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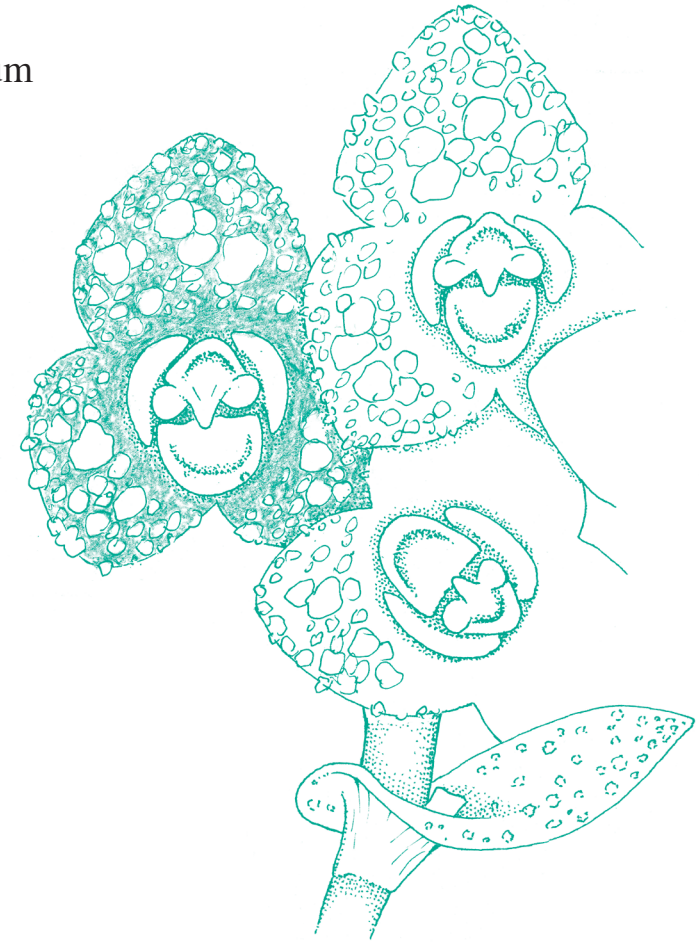

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DRABA BRUCE-BENNETTII (BRASSICACEAE), A REMARKABLE NEW SPECIES FROM YUKON TERRITORY, CANADA

Ihsan A. Al-Shehbaz[1]

Abstract. *Draba bruce-bennettii* (Brassicaceae), a new species from Yukon (Canada), is described and illustrated. It is easily distinguished from the closely related to *D. aleutica* and *D. macounii* by having linear to linear-oblanceolate basal leaves pubescent adaxially with simple trichomes and abaxially with 2–4-rayed forked trichomes, oblong fruit pubescent with simple and forked trichomes, fruiting pedicels pilose with simple trichomes, and yellow, obovate petals 5–6.5 × 2.5–3.2 mm.

Keywords: Brassicaceae, Canada, Cruciferae, *Draba*, Yukon Territory

Draba L., the largest and most complex genus in the family Brassicaceae (Cruciferae), includes at least 390 species (Al-Shehbaz, 2012) represented in the Americas by more than 200 species centered mainly in the Rocky Mountains and along the Andes from Colombia to the tip of Patagonia (author's compilation). The United States and Canadian species have recently been well covered, and as many as 17 species were added within the past eight years (Al-Shehbaz, 2009, 2013; Al-Shehbaz & Mulligan, 2013; Al-Shehbaz & Windham, 2007; Al-Shehbaz et al., 2010; Elven & Al-Shehbaz, 2008). These findings clearly indicate that our knowledge of the genus in North America is far from being complete, and with intensive fieldwork in the poorly explored parts, it is expected that several more novelties will be added. The following new species was discovered during the study of specimens of Canadian *Draba* that were sent to the author for determination.

Draba bruce-bennettii Al-Shehbaz, *sp. nov*. Type: Canada, Yukon Territory, Langham Mountain, 19 July 2012, 62.25057°N, 138.04092°W, 1898 m, *B. A. Bennett & S. G. Cannings 12-0195* (Holotype: MO 6598201; Isotype: BABY 8349). Fig. 1.

Plants perennial, scapose, pulvinate and 4–6 cm in diam.; caudex many branched, with persistent petioles of previous seasons, some branches terminated in sterile rosettes. *Basal leaves* rosulate, densely imbricate; petiole-like base thin, 2–4 mm, becoming indurated and stramineous in subsequent years; blade linear to linear-oblanceolate, 5–8 × 0.7–1.5 mm, entire, abaxially pubescent with stalked 3- or 4-rayed trichomes 0.2–0.4 mm, adaxially and ciliate margin pubescent with straight, subsetose, simple trichomes (0.5–)0.7–1.2 mm; midvein obscure; cauline leaves of flowering stems absent. *Racemes* ebracteate, 1–4-flowered, sometimes appearing 1-flowered due to abortion of all but one flower bud, not or hardly elongated in fruit; peduncle 1–4 mm, pilose, hidden by imbricated leaves; rachis straight; fruiting pedicels 4–11 mm, divaricate, straight, pilose with soft, simple trichomes 0.6–1 mm, emerging above rosettes. *Flowers*: sepals oblong, 2–3 mm, caducous, sparsely pubescent with simple and forked trichomes; petals bright yellow, obovate, 5–6.5 × 2.5–3.2 mm, cuneate to a minute claw-like base; filaments 2.5–3 mm, dilated at base; anthers oblong, 0.3–0.4 mm. *Fruit* oblong, 3.5–4.5 × 2.5–3 mm, laterally ca. 2 mm wide at base; valves inflated basally into a pouch, latiseptate distally and at margins, not twisted, densely pubescent with simple and short-stalked forked trichomes 0.1–0.2 mm; style 0.2–0.4 mm; stigma distinctly wider than style; ovules and seeds 8–14 per fruit. *Seeds* oblong-ovate, slightly flattened, 0.9–1.4 × 0.5–0.6 mm, wingless.

Eponymy: This novelty is named in honor of Bruce Andrew Bennett, director of the BABY herbarium in recognition of his extensive fieldwork in western Canada, especially Yukon Territory, and for gathering the type collections.

Additional specimen examined: Canada, Yukon Territory, Tritop Mountain, 19 July 2012, 62.21593°N, 137.51984°W, 1836 m, *B. A. Bennett & S. G. Cannings 12-0205* (MO 6598200).

Distribution: known thus far only from Langham and Tritop mountains in southwestern Yukon.

Habitat: in tundra on unglaciated volcanic (andesite) bedrock dominated by moss and lichens amongst *Dryas ajanensis*/*Salix arctica* tundra with *Anthoxanthum monticola*, *Saxifraga tricuspidata, Minuartia arctica*, and *Carex microchaeta*.

IUCN Red List Category: *Draba burce-bennettii* is known only from the two collections above. Although the collection labels indicated that it is somewhat common, a full conservation assessment cannot be determined at this point and, therefore, according to the IUCN (2001) classification, I prefer to tentatively give it a Data Deficient (DD) criterion.

Draba bruce-bennettii is most closely related to *D. aleutica* E.Ekman (Aleutian Islands, Pribilov Islands (St. Paul), Alaskan Peninsula near Ugashik, and Ogilvie

I am grateful to Bruce A. Bennett (BABY) for sending his Canadian collections of the Brassicaceae for verification of their identities and for providing data on the habitat and communities where the above novelty grows. Thanks also to Jeff Bond and Charlie Roots (Geological Survey of Canada) for information on the rock formation on which the novelty grows, as well as to Heather Cole for providing distribution data on *Draba macounii*. I also thank Gustavo A. Romero and Deborah Smiley for their editorial advice. Partial funding for this research was supported by the United States National Science Foundation grant DEB-1252905, for which I am profoundly grateful.

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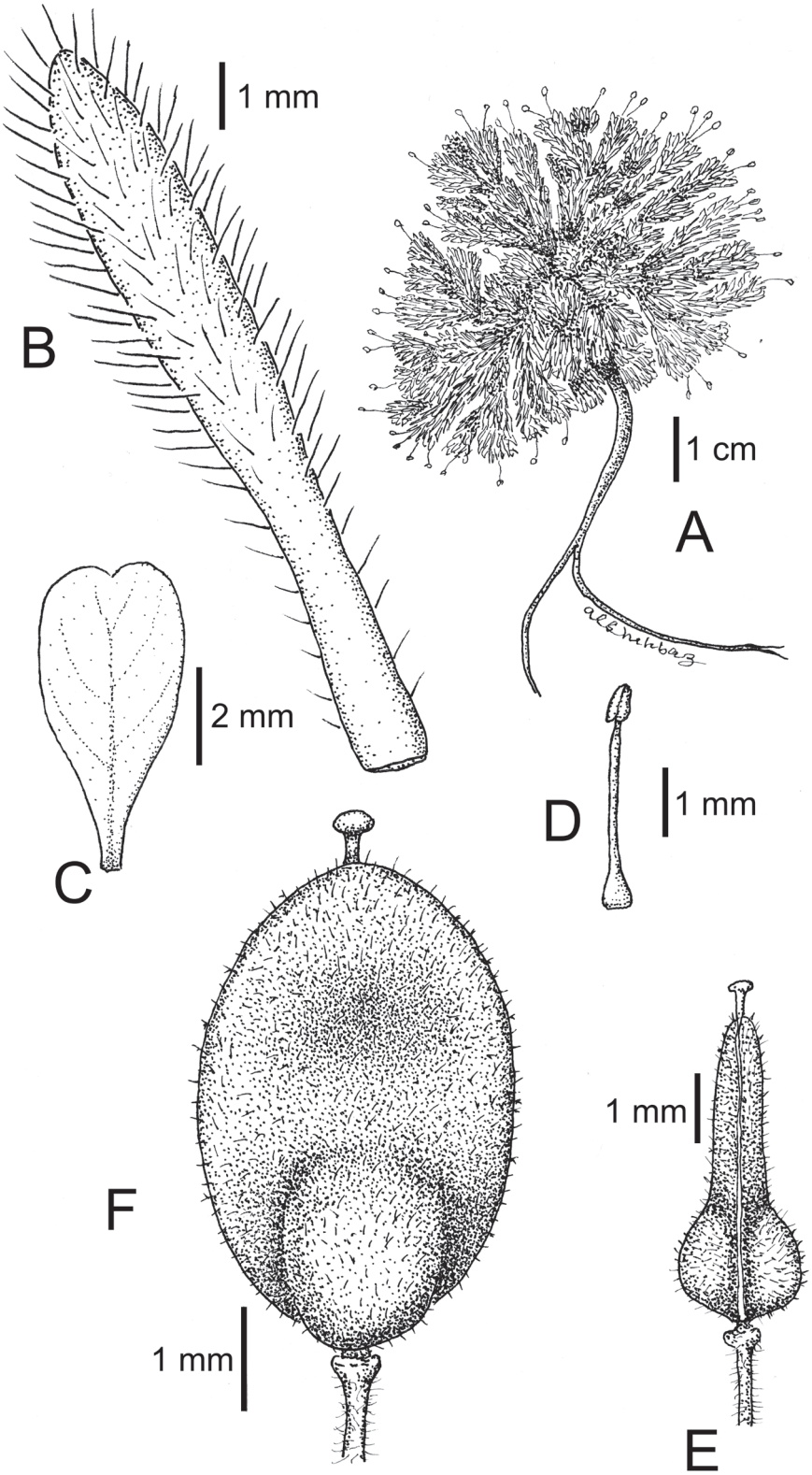

FIGURE 1. *Draba bruce-bennettii* Al-Shehbaz. **A**, plant; **B**, leaf; **C**, petal; **D**, stamen; **E**, fruit side view; **F**, fruit front view. Drawn by Al-Shehbaz: A, from paratype, *Bennett & Cannings 12-0205* (MO 6598200); B–F from the holotype, *Bennett & Cannings 12-0195* (MO 6598201).

and Montana Mts. in Yukon) and *D. macounii* O. E.Schulz (Alberta, Alaska, British Columbia, Montana, Northwest Territories, Yukon), which it resembles by lacking the cauline leaves and by having basally inflated fruit, yellow petals, and leaf indumentum of simple and 2–4-rayed trichomes. It differs from *D. aleutica* by having linear to linear-oblanceolate (vs. spatulate to obovate) basal leaves 0.7–1.5 (vs. 2–4.5) mm wide and abaxially with 2–4-rayed and adaxially simple subsetose trichomes (vs. both surfaces glabrous or with simple and 2-rayed trichomes), bright yellow (vs. yellowish green or pale yellow) and obovate (vs. linear-oblanceolate) petals 5–6.5 × 2.5–3.2 mm (vs. 3–4 × 0.5–0.8 mm), oblong (vs. broadly obovoid to subglobose) fruit 2.5–3 (vs. 3–4.5) mm wide and covered with simple and forked (vs. glabrous or only with simple) trichomes, 8–14 (vs. 4–8) ovules and seeds per fruit, and seeds 0.9–1.4 × 0.5–0.6 mm (vs. 1.4–1.8 × 0.9–1.1 mm). From *D. macounii,* the new species differs by having pulvinate (vs. non-pulvinate) plants with linear to linear-oblanceolate (vs. oblanceolate to obovate) basal leaves 0.7–1.5 (vs. 2–4) mm wide, 1–4-flowered (vs. 3–13-flowered) racemes, straight (vs. curved) fruiting pedicels pilose all around (vs. glabrous or pubescent only abaxially) with simple (vs. simple and 2-rayed) trichomes, obovate petals 5–6.5 × 2.5–3.2 mm (vs. spatulate and 2.7–4 × 1–2 mm), and oblong (vs. ovoid) fruit 3.5–4.5 × 2.5–3 mm (vs. 4–8 × 2–4.5 mm) that are rounded (vs. acute) apically and pubescent with simple and 2-rayed trichomes (vs. glabrous).

Draba bruce-bennettii is remarkable among the North American species of the genus and can easily be separated from them by a combination of having latiseptate fruit distinctly pouched basally, strongly ciliate and densely imbricate leaves pubescent adaxially with subsetose trichomes, and 1–4-flowered racemes of which the pedicels appear solitary and slightly emerging above the rosettes.

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FIRST REPORT OF RHABDODENDRACEAE FOR THE VASCULAR FLORA OF COLOMBIA AND THE UPPER RÍO NEGRO BASIN, WITH COMMENTS ON PHYTOGEOGRAPHY, HABITATS, AND DISTRIBUTION OF *RHABDODENDRON AMAZONICUM*

Gerardo A. Aymard,[1–3] Henry Arellano-Peña,[1,4]
Vladimir Minorta-C.,[4] and Francisco Castro-Lima[1]

Abstract. Rhabdodendraceae is recorded for the first time in the vascular flora of Colombia and the upper Río Negro basin, based on collections of *Rhabdodendron amazonicum* from the upper Cuyarí river, Guianía department, Colombia, and the upper Isana (Içana) river, Amazonas state, Brazil, respectively. These two localities extend considerably the northwesternly distribution of this taxon inside the Amazon Basin. Notes about the phytogeography (e.g. insights as to why this species has not yet been found between Manaus and the confluence of the Guainía and Casiquiare rivers), the habitats of *R. amazonicum*, and an updated overview of the known specimens using a geographic distribution map of this taxon is also included. The discovery of this family in the upper Río Negro region, demonstrates the value of field work through alliances between private initiatives and the Kuripaco nation.

Resumen. Se registra la familia Rhabdodendraceae para la flora vascular de Colombia y la región del alto Río Negro basándose en dos colecciones de *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber del alto río Cuyarí, departamento del Guianía y el medio río Isana (Içana), estado Amazonas, Brasil, respectivamente. Estas localidades extienden considerablemente la distribución de esta familia al noroeste de la región Amazónica. Se incluyen notas acerca de la fitogeografía (información acerca de la ausencia de esta especie entre Manaus y las confluencias de los ríos Guianía y Casiquiare), hábitats de *R. amazonicum*, y un mapa de la distribución geográfica elaborado a partir de la actualización de las colecciones de este especie. El hallazgo de *R. amazonicum* en la región del alto Río Negro demuestra el valor de los trabajos de campo realizados a través de la alianza de iniciativas privadas y el pueblo Kuripaco.

Yaakuti iipenaa (Kuripaco). Pakapa jnaji jaiko Rhabdodendraceae ikitsiñape Colombialiko jnite payawiya jiwidaapuliko tsakja nayu jnaji yamada naniwampe nepitana *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber aji kuwiali jiwidapuliko, departamento del Guainía jnite pamuyua Iniali (Isana), estado Amazonas, Brasil, tsakja. Jnaji jipai niniperi nayapita manupe natawiñakawa jnaji jaiko nakitsiñape jnaji wakaiteri aji noroeste lisro jliaji región Amazónica. Ninitsakja nadanampe jaikolima inakuapana (nawaupiakje linaku jliaji kuadaka kuri pakapa jnaji jnapepe jaiko itiaji Manaus jnite liukawa aji nauketaakakawa jnaji payawiya jnite katsikiali), natawiñakawa jnaji *R. amazonicum*, jnite pada mapa nakaitekawa kjereka natawiñawa jnaji jaikolima nauyawaka najnaitanda nayu jnaji nauketampe jlipepe jliaji jaiko wakaiteli inaku. Jliaji wauketaka *R. amazonicum* payawiya jiwidapuliko likadaa wakapa kanakaidalika jliaji idejnikjeti awakadaliko napiyawaka jnaji empresa privada jnite kuripako nai.

Keywords: Rhabdodendraceae, Colombia Flora, Upper Río Negro, new family record

Rhabdodendraceae currently is a tropical family with one genus, *Rhabdodendron* Gilg & Pilg., and three species (Huber, 1909, Prance, 1972, 2004; Medeiros and Amorim, 2014); they are a significant component of some Neotropical rain forests, such as the terra-firme forests, Amazon caatingas ("campinaranas") as well as open areas like Amazon caatinga shrubland or campinas. The genus *Rhabdodendron* has had rather a remarkable taxonomic history, summarized in Prance (1972: 3–5). Although the first species was not described until 1905, specimens eventually referred to the genus had been collected in Brazil in the early 19th century by Carl Friedrich Philipp von Martius in 1819 and by Ludwig Riedel in 1826–1828 (Fig. 1–2).

Gilg and Pilger (1905) placed *Rhabdodendron* in Rutaceae, suggesting affinities with tribe *Cusparieae*. Species eventually transferred to *Rhabdodendron*, described by Bentham in 1853, were at first referred to *Lecostemon* Sesse & Moc. ex DC., a genus based on one of the original drawings of Mexican plants by Mociño and Sesse (Prance, 1968). Huber (1909) transferred three of

We gratefully acknowledge the support provided by Compensation International Progress S.A., -Ciprogress Greenlife- and the Kuripaco nation alliance in the course of a botanical expedition to the Cuyarí and Isana rivers sponsored by the "Flor de Inírida REDD+ project of the Guayana-Amazonian transition region," which greatly facilitated the discovery of this new family for the Flora of Colombia. We thank G. Bernal G., A. Micolta C., and D. S. Bernal L. for logistic support, O. Cordubí and L. Flores for their field assistance, the Kuripaco people of the communities of Cejal, Amanadona and Campo Alegre (Cuyarí river) for their extraordinary effort carrying hundreds of kilograms of equipment and food along ancestral trails between Caño Nakén and Río Cuyarí, and the "raudal" Yuruparí along the Río Cuyarí. The authors were honored to have the paper reviewed by Sir G. T. Prance (K), and are also thankful to G. A. Romero (AMES) for his help finding literature and further reviewing the text, to J. Rohwer (HBG), C. Parra-O. (COL), A. M. Amorim (CEPEC), and A. Fleischmann (M) for their herbarium assistance, to H. ter Steege for providing the ATDN *Rhabdodendron* database, to J. Stropp for preparing the information from the Içana river, to S. Mori (NY) and B. Angell for kindly providing the beautiful *R. amazonicum* plate, and finally to Albeiro Calero Cayopare, a native expert in the Kuripaco language (from Tonina, a Colombian village along the Guianía river) for his help translating the abstract into Kuripaco.

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FIGURE 1. One of the first specimens of the genus *Rhabdodendron* Gilg & Pilg., collected in the Amazon Basin by C. F. P. von Martius, representing *R. microphyllum* (Spruce ex Benth.) Huber. Image courtesy of the Herbarium—Botanische Staatssammlung München (M).

FIGURE 2. One of the first specimens of the genus *Rhabdodendron* Gilg & Pilg., collected in the Amazon Basin by L. Riedel. Image courtesy of the New York Botanical Garden (NY).

Bentham's species of *Lecostemon* to *Rhabdodendron*, and proposed a new tribe in Rutaceae, *Rhabdodendreae*; Sandwith (1943) transferred the fourth species. The genus *Rhabdodendron* was included in Rutaceae in Engler's Pflanzenfamilien (Krause, 1914). Later, Engler (1931) gave *Rhabdodendron* subfamily rank, *Rhabdodendroideae*. The genus was placed in a separate family after it was shown it differed from Chrysobalanaceae, Phytolaccaceae, and Rutaceae in many features of morphology and anatomy, which were described in detail by Prance (1968, 1972, 2002, 2004). Subsequently, a molecular phylogenetic analysis indicates a relationship with Caryophyllidae (Fay et al., 1997).

The occurrence of Rhabdodendraceae in the flora the Colombia, as well as the extension of their distribution in the Upper Río Negro basin, is reported here for the first time based on collections of *R. amazonicum* (Spruce ex Benth.) Huber from the Rio Cuyarí, Guianía Department (Fig. 3–5), and the upper Isana (or Içana) river, Amazonas state, Brazil. In addition, we provide morphological features that help identify this species, update information about its geographical distribution and the habitats it occupies, and give insights on why this taxon so far has not been found between Manaus and the upper Río Negro (i.e. the confluence of the Guainía and Casiquiare rivers), along the northern and eastern margin of the Río Negro.

Material and Methods

Specimens were determined consulting relevant literature (Prance, 2005, 2009, Riviero et al., 1999). An updated database and a map of the geographic distribution of this species (Fig. 6) was compiled using information from the following databases: Tropicos (www.Tropicos. org), The speciesLink Network (http://www.splink.org.br), Lista de espécies da Flora do Brasil (http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB206), Jabot (http://www.jbrj.gov.br/jabot), Catalog of Vascular Plant Species of Central and Northeastern Brazil (http://sciweb.nybg.org/Science2/hcol/planalto/checklist.asp.html#), and the Amazon Tree Diversity Network (http://atdn.myspecies.info/). In addition, we considered the specimens of *R. amazonicum* deposited in the following herbaria: GH, MO, US, and NY (acronyms according to Thiers, 2012). Our updated database has 288 records (Brazil: 227; Colombia: 1; French Guiana: 29; Guyana: 16; Suriname: 15); it is available from the corresponding author.

Results

Rhabdodendraceae are shrubs to small evergreen trees, with exstipulate, simple, alternate leaves, gland-dotted, covered by fringed-peltate hairs, rather congested and grading into much smaller undifferentiated leaves at the beginning of each innovation. The flowers have five petals and numerous stamens with short filaments and long anthers, and a single carpel with a basal style. The fruit is a distinctive drupe held in a cup-shaped structure (like several genera of Lauraceae) formed by the persistent calyx and the swollen apex of the pedicel. Fig. 7.

Presently, three species of Rhabdodendron are recognized: *R. amazonicum*, a taxon hitherto well known from the Guianas, central and eastern Amazon Basin, which extends its southern range to the "Serra do Cachimbo" (on the border of Mato Grosso and Pará states), where it reaches an altitude of 600 m, in a region that represents a transition between the Amazon and the Central Planalto vegetation (Lleras & Kirkbride, 1978, Prance, 1989). The other two species have more restricted distributions: *R. macrophyllum* (Spruce ex Benth.) Huber (which includes in its synonymy the type of the genus, *R. columnare*) is limited to white sand habitats and secondary vegetation edges of terra firme forests located between the Trombetas river and Manaus, one collection from río Mojú, and *R. gardnerianum* (Benth.) Sandw., a shrub only known by fewer collections in the Cerrado habitats situated in the Northwestern portion of the Bahia and Tocantins states, Brazil (The speciesLink Network: http://www.splink.org.br).

Rhabdodendron Gilg & Pilg., Verh. Bot. Vereins Prov. Brandenburg 47: 152. 1905.

Type species: *R. columnare* Gilg et Pilger.

Rhabdodendron amazonicum (Spruce ex Benth.) Huber, Bol. Mus. Paraense Emilio Goeldi: Zool. 5: 427. 1909. Fig. 2–8.

Basionym: *Lecostemon amazonicum* Spruce ex Bentham, Jour. Bot. Kew. Misc. 5: 295. 1853. TYPE. BRAZIL. Pará: Santarém, *R. Spruce 377* (Holotype: K; Isotypes: LD, MG, OXF, P).

