., tendrils 10–14 cm long with 3 distal arms to 2 cm long, vegetative parts smelling like garlic, leafy stems 2.5–8 mm diam., glabrous, longitudinally striate, nodes with a few punctate glands; pseudostipules small, conical. **Leaves** 2-foliolate, petioles 9–48 mm long, 1.7–2.7 mm diam., glabrous, petiolules 7–25 mm long, thickened at the apex; **leaflet blades** 10–20(–24) cm long, 6–11(–14) cm wide, elliptic-ovate to broadly ovate, apex acute to short-acuminate, base obtuse or rounded, drying green to olive green and chartaceous (subcoriaceous in life), surfaces glabrous, with gland fields in the axils of basal veins beneath, 2° veins 6–9/side. **Inflorescences** axillary or terminal, to 45 cm long, pyramidal panicles or reduced to racemose, usually with short (1–3 cm) opposite branches, peduncles to 18 cm long, glabrous, bracts 8–19 mm long, 6–11 mm wide, bright red, caducous, pedicels 8–20 mm long. **Flowers** with cupulate calyx (9–)17–21 mm long, (8–)15–18 mm wide, rounded at the base, glabrous, margin with 5 undulate lobes or subentire, thin-papery in life and green to red-violet; **corolla** (38–)66–85 mm long, tubular-campanulate, rose-red to violet on lobes and upper tube, base of tube yellow, glabrous externally, lobes 6–27 mm long, apically obtuse; filaments 11–22 and 22–30 mm long, thecae 3–4 mm long, linear. **Fruits** 35–75 cm long, 26–38 mm wide, elongate-linear, acute at both ends, flat (midvein obscure), pale brown; seeds 20–28 mm long, 75–110 mm wide, central area poorly differentiated, wings whitish, thin.

Uncommon plants of evergreen forest formations on both the Caribbean and Pacific slopes, 50–1100 m elevation (1300–1400, m elevation in

Guatemala). Probably flowering throughout the year. This species ranges from Mexico to Peru and Brazil.

Mansoa standleyi is recognized by its climbing habit with distally trifid tendrils, mostly glabrous parts, opposite bifoliolate leaves with large leaflets, large cupulate calyces, large pinkish corollas, and long linear fruits with large winged seeds. The plants are also distinctive because of the onion-like odor of vegetative parts and flowers and the gland fields in basal vein axils of the lower leaf surface. This species was treated under *Pachyptera* in *Flora of Panama* and as *Pseudocalymma sagotii* var. *macrocalyx* (Sandw.) L. O. Williams in *Flora of Guatemala* (Standley & Williams, 1974, p. 216). The type collection (Steyermark 33533 F) cites *bejuco de ajo* as a common name in Guatemala.

Mansoa verrucifera (Schldl.) A. Gentry, Ann. Missouri Bot. Gard. 63: 62. 1976. *Bignonia verrucifera* Schldl., Linnaea 26: 655. 1853. *Adenocalymma verruciferum* (Schldl.) Miers, Ann. Mag. Nat. Hist., ser 3, 7: 393. 1861. *A. fissum* Loes., Verh. Bot. Vereins Prov. Brandenburg 65: 102. 1923. *A. seleri* Loes., Verh. Bot. Vereins Prov. Brandenburg 65: 101. 1923. *Onohualcoa seleri* (Loes.) Lundell, Contrib. Univ. Michigan Herb. 7: 52. 1942. *O. fissa* (Loes.) Sandw., Kew Bull. 1946: 88. 1947. *A. perezii* Standl. & L. O. Williams, Ceiba 3: 61. 1952. *O. verrucifera* (Schldl.) A. Gentry, Ann. Missouri Bot. Gard. 60: 885. 1973 (1974). Figure 18.

Lianas to 20 m high, to over 8 cm diam., tendrils to 15 cm long, leafy stems 1.3–9 mm diam., terete or slightly quadrangular, subglabrous or sparsely and minutely puberulent with peltate or straight hairs ca. 0.1 mm long, V-shaped interpetiolar ridges often present, gland fields absent; pseudostipules inconspicuous. **Leaves** 3- or 2-foliolate, petioles 2–9 cm long, 1.3–2.7 mm diam., subglabrous, longitudinally striate, lateral petiolules 8–35 mm long, terminal petiolule 3–7 cm long; **leaflet blades** 6–14(–17) cm long, 2.5–9(–11) cm wide, ovate-elliptic to ovate-triangular or ovate-oblong, apex acute to acuminate, base obtuse to rounded, drying chartaceous, upper surface glabrous except for the midvein, lower surface subglabrous, often with gland fields in proximal vein axils beneath, 2° veins 5–7/side, basal secondary veins strongly ascending. **Inflorescences** axillary to leaves or fallen leaves, 3–12 cm long,

racemose or narrowly paniculate (thyse) with 3–15 flowers, peduncle puberulent and lenticellate, pedicels 4–7 mm long, ca. 1 mm diam., sparsely to densely puberulent with hairs 0.1–0.2 mm long. **Flowers** with calyx 8–12 mm long, 4–6 mm diam., narrowly cupular, surface sparsely to densely minutely puberulent, with 5 longitudinal ridges terminating in apical teeth 0.5–3 mm long; **corolla** 47–82 mm long, tubular-campanulate, lilac to purple, puberulent with thin curved hairs ca. 0.2 mm long externally, lobes 13–35 mm long, rounded distally, throat white; filaments 23–24 and 11–16 mm long, thecae ca. 4 mm long. **Fruits** 13–30 cm long, 17–33 mm wide, linear-oblong, valves flat to rounded and covered with tubercles 1–5 mm long from a base 1–4 mm wide; seeds 12–17 mm long, 37–58(–80) mm wide, wings distally translucent, central area poorly differentiated.

Rarely collected plants of evergreen and partly deciduous forest formations along the Pacific slope in Costa Rica, 10–1100 m elevation. Flowering in January and April (March–June from Mexico to Nicaragua); fruiting in December. The species ranges from Mexico to Bolivia and Guyana.

Mansoa verrucifera is recognized by its climbing habit with tendrils that are distally trifid, opposite two- or three-foliolate leaves with gland fields in vein axils beneath, short axillary inflorescences, prominently five-dentate calyx lobes, large purple or rose corollas minutely puberulent externally, and unusual woody fruits with verrucose-tuberculate surface. The longer petiolules of terminal leaflets (in three-foliolate leaves), strongly ascending basal secondary veins, and stems lacking well-developed interpetiolar gland fields or pseudostipules are additional distinctions. This species was treated as *Adenocalymma fissum* in *Flora of Guatemala* (Standley & Williams, 1974) and as *Onohualcoa verrucifera* in *Flora of Panama* (Gentry, 1973b).

Martinella Baillon

Lianas climbing with distally trifid tendrils, stems terete, cross-sections of stems with large pith and 4 phloem areas, nodes with an interpetiolar ridge, without glandular fields; pseudostipules absent. **Leaves** opposite, 2-foliolate, petiolate, often bearing a distally trifid tendril, margin entire, glabrous or with short glandular hairs, venation pinnate. **Inflorescences** axillary racemes, pedunculate, bracts minute or absent, ped-

icels prominent. **Flowers** with calyx closed and conical in bud, tubular-campanulate, opening irregularly with 4- or 5-lobed margin or splitting and 2-lipped; **corolla** tubular-campanulate or funnelform, dark wine-red, tube with a narrow base, glabrous or with minute peltate hairs externally; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, a small staminode present; ovary linear-cylindric, 2-locular, ovules in 4 (2) series in each locule. **Fruits** long linear capsules, valves parallel to the septum, thin and flat, smooth, midvein obscure, margins slightly thickened; seeds thin, transversely oblong with 2 poorly differentiated lateral membranaceous wings.

Martinella is a genus of two species, one South American and one ranging from Mexico to Brazil and Bolivia. The very long fruits and unusual color of the corolla help distinguish our representative of this genus.

Martinella obovata (Kunth in H.B.K.) Bureau & K. Schum. in Mart., Fl. Bras. 8(2): 161, pl. 84. 1896. *Spathodea obovata* Kunth in H.B.K., Nov. Gen. Sp. 3: 147. 1819. *Bignonia obovata* (Kunth in H.B.K.) Spreng., Syst. Veg. 2: 830. 1825. Figure 23.

Lianas to over 25 m high, to 7 cm diam., tendrils 5–25 cm long with tips 2–24 mm long, leafy stems 1.7–9 mm diam., glabrous or minutely glandular puberulent, a raised interpetiolar ridge usually present at nodes. **Leaves** 2-foliolate, petioles 2–7 cm long, 1–2.3 mm diam., petiolules 12–32(–66) mm long, glabrous or very minutely (0.05 mm) puberulent; **leaflet blades** 6–16(–21) cm long, 2.5–8(–15) cm wide, ovate-elliptic to ovate-oblong or broadly ovate, apex short-acuminate or acuminate with narrow tip, base obtuse to rounded (subcordate) and slightly asymmetric, drying chartaceous and often dark, glabrous on both surfaces with very minute hairs along the major veins beneath, flat glands often present along the midvein beneath, 2° veins 3–7/side. **Inflorescences** axillary, 5–15 cm long, racemes with 1–21 flowers, peduncles 16–26 mm long, ca. 1.5 mm diam., glabrous or very minutely puberulent, bracts less than 1 mm long, pedicels 6–14 mm long. **Flowers** with calyx 11–16(–21) mm long, 6–9(–12) mm diam., tubular or tubular-campanulate, margin irregularly split or 2–4-lobed, surface glabrous with many parallel longitudinal veins or minutely puberulent; **corolla** 48–65 mm long, campanulate above a narrowed (3–5 mm diam.)

tubular base, dark reddish purple or maroon, 8–21 mm wide at the mouth, lobes 6–15 mm long, glabrous or with minute glandular peltate hairs externally; filaments 15–17 and 11–14 mm long, thecae 2.5–3 mm long. **Fruits** 31–130 cm long, 14–22 mm wide, 2–4 mm thick, valves flat with smooth surface, acute at the ends, midveins slightly elevated or obscure, margins thickened; seeds 12–15 mm long, (30–)43–60 mm wide, central area ca. 17 mm wide, wings membranaceous, pale brownish.

Uncommon plants of moist evergreen forest formations on both Caribbean and Pacific slopes, 20–1600 m elevation. Flowering in February–July in Costa Rica. This species ranges from Mexico to Brazil and Bolivia.

Martinella obovata is recognized by its climbing habit with distally trifid tendrils, opposite two-foliolate leaves often with long petioles, axillary few-flowered racemes, tubular calyx with irregular margins, deep purple or maroon corollas, and long thin linear fruits with smooth flat valves. In addition, the petioles and petiolules are often twisted, and the leaflets are lustrous above in life. The fruits can be more than 1 m long.

Melloa Bureau

Lianas, tendrils with 3 terminal claw-like arms, stems terete, cross-section with irregular phloem areas, interpetiolar glandular fields present or absent; pseudostipules ovate to subulate. **Leaves** opposite, 2-foliolate, petiolate, often with a tendril, margins entire, glabrous, venation pinnate. **Inflorescences** terminal or axillary, panicles or few-flowered cymes, foliaceous bracts present and early caducous, pedicels prominent. **Flowers** with tubular-campanulate thin-textured calyx, distally irregularly lobed or spathaceous with recurved tip; **corolla** tubular-funnelform, yellow, glabrous externally; stamens 4, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, a staminode present; ovary flattened-ovoid, 2-locular, ovules multiseriate in each locule. **Fruits** capsules, ellipsoid-oblong and slightly flattened, valves parallel to the septum, thick and woody, splitting along the middle at maturity; seeds thin, transversely oblong with 2 lateral wings, seed body well differentiated from the membranaceous wings.

Melloa has a single species, ranging from Mexico to Argentina.

Melloa quadrivalvis (Jacq.) A. Gentry, *Brittonia* 25: 237. 1973. *Bignonia quadrivalvis* Jacq., *Fragm. Bot.* 37, tab. 40, fig. 3. 1800–1809. Figure 17.

Lianas to over 20 m high, tendrils with 3 stiffened curved tips 11–18 mm long, leafy stems 1.3–6 mm diam., glabrous, longitudinally striate, interpetiolar ridge usually present; pseudostipules 1.5–3.5 mm long, subulate. **Leaves** with petioles 11–55 mm long, 1–2 mm diam., glabrous, striate, petiolules 6–20 mm long; **leaflet blades** 4–11(–15) cm long, 2–5(–7) cm wide, ovate-elliptic to ovate-lanceolate or elliptic, apex acute to acuminate, base obtuse or slightly rounded and truncate, drying chartaceous, glabrous above and below, 2° veins 3–6/side. **Inflorescences** axillary or terminal (often on lateral short shoots), paniculate or dichotomous cymes, mostly 3–9 flowered, flowers usually in distal triads (rarely solitary), peduncles 13–36 mm long, 0.8–1.3 mm diam., glabrous and drying dark, with caducous bracts 7–21 mm long and 3–6 mm wide, pedicels 16–32 mm long. **Flowers** with tubular-campanulate calyx, 10–21 mm long, 9–13 mm diam., surface glabrous (rarely puberulent), without glands, margin split and spathaceous or irregularly lobed; **corolla** 35–75 mm long, tubular-funnelform, bright yellow, glabrous or subglabrous externally (lobes ciliolate), tube 8–15 mm diam., lobes 10–18 mm long; filaments 21–28 and 14–18 mm long, thecae 4–5 mm long; disc 1.5–2 mm high (subtended by a broad thin layer and appearing double). **Fruits** 8–15 cm long, 25–52 mm wide, 15–20 mm thick, ellipsoid-oblong with narrowed ends, valves 5–8 mm thick, each splitting longitudinally into 2 equal parts, surface dark brown with many pale lenticel-like spots; seeds 10–16 mm long, 25–52 mm wide, central area 9–12 mm wide and clearly differentiated from the transparent wings.

Uncommon lianas of seasonally dry deciduous or partly deciduous (less often evergreen) forest formations on both Caribbean and Pacific slopes, 10–1000 m elevation. Flowering in February–August; fruiting throughout the year. This species ranges from northeastern Mexico to Argentina.

Melloa quadrivalvis is recognized by its climbing habit with three-clawed tendrils, opposite two-foliolate glabrous leaves, few-flowered inflorescences, bright yellow corollas, and thick woody ellipsoid-oblong fruits that split into four parts. The large floral bracts would be a useful feature for determination, but they are quickly caducous and rarely collected. These plants are similar to

those of *Adenocalymma imundatum* (q.v.), but their fruits are very different.

Mussatia Bureau ex Baillon

Lianas, climbing with distally coiled simple tendrils, branchlets quadrangular, with 8 (16) phloem areas in cross-section, nodes without interpetiolar gland fields; pseudostipules large and resembling small leaves. **Leaves** opposite, petiolate, 2-foliolate, often with a terminal tendril, tendril with 1 tip, leaflets petiolulate, margins entire, venation pinnate, domatia present. **Inflorescences** terminal, panicles with opposite branching, bracts inconspicuous, flowers pedicellate. **Flowers** with short calyx forming a shallow cup, margin entire to lobed or split; **corolla** funnelliform and 2-lipped, yellow with red or brownish stripes within, minutely glandular with peltate hairs externally; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae short, divergent or divaricate; disc cupular, ovary 2-locular, ovules in 4–6 series in each locule, stigma simple. **Fruits** oblong to linear-oblong capsules, valves parallel to the septum, woody, flat or slightly convex, surface tuberculate to muriculate; seeds thin, with 2 poorly differentiated lateral wings.

Mussatia is a genus of two species; the other species is found in eastern Amazonia and Guiana.

Mussatia hyacinthina (Standl.) Sandw., Recueil Trav. Bot. Néerl. 34: 218. 1937. *Tynanthus hyacinthinus* Standl., Carnegie Inst. Wash. Publ. 461: 87. 1935. Figure 19.

Lianas to 30 m high, stems to 18 cm diam., tendrils 12–23 cm long, leafy stems 2.5–8 mm diam., strongly quadrangular with 4 raised longitudinal ridged edges, minutely (0.1 mm) puberulent but soon glabrescent and pale gray; pseudostipules usually 4/node, 3–18 mm long, ovate or rounded. **Leaves** with petioles 4–9(–12) cm long, 1.5–2.5 mm diam., subglabrous or minutely puberulent, petiolules 1.4–4.5(–6) cm long; **leaflet blades** 7–20(–26) cm long, 4–13(–17) cm wide, broadly ovate to ovate-elliptic or ovate-suborbicular, apex acute to acuminate, base obtuse or rounded and truncate, drying chartaceous, glabrous above, minutely papillate-puberulent on the veins or subglabrous beneath, with longer hairs in vein axils (domatia), 2° veins 4–7/side, minor venation slightly raised above (dried). **Inflorescences** terminal (often on short lateral shoots), 5–16

cm long, peduncles 3–40 mm long, ca. 1.5 mm diam., with minute (0.1 mm) peltate hairs, dark brown, 2° peduncles ca. 1 cm long, bracts 0.5–1 mm long, pedicels 2–5 mm long (above bract scars). **Flowers** with broadly campanulate calyx 1.2–2.3 mm long, 3–3.5 mm wide, margin entire, glabrous; **corolla** 15–24 mm long, funnelliform and bilabiate, white with maroon tips, becoming yellowish brown or reddish brown, minutely papillate-puberulent, tube 2.5–7 mm diam., lobes 5–10 mm long; filaments ca. 8–12 and 6–7 mm long; ovary 3 mm long, with minute peltate hairs. **Fruits** 17–37 cm long, 4–6 cm wide, ca. 2 cm thick, valves obtuse at both ends, surface muricate with rounded projections ca. 1 mm high, brown; seeds 20–43 mm long, 50–120 mm wide, central area 20–40 mm wide, wings membranaceous, pale brown.

Uncommon plants of evergreen rain forest formations on both the Caribbean and Pacific slopes, 50–900 m elevation. Flowering in February–May in Central America. This species ranges from eastern Mexico to Brazil.

Mussatia hyacinthina is recognized by the woody climbing habit, two-foliolate leaves, small flowers, short calyx cups with entire margins, bilabiate white or yellowish brown corollas, long thick muricate woody fruits, and large winged seeds. Leaves with hairs in vein axils beneath (domatia), square stems with four prominent ridges, rounded pseudostipules, and tendrils with simple tips are useful vegetative distinctions. Compare this species with *Cydista diversifolia*, which has similar stems and pseudostipules. The fruits are similar to those of *Callichlamys*, where the valves have a smoother surface.

The genera *Onohualcoa* and *Pachyptera* are now considered to be synonyms of *Mansoa* (q.v.).

Parabignonia Bureau ex K. Schumann

Lianas climbing with tendrils with 3 stiff curved distal “claws,” stems terete, with 4 phloem areas in cross-section, interpetiolar gland fields present; pseudostipules small and ovate. **Leaves** opposite, 2-foliolate, petiolate, blades entire, usually glabrous, venation pinnate or subpalmate. **Inflorescences** axillary, very short and few-flowered, usually solitary racemes, bracts short and narrow, pedicels subglabrous or minutely puberulent. **Flowers** with tubular-campanulate calyx, 4- or 5-lobed, rounded or acute at the apex;

corolla funnellform-campanulate and somewhat 2-lipped, glabrous externally or with minute puberulence on the lobes, lobes 5, rounded; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae straight, divergent, staminode present; ovary oblong, with minute peltate hairs, 2-locular, ovules 2-seriate in each locule. **Fruits** capsules, narrowly linear, valves parallel to the septum but dehiscing perpendicular to it; seeds thin, transversely oblong, with 2 membranaceous lateral wings.

A genus of two species (more if *Paradolichandra* is included), one ranging from southern Costa Rica to Venezuela and the other in southern Brazil. Recently collected material (1992–1993) is the first record of the genus in Central America.

Parabignonia steyermarkii Sandw., Bol. Soc. Venez. Cienc. Nat. 26: 446. 1966. Figure 17.