Synonyms: *Lecostemon crassipes* Spruce ex Bentham, Jour. Bot. Kew Misc. 5: 295. 1853. TYPE. BRAZIL. Amazonas: Manaus, *R. Spruce 1497* (holotype: K; Isotypes: BM, CGE, M, NY, OXF, P).

Rhabdodendron crassipes (Spruce ex Bentham) Huber, Bol. Mus. Emilio Goeldi 5: 428. 1909.

Lecostemon crassipes var. *cayennense* Bentham, Jour. Bot. Kew Misc. 5: 295. 1853. TYPE: FRENCH GUIANA ["CAYENNE"]. Without any other locality, *J. Martin s.n.* (Holotype: K; isotype, BM).

Rhabdodendron duckei Huber, Bol. Mus. Emilio Goeldi 5: 428. 1909. TYPE. BRAZIL. Pará: Prope Obidos, *in sylvulis capueiras dictis*, 20 December 1903, *A. Ducke 8546* (Holotype: MG; Isotypes: BM, RB, US).

Rhabdodendron paniculatum Huber, Bol. Mus. Emilio Goeldi 5: 429. 1909. TYPE. BRAZIL. Pará: [*in sylvulis capueiras dictis prope*] Obidos, 21 November 1907, *A. Ducke 8854* (Holotype, MG; Isotypes, BM, US).

Rhabdodendron longifolium Huber, Bol. Mus. Emllio Goeldi 5: 429. 1909. TYPE: BRAZIL. Pará: [*in cacumine collinis prope*] Faro, 26 August 1907, *A. Ducke 8504* (Syntype: MG); Pará: [*in cacumine Morro do Taboleirinho ad fl.*] Mapuera, 1 December 1907, *A. Ducke 8989* (Syntype: MG).

FIGURE 3. Representative specimen of *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber from the Cuyarí river, Guianía, Colombia (*Minorta-C. 991*, COL). Image courtesy of the Colombian National Herbarium (COL).

FIGURE 4. Representative specimen of *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber from the Cuyarí river, Guianía, Colombia (*F. Castro-Lima et al. 18215*, COL). Image courtesy of the Colombian National Herbarium (COL).

FIGURE 5. Representative specimen of *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber from the Cuyarí river, Guianía, Colombia (*González et al. 635*, COL). Image courtesy of the Colombian National Herbarium (COL).

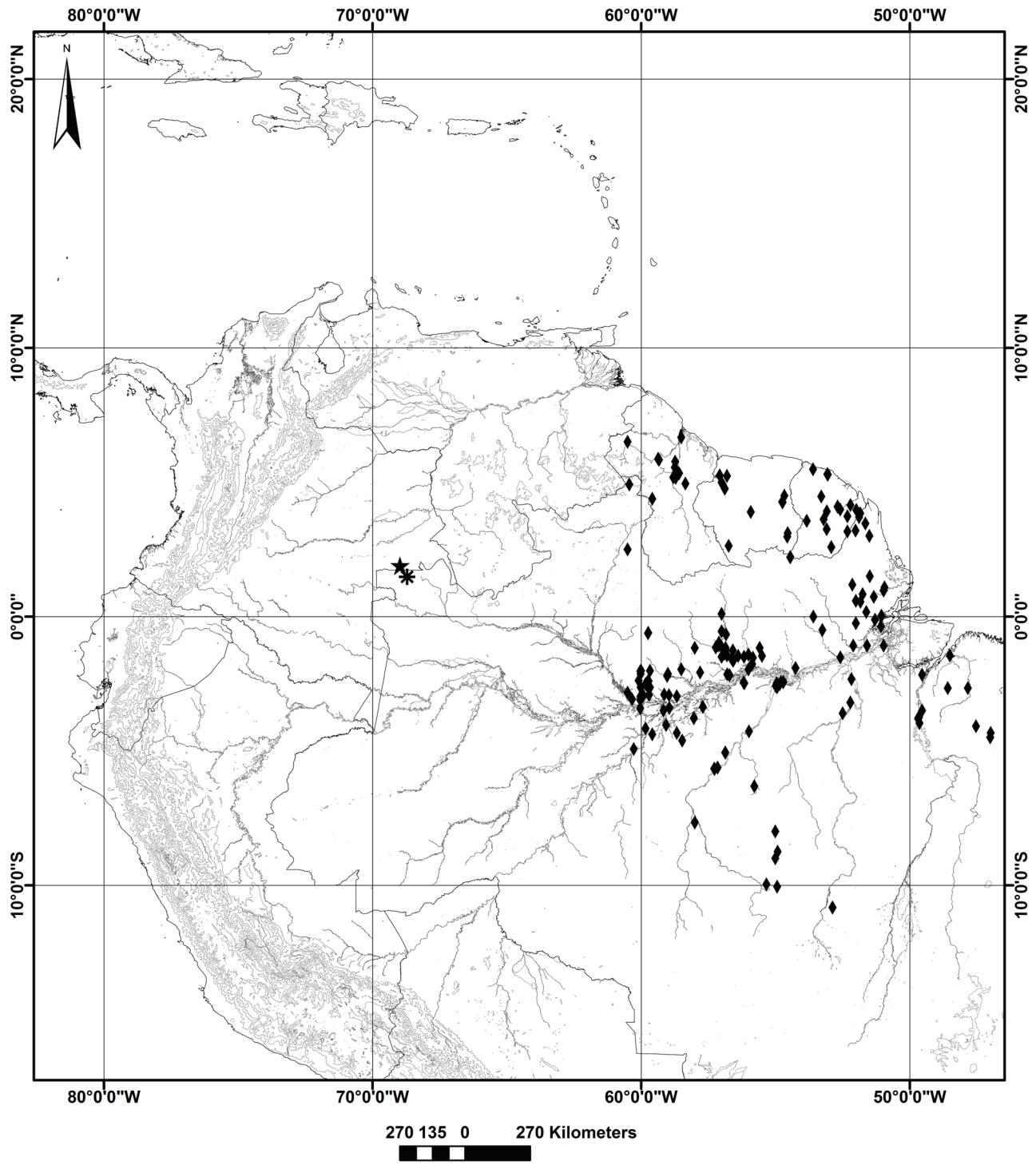

FIGURE 6. Geographical distribution of *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber (♦), with emphasis on new records from Colombia (★) and upper Río Negro of Brazil (✱).

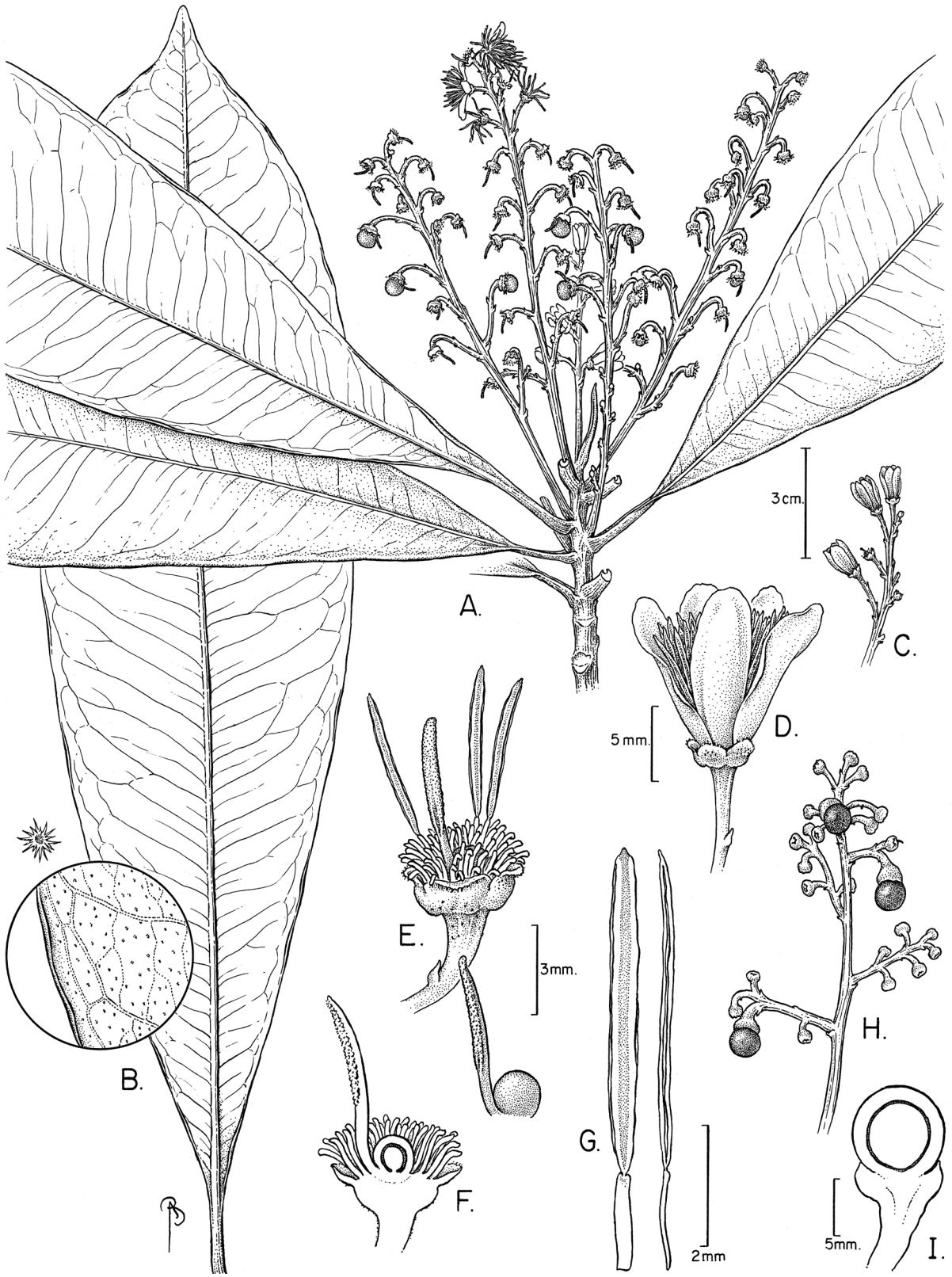

FIGURE 7. *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber. **A**, stem with leaves and inflorescences; **B**, leaf with detail of abaxial surface and lepidote scale; **C**, part of inflorescence; **D**, lateral view of flower; **E**, lateral view of flower with most of anthers disarticulated; **F**, medial section of flower (left) and gynoecium with gynobasic style (right); **G**, adaxial (right) and lateral (left) views of anther; **H**, part of infructescence; **I**, medial section of fruit. Drawing by B. Angell. Reprinted with permission from S. Mori and B. Angell.

Rhabdodendron arirambae Huber, Bol. Mus. Emilio Goeldi 5: 430. 1909. TYPE. BRAZIL. Pará: Alto Ariramba, campina-rana, 20 December 1906, *A. Ducke 8000* (Holotype: MG).

Lecostemon sylvestre Gleason, Bull. Torrey Club 54: 68. 1927. TYPE. GUYANA. Kangaruma-Potaro Landing, dense upland bush, small tree, 15 feet high, 25–27 June 1921, *H. A. Gleason 211* (Holotype: NY; Isotype: GH, K, US).

Rhabdodendron sylvestre (Gleason) Maguire, Bull. Torrey Club 75: 397. 1948.

Shrub to small *trees* to 15 m × 20 cm diameter, the wood with anomalous secondary phloem, the young branches with scattered peltate hairs, with a thin hard bark. *Leaves* oblanceolate, oblong to oblong-obovate, gradually narrowing from above middle to base, coriaceous, 20–39 × 3–10 cm, the apex acute, acuminate or mucronate, most frequently with an acumen 2–9 mm long, gradually narrowed to a cuneate base, glabrous above, with few scattered peltate hairs beneath, not rugose on both surfaces; midrib plane to prominulous above, prominent beneath; primary veins 30–45 pairs, plane to prominulous above, prominulous beneath, anastomosing but not forming a conspicuous marginal nerve; *petioles* 1.5–3.5 cm long, with scattered peltate hairs, terete, not winged. *Stipules* absent. *Inflorescences* of axillary and sometimes terminal panicles or occasionally reduced to racemes, 9–17 cm long, sparsely peltate pubescent becoming glabrous with age. *Bracts* and bracteoles ovate to lanceolate, persistent, 1–2 mm long, chartaceous; pedicels 6–15 mm long, glabrescent, frequently recurved, often with 2 lanceolate bracteoles. *Calyx-tube* turbinate-campanulate, 2–4 mm long, the lobes small but distinct, and apparent in young flowers only. *Petals* 5, oblong, 7–8 mm long, sepaloid, minutely punctate. *Stamens* ca. 45, the filaments short and flattened, persisting after flowering and then recurved; anthers linear, ca 7 mm long, basifixed, caducous. *Ovary* globose, glabrous. *Style* arising from base of ovary to one side of it, elongate, the stigmatic surface long and linear. *Fruit* subglobose, 6–10 mm diameter (Fig. 8); exocarp glabrous, smooth but wrinkled when dry; mesocarp very thin, fleshy; endocarp thin, bony; fragile, with median line of fracture, glabrous within.

Iconography: Prance (1968: Figures 4B [as *R. sylvestre*], 5A–B; 1972: Figures 3A, 6C–J).

Nomenclatural note: Comparing the protologue of *R. duckei* (Huber, 1909) with what has been cited most recently (e.g., Prance, 1968; 1972: 14), and the specimens bearing the type number in different herbaria, there seems to be a discrepancy in the type locality of *Rhabdodendron duckei*. Huber cited "*Hab. in silvulis Capueiras dictis prope Obidos*, 20 XII 03 Leg. *A. Ducke 4856,*" which differs from what is found, for example, on the label of an isotype at BM. The locality cited in the protologue may be a typographical error, but we have not located any possible *errata* in two separate copies of the journal. In the meantime, here we cite the locality reported in Prance (1968; 1972: 14), reflecting the label data on the different replicates of the type reported herein.

Prance (1972: 14) cited "*Rhabdodendron crassipes* var. *cayenense* **[*sic*]** Bentham," a name never published by Bentham under that generic name, but the citation can be interpreted as a typographical error, and the listing does account for the new synonymy.

Additional Specimens examined: BRAZIL. Amazonas: Upper rio Içana, Comunidad de Jandu Cachoeira, Campinarana atrás da Pista de Avião, 0°07'49"S, 67°05'21.1"W, May 2007, sterile, *J. Stropp, P. Assunção & P. Assunção 214* (EAFM). COLOMBIA. Guainía: Panapaná, estribaciones del Cerro Campo Alegre o Guagua, ca. 3.5 km al Norte de la comunidad de Campo Alegre, 01°53'13"N, 68°58'27"O, 70 m, 01 May 2014, flowering and fruiting, *V. Minorta-C., G. Aymard, F. Castro-Lima, A. Lozano, M. González y C. Villegas 991* (COL, COAH, FMB, HUA; HUAZ); *F. Castro-Lima, G. Aymard, V. Minorta-C., A. Lozano, M. González y C. Villegas 18215* (COL, COAH); same locality and date, fruiting, *M. González, F. Castro-Lima, G. Aymard, V. Minorta-C., A. Lozano, y C. Villegas 635* (COL, COAH, UDBC).

The species is similar to *R. macropyllum*, however it can be distinguished from the latter by the presence of secondary phloem, the leaves distinctly coriaceous, petiolate, the primary leaf veins not anastomosing and marginal vein absent (versus chartaceous, subsessile; primary leaf veins strongly anastomosing to form a marginal vein, and the wood without secondary phloem; Prance, 1972). Both species are extremely polymorphic in leaf shape and size, and also in flower dimensions, in this case, as suggested by Prance (1972: 18), perhaps accounting for the long list of synonyms referred to *R. amazonicum*.

Discussion

Assessing distribution patterns, endemisms, and diversity of plants of the Río Negro basin as well as the core Amazon Basin continues to be a major challenge (Milliken et al., 2011; ter Steege et al., 2013; 2015, Prance, 2014; Pennington et al., 2015). The fact that enormous areas are not represented by even a single collection implies that many species distributions are still poorly known or not well understood (Nelson et al.,1990; Hopkins, 2007; Schulman et al., 2007; Cardoso et al., 2015).

Schulman et al. (2007) utilized a dataset of ca. one million herbarium collections and showed that 43% of total area of Amazonia basin is not collected, 28% is poorly explored, and only the 2% of the basin (i.e., Manaus, São Gabriel de Cachoeira, Santarém, Iquitos) could be considering relatively well collected. Nevertheless, the Río Negro basin had been relatively well explored and studied, first by the inhabitants of this region who were able to classify the vegetation types and its most important species before the Europeans arrived (Abraão et al., 2009).

The first account of the Río Negro by European travelers came from the diary written by Gaspar de Carvajal; he was a priest who accompanied Francisco de Orellana in the first voyage down the Amazon River in 1542 (Carvajal, 1848). Subsequently, many outstanding botanists collected plants and studied the vegetation of this amazing river. The first known large collection of Amazon plants was made by

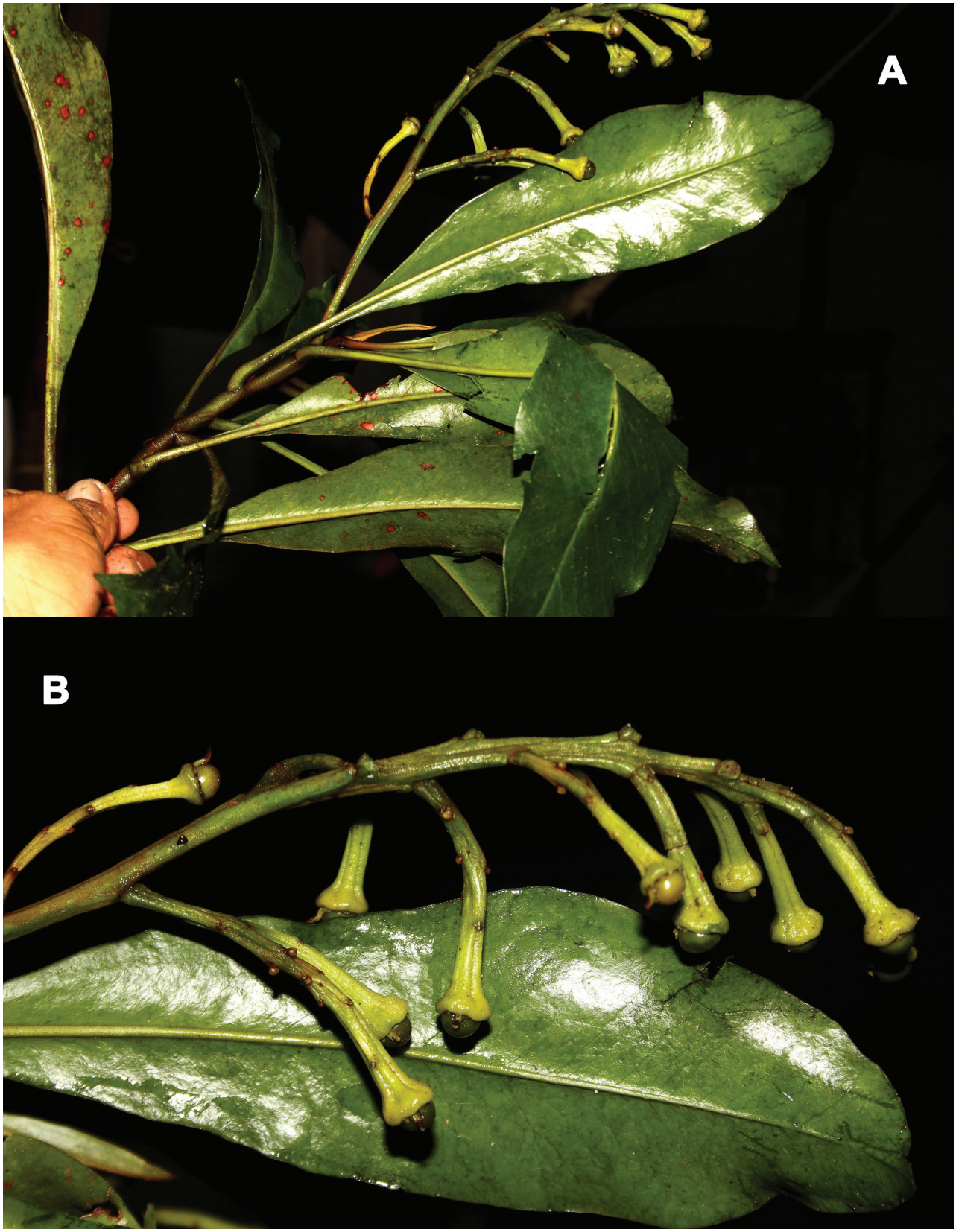

FIGURE 8. *Rhabdodendron amazonicum* (Spruce ex Benth.) Huber. **A**, fruiting branch; **B**, close-up of the immature fruits. Photographs by Francisco Castro-Lima based on *F. Castro-Lima et al. 18215* (COL; see Fig. 4 above).

Alexandre Rodrigues Ferreira (Wurdack, 1971) during his voyage of 1783–1792. He explored the Amazon River and its main tributaries, including the Río Negro, where his itinerary notably included the Içana river (Rodrigues-Ferreira, 2008). Later, A. von Humboldt and A. G. Bonpland, traveling from the Orinoco river, reached San Carlos de Río Negro, Venezuela, in April 1800 (Huber and Wurdack, 1984). The exploration of the Río Negro basin and its most important rivers continued with the work, among others, of C. F. P. von Martius and J. B. von Spix (1819–1820), L. Reidel (1826–1828), R. H. Schomburgk (1839), P. J. Ayres (1842–1844, see Romero-González, 2016), A. R. Wallace (1851), R. Spruce (1849–1854), J. Barbosa Rodrigues (1883), G. A. E. Hübner (1903–1907, 1914), T. Koch-Grünberg (1903–1905), E. H. G. Ule (1901–1908), J. G. Kuhlmann (1918), F. von Luetzelburg (1928–1929), W. A. Ducke (1910–1932, 1933–1936, 1941–1942), E. P. Killip and A. C. Smith (1929), B. A. Krukoff (1936), J. Cuatrecasas (1939), Ll. Williams (1942), R. de Lemos Fróes (1942–1945, 1949–1952), J. A. Steyermark (1944), P. H. Allen (1945), R. E. Schultes and F. López (1947–1948), J. Murça Pires (1947–1952), G. A. Black (1947–1950), B. Maguire, J. J. Wurdack and R. S. Cowan (1950–1953), H. García–Barriga (1951), R. Romero-Castañeda (1952), A. Fernández-Pérez (1953), W. A. Rodrigues (1957–1959), B. Maguire, J. Murça Pires, and J. A. Steyermark (1965), N. T. Silva and U. Brazâo (1966), P. Maas (1971), G. T. Prance (1971), J. Zarucchi and M. Balick (1975), K. Kubitzki (1975), R. Liesner and H. Clark (1977), and B. Stergios (1981). Besides this amazing amount of field work, thousands of plant collections from the Amazon River (including some from the Río Negro) and the Guayana Shield were products of the eight expeditions to the Amazon Basin conducted by B. A. Krukoff in 1923–1950 (Landrum, 1986), the twenty five expeditions sponsored by the bi-national plant collecting program "Projeto Flora Amazônica" (Prance et al., 1984), the interdisciplinary and multi-national I.V.I.C. project (which represents the most detailed study ever conducted of Amazon caatinga and terra-firme forests in the Upper Río Negro; Medina et al., 1977), and the Neblina expeditions (Brewer-Carías, 1988). In addition, supplementary work was carried out by the Biological Diversity of the Guiana Shield Program (Funk, 2007), and the twenty five years of botanical exploration in the Colombia Amazon conducted by the SINCHI Institute (Cárdenas-López et al. 2007a). As a result, currently there exists a relatively good understanding of the structure and floristic composition of the Río Negro basin (Dezzeo et al., 2000; Córdoba y Etter, 2001; Rudas et al., 2002; Boubli, 2002; Cárdenas-López, 2007 Cárdenas-López et al., 2007b, 2014; Aymard et al., 2009; Aymard, 2011; Medina and Cuevas, 2011; Stropp et al., 2011, 2013; Pombo de Souza, 2012).

The Río Negro basin harbors a considerable number of regional endemics (Lleras, 1997; Clark et al., 2000, Aymard et al., 2009), no doubt due to its unique habitats, such as diverse terra-firme forests and the peculiar scrub-savanna locally called "sabanas de arenas blancas," (Spanish) or "campina de solo arenoso" (Portuguese), and the Amazonian caatinga or campinarana forest (Prance, 2001 and references therein). This type of vegetation growing in white-sand and often near black-water rivers is frequent in the Guianía and Río Negro basins. They occupy small areas in the lower Río Negro (Rodrigues, 1961; Takeuchi, 1961, 1962) but are much more extensive in the upper basin, where they are subject to partial or total seasonal flooding (Klinge and Medina, 1979; Prance, 1989, 2001; Huber, 1995a,b). The soils are acidic, deep, sandy spodsols or quarzitaments; the parent material is characterized by a subsurface accumulation of humus that is complexed with aluminum and iron (Herrera, 1985; Dubroeucq and Volkoff, 1998; Schargel et al., 2000).