Lianas climbing to over 25 m high, stems to 19 cm diam., tendrils 5–12 cm long, with 3 curved tips, leafy stems 2–6 mm diam., glabrous (in ours) or with short thin hairs, terete, becoming brown with elliptic lenticels ca. 1 mm long; interpetiolar gland fields inconspicuous. **Leaves** 2-foliolate, petioles 10–28 mm long, 1.2–1.7 mm diam., petiolules 4–11 mm long, glabrous, drying dark; **leaflet blades** 4–11 cm long, 2–6.5 cm wide, ovate-elliptic, ovate, ovate-oblong, or elliptic-oblong, apex acute or short-acuminate, base obtuse to slightly rounded, drying stiffly chartaceous and dark, glabrous above and below, 2° veins 4–7/side, basal pair strongly ascending (subtripleveined). **Inflorescences** axillary, 1–5-flowered racemes or corymbs or flowers solitary, 1–3 cm long, peduncle 1–5 mm long, glabrous, drying dark, bracts 1.3–2.5 mm long, linear-lanceolate or subulate, pedicels 6–18 mm long, glabrous or very minutely (0.03 mm) puberulent. **Flowers** with calyx 6–12(–22) mm long, 4–7(–14) mm wide, cupulate or campanulate, subglabrous, drying dark, lobes 2–4(–7) mm long, rounded to obtuse; **corolla** 35–62 mm long, funnellform-campanulate, deep magenta (in ours) to rose-purple or pale lavender, 10–15 mm wide at the mouth, tube glabrous but the lobes minutely papillate puberulent externally, lobes 10–17 mm long; filaments 17–24 and 12–16 mm long, thecae 2.5–3.5 mm long. **Fruits** not seen at maturity, young fruits ca. 10 cm long, 4–5 mm diam., valves glabrous; seeds unknown.

Rarely collected climbers of lowland evergreen rain forest formations in the Golfo Dulce area at

300–450 m elevation (300–1200 m in Venezuela). Collected with flowers in January (*Aguilar 817, Gentry et al. 78682*) at Rancho Quemada in the Reserva Forestal Golfo Dulce. This species is known only from southwestern Costa Rica and Venezuela.

Parabignonia steyermarkii is recognized by its climbing habit with distally 3-clawed tendrils, opposite 2-foliolate leaves, short few-flowered axillary inflorescences, 4- or 5-lobed calyx, and magenta corollas with externally glabrous tube and minutely puberulent lobes. Costa Rican collections seem to have broader thinner leaves than those from Venezuela. In addition, the calyx is smaller in Costa Rican material (Venezuelan measurements are in parenthesis in the description above).

Paragonia Bureau

REFERENCE—W. D. Hauk, A review of the genus *Paragonia* (Bignoniaceae). *Ann. Missouri Bot. Gard.* 85: 460. 1998.

Lianas climbing with the aid of minutely simple, bifid or trifid tendrils, stems terete, with 4 phloem areas in cross-section, becoming lenticellate, glabrate to lepidote or puberulent, nodes lacking gland fields; pseudostipules conical with broad base and narrow tip, usually curved in toward the stem. **Leaves** opposite, 2-foliolate, petioles usually with gland fields near the apex, blades entire, glabrate to densely puberulent, pinnately veined. **Inflorescences** terminal or axillary, paniculate, often large and many-flowered, minutely bracteate, pedicellate. **Flowers** with cupulate calyx, with minute peltate hairs, distally truncate or irregularly lobed or split, ciliolate; **corolla** tubular-campanulate, rose red to lilac or magenta, densely and minutely puberulent with crooked moniliform hairs; stamens 4, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate; disc prominent, ovary narrowly cylindrical, locules 2, ovules in 2 series in each locule. **Fruits** woody capsules, linear to linear-oblong, valves flattened parallel to the septum, surface smooth to tuberculate (in ours), midvein slightly elevated or not apparent; seeds thin, transversely oblong with 2 lateral wings, brown, the central area not differentiated from the wings.

Paragonia is a genus of two species, one restricted to eastern Brazil.

Paragonia pyramidata (L. C. Rich.) Bureau, Vidensk. Meddel. Dansk. Naturhist. Foren. Kjobenhavn 1893: 104. 1894. *Bignonia pyramidata* L. C. Rich., Actes Soc. Hist. Nat. Paris 1: 110. 1792. *B. sinclairii* Benth., Bot. Voy. Sulphur 129. 1844. *Tabebuia pyramidata* (L. C. Rich.) DC., Prodr. 9: 214. 1845. *Arrabidaea dichasia* J. D. Smith, Bot. Gaz. 20: 6. 1895. Figure 23.

Lianas. stems to 5 cm diam., often with thickened nodes, tendrils 5–17 cm long, distally simple or bifid (rarely trifid), leafy stems 2–6 mm diam., glabrous or less often minutely puberulent, interpetiolar ridge often present; pseudostipules 3–7 mm long, sharply acute. **Leaves** 2-foliolate, petioles 9–45 mm long, 1.4–3 mm diam., subglabrous to minutely puberulent, often with glands near the apex, petiolules 7–35(–46) mm long, sulcate above; **leaflet blades** 6–19(–25 cm) long, 3–9(–13) cm wide, elliptic-oblong to elliptic or broadly ovate-oblong, apex acute to short-acuminate or rounded, base obtuse to slightly rounded, drying stiffly chartaceous, glabrous above, glabrous beneath or minutely puberulent on the midvein beneath, with minute (0.05 mm) punctate depressions beneath, 2° veins 4–8/side. **Inflorescences** terminal, 10–30 cm long, peduncles 3–11 cm long, ca. 2 mm diam., minutely puberulent, pedicels 4–9 mm long. **Flowers** with cupular calyx 4–7 mm long, 4–8 mm diam., subglabrous or minutely puberulent, margin entire to split or with minute (0.3 mm) teeth; **corolla** 35–65 mm long, tubular-campanulate, pink to lavender or magenta (white at the base), densely puberulent with crooked hairs 0.1–0.3 mm long externally, 12–22 mm wide at the mouth; filaments ca. 18 and 13–16 mm long, thecae 2–2.5 mm long. **Fruits** (10–)32–61 cm long, 10–17 mm wide, 5–8 mm thick, narrowed at base and apex, valves slightly rough to the touch with muricate surface of small projections; seeds 8–12 mm long, 21–43 mm wide, oblong with blunt tips, uniformly grayish brown to dark brown. Common plants of evergreen lowland rain forest formations on both Caribbean and Pacific slopes, 5–800 m elevation. They are found on well-drained slopes and in poorly drained swamps. Flowering occasionally throughout the year but with the majority of flowering in January–May. The species ranges from Mexico to Brazil and Bolivia.

Paragonia pyramidata is recognized by its climbing habit with simple or bifid tendrils, opposite two-foliolate leaves with gland field at petiole apex, many-flowered terminal panicles, cu-

pular calyx with irregular margin, pink to magenta corollas densely puberulent on the exterior, long linear fruits with flat muricate surfaces, and thin, uniformly brown, blunt-ended, two-winged seeds. The pseudostipules and sweet smell when leaves are crushed are useful vegetative features. The immature calyx has a conical apex that sometimes splits off in a calyprate fashion as in *Lundia* (q.v.). Compare also the vegetatively similar *Ceratophyllum tetragonolobium*, which differs in having trifid tendrils and interpetiolar gland fields.

Parmentiera DeCandolle

REFERENCE—A. Gentry, *Parmentiera* in Bignoniaceae—part I (Crescentiae and Tourrettiae). Flora Neotropica Monogr. 25(I): 1–130. 1980.

Trees or shrubs, stems terete, leaves subtended by simple spines or hard smooth shelf-like tissue, an interpetiolar line or ridge absent; pseudostipules absent. **Leaves** opposite or subopposite (occasionally alternate), sometimes fasciculate, usually 3- or 5-foliolate (rarely simple or 2- or 4-foliolate), petioles sometimes with narrow lateral wings, leaflets mostly glabrous, entire or with few distal teeth, venation pinnate, domatia usually present in vein axils beneath. **Inflorescences** terminal or often on leafless short-shoots or cauliflorous on trunk and older stems, with 1–3 flowers, bracts minute, pedicels drying black. **Flowers** drying black, calyx tubular, entire distally but split abaxially and spathe-like, subglabrous; **corolla** white to greenish white, tubular-campanulate and often bent in the middle (with a transverse ridge across the lower side) of the throat, 2-lipped with 2 upper lobes partly united, thick-textured, glabrous externally; stamens 4, subexserted near the mouth, filaments subequal, thecae thick, straight, somewhat divergent, a staminode present; disc annular; ovary cylindrical, 2-locular, ovules multiseriate. **Fruits** fleshy and indehiscent, elongate oblong to linear, terete or with prominent longitudinal ridges, surface smooth, outer cortex firm and fleshy; seeds borne on a fibrous-fleshy central core, small, flattened, with or without a narrow circumferential wing.

Parmentiera is a genus of ten species ranging from Mexico to Panama, with one in Colombia. The genus is unusual because of its glabrous flowers that dry black, tubular calyx split down one side, large white or greenish white two-lipped corollas with thick texture that usually have a trans-

verse fold at the bottom of the tube, and the elongate fleshy fruits. The usually opposite three- or five-foliolate leaves, blades with domatia beneath, and hard spines or hard tissue at leaf bases are additional distinguishing features. All of the spe-

cies are probably pollinated by bats, with seeds adapted to dispersal by mammals. Our introduced species may resemble *Crescentia alata*, but that species has leaves in alternate fascicles and the petioles are broadly winged.

Key to the Species of *Parmentiera*

- 1a. Native trees found in evergreen forest formations; leaves usually 3-foliolate or 5-foliolate, petioles lacking narrow green margins, larger leaf blades 3–17 cm long 2
- 1b. Introduced trees planted in gardens and parks (rarely collected); leaves mostly 3-foliolate, petioles usually with narrow green margins or wings, larger leaf blades 2–9 cm long 4
 - 2a. Leaves usually 5-foliolate, largest blades to 9 cm long; 600–1500 m elevation in the Cordillera de Guanacaste and near Tilarán *P. valerii*
 - 2b. Leaves usually 3-foliolate, largest blades to 17 cm long; wet forests of the Caribbean slope 10–750 m 3
 - 3a. Corollas ca. 25 mm long; fruits ca. 15 mm diam.; rarely collected *P. dressleri*
 - 3b. Corollas 50–75 mm long; fruits ca. 30–60 mm diam.; more commonly collected *P. macrophylla*
- 4a. Stems usually with 2 small hard spines subtending each node; flowers terminal or in axils of distal leaves; fruits > 30 mm diam. in life; petioles with very narrow margins *P. aculeata*
- 4b. Stems without spines; flowers borne on trunks and older branches; fruits < 25 mm diam. in life; petioles often with winged margins *P. cereifera*

Parmentiera aculeata (Kunth in H.B.K.) Seem., Bot. Voy. Herald 183. 1854. *Crescentia aculeata* Kunth in H.B.K., Nov. Gen. Sp. 3: 158. 1819. *C. edulis* Moc. ex DC., Prodr. 9: 244. 1845, non *C. edulis* Desv. *P. edulis* DC., Prodr. 9: 244. 1845. Figure 11.

Shrubs to medium-size trees 2–6 m tall, leafy stems 1–10 mm diam., glabrous, terete, leaf bases subtended by a forward-pointing sharp-tipped conical spine 3–8 mm long, with smooth glossy surface. **Leaves** opposite or occasionally alternate, 3-foliolate or simple, 2–4/node, petioles 11–47 mm long, 0.6–1.8 mm wide, with narrow wings 0.1–0.5 mm wide, petiolules 0–15 mm long; **leaflet blades** 25–90 mm long (distal leaflets), 6–40 mm wide, elliptic to rhombic-elliptic, apex obtuse, base cuneate and decurrent on the petiole, drying chartaceous, glabrous above, with depressions and minute hairs in the vein axils beneath (domatia), 2° veins 3–7/side. **Inflorescences** of 1–4 terminal flowers or 1 or 2 flowers in axils of near-terminal leaves or fasciculate on older stems, pedicels 12–21 mm long, 0.7–1 mm diam., with few minute peltate trichomes, drying dark. **Flowers** with calyx 25–35 mm long, spathe-like or split more than once, glabrous, drying dark; **corolla** 4–6.5 cm long, campanulate, white or

greenish with purple lines, glabrous externally, tube 20–25 mm wide at the mouth; thecae 8–9 mm. **Fruits** 9–17 cm long, to 3 cm diam. in life (12–20 mm diam. when dried), linear-cylindric with narrowed tips, usually slightly curved, with thick longitudinal ridges.

Parmentiera aculeata is recognized by the tree habit (usually with a short trunk and dense crown), nodes with short spines, mostly opposite and trifoliolate leaves, spathe-like calyx, white or greenish corollas, and slightly curved succulent fruits that are edible. This species has not been collected in Costa Rica, but Standley (1938) reported it to be cultivated in the hot lowlands. Its natural range is Mexico to Honduras. Common names in northern Central America are *cuajilote*, *pepino de arbol*, and cow okra.

Parmentiera cereifera Seem. in Hook., J. Bot. 3: 302. 1841.

Small trees to 7 m tall, trunks to 20 cm diam., with strongly ascending main branches from near the ground and open crown, leafy stems 1.2–6 mm diam., glabrous, terete, usually with hard shelf-like tissue below the leaf base. **Leaves** opposite, often with a smaller leaf in the axil of a larger (4/node), 3-foliolate, petioles 1–4(–6) cm

long, to 3 mm wide with narrow greenish wings, petiolules not clearly differentiated; **leaflet blades** 0.5–7(–9.5) cm long, 0.5–3(–4) cm wide, elliptic to elliptic-rhombic, terminal leaflets larger than the laterals, apex acute to acuminate, base acute and decurrent on the petiole, glabrous above, with small hairs in vein axils beneath (domatia), 2° veins 3–6/side. **Inflorescences** of solitary flowers or 2 or 3 flowers on short-shoots borne on trunks and larger branches, peduncles (to bracts) ca. 3 mm long, pedicels 9–16 mm long, 0.7–1 mm diam., glabrous or with minute peltate trichomes, drying black. **Flowers** with calyx 2–5 cm long, 9–25 mm diam., split and spathe-like, glabrous; **corolla** 37–64 mm long, tubular-campanulate and with a transverse fold on the lower side, white, glabrous externally, tube 18–29 mm wide at the mouth, lobes ca. 10 mm long; filaments 26–35 mm long. **Fruits** 30–54 cm long, 1–2.5 cm diam., linear-cylindric and slightly curved, yellow, glabrous or with few minute peltate trichomes; seeds 3–4 mm long, 3–4 mm wide, with a narrow mucilaginous wing.

Parmentiera cereifera, originally described from the Caribbean slope of central Panama, is not known to occur in Costa Rica, but it is often planted as a botanical curiosity. The short trunk with spreading branches, opposite or fasciculate trifoliolate leaves, cauliflorous flowers, white corolla, and pendulous yellow linear fleshy fruits make the species quite distinctive.

Parmentiera dressleri A. Gentry, *Wrightia* 7: 85. 1982.

Small **trees** 2–3 m tall, stems terete to subangulate, without spines or prominent lenticels. **Leaves** opposite or fasciculate, 3-foliolate, lateral petiolules poorly distinguished from the base of the blade, petioles 3–8 cm long, glabrous, petiolules of terminal leaflet ca. 1–2 cm long; **leaflet blades** 5–13 cm long, 3.5–5.5 cm wide, elliptic to elliptic-ovate, apex acute to acuminate, base cuneate, glabrous except for tufts of hairs in the vein axils below (domatia). **Inflorescences** cauliflorous or ramiflorous, usually of solitary flowers borne on pedicels less than 1 cm long, glabrous. **Flowers** with spatheous calyx 16–17 mm long, lepidote near the base, glabrous distally, bluntly acute; **corolla** ca. 25 mm long, broadly tubular-funnelform, white, 20 mm wide at the mouth, lobes ca. 8 mm long, glabrous; stamens and pistil not examined. **Fruits** 23–24 cm long, ca. 15 mm wide, cylindric, not ridged.

Plants of rain forest formations in northern Costa Rica and the Caribbean lowlands. Flowering in August; fruiting in March (Panama). The species ranges from northern Costa Rica to central Panama.

Parmentiera dressleri is recognized by its tree habit, trifoliolate leaves, solitary flowers with spatheous calyx, and cylindric fruits. This species was at first thought to be a variant of *P. macrophylla*, but the much smaller flowers and much narrower fruits indicate that the plants placed here are distinct. We have not seen Costa Rican material and base this report on the original description and the *Manual Flora* manuscript of J. F. Morales and Q. Jiménez (1997).

Parmentiera macrophylla Standl., *Publ. Field Columb. Mus. Bot. Ser.* 4: 263. 1929. Figure 11.

Small or medium-size **trees** 3–12(–25) m tall, trunk unbranched for much of its length, to 30 cm diam., leafy stems 1.8–4 mm diam., glabrous, becoming pale gray and terete, petioles often subtended by smooth thickened shelf-like tissue. **Leaves** opposite or subopposite, 3-foliolate (rarely 2–4-foliolate), petioles 2–10 cm long, 0.8–1.5 mm diam., glabrous, sulcate above, lateral petiolules 2–9 mm long and merging with base of blade, terminal petiolules 8–32 mm long; **leaflet blades** (2–)6–17 cm long, (1–)2–6 cm wide (lateral blades smaller than the terminal), elliptic to elliptic-obovate or elliptic-rhombic, apex acuminate or caudate-acuminate, base narrowly cuneate and decurrent on the petiole, drying thin-chartaceous, subglabrous above, with minute sessile peltate trichomes beneath and tufts of hairs (or webbed tissue) in the vein axils (domatia), 2° veins 4–7/side. **Inflorescences** cauliflorous, 1 or 2 flowers borne on trunk and larger branches, pedicels 1–2 cm long, glabrous or with minute (0.05 mm) hairs, drying dark. **Flowers** with tubular calyx 28–48 mm long, 8–13 mm diam., spathe-like (split abaxially), green or purplish, glabrous; **corolla** 50–75 mm long, trumpet-shaped to tubular campanulate, white or the tube greenish white, glabrous externally, with a saccate bulge in the floor of the throat, tube 10–14 mm diam., in the proximal half, mouth to 24 mm wide; filaments subequal, 32–38 mm long, thecae 5–6 mm long, 1–2 mm wide. **Fruits** 20–47 cm long, 3–6 cm diam. in life, narrowly cylindric with longitudinal ribs (8-sided in cross-section), yellowish and fleshy (shrinking on drying); seeds ca. 6–9 mm

long, 5–6 mm wide, flat, obovoid with rounded emarginate (obcordate) apex, brown.

Trees of the shaded Caribbean rain forest interior, 10–750 m elevation. Flowering irregularly throughout the year (more often in the wet season). This species ranges from southeastern Nicaragua along the Caribbean slope to central Panama.

Parmentiera macrophylla is recognized by its tree habit, usually opposite trifoliolate leaves, cauliflorous flowers, spathe-like calyx, thick white corolla, and narrow fleshy fruits. This species may flower when only 3 m tall with a stem only 2.5 cm diam. (Gentry, 1973b). It is similar to *P. trunciflora* Standl. & L. O. Williams, but the latter species has flowers borne on prominent (1–2 cm) woody short-shoots and grows at higher elevations in the mountains west of Jinotega, Nicaragua.

Parmentiera valerii Standl., J. Wash. Acad. Sci. 17: 16. 1927. Figure 11.

Small to medium-size trees 5–20 m tall, trunk to 1 m diam., leafy stems 1.2–5 mm diam., glabrous, pale grayish with conspicuous lenticels. **Leaves** opposite or subopposite, usually 5-foliolate, less often 3–7-foliolate, petioles 18–70 mm long, 0.8–1.5 mm diam., glabrous, petiolules 0–12 mm long and intergrading into the base of the blade, glabrous; **leaflet blades** (1.2–)2–9 cm long, (6–)8–34 mm wide, elliptic to narrowly elliptic or elliptic-obovate, apex acute to short-acuminate, base acute to cuneate and decurrent on the petiole, drying thin chartaceous, glabrous above or with the midvein minutely puberulent, glabrous beneath but with crooked hairs in depressions in the vein axils (domatia), 2° veins 3–6/side. **Inflorescences** of few fasciculate cauliflorous flowers on lower part of the trunk, pedicels 15–25 mm long, glabrous, drying dark. **Flowers** with tubular calyx 32–40 mm long, 12–17 mm diam., glabrous, spathe-like; **corolla** 60–75 mm long, tubular-campanulate, white or greenish white, glabrous externally. **Fruits** 12–35 cm long, 2–4 cm diam. in life (1.2–3.5 cm dried), glabrous (purplish to green-violet in life); seeds 5–7 mm long, 7–8 mm wide,

thin-lenticular, obovate with obtuse base and cordate apex.

Plants of the moist evergreen lower montane forest understory, 600–1500 m elevation. Flowering throughout the year. This species has been collected only on the Cordillera de Guanacaste and near Tilarán in northwestern Costa Rica.

Parmentiera valerii is recognized by its tree habit, opposite usually pentafoliolate leaves, few cauliflorous flowers, spathe-like calyx, thick white corolla, and pendulous cylindrical fleshy fruits. The limited geographical area and narrow altitudinal range are also noteworthy. *Jicaro danto* and *pepino de danta* are common names.

Phryganocydia Martius ex Bureau

Lianas and herbaceous vines, climbing with simple (distally unbranched) tendrils, stems mostly terete, cross-section with 4 or 8 phloem areas, interpetiolar gland fields absent; pseudostipules absent or early caducous. **Leaves** opposite, simple or 2-foliolate, petiolate, blades glabrous or with few minute peltate scales, venation pinnate. **Inflorescences** terminal or axillary, panicles with few flowers on bifurcating axes, or of 1 or 2 flowers, subglabrous with few peltate scales. **Flowers** with tubular-funnel form calyx split more than 60% and spathe-like, tip often thickened and reflexed; **corolla** tubular-funnel form, lavender to magenta, subglabrous with few minute peltate scales externally, 2-lipped and 5-lobed; stamens 4, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, staminode present; disc absent; ovary 2-locular, ovules in 2 series in each locule. **Fruits** linear-oblong flattened capsules, valves parallel to the septum, surface smooth but with a dense covering of minute lepidote trichomes; seeds 2-winged with thin lateral wings or corky-ovoid without wings.

Phryganocydia is unusual because of its spathe-like calyx with thickened tip and the fruit surface with a dense covering of minute hairs. Our species are mostly glabrous or with minute (0.05–0.1 mm) sessile peltate scales.

Key to the Species of *Phryganocydia*

- 1a. Fruits narrowly oblong to linear, < 28 mm wide, to 60 cm long, surface grayish; seeds thin with lateral membranaceous wings; leaves consistently 2-foliolate; plants of well-drained sites *P. corymbosa*

- 1b. Fruits broadly ovate, > 35 mm wide, to 8 cm long, surface yellowish to dark brown; seeds thick and corky, lacking thin wings; leaves simple or 2-foliolate; plants of mangroves and lowland swamps
 *P. phellosperma*

Phryganocydia corymbosa (Vent.) Bureau ex K. Schum. in Engler & Prantl, *Naturl. Pflanzenfam.* 4(3b): 224, fig. 89H. 1894. *Spathodea corymbosa* Vent., Choix, tab. 40. 1807; *Mém. Math. Phys. Inst. Natl. France* 1: 1–20. 1807. *S. laurifolia* Kunth in H.B.K., *Nov. Gen. Sp.* 3: 114. 1819. *S. orinocensis* Kunth in H.B.K., *Nov. Gen. Sp.* 3: 147. 1819. Figure 22.

Lianas or herbaceous vines, 1–25 m high, to 5 cm diam., tendrils 7–16 cm long, leafy stems 2–6 mm diam., sparsely to densely covered with flat peltate scales 0.05–0.1 mm diam., terete, with 8 phloem areas in cross-section, interpetiolar ridge usually present. **Leaves** 2-foliolate (simple on young stems), petioles 8–33(–70) mm long, 1.2–2 mm diam., vesture similar to the stem, petiolules 6–40 mm long; **leaf blades** 5–15(–22) cm long, 3–9(–11) cm wide, ovate-elliptic to ovate-oblong or oblong-rounded, apex acute to short-acuminate or rounded, base obtuse to rounded, stiffly chartaceous to subcoriaceous, glabrous on both surfaces, 2° veins 3–7/side. **Inflorescences** terminal or axillary, 3–15 cm long, flowers usually cymose, peduncles to 5 cm long, pedicels 2–3 mm long (node to calyx base) and subtended by an internode 10–30 mm long, drying black. **Flowers** with calyx 26–37(–48) mm long, 3–14 mm diam., gradually expanding in width, with a straight or curved terminal projection 3–9 mm long, split down 1 side with entire margins, surface with few peltate scales; **corolla** 55–85(–97) mm long, tubular-funnelform, rose-lilac to purplish (often with a magenta area beneath the upper 2 lobes), subglabrous externally, 9–24 mm wide at the mouth, throat white with purple lines, lobes 1–3 cm long; filaments 18–21 and 10–13 mm long, thecae 3.5–4.5 mm long. **Fruits** 13–53 cm long, 16–26 mm wide, narrowly oblong to linear-oblong, flat with smooth surface, grayish with dense covering of minute peltate scales, midvein slightly elevated; seeds 13–21 mm long, 27–73 mm wide, pale brown throughout, wings membranaceous.

Plants of lowland evergreen or partly deciduous forest formations, 10–400 m elevation. Flowering in May–December in the Golfo Dulce area (not known elsewhere in Costa Rica); flowering throughout the year in Panama. The species is common in central and eastern Panama but has

only been collected on the Burica Peninsula in western Panama. The species ranges from southwestern Costa Rica to Brazil.

Phryganocydia corymbosa is recognized by its climbing habit with simple tendrils, opposite bifoliolate leaves, few-flowered dichotomously branched inflorescences, spathe-like calyx with terminal appendage, large pinkish corollas, and elongate flattened fruits differing greatly in length and with grayish crystalline surface. The leaflet blades are sometimes nearly as broad as long. An interesting feature of this species is that some plants flower while only 1 m high in open roadside vegetation. Vegetatively, this species is very similar to *Cydista aequinoctialis*, but the fruit of that species lacks the surface trichomes found in *P. corymbosa*.

Phryganocydia phellosperma (Hemsl.) Sandw., *Kew Bull.* 1940: 302. 1941. *Macfadyena phellosperma* Hemsl., *Biol. Central Am. Bot.* 2: 492. 1892.

Lianas to 2.5 cm diam., tendrils 8–15 cm long, stem with 4 phloem areas in cross-section, leafy stems 2–4 mm diam., terete, reddish brown and with scattered minute peltate scales, lacking conspicuous lenticels; pseudostipules absent. **Leaves** 2-foliolate or simple, petioles 8–42 mm long, 1–2.4 mm diam., subglabrous, petiolules 8–32 mm long, sulcate above; **leaf blades** 5–13 cm long, 3–8 cm wide, ovate to ovate-triangular, ovate-oblong or oblong-elliptic, apex short- to long-acuminate, base obtuse to rounded and often truncate, drying chartaceous and grayish, glabrous above, glabrous or with few minute (0.05 mm) peltate scales beneath, 2° veins 4–8/side. **Inflorescences** terminal, usually of 2 (1) flowers, peduncles ca. 10 mm long, 2° peduncles to 4 cm long, subglabrous, pedicel 2–3 mm long, often terminated by a pair of linear-elliptic bracts 6–8 mm long. **Flowers** with calyx 18–27 mm long, 4–10 mm diam., terminated by a thick tip 2–3 mm long, split along side, subglabrous; **corolla** 44–65 mm long, tubular-funnelform, lavender with a white throat, glabrous or with few minute hairs externally, 8–20 mm wide at the mouth, lobes 12–25 mm long; filaments 13–15 and 8–11 mm long. **Fruits** 4–8 cm long, 35–67 mm wide, ca. 6 mm thick, broadly

ovate to ovate-suborbicular, surface dark brown and minutely papillate puberulent (smooth to the touch); seeds 20–27 mm long, 22–35 mm wide, thick, corky, and wingless.

Rarely collected plants of mangrove swamps and wet muddy sites along the Pacific coast, 0–20 m elevation. Flowering mostly in the wet season. The species ranges from southwestern Costa Rica to Colombia.

Phryganocydia phellosperma is recognized by its climbing habit with simple tendrils, opposite bifoliate or simple leaves, glabrous leaflets rounded at the base, usually two-flowered terminal inflorescences, spathe-like calyx, pink or magenta corollas, flattened broadly ovate fruits, and corky seeds lacking thin lateral wings. The seeds of this species are probably dispersed by water, consistent with its restriction to mangroves and low wet sites.

Pithecoctenium Martius ex Meisner

Lianas, tendrils trifold with 0–5 further distal divisions (sometimes with adhesive pads), stems strongly 6-angled, with 4 phloem areas in cross-section, interpetiolar lines often present, gland fields absent; pseudostipules narrowly spatulate or lanceolate, caducous. **Leaves** opposite, 2- or 3-foliolate (occasionally simple), petiolate, margin entire, venation palmate to pinnate. **Inflorescences** terminal (or terminal on axillary short-shoots), racemes or racemose panicles, bracteate, flowers pedicellate. **Flowers** with cupulate calyx, distally truncated or minutely 5-toothed, densely puberulent, without glands; **corolla** tubular-campanulate, relatively thick, puberulent externally, 2-lipped, 5-lobed; stamens 4, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, a small staminode present; ovary 2-locular, ovules multiseriate in each locule. **Fruits** thick woody capsules, valves parallel with the septum and somewhat compressed, covered with short woody spines; seeds thin, with membranaceous wing around 3 sides, central body clearly differentiated from the wings.

Pithecoctenium is a Neotropical genus of four species, one wide-ranging and the others found in Argentina and eastern Brazil.

Pithecoctenium crucigerum (L.) A. Gentry, Taxon 24: 121. 1975. *Bignonia crucigera* L., Sp. Pl. 2: 624. 1753. *B. echinata* Jacq., Enum. Pl. Carib. 25. 1760. *B. tiliaefolia* Kunth in H.B.K.,

Nov. Gen. Sp. 3: 136. 1819. *P. echinatum* (Jacq.) Baill., Hist. Pl. 10: 8. 1888. Figure 18.

Lianas to ca. 10 cm diam., to over 20 m high, tendrils 5–20 cm long, with 3–15 slender divisions (sometimes terminating in a disc that becomes attached to bark), leafy stems 1.5–5 mm diam., with minute peltate scales and with or without slender hairs ca. 0.2 mm long, with 6 prominent longitudinal ridges; pseudostipules 8–15 mm long, 1–2 mm diam. **Leaves** opposite, 2- or 3-foliolate (simple), petioles 14–72 mm long, 1–2 mm diam., subglabrous or with thin hairs ca. 0.2 mm long, petiolules 28–80 mm long, with longitudinal ridges; **leaf blades** (4–)6–18 cm long, (2.5–)4–13 cm wide, ovate to broadly ovate or ovate-oblong, apex acuminate, base rounded and truncate to cordate, drying thin chartaceous, both surfaces with lustrous peltate scales 0.05–0.1 mm diam., simple hairs 0.2 mm long present or absent, venation palmate or subpalmate, 2° veins 4–6/ side, strongly ascending, with disc-like glands at the base beneath. **Inflorescences** 3–19 cm long, 3–15 flowered racemes or racemose panicles, peduncle 1.5–2.5 mm thick, resembling the stems, lateral branches 7–12 mm long, bracts 1–6 mm long, pedicels 1–2 mm long. **Flowers** with calyx 7–11 mm long, 8–10 mm wide, densely puberulent and lepidote, margin entire or minutely 5-dentate, eglandular; **corolla** 32–62 mm long, tubular-campanulate but often bent at almost 90° near the base, white or yellowish white, densely puberulent externally with minute hairs (drying yellowish), lobes 6–17 mm long; filaments 17–21 and 12–17 mm long, thecae 3–4 mm long. **Fruits** 12–23(–31) cm long, 50–65(–75) mm wide, 23–38 mm thick, ellipsoid-oblong with somewhat flattened sides, surface densely tuberculate with woody projections 1–3 mm high, 1.5–2.5 mm diam. at the base, yellowish brown; seeds 24–36(–41) mm long, 45–88(–95) mm wide, central area 18–28 mm wide, wings transparent.

Common lianas of deciduous, partly deciduous, and wet evergreen forest formations on both Caribbean and Pacific slopes, 1–1100 m elevation. Flowering primarily in May–June; fruiting mostly in December–February. This species ranges from Mexico to Argentina.

Pithecoctenium crucigerum is recognized by its climbing habit with multifid tendrils, opposite bi- or trifoliolate leaves (occasionally simple), racemose inflorescences, usually entire densely puberulent calyx cups, densely puberulent white corollas sharply bent near the middle, echinate-tu-

berculate woody fruits, and thin seeds with large thin transparent wings on three sides. The hexagonal twigs, elongate pseudostipules, multi-branched tendrils (sometimes terminating in discs), subpalmate leaf venation, and minute shiny peltate scales on leaves are useful vegetative attributes. Vegetatively, these plants resemble *Ampelophium*, but those species have branched hairs and trifid tendrils and lack the elongate pseudostipules of *P. crucigerum*. The seeds are often called *mariposas* and *palomitas* in Central America (Standley, 1938). *Bateíta*, *cucharilla*, *peine de mico*, and *peina de mono* are common names.

Pleonotoma Miers

Lianas and vines, climbing with tendrils usually 3-parted at the apex, stems hollow at the center, with 4 radiating phloem arms in cross-section and quadrangular, an interpetiolar line usually present at the node; pseudostipules leaf-like, tubular, or absent. **Leaves** opposite, bi- or triternate to tripinnate, the terminal petiolule of the first division often replaced by a tendril, margins entire, venation pinnate, domatia sometimes present. **Inflorescences** axillary or terminal racemes, bracts small, lateral bracteoles sometimes present, pedicels well developed. **Flowers** with calyx cupular, truncated at the apex and subentire or with 5 minute teeth; **corolla** tubular-funnelform, white to yellowish, usually glabrous along the tube and puberulent distally; stamens 4, of 2 lengths, included, anthers glabrous, thecae straight, divaricate, pollen grains 3-colpate, a staminode present; disc cupular-pulvinate; ovary oblong, puberulent or lepidote, ovules many in 2 series on the central placenta. **Fruits** capsule, linear to narrowly oblong, valves flat, paralleling the septum, smooth; seeds thin and with 2 membranaceous lateral wings.

Pleonotoma is a genus of 14 species; all are South American except for one, which ranges northward into Central America.

Pleonotoma variabilis (Jacq.) Miers, Proc. R. Hort. Soc. N.S. 3: 184. 1863. *Bignonia variabilis* Jacq., Hort. Schoenb. 2: 45, tab. 212. 1797. Figure 16.

Vines or lianas, climbing by tendrils (3–15 cm long) with 3 short distal arms 5–20 mm long, larger stems ca. 3 cm diam., leafy stems 2–7 mm diam., with 4 prominent longitudinal ridge, subgl-

abrous; pseudostipules 2–5 mm long. **Leaves** opposite, bicomound with 2- or 3-trifoliate parts, 1° petioles 1–7.5 cm long, 1–2 mm diam., glabrous, 2° petioles 2–6 cm long, longitudinally striate, glabrous, petiolules 7–40 mm long with those of central leaflet often twice as long as laterals; **leaflet blades** 3–18 cm long, 1–9 cm wide, elliptic to elliptic-ovate or elliptic-obovate, apex acute to acuminate, base obtuse to rounded (lateral leaflets often asymmetric at the base), drying chartaceous, glabrous except for short (0.2–0.5 mm) whitish hairs along the midvein and vein axils beneath (domatia), 2° veins 4–7/side. **Inflorescences** usually terminal racemes, peduncle and rachis 2–8 cm long, with 3–12 flowers, pedicels 6–14 mm long, 0.6–1.4 mm diam., drying dark, with minute peltate glands or subglabrous. **Flowers** with cupular calyx 5–9 mm long, 5–7 mm diam., mostly glabrous, margin subentire with teeth ca. 0.2 mm long and a ciliate or glabrous edge; **corolla** 50–90 mm long, tubular-funnelform, white or yellowish white, tube 10–20 mm wide at the mouth, glabrous along the tube and minutely glandular lepidote distally, lobes 14–22 mm long, rounded; longer stamens ca. 27 mm long, thecae ca. 4 mm long, divaricate; ovary ca. 4 × 1.5 mm. **Fruits** 18–35 cm long, 1.5–2.7 cm wide, 3–7 mm thick, linear to linear-oblong, surface flat and slightly muricate, drying dark and lustrous; seeds 1–1.5 cm long, 3–5 cm wide, central part ca. 12 mm wide, wings translucent at the tips.

Uncommon evergreen lianas of deciduous, partly deciduous, and evergreen forest formations, 10–800 m elevation. Known from the Caribbean lowlands of Nicaragua but as yet collected only on the Pacific slope in Costa Rica. Flowering in February–May; fruiting in December–April. The species ranges from Guatemala to Trinidad and the Amazon Basin.

Pleonotoma variabilis is recognized by its vining habit with trifid tendrils, the strongly four-angled hollow stems, the twice-compound opposite leaves (each of which have two or three trifoliate parts), short racemes, truncated calyx cup, and white or yellowish corolla. The tendrils are usually borne from a 1° petiole that also bears two trifoliate 2° petioles. This species and the herbaceous *Tourrettia lappacea* are the only Costa Rican climbing bignons having twice-compound leaves.

Podranea Sprague

Scandent **shrubs** or climbing vines, tendrils absent, stems terete, gland fields absent at the nodes;

pseudostipules not developed. **Leaves** opposite, imparipinnate with opposite lateral leaflets, blades entire or distally serrate, venation pinnate. **Inflorescences** terminal, solitary, paniculate with opposite lateral branches, pedicels subtended by caducous bracts. **Flowers** large, calyx tubular or campanulate (slightly inflated), glabrous, with 5 prominent lobes shorter than the tube; **corolla** tubular-funnelform or tubular-campanulate, lavender, slightly 2-lipped, glabrous externally, the 5 lobes rounded; stamens 4, included, filaments of 2 lengths, anthers glabrous, thecae straight, parallel and later divergent, staminode small; disc saucer-shaped, thick; ovary ovoid, 2-locular, ovules ca. 6-seriate in each locule, stigma of 2 flat ovate lobes. **Fruits** elongated linear capsules, valves leathery, compressed parallel to the septum, dehiscing perpendicular to the septum; seeds flat, 2-winged.

Podranea is a monotypic African genus of east-tropical and southern Africa, now a popular garden ornamental in the tropics. The name *Podranea* is an anagram of *Pandorea*, a similar and closely related genus of five species native to Malaysia, Australia, and the western Pacific (with two species widely cultivated ornamental vines). *Pandorea* differs in having pod-like oblong capsules with woody valves, and a noninflated calyx.

Podranea ricasoliana (Tanfani) Sprague in Thielson-Dyer, Fl. Cap. 4 (2): 450. 1904. *Tecoma ricasoliana* Tanfani, Bull. Soc. Tosc.ortic. 1887: 17. 1887. *Pandorea ricasoliana* (Tanfani) Baill., Hist. Pl. 10: 40. 1888. Figure 15.

Scandent **shrubs** and vines, tendrils absent, leafy stems 1–5 mm diam., glabrous, becoming pale gray in age with rounded lenticels, interpetiolar lines usually present. **Leaves** 6–25 cm long, with usually 5–13 leaflets, petioles 16–60 mm long, 0.6–1.5 mm diam., glabrous, petiolules 2–12 mm long; **leaflet blades** (12–)20–55 mm long, 8–25 mm wide, lanceolate to ovate-lanceolate or ovate-elliptic, apex acuminate, margin with 3–9 teeth/side, base somewhat asymmetric (rounded and cuneate) on lateral leaflets, glabrous, 2° veins 3–5/side. **Inflorescences** terminal, 6–18 cm long, paniculate with short opposite lateral branches, glabrous, bracts 2–4 mm long, subulate, pedicels 4–14 mm long. **Flowers** with calyx 14–20 mm long, 6–9 mm diam., whitish to pale lavender in life, with few round glands on the distal surface, with 5 apiculate lobes 3–6 mm long; **corolla** 5–8 cm long, tubular-campanulate, pale lavender to

pink with purple areas near the 2 adaxial lobes (white inside), glabrous externally but with dense crooked hairs in the sinuses of the lobes; filaments 18–20 and 14–16 mm long, thecae 3–4 mm long. **Fruits** 25–30 cm long, linear and terete (rarely produced in cultivation).

Podranea ricasoliana, native of southern Africa, is now widely cultivated as a garden ornamental. It is recognized by its clambering habit (without tendrils), opposite pinnately compound leaves, narrow leaflets with serrate margins, slightly inflated calyx with prominent lobes, and large pink corollas, often with tufts of hairs in the sinuses of the lobes. It flowers throughout the year and does well from near sea level to 2000 m elevation when grown on a wall or trellis in open sunny locations. Called *bombilla*, *linda*, and *mírame linda* in Guatemala.

Pyrostegia Presl

Vines or lianas, climbing with the aid of coiling petiole-borne tendrils usually trifid near the tip, stems with longitudinal ribs, lacking interpetiolar gland fields; pseudostipules small or inconspicuous. **Leaves** opposite or subopposite, petiolate, 2- or 3-foliolate, petiolules present, margins entire, venation pinnate. **Inflorescences** terminal or axillary panicles, often much branched, pedicels subtended by small paired bracts. **Flowers** with cupular calyx, minutely glandular lepidote or subglabrous, distal margin truncated with 5 small teeth; **corolla** tubular or narrowly funnelform, orange or reddish orange, with 5 lobes, valvate in bud; stamens 4, exerted, anthers glabrous, thecae straight, parallel or slightly divergent; disc annular; ovary narrowly tubular, stigma bifid. **Fruits** dry capsules, valves parallel to septum, smooth and leathery, with an indistinct median vein; seeds thin, 2-winged and transverse-oblong, wings smooth and with hyaline margins.