Rhabdodendron amazonicun has been found in the Guianas over ferro-bauxite soils (e.g. Lely region, 500–700 m, Suriname) and also growing in sandy loam soils not subject to flooding such as Wallaba communities dominated by *Eperua falcata* Aubl. located in the Bartica-Potaro area, and in forests with high presence of Morabukea (*Mora gonggrijpii* (Kleinh.) Sandw.), and Greenheart (*Chlorocardium rodiei* (R. H. Schomb.) Rohwer, Richt, & van der Werff) situated in the Mabura Hill region. In Brazil (including the foothills of Roraima) this species is found through the central to eastern Brazilian Amazon, where it is quite frequent along campina aberta and campinarana forests (e.g., Amazonas: Manaus-Caracaraí Highway; Pará: Rio Mapuera, Tucuruí, Oriximiná), in terra-firme forests growing in clay soils (e.g., Amapá: Matapí, Macapá, Pará: Monte Dourado, Rio Cuieiras), and in disturbed areas such as forests growing on road sides. The wide variety of habitats where *R. amazonicum* is found strongly indicates that this species is not a white sand specialist as was suggested recently (García-Villacorta et al., 2016). The same wide habitat preference is found in many other species frequent in forests that grow in white sand in the upper Río Negro region, such as *Aldina kunhardtiana* Cowan, *Eperua leucantha* Benth., *E. purpurea* Benth., *Dendroponax neblinae* Maguire, Steyerm & Frodin, *Helianthostylis steyermarkii* C. C. Berg, *Pentamerista neotropica* Maguire, *Sloanea floribunda* Spruce ex Benth., *Tetrameranthus duckei* R E. Fr., *Hebepetalum humiriifolium* (Planch.) Benth., *Erisma micranthum* Spruce ex Warm., and *Asteranthos brasiliensis* Desf., all considered soil generalists (Aymard et al., 2009), suggesting that plant communities growing in white-sand and terra-firme forests growing in clay soils in the upper Río Negro basin may have a common evolutionary history.

We show here that *Rhabdodendron amazonicum* also occurs in Amazonian caatingas or campinaranas of the middle Río Negro basin, specifically in the middle Içana river, Brazil, and the upper Cuyarí river, Colombia (Fig. 3–5); the latter is a black-water river the basin of which includes largely unexplored flooded and non flooded forests (Aymard and Castro-Lima, 2015). The collection from the Içana river was made during inventories made to compare the tree communities of white-sand and terra-firme forests, and included plots established in Amazonian caatinga forests in the vicinity of São Gabriel de Cachoeira and the Içana river (Stropp et al., 2011, 2013). These authors neither realized the phytogeographic significance of the collection nor presented information to distinguish

the caatingas around São Gabriel de Cachoeira from those in the the Içana river. The collection from the Cuyarí river, reported herein, was made in a tall Amazonian caatinga forest, with a close canopy which let little light filter to the understory. At this site, the primary dominant species were *Hevea rigidifolia* (Spruce ex Benth.) M. Arg., *Mezilaurus caatingae* van der Werff, *Caraipa longipedicellata* Steyerm., and *Micropholis maguirei* Aubrév.

When the geographical distribution of *R. amazonicum* is plotted and analyzed (Fig. 6), it is evident that the species is known from the Río Negro basin from only the two collections cited above, and that apparently it is absent from a large area between Manaus and the confluence of the Guainía and Casiquiare rivers, two points ca. 1000 km apart and encompassing basically the northern and eastern bank of the Río Negro, dominated mainly by habitats where this species has been previously collected (e.g., Amazonian caatinga, "campina de solo arenoso," and terra-firme forest). It would be easy to treat the absence of *R. amazonicum* from this large area as a collection artifact, which we regard as an unlikely explanation given the largest number of exceptional plant collectors who have worked in this particular area in the last 250 years, since the age of exploration in the Neotropics began.

Nonetheless, despite the lack of tools to reconstruct phylogenies (e.g., material for DNA extraction) and of information about dispersal biology (although the fruits are most likely dispersed by animals, especially birds: see Prance, 2002; 2004), here we would like to explore an alternative hypothesis to explain the peculiar distribution of *R. amazonicum* in the Río Negro basin based on palaeobotanical records and paleoclimatic events. It is already well known that vegetation responds to factors such as temperature, precipitation, and atmospheric CO_2 and fluctuating dry seasons, all resulting in changes in plant communities (Mayle et al., 2004; Colinvaux, 2005; Jaramillo et al., 2010).

Rhabdodendron amazonicum could be a representative of a relictual flora, the former range of which was reduced by extreme nutrient deficiency, frequent fires, unfavorable soil-water conditions (Klinge and Cuevas, 2000), and the influence of the Last Glacial Maximum (LGM) some 21,000–18,000 years ago (Hooghiemstra et al., 2002; Mayle et al., 2009). During this period, the climate was very dry and cool, factors that generated severe aridity in this region and, as a result, the structure and floristic composition of the forest vegetation changed in several areas of the Amazon Basin (Hooghiemstra et al., 2006; Wesseling et al., 2010), where forest was substituted by savannah and others types of low vegetation such us shrublands (Mayle et al., 2004; Gosling et., 2009; Absy et al., 2014). Furthermore, Levine et al. (2016) demonstrated that water stress operating at the scale of individual plants, combined with spatial variation in soil texture can explain observed patterns of variation in ecosystem biomass, composition, and dynamics across the Amazon region, and strongly influences the ecosystem's resilience to changes in the length of the dry season. Bush et al. (2004) provided the strongest evidence, resulting from palynological studies conducted in the upper Río Negro (São Gabriel de Cachoeira, Brasil), that many species disappeared from this region as a consequence of climate instability. These authors found pollen of *Alnus* Mill., *Gordonia* J. Ellis, *Hedyosmum* Sw., *Myrsine* L., *Podocarpus* Pers., and *Weinmannia* L. (taxa that currently are common in the Andes), mixed with genera of the lowlands (e.g., *Caryocar* L., *Cedrela* P. Browne, *Guarea* F.Allam. ex L., *Pachira* Aubl., and *Pouteria* Aubl.; Bush et al., 2004). This profile shows that Andean taxa were abundant in the Upper Río Negro basin 45,000–12,000 years ago and that, during this period, this portion of Amazonia had high levels of diversity due to the boundary conditions that sustained rainforests: relatively low seasonality, high precipitation, and an edaphically heterogeneous substrate (ter Steege et al., 2010). Later, between 12,000 years ago and the present, pollen of these genera (and also *Cedrela*) completely vanished. Currently, with the exception of a few *Podocarpus* species, and *Gordonia fruticosa* (Schard.) H. Keng, none of these Andean genera are present in the lowland flora of the upper Río Negro. *Podocarpus* is a broad-leafed conifer with a primarily southern hemispheric and the Andean mountain distribution (de Laubelfels, 2004); it is tolerant to dry and cool climates (Mayle et al., 2004). *Podocarpus tepuiensis* J. Buchholz & N. E. Gray was found in the lowlands of the southern Orinoco basin of Venezuela, neighboring the Río Negro basin (in Río Temi, a tributary of the Atabapo river, at ca. 100 m, running north and parallel to the San Miguel river, a tributary of the Guainía and therefore of the Río Negro; Berry and Aymard, 1997; de Laubenfels, 2004). In addition, *Podocarpus magnifolius* Buchholz & N. E. Gray and *P. celatus* de Laubenf. had been collected in Northwestern portion of Amazon Basin of Colombia (Araracuara) and in Loreto-Perú (Vásquez, 1997), respectively, and *P. aracaensis* de Laubenf. & Silba, was described from Araçá (de Laubenfels and Silba, 1988), an outlying tepui within Brazil (Prance and Johnson, 1992). This evidence shows that the Río Negro region and other places of the Amazon Basin housed a set of species before the Last Glacial Maximum (LGM), that many have since disappeared, and that a few others, components of a relictual flora, survive in specific habitats such as the communities over very acidic soils (Punyasema et al., 2011). As postulated above, *Rhabdodendron amazonicum* easily could be another representative of a flora with formerly a much more widespread distribution in the Río Negro region, but that currently is restricted to a few and unique habitats and sites.

The first occurrence of Rhabdodendraceae reported herein for the flora of Colombia and the flora of the Upper Río Negro (NW of Amazonas state, Brazil) greatly expands the geographical distribution and improves the family-level information of the flora of Colombia (Bernal et al., 2016; Rangel, 2015), and our knowledge of the geographical range of *Rhabdodendron*, an interesting Neotropical genus. The family so far is absent in Venezuela, Ecuador, Perú, Bolivia, as well as the Southeastern and Northwestern Amazon Basin regions (Gentry, 1983). The latter is an area that comprises a large portion of the Amazon Basin of Colombia, Ecuador

and Perú, considered one of the world's last zone of high biodiversity with an extraordinary number of species across taxa and where large tracts of forests still remain largely intact (Pitmann et al., 2008; Bass et al., 2010). The absence of this family in southeastern and northwestern Amazonia could be related with the the Pebas wetland system (Hoorn et al., 2010; Sacek, 2014), which may also have played a role as a dispersal barrier for pre-Pebas groups, that could account for the well-known pattern of Andean-centred vs. Amazonian-centred biodiversity (Gentry, 1982; Antonelli and Sanmartín, 2011).

The Río Negro basin has outstanding global conservation significance due to its extraordinary biodiversity and the potential to sustain this biodiversity in the long term because of its large size and wilderness nature, and the probability of maintaining wet, rainforest conditions while anticipated climate change-induced drought intensifies in the Western Amazon. However, further mining activities, selective logging, and new road developments will threaten its as yet unvalued conservation status. These findings help to form the scientific basis for policy recommendations, including stopping new destructive events, and creating more areas off-limits to large-scale development in adjacent regions of the three countries that comprise the basin. Finally, this report is yet another example that demonstrates the need for continued taxonomic and floristic studies in regions where there are large geographic gaps in the knowledge of Amazonian flora, so that there is adequate planning for conservation and sustainable use of regional biota. Advances in documentation of the Upper Río Negro flora will only be achieved through institutional and private partnerships, improvements in training, and continued field work mounting new expeditions with many researchers working in collaboration with the local people.

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NOVELTIES IN THE ORCHID FLORA OF VENEZUELA IX. SUBTRIBE PLEUROTHALLIDINAE. NEW COMBINATIONS IN *ANATHALLIS* AND A NEW REPORT FOR THE ORCHID FLORA OF COLOMBIA[1]

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Abstract. We discuss a group of four species from the Venezuelan Guayana, two of them closely related to *Anathallis nanifolia* (based on *Pleurothallis nanifolia*). These two species, *Pleurothallis deborana* and *P. pemonum*, were erroneously placed in the synonymy of *Anathallis holstii* (based on *Pleurothallis holstii*). We propose new combinations in *Anathallis* for these two species, discuss the current status of all four species, and provide a key to distinguish them.

Resumen. Se discute un grupo de cuatro especies de la Guayana venezolana, dos de ellas muy cercanamente relacionadas a *Anathallis nanifolia* (basada en *Pleurothallis nanifolia*). Estas dos especies, *Pleurothallis deborana* y *P. pemonum*, fueron erroneamente colocadas en la sinonimia de *Anathallis holstii* (basada en *Pleurothallis holstii*). Se proponen nuevas combinaciones en *Anathallis* para estas dos especies, se discute el actual status de las cuatro especies y se presenta una clave para distinguirlas.

Keywords: *Anathallis*, Brazil, Colombia, Guayana shield, Orchidaceae, Pleurothallidinae, *Pleurothallis*, Venezuela

Recent nomenclatural changes based upon phylogenetic or natural classifications in Pleurothallidinae, and particularly in *Pleurothallis* R. Br. and closely related genera, have resulted often in conflicting circumscriptions.

Anathallis Barb. Rodr. is no exception. In the past two centuries, it was treated first as a synonym of *Pleurothallis* subgenus *Specklinia* section *Acuminatae* (Luer, 1986), later referred to *Specklinia* Lindl. (Luer, 2004), and then reinstated by Pridgeon and Chase (2001). Luer (2006) proposed the genus *Panmorphia*, where he placed many species Pridgeon and Chase (2001) had referred to *Anathallis*, but then he later transferred *Panmorphia* to *Anathallis* (Luer, 2009). Karremans (2014) more recently segregated some 20 species of *Anathallis* to his new genus *Lankesteriana*, apparently more closely related to species in *Trichosalpinx* Luer and *Zootrophion* Luer than to *Anathallis*. *Lankesteriana* is not accepted in the latest published, comprehensive classification of Orchidaceae (Chase et al., 2015). Reading current publications on Pleurothallidinae, due to these constant changes, is not for the impatient or faint-of-heart. We hope that a stable system for this subtribe, covering perhaps one fifth of the species of Orchidaceae, will be presented in the near future.

Here we treat a small group of miniature, epiphytic Pleurothallidinae from the Venezuelan Guayana characterized by a creeping habit, with leaves usually appressed to (i.e., growing against or on top of) the substrate, and by short, successively few-flowered inflorescences, small flowers with free sepals, and a purple or yellow labellum.

The first species described in Venezuela was *Pleurothallis nanifolia* Foldats (Fig. 1), based on a collection from the Paragua river, Bolívar state.

Pleurothallis holstii Carnevali and I.Ramírez (Fig. 2) was described next, based on a collection from northwestern Bolívar state. This species, although undoubtedly referable to our current concept of *Anathallis* (Luer, 2009), differs significantly from *A. nanifolia* in its caespitose, erect habit.

Two additional species followed, *Pleurothallis deborana* Carnevali & I.Ramírez (Fig. 3) and *P. pemonum* Carnevali & I.Ramírez (Fig. 4), based on collections from the type locality of *A. holstii* and from near Puerto Ayacucho, Amazonas state, respectively. The latter two species were later placed, implicitly, although incorrectly, in the synonymy of *Anathallis holstii* (Luer, 2006, 2009).

A summary of the key to *Pleurothallis* in the Flora of the Venezuelan Guayana (Carnevali and Ramírez, 2003: 505–512), adding a few additional characters, can help us sort out this group of species. A magnifying glass or loupe will be needed to examine specimens *in vivo*, and obviously a dissecting microscope to examine rehydrated herbarium material:

1a. Plants long to shortly creeping, with leaves appressed to substrate, labellum dark red or purple, with or without side-lobes 2
1b. Plants caespitose to shortly creeping, but leaves erect, never appressed to substrate, labellum yellow, without side lobes . . . . . *A. holstii*

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2a. Petals obovate to elliptic-obovate, broader than sepals; labellum with conspicuous side-lobes, apical portion conspicuously thickened . . . . . *P. nanifolia*

2b. Petals elliptic or ovate-elliptic, acuminate, about as broad as the sepals; labellum with or without side lobes, the apical portion of labellum flat or recurved 3

3b. Labellum narrowly elliptic or narrowly ovate-elliptic, without side lobes, apex acute, flat . . . . . *A. pemonum*

3a. Labellum narrowly obovate, with side lobes, apex concave, recurved . . . . . *A. deborana*

Nomenclature

Anathallis deborana (Carnevali & I.Ramírez) Carnevali & I.Ramírez, *comb. nov*. Fig. 2–3.

Basionym: *Pleurothallis deborana* Carnevali & I.Ramírez, Ann. Missouri Bot. Gard. 77(3): 553. 1990. TYPE: VENEZUELA. Bolívar: Municipio Cedeño, bosque al borde de sabana al este del río Parguaza, 125 km al norte de Puerto Ayacucho, collected by B. Holst and flowering under cultivation June 1987 and preserved *sub G. Carnevali and I. Ramírez 2317* (Holotype: VEN).

Distribution: Colombia and Venezuela, but most likely to be found in Brazil.

Additional specimen examined: COLOMBIA. Vaupés: Cerro La Campana, Summit about 800–1200 ft [244–366 m] above forest floor, 1700–2100 ft [518–640 m] above sea level, epiphyte, very xerophytic exposure, all flowers deep blood, 1–6 June 1943, *R. E. Schultes 5558* (AMES, SEL).

Eponymy: Named after Debora Carnevali-Ramírez, daughter of the authors of the species.

Iconography: Carnevali and Ramírez (1990; 2003: 523, Fig. 456, *sub Pleurothallis*).

The protologue clearly states that the plant on which the name was based was a "small creeping epiphyte, adpressed to substrate" with "…sepals… clear greenish yellow, maroon-tinged within," the petals "…with the general coloration of the sepals but with a dark purple longitudinal central zone," and the labellum "…fleshier than the other perianth segments, dark red-purple with a yellow longitudinal streak, the ventral [adaxial] surface finely papillose" (Carnevali and Ramírez, 1990). The described habit and color of the flower parts should easily distinguish it from *Anathallis holstii* ("creeping… adpressed to the substrate" versus "densely cespitose" and flowers greenish purple versus "greenish-yellow," respectively).

The collection *Schultes 5558* listed above represents the first report of this species for the orchid flora of Colombia.

Anathallis holstii (Carnevali & I.Ramírez) Luer., Monogr. Syst. Bot. Missouri Bot. Gard. 115: 258. 2009. Fig. 4.

Basionym: *Pleurothallis holstii* Carnevali & I.Ramírez, Ernstia 39: 18. 1986. TYPE: VENEZUELA. Bolívar: "forest bordering savanna east of Río Parguaza, km 125 from northern alcabala of Puerto Ayacucho, epiphyte on *Parinari aff. excelsa*, flowers greenish yellow," 8 September 1985, *J. A. Steyermark, B. Holst, B. Manara 131611* (Holotype: VEN; Isotype: MO).

Panmorphia holstii (Carnevali & I.Ramírez) Luer, Monogr. Syst. Bot. Missouri Bot. Gard. 105: 159. 2006.

Distribution: Apparently endemic to the Venezuelan Guayana, but most likley to be in neighboring Colombia.

Eponymy: Named after Bruce Holst, one of the collectors of the type material, who preserved part of the gathering in alcohol and made it available to the authors.

Iconography: Carnevali and Ramírez (1986, *sub Pleurothallis*); Carnevali and Ramírez (2003: 524, Fig. 457, *sub Pleurothallis*).

The protologue states that the plant is a "diminutive epiphytic herb... densely cespitose," that the leaves are erect, and, from the holotype sheet label, the flowers are "greenish yellow."

The holotype sheet at VEN also says "Epiphyte on *Licania*" and provides the following coordinates for the type locality: Lat. 6°17'N, Long. 67°5'W."

Anathallis nanifolia (Foldats) Luer, Monogr. Syst. Bot. Missouri Bot. Gard. 115: 259. (2009). Fig. 1.

Basionym: *Pleurothallis nanifolia* Foldats, Bol. Soc. Venez. Ci. Nat. 22: 258 (1961). TYPE: VENEZUELA. Bolívar: woods bordering savanna by río Asa, above raudal Cotua, south of La Paragua, 300 m, creeping on living tree trunk, leaves fleshy-coriaceous, dull olive green above, paler below, ovary maroon, corolla wine purple, 1 August 1960, *J. A. Steyermark 86725* (Holotype: NY; Isotypes: AMES, US, VEN).

Homotypic synonyms: *Specklinia nanifolia* (Foldats) Luer, Monogr. Syst. Bot. Missouri Bot. Gard. 95: 262 (2004).

Panmorphia nanifolia (Foldats) Luer, Monogr. Syst. Bot. Missouri Bot. Gard. 105: 169 (2006).

Anathallis nanifolia (Foldats) F.Barros & Barbarena, Rodriguésia 61 (1): 129 (2010).

Distribution: Brazil, Bolivia, Ecuador, and Venezuela, and most likely in neighboring Colombia.

Additional specimen examined: VENEZUELA. Amazonas: Municipio Autónomo Atures, Puerto Ayacucho, on branches of tree in fairly open rather scrubby forest on igneous hill near Cataniapo bridge, flower in Caracas December 1965, *G. C. K. Dunsterville 969* (AMES [both spirit collection and drawing]).

Etymology: From the latin *nanus*, a dwarf, and *folium*, leaf, referring to the very small leaves.

Iconography: Foldats (1961: 259; 1970: 350, *sub Pleurothallis*); Luer (1977: 349, *sub Pleurothallis*); Dunsterville and Garay (1976: 361; 1979: 797, *sub Pleurothallis*); Barros and Toscano de Brito (1985: 29, *sub Pleurothallis*); Romero and Carnevali (2000: 216, *sub Pleurothallis*), Luer (2006: 188, fig. 136, *sub Panmorphia*).

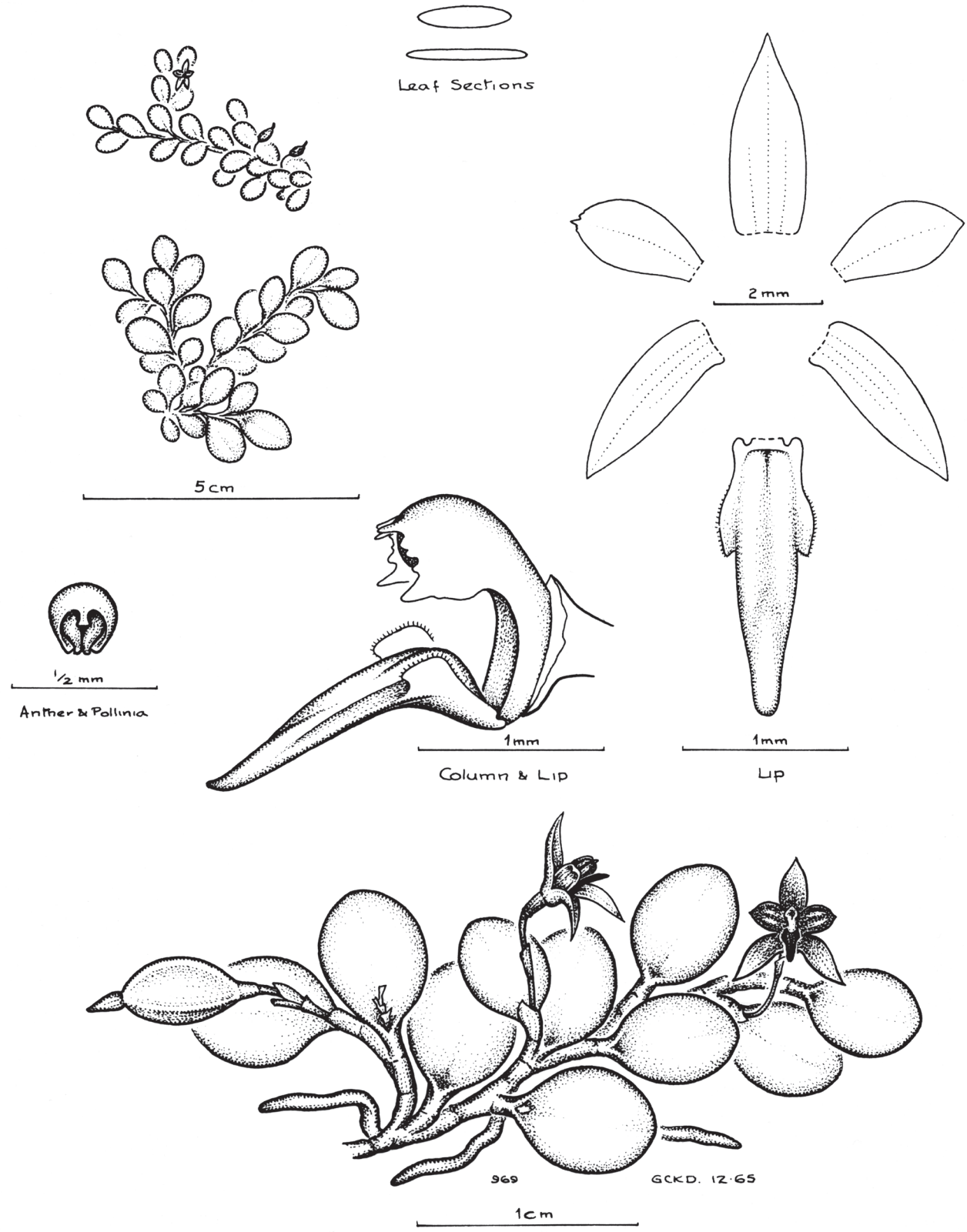

FIGURE 1. *Anathallis nanifolia* (Foldats) Luer. Drawing by G. C. K. Dunsterville based on *Dunsterville 396* (reproduced from a photostat at AMES).