A genus of four species, originally native to tropical South America. One species is now widely planted for its showy orange flowers.

Pyrostegia venusta (Ker-Gawler) Miers, Proc. R. Hort. Soc. N.S. 3: 188. 1863. *Bignonia venusta* Ker-Gawler, Bot. Reg. 3: 5. 1818. *B. ignea* Vell., Fl. Flumin. 244. 1825. *P. ignea* (Vell.) K. B. Presl., Bot. Bemerk. 93: 1843. Figure 15.

Vines, climbing with tendrils to 15 cm long, leafy stems 2–5 mm diam., glabrous or with short

(0.2–0.5 mm) hairs near the nodes, with 6 or 8 longitudinal ribs. **Leaves** 3-foliolate or 2-foliolate and often with a tendril, petioles 7–35 mm long, 0.8–1.8 mm diam., with short hairs along the adaxial side, petiolules 4–18 mm long (distal leaflet with longer petiolules); **leaflet blades** 3–9 cm long, 1.5–6 cm wide, ovate-elliptic to ovate-oblong, apex acute to caudate-acuminate, base obtuse to slightly rounded and truncate or subcordate, drying chartaceous, glabrous, minutely punctate beneath, 2° veins 3–5/side. **Inflorescences** dense panicles usually terminal on short shoots, often pendulous with 8–25 flowers, rachis to 9 cm long, borne on woody peduncles 5–50 mm long, 1–2.5 mm diam., glabrous or puberulent along 1 side, pedicels 12–20 mm long, glabrous. **Flowers** with calyx 4–5 mm long, 4–6 mm wide, puberulent and glandular lepidote or subglabrous, distal margin minutely ciliolate, subtire or with minute (0.3 mm) lobes (teeth); **corolla** 6–9 cm long, 2–3 mm diam. near the base, 8–12 mm wide at the mouth, orange, tubular to narrowly tubular-funnelform, straight or slightly curved, lobes 6–18 mm long, oblong with blunt apex, becoming reflexed, whitish puberulent along the margin; stamens slightly exerted, filaments 3–5 cm long, thecae ca. 4 mm long. **Fruits** 20–30 cm long, 10–16 mm wide; seeds 1.2–1.6 mm long, 3–4 cm wide.

Pyrostegia venusta is recognized by its climbing habit with distally trifid tendrils, opposite 2- or 3-foliolate leaves, long narrowly tubular orange corollas, and exerted stamens. These plants are often seen climbing over garden walls, with their clusters of brilliant orange flowers making a fine display. The corollas are usually slightly curved, held horizontally when in anthesis, and drooping afterward. Native to Brazil, Bolivia, and Paraguay, this species is now planted as an ornamental throughout the tropics. In Central America it is grown from near sea level to 1500 m elevation. This species has been called *chorro*, *chorro de oro*, *San Carlos*, and *Triquitraque* in Central America.

Saritea Dugand

Lianas climbing with simple tendrils, young stems terete and without interpetiolar gland fields; pseudostipules conspicuous and leaf like (ca. 5–25 mm long). **Leaves** opposite, short-petiolate, 2-foliolate, leaf blades 5–12 cm long, 3–7 cm wide, cuneate at the base, subglabrous, basal 2° veins

strongly ascending, usually with a gland field in the axil of proximal veins beneath. **Inflorescences** usually terminal with 1–9 flowers, peduncles and pedicels drying dark, subglabrous with few minute lepidote hairs, flowers sometimes in distal triads. **Flowers** with tubular subglabrous calyx 6–10 mm long, margin truncate; **corolla** 6–9 cm long, tubular-campanulate, magenta, glabrous externally; stamens 4, filaments ca. 2.8 and 2.1 mm long, anthers glabrous and straight, staminode small; disc small; ovules 2-seriate (or appearing 1-seriate) in each locule. **Fruits** linear capsules, valves flattened parallel to the septum; seeds thin, with 2 membranous lateral wings.

Saritea magnifica (Sprague ex van Steenis) Dugand, native to Colombia and Ecuador, is the only species of this genus and is widely planted as an ornamental. This taxon is closely related to *Cydistia* and *Phyrganocydia* and also to *Arrabidaea* (Gentry, 1973b). Although not recorded from Costa Rica, this species may be expected in gardens. The bifoliolate leaves with cuneate-based leaflets, gland fields in vein axils beneath, conspicuous pseudostipules, and large magenta corollas make it easy to identify.

Schlegelia is now placed in the family Schlegeliaceae (q.v.).

Scobinaria is now considered to be part of *Arrabidaea*. See Gentry's discussion (Selbyana 2: 43–45. 1977).

Spathodea Beauvois

Trees with well-developed trunks, nodes lacking interpetiolar lines or glands; pseudostipules absent. **Leaves** opposite or 3/node, petiolate, imparipinnately compound, lateral leaflets opposite, venation pinnate. **Inflorescences** terminal and erect, compact racemes and somewhat corymb-like with the lower pedicels longer than the distal. **Flowers** large, calyx spathe-like and curved with a narrowed apex, opening from beneath (abaxially); **corolla** with a narrow cylindrical base and large curved-campanulate throat, deep red to orange-red, glabrous on the exterior, 5-lobed; stamens 4, anthers with slender divaricate thecae; ovary 2-locular, narrowly oblong, ovules multiserial in each locule, stigma flat and bifid. **Fruits** narrowly oblong-ellipsoid capsules, dehiscence perpendicular to the septum along 1 side; seeds

flat with broad thin hyaline wing around the entire circumference.

The genus *Spathodea*, member of the tribe Tecmeae, contains a single species native to tropical Africa. A densely puberulent variant of East Africa is sometimes segregated as *S. nilotica* Seem. The compact terminal inflorescences with large red corollas and spathaceous calyx are distinctive.

Spathodea campanulata Beauvois, Fl. Oware 1: 47, tab. 27. 1805. Figure 15.

Trees to 25 m tall, trunks to 40 cm diam., bark somewhat rough and scaling near the base, leafy stems 3–12 mm diam., minutely appressed puberulent, lenticellate. **Leaves** 19–40 cm long, with 7–13(–17) leaflets, petioles to 20 cm long, petioles 1–3 mm long (terminal leaflet with petiole to 15 mm long), ca. 1 mm diam., puberulent; **leaf blades** 5–14 cm long, 2–6 cm wide, elliptic to ovate-elliptic or ovate-oblong, apex acute to acuminate, base acute to obtuse or rounded on 1 side and asymmetric, puberulent on the veins beneath to densely puberulent throughout, with a gland at the base of the midvein abaxially, 2° veins 5–10/ side. **Inflorescences** compact terminal corymb-like racemes with a closely placed spiral of 6–35 flowers, ca. 7 × 15 cm (not including corollas), pedicels to 6 cm long, distal pedicels shorter than the proximal and giving a flat-topped effect. **Flowers** with calyx 2–6 cm long, split on 1 side, recurved and acuminate, densely sericeous, yellowish brown; **corolla** 6–15 cm long, 5–9 cm wide at the apex, widely campanulate and curved from a short-tubular base, deep red to orange-red, lobes 2–3 cm long, obtuse, distal edge of the corolla crinkled and yellowish. **Fruits** 17–27 cm long, 3–7 cm wide, 1–2 cm thick, narrowly ellipsoid-oblong; seeds ca. 15 × 20 mm, with thin membranaceous wing.

Spathodea campanulata is recognized by its tree habit, opposite pinnately compound leaves, compact terminal inflorescences, curved spathaceous calyx, and very large curved-campanulate red corollas. This is a very striking ornamental tree when in full flower, with the huge corollas often in a whorl-like configuration. The distal unopened flower buds often form a tight cluster on which birds can perch while taking nectar from the upwardly open corollas. Native to evergreen

forests of tropical central Africa, the species is now cultivated throughout the tropics. In Costa Rica it has been grown successfully in evergreen and partly deciduous areas below 1500 m elevation. African tulip tree, *llama del bosque*, and *tulipán* are common names.

Stizophyllum Miers

Lianas or vines, climbing with simple or trifid tendrils, stems with 4 phloem areas in cross-section, terete, longitudinally striate, hollow in the center, nodes without gland fields; pseudostipules spatulate or inconspicuous, caducous. **Leaves** opposite, 2- or 3-foliolate, petiolate, blades with conspicuous pellucid-lustrous round sessile glands on the lower surface, venation palmate or subpalmate. **Inflorescences** axillary to distal (sometimes early developing) leaves, few-flowered racemes, peduncles short, bracts well developed, pedicels puberulent. **Flowers** with cupulate or campanulate calyx, often slightly inflated, 5-lobed or irregularly split (2-lipped), densely puberulent, thin-textured; **corolla** campanulate-funnelform, slightly 2-lipped, white or yellowish white, puberulent and with minute glandular hairs externally, the lobes often tinged with pink, lobes rounded; stamens 4, filaments of 2 lengths, anthers glabrous or puberulent along the lines of dehiscence, thecae straight, divaricate, staminode present; disc thick; ovary linear-tetragonal, 2-locular, ovules 2-seriate in each locule. **Fruits** linear capsules, valves flattened parallel to the septum, slightly convex, dehiscence septicial, surface puberulent; seeds transversely oblong, thin and flat, with 2 translucent lateral wings weakly differentiated from the central area.

A Neotropical genus of three species, one of which ranges from Mexico to Amazonia. The genus is unusual because of the pellucid dots on the lower leaf surfaces, the hollow stems, and the very slender fruits, which may resemble stems. Central American material of our two species is difficult to separate on the basis of herbarium material. Both species exhibit a wide range of variability as regards density of pubescence, size of leaves, and size and shape of calyx and corolla. Study in the field is the basis for determining their status as separate species (Gentry, 1973b, p. 936).

Key to the Species of *Stizophyllum*

- 1a. Branchlets and petioles yellowish brown to reddish brown or dark brown with hairs 0.5–2 mm long; tendrils with 3-branched tips; calyx 10–18 mm long; fruit surface with longer (to 1 mm) hairs *S. inaequilaterum*
- 1b. Branchlets and petioles grayish or pale brownish with short (0.1–0.5 mm) hairs; tendrils simple with unbranched tip (rarely 2-branched); calyx 7–12 mm long, chartaceous; fruit surface with minute (0.1–0.3 mm) hairs *S. riparium*

Stizophyllum inaequilaterum Bureau & K. Schum. *in Mart.*, Fl. Bras. 8(2): 221. 1896. *Bignonia inaequilatera* Poeppig ex Bureau & K. Schum. *in Mart.*, Fl. Bras. 8(2): 222, 1896, pro syn., non Poeppig ex Bureau, *Adansonia* 8: 289. 1868. Figure 26.

Lianas and vines, to 3 cm diam., tendrils 8–18 cm, with 3 short (6–20 mm long) distal parts, leafy stems 2–7 mm diam., densely villous with yellowish brown hairs 0.5–2 mm long, older stems glabrescent; pseudostipules to 8 mm long. **Leaves** 2- or 3-foliolate, petioles 22–68(–150) mm long, densely villous, petiolules 9–28(–60) mm long; **leaflet blades** 7–13(–19) cm long, 4–7(–14) cm wide, ovate to oblong or elliptic-oblong, apex acute to acuminate, margin entire or denticulate, base of lateral leaflets asymmetric with a rounded and a cuneate side, drying chartaceous, upper surface with slender curved hairs 0.5–1 mm long, lower surface more densely villous, venation pinnate or subpalmate, 2° veins 3–6/side. **Inflorescences** a few-flowered terminal fascicle or contracted raceme on a short axillary shoot, peduncles ca. 1 cm long, bracts conspicuous, linear, pedicels 8–24 mm long, densely villous with reddish brown hairs. **Flowers** with calyx 10–18 mm long, 7–10 mm diam., inflated-campanulate, thin-chartaceous, villous with hairs to 1.5 mm long, margin irregular or with lobes to 4 mm long; **corolla** 5–7 cm long, tubular-funnel-form, greenish yellow with pink lobes (purple), tube puberulent externally, lobes 8–11 mm long; filaments 20–21 and 15–16 mm long, thecae 2 mm long. **Fruits** 24–35 cm long, 4–6 mm wide, 3–4 mm thick, linear, densely brownish villous; seeds not seen.

Rarely collected plants of lowland evergreen rain forest formations on the Caribbean slope, 0–500 m elevation. Flowering in March–May. The species ranges from eastern Nicaragua to Peru.

Stizophyllum inaequilaterum is recognized by its climbing habit with trifid tendrils, dense pubescence of reddish brown hairs, opposite bi-

trifoliolate leaves, short few-flowered inflorescences, thin villous calyx with irregular margins, puberulent corollas with pink lobes, and slender long-linear pubescent fruits. The dense pubescence of longer (0.5–2 mm) hairs and distally trifid tendrils (rarely well preserved in herbarium material) help distinguish this species from its more common congener.

Stizophyllum riparium (Kunth *in* H.B.K.) Sandw., *Lilloa* 3: 462. 1938. *Bignonia riparia* Kunth *in* H.B.K., *Nov. Gen. Sp.* 3: 138. 1819. *Adenocalymma flos-ardeae* Pittier, *Contrib. U.S. Natl. Herb.* 18: 256. 1917. *A. punctifolium* Blake, *Contrib. U.S. Natl. Herb.* 24: 22. 1922. *S. flos-ardeae* (Pittier) Sandw., *Recueil Trav. Bot. Néerl.* 34: 212. 1937. *S. punctifolium* (Blake) Sandw., *Recueil Trav. Bot. Néerl.* 34: 212. 1937. Figure 23.

Lianas and vines to 5 cm diam., tendrils 7–15 cm long, apex simple or rarely with reduced second tip, leafy stems 1.3–6 mm diam., sparsely to densely puberulent with hairs to 0.7 mm long, terete; pseudostipules 3–8 mm long, strap-shaped. **Leaves** 2- or 3-foliolate, petioles 12–110 mm long, ca. 1 mm diam., puberulent, lateral petiolules 7–37 mm long (terminal to 70 mm); **leaflet blades** 3.5–17(–20) cm long, 2–9.5(–12) cm wide, ovate-elliptic, ovate, or elliptic-oblong to narrowly ovate-oblong, apex acute to short-acuminate, margin entire or with 1–7 obtuse teeth/side in early stages, base rounded and truncate to subcordate, drying thinly chartaceous, sparsely puberulent with slender hairs 0.2–0.6 mm long above, more densely puberulent beneath, with pellucid dots 0.1–0.2 mm diam. beneath, venation subpalmate, 2° veins 4–6/side. **Inflorescences** terminal fascicles or axillary few-flowered racemes, peduncles 1–5 cm long, puberulent like the stems, pedicels 4–7 mm long. **Flowers** with calyx 7–12 mm long, 4–9 mm diam., deeply cupular or tubular-funnel-form, densely minutely puberulent, margin 5-lobed or irregular, glandular on lobes;

corolla 32–53 mm long, tubular-funnelform to tubular-campanulate, white to pale yellowish white, minutely papillate puberulent, lobes 5–8 mm long; filaments 15–18 and 11–12 mm long, thecae 2–2.5 mm long. **Fruits** 24–45 cm long, 3–8 mm wide, 3.5–5 mm thick, linear and narrowed at the ends, straight or more often curved, lenticular in cross-section, surface densely minutely puberulent, grayish; seeds 4–6 mm long, 14–26 mm wide, transversely oblong, wings translucent.

Climbers in lowland evergreen rain forest formations, 0–300 m elevation. Flowering mostly in June–November (but rarely seen with flowers and rare in herbaria). This species ranges from eastern Mexico to the Amazon basin.

Stizophyllum riparium is recognized by its climbing habit with simple tendrils, hollow puberulent stems, opposite bi- or trifoliolate leaves, blades with pellucid dots beneath, white or yellowish corollas puberulent externally, and the very narrow linear usually curved fruits. Leaflets on juvenile growth may have conspicuous broad-based teeth. The differences between this and the preceding species are often very difficult to discern in herbarium material.

Tabebuia Gomes ex De Candolle

REFERENCES—A. Gentry, A revision of *Tabebuia* (Bignoniaceae) in Central America. *Brittonia* 22: 246–264. 1970. A. Gentry, Bignoniaceae—Part II (tribe Tecomeae). *Flora Neotropica*, Monogr. 25(II). 1992.

Small to large trees or shrubs, wood usually dense and fine-grained, branchlets terete, nodes lacking interpetiolar gland fields; pseudostipules absent. **Leaves** opposite, palmately 3–7(9–)foliolate or less often simple or 1-foliolate, petiolate,

basal leaflets usually smaller and with shorter petioles than the more terminal, venation pinnate. **Inflorescences** terminal, short, open or congested panicles, few-flowered racemes or fascicles of 1 to few flowers, bracts subtending the pedicels; some species flowering when the tree is leafless. **Flowers** with tubular to cupular or campanulate calyx, margin 2–5-lobed, irregular or truncate, surface with flat rounded appressed, stellate or straight hairs; **corolla** tubular-funnelform to tubular-campanulate, white, yellow, rose, purple, or red, glabrous or puberulent externally, lobes 5, rounded; stamens 4, exerted or included, filaments of 2 lengths, anthers glabrous, thecae straight, divaricate, staminode present; disc cushion-shaped, ovary oblong, 2-locular, ovules in 2 to many series in each locule. **Fruits** capsules, linear-cylindric to oblong-cylindric, subterete, valves dehiscing approximately perpendicular to the septum, surface smooth to verrucose-muricate, glabrous to variously puberulent; seeds thin, transversely oblong with 2 thin lateral wings (thicker, corky, and without wings in *T. palustris* et al.).

Tabebuia, a member of tribe Tecomeae, is a Neotropical genus of 100 species, with many species in South America and the West Indies. In Central America most of the species can be distinguished by the tree habit, opposite usually palmately compound leaves, compact but showy terminal inflorescences (often in flower when the leaves are absent), large corollas, and the linear to oblong fruits that are rounded in cross-section and split at right angles to the septum. In our species, the corolla may be white, yellow, or rose to purple. When in full flower, these are some of the most beautiful trees in Central America. The wood of this genus is a commercially important tropical hardwood, and the bark contains pharmacologically active compounds (Gentry, 1992).

Key to the Species of *Tabebuia*

- 1a. Seeds corky, without thin transparent lateral wings; fruits to 11 cm long; corollas white with yellowish markings within; shrubs and small trees of mangroves and river deltas along the Pacific coast; leaves simple or 3-foliolate, leaflets mostly narrowly lanceolate *T. palustris*
- 1b. Seeds thin with transparent lateral wings; fruits usually > 15 cm long; corolla yellow to rose or purple (white with pink lobes in *T. rosea*); medium to large trees, not found in mangrove formations (occasionally in lowland riversides); leaves usually 3-, 5-, or 7-foliolate, leaflets rarely lanceolate 2
- 2a. Corollas rose, purple, or white, marked with pink; leaflets and stems without stellate hairs; fruits glabrous or with flat rounded appressed peltate (lepidote) hairs or minutely papillate, the surfaces smooth 3

- 2b. Corollas bright yellow; leaflets with stellate hairs (sometimes only in vein axils beneath and difficult to see); fruits stellate-pubescent to minutely villous or with an undulate surface if with minute rounded appressed (lepidote) hairs 4
- 3a. Surface of leaflets with minute flat rounded (lepidote) hairs; corolla glabrous externally; calyx with minute flat rounded hairs; capsule with minute papillate or appressed peltate hairs; native in dry deciduous to wet evergreen rain forest formations and planted as ornamental, 0–1500 m elevation *T. rosea*
- 3b. Surface of leaflets with straight hairs, at least in the vein axils beneath; corolla puberulent externally; calyx with minute straight or scurfy hairs; capsule mostly glabrous; in deciduous and partly deciduous forest, 5–300 m elevation *T. impetiginosa*
- 4a. Leaflets with minute stellate hairs only in the vein axils beneath, leaves often 7-foliolate; fruits with slightly undulate surface and appressed rounded flat (lepidote) hairs [trees of lowland rain forests] *T. quayacan*
- 4b. Leaflets with stellate hairs scattered on the surface beneath or along the veins, leaves rarely 7-foliolate; fruit with few to many minute stellate or tomentulous hairs 5
- 5a. Leaves puberulent mostly along veins and petioles; calyx without long simple hairs, lobes becoming reflexed; corolla lobes with dark interconnecting veins to the distal margin; fruits minutely stellate-puberulent; trees of evergreen rain forest formations (in Costa Rica) *T. chrysantha*
- 5b. Leaves densely puberulent over the entire surface beneath; calyx yellowish pubescent with thin straight hairs 2–7 mm long, lobes erect; corolla lobes with venation not so clearly reaching the margin; fruits tomentulous; trees of deciduous and partly deciduous forest formations *T. ochracea*

Tabebuia chrysantha (Jacq.) G. Nichols., Ill. Dict. Gard. 4: 1. 1887. *Bignonia chrysantha* Jacq., Hort. Schoenb. 2: 45, tab. 211. 1797. *Tecoma chrysantha* (Jacq.) DC., Prodr. 9: 221. 1845. *Tec. evenia* J. D. Smith, Bot. Gaz. 20: 8. 1895, pro parte (fls.). *Tec. palmeri* Kränzl., Fedde Repert. 17: 220. 1921. *Tab. chrysantha* ssp. *pluvicola* A. Gentry, Phytologia 35: 190. 1977. Figure 13.