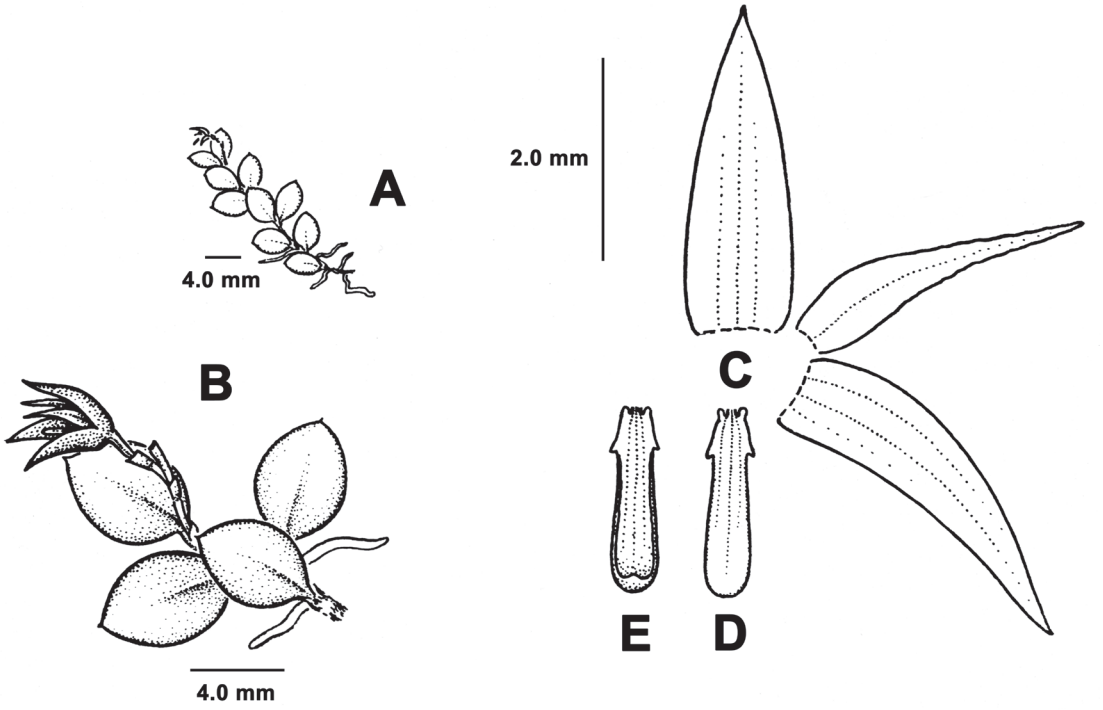

FIGURE 2. *Anathallis deborana* (Carnevali & I.Ramírez) Carnevali & I.Ramírez. **A**, habit; **B**, close-up of plant; **C**, floral diagram; **D**, adaxial side of the labellum, flattened; **E**, abaxial side of the labellum, flattened. Drawing by B. Manara courtesy of the Missouri Botanical Garden (first reproduced in Carnevali and Ramírez, 1990).

FIGURE 3. *Anathallis deborana* (Carnevali & I.Ramírez) Carnevali & I.Ramírez. Traces of the flower color are still discernable in this herbarium specimen preserved for over 70 years. Based on a small fragment of *R. E. Schultes 5558* (AMES).

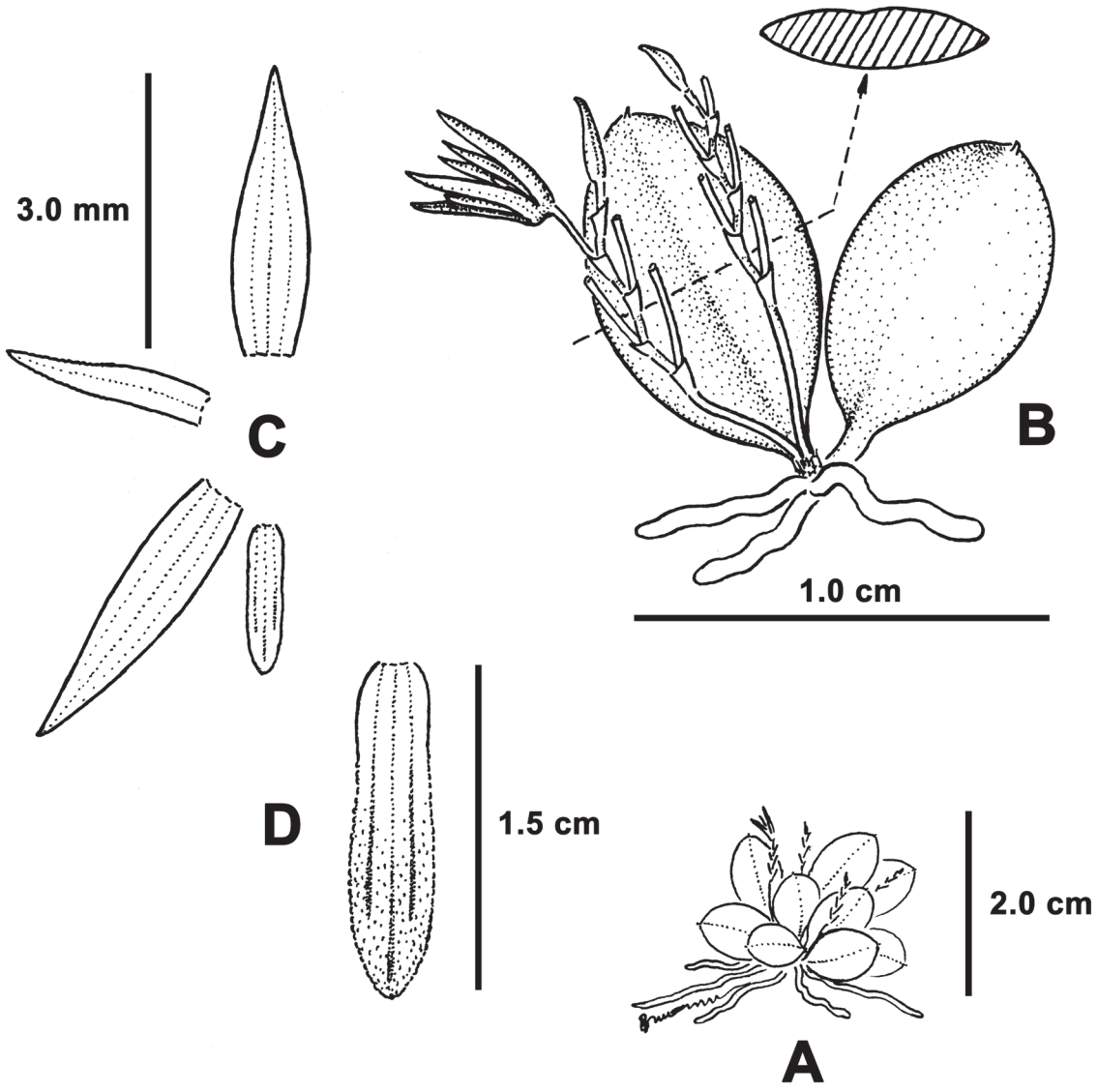

FIGURE 4. *Anathallis holstii* (Carnevali & I.Ramírez) Luer. **A**, habit; **B**, detail of the plant and a cross section of a leaf; **C**, floral diagram; **D**, detail of the labellum. Drawing by Bruno Manara courtesy of the editors of Ernstia (First reproduced in Carnevali and Ramírez. 1986).

According to Dunsterville, in unpublished notes kept at AMES, the "…sepals [are] lightly fleshy at the apex, dorsal sepal variably pale maroon or dark maroon-red, lateral sepals dark maroon…. Petals [are] pale pink with very dark maroon along mid-nerve… lip [is] …about 0.4 mm across fleshy mid-lobe and 0.6 mm across ciliate lateral lobes. Disc and base also fleshy, the latter bearing two thin lobes. Dark purple throughout. Column cream with dark purple at the apex. Anther cream."

According to Foldats in the protologue of *Pleurothallis nanifolia* (1959: 260), "…el holótipo se encuentra en el herbario de New York Botanical Garden y un isótipo en Instituto Botánico, en Caracas," yet the sheet at VEN is labeled "Holotype" and the one at NY as "Isotype." Above, as far as the distribution of types is concerned, we follow what was stated in the protologue.

Despite its wide distribution, this species is apparently locally rare. One of the authors (GAR-G) lived for many years within a few kilometers of the locality where *Dunsterville 969* was collected and never was able to find it despite countless hours spent searching trees in the area.

Anathallis pemonum (Carnevali & I.Ramírez) G.A.Romero, Carnevali & Toscano, *comb. nov.* Fig. 5.

Basionym: *Pleurothallis pemonum* Carnevali & I.Ramírez, Ann. Missouri Bot. Gard. 77: 555. 1990. TYPE: VENEZUELA. Amazonas: Municipio Atures, road Puerto Ayacucho–Gavilán, east of Fundo Doña Juana, June 1987, *G. A. Romero, F. J. Guánchez & E. Gutiérrez 1334* (Holotype: VEN; Isotype: TFAV).

Distribution: Apparently endemic to the Venezuelan Guayana, but most likely to be found in neighboring Brazil, Colombia, and Guyana.

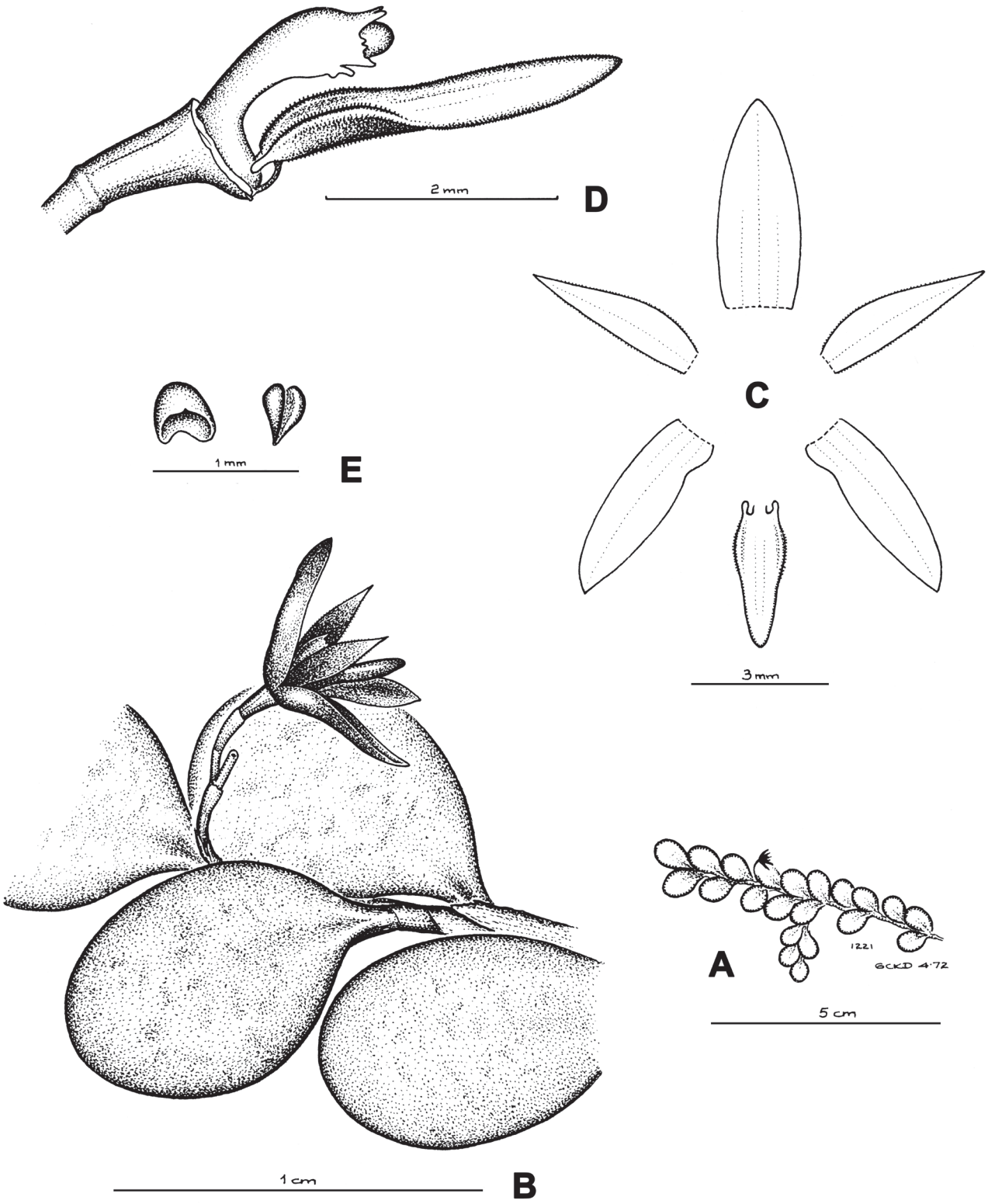

FIGURE 5. *Anathallis pemonum* (Carnevali & I.Ramírez) G.A.Romero, Carnevali & Toscano. **A**, habit; **B**, detail of plant with a flower; **C**, floral diagram; **D**, labellum and column; **E**, anther and pollinia. Drawing by G.C.K. Dunsterville based on *Dunsterville 1221* (reproduced from a photostat at AMES).

Additional specimens examined: VENEZUELA. Bolívar: selva virgen siempre verde a lo largo de la Quebrada Los Brasileros, 4.5 km al S de Icabarú, 4°20'N, 61°48'W, 480 m, "Creeping on *Licania* trunk (no. 117796)," 16 December 1978, *J. A. Steyermark, V. Carreño Espinosa, & G. C. K. & E. Dunsterville 117784* (VEN); Río Carrao, near Orchid Island, in light forest at about 1500 ft. [457 m], April 1972, *G. C. K. Dunsterville 1221* (SEL [four samples in spirit], AMES [drawing]).

Eponymy: Named after the Pemón Indians, who live in part of the range of the species, the Gran Sabana region of Bolívar state, Venezuela.

Iconography: Carnevali and Ramírez (1990, *sub Pleurothallis*); Romero and Carnevali (2000: 823, *sub Pleurothallis*); Carnevali and Ramírez (2003: 523, Fig. 455, *sub Pleurothallis*); Luer (2006: 183, Fig. 120, as *Panmorphia holstii*, based on Romero-González and Carnevali Fernández-Concha, 2000: 823).

The holotype of this species was collected by one of the authors (GAR-G), growing on the bark of a rather tall specimen of *Parkia pendula* Benth. ex Walp. (Fabaceae), by far the tallest tree in the local forest. The enormous tree had been cut down during the process of clearing the forest and planting poles to conduct electricity to the native Indian village of Gavilán. The plants were found growing in small patches, roughly 5–15 cm in diameter, found at ca. 15–20 m above ground. In cultivation, some of the patches, left to grow on the bark where they were found, eventually turned out to have two different species, *Anathallis pemonum* and *Octomeria romerorum* Carnevali & I.Ramírez.

According to G. C. K. Dunsterville, the plant illustrated in his drawing 1221 was "[e]piphytic, repent, occasionally branching," and the flowers had "…sepals dark winy [sic] red externally, internally yellow with a strong pink flush, the apex yellow… petals …dark winy [sic] red with yellow at the extreme apex, the margins finely very shortly ciliate," the labellum "…lightly hinged… by a short white lamina; fleshy, red with a yellow stripe down the axis and a yellow apex. The very lightly developed lateral lobes bear short red hairs, the remainder of the surface is very finely muricate. The column was "dorsally red, the remainder pink. The anther was "…dark winy [sic] red."

Anathallis pemonum appears to be closely related to *A. deborana*, but it can easily be distinguished using the key presented above, particularly by characters found in the labelum.

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LAURENT GARCIN, M.D. F.R.S.: A FORGOTTEN SOURCE FOR N. L. BURMAN'S *FLORA INDICA* (1768)

ALEXANDRA COOK[1]

Abstract. Laurent Garcin (ca. 1681–1751), a Dutch East India Company ship's surgeon, Fellow of the Royal Society and corresponding member of the Académie royale des sciences (Paris), has largely vanished from the annals of botanical and medical science. Yet data presented in this article demonstrate that ca. 1740 he gave some or all of his plant collections from his Asian travels in the 1720s to J. Burman, a correspondent in Amsterdam. Those collections in turn greatly enriched *Flora Indica* by N. Burman (hereafter Burman fil.) to the tune of 98 specimens. Burman's work is an important historical source for the botany not only of modern-day India, as the title suggests, but also of Sri Lanka, Indonesia and Iran—the "Indies" as they were understood in the eighteenth century. So far only a handful of Garcin's specimens have come to light (G-Burman). These few extant specimens testify to Garcin's collecting zeal and keen eye for *materia medica*.

Keywords: Asia, Johannes Burman, *Cinnamomum, Garcinia, materia medica*, *Salvadora*

Laurent Garcin (ca. 1681–1751),[2] a Franco-Swiss botanist, Dutch East India Company (hereafter VOC) ship's surgeon, Fellow of the Royal Society and corresponding member of the Académie royale des sciences (Paris), has largely vanished from the annals of botanical and medical science. Yet, as D. G. Crawford (1857–1942) noted over one hundred years ago, "Garcin was a man of much more note than any other Surgeon serving the European Companies in the East at the time" (Crawford, 1903: 28). Garcin has more recently been praised in the botanical literature as one of the "pioneers of the botanical exploration of the continental as well as insular areas of Asia" (Staples and Jacquemoud, 2005: 446; see also Wijnands, 1992: 490). Going beyond these limited assessments, the present article demonstrates that Garcin, who should be fully recognized for his noteworthy achievements in identifying and circulating Asian plants and *materia medica* to Europe, is in fact a forgotten source for Nicolaas Burman's *Flora Indica* (1768) (hereafter *FI*).

Most sources state that Garcin was born in Grenoble (France) into a Huguenot family that fled France after Louis XIV's 1685 revocation of the Edict of Nantes (1598) that had granted toleration to Protestants. Traditionally, Garcin's date of birth has been given as 1683 (Bridel, 1831: 98; Jeanneret and Bonhôte, 1863: 373; Briquet, 1940: 233), although no known document supports this presumption, the birth records for Grenoble's Huguenots having largely disappeared. The traditional birth year has to be revised in light of Garcin's statement in 1749 that he was 68 years old (letter of Garcin to Emanuel Mendes da Costa, dated July 30, 1749, British Library; see also Lequin, 1982: 168, 314, n. 97). We have no information about Garcin's childhood or upbringing. According to the naturalization records of Neuchâtel, his father, Jean, was a physician who practiced at Vevey (on the north shore of Lake Geneva between Lausanne and Montreux), and then ca. 1710 joined an uncle at Neuchâtel in the Prussian principality of the same name (now a canton of the Swiss Confederation) (Chambrier 1900: 251; Bridel 1831: 99). Upon joining the VOC Garcin himself reported that he came from Nyon, a town in the canton of Vaud not far from Geneva.

When Garcin was "of age," probably ca. 14 years old (the traditional age of apprenticeship), he was sent to the United Provinces of the Netherlands (UP) to learn surgery and medicine (Bridel, 1831: 99). Whether he formally studied the latter in his youth is, *pace* Bridel, doubtful; he does not show up in the matriculation records of any Dutch university of the time, so it has to be presumed that, like most surgeons of his day, he served an apprenticeship to a master surgeon. It has likewise proven impossible to discover any details of his surgical apprenticeship. The first solid career detail is his reference to his sixteen-year service with an unnamed Dutch regiment in Flanders, Portugal and Spain until his entry into the VOC in 1720 (Garcin, 1744a: 269); his service would therefore have commenced ca. 1704.

At the conclusion of his military service, Garcin joined the VOC and departed Middelburg (Zeeland) in the capacity of chief surgeon ("oppermeester") of the *Oudenaarde* on 20 May 1720. He arrived seven months later, on 19 January 1721, in Batavia. The surgeon of the VOC hospital would have determined his further deployment, whether in the hospital itself or on VOC ships in the Company's intra-Asian trade; Garcin seems to have spent most of his time in the Indies in the latter capacity (Lequin, 1982: 168, 313–314, n. 96). This enabled him to collect plants from Persia, India, Ceylon and the archipelago that forms present-day Indonesia; in many cases those collection locales are indicated by the names he assigned to plant specimens listed in Table 1 (discussed in "Garcin and *Flora Indica*" below). He boarded the *Valkenisse* on 1 November 1728 and was repatriated in the UP on 26 June 1729 (unpublished Sea Muster Roll, Algemeen RijksArchief Inv. Nr. 12801, National Archives of the Netherlands, The Hague).

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[2] Garcin's death year is usually given as 1752, but the Archives de l'état de Neuchâtel clearly indicate that he died on April 18, 1751.

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The surgeon and plants

Garcin was one of those ship's surgeons fortunate enough to survive the rigors of a risky journey to and from the Indies as well as a relatively long eight-year sojourn in what for so many proved a fatal clime—the VOC settlements in South and Southeast Asia. In his recently-discovered, unpublished Journal (Special Collections, Kenneth Spencer Research Library, University of Kansas) Garcin comments that he left for the Indies at an age (ca. 40) when others were returning. However, given the high mortality rates among ship's surgeons, more than half never returned. A high percentage of Garcin's peers perished on the outbound journey; if they survived the trip to the East Indies, they as often as not succumbed to disease within a year after they reached Batavia, the endpoint of the outbound journey of a VOC Indiaman, during intra-Asian VOC voyages or on the return home. If a surgeon survived to make a second voyage his average age at death was 38, whereas if he declined to make a second voyage, he died on average at 58. Indeed, the average age of death for a ship's surgeon who shipped out to Asia before 1725 and remained in a settlement was a mere 27 (Bruijn, 2009: 199–200).

Garcin was keen to learn the medical uses of plants that were little- or unknown to Europeans. On his outbound voyage and during his intra-Asian voyages with the VOC, he found time in addition to his duties as ship's surgeon to botanize and observe natural phenomena. According to his own account:

> "I was on the vessels of the incomparable East India Company for 9 years, i.e. from 1720 to 1729. That is what furnished me with an ability to make many observations in *natural history, pharmacy* and *medicine*, in attaching myself in particular to everything that could perfect my practice of the last. And as all men are called to contribute…to the good of society, I had a duty to be *useful to society*, as much by my observations as by the *remedies* that I discovered…" (emph. added; Garcin, 1744a: 269)[3]

Garcin's travels convinced him to reject trendy, so-called "chemical" remedies such as mercury in favor of those derived from plants, as shown in his *Journal* entries during his outbound journey to the Indies in 1721–1722:

> "What we have discovered from plants, relative to Medicine, is so to speak, merely the preliminary sketch of the Science. I departed from Europe with the prejudices of Europe, but my voyages have convinced me that the true Therapeutics reside in plants. This truth will make itself evident sooner or later; I see it even now advancing toward us, such that the science will be stripped of its old jargon, and returned to its true principles."

This stance marks him out as an original thinker who rejected fashionable fads in medicine. Given his view that plants should form the basis for medical treatment, Garcin was particularly motivated to explore novel *materia medica* that he encountered on his travels. In this endeavor he was hardly alone, of course. Recent research demonstrates that surgeons posted to European ships, colonies, and trading posts worked at the forefront of identifying and appropriating exotic plants for medical and other uses on site as well as in Europe. It has been suggested that surgeons were the "most innovative contributors to the study of tropical medicine in the Americas…" (Furtado, 2008: 132). The same could undoubtedly be said of the surgeons serving European trading companies in the Indies.

Surgeons posted to the colonies were often able to establish themselves as medical authorities on the ground as well as on board ship in a way they could not do at home, where the distinction between the medical and surgical professions was maintained by tradition, education and guild regulations dating from the Middle Ages. Their occupation often gave them the flexibility to explore ethnobotany and pharmacology rather independently of their employers' agendas before the "colonial arteries hardened" (Kumar, 2015: 28). Moreover, a commitment to the care of the body may have conferred on them a certain legitimacy in approaching local medical authorities for information, despite the secrecy that often impeded Europeans' access to indigenous medical knowledge (Katharithamby-Wells, 2015: 193). Garcin worked hard to penetrate closely-guarded indigenous medical knowledge; he was aware, for example, that "*Brahmins*…have a singular talent for discovering by experience the best Remedies that the nature in their Country fertile in Aromatics & Plants could present to them…They possess Secrets from the distant past…" (emph. orig.; Garcin, 1744a: 276).

In 1722 during a visit to Ceylon Garcin learned of a secret stomachic using the bark of a "Sindoc" tree that he said was indigenous to the island (Garcin, 1747: 476). He succeeded in obtaining the closely-guarded remedy when the Dutch governor made a gift of precious bezoar stones to a Brahmin medical practitioner who agreed to share the secret if Garcin did not divulge it in Ceylon.