Trees to 30 m tall, trunks to 1 m diam., bark light gray and smooth with few widely spaced long vertical furrows, leafy stems 3–9 mm diam., terete, densely puberulent with stellate hairs 0.1–0.3 mm long, glabrescent, becoming pale gray. **Leaves** usually 5-foliolate (3-, 4-, 7-foliolate), petioles (5–)8–19(–28) cm long, 1.5–3.5 mm diam., densely stellate puberulent, petiolules 1–9 cm long (basal laterals 8–20 mm), with node-like area below the blade; **leaflet blades** (4–)7–21(–26) cm long, (2–)3–12 cm wide (proximal lateral leaflets smaller than the distal), elliptic to broadly elliptic or elliptic-obovate, apex acuminate to caudate-acuminate, margin entire or sometimes bluntly serrate, base obtuse to rounded and slightly truncate, drying thinly to stiffly chartaceous, subglabrous to sparsely stellate puberulent above, more densely stellate-puberulent beneath, peltate trichomes 0.02–0.05 mm diam. often conspicuous

beneath, 2° veins 6–12/side. **Inflorescences** terminal, condensed (almost fasciculate) panicles with 7–25 flowers, peduncles 4–20 mm long, densely stellate pubescent, pedicels 4–20 mm long, 1.2–2 mm diam. **Flowers** with calyx 8–14 (–19) mm long, 7–10(–13) mm diam., cupular-funnelform or campanulate, densely pubescent with hairs 0.3–0.8 mm long, lobes 2–3 mm long, broadly triangular; **corolla** 52–95 mm long, tubular-funnelform, bright yellow with narrow reddish lines within, glabrous externally, lobes 9–28 mm long; filaments 16–22 and 10–15 mm long, thecae 2–3 mm long. **Fruits** 20–50(–90) cm long, 14–24 mm wide, linear-cylindric, narrowed at the ends, surfaces smooth and minutely stellate puberulent; seeds 6–12 mm long, 14–38 mm wide, wings transparent, well differentiated.

Trees of wet evergreen lowland rain forest formations on both the Caribbean and Pacific slopes in Costa Rica and Panama, 20–600 m elevation (also occurring in much drier habitats in its range from Mexico to Nicaragua and in Venezuela). Flowering primarily in January–March, occasionally at other times. The species ranges from Mexico, disjunctly, to Peru.

Tabebuia chrysantha is recognized by its large tree habit, small stellate hairs on many parts, opposite palmately 5-foliolate leaves, compact terminal inflorescences, large brilliant yellow exter-

nally glabrous corollas, and long linear-cylindric fruits with transparent-winged seeds. The leaflets are sometimes serrate. The trees make a brilliant show when flowering, in part because they usually flower when all the leaves have fallen. Common names are *corteza* and *cortes amarilla*.

Our collections are placed in subspecies *pluvicola* A. Gentry, which ranges from northeastern Costa Rica to northern Venezuela and Ecuador. Subspecies *chrysantha* is found from Mexico to Nicaragua and disjunctly in Amazonian Peru. The two subspecies can be separated by the following key.

- 1a. Trees usually 10–20 m tall, usually found in seasonally dry deciduous or partly deciduous forests below 1200 m elevation; calyx < 10 mm long, densely rufescent with stellate to curved-barbate hairs ca. 1 mm long; fruits 15–50 × 0.8–2 cm, persistently stellate-tomentose, often striate or with rough surface. . . . subsp. *chrysantha*
- 1b. Trees to 30 m tall, usually found in lowland and lower montane evergreen forest formations, 0–1500 m; calyx > 10 mm long, rufescent with short stellate hairs ca. 0.5 mm long; fruits 30–80 × 1.5–2.4 cm, nearly glabrescent and smooth. subsp. *pluvicola*

Tabebuia guayacan (Seem.) Hemsley, Biol. Centr. Am. Bot. 2: 495. 1882. *Tecoma quayacan* Seem., Bot. Voy. Herald, 180. 1854.

Trees to 50 m tall, trunks to 1.7 m diam., bark gray or brown and ridged with well-developed vertical furrows, leafy stems 2–8 mm diam., subglabrous or with few minute hairs, becoming pale grayish, terete. **Leaves** 5- or 7-foliolate, petioles, 8–23 cm long, 1.5–3 mm diam., sparsely puberulent with scurfy hairs or glabrous, petiolules 1–7 cm long (basal lateral petiolules 1–3 cm long), geniculate and drying dark below the blade; **leaflet blades** 5–20(–30) cm long, 3–11(–15) cm wide (terminal larger than laterals), ovate-elliptic to elliptic or lanceolate, apex acute to acuminate, margin entire (serrate in juveniles), base rounded to obtuse (lateral leaflets usually asymmetric), drying thin-chartaceous, subglabrous or minutely puberulent on the veins beneath and with short stellate hairs in vein axils (domatia), lower surface with minute appressed peltate hairs, 2° veins 6–9/ side. **Inflorescences** compact panicles with flow-

ers in diads or triads and opening at the same time, peduncles 6–14 mm long, pedicels 10–18 mm long, 0.6–0.9 mm diam., sparsely puberulent with scurfy hairs 0.1–0.3 mm long. **Flowers** with calyx 9–15 mm long, 4–9 mm diam., campanulate, with minute scurfy scattered hairs, margin split or with 2–5 rounded/obtuse lobes; **corolla** 63–105 mm long, tubular-funnelform, yellow with brown lines within, glabrous externally, 13–22 mm wide at the mouth, lobes 22–35 mm long; filaments 15–21 and 11–16 mm long, thecae 2–3 mm long. **Fruits** 30–60 cm long, 12–28 mm wide, linear, surface subglabrous to thick stellate-puberulent; seeds 6–11 mm long, 23–40 mm wide, wings transparent and clearly differentiated.

Rarely collected trees of lowland evergreen rain forest formations, 5–600 m elevation. Flowering in February–March (March–May elsewhere in Central America); seeds are released in May–July. The species ranges from Mexico to Peruvian Amazonia.

Tabebuia quayacan is recognized by its tree habit, opposite palmately penta- or septa-foliolate subglabrous leaves, usually narrow leaflets, compact terminal inflorescences, large yellow corollas, and long linear cylindric fruits. The leaves are often almost glabrous, except for the minute round flat peltate trichomes and the stellate hairs in vein axils beneath. The hard wood has been used as uprights in home construction, as axles, and for tool handles (*Englesing 181*, Nicaragua). This species is very closely related to *T. serratifolia* (Vahl) Nichols., a wide-ranging species of South America (Gentry, 1992). Common names are *cortes* or *corteza*.

Tabebuia impetiginosa (Mart. ex DC.) Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11: 176. 1936. *Tecoma impetiginosa* Mart. ex DC., Prodr. 9: 218. 1845. *Tab. palmeri* Rose, Contrib. U.S. Natl. Herb. 1: 109, tab. 11. 1891. *Tab. nicaraguensis* Blake, Contrib. Gray Herb. 52: 95. 1917. *Tab. dugandii* Standl., Trop. Woods 36: 17. 1933. Figure 13.

Trees to 30 m tall, trunks to 70 cm diam., bark slightly furrowed, leafy stems 3–8 mm diam., glabrous or sparsely puberulent with minute (0.05 mm) hairs, terete, longitudinally striate, becoming smooth and grayish. **Leaves** 3- or 5-foliolate (in Central America), petioles 4–14 cm long, 1.3–2.5 mm diam., sparsely and minutely puberulent, longitudinally striate, petiolules 7–50 mm long (basal laterals to 15 mm); **leaflet blades** (3–)11–19 cm

long, (2-)4-8 cm wide (basal leaflets often much smaller than distal), elliptic to elliptic-oblong or narrowly ovate-elliptic, apex short- to long-acuminate, margin serrate in juvenile plants, base acute to obtuse or rounded, drying chartaceous, glabrous above, lower surface subglabrous or with short (0.4 mm) thin hairs along the midvein, and with tufts of hairs in the vein axils (domatia), 2° veins 9-12/side. **Inflorescences** terminal, compact-paniculate (congested-fasciculate), peduncles 2-12 mm long, 1-1.7 mm diam., densely yellowish pubescent with thick stellate hairs, pedicels 2-6 mm long. **Flowers** with calyx 5-8 mm long, 3-6 mm diam., tubular-campanulate, sparsely to densely yellowish stellate puberulent, margin truncate or slightly 5-lobed; **corolla** 35-75 mm long, tubular-funnelform, purple to red-purple (yellow within), sparsely to densely minutely puberulent externally, 15-25 mm wide at the mouth, lobes 10-17 mm long; filaments 16-23 and 10-16 mm long, thecae 2.5-3.5 mm long. **Fruits** 15-56 cm long, 12-25 mm wide, 10-13 mm thick, surface subglabrous and drying dark, with few longitudinal ridges; seeds 9-13 mm long, 30-48(-80) mm wide, central area 17-18 mm wide, wings translucent and clearly differentiated.

Deciduous trees of seasonally very dry deciduous or partly deciduous (rarely in lowland evergreen) forest formations, 10-300 m elevation (to 1400 m elsewhere). Flowering in November-February; fruiting in January-February. This species ranges from Mexico to Argentina.

Tabebuia impetiginosa is recognized by its tree habit, opposite palmately tri- or pentafoliolate leaves, compact terminal inflorescences, externally puberulent purple corollas, long linear fruits, and seeds with transparent wings. The leaflets are mostly glabrous. Gentry (1973b, 1992) discussed the regional differentiation and nomenclatural aspects of this species. Common names are *cortez negro* and *roble macho*. Compare *T. rosea*

Tabebuia ochracea (Cham.) Standl., Field Mus. Nat. Hist. Bot. Ser. 11: 176. 1936. *Tecoma ochracea* Cham., Linnaea 7: 653. 1832. *Tab. chrysantha* (Jacq.) Nichols., Dict. Gard. 4:1. 1897, sensu Sandw., non Jacq. *Tab. neochrysantha* A. Gentry, Brittonia 22: 260. 1970. *Tab. ochracea* subsp. *neochrysantha* (A. Gentry) A. Gentry, Ann. Missouri Bot. Gard. 60: 948. 1973. Figure 13.

Trees 8-25 m tall, bark with flat-surfaced gray ridges alternating with darker furrows, leafy stems

3-7 mm diam., densely stellate pubescent with hairs 0.2-0.5 mm long, soon glabrescent and terete. **Leaves** 5-foliolate, petioles 4-18 cm long, 1.3-2.7 mm diam., densely stellate pubescent, petiolules 5-58 mm long, lateral basal petiolules 3-15 mm long; **leaflet blades** 4-22 cm long (basal laterals 2-11 cm), 2-14 cm wide, oblong-obovate or elliptic-obovate to broadly elliptic, apex acuminate, margin serrate in juvenile plants, base obtuse to rounded and truncate, drying chartaceous, densely stellate puberulent beneath with hairs ca. 0.5 mm wide, 2° veins 6-12/side. **Inflorescences** terminal, condensed subcapitate clusters of 2- and 3-flowered groups or contracted panicles, distal stems often terminating in a rounded pubescent inflorescence "bud" 1-2 cm diam., peduncles and pedicels not usually visible in the dense pubescence of yellowish (dried) hairs to 1.5 mm long. **Flowers** sweet-scented, calyx 8-13 mm long, 4-8 mm diam., campanulate, densely yellowish (dried) tomentulous with straight hairs to 2(-7) mm long (stellate at base), margin with 5 lobes 1-2 mm long; **corolla** 36-75(-83) mm long, tubular-funnelform, yellow with red lines within, glabrous externally except near the lobes, lobes 10-25 mm long; filaments 15-20 and 9-15 mm long, thecae 1.5-2.5 mm long. **Fruits** 11-38 cm long, 10-17 mm wide, 5-10 mm thick, linear-cylindric, surface densely tomentulous with hairs 0.3-2 mm long (sometimes subglabrous and with prominent longitudinal ridges); seeds 6-12 mm long, 17-88 mm wide, wings transparent, well differentiated.

Common deciduous trees of seasonally dry deciduous and partly deciduous forest formations of the Pacific slope, 5-900 m elevation. Flowering in January-June; fruiting in February-June. This species is represented in our area by subspecies *neochrysantha*, which ranges from Guatemala to northwestern Venezuela; the other subspecies are South American.

Tabebuia ochracea subspecies *neochrysantha* is recognized by its tree habit, opposite palmately pentafoliolate leaves, compact inflorescences (early stages form round pubescent "buds" at the tips of distal stems), bright yellow corollas mostly glabrous externally, long cylindrical fruits, and seeds with transparent wings. The leaflets are densely stellate tomentulose beneath. This species is similar to *T. chrysantha* of evergreen forests; both are called *cortez amarilla* and *cortez*.

Tabebuia palustris Hemsley, Biol. Centr. Am. Bot. 2: 495. 1882. Figure 12.

Shrubs or small trees 1.5–4 m tall, trunks to 5 cm diam., often twisted and sometimes forming dense colonies, leafy stems 2–8 mm diam., terete, surface with flat rounded trichomes. **Leaves** simple or 3-foliolate (2-foliolate), petioles 24–100 mm long, 1.5–2.5 mm diam., with appressed peltate hairs but often appearing glabrous, often with gland fields along the proximal half, petiolules of distal leaves 12–35 mm long; **leaflet blades** 6–19 cm long, 1.4–5 cm wide, narrowly lanceolate to narrowly elliptic or elliptic-oblong, apex acute, base acute to cuneate, drying yellowish and subcoriaceous, glabrous above, densely lepidote with minute (0.1 mm) appressed rounded trichomes beneath, 2° veins 8–13/side. **Inflorescences** terminal on short shoots or terminal in a distal branch-dichotomy, flowers 1–5, often in diads or triads, peduncle 8–25 mm long, bracts 2–8 mm long, linear, pedicels 9–11 mm long, with minute appressed rounded hairs. **Flowers** with calyx 11–17 mm long, 6–8 mm diam., cupulate-funnelform, drying dark, surface with flat rounded hairs ca. 0.1 mm diam., margin cleft into 2–4 lobes 1–5 mm long; **corolla** 40–75 mm long, tubular-funnelform, white with yellow lines within, glabrous externally, 9–18 mm wide at mouth, lobes 8–23 mm long; filaments 18–26 and 14–19 mm long, thecae 3 mm long. **Fruits** 5–11 cm long, 14–26 mm diam., oblong-cylindric with a narrow tip, surface smooth, covered by minute peltate scales; seeds 14–18 mm long, 18–22 mm wide, suborbicular with corky texture, wings absent.

Shrubs of tidal mangrove formations and seaside marshes along river estuaries, 0–10 m elevation. Flowering throughout the year. The northernmost collection (*Croat 663* from Playa Coco, Guanacaste) may be an outlier. The estuary of the Río Tempisque may be the northernmost area in which this species is common; it is common around Golfo Dulce. This species ranges along the Pacific Coast from Costa Rica to northwestern Ecuador.

Tabebuia palustris is recognized by its Pacific coastal habitats, short shrubby (small tree) habit, opposite usually trifoliolate leaves with narrow leaflets, few white flowers, and cylindrical fruit with corky wingless seeds. The habitat, gland fields on petioles, narrow leaf blades, and corky seeds easily distinguish this species from all its congeners in Costa Rica.

Tabebuia rosea (Bertol.) DC., Prodr. 9: 215. 1845. *Tecoma rosea* Bertol., Fl. Guatimal. 25. 1840. *Tec. mexicana* Mart. ex DC., Prodr. 9:

218. 1845. *Sparattosperma rosea* (Bertol.) Miers, Proc. R. Hort. Soc. 3: 99. 1863. *Tab. mexicana* (Mart. ex DC.) Hemsl., Biol. Centr. Am. Bot. 2: 495. 1882. *Tab. pentaphylla* (L.) Hemsl., Biol. Centr. Am. Bot. 2: 495. 1882, non *Bignonia pentaphylla* L. *Couralia rosea* (Bertol.) J. D. Smith, Bot. Gaz. 20: 9. 1895. *Tec. evenia* J. D. Smith, Bot. Gaz. 20: 8. 1895, pro parte. Figure 13.

Trees 5–30 m tall, to 1 m diam., bark dark gray and rough with a distinct pattern of vertical ridges, leafy stems 3–12 mm diam., with minute peltate scales, glabrescent, becoming terete. **Leaves** 5-foliolate, basal leaflets often smaller than distal, petioles 6–17(–32) cm long, 2–3.4 mm diam., lepidote, petiolules of distal leaflets 2–7(–11) cm long; **leaflet blades** 5–18(–35) cm long, 3–10(–18) cm wide (distal leaflets larger), elliptic to elliptic-oblong, apex acute to acuminate, margin entire, base cuneate or rounded, drying stiffly chartaceous and grayish, both surfaces with flat appressed rounded hairs 0.05–0.1 mm diam. (lepidote), gland fields sometimes present along the midvein near the base beneath, 2° veins 7–12/side. **Inflorescences** 2–20 cm long, short or condensed panicles often with dichotomous branching, peduncles 8–25 mm long, lepidote, bracts 1–2 mm long, pedicels 4–20 mm long, with minute peltate scales. **Flowers** with calyx 11–21 mm long, 6–11 mm diam., cupular-funnelform, surface densely minutely papillate puberulent or lepidote, margin with 2 or 3 rounded or obtuse lobes separated by irregular sinuses 1–3 mm deep; **corolla** 53–97 mm long, tubular-funnelform, pink to purple or white with pinkish lobes, often yellowish within, glabrous externally, lobes 18–26 mm long; filaments 14–20 and 10–15 mm long, thecae 2.5–3.5 mm long. **Fruits** 21–38 cm long, 10–18 mm diam., linear-cylindric, densely covered with minute peltate or papillate hairs, apex narrowly acuminate; seeds 8–12 mm long, 28–45 mm wide, wings transparent and sharply differentiated.

Trees of deciduous, partly deciduous, and lowland evergreen rain forest formations on both Caribbean and Pacific coasts, 0–1100 m elevation (planted at elevations up to 1500 m). Flowering primarily in January–March; fruits usually dehiscent in April–May. This species ranges from Mexico to Venezuela and western Ecuador.

Tabebuia rosea is recognized by its tree habit, opposite palmately pentafoliolate leaves, tubular and irregularly lobed calyx, large pink or white and pink corollas, linear-cylindric fruits, and seeds

with thin transparent wings. The leaf surfaces appear glabrous but have a dense covering of minute appressed peltate hairs; some leaves have gland fields along the base of the midvein beneath. Unlike *T. chrysantha*, the leaflets of this species are always entire. This species is one of the most important commercial sources of fine quality hardwood; it is used in making furniture and interior trim and for other purposes. The tree flowers with or without its foliage and is one of Central America's most beautiful native species, often planted for ornament. Common names are *roble*, *roble de blanco*, and *roble de sabana*.

Tanaecium Swartz

Lianas climbing with simple tendrils, stems terete, with 8 or 16 phloem areas in cross-section, interpetiolar gland fields present or absent; pseudostipules small or absent. **Leaves** opposite, 2- or 3-foliolate, petiolate, blades often with a cyanide odor when crushed, venation pinnate. **Inflorescences** axillary or terminal, panicles or racemose panicles, or solitary in distal leaf axils. **Flowers** with cupulate calyx, margin entire or with 5 minute teeth, often with flat rounded glands on the distal surface; **corolla** with a very long tube and salverform distally, white, externally glabrous or puberulent, lobes 5; stamens 4, exerted or partly exerted, filaments of 2 lengths, anthers glabrous, thecae straight or curved, somewhat divergent, staminode present; ovary oblong, lepidote, 2-locular, ovules multiseriate in each locule. **Fruits** capsules, oblong to ellipsoid-cylindric, valves parallel to the septum, thick, woody, convex, smooth; seeds lacking wings or with 2 lateral poorly differentiated membranaceous wings.

Tanaecium is a genus of about six species ranging from Costa Rica and the West Indies to Brazil.

Tanaecium jaroba Sw., Prodr. 92. 1788. *T. albiflora* DC., Prodr. 9: 245. 1845. Figure 16.

Lianas climbing with tendrils 5–22 cm long, leafy stems 2.5–7 mm diam., glabrous, terete, nodes with 10–15 round flat glands between the leaf bases; pseudostipules ca. 3 mm long or absent. **Leaves** 2- or 3-foliolate, petioles 4–9 cm long, 1.5–2.3 mm diam., glabrous or puberulent, petiolules 7–37 mm long (shorter on lateral leaflets); **leaflet blades** 6.5–16 cm long, 3–9 cm wide, elliptic-oblong to elliptic or ovate-elliptic, apex acute to short-acuminate, base obtuse to rounded and somewhat truncate, glabrous above, glabrous

or with curled thin hairs to 0.6 mm long beneath, 2° veins 5–9/side. **Inflorescences** terminal or axillary, solitary flowers in distal leaf axils or short few-flowered racemes on leafless stem-tips, pedicels 7–24 mm long, 1–2 mm diam., glabrous, drying black. **Flowers** with calyx 9–16 mm long, 5–10 mm diam, deeply cupulate, subglabrous, with flat circular glands distally, margin subentire with minute (0.3 mm) teeth; **corolla** 11–24 cm long, long-tubular-salverform, white, minutely puberulent externally, tube 3.5–5 mm diam. for most of its length, ca. 10 mm wide at the throat, lobes 17–27 mm long; filaments ca. 28 and 15 mm long, thecae 5–6 mm long. **Fruits** 9–22 cm long, 5–11 cm wide, 4–8 cm thick, ellipsoid-oblong to oblong, pale brown, subglabrous; seeds 25–33 mm long, 30–32 mm wide, woody, angular with thin edge on 3 sides.

Rarely collected plants of evergreen lowland rain forest formations along the Caribbean coastal plain. Collected in flower in late May (*Pittier 3631*) and early October (*Gómez-Laurito 12913*) in Costa Rica. This species ranges from southeastern Nicaragua and Jamaica to Venezuela and Peru.

Tanaecium jaroba is recognized by its climbing habit with simple tendrils, opposite bi- or trifoliolate leaves, few-flowered inflorescences, very long slender white corollas, and rounded woody fruits with woody seeds. No other species of Bigoniaceae in Central America has such long and narrow corolla tubes. The flowers have a sweet odor (like *Hedychium*, Zingiberaceae) and open at night. They are probably pollinated by sphingid moths with very long tongues. Little Central American material of this species has been seen; the description is based largely on South American material and Gentry's (1973b) description.

Tecoma Jussieu

Shrubs or small trees, stems terete, interpetiolar lines weakly differentiated at the node (glandular fields absent). **Leaves** opposite, simple, 3-foliolate or pinnately compound with opposite lateral leaflets and a terminal leaflet, petiolate, blades very variable in form, margins serrate, venation pinnate. **Inflorescences** terminal racemes or racemose panicles, bracts small and inconspicuous, flowers pedicellate. **Flowers** showy, calyx cupulate, glands often present on the distal surface, margin with 5 deltoid lobes; **corolla** tubular-campanulate to tubular-funnelform, radially symmet-

ric, glabrous externally, yellow to orange, 5-lobed; **stamens** 4, exserted or included, filaments of 2 lengths, anthers glabrous or puberulent, thecae divergent, pollen 3-colpate, a staminode present; disc cupular; ovary lepidote, 2-locular, ovules in 2 series in each locule, stigma flat. **Fruits** long linear capsules, compressed parallel to the septum but dehiscent perpendicular to the septum, valves smooth and glabrous; seeds thin, with 2 lateral

membranaceous wings sharply differentiated from the central area of the seed.

Tecoma is a genus of 14 species, with two in Africa and 12 in the New World (ranging from the southernmost United States to Argentina). Gentry (1992) placed *Tecomaria* under *Tecoma*. One species is both native and planted in gardens in Central America; the other is an introduced ornamental.

Key to the Species of *Tecoma*

- 1a. Corollas yellow, tubular-campanulate; leaflet blades 3–14 cm long; fruits 9–25 cm long; wild and planted *T. stans*
- 1b. Corollas orange to red-orange, tubular; leaflet blades 1–4 cm long; fruits 5–12 cm long; planted ornamental *T. capensis*

Tecoma capensis (Thunb.) Lindley, Bot. Reg. 13: tab. 1117. 1827. *Bignonia capensis* Thunb., Prodr. 105. 1800. *Tecomaria capensis* (Thunb.) Spach, Hist. Nat. Vég. Phan. 9: 137. 1840. Figure 15.

Shrubs or scandent subshrubs 1–2 m tall, leafy stems 1.5–4 mm diam., usually terete, minutely (0.05–0.1 mm) puberulent. **Leaves** 4–14 cm long, pinnate with 7 or 9 (11) leaflets, petioles 10–18 mm long, 0.5–1.2 mm diam., rachis sulcate above, minutely puberulent; **leaflet blades** 8–37 mm long, 8–16 mm wide, broadly ovate to ovate-rhombic or broadly ovate-elliptic, apex acute to obtuse, distal margin with 4–7 teeth/cm, base broadly cuneate or rounded, mostly glabrous but with thin white hairs in vein axils beneath (domatia), 2° veins 4–7/side. **Inflorescences** 7–15 cm long, racemes with 10–40 flowers, with short (4–9 mm) lateral branches, bracts 3–14 mm long, mostly linear, pedicels 6–12 mm long. **Flowers** with calyx 4–8 mm long, 3–4 mm diam., subglabrous, lobes 0.5–1 mm long, triangular with an apiculate apex; **corolla** 4–8 cm long, tubular, orange to orange-red, glabrous externally, tube 2–3 mm diam. at base, 8–11 mm diam. at mouth, lobes 9–14 mm long; thecae 3 mm long. **Fruits** rarely produced in Central America, 5–12 cm long, 6–11 mm wide; seeds 5–6 mm long, 18–22 mm wide.

Tecoma capensis is planted as an ornamental in the tropics and subtropics; its vigorous growth and scandent branches make it useful in hedges. The opposite dark green leaves with 7–11 small serrate leaflets and brilliant curved-tubular orange-red corollas with exserted anthers make

these plants easy to identify. Not often seen in Central America, these plants are likely to grow best at middle (1000–2000 m) elevations. The genus *Tecomaria* with two African species is now considered part of *Tecoma* (Gentry, 1992). *Julia* and cape honeysuckle are common names.

Tecoma stans (L.) Juss. ex Humboldt in H.B.K., Nov. Gen. Sp. 3: 144. 1819. *Bignonia stans* L., Sp. Pl. ed. 2, 2: 871. 1763. Figure 15.

Shrubs or small trees 1–6(–12) m tall, with many branches, trunk up to 25 cm diam. with ridged dark brown bark, leafy stems 2–5 mm diam., glabrous, drying pale yellowish gray. **Leaves** 8–22(–28) cm long, usually with 7, 9, or 11 (1–5) leaflets, petioles 25–90 mm long, 0.8–1.7 mm diam., glabrous or puberulent at base of leaflets, sulcate above, petiolules of lateral leaflets 0–2 mm long, terminal petiolules 6–18 mm long; **leaflet blades** 3–14 cm long, 1–6 cm wide (terminal leaflet larger than laterals), elliptic-ovate to narrowly elliptic-oblong or lanceolate, apex acuminate, margin with 3 or 4 prominent teeth/cm, base cuneate and slightly decurrent on the petiole, lateral leaflets asymmetric at base, drying thin-chartaceous, glabrous (in ours), 2° veins 6–10/side. **Inflorescences** 5–18 cm long, racemose or paniculate with 8–20 flowers, peduncles 1–3 cm long, glabrous, bracts ca. 1 mm long, triangular, pedicels 3–8 mm long, glabrous. **Flowers** with calyx 4–7 mm long, 2.3–4 mm diam., cupulate, glabrous, with submarginal glands, lobes 0.7–2 mm long, acute or apiculate; **corolla** 3.5–6 cm long, to 4 cm wide at the rotate lobes, tubular-campanulate from a narrow (2–3 mm diam.) base, yellow,

12–20 mm diam. at the mouth, lobes ca. 15×18 mm, rounded; filaments ca. 16 and 21 mm long, thecae 3–4 mm long, pubescent. **Fruits** 9–22 (–26) cm long, 5–8 mm wide, linear, cylindric or slightly flattened perpendicular to the septum, narrowed at base and apex, surfaces glabrous, pale brown; seeds 4–6.5 mm long, 17–28 mm wide, wings translucent, central area ca. 4×7 mm.

Plants of deciduous and partly deciduous forest (or escaped from gardens in evergreen areas) of the Pacific slope and central highlands, 10–1300(–1800) m elevation. Flowering primarily in November–March; fruiting throughout the year. This species, originally ranging from southernmost Arizona and Florida to Argentina, is widely planted as an ornamental in the tropics and subtropics.

Tecoma stans is recognized by its opposite imparipinnately compound leaves with serrate leaflets, large bright yellow corollas that are only slightly bilaterally symmetric (obscurely 2-lipped), and long narrow seed pods with 2-winged seeds. This species is rather uniform in morphology in southern Central America. In Mexico and among cultivated forms there is extraordinary variation, with some plants having simple linear (25×1 cm) leaves and others with the blades densely hirtellous beneath. This great range of variation has produced many specific and varietal names (see synonymy of Gentry, 1992). An often straggly growth habit prevents this species from being a more popular ornamental. *Candelillo*, *carboncillo*, and *vainillo* are common names.

Tourrettia Fougeroux

Herbaceous annual **vines**, climbing by means of tendrils with 3 coiled branches and dichotomous tips (transformed leaflets), stems tetragonous with 4 longitudinal ridges, an interpetiolar line or ridge usually present at the node, glandular fields absent; pseudostipules absent. **Leaves** opposite, twice divided with 3 2° petioles each bearing 3–5 leaflets or with 2 2° petioles bearing 3–5 leaflets and a distally branched tendril; blades with strongly serrate margin, lateral leaflets asymmetric and sometimes divided, thin, venation pinnate. **Inflorescences** terminal spike-like racemes, sparsely to densely puberulent with thin gland-tipped hairs, bracts linear, pedicels short, the upper flowers usually sterile and deciduous (with calyx and corolla not clearly separated). **Flowers** of two kinds with the distal usually sterile and shorter than the lower (proximal) fertile flowers, calyx

tubular near the base and separating into 2 lobes distally (upper and lower) in fertile flowers, deciduous during anthesis; **corolla** tubular and 2-lipped, slightly longer than the calyx, orange to red, puberulent distally; stamens 4, of 2 lengths, included, anthers glabrous, thecae divaricate, staminode absent; disc a thin cup; ovary ovoid, 4-locular, ovules many on uniseriate placentas, surface short-echinate, style slender, stigma simple. **Fruits** slightly woody capsules covered with straight and uncinat spines, dehiscing septically into 2 valves united near the base; seeds small, oblong, with a thin narrow wing.

Tourrettia contains a single species, ranging from the highlands of Guatemala to Argentina. The unusual fruits are reminiscent of the family Pedaliaceae, but the compound leaves, vining tendrils, and winged seeds are characteristics of the Bignoniaceae.

Tourrettia lappacea (L'Hér.) Willd., Sp. Pl. ed. 4, 3: 263. 1801. *Dombeya lappacea* L'Hér., Stirp. Nov. 33, tab 17. 1785. *T. volubilis* J. F. Gmel., Syst. Nat. 2: 940. 1791. Figure 16.

Herbaceous **vines** to 3 m high, climbing with slender (0.3–0.7 mm) coiled tendrils 3–10 cm long, leafy stems 0.8–5 mm diam., with 2 or 4 prominent longitudinal ridges, subglabrous or sparsely puberulent with thin multicellular hairs 0.2–0.5 mm long (especially at the nodes). **Leaves** opposite, to 25 cm long, 1° petiole 3–5 cm long, 1.5–3.3 mm diam., usually glabrous, 2° petioles 2–6 cm long bearing 3–5 leaflets, petiolules of central leaflet 8–18 mm long; **leaflet blades** 0.8–10 cm long, the central leaflet 2–8(–10) cm long, 1.3–5 cm wide, ovate to ovate-elliptic, apex acute, margin strongly serrate with teeth 0.3–3 mm high (4–9 teeth/cm), drying thin and dull greenish, glabrous above and below, 2° veins 6–13/side. **Inflorescences** to 20 cm long, with both sterile distal flowers (5–10 mm long) and fertile (to 2 cm long) usually proximal fertile flowers, peduncles 3–12 cm long, subglabrous to densely pubescent with gland-tipped hairs, pedicels 0.8–3.5 mm long, ca. 0.3 mm diam., with a linear bract to 4 mm long from near the base. **Flowers** dimorphic, distal calyx 4–7 mm long and reddish, fertile calyx 11–15 mm long, greenish, lobes slightly longer than the tube, subglabrous to densely glandular puberulent; **corolla** of fertile flowers 12–24 mm long, 3–4 mm diam. near the base, greenish to orange, rose red or deep scarlet red, puberulent except near the base, upper lobe 8–12 mm long, hooded (galeate); filaments 8–9 and 9–12 mm long, an-

ther thecae 2–3 mm long; style to 16 mm long. **Fruits** 3–5 cm long, body of the fruit ca. 3 × 1.4 cm, ellipsoid, surface covered with longer (7–14 mm) uncinately reddish spines and shorter (1–3 mm) acute spines, drying dark brown; seeds 6–7 mm long, 4–5 mm wide, flat.

Plants of moist open sites and forest edges in evergreen lower montane forest formations, (600–)1100–2100 m elevation. Flowering and fruiting throughout the year. This species ranges from Mexico to Venezuela, Peru, and northwestern Argentina.

Tourrettia lappacea is a very unusual herbaceous vine with slender divided coiling tendrils, twice-compound opposite leaves, strongly serrate thin blades, and colorful spike-like inflorescences usually bearing flowers of two different forms. The sterile (usually terminal) flowers are shorter and have the calyx and corolla often united, while the larger fertile flowers have the calyx clearly differentiated and deciduous. In addition, the two-valved fruits covered with both shorter straight spines and longer hooked spines are distinctive. Because of the slender tendril-bearing stems and spiny fruits, these plants are sometimes mistaken for Cucurbitaceae (see Gentry, 1980).

Tynanthus Miers

Lianas climbing with the aid of simple or trifid tendrils (rarely small trees?), stems subterete to quadrangular with 4 phloem areas in cross-section,

often with an interpetiolar ridge at the nodes but interpetiolar gland fields lacking; pseudostipules lacking or leaf-like. **Leaves** opposite, 2- or 3-foliolate, often with the terminal leaflet replaced by a simple or distally trifid tendril, blades entire, venation pinnate. **Inflorescences** terminal or axillary, usually small (4–12 cm) open or condensed panicles or dichasia, pedicels densely puberulent. **Flowers** with small cupular or campanulate calyx, puberulent, apex subtruncate with 5 denticulate lobes or setae, persisting; **corolla** funnelliform and somewhat curved, bilabiate and split to near the middle, white, puberulent on the exterior, with 4 or 5 lobes (upper lobe emarginate or 2-lobed); stamens 4, of 2 lengths, included or slightly exerted, anthers glabrous, thecae divaricate, staminode present; disc very small; ovary conical, densely puberulent, 2-locular, ovules in 2–4 series on the placenta. **Fruits** long-linear capsules, slightly flattened with valves parallel to the septum, flat and smooth with a slightly or distinctly raised (winged) margin, dehiscing septicidally; seeds flat, with 2 lateral hyaline wings.

Tynanthus is a genus of about 12 species ranging disjunctly from southern Mexico and the West Indies to Brazil and Bolivia. The genus has a number of species with unusually small flowers for Bignoniaceae; for example, the corollas of *T. guatemalensis* J. D. Smith are only 6–9 mm long. Our species, based on only two collections, is the only representative of the genus known from between Guatemala and Central Panama; for comparison we include a key to the three species of the genus known in Central America.

Key to the Central American Species of *Tynanthus*

- 1a. Corollas 25–30 mm long; small trees (?) without tendrils; lower leaf surfaces grayish with a dense covering of minute scurfy hairs; known only from the Caribbean slope of Costa Rica at 100–800 m elevation *T. macranthus*
- 1b. Corollas 6–20 mm long; lianas climbing with tendrils; lower leaf surfaces greenish, glabrous or with minute hairs along the veins; Panama or Mexico to Guatemala and not included in the descriptions 2
- 2a. Corollas 6–9 mm long; leaves mostly elliptic to ovate-elliptic; ranging from central Mexico to Belize and Guatemala *T. guatemalensis*
- 2b. Corollas 12–20 mm long; leaves mostly ovate to broadly ovate; central to eastern Panama *T. croatianus*

Tynanthus macranthus L. O. Williams, Fieldiana Bot. 31: 250. 1967. Figure 12.

Small trees 3 m tall (in the type) but also lianas, leafy stems 1.5–5 mm diam., densely grayish

puberulent with minute (ca. 0.1 mm) rounded, peltate or scurfy hairs, terete, node with a slightly elevated interpetiolar ridge. **Leaves** 2-foliolate, petioles 8–17 mm long, ca. 1 mm diam., densely puberulent like the stems, petiolules 6–11 mm

long, sulcate above; **leaf blades** 4–12 cm long, 2–6 cm wide, elliptic-oblong to oblong, apex acute to abruptly short-acuminate, base asymmetric with narrowed and slightly rounded sides, drying stiffly chartaceous and brown above, upper surface minutely papillate puberulent or subglabrous, lower surface grayish to brownish and densely to sparsely puberulent with whitish hairs 0.05–0.1 mm long, 2° veins 3–6/side. **Inflorescences** axillary, 1–3 cm long, few-flowered racemes or dichasia, peduncle 10–16 mm long, 1 mm diam., densely puberulent, bracts 1–2 mm long, caducous, pedicels 3–6 mm long. **Flowers** with calyx 6–9 mm long, 4–5 mm diam., tubular-campanulate, densely pale brownish puberulent (dried), margin subentire with 5 minute (0.3 mm) teeth; **corolla** 22–23 mm long, tubular-funnelform, 2-lipped and split along the sides to within 5–8 mm of the base, white, densely pale yellowish brown puberulent on the exterior when dried, tube 2–4 mm diam. near the base, 5–8 mm diam. at the mouth (lower lip becoming bent downward and recurved in *Barringer et al.* 2671), lobes 5–12 mm long, obtuse at the apex; thecae ca. 2 mm long, the pair U-shaped when dried; ovary minutely puberulent. **Fruits** unknown.

Rarely collected plants of wet evergreen rain forest formations of the Caribbean slope, 100–800 m elevation. Flowering in late April and early July. Endemic to Costa Rica and northwestern Panama.

Tynanthus macranthus is recognized by its opposite bifoliolate leaves with blades usually grayish puberulent beneath, the short axillary racemes, the densely puberulous calyx with minutely dentate margin, and the densely puberulous white corollas deeply split along the two sides. Although the type (*Lent* 42) was said to be a tree, other collections appear to be lianas. The flowers of this species, while modest in size for the family, are large for the genus. No other bignon in our flora has a corolla tube so deeply incised.

Xylophragma Sprague

Lianas climbing with simple tendrils (undivided distally), stems terete or subquadrangular, with 4 phloem areas in cross-section, interpetiolar glandular fields present; pseudostipules short, acute. **Leaves** opposite, 3-foliolate or 2-foliolate with the terminal leaflet sometimes replaced by a tendril, pubescence of small simple or branched (dendritic) hairs, venation pinnate. **Inflorescences**

racemes or panicles with racemose branches, usually axillary on older branchlets, bracts present, pedicels often with paired bracteoles. **Flowers** with cupular calyx, margin with 5 short teeth, pubescent with stellate or branched hairs; **corolla** tubular-campanulate, slightly bilabiate, rose to lavender or purple, puberulent on the exterior; stamens 4, of 2 lengths, anthers glabrous, thecae straight and divaricate, a staminode present; disc cupular; ovary ovoid, 2-locular, ovules 6–8 series on each placenta, stigma simple. **Fruits** capsules, valves woody, flat, and parallel to the septum, median vein not evident, smooth or with raised glandular areas; seeds thin with 2 lateral membranaceous wings clearly delineated from the central seed area.

Xylophragma is a genus of four species centered in South America, with one species ranging northward as far as Mexico.

Xylophragma seemannianum (Kuntze) Sandw., *Kew Bull.* 1953: 469. 1954. *Saldanhaea seemanniana* Kuntze, *Rev. Gen. Pl.* 2: 480. 1891. *Distictis rovirosana* J. D. Smith, *Bot. Gaz.* 20: 7. 1895. *Adenocalymma cocleense* Pittier, *Contrib. U.S. Natl. Herb.* 18: 255. 1917. Figure 21.