The identity of Garcin's "Sindoc" is uncertain and he does not give it a Latin name in his 1747 article. One possible assumption is that it is the "Sindoc" reported by Rumphius in Ambon and given as a synonym for *Laurus malabatrum* by Burman fil. (Rumphius, 1741: 69; Burman, 1768: 92) (Fig. 1). Rumphius's "Sindoc" is *Cinnamomum javanicum* Blume (not *C. sintoc* Blume, which might intuitively seem to be the correct name; Merrill, 1921: 351). However, Garcin states that his "Sindoc" is indigenous on the island of Ceylon, where neither *Cinnamomum javanicum* Blume, nor *C. sintoc* Blume are indigenous (Soh, 2011: 251, 257). So either Garcin was wrong about the nativity of his tree or another candidate should be considered. It should be borne in mind that *Cinnamomum* comprises at least 250 species, many of which closely resemble each other. As a result, this taxonomically difficult genus has had 628 binomials published on IPNI (Soh, 2011: 241). In southern India alone there are 12 species (Kostermans, 1983: 90); Garcin already knew of 10 species (Garcin 1742: 648).

[3] All translations by the author.

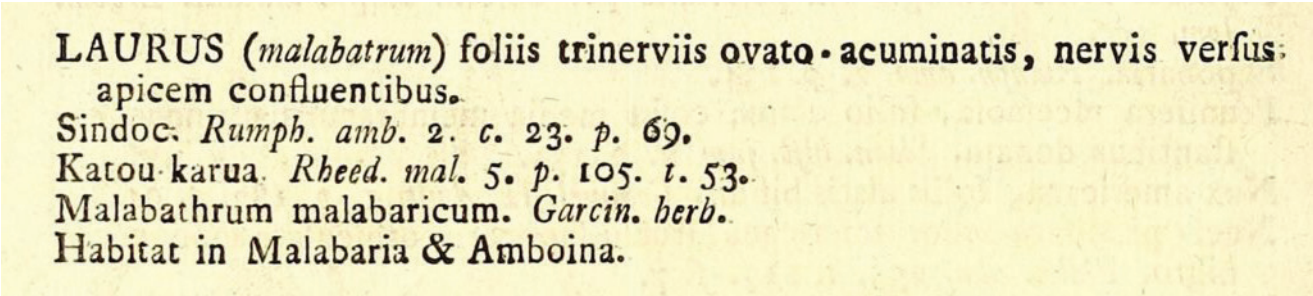

LAURUS (*malabatrum*) foliis trinerviis ovato-acuminatis, nervis verſus apicem confluentibus.
Sindoc. *Rumph. amb.* 2. *c.* 23. *p.* 69.
Katou-karua. *Rheed. mal.* 5. *p.* 105. *t.* 53.
Malabathrum malabaricum. *Garcin. herb.*
Habitat in Malabaria & Amboina.

FIGURE 1. *Laurus* (*malabatrum)* (= *Cinnamomum malabatrum* [Burm. f.] Presl) (Burman, 1768: 92; see also Table 1.37). Courtesy of Biodiversity Heritage Library (online).

Another approach to unraveling this puzzle is to take our cue from *Malabathrum malabarica*, Garcin's unpublished name for the specimen on which Burman fil. relied for the entry on *Laurus malabathrum* (cf. Kostermans 1983: 110). Garcin applies the name "Malabathrum" to a species of "Canelle" or cinnamon that he says supplied the medicinal "Folium indicum" of Antiquity and is indigenous to both Ceylon and the Malabar Coast of southwestern India (Garcin, 1742: 649). With this in mind it makes sense to follow Burman's synonymy further by investigating the modern nomenclature for Rheede's "Katou-karua," likewise a tree with pharmacological properties for treating the stomach and tasting like "cannelle [cinnamon]" (Garcin, 1747: 476; Rheede, 2003: 206). Proceeding on this interpretation, the "Sindoc" of which Garcin speaks in 1747 might therefore be *Cinnamomum malabathrum* (Lam.) C. Presl, the suggested modern name for Rheede's Katou-karua (Kostermans, 1983: 112; Rheede, 2003: 207). This supposition tracks with Garcin's assertion that "Malabathrum" is none other than the "Folium Indicum" (Garcin, 1742: 649), for leaves of *C. malabathrum* "have been and are still sold as an inferior substitute" for *C. tamala* leaves, the true "Folium Indicum" (Kostermans, 1983: 112). Without Garcin's specimen (see discussion below in "Garcin's herbarium that is not") it is impossible to state definitively which species Garcin in fact collected and passed on to J. Burman for later use by Burman fil. in *FI*.

As a result of Garcin's efforts and of those like him, "European medicine was transformed. Studying, classifying and experimenting with [exotic] plants became an important part of medical training in Europe….new medical plants entered European medicine, new apothecary practices emerged, and new dispensatories and medical texts were produced" (Chakrabarti, 2014: 35–36). Medicinal plants enumerated in *FI* such as *Salvadora persica* L. and the *Cinnamomum* discussed above (see Table 1.15 and 1.37) mutely testify to the transformation of early-modern Western medicine by Asian *materia medica*. Many of these medicinal plants offered important new remedies to Europeans hungry for relief from their ills. In the last decade of his life Garcin continued to criticize chemical remedies and promote plant-based medicine in his publications (Garcin, 1744b: 337–338).

Correspondence, exchange and the Republic of Science

Garcin secured his place in the esteem of contemporaries through his connections with key members of the Republic of Science, corresponding with Daniel Bernoulli (1700–1782), Herman Boerhaave (1668–1738), Emanuel Mendes da Costa (1717–1791), Sir Hans Sloane (1660–1753), Louis Bourguet (1678–1742), Johannes Burman (1707–1780), Abraham Gagnebin (1707–1800), René-Antoine Ferchault de Réaumur (1683–1757), the Dutch physicist and mathematician, Pieter van Musschenbroek (1692–1761; inventor of the Leiden Jar, the first electrical capacitor), and the Genevan physicist, Jean Jallabert (1712–1768). As discussed below in "Garcin's herbarium that is not," Garcin accompanied his correspondence with gifts of specimens, as was customary in the eighteenth-century Republic of Science.

Although no written correspondence between the Swedish naturalist, Carl Linnaeus (1707–1778), and Garcin survives, it is likely that Garcin was acquainted with Linnaeus, who during his 1735–1738 visit to the UP lodged with Burman before moving to George Clifford's estate of Hartekamp near Leiden. Linnaeus and Garcin both frequented the circle of savants around Burman and Boerhaave during 1737–1738 when Garcin, who had in the meantime qualified as a physician, returned to the UP to practice medicine (Hulst, Zeeland). It is therefore perhaps not surprising that Linnaeus named the genus *Garcinia* L. for Garcin and likewise accepted Garcin's proposal to name a genus—now known as *Salvadora* L.—in commemoration of his friend, the Catalan botanist, Joan Salvador I Riera (1683–1726) (Garcin, 1749–1750; Linnaeus, 1753: 122; see Table 1.15, 1.35; see also Ibánez et al., 2006).

Upon settling in Neuchâtel in 1739, Garcin became a prominent member of the principality's small scientific circle of physician-botanists: "Mr. Garcin, our mutual friend, Member of the Royal Society of Sciences of England and Correspondent of that of Paris, has bestowed a new luster on Swiss botanists by settling among them" (D'Ivernois, 1742: 31). Garcin brought new ideas from the vibrant Dutch Republic, whose rich botanical offerings included well-stocked botanical gardens, the most recent publications and leading lights such as Boerhaave at Leiden, Johannes Burman at Amsterdam, and of course

their Swedish protégé, Carl Linnaeus (see e.g. Gibbs, 2006). In 1739 Garcin introduced his Swiss colleagues to Linnaeus's artificial sexual system of classification (letter from Abraham Gagnebin to Albrecht von Haller, dated 25 November 1739, quoted in Jacquat, 1996: 101) and, in contrast to other Neuchâtel savants, preferred Linnaeus as a botanist to Albrecht von Haller (1708–1777), author of important works on Swiss botany (Haller, 1742; Haller, 1768) (letter of Garcin to Abraham Gagnebin dated 27 June 1743, quoted in Brandt, 1931: 219). Yet, despite his high regard for Linnaeus, Garcin moved beyond the sexual system to teach a natural system of classification, the exact content of which is at present unknown (Anonymous, 1747: 145–146).

Garcin published four botanical studies in the *Philosophical Transactions* of the Royal Society of London (Garcin 1729–30; Garcin 1733; Garcin 1748; Garcin 1749–50), and eleven articles on various topics ranging from medicine to meteorology in the *Journal helvétique/Mercure Suisse*, a learned, but more popular publication produced in Neuchâtel. Less notice has been taken of Garcin's substantial contribution to the revised edition of the four-volume *Dictionnaire universel de commerce* (1742) in which he authored at least 35 articles and 37 "additions" to articles on trade, commodities and related subjects (see e.g. Garcin 1742a); according to Bourguet, Garcin corrected ca. 70 articles, many of which addressed botanical topics such as the various species of *Cinnamomum*. These articles and revisions constituted important contributions in their respective fields of knowledge, as indicated by Bourguet (1742: 150–152). These varied works disseminated Garcin's medical, botanical and commercial knowledge both to specialized and popular audiences, in the manner of other surgeons who had practiced in the colonies (Furtado, 2008: 140).

Garcin's herbarium that is not

We know that Garcin collected plant specimens in Dutch trading posts and colonies in the Cape, Persia, the Malabar Coast, Bengal, Ceylon and Southeast Asia; yet we have no precise information regarding the contents of his herbarium beyond a very few extant specimens (G-Burman). We also know that Garcin gave all or part of his herbarium to Johannes Burman, Director of the Amsterdam botanical garden. According to reliable testimony from the noted Neuchâtel savant, Louis Bourguet (1678–1742), Garcin gave specimens to Burman during or before 1740:

> "The beautiful Collection of dried Plants that you brought to Europe from the Indies & the Cape of Good Hope, of which you generously presented the largest part to the famous Mr. BURMAN, Doctor of Medicine in Amsterdam; this Collection, I say, of which you have made such an excellent use, by giving it to Friends, shows better than I could possibly ever convey, how much Wealth the Republic of Letters could have expected from you if you had been supported by a powerful Patron" (emphasis original; Bourguet, 1740: 278).

In a letter to Linnaeus dated 20 July 1756 Johannes Burman himself confirmed receipt of herbarium specimens from Garcin (Burman, 1756). Garcin's Asian herbarium therefore seems to have been dispersed well before he died, given to Burman and possibly to others (*pace* Bridel, who states that the herbarium was lost or destroyed; Bridel, 1831: 105). The specimens given to Johannes Burman passed at his death to his son, Nicolaas Laurens Burman (1733–1793). In 1810 the Burmans' herbarium was purchased by the great botanical collector, Benjamin Delessert (1773–1847), whose vast collections formed a principal basis for G (Miller, 1970: 509; Lasègue, 1845: 65–67). A mere handful of Garcin's specimens are currently accessible (G-Burman) (Fig. 2–7): *Convolvulus spinosus* Burm. f., *Erigeron denticulatus* Burm. f. (= *Pluchea indica* (L.) Less.), *Ficus tsjakela* Burm. f., *Hieracium javanicum* Burm. f. (= *Emilia sonchifolia* var. sagittata), *Origanum benghalense* Burm. f. (= *Pogostemon benghalensis* (Burm. f.) Kuntze) and *Senecio coronopifolius* Burm. f. According to Staples and Jacquemoud (2005), two other specimens, *Convolvulus vitifolius* Burm. f. (= *Merremia aegyptia* (L.) Urb.) and *Ipomoea sagittifolia* Hochr. (= *Ipomoea aquatica* Forssk.), are also extant (G-Burman). However, these appear so far not to have been digitized. As the herbaria at G are, at this writing, being relocated, the presence of those specimens in their collections cannot be confirmed.

It therefore has to be presumed, given Bourguet's comment quoted above, that most of Garcin's specimens are either no longer extant or have yet to be located. On this point there has been some misunderstanding because a number of specimens labelled as Laurent Garcin's in the National Museum Wales probably came from the herbarium assembled by his son, Jean-Laurent Garcin (1733–1781). Like his father, Garcin fil. pursued botany and sought to surpass Haller (1768) with a more accurate Swiss flora (letter to Philippe Sirice Bridel, dated 18 June 1776 quoted in Bridel, 1831: 121). Upon Garcin fil.'s untimely death, this important collection was purchased by the Scottish naturalist, John Stuart, Lord Bute (1713–1792), and later dispersed to various collections in Great Britain, including the National Museum Wales (Cook, 2012: 300; Miller, 1970: 524).[4]

Garcin and *Flora Indica*

A large number of Garcin's specimens served as fundamental reference material for *FI*, compiled by Burman fil., who refers to 98 Garcin specimens in *FI*, out of 1,305 species *in toto* (Merrill, 1921: 330). Those specimens constitute approximately 25 percent of the 393 specimens cited in *FI* (Table 1). Twenty-one of them appear to have been collected in Persia (Iran), 5 in Surat (Gujarat state, India), 13 in Ceylon (Sri Lanka), 11 on the Malabar Coast (Kerala state and Tamil Nadu state, India) and 17 in Java (Indonesia). According to Burman fil. 35 of Garcin's

[4] The inference that the specimens in the National Museum Wales came from Garcin fil.'s herbarium is supported by the absence of Asian specimens from the collection (pers. comm., T. Rich and V. Purewal).

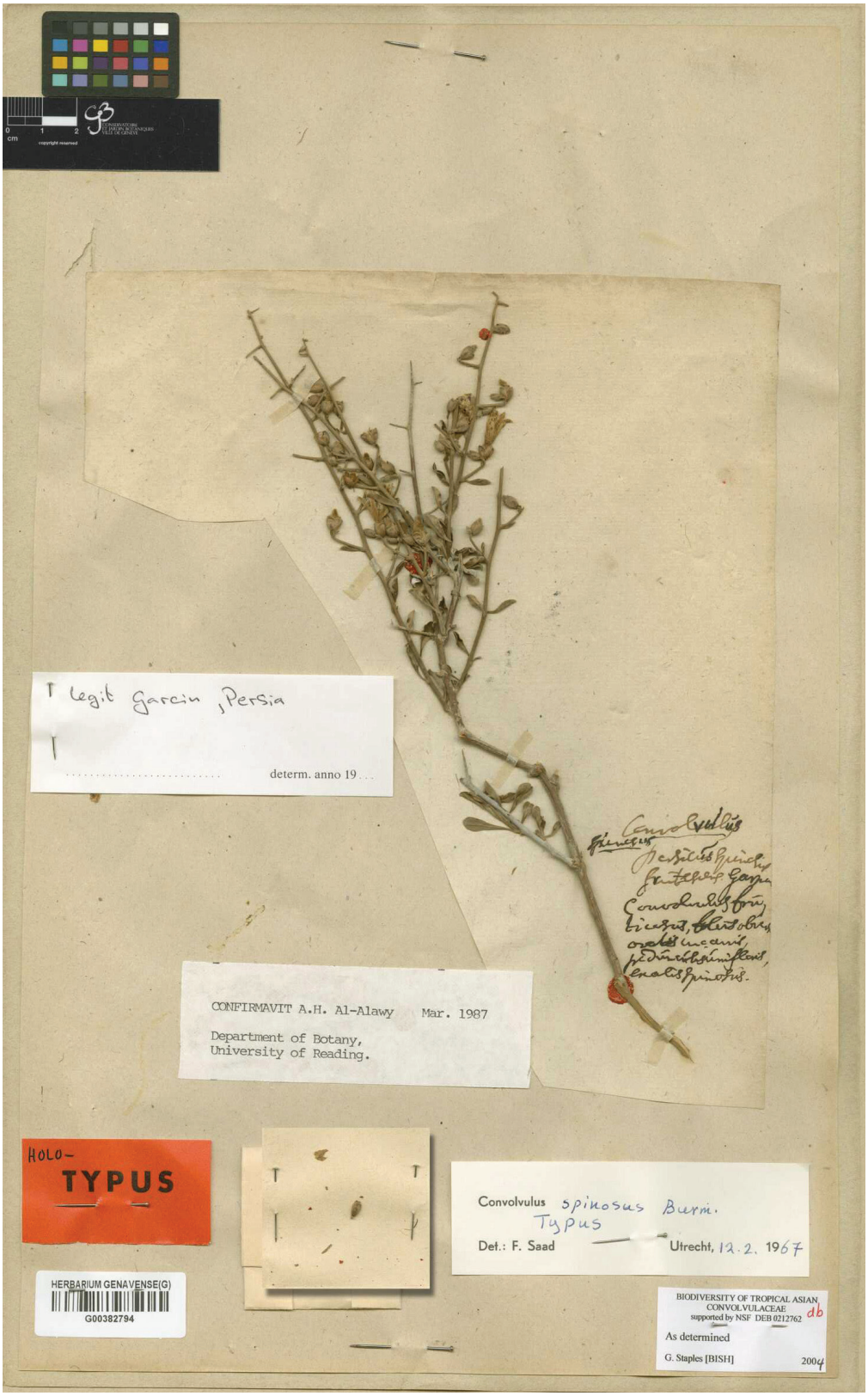


FIGURE 2. *Convolvulus spinosus* Burm. f. Burman fil.'s writing appears mixed with that of Garcin. In Garcin's hand we read "Convolvulus persicus spinosus frutescens" (G-Burman) (see also Table 1.23). © Conservatoire et Jardin botaniques de la Ville de Genève.

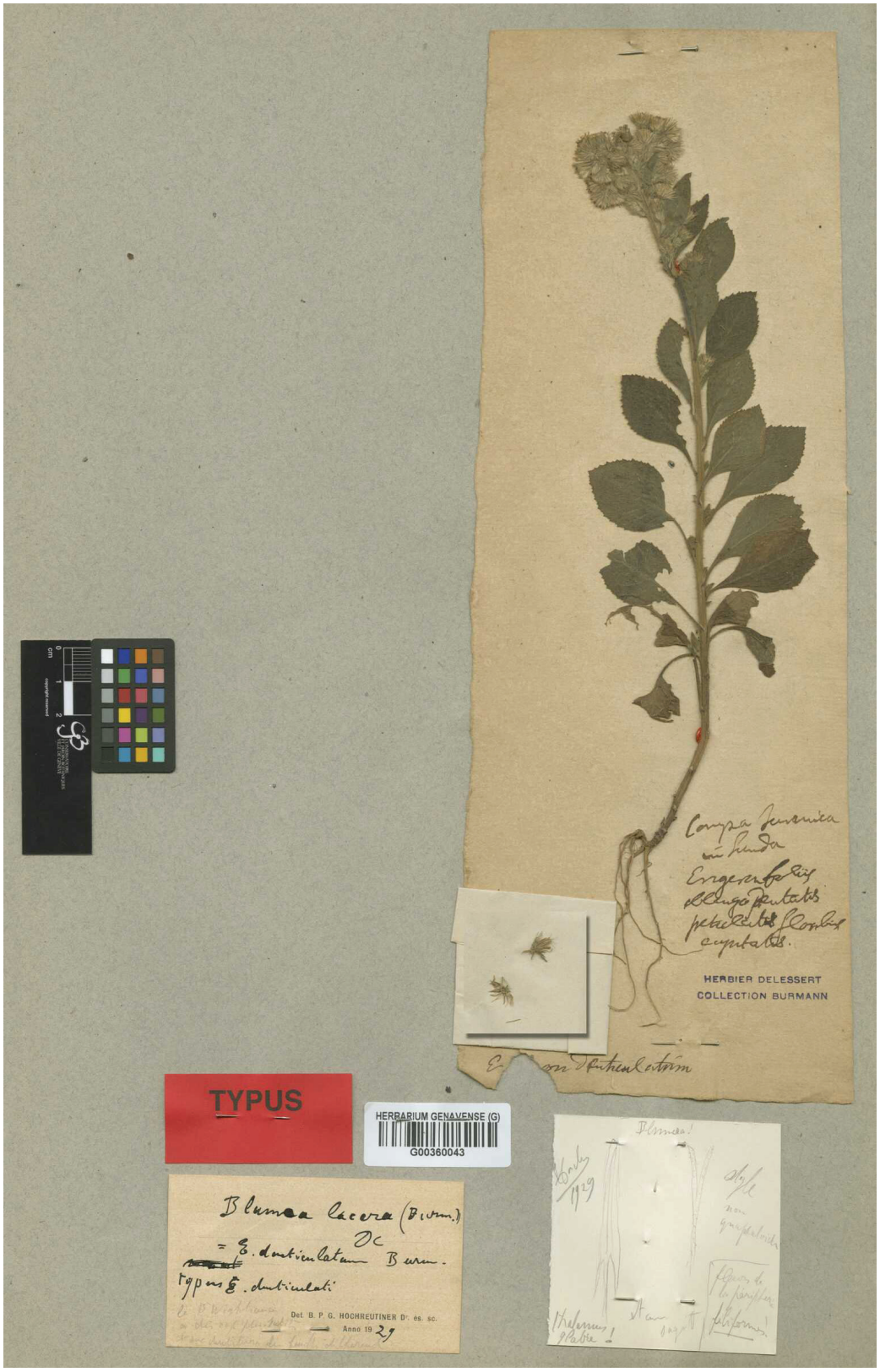


FIGURE 3. *Erigeron denticulatum* Burm. f. (G-Burman). Garcin's note reads: "Conyza javanica in funda" (see also Table 1.83). © Conservatoire et Jardin botaniques de la Ville de Genève.

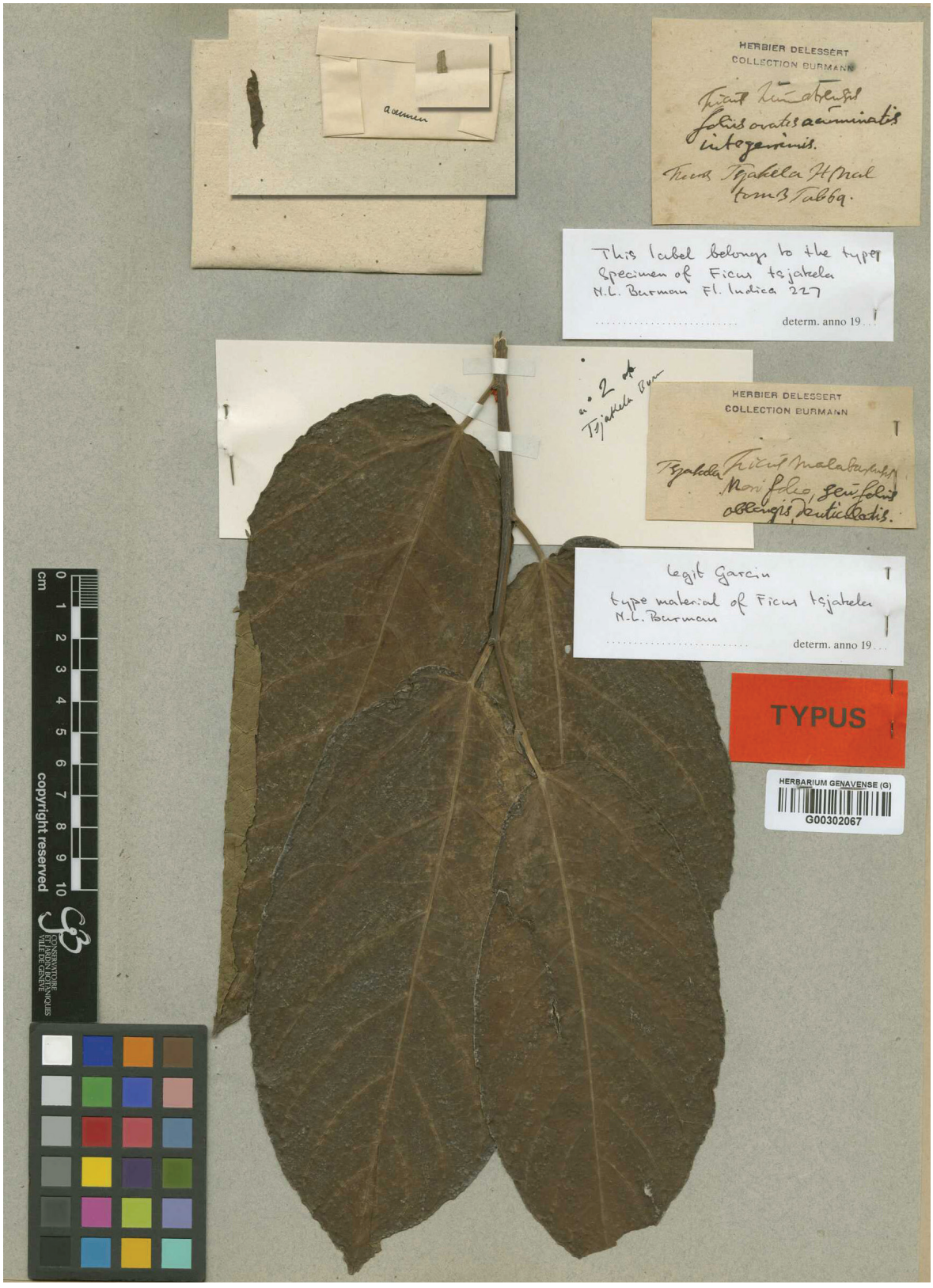


FIGURE 4. *Ficus tsjakela* Burm. f. (G-Burman). Garcin references "*Rheed. mal. 3. p. 87. t. 64.*" (Rheede, 1682: 87. fig. 64); he describes this plant as "Ficus Tsjakela malabarica mori folio" (see also Table 1.96). © Conservatoire et Jardin botaniques de la Ville de Genève.