Lianas stems to 10 cm diam., tendrils to 20 cm long, leafy stems 2–6 mm diam., at first puberulent with branched or stellate hairs ca. 0.2 mm long, glabrescent, terete, developing whitish lenticels, gland fields often present at the nodes; pseudostipules 1–3 mm long, conical. **Leaves** 3-foliolate or 2-foliolate with a tendril, petioles 4–16(–20) cm long, 0.7–2.2 mm diam., minutely puberulent with straight or crooked hairs 0.1–0.3 mm long, petiolules 6–40(–70) mm long, petiolules of central leaf often twice the length of lateral petiolules; **leaflet blades** (4–)6–16(–23) cm long, (2.5–)4–10(–13) cm wide, ovate, broadly elliptic, obovate or slightly rhombic, apex acute to acuminate, base obtuse to slightly rounded and truncated, drying chartaceous, minutely puberulent on the veins above, usually puberulent beneath with branched hairs 0.2–0.5 mm long beneath, 2° veins 5–7/side. **Inflorescences** terminal on axillary short-shoots, racemes or short panicles, peduncles 5–20 mm long, ca. 1 mm diam., densely stellate puberulent, bracts 3–6 mm long, linear to linear-lanceolate, pedicels 5–15 mm long. **Flowers** with calyx 4–8 mm long, 3–5 mm diam., densely papillate or stellate puberulent, teeth (lobes) 0.2–1 mm long, ca. 0.5 mm wide; **corolla** (2.5–)3–6 cm long, tubular-funnelform,

lavender to rose and minutely puberulent on the exterior, yellow and white within, tube 1.5–2 mm diam. near the base, 10–18 mm wide at the mouth, lobes to 22 × 16 mm and acute; filaments ca. 9 and 14 mm long, thecae 2.3–3.5 mm long; ovary ca. 3 mm long, lepidote. **Fruits** 5–16 cm long, 3–5 cm wide, ca. 5 mm thick, oblong-rounded, valves flat and smooth; seeds 14–22 (–29) mm long, 28–52 mm wide, central dark area 17–24 mm wide.

Common deciduous lianas of seasonally dry deciduous and partly deciduous forest formations (rarely collected in evergreen forest formations), 1–500 m elevation. Flowering in March–May when the plants are usually leafless; fruits mature and open in the following year's dry season. This species ranges from Veracruz, Mexico, to northern Brazil.

Xylophragma seemannianum is recognized by its climbing habit with simple woody tendrils (rarely shrubs), the usually trifoliolate leaves, short inflorescences usually blooming when the leaves are absent, showy lavender or magenta corollas, and oblong flattened fruits with two-winged seeds. The gland fields at older nodes, larger leaves with symmetric lateral leaflets, and pubescence of small branched hairs (dendroid, often appearing farinose) are also helpful in recognizing this species.

List of Accepted Species of Bignoniaceae

Key: END-CR = endemic to continental Costa Rica; END-CR&WP = endemic to Costa Rica and western Panama; END-WP = endemic to western Panama; INTRO = introduced weed; ORNAM = cultivated ornamental; ORNAM & NAT = cultivated and naturalized; ?? = not collected in Costa Rica but known from nearby areas. Total number of species covered is 79; the number of documented native species is 69. One new species, *Amphitecna gentryi*, is described here.

Adenocalymna inundatum
Amphilophium paniculatum
Amphilophium pannosum
Amphitecna gentryi END-CR & SP. NOV.
Amphitecna isthmica
Amphitecna kennedyi
Amphitecna latifolia
Amphitecna sessilifolia END-CR & WP
Anemopaegma chrysanthum
Anemopaegma chrysoleucum
Anemopaegma orbiculatum
Aneuopaegma puberulum

Anemopaegma santoritense
Arrabidaea candicans
Arrabidaea chica
Arrabidaea conjugata
Arrabidaea corallina
Arrabidaea costaricensis
Arrabidaea florida
Arrabidaea mollissima
Arrabidaea patellifera
Arrabidaea pubescens ??
Arrabidaea verrucosa

Callichlamys latifolia
Ceratophytum tetragonolobum
Clytostoma binotum
Crescentia alata
Crescentia cujete
Cydista aequinoctialis
Cydista diversifolia
Cydista heterophylla
Cydista lilacina
Cydista potosina

Distictella magnoliifolia

Godmania aesculifolia

Jacaranda caucana
Jacaranda copaia
Jacaranda mimosifolia ORNAM

Kigelia pinnata ORNAM

Lundia corymbifera
Lundia puberula

Macfadyena uncata
Macfadyena unguis-cati
Mansoa hymenaea
Mansoa kerere
Mansoa parvifolia
Mansoa standleyi
Mansoa verrucifera
Martinella obovata
Melloa quadrivalvis
Mussatia hyacinthina

Parabignonia steyermarkii
Paragonia pyramidata
Parmentiera aculeata ORNAM
Parmentiera cereifera ORNAM
Parmentiera dressleri
Parmentiera macrophylla
Parmentiera valerii END-CR
Phryganocydia corymbosa
Phryganocydia phellosperma
Pithecoctenium crucigerum
Pleonotoma variabilis
Podranea ricolasiona ORNAM
Pyrostegia venusta ORNAM

Spathodea campanulata ORNAM
Stizophyllum inaequilaterum
Stizophyllum riparium

Tabebuia chrysantha
Tabebuia guayacan
Tabebuia impetiginosa
Tabebuia ochracea
Tabebuia palustris
Tabebuia rosea

Tanaecium jaroba
Tecoma capensis ORNAM
Tecoma stans ORNAM & native
Tourrettia lappacea
Tynanthus macranthus END-CR & WP
Xylophragma seemannianum

PEDALIACEAE

By William Burger

Herbs or more rarely shrubs or small trees, stems erect, often with mucilaginous glands that become slimy when wet; stipules absent. **Leaves** opposite or the distal alternate, petiolate, simple, entire or lobed, pinnately or palmately veined. **Inflorescences** of usually solitary axillary flowers, sometimes cymose, usually with glands at the base of the pedicel. **Flowers** bisexual, bilaterally symmetric, sepals 5, united at the base or free; corolla tubular to campanulate and slightly 2-lipped, 5-lobed, imbricate in bud; stamens 4, filaments of 2 lengths, anthers dorsifixed, parallel or separate, a staminode usually present; disc present on 1 side of the ovary; ovary superior (rarely inferior), 2- or 4-locular, placentation axile, ovules few to many, style slender, stigma 2-lobed. **Fruits** capsules or indehiscent, often woody and spiny or with projections; seeds few to many, smooth, endosperm thin.

Pedaliaceae is an Old World family of about 15 genera and 50 species. Closely related to Scrophulariaceae, this family is distinguished by its slime cells and unusual fruits. Some authors have enlarged this family to include Martyniaceae (Cronquist, 1981), but that family has parietal placentation and is restricted to the New World. The only representative of this family likely to be seen in Central America is *Sesamum orientale*, the source of sesame seed.

Sesamum Linnaeus

Annual or perennial **herbs**, stems erect, usually with mucilaginous sap or glands. **Leaves** opposite or alternate, petiolate, blades with pinnate venation. **Inflorescences** of usually solitary flowers in leaf axils or sometimes in few-flowered cymes, pedicels subtended by lateral glands. **Flowers** with 5-parted calyx; corolla tube oblique at the base and slightly expanded (gibbous), slightly 2-

lipped with 5 spreading lobes; stamens 4 (rarely 2), inserted near the base of the corolla tube, anthers divergent (sagittate); ovary superior or partly inferior, 2-locular with many ovules. **Fruits** capsules, oblong, somewhat 4-angled in cross-section, loculicidally dehiscent.

Sesamum is a tropical genus of about 12 species, native to Africa and Asia. The following species has been widely cultivated in tropical regions for its oil-containing seeds.

Sesamum orientale L., Sp. Pl. 634. 1753. *S. indicum* L., Sp. Pl. 634. 1753. Figure 27.

Erect annual **herbs** to ca. 1.5 m tall, stems simple or branched, leafy stems 1–5 mm diam., with thin whitish hairs 0.2–1.5 mm long; bracts may resemble stipules at flowering nodes. **Leaves** mostly alternate, petioles 6–35(–80) mm long, 0.5–1.3(–2) mm diam., puberulent with thin hairs ca. 0.5 mm long; **leaf blades** 3–15 cm long, 0.7–9 cm wide, varying from broadly ovate-triangular (or deeply 3-lobed in basal leaves) to lanceolate or narrowly oblong, apex acute to obtuse, margin entire (sometimes with rounded lobes), base acute to obtuse, drying chartaceous, sparsely puberulent with thin hairs on both surfaces, 2° veins 5–6/side and strongly ascending. **Inflorescences** of solitary axillary flowers, bracts to 4 mm long, linear, pedicels 1–2 mm long (to 5 mm in fruit), with a pair of lateral sessile round glands (0.7 mm diam.) at the base, puberulent. **Flowers** with calyx 4.5–6.5 mm long, sepals united only at the base, ca. 5 mm long, narrowly triangular, acute, with thin white hairs; **corolla** 20–30 mm long, white to pink or lavender, sparsely puberulent with thin hairs 0.3–1.5 mm long, lobes 2–7 mm long, broadly rounded. **Fruits** 17–30 mm long, 8–10 mm wide, oblong-rectangular, base rounded, apex acute or apiculate, with a central longitudinal sulcus on the nondehiscent sides, pale brown, puberulent; seeds 3 × 1.8 × 1 mm, ovate-lenticular, lustrous white.

Cultivated or occasionally escaped plants in seasonally dry deciduous areas, 100–800 m elevation in Central America. Flowering in June–December; fruiting in July–January. Rarely encountered in Costa Rica, this species is naturalized in parts of Guatemala and Honduras. Cultivated since ancient times in southern and western Asia, it has been introduced throughout the tropics.

Sesamum orientale is recognized by its solitary axillary flowers subtended by glands at the base of the pedicels, bent campanulate white or pink corollas, and the distinctive oblong capsules.

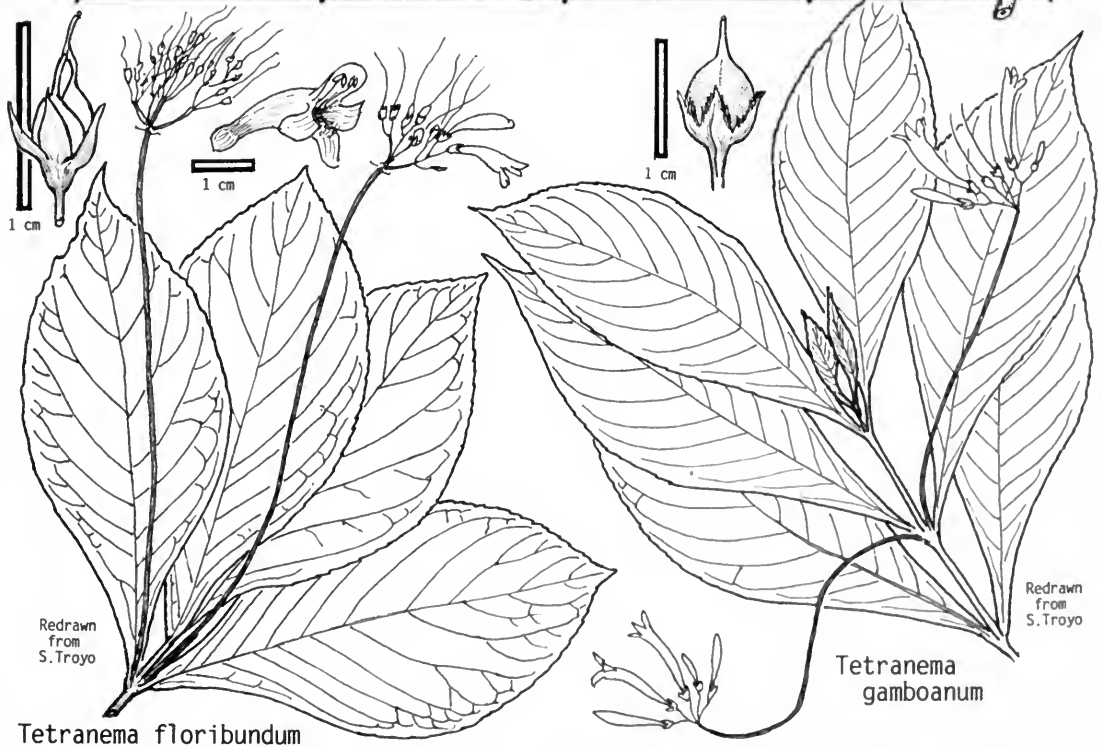
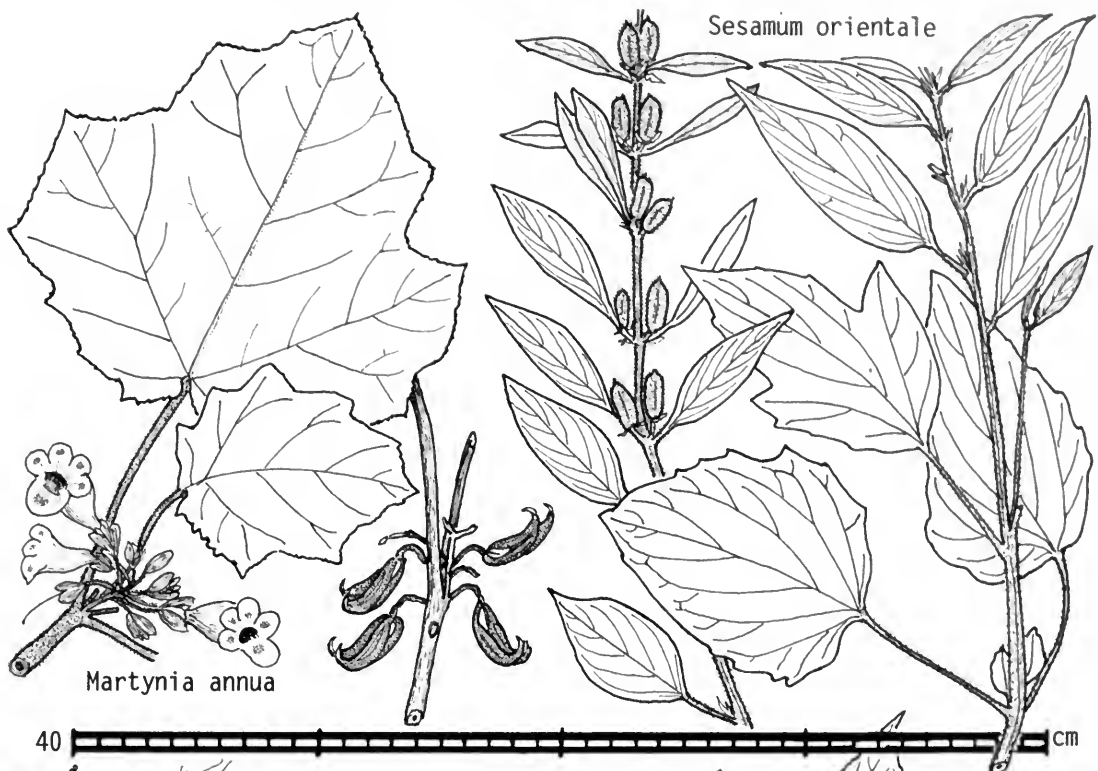


FIG. 27. Unusual herbs of the Martyniaceae, Pedaliaceae, and Scrophulariaceae families.

Ajonjolí and sesame are common names. The oil expressed from the seeds is used much like olive oil, and the seeds are used on bread or in making sweets.

MARTYNIACEAE

By William Burger

Herbs, usually with viscid gland-tipped multicellular hairs; stipules absent. **Leaves** alternate or opposite, simple, petiolate, leaf blades entire to undulate, dentate or somewhat lobed. **Inflorescences** terminal or axillary, racemose, flowers pedicellate, often subtended by 1 or 2 large bracteoles, sometimes becoming thick and fleshy in age. **Flowers** bisexual, calyx 5-parted or 5-lobed and split down 1 side, glandular puberulent externally; **corolla** bilaterally symmetric and somewhat 2-lipped, tubular at base and expanded to campanulate or funnellform distally, 5-lobed with the 2 upper lobes exterior in bud; stamens 4 or 2, filaments equal or of 2 lengths, arising from the base of the expanded corolla tube, anthers of each stamen pair at first coherent, 2-theous, staminodes 1–3; disc annular; ovary superior, unilocular but with 2 intruding parietal placentas and appearing 2- or 4-locular by intrusion of the placentas, ovules few to many, style slender, stigma 2-lobed. **Fruits** woody capsules, usually with distal recurved horns, exocarp fleshy and deciduous, endocarp hard and woody; seeds few to many, sculptured, black, compressed or oblong.

This family of three genera is restricted to the New World, but some authors place it in the Pedaliaceae (Cronquist, 1981). The Martyniaceae differ from the Pedaliaceae in having intruding parietal placentae and lacking glands at the base of the pedicels, and they do not become slimy when wet. The monotypic genus *Martynia* is rarely collected in Costa Rica. A second genus and species, *Proboscidia triloba* (Cham. & Schldl.) Decne., is found in northern Central America. That genus is distinguished by having a spathe-like calyx, four fertile stamens, and distal horns of the capsule usually surpassing the body of the fruit in size.

Martynia Linnaeus

Erect annual **herbs**, puberulent to villous with thin multicellular gland-tipped viscid hairs on

most parts. **Leaves** opposite or alternate distally, petiolate, blade broadly ovate with palmate venation. **Inflorescences** terminal or axillary, short-racemose, viscid puberulent, flowers subtended by 2 large bracts. **Flowers** with deeply 5-parted calyx, sepals unequal, thin-textured; **corolla** campanulate from a short tubular base, somewhat 2-lipped and oblique, with 5 broadly rounded lobes; stamens 2, included, filaments borne from the apex of the short narrow basal tube, anthers strongly divaricate (180°) and coherent on their sides, staminodes 2 or 3; ovary with 2 intruding parietal placentae, stigma 2-lobed. **Fruits** a horned capsule, exocarp glandular pubescent but deciduous and exposing the hard woody exocarp, adaxial and abaxial sides of the exocarp each with 4 longitudinal ribs separated by deep sulci, the hard recurved distal horns shorter than the body of the fruit.

Martynia annua L., Sp. Pl. 618. 1753, non L. Syst. Nat. 1113. 1759. *M. diandra* Gloxin, Obs. Bot. 14. 1785. *M. angulosa* Lam., Encycl. Meth. Bot. 2: 112. 1786. *Carpoceras angulata* A. Rich., Bull. Sci. Nat. Geol. 21: 98. 1830. *Disteira angulosa* Raf., Fl. Telluriana: 68. 1881. *Vatkea diandra* O. Hoffm., Verh. Bot. Brandenb. 73: 45. 1881; Linnaea 43: 554. 1882. Figure 27.

Annual erect **herbs** 0.3–1.5 m tall, stems sparsely to densely viscid pubescent with hairs ca. 0.5 mm long. **Leaves** with petioles 4–14(–40) cm long, 1.4–5 mm diam., villous with gland-tipped hairs 0.3–1 mm long; **leaf blades** 7–24(–40) cm long, 5–21(–32) cm wide, ovate to ovate-triangular (sometimes weakly 3- or 5-lobed), apex obtuse, margin with widely triangular or obtuse lobes and more numerous minute (0.5 mm) teeth, base cordate to subcordate, drying membranaceous, upper surface with scattered short hairs, lower surface with hairs and pellucid dots, venation palmate, 2° veins 3–4/side. **Inflorescences** 3–6 cm long, terminal or axillary to distal leaves, with 5–15(–20) flowers bracts 12–23 mm long, broadly elliptic and somewhat similar to the sepals, pedicles 12–28 mm long, slender, glandular pubescent. **Flowers** with 5 unequal sepals 16–20 mm long, 4–7 mm wide, oblong to broadly elliptic or oblanceolate, obtuse or rounded at the apex, ciliolate on the edge; **corolla** 40–55 mm long, white or pinkish white with rounded purple spots on the sepal lobes within and yellow area on the floor of the throat, lobes broadly rounded distally,

the 2 smaller (adaxial) lobes held erect, the broad abaxial lobe forming the lower lip; anthers ca. 8 mm wide, filaments ca. 12 mm long; style ca. 30 mm long. **Fruits** 3–4 cm long, 1.6–2 cm wide, slightly curved and boat-shaped (curved ellipsoid), the distal ends with hard recurved sharp-tipped horns ca. 1 cm long, woody endocarp with deep sulci and drying black.

Plants of seasonally dry deciduous forest areas 5–300 m elevation (to 1000 m in Honduras, to 2400 m in Guatemala). Flowering in July–August; fruiting in August–February. Although common in central Honduras and along the shore of Lake Nicaragua near Granada, this species has been collected only a few times in Guanacaste Province. The species ranges from Mexico to north-eastern Costa Rica.

Martynia annua is recognized by its short-lived herbaceous habit, viscid pubescence, broad palmately veined leaves, racemose inflorescences, five large subequal sepals, and whitish slightly two lipped corolla with purple spots. The mature woody fruits are especially distinctive with their two distal recurved sharp-tipped horns. The somewhat coherent anthers are reminiscent of those seen in Gesneriaceae. *Uñas de diablo* is a common name.

OROBANCHACEAE

By Luis D. Gómez P. and William Burger

REFERENCES—L. D. Gómez, Notes on the biology of Central American Orobanchaceae. *Brenesia* 17: 389–396. 1980. G. B. von Mannagetta, Orobanchaceae, in A. Engler, *Pflanzenreich* IV, 261: 1–348. 1930. J. Thieret, The Genera of Orobanchaceae in the Southeastern United States. *J. Arnold Arbor.* 52: 404–434. 1971.

Key to the Genera of Orobanchaceae

- 1a. Scales overlapping on the lower stem; corolla glabrous externally; anthers slightly exserted; parasites in high-elevation oak forests *Conopholis*
- 1b. Scales not overlapping on the lower stems; corolla puberulent externally; anthers included; rarely collected parasites at higher elevations in open fields *Orobanche*

Annual or perennial **herbs**, all parts lacking chlorophyll, parasitic on the roots of other plants, arising from a thickened base, stems simple or few-branched, thin to thick, usually succulent, glabrous to pubescent, hairs simple or glandular; stipules absent. **Leaves** alternate and simple, reduced to sessile scales, without chlorophyll, margins entire. **Inflorescences** simple or less often branched, flowers in racemes or spikes (rarely solitary and terminal), flowers solitary in the axils of bracts, sessile or pedicellate, bracteoles usually present. **Flowers** bisexual, calyx radially or bilaterally symmetric, tubular or campanulate with 2–5 unequal lobes or teeth, sometimes split on 1 or 2 sides, open or valvate in bud; corolla tubular to campanulate and usually 2-lipped, 4- or 5-lobed, tube curved or straight, upper lip 2-lobed or entire; **stamens** 4, included or exserted, alternate with the corolla lobes, filaments 2 pairs of unequal length, borne on the proximal half of the corolla tube, free, anthers free, dorsifixed, 2 thecae with 1 or 2 thecae fertile, free or coherent, opening by a longitudinal slit, a staminode present or absent; ovary superior, 1-locular with 4 (2–6) intruded parietal placentae, ovules many and anatropous, style simple, stigma simple or 2–4-lobed. **Fruits** capsules, dehiscent loculicidally into 2 or 3 valves; seeds many, small, with ornamented testa, embryo undifferentiated.

A family of ca. 17 genera and 200 species (Mabberley, 1987), in temperate and subtropical climates throughout the northern hemisphere, but with the greatest number of species in the Old World. The lack of chlorophyll, usually simple or few-branched stems, tubular two-lipped corollas, unilocular ovary with intruding parietal placentae, and capsular fruits make these plants easy to identify. The aboveground parts of these plants are short-lived and are easily missed by collectors. One genus is native to Central America and one may be found as an introduced weed. This family is closely related to Scrophulariaceae.

Conopholis Wallroth

REFERENCE—R. Haynes, A monograph of the genus *Conopholis* (Orobanchaceae). Sida 4: 246–264. 1971.

Herbs with short erect unbranched stems, parasitic on oak (*Quercus*) roots, aerial parts of 1 or several annual flowering stems that are covered by imbricate scales near the base, stems arising from a gall-like perennial base, simple or rarely branched, glabrous to densely glandular-pubescent. **Leaves** represented by broad-based sessile scales that are imbricate at the base and alternate distally, yellowish white at first and becoming brown, intergrading with the very similar bracts. **Inflorescences** spike-like racemes with thick axis, flowers separate or crowded, bracts exceeding the calyx in length, sessile or short-pedicellate, 1 or 2 small bracteoles arising from the base of the calyx. **Flowers** with tubular or spathe-like calyx, cleft on one side, irregularly 2-, 4-, or 5-lobed or dentate on the distal margin, divisions acute or rounded; **corolla** tubular and 2-lipped, yellowish white, the upper lip curved or straight, the lower lip with (1 or 2) 3 subequal spreading lobes; stamens 4, exserted, anthers with spurs, thecae slightly divergent, glabrous or sparsely pilose; ovary unilocular with 4 parietal placentas, stigma discoidal. **Fruits** 2-valved capsules, usually enclosed by the persisting perianth, dehiscing irregularly; seeds oval to angular, testa reticulate.

Conopholis is a North and Central American genus of two species, according to Haynes (1971, reference above). A brief overview, however, makes it appear that the collections of *Conopholis* could also be interpreted as representing either a single variable species or several species. The main characteristics used by Haynes to distinguish the two species, apart from geographic separation, are quite variable, even within a single population. Earlier, Standley (1938) placed the Costa Rican material under the name *C. americana* (L.) Wallroth. The genus is distinctive because of its lack of green pigmentation, parasitic association with oak trees, short thick succulent spike-like stems with imbricate bract-like scales, many distally crowded flowers, and pale yellowish tubular two-lipped corollas.

Conopholis alpina Liebmann, Forh. Skand. Naturf. Möde 4: 184. 1847. *C. sylvatica* Liebmann, Forh. Skand. Naturf. Möde 4: 185. *C. mexicana* Gray ex Watson, Proc. Am. Acad.

Arts Sci. 18: 131. 1883. *C. panamensis* Woodson, Ann. Missouri Bot. Gard. 25: 835. 1935. *C. alpina* var. *mexicana* (Gray ex Watson) Haynes, Sida 4: 255. 1971. Figure 28.

Parasitic herbs, stems 6–24(–30) cm tall, 4–12 mm diam., glabrous, proximal scales imbricate, thickened at the base, glabrous. **Leaves** represented by sessile scales 6–18(–21) mm long, 4–7(–11) mm wide, ovate-lanceolate to narrowly oblong-lanceolate, widest just above the base, apex acute to acuminate, margins entire, drying subcoriaceous, surfaces glabrous, often dark brown distally (in life), drying uniformly yellowish brown. **Inflorescences** 2–18 cm long, 2–4 cm wide, bracts 8–20 mm long, separate or overlapping, usually concealing the calyx, pedicels 0–3 mm long, bracteoles 2–4 mm long, ca. 1.5 mm wide, ovate-elliptic, on the lateral sides of the calyx or absent. **Flowers** with calyx 8–12 mm long, 3–4 mm diam., ovoid-tubular, usually split down the anterior side, lobes 2–5, acute to rounded; **corolla** 7–15 mm long, curved downward, white to greenish white (yellowish white when dried), glabrous externally; filaments 9–15 mm long, anthers 1.5–2.5 mm long, with basal appendages ca. 0.4 mm long, usually glabrous. **Fruits** 8–18 mm long, 6–11 mm diam., ovoid-rounded, drying dark, style often persisting; seeds 0.6–1 mm long, with rounded edges, surface yellowish to dark brown and lustrous, minutely reticulate (20×).

Plants of the forest floor in montane oak forests, 2000–2800 m elevation. Flowering in December–April; fruiting in February–July. Costa Rican collections come from the Cordillera de Talamanca and Volcán Irazú. This species, as circumscribed by Haynes, ranges from the southwestern United States to northern Panama.

Conopholis alpina is recognized by its lack of green pigment, restriction to high-elevation oak forests, short thick unbranched stems, curved tubular yellowish corollas, exserted stamens, and many-seeded capsules. The seeds germinate only near young oak roots, and the flowers are pollinated by bumblebees (Gómez, 1980). Haynes placed our material in variety *alpina*, which ranges from southern Mexico to Panama. However, the senior author has seen these plants in a number of areas ranging from Chiapas to Panama and believes that there is a discontinuity of morphology in the Guatemala–Honduras region. Thus, it is possible that the plants of southern Central America are deserving of taxonomic recognition as *C. panamensis*.

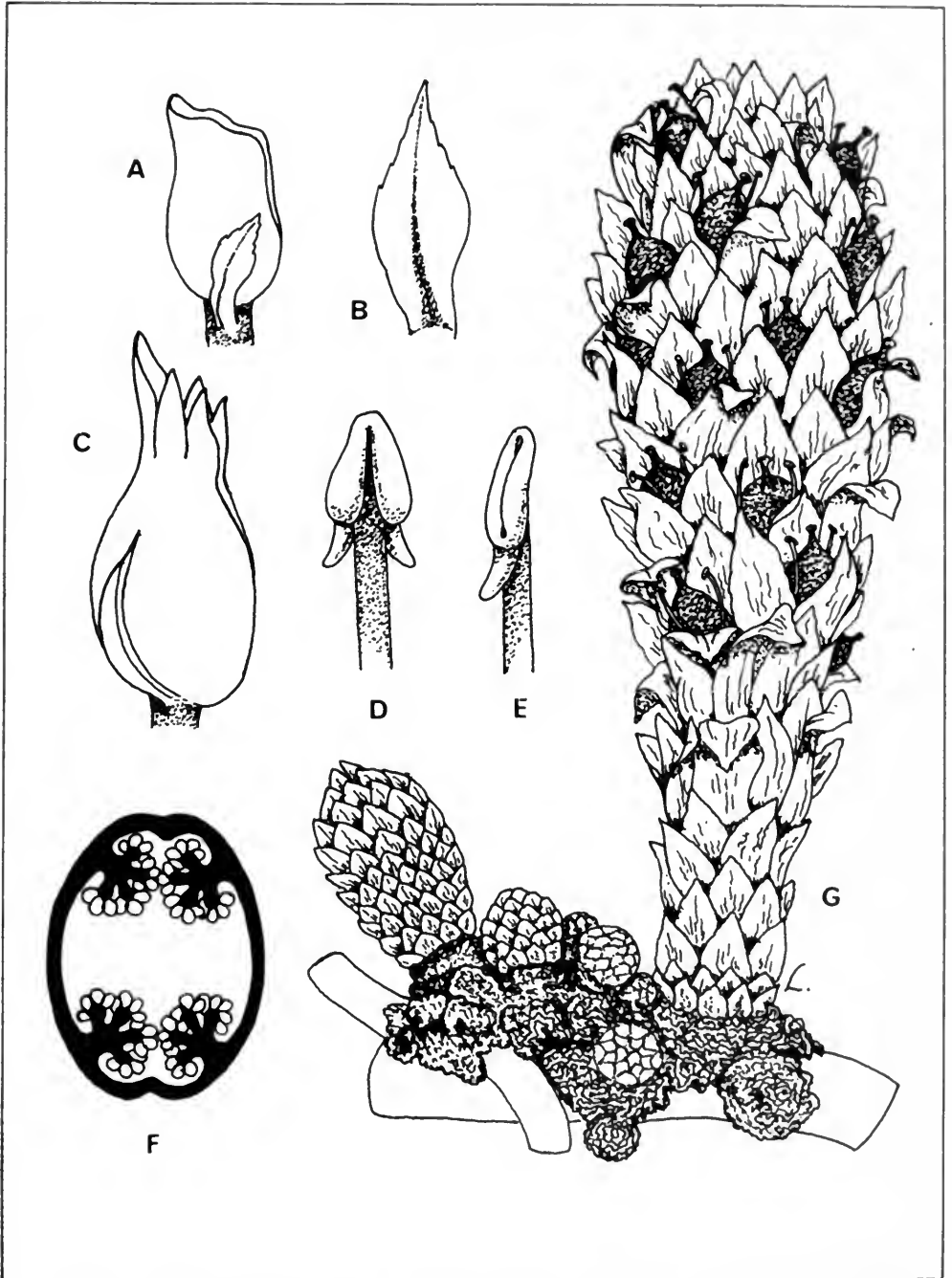


FIG. 28. Orobanchaceae: *Conopholis alpina*. A, Calyx in lateral view. B, Sepaloid bracteole. C, A different calyx in side view. D, Ventral view of stamen. E, Lateral view of stamen. F, Placentation. G, Inflorescence and base.

Orobanche Linnaeus

Herbs parasitic on roots, lacking chlorophyll, stems simple or branched, usually succulent, usually covered with minute gland-tipped hairs. **Leaves** reduced to alternate sessile scales, separate along the stem, yellowish to brown or purple, margins entire. **Inflorescences** terminal spikes or racemes, bracts conspicuous and similar to the scales, bracteoles present or absent. **Flowers** with calyx cupulate to campanulate, 2–5-lobed or divided to the base adaxially and abaxially, lobes equal or unequal; **corolla** tubular, often with minute gland-tipped hairs, 2-lipped, 4- or 5-lobed, upper lip entire or 2-lobed; stamens 4, included, filaments borne near the base of the tube, anthers 2-theous, thecae parallel; disc not apparent; ovary 1-locular, ovules many on 4 parietal placentas, stigma 2-lobed. **Fruits** capsules, oblong, enclosed within the persisting corolla; seeds ellipsoid, coarsely reticulate.

Orobanche is a genus of about 150 species, mostly north temperate, and is especially speciose in Europe. The following species has become a serious agricultural problem in some parts of the world.

Orobanche minor J. E. Smith, English Bot. 6: 422, tab. 422. 1797.

Herbs with single or several clustered stems 8–80 cm tall, the stems rarely with distal branches, 4–10 mm diam., pale rose-yellow to brownish, surface with glandular hairs 0.2–1 mm long. **Leaves** represented by alternate simple scales 1–3 cm long, sessile, broadly ovate, acute, venation parallel. **Inflorescences** spicate, bracts 9–12 mm long, ca. 4 mm wide, sessile, difficult to distinguish from the sepals in dried material, pedicels 0–2(–5) mm long, glandular puberulent, bracteoles absent. **Flowers** with calyx usually split to the base abaxially and adaxially, each portion with 2 long narrow acuminate lobes; **corolla** 12–18 mm long, slightly purplish with purple veins but usually yellowish at the base and lower lip, sparsely puberulent externally, tube ca. 4 mm diam.; filaments ca. 6 and 7 mm long.

Orobanche minor is not native to the Americas and is rarely collected in the American tropics. The senior author observed this species near Prusia, at 1500 m elevation on the slopes of Vocán Irazu, Cartago province, in November 1979 (Gómez 7140 CR, US), where it was parasitizing a

species of clover (*Trifolium*) and two species of grasses. This adventive population probably came from introduced grass or forage (Gómez, 1980). These plants are distinctive because of their lack of green pigmentation, erect unbranched stems with gland-tipped hairs, scale-like leaves similar to the bracts, split calyx, and tubular purple and yellowish corollas. Although associated with a variety of herbs and small shrubs, this species is often found parasitizing plants of the family Fabaceae. In tropical areas they are unlikely to be found below 1000 m elevation.

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Index

The index includes all accepted names (in roman type), synonyms (*italics*), common English names (roman) and vernacular Spanish names (*italics*). The text includes only one new species (**boldface**), *Amphitecna gentryi*.

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Families of seed plants known or expected to occur in Costa Rica and adjacent areas numbered according to the sequence of Engler's *Syllabus der Pflanzenfamilien*, edition II, reworked by L. Davis (1936).

1	Cycadaceae	71	Nyctagynaceae	140	Oxymonaceae
2	Taxaceae	72	Ceratophyllaceae	141	Theaceae
3	Rubiacarpaceae	73	Ranunculaceae	142	Guttiferae, incl. Hypericaceae
4	Araucariaceae	74	Berberidaceae	143	Elatinaceae
5	Pinaceae	75	Menispermaceae	144	Elatinaceae
6	Cupressaceae	76	Magnoliaceae	145	Bixaceae
7	Gnetaceae	77	Alnaceae	146	Cochlospermaceae
8	Typhaceae	78	Myrsinaceae	147	Violaceae
9	Potamogetonaceae	79	Monimiaceae	148	Placourtiaceae
10	Najadaceae	80	Lauraceae	149	Torneaeae
11	Alismataceae	81	Utriculariaceae	150	Possilloraceae
12	Butomaceae	82	Papaveraceae, incl. Fumariaceae	151	Caryaceae
13	Hydrocharitaceae	83	Capparidaceae	152	Leguminales
14	Triuridaceae	84	Cruciferae	153	Regoniaceae
15	Graminaceae	85	Tovariaceae	154	Cactaceae
16	Cyperaceae	86	Resedaceae	155	Thymelaeaceae
17	Palmaceae	87	Moringaceae	156	Elaeagnaceae
18	Cyclanthaceae	88	Droseraceae	157	Lythraceae
19	Araceae	89	Crassulaceae	158	Punicaceae
20	Lemnaceae	90	Saxifragaceae	159	Lecythidaceae
21	Mayacaceae	91	Brunelliaceae	160	Rhizophoraceae
22	Xyridaceae	92	Cunoniaceae	161	Combretaceae
23	Eriocaulaceae	93	Hamamelidaceae	162	Myrtaceae
24	Bromeliaceae	94	Rosaceae	163	Melastomataceae
25	Commelinaceae	95	Connaraceae	164	Onagraceae
26	Pontederiaceae	96	Leguminosae	165	Malvaceae
27	Juncaceae	97	Krameriaceae	166	Araliaceae
28	Liliaceae	98	Oxalidaceae	167	Umbelliferae
29	Haemodoraceae	99	Geraniaceae	168	Cornaceae
30	Amaryllidaceae	100	Tropaeolaceae	169	Clethraceae
31	Velloziaceae	101	Linaceae, incl. Humiriaceae	170	Monotropaceae
32	Dioscoreaceae	102	Erythroxylaceae	171	Pyrolaceae
33	Iridaceae	103	Zygophyllaceae	172	Ericaceae
34	Musaceae	104	Rutaceae	173	Theophrastaceae
35	Zingiberaceae	105	Simarubaceae	174	Myrsinaceae
36	Cannaceae	106	Burseraceae	175	Primulaceae
37	Marantaceae	107	Meliaceae	176	Plumbaginaceae
38	Burmanniaceae	108	Malpighiaceae	177	Sapotaceae
39	Orchidaceae	109	Trigonaceae	178	Ebenaceae
40	Casuarinaceae	110	Vochysiaceae	179	Symplocaceae
41	Piperaceae	111	Polygalaceae	180	Styracaceae
42	Chloranthaceae	112	Dichapetalaceae	181	Oleaceae
43	Laciniaceae	113	Euphorbiaceae	182	Loganiaceae
44	Salicaceae	114	Callitrichaceae	183	Gentianaceae
45	Garryaceae	115	Buxaceae	184	Apocynaceae
46	Myricaceae	116	Coriariaceae	185	Asclepiadaceae
47	Juglandaceae	117	Anacardiaceae	186	Convolvulaceae
48	Batidaceae	118	Cyrillaceae	187	Poleniaceae
49	Betulaceae	119	Aquifoliaceae	188	Hydrophyllaceae
50	Fagaceae	120	Celastraceae	189	Boraginaceae
51	Ulmaceae	121	Hippocratiaceae	190	Verbenaceae
52	Moraceae	122	Staphyleaceae	191	Labiatae
53	Urticaceae	123	Loasaceae	192	Solanaceae
54	Podostemonaceae	124	Hippocastanaceae	193	Scrophulariaceae
55	Proteaceae	125	Sapindaceae	194	Schlegeliaceae
56	Oleaceae	126	Sabiaceae	195	Pedaliaceae
57	Opiliaceae	127	Balsaminaceae	196	Martyniaceae
58	Loranthaceae	128	Rhamnaceae	197	Orobanchaceae
59	Aristolochiaceae	129	Vitaceae	198	Cesariaceae
60a	Hydnoraceae	130	Elaeocarpaceae	199	Leptulariaceae
60b	Rafflesiaceae	131	Tiliaceae	200	Acanthaceae
61	Balanophoraceae	132	Nitellaceae	201	Flacourtiaceae
62	Polygonaceae	133	Boraginaceae	202	Rubiaceae
63	Chenopodiaceae	134	Stracocaceae	203	Caprifoliaceae
64	Amaranthaceae	135	Dilleniaceae	204	Viburnaceae
65	Nyctaginaceae	136	Auliniaceae	205	Dipsacaceae
66	Phytolaccaceae	137	Ochnaceae	206	Cucurbitaceae
67	Aizoaceae	138	Caryocaraceae	207	Carpantiliaceae
68	Portulacaceae	139	Marcgraviaceae	208	Compositae
69	Basellaceae				
70	Caryophyllaceae				

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