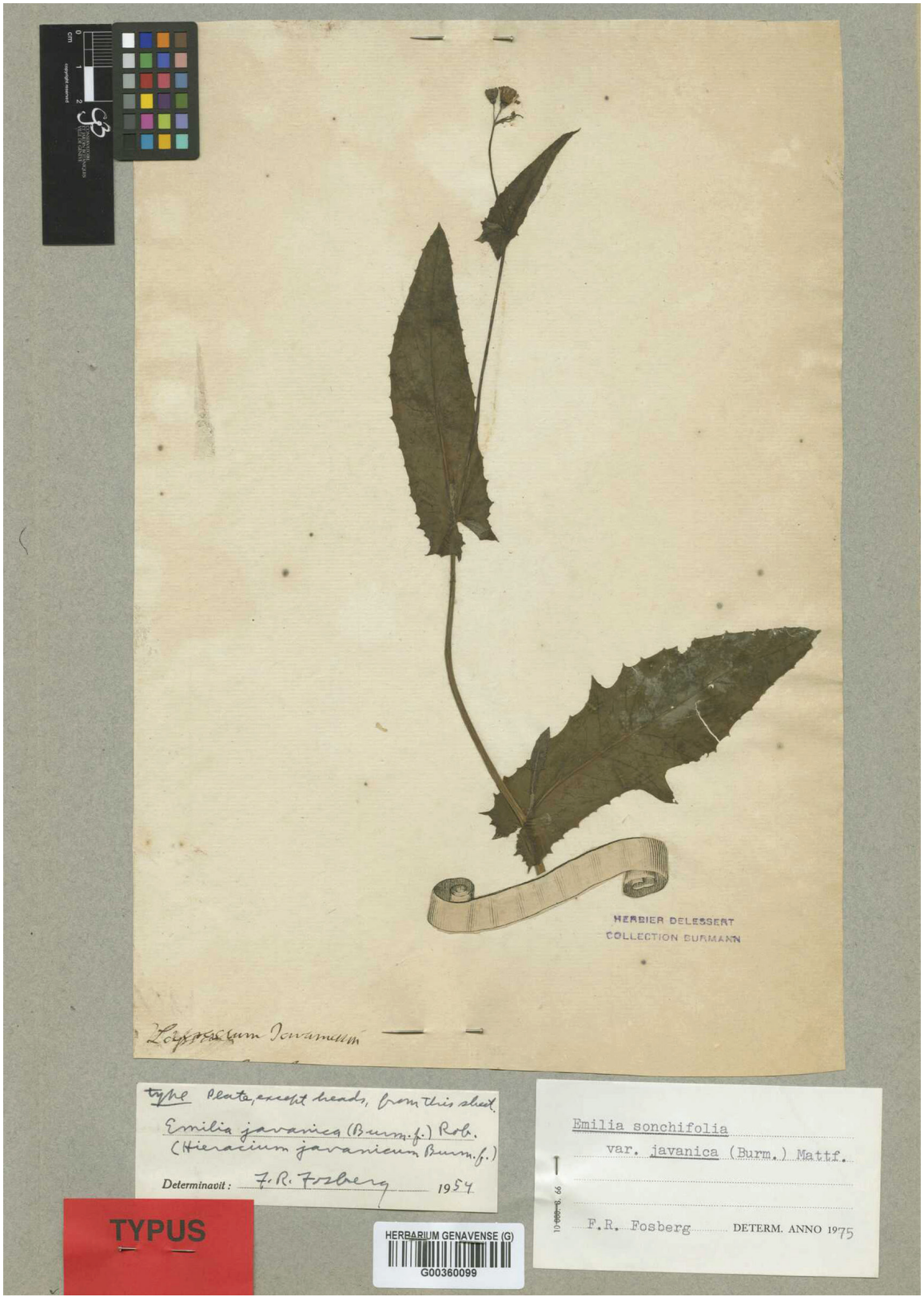


FIGURE 5. *Hieracium javanicum* Burm. f. (G-Burman) The first word of Garcin's note in the lower left- corner of the herbarium sheet is illegible, bearing no resemblance to likely synonyms; the second word is "javanicum" (see also Table 1.81). © Conservatoire et Jardin botaniques de la Ville de Genève.

FIGURE 6. *Origanum benghalense* Burm. f. (G-Burman). "Ocimum Benghalense" is in Garcin's hand (see also Table 1.51). © Conservatoire et Jardin botaniques de la Ville de Genève.

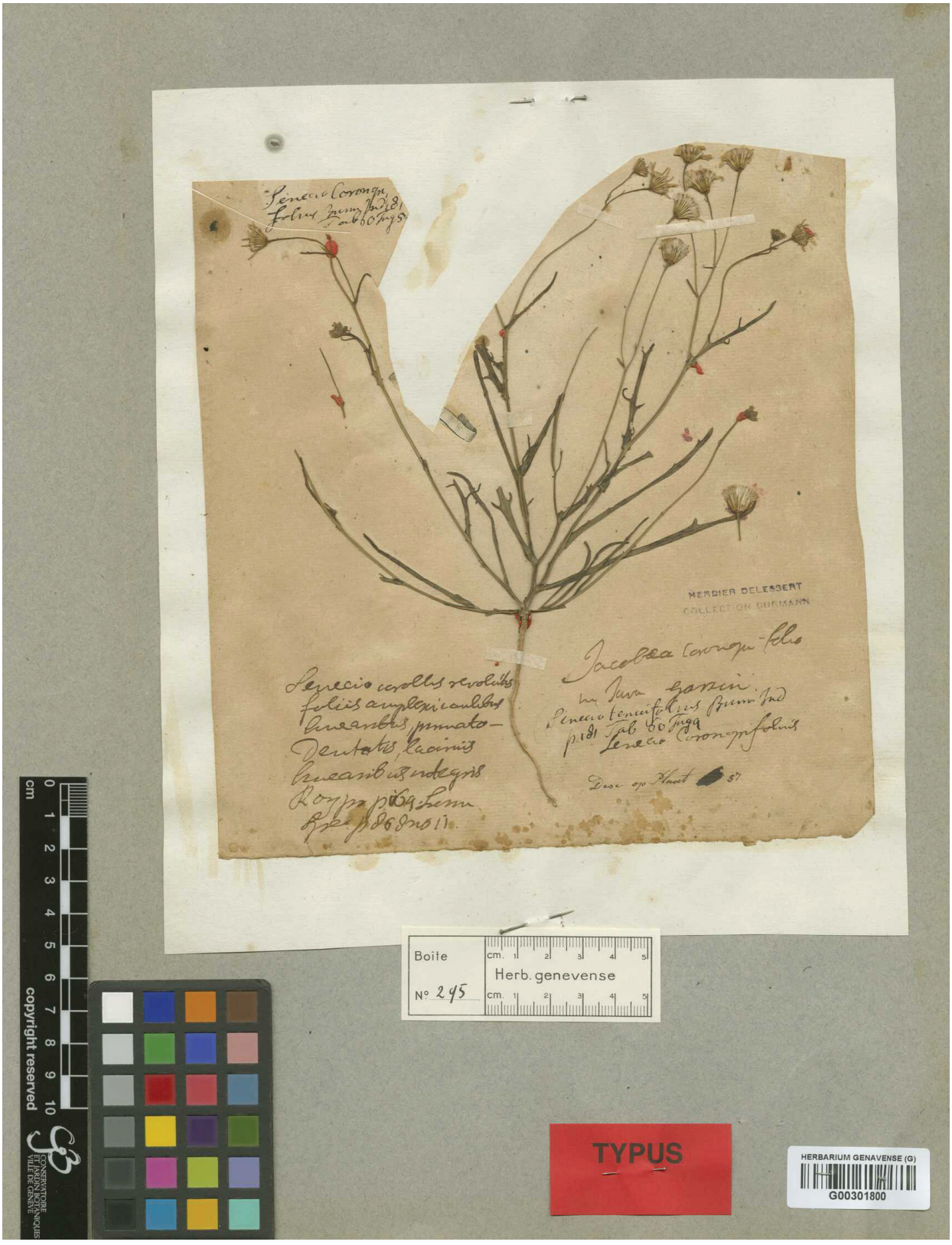


FIGURE 7. *Senecio coronopifolius* Burm. f. (G-Burman). "Jacobæa Coronopi folio in Java Garcin" and "Senecio Coronopifolius" appear to be in Garcin's hand (see also Table 1.85). © Conservatoire et Jardin botaniques de la Ville de Genève.

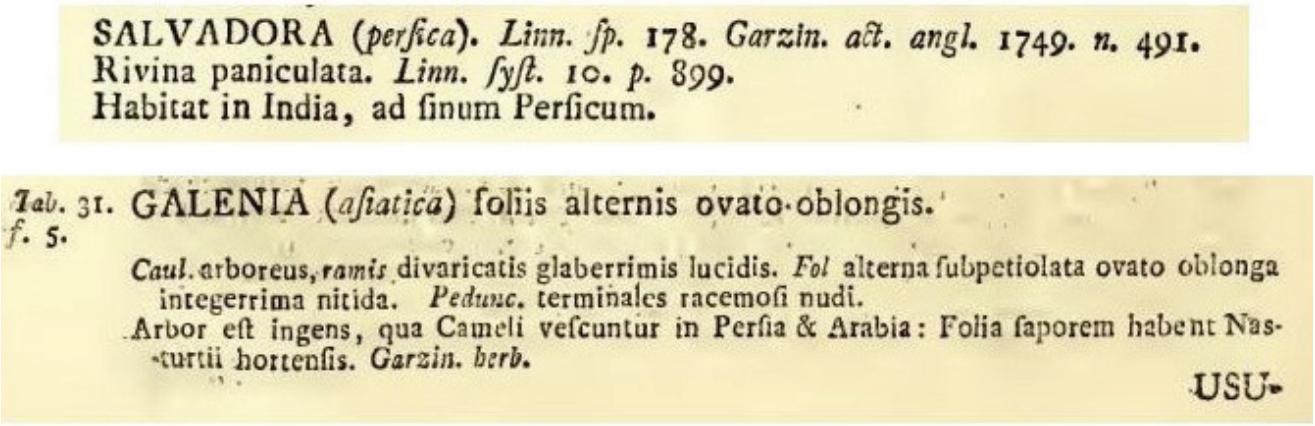
specimens came from "India," without more specific locale. Their origin could refer to any number of places within a huge geographical area ranging from the Middle East to modern China, India and Southeast Asia (Cook, 2010: 124)

It should be noted that Burman fil.'s references to Garcin's specimens are inconsistent, taking 10 different italicized forms: *Garcin. herb.* (39 instances), *Garzin. herb.* (31 instances), *Herb. Garzin* (12 instances), *Herb. Garcin* (5 instances), *D. Garzin* (5 instances), *D. Garcin* (2 instances), *Garzin* (2 instances) *D^ni^ Garcin* (1 instance), *Garcini* Herbarium (1 instance) and *Garzin act. angl.* (1 instance, referring to *Salvadora persica* Garcin ex L., which relies on a published description only) (Garcin 1749–1750). Note that *S. persica* L. is synonymous with *Galenia asiatica* Burm. f., for which Burman fil. does rely on a Garcin specimen (Fig. 8; see also table 1.15 and 1.35).

To my knowledge, the references to these specimens in Burman fil.'s text have never been thoroughly examined in their historical context. The limited literature on the sources for *FI* either completely ignores (Florijn, 1987) or fails to credit the full extent of Garcin's contribution to that work (Wijnands, 1992; Staples and Jacquemoud, 2005). For example, Florijn discusses contributors such as H. O. van Oudgaarden (1751–1788) and H. Santen (1714–1765), who together contributed only 30 specimens in toto to *FI* (Florijn, 1987: 35–36). Merrill, on the other hand, shows that Garcin contributed 8 species to *FI* that were new to science (1921: 345–346, 351, 356, 370, 377–378, 386); one of these, *Ficus tsjakela* Burm. f. is extant (G-Burman). Wijnands states that "Burman mentioned Garcin repeatedly" in *FI* and relied on his "African specimens" in the *Prodromus* of Cape species appended to the former work (Wijnands, 1992: 490). In fact, however, our inspection shows that Burman fil.'s *Prodromus* does not refer directly to any Garcin specimens; yet since Burman fil. had them in his possession he could, of course, have consulted them. Wijnands is not the only author to refer to "African" specimens from Garcin; Rudio claimed that 400 such specimens could be found in the herbarium of the Naturforschenden Gesellschaft in Zürich (now incorporated into the herbarium of the Institute for Systematic Botany, University of Zurich) (Rudio, 1896: 187). However, enquiries to that institution reveal that at present no such specimens can be located (pers. comm., R. Rutishauser).

For their part, Staples and Jacquemoud acknowledge Garcin's contribution of type specimens to *FI*, but do not touch on the question of Garcin's quantitative contribution to that work, limiting their discussion to Garcin's contribution of type specimens of *Convolvulaceae* to G-Burman.

Table 1 presents the species in *FI* that are based on Garcin specimens: it makes apparent for the first time the extent and importance of Garcin's contributions to *FI*. However, as stated above, it is for the moment impossible to state where most of the actual specimens are located, or if they are even extant. The few extant specimens and the traces of many others in *FI* silently testify to Garcin's collecting zeal and keen eye for *materia medica*.



SALVADORA (*perſica*). *Linn. ſp.* 178. *Garzin. act. angl.* 1749. *n.* 491.
Rivina paniculata. *Linn. ſyſt.* 10. *p.* 899.
Habitat in India, ad ſinum Perſicum.

Tab. 31. *f.* 5. GALENIA (*aſiatica*) foliis alternis ovato-oblongis.

Caul. arboreus, *ramis* divaricatis glaberrimis lucidis. *Fol* alterna ſubpetiolata ovato oblonga integerrima nitida. *Pedunc.* terminales racemoſi nudi.
Arbor eſt ingens, qua Cameli veſcuntur in Perſia & Arabia: Folia ſaporem habent Naſturtii hortenſis. *Garzin. herb.*

USU-

FIGURE 8. Top: *Salvadora persica* L. (Burman, 1768: 40; see Table 1.15). Bottom: *Galenia asiatica* Burm. f. (Burman, 1768: 88; see also Table 1.35). Courtesy of Biodiversity Heritage Library (online).

TABLE 1. Garcin material relied upon in N. Burman's *FI*

[*] = Noted by Merrill (1921) as a new species.

[**] = Garcin's specimen is confirmed in G-Burman.

	Page in *FI*	Burman's name	Current plant name
1.	4 *Tab*. 2.	NYCTANTHES (*triflora*) foliis alternis, ramulorum oppositis ovatis, pedunculis terminalibus ternis, pedicellis unifloris. Jasminum javanicum *D^ni^*. *Garcin*. Habitat in Java.	*Nyctanthes triflora* Burm. f. = *Jasminum angustifolium* (L.) Willd.
2.	6 *Tab*. 3. *f*. 2.	JASMINUM (*oblongum*) foliis oppositis simplicibus, pedunculis alternis axillaribus umfloris. Jasminum javanicum. *Herb*. *Garcin*. Habitat in Java.	*Jasminum oblongum* Burm. f. = *Gymnanthera oblonga* (Burm. f.) P. S. Green.
3.	7	JUSTICIA (*Ecbolium*[c]) arborea, foliis lanceolato-ovatis, bracteis ovatis deciduis mucronatis, corollarum galea reflexa. […] Adhatoda zeylanica, plantaginis folio. *Herb*. *Garcin*. […] Invenitur præcipue in Malabara & Zeylona.	*Justicia ecbolium* L. = *Ecbolium ligustrinum* (Vahl) Vollesen.
4.	8	JUSTICIA (*Betonica*) fruticosa, foliis lanceolato-ovatis, bracteis ovatis acuminatis venofo reticulatis coloratis. […] Adhatoda malabarica. *Herb*. *Garcin*. […] Crescit in variis Indiæ locis.	*Justicia betonica* L.
5.	8	JUSTICIA (*chinensis*) herbacea, foliis ovatis, floribus lateralibus, pedunculis trifloris, bracteis ovalibus. […] Planta, quæ in urbe Batavia crescit juxta muros. *Herb*. *Garcin*. Habitat in China.	*Justicia chinensis* L. = *Dicliptera chinensis* (L.) Juss.
6.	9	JUSTICIA (paniculata) diffusa, panicula axillari, foliis sessilibus lanceolatis. Adhatodæ similis planta zeylanica. *Herb*. *Garzin*. […] Habitat in Malabara & Zeylona.	*Justicia paniculata* Burm. f. = *Andrographis paniculata* (Burm. f.) Nees.
7.	9 *Tab*. 4. *f*. 3.	JUSTICIA (madurensis) fruticosa, foliis ovalibus obtusis dentatis, floribus axillaribus folitariis. Adhotoda madurensis frutescens, sampsanchi folio, caule argenteo. *Herb*. *Garzin*. […] Habitat in Madura.	*Justicia madurensis* Burm. f. is an unresolved name, but some data suggest that it is synonymous with *Calophanes littoralis* (L. f.) T. Anderson.
8.	10	JUSTICIA (*Gendarussa*) fruticosa, foliis lanceolatis integerrimis, spicis terminalibus simplicibus. Adhatoda malabarica, falicis folio, floribus spicatis. *Herb*. *Garzin*. […] Crescit in Malabara, Amboina & Java, unde specimina sæpius missa.	*Justicia gendarussa* Burm. f.

TABLE 1 CONT. Garcin material relied upon in N. Burman's *FI*

[*] = Noted by Merrill (1921) as a new species.

[**] = Garcin's specimen is confirmed in G-Burman.

	Page in *FI*	Burman's name	Current plant name
9.	18–19	SCHOENUS (*Coloratus*) culmo triquetro, capitulo subrotundo, involucro longissimo plano variegato. […] Gramen malabaricum repens aquaticum. *D. Garzin*. […] Habitat in utrisque Indiis.	*Schoenus coloratus* L. = *Rhynchospora colorata* (L.) H. Pfeiff.
10.	20	CYPERUS (*haspan*) culmo triquetro folioso, umbella supradecomposita, spiculis umbellato-fessilibus. […] Gramen cyperoides javanicum pectinatum. *Herb. Garzin*. Habitat in Java.	*Cyperus haspan* L.
11.	28 *Tab*. 12. *f*. 2.	DACTYLUS (*lagopoides*) spica compressa simplici, foliis divaricatis pungentibus. […] Gramen dactyloides javanicum. *Garzin. herb*. N.B. No habitat is mentioned.	*Dactylis lagopoides* L. = *Aeluropus lagopoides* (L.) Thwaites.
12.	31	MOLLUGO (*oppositifolia*) foliis oppositis lanceolatis, ramis alternis, pedunculis lateralibus consertis unifloris. […] Alsine madurensis, spergulæ facie. *Herb. Garzin*. Crescit in Zeylona.	*Mollugo oppositifolia* L. = *Glinus oppositifolius* (L.) Aug. DC.
13.	37	OLDENLANDIA (*biflora*) pedunculis bifloris, petiolo longioribus, foliis lanceolatis. […] Alsine zeylanica. *D. Garzin*. quæ magnitudine & foliis latioribus differt. Habitat in India, præsertim in Zeylona.	*Oldenlandia biflora* L.
14.	39	COMETES (*surattensis*) Clinopodium parvum finicum, hirfutis majoranæ foliis coronatum. […] Planta surattensis & malabarica, Trifolii Lagopi capitulis. *Garzin. herb*.	*Cometes surattensis* Burm. f.
15.	40	[*] SALVADORA (*persica*). […] *Garzin. act. angl.* 1749. *n*. 491. […] Habitat in India, ad sinum Persicum.	*Salvadora persica* L. N.B. See entry 35, *Galenia asiatica* Burm. f.
16.	40	HELIOTROPIUM (*europæum*) foliis ovatis integerrimis tomentosis rugosis, spicis conjugatis. […] Heliotropium malabaricum incanum. *D. Garzin*. Habitat in Malabara & Europa.	*Heliotropium europaeum* L.
17.	41 *Tab*. 16. *f*. 2.	HELIOTROPIUM (*curassavicum*) foliis lanceolato-linearibus glabris aveniis spicis conjugatis. […] β Heliotropium zeylanicum angustifolium in Tutukorin. *Garzin*. e cujus herbario hanc varietatem produco. Habitat in Indiis.	*Heliotropium curassavicum* L.

TABLE 1 CONT. Garcin material relied upon in N. Burman's *FI*

[*] = Noted by Merrill (1921) as a new species.

[**] = Garcin's specimen is confirmed in G-Burman.

	Page in *FI*	Burman's name	Current plant name
18.	41 *Tab*. 19. *f*. 1.	HELIOTROPIUM (*fruticosum*) foliis lineari-lanceolatis pilosis, spicis folitariis sessilibus. […] Heliotropium persicum incanum, floribus variegatis. *Garzin*. e. cujus *herbario* figuram defumfi.	*Heliotropium fruticosum* L. = *Euploca fruticosa* (L.) J. I. M. Melo & Semir.
19.	41 *Tab*. 14. *f*. 2.	BORAGO (*zeylanica*) foliis ramifactionum oppositis, florum alternis, oblongis, pedunculis terminalibus unifloris, calycibus protuberantibus. […] Borraginoides zeylanicum. *Herb*. *Garzin*. Habitat in Zeylona.	*Borago zeylanica* Burm. f. = *Trichodesma zeylanicum* (Burm.f.) R. Br.
20.	43	CONVOLVULUS (*medium*) foliis linearibus hastato-acuminatis, auriculis dentatis, pedunculis subunifloris, calycibus fagittatis, caule volubili. […] Convolvulus javanensis. *herb*. *Garzin*. […] Habitat in India.	*Convolvulus medium* L. = *Merremia medium* (L.) Hallier f.
21.	45 *Tab*. 18. *f*. 1.	CONVOLVULUS (*vitifolius*) foliis palmatis quinquelobis glabris dentatis, caule piloso. […] Convolvulus vicis folio janavicus. *D*. *Garzin*. Ginda pura utan. Javanis.	*Convolvulus vitifolius* Burm. f. = *Merremia aegyptia* (L.) Urb.
22.	47 *Tab*. 19. *f*. 3.	CONVOLVULUS (*sericeus*) caule procumbente villoso, foliis inferioribus lanceolatis superioribus ovatis, calycibus villosis. Convulvulus persicus argenteus. *Garzin*. *herb*. Habitat in Persia.	*Convolvulus sericeus* L. = *Argyreia mollis* (Burm. f.) Choisy.
23.	47 [**] *Tab*. 19. *f*. 4.	CONVOLVULUS (*spinosus*) caule erecto suffruticoso, apice spinoso, foliis ellipticis, floribus solitariis. Convulvulus persicus spinosus frutescens. *Garzin*. *herb*. Habitat in Persia.	*Convolvulus spinosus* Burm. f.
24.	49	IPOMAEA (*campanulata*) foliis cordatis, pedunculis multifloris, perianthio exteriori orbiculari, corollis campanulatis lobatis. […] Convolvulus maritimus zeylanicus et javanicus. *herb*. *Garzin*. […] Habitat in [M]alabara.	*Ipomoea campanulata* L. = *Stictocardia tiliifolia* (Desr.) Hallier f.
25.	50 *Tab*. 18. *f*. 2.	IPOMAEA (*sagittæfolia*) foliis hastatis, pedunculis bifloris. Convulvulus javanicus. *Garzin*. *herb*. Habitat in Java.	*Ipomoea sagittifolia* Hochr. = *Ipomoea aquatica* Forssk.
26.	57 [*]	SOLANUM (*surattense*) caule aculeato herbaceo, foliis oblongis pinnatifide laciniatis utrinque spinis flavescentibus. […] Bina hujus specimina in infula Zuratta collegit D. *Garzin*., quorum alterum optime cum citatis figuris convenit, alterum, differt foiiatura minori. Spinis rarioribus brevioribus, quadratque cum *Plukn* figura 6.	*Solanum surattense* Burm. f.

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27.	60	RHAMNUS ([*j*]*ujuba*) aculeis solitariis recurvis, pedunculis aggregatis, floribus semidigynis, foliis retusis subtus tomentosis. […] Jujuba malabarensis. *Garzin herb*. […] Habitat in variis Indiæ locis.	*Rhamnus jujuba* L. = *Ziziphus jujuba* Mill.
28.	61	RHAMNUS (*nummularia*) aculeis solitariis geminisque recurvis, pedunculis corymbosis, foliis ovatis integerrimis. Rhamnus persica. *herb*. *Garzin*. […] Habitat in Zeylona & Java.	*Rhamnus nummularia* Burm. f. = *Ziziphus nummularia* (Burm. f.) Wight & Arn.
29.	61	RHAMNUS (*heterogeneus*) aculeis geminis, simplici & recurvo, pedunculis solitariis unifloris, foliis ovatis serrulatis trinerviis lucidis. […] Jujuba persica. *herb*. *Garzin*. Habitat in India orientali & Persia.	*Rhamnus heterogenea* Burm. f. is an unresolved name.
30.	69 *Tab*. 28. *f*. 1.	ECHITES (*nummularia*) foliis cordatis acuminatis, pedunculis bifloris. […] Apocynum nummulariæ foliis. *Garzin*. *herb*. […] Habitat in India.	*Echites nummularius* Burm. f. is an unresolved name.
31.	70	CYNANCHUM (*indicum*) caule volubili herbaceo, foliis ovatis acuminatis, pedunculis axillaribus umbellatis. Asclepias javanica & zeylanica. *Garzin*. *herb*. […] Javanis.	*Cynanchum indicum* Burm. f. is an unresolved name, but some data suggest that it is synonymous with *Tylophora indica* (Burm. f.) Merr. *Cynanchum indicum* Lam. = *Tylophora laevigata* Decne.
32.	71	APOCYNUM (*reticulatum*) caule volubili perenni, foliis ovatis venosis. […] Asclepias javanica angustifolia. *Garzin*. *herb*. Habitat in India.	*Apocynum reticulatum* L. = *Parsonsia alboflavescens* (Dennst.) Mabb.
33.	71	APOCYNUM (*vincæfolium*) caule erectiusculo perenni, foliis ovatis oblongis, pedunculus bifloris lateralibus. Asclepias javanica angustifolia. *Garzin*. *herb*.	*Apocynum vincifolium* Burm. f. = *Parsonsia alboflavescens* (Dennst.) Mabb.
34.	88	LAWSONIA (*inermis*) ramis inermibus. […] Cyprus verus antiquorum. *Garzin*. *herb*. […] Parjar Tjalong. Javanis Crescit per totam Indiam, ubi colitur, tum & in Ægypto, Palæstina, Persia.	*Lawsonia inermis* L.
35.	88 [*] *Tab*. 31. *f*. 5.	GALENIA (*asiatica*) foliis alternis ovato-oblongis. […] Arbor est ingens, qua Cameli vescuntur in Persia & Arabia: Folia saporem habent Nasturtii hottensis. *Garzin*. *herb*.	*Galenia asiatica* Burm. f. = *Salvadora persica* L. N. B. See entry 15.
36.	89	POLYGONUM (*orientale*) floribus heptandris digynis, foliis ovatis, caule erecto, stipulis hirtis hypocrateriformibus. […] Persicaria javanica. *herb*. *Garzin*. Cabur Cabur Javanis. Habitat in India & Oriente.	*Polygonum orientale* L. = *Persicaria orientalis* (L.) Spach.

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37.	92	[*] LAURUS (*malabatrum*) foliis trinerviis ovato-acuminatis, nervis versus apicem confluentibus. […] Malabathrum malabaricum. *Garcin. herb.* Habitat in Malabaria & Amboina.	*Cinnamomum malabatrum* Burm. f. (Kostermans, 1983: 102–113; Rheede, 2003: 207).
38.	94	BAUHINIA (*variegata*) foliis cordatis, lobis coadunatis obtusis. […] Bauhinia malabarica. *Garzin herb.* […] Habitat in India.	*Bauhinia variegata* L.
39.	95	CASSIA (*Tora*) foliis trijugis obovatis, exterioribus majoribus, glandula subulata inter inferiora quatuor. […] Senna javanica frutescens. *Garzin. herb.* […] Habitat in India.	*Cassia tora* L. = *Senna tora* (L.) Roxb.
40.	95–96	CASSIA (*obtusifolia*) foliis trijugis ovatis obtusiusculis. […] Senna javanica. *Garzin. herb.* […] Habitat in Indiis.	*Cassia obtusifolia* L. = *Senna obtusifolia* (L.) H. S. Irwin & Barneby.
41.	96 *Tab.* 33. *f.* 2.	CASSIA (*Senna*) foliis trijugis quadrijugisque subovatis, siliquis falcatis. […] Senna persica, siliquis falcatis. *Garzin. herb.* […] Habitat in India & Ægypto.	*Cassia senna* L. = *Senna alexandrina* Mill.
42.	97	CASSIA (*surattensis*) foliis octojugis ovato-oblongis obtusis emarginatis inferioribus minoribus, glandula ad basin binorum inferiorum pedicellata. Senna surattensis. *Garzin. herb.*	*Cassia surattensis* Burm. f. = *Senna surattensis* (Burm. f.) H. S. Irwin & Barneby.
43.	97	CASSIA (*javanica*) foliis duodecim jugis oblongis obtusis glabris, glandula nulla. […] Senna malabarica. *Garzin. herb.* […] Habitat in Indiis.	*Cassia javanica* L.
44.	102 *Tab.* 34. *f.* 1.	FAGONIA (*indica*) spinis geminis, foliis oppositis ovalibus. Fagonia indica ad alas spinosa, flore pentapetalo, fructu quinque capsulari; planta persica. *Garzin. herb.* Habitat in Persia.	*Fagonia indica* Burm. f.
45.	102	TRIBULUS (*lanuginosus*) foliolis quinquejugatis subæqualibus, seminibus bicornibus. […] Tribulus javanicus & persicus. *Garzin. herb.* Habitat in Zeylona.	*Tribulus lanuginosus* L. = *Tribulus terrestris* L.
46.	104–106	MELASTOMA (*hirta*) foliis dentieulatis quinque nerviis ovato-lanceolatis, caule hispido […] Agrimoniæ congener indica. *Garzin. herb.* Habitat in Indiis.	*Melastoma hirtum* L. = *Clidemia hirta* (L.) D. Don.

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47.	112	EUPHORBIA (*parviflora*) subdichotoma, foliis serratis oblongis glabris, floribus solitariis, caule erectiusculo alterne ramoso. […] Tithymalus malabaricus & zeylanicus argenteus, Buxi folio. *Herb. Garzin.* Habitat in Zeylona.	*Euphorbia parviflora* L.
48.	123	CORCHORUS (*trilocularis*) capsulis lineari-siliquosis sexsulcatis tricuspidatis, foliis oblongis, serraturis æqualibus, infimis setaceis. Habitat in India, juxta *Garcini* herbarium.	*Corchorus trilocularis* L.
49.	127	LEONURUS (*sibiricus*) foliis tripartitis multisidis linearibus obtusiusculis. […] Cardiaca javancia. *Garzin. herb.* Habitat in Sibiria, China & Java; undesæpius missa.	*Leonurus sibiricus* L.
50.	128 *Tab.* 38. *f.* 2.	MOLUCCELLA (*persica*) calycibus quinquefidis obtusis, laciniis obovatis membranaceis, foliis cuneiformibus[…] Moldavica persica spinosa. *Garzin. herb.* Habitat in Persia.	*Moluccella persica* Burm. f. = *Rydingia persica* (Burm. f.) Scheen & V. A. Albert.
51.	128 [**] *Tab.* 38. *f.* 3.	ORIGANUM (*benghalense*) foliis ovatis dentatis, spicis imbricatis lanuginosis, bracteis ovatis. Ocymum Benghalense. *Garzin. herb.* Habitat in Benghala.	*Origanum benghalense* Burm. f. = *Pogostemon benghalensis* (Burm. f.) Kuntze.
52.	131	ANTIRRHINUM (*papilionaceum*) corollis ecaudatis, floribus axillaribus, calycum foliolo supremo majori, foliis carnosis. […] Asarina persica nummulariæ facie. *Garzin. herb.* Habitat in Persia.	*Antirrhinum papilionaceum* L. is an unresolved name, but some data suggest that it is synonymous with *Schweinfurthia papilionacea* (L.) Boiss.
53.	134 *Tab.* 40. *f.* 1.	RUELLIA (*tentaculata*) foliis obovatis, verticillis obvallatis, spinis inermibus bifurcatis […] Ruellia surattensis. *Garzin. herb.* […] Habitat in India.	*Ruellia tentaculata* L. is an unresolved name, but some data suggest that it is synonymous with *Haplanthus nilgherrensis* Wight.
54.	135	RUELLIA (*persica*) foliis lanceolatis dentatis spinulosis, floribus oppositis. Acanthus persicus. *Garzin. herb.* Habitat in Persia.	*Ruellia persica* Burm. f. = *Blepharis ciliaris* (L.) B. L. Burtt.
55.	136	BARLERIA (*buxifolia*) spinis axillaribus oppositis solitariis, foliis subrotundis integerrimis. […] Planta javanica, jalappæ flore, *D. Garcin.* […] Habitat in Indiis.	*Barleria buxifolia* L.

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56.	137	VOLKAMERIA (*multiflora*) ramis inermibus, foliis oppositis cordatis subdentatis acuminatis, pedunculis axillaribus multifloris. Planta javanica, flore irregulari. *Garcin. herb.* Habitat in Java.	*Volkameria multiflora* Burm. f. = *Clerodendrum phlomidis* L. f.
57.	139	ACANTHUS (*ciliaris*) foliis quaternis ellipticis, calycibus ciliatis. Acanthus quadrifolius zeylanicus. D. *Garcin.* […] Habitat in Zeylona.	*Acanthus ciliaris* Burm. f. = *Blepharis maderaspatensis* (L.) B. Heyne ex Roth.
58.	139 [*]	PELTARIA (*Garzini*) foliis petiolatis ellipticis, siliculis unilocularibus compressis. Alysson persicum Plantaginis aquatici folio. *Garzin. herb.* Habitat in Persia.	*Peltaria garcinii* Burm. f. = *Fortuynia garcini* (Burm. f.) Shuttlew.
59.	140 *Tab.* 46. *f.* 2.	HELIOPHILA (*incana*) caule flexuoso, foliis linearibus subsalcatis obtusis. Leucojum incanum javanicum. *Garcin. herb.* Habitat in India.	*Heliophila incana* W. T. Aiton = *Farsetia jacquemontii* Hook. f. & Thomson
60.	148 *Tab.* 47. *f.* 1.	SIDA (*persica*) foliis inferioribus petiolatis cordatis acuminatis, superioribus sessilibus lanceolatis dentatis, pedunculis folitariis unifloris. Abutilon. *Garzin. herb.* Habitat in Persia.	*Sida persica* Burm. f. = *Abutilon persicum* (Burm. f.) Merr.
61.	151	HIBISCUS (*panduræformis*) foliis cordato-lanceolatis denticulatis tomentosis, caule hirto. Ketmia folio hastato subtus incano. *Garcin. herb.*	*Hibiscus panduriformis* Burm. f.
62.	155	ASPHALATHUS (*persica*) foliis bijugis sessilibus, stipulis integerrimis, floribus lateralibus sessilibus. Dorycnium persicum incanum. *Garcin. herb.* […] Habitat in Persia & Malabaria.	*Aspalathus persica* Burm. f. = *Lotus garcinii* DC.
63.	155	CROTALARIA (*juncea*) foliis simplicibus lanceolatis petiolato-sessilibus, caule striato. […] Crotalaria malabarica falicis folio. *Garcin. herb.* […] Habitat in India.	*Crotalaria juncea* L.
64.	155	CROTALARIA (*retusa*) foliis simplicibus oblongis cuneiformibus retusis. […] Crotalaria benghalensis, ex cujus viminibus fila & vela conficiuntur. *Garcin. herb.* […] Habitat in India.	*Crotalaria retusa* L.
65.	156 *Tab.* 48. *f.* 2.	CROTALARIA (*nana*) foliis simplicibus oblongis subsessilibus glabris, pedunculis lateralibus trifloris. […] Crotalaria malabarica. *Garcin. herb.* Habitat in India.	*Crotalaria nana* Burm. f.

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66.	157 *Tab*. 49. *f*. 1.	ONONIS (*persica*) stipulis integerrimis lanceolatis, foliis ternis cuneiformibus apice tridentatis, spica foliosa terminali […] Anonis persica, flore luteo. *Garcin*. *herb*. Habitat in Persia.	*Ononis persica* Burm. f. is an unresolved name.
67.	159	DOLICHOS (*scarabæoides*) volubilis, foliis ovatis tomentosis, floribus solitariis, seminibus bicornibus. […] Phaseolus persicus mollis. *Garcin*. *herb*. […] Habitat in India.	*Dolichos scarabaeoides* L. = *Cajanus scarabaeoides* (L.) Thouars
68.	161	DOLICHOS (*biflorus*) caule perenni lævi, pedunculis bifloris, leguminibus erectis […] Phaseolus frutescens persicus biflorus. *Garcin*. *herb*. Habitat in India.	*Dolichos biflorus* L. = *Vigna unguiculata* (L.) Walp.
69.	162	LATHYRUS (*sativus*) pedunculis unifloris, cirrhis diphyllis, leguminibus ovali-compressis, dorso bimarginatis […] Clymenum benghalense, cadjan dictum. *Garzin*. *herb*. Habitat in India & Europa.	*Lathyrus sativus* L.
70.	163	CYTISUS (*persicus*) ramis strictis divaricatis, floribus solitariis sparsis, foliis lineari-lanceolatis, medio duplo longiore. Cytisus persicus humilis. *Garcin*. *herb*. Habitat in Persia.	*Cytisus persicus* Burm. f. = *Crotalaria persica* (Burm. f.) Merr.
71.	163	HIPPOCREPIS (*multifiliquosa*) leguminibus pedunculatis consertis, margine altero lobatis. […] Ferrum equinum persicum. *Garcin*. *herb*. Habitat in India & Europa.	*Hippocrepis multisiliquosa* L.
72.	166 [*] *Tab*. 51. *f*. 2.	HEDYSARUM (*spartium*) foliis simplicibus ternatisque, leguminibus articulatis hispidis, flosculis subgeminis. Spartium persicum monophyllum & triphyllum. *Garzin*. *herb*. Habitat in India.	*Hedysarum spartium* Burm. f. = *Taverniera spartea* (Burm. f.) DC.
73.	168 *Tab*. 54. *f*. 2.	HEDYSARUM (*stipulaceum*) caule procumbente, foliis ternatis obcordatis, ramulis stipulaceis, floribus solitariis. Hedysarum Persicum & malabaricum. *Garcin*. *herb*. Crecit in Persia.	*Hedysarum stipulaceum* Burm. f. = *Desmodium triflorum* (L.) DC.
74.	170	INDIGOFERA (*tinctoria*) leguminibus arcuatis incanis, racemis folio brevioribus. […] Indigo benghalensis. *Garcin*. *herb*. […] Habitat in Indiis.	*Indigofera tinctoria* L.

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75.	171		INDIGOFERA (*argentea*) leguminibus subsessilibus torulosis, foliis ternis quinisque orbiculatis. Coronilla persica argentea. *Garcin. herb.* Habitat in Persia.	*Indigofera argentea* Burm. f.
76.	172		GALEGA (*senticosa*) leguminibus binis lateralibus glabris, foliolis emarginatis subtus sericeis, caule fruticoso. […] Coronilla surattensis. *Garcin. herb.* Habitat in Zeylona.	*Galega senticosa* (L.) L. = *Tephrosia senticosa* (L.) Pers.
77.	172		GALEGA (*barba jovis*) leguminibus solitariis glabris axillaribus, foliis oblongis, stipulis subulatis. Barba Jovis bombayensis incana. *Garcin. herb.* […] Habitat in India.	*Galega barba-jovis* Burm. f. is an unresolved name.
78.	172 *Tab.* 49. *f.* 2.		PSORALEA (*corylifoila*) foliis simplicibus ovatis. […] Lotus zurattensis. *Garcin. herb.* Habitat in India.	*Psoralea corylifolia* L. = *Cullen corylifolium* (L.) Medik.
79.	173 *Tab.* 49. *f.* 3.		LOTUS (*persicus*) leguminibus ternis terminalibus torulosis, foliis ternis quinisve lineari-lanceolatis pilosis. Lotus persicus tomentosus. *Garcin. herb.* Habitat in Persia.	*Lotus persicus* Burm. f. is an unresolved name, but some data suggest that it is synonymous with *Ononis aspalathoies* G. Don. *Lotus persicus* (Burm. f.) M. R. Almeida is an unresolved name.
80.	173		TRIGONELLA (*indica*) leguminibus sessilibus subsolitariis subfalcatis, foliolis integerrimis, caule diffuso. […] Lotus indicus, filiquis acinaciformibus. *Garcin. herb.* Habitat in India.	*Trigonella indica* L. = *Rothia indica* (L.) Druce.
81.	174	[**]	HIERACIUM (*javanicum*) foliis lanceolatis amplexicaulibus denticulatis, pedunculis unifloris, calycibus glabris. Sonchus flore purpureo in Java inventus. *Garcin. herb.*	*Hieracium javanicum* Burm. f. = *Emilia sonchifolia* var. sagittata.
82.	178		CONYZA (*balsamifera*) foliis lanceolatis subtus tomentosis, petiolis etiam serrato dentatis. […] Conyza banthamica Helenii folio. *Garcin. herb.* […] Sombong malaice Javanis, ubi loco salviæ adhibetur & sub hoc nomine occurrit, pluresque varietates in *Rumph. herb. Recensentur 6. l. 19. p. 56.*	*Conyza balsamifera* L. = *Blumea balsamifera* (L.) DC.
83.	180	[**]	ERIGERON (*denticulatum*) foliis obovatis, apicibus serratis, corymbo terminali. Conyza javanica in funda collecta. *Garcin. herb.*	*Erigeron denticulatum* Burm. f. = *Pluchea indica* (L.) Less.

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84.	181	SENECIO (*tenuifolius*) […] corollis revolutis, foliis pinnatifidis, pinnis cornutis apice bifidis, caule herbaceo. Jacobæa tenuifolia. *Garcin. herb.* Habitat in Java.	*Senecio tenuifolius* Burm. f.
85.	181 [**]	SENECIO (*coronopifolius*) corollis radiantibus revolutis, foliis linearibus pinnatifido dentatis, caule herbaceo. Jacobæa javancia Coronopi folio. *Garcin. herb.* Habitat in Java.	*Senecio coronopifolius* Burm. f.
86.	181	ASTER (*indicus*) foliis ovato oblongis serratis, floralibus ovali-lanceolatis integerrimis, ramulis unifloris. […] Aster javanicus. *Garcin. herb.* Habitat in Java & China.	*Aster indicus* L. = *Kalimeris indica* (L.) Sch. Bip.
87.	183 [*] *Tab.* 60. *f.* 1.	ANTHEMIS (*Garcini*) caule fruticoso, foliis subcuneiformibus truncatis eroso dentatis tomentosis, calyce folioso. Bupthalum persicum. *Garcin. herb.*	*Anthemis garcinii* Burm. f. = *Anvillea garcinii* (Burm. f.) DC.
88.	184	VERBESINA (*alba*) foliis lanceolatis serratis sessilibus. […] Bidens Latifolia indica. *Garcin. herb.* Habitat in India.	*Verbesina alba* L. = *Eclipta prostrata* (L.) L.
89.	201	SAGITTARIA (*obtusifolia*) foliis sagittatis obtusis, caule ramoso. […] Sagitta zeylanica. *Garcin. herb.* […] Habitat in Malabara.	*Sagittaria obtusifolia* L. = *Limnophyton obtusifolium* (L.) Miq.
90.	205	CROTON (*Hastatum*) foliis trilobo-hastatis lanceolatis dentatis. […] β Ricinoides malabarica surattensis *Garcin. herb.* quæ foliis integerrimis tomentosis, cujusque figuram produco. Habitat in Suratta.	*Croton hastatus* L. = *Tragia plukenetii* Radcl.-Sm. *Croton hastatus* Burm. f. = *Chrozophora plicata* (Vahl) A. Juss. ex Spreng.
91.	211	SICYOS (*Garcini*) foliis quinquepartitis, lanciniis cuneiformibus quinquefidis cum acumine, fructu ciliato. Bryonia zeylanica in Tutokorin inventa. *Garcin. herb.* Habitat in Zeylona.	*Sicyos garcini* Burm. f. = *Ctenolepis garcini* (L.) C. B. Clarke. *Sicyos garcini* L. = *Ctenopsis garcini* (L.) Naudin.
92.	212 *Tab.* 65. *f.* 1.	IRESINE (*persica*) foliis obovalibus, panicula terminali, spicis simplicilibus longissimis. Amaranthus persicus paniculatus. *Garcin. herb.* Habitat in Persia.	*Iresine persica* Burm. f. = *Aerva javanica* (Burm. f.) Juss. ex Schult.
93.	221	ACER (*platanus*) foliis quinquepartito-palmatis, lobis ovatis acuminatis, subtus tomentosis = Acer Platano similis. *Garcin. herb.* Habitat in India.	*Acer platanus* Burm. f. is an unresolved name.

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[**] = Garcin's specimen is confirmed in G-Burman.

	Page in *FI*		Burman's name	Current plant name
94.	221		ACER (*javanicus*) foliis quinquepartito-palmatis, lobis ovatis acuminatis, subtus tomentosis. Acer javanicus. *Garcin. herb.* Habitat in Java.	*Acer javanicum* Burm. f. is an unresolved name. *Acer javanicum* Jungh. = *Acer laurinum* Hassk.
95.	226		FICUS (*padana*) foliis cordato-ovatis subdenticulatis subtus tomentosis, fructu rotundo villofo. Ficus Sumatrensis venenatissima, fructus ferens rotundos villosissimos *Garcin. herb.* ubi notatur: omnium venenatissima, inventa in pago Padano prope Sumatram.	*Ficus padana* Burm. f.
96.	227	[*][**]	FICUS (*Tsjakela*) foliis ovato-oblongis integerrimis & crenatis. Ficus surattensis & β malabarica, mori folio. *Garcin. herb.* Habitat in Malabara.	*Ficus tsjakela* Burm. f.
97.	227	[*]	FICUS (*grossularioides*) foliis petiolatis ovatis basi integris apice serratis, subtus e luteo albicantibus. Ficus surattensis, Grossulariæ fructu flavo ac venenato *Garcin. herb.* β Valli-teregam. *Rheed. mal.* 3. *p.* 83. *t.* 62. Quæ differt petiolis brefissimis, qui in Garcini specimine longitudine foliorum. Habitat in Suratta.	*Ficus grossularioides* Burm. f.
98.	227		OPHIOGLOSSUM (*flexuosum*) caule flexuoso angulato, frondibus diphyllis, pinnis trifido-palmatis. […] Valli-panna. *Rheed. mal.* 12. *p.* 63. *t.* 32. Cujus varietas: Adianthum folio vario. *herb. Garcin.* quod differt frondibus bi & triphyllis angustioribus integerrimis. Habitat in Malabara.	*Ophioglossum flexuosum* L. = *Lygodium flexuosum* (L.) Sw.
99.	228		OSMUNDA (*zeylanica*) scapo caulino solitario, frondibus verticillatis lanceolatis indivisis. […] Osmunda javanica. *Garcin. herb.* […] Habitat in Zeylona, Amboina & Java.	*Osmunda zeylanica* L. = *Tectaria zeylanica* (Houtt.) Sledge

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NEW SPECIES OF MYRTACEAE FROM YASUNÍ NATIONAL PARK, ECUADOR

MARIA LÚCIA KAWASAKI[1, 2] AND ÁLVARO J. PÉREZ[3]

Abstract. Two new species of Myrtaceae from Yasuní National Park in Ecuadorian Amazon, *Myrcia gigantifolia* and *Plinia valenciana*, are described and illustrated. *Myrcia gigantifolia* grows in Varzea forest along Tiputini river, while *Plinia valenciana* grows in lowland forest.

Resumen. Se describen y se ilustran *Myrcia gigantifolia* y *Plinia valenciana*, dos especies nuevas de Myrtaceae provenientes del Parque Nacional Yasuní en la Amazonía Ecuatoriana. *Myrcia gigantifolia* crece en el bosque de Varzea a lo largo del río Tiputini, mientras que *Plinia valenciana* crece en bosques de Tierra Firme.

Keywords: Myrtaceae, *Myrcia*, *Plinia*, Ecuador, Yasuní

Yasuní National Park, located in the Ecuadorian Amazon, is remarkable for its exceptional diversity of plants, especially trees and shrubs (Pitman et al., 2002; Valencia et al., 2004; Bass et al. 2010). In preparation of the treatment of Myrtaceae for the Flora of Ecuador project, ca. ten new species have been recognized in Yasuní; two additional ones, *Myrcia gigantifolia* and *Plinia valenciana*, are described and illustrated herein.

Myrcia gigantifolia M.L.Kawasaki & A.J.Pérez, *sp. nov*. TYPE: ECUADOR. Orellana: Yasuní National Park, Río Tiputini, 00°38'S, 76°30'W, 200–300 m, 20 June 2011 (fr), *A. J. Pérez, E. Pinto, W. Loor & J. Guittar 5107* (Holotype: QCA; Isotypes: F, W). Fig. 1.

Among the species of *Myrcia*, this new species is distinguished by the very large (35–75 × 17–33 cm) ovate to lanceolate leaves, cordate at base, and by the large panicles (17.5–35 cm long).

Trees 7–10 m high, ca. 10 cm dbh, puberulous to glabrous. *Leaves* subsessile, the blades ovate to lanceolate, coriaceous, 35–75 × 17–33 cm, drying olive-green, puberulous to glabrous; glands numerous, punctiform, indistinct on both surfaces; midvein impressed above, convex below; lateral veins 20–30 pairs, impressed above, convex below; marginal vein 1, 2–4 mm from blade margin, similar in prominence to the lateral veins; apex abruptly acuminate; base cordate, amplexicaul. *Inflorescences* subterminal, paniculate, multiflorous, 17.5–35 cm long, the axes puberulous to glabrous; bracts and bracteoles deciduous, not seen. *Flower buds* subglobose, 4–6 mm long; hypanthium not prolonged beyond the ovary; calyx-lobes 5, ca. 2 × 3 mm, broadly rounded at apex, puberulous; petals 5, suborbicular, 4–5 × 3–5 mm, sericeous within, puberulous without; stamens numerous, the filaments 3–9 mm long, the anthers ca. 0.5 mm long; style ca. 1 cm long, the stigma punctiform; disk 5–6 mm diam., densely pubescent; ovary 2-locular, with 2 ovules per locule. *Fruits* ellipsoid, 1.5–2 cm long, red to dark purple, puberulous to glabrous; seeds 1 or 2, 1–1.5 cm long, the seed coat membranous; embryo myrcioid, the cotyledons leafy and folded, the radicle elongate, equaling the cotyledons in length.

Myrcia gigantifolia is readily recognized from the other species of the genus by the very large (35–75 × 17–33 cm), ovate to lanceolate leaves, cordate at base; these are among the largest leaves known in Neotropical Myrtaceae. *Myrcia obumbrans* (O. Berg) McVaugh from Peru (*Rubachia obumbrans* O. Berg, *E. F. Poeppig 2210*: W, holotype [photo F neg. 31508]; F, isotype) also has cordate and sessile leaves, but they are smaller (20–35 × 11–17 cm), elliptic or ovate (vs. ovate to lanceolate), drying dark-brown (vs. olive-green); the panicles are shorter (ca. 14 cm long vs. 17.5–35 cm long), the flower buds are larger (ca. 7 mm long vs. 4–6 mm long), and the hypanthium is costate and sericeous (vs. smooth and puberulous).

Etymology: The specific epithet refers to the very large size of the leaves.

Additional specimens examined: ECUADOR. Orellana: Yasuní National Park, Yasuní Scientific Station, Tiputini River, 00°38'S, 76°30'W, 200–300 m, 15 Mar 2016 (fl), *A. J. Pérez et al. 9338 (F, QCA); 9341 (COLG, F, QCA)*.

Distribution and habitat: Known only from the Yasuní National Park in Orellana Province; several individuals of all stages have been observed growing in Varzea forest along the Tiputini river.

Phenology: Collected with flowers in March and with fruits in June.

Plinia valenciana M.L.Kawasaki & A.J.Pérez, sp. nov. TYPE: ECUADOR. Orellana: Yasuní National Park - ECY, PDBY 50-ha plot, 00°38'S, 76°30'W, 200–300 m, 11 September 2007 (fl), *A. J. Pérez & P. Alvia 3532* (Holotype: QCA; Isotype: F). Fig. 2.

We are grateful to the herbaria F and QCA for their continuing support, to Renato Valencia for encouraging research studies in the Yasuní Forest, and to Wilson Loor, Jugalio Suárez, and Pablo Alvia for field assistance. The Ecuadorian Ministerio del Ambiente granted permission for fieldwork in Yasuní National Park (002-2015-IC-FLO-PNY-DPAO). Columbus State University provided funds for fieldwork at Yasuní National Park in March 2016 through the Elena Diaz-Verson Amos Eminent Scholar in Latin American Studies Program. This study was supported by PUCE through the Proyecto Dinámica Forestal de un Bosque Megadiverso (código L 13 251).

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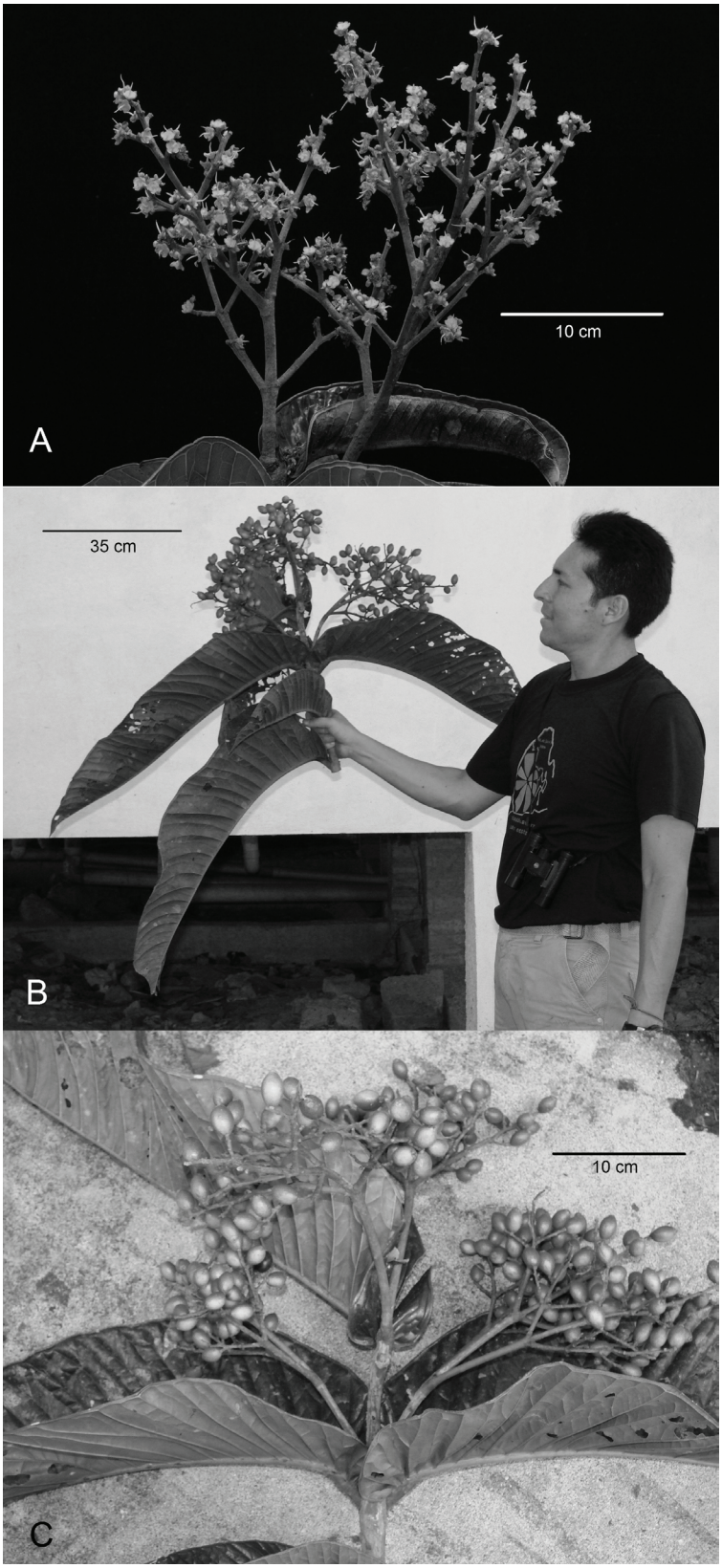

FIGURE 1. *Myrcia gigantifolia* M.L.Kawasaki & A.J.Pérez. **A**, leaves and old flowers; **B**, branchlet with leaves and fruits; **C**, leaves and fruits. A from *Pérez et al. 9338* (QCA); B–C from *Pérez et. al. 5107* (QCA).

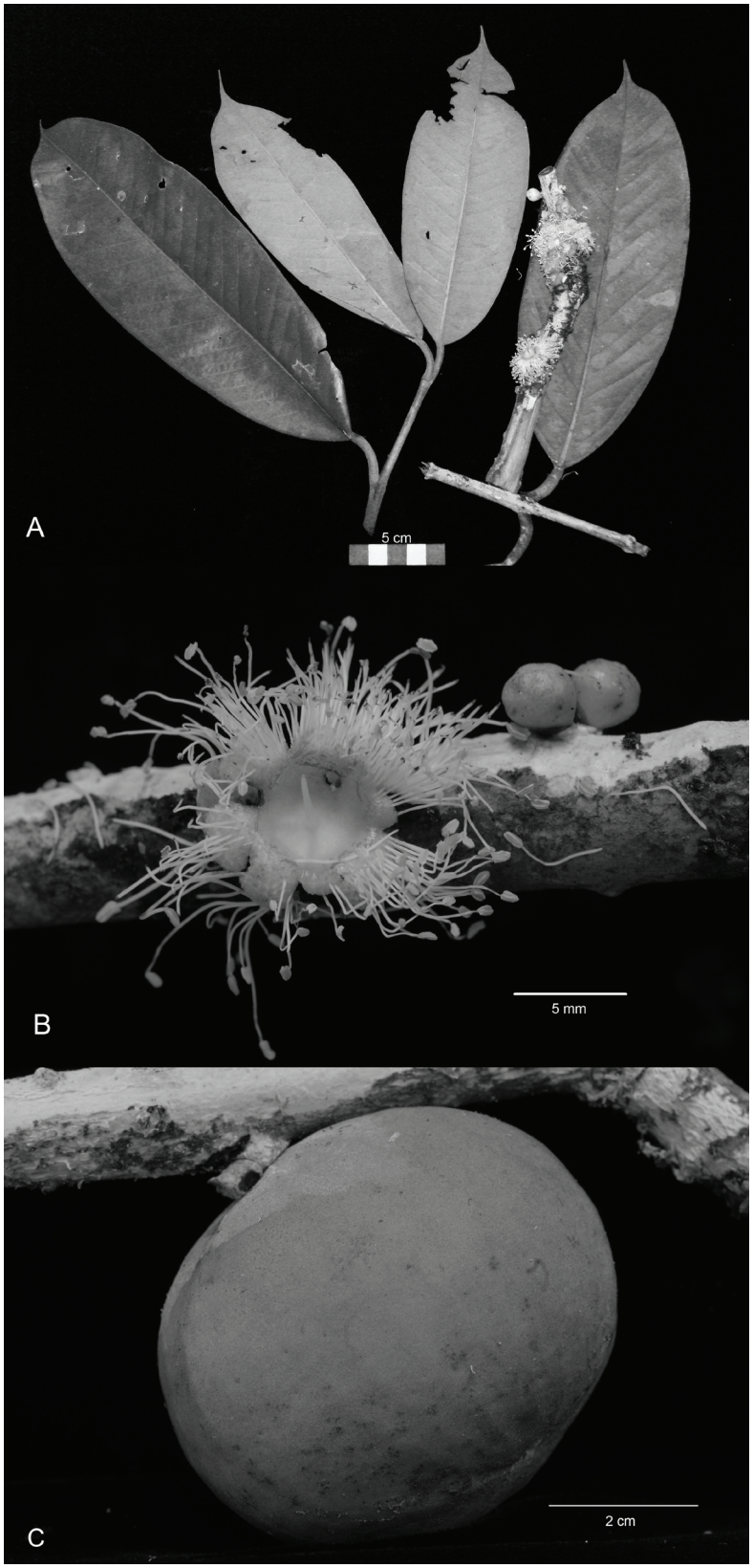

FIGURE 2. *Plinia valenciana* M.L.Kawasaki & A.J.Pérez. **A**, leaves and inflorescences; **B**, flower buds and open flower; **C**, fruit. A from *Pérez & Alvia 3532* (QCA); B from *Pérez et. al. 4950* (QCA); C from *Pérez et. al. 4831* (QCA).

Similar to *Plinia darienensis* Barrie in leaf morphology, but it differs in the smaller flowers and fruits.

Trees ca. 8 m high, ca. 8 cm dbh; trichomes mainly on young growth, lower surface of leaves, and flowers, yellowish-white; bark smooth, whitish. *Leaf blades* narrowly elliptic, coriaceous, 24–30 × 7–9 cm, the upper surface glabrous, drying olive-green, the lower surface olive-green or brownish-green, sparsely pubescent to puberulous, the trichomes especially on midvein, glabrescent; glands numerous, punctiform, salient on both surfaces; midvein salient or biconvex on upper surface, salient on lower surface; lateral veins 13–17 pairs, salient on both surfaces; marginal veins 2, the innermost almost parallel to the margin, 2–3 mm from it, similar to the lateral veins in prominence; apex abruptly acuminate; base cuneate to obtuse; petioles 2–2.5 cm long, puberulous. *Inflorescences* cauliflorous, of glomerules pauciflorous; bracts and bracteoles ovate, ca. 2 mm long, puberulous. *Flower buds* globose, ca. 5 mm diam., sessile; calyx lobes 4, tearing irregularly at anthesis, glabrous; hypanthium ca. 3 mm long, sparsely pubescent, prolonged ca. 1 mm beyond the ovary; petals 4, obovate, ca. 3 mm long, white, ciliate; disk ca. 5 mm diam., glabrous; stamens numerous, the filaments to 1 cm long, the anthers ca. 1 mm long; style ca. 1 cm long, the stigma punctiform; ovary 2-locular, with 2 ovules per locule. *Fruits* globose to oblate, 5.5–6 cm diam., yellow, glabrous, crowned by remnants of the calyx lobes; seeds 1 or 2, ca. 5 × 3.5 cm, the seed coat membranous; embryo eugenioid, the cotyledons fleshy, separate, the radicle indistinct.

Plinia valenciana resembles *P. darienensis* Barrie from Panama (Barrie, 2004) in the narrowly elliptic leaves with salient venation (midvein and lateral veins) on both surfaces, but it is distinguished by the longer petioles (2–2.5 cm long vs. 1–1.5 cm long) and the smaller flowers and fruits. In *P. valenciana*, the flower buds are globose, ca. 5 mm diam. (vs. pyriform, 12–15 mm long), the disk is ca. 5 mm diam. (vs. 6–8 mm diam.), the style is ca. 1 cm long (vs. ca. 1.8 cm long), and the fruits are smooth, 5.5–6 cm diam. (vs. ribbed, 6.5–8 cm diam.).

Eponymy: Named in honor of Dr. Renato Valencia, Principal Investigator of the Yasuní Forest Dynamic Project and professor at Pontificia Universidad Católica del Ecuador, for his support and contribution to the development and knowledge of botany and ecology in Ecuador.

Additional specimens examined: ECUADOR. Orellana: Yasuní National Park - ECY, PDBY 50-ha plot, 00°38'S, 76°30'W, 200–300 m, 23 Aug 2010 (fr), *A. J. Pérez et al. 4831*(F, QCA); 22 Nov 2010 (fl), *A. J. Pérez et al. 4950* (F, QCA).

Distribution and habitat: Known only from the Yasuní National Park in Orellana Province, in lowland wet forests. In a 25-ha plot there were 13 individuals with dbh ≥ 1 cm, averaging one individual per two hectares; from 1995 to 2007 the average growth rate was 0.47 mm per year.

Phenology: Collected with flowers in September and November; with fruits in August.

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ICONES STELIDARUM (ORCHIDACEAE) COLOMBIAE

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Abstract. Fifty new species of *Stelis* from Colombia are described and illustrated in this the first of a series of fifty species that are not identified when compared with any of the previously known species.

Keywords: Colombia, Orchidaceae, Pleurothallidinae, *Stelis*

The earliest Colombian collections of species of the genus *Stelis* Sw. were made under the direction of José Celestino Mutis in the late eighteenth century, but their paintings were not published until the 1960s (Schweinfurth and Fernández Pérez, 1963: 55–61, tab. 43–52). Hipólito Ruiz and Antonio Pavón made collections in Peru, also in the late eighteenth century, that have subsequently been found to occur in Colombia.

The Colombian collections of Humboldt and Bonpland made in the first years of the nineteenth century were published in 1816 (Kunth, 1816: 361–364). Between 1836 and 1859, John Lindley described 27 species from Colombia (1859), and between 1854 and 1878, Heinrich G. Reichenbach f. published 19 species. The first and only list of the known species from Colombia was published in 1920 by Rudolf Schlechter (1920) when 48 species were counted. The largest numbers of new species were published afterward: 56 by Schlechter (1924), and 52 by Oscar Duque (1997, 2010).

As of today, about 240 species attributed to *Stelis*, excluding those of other genera transferred to *Stelis* by Pridgeon and Chase (e.g., 2001), have been reported from Colombia.

While preparing to revise the genus *Stelis* for Colombia, the following species described as new will constitute the first of a series of 50 that have not been identified with any of the previously known species.

For lip types in *Stelis* consult Luer (2009).

Stelis acuminosa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Pabón, road to Santa Ana, 2050 m, 31 May 1995, *C. Luer, J. Luer, R. Escobar et al. 17660* (Holotype: MO). Fig. 1.

This medium-sized, densely caespitose species produces a few, simultaneously many-flowered racemes about as long as narrowly linear-elliptical leaves; ovate, three-veined sepals with the lateral sepals oblique, antrorse, acute; thin, faintly single-petals; and a lip with an acuminate apex.

Plant medium in size, epiphytic, densely caespitose; roots slender. Ramicauls erect, very slender, 6–8 cm long, enclosed by a close, tubular sheath from below the middle and another sheath at the base. *Leaf* erect, coriaceous, narrowly linear-elliptical, acute, 6–7.5 cm long, including an ill-defined petiole ca. 1 cm long, the blade 5–7 mm wide in the dry state, narrowed below into the petiole. *Inflorescence* 2–3; 6–8 cm tall, the racemes erect, crowded, distichous, many-flowered, with most flowers open simultaneously, flowering from the base; floral bracts oblique, subacute, 2 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle less than 1 cm long, from a node at the apex of the ramicaul; flowers light yellow–green; *sepals* glabrous, ovate, 3-veined, the dorsal sepal 2.5 mm long, 2 mm wide, the lateral sepals oblique, acute, 3.5 mm long, 1.5 mm wide; *petals* transversely elliptical, shallowly concave, the apex broadly rounded without a thickened margin, 0.6 mm long, 0.76 mm wide, faintly 1-veined; *lip* ovoid, 1 mm long, 0.6 mm wide, 0.5 mm deep, concave below a transverse callus across the base, the sides incurved, the apex sharply acuminate, the dorsum narrow, truncate, hinged to the base of the column; *column* clavate, ca. 0.75 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *acuminosus*, "with well-developed acumen," referring to the apex of the lip.

This species is characterized by two or three densely many-flowered racemes that are slightly shorter than, to slightly longer than narrow, linear-elliptical leaves. The dorsal sepal is erect, ovate and subacute, while the longer, acute lateral sepals are antrorse. The petals are thin and faintly single-veined. The lip is ovate and concave with involute sides. The bar is a transverse callus across the base. The apex is acuminate into a sharp point.

Stelis alleyoop Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Cundinamarca: terrestrial in thin forest above power line near pass between Bogatá and Fusagasuga, 2800 m, 22 April 1982, *C. Luer, J. Luer & R. Escobar 7517* (Holotype: SEL). Fig. 2.

This medium to large, coarsely repent species is characterized by a thick rhizome; stout ramicauls bearing elliptical leaves and a longer raceme; ovate, five-veined, long-pubescent sepals; three-veined petals; and a subquadrate lip with a glenion and a rounded, concave apex.

The author is grateful to the staff of MO and SEL for making their specimens available for study, to S. Dalström for inking the figures presented herein, all based on pencil drawings by the author, to Nancy Karam and A. L. V. Toscano de Brito at the Selby Botanical Gardens for scanning the original drawings, and to G. A. Romero-González for his editorial help.

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Plant medium to large, epiphytic to terrestrial, coarse, caespitose-fasciculate, or ascending-repent, the rhizome with tubular sheaths, stout, branching, ca. 5 mm thick, up to 2 cm long between ramicauls; roots slender. Ramicauls ascending to erect and fasciculate, stout, 2–4 cm long, enclosed by a tubular sheath from near the middle, and 1–2 sheaths below about the base. *Leaf* erect, coriaceous, elliptical, subacute, 3–6 cm long, 1–1.5 cm wide in the dry state, narrowed below into an ill-defined petiole ca. 1 cm long; *Inflorescence* single; 12–16 cm long, the raceme strict, erect, congested, secund, many-flowered with many capsules, floral bracts tubular, oblique, obtuse, 2.5 mm long; pedicels 1.5 mm long; ovary 1.5 mm long; the peduncle 5–8 cm long, subtended by a spathe less than 1 cm long, from a node below the apex of the ramicaul; *flowers* light yellow-green; *sepals* long-pubescent, ovate, obtuse, connate below the middle, 3-veined, the dorsal sepal 3 mm long, 3 mm wide, the lateral sepals 2.5 mm long, 2.5 mm wide; *petals* thin, minimally thickened on the apical margin, transversely oblong, concave, broadly subtruncate at the apex, 1.2 mm long, 1.5 mm wide, 3-veined; *lip* subquadrate, 1 mm long, 1.3 mm wide, 0.9 mm deep, concave below the thick bar cleft with a glenion, the apex rounded, the dorsum slightly convex, minutely pubescent at the base, the base broadly truncate, hinged to the base of the column; *column* ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Eponymy: Named for the rough, hairy-faced caveman Alley Oop, a 1933 cartoon character created by V.T. Hamlin.

Additional specimens examined: Colombia: Boyacá: epiphytic between Arcabuco and Moniquira, 2500 m, 25 April 1982, *C. Luer, J. Luer & R. Escobar 7532* (SEL).

Both caespitose and creeping phases of the habit of this species occur, apparently depending on local conditions. Most notable is a robust, five-millimeter thick ascending or branching rhizome that is clad in tubular, disintegrating sheaths. Ramicauls arise singly, or several in a fascicle. A single, many-flowered, secund raceme that produces numerous capsules far exceeds the leaf. The sepals are five-veined and long-pubescent; the petals are thin and three-veined; and the lip type A with a glenion and rounded apex.

Stelis arbuscula Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Frontino, above Frontino toward Nutibara, 1900 m, 3 May 1983, *C. Luer, J. Luer, R. Escobar et. al., 9029* (Holotype: SEL). Fig. 3.

This small, repent, suberect species is distinguished by a stout, branching rhizome; short ramicauls with a loose, tubular sheath; two to three densely flowered racemes about as long as elliptical leaves; obtuse, pubescent sepals; three-veined petals; and an obtuse lip concave below a bar with a glenion.

Plant small, epiphytic, repent to suberect, the rhizome stout, ascending, enclosed by loose sheaths, 0.5–1 cm long between ramicauls; roots slender. Ramicauls ascending to suberect, relatively stout, 1–1.5 cm long, enclosed by a loose, tubular sheath and another loose sheath at the base. *Leaf* erect, coriaceous, elliptical, subacute to obtuse, 2.5–3.5 cm long, 1–1.3 cm wide in the dry state, cuneate below into a petiole 2–3 mm long. *Inflorescence* 2–3; 2.5–3.5 cm long, the racemes erect, strict, simultaneously many-flowered with most flowers open simultaneously, flowering to the base; floral bracts oblique, acuminate, acute, 3 mm long; *pedicels* 1 mm long; ovary 1 mm long; peduncle abbreviated, if at all, from a node at the apex of the ramicaul; *flowers* light yellow; *sepals* expanded, shortly pubescent, broadly ovate, obtuse, 3-veined, connate to near the middle, the dorsal sepal 2 mm long, 2 mm wide, the lateral sepals 1.6 mm long, 2 mm wide; *petals* transversely ovate, 0.5 mm long, 0.9 mm wide, 3-veined, the apex broadly rounded with a thickened margin, with a transverse carina; *lip* thickly subtriangular, 0.6 mm long, 0.75 mm wide, 0.5 mm deep, shallowly concave below the bar with a glenion, the apex obtuse with minimally thickened margins, the dorsum with a low, rounded callus, the base truncate, hinged to the base of the column; *column* stout, ca. 0.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *arbuscula*, "a little tree," referring to the habit.

This small, creeping to suberect species is characterized by a thick, branching rhizome clothed in loose sheaths, and closely spaced short ramicauls with elliptical leaves and congested racemes that barely surpass them, if at all. The floral bracts are long-acuminate; the sepals are broadly ovate, obtuse and shortly pubescent; the petals are three-veined; and the lip is classical type A.

Stelis atomacea Luer & R.Escobar, *sp. nov.* COLOMBIA. Antioquia: Cerro Padre Amaya, W of Medellín, 2900 m, 16 January 1979, *C. Luer, J. Luer & R. Escobar 3693* (Holotype: SEL). Fig. 4.

This very small species is distinguished by narrowly linear leaves; a much longer, successively many-flowered raceme of tiny flowers; subacute sepals about one millimeter long; single-veined petals; and an ovate lip with a low, oblong callus and an acuminate apex.

Plant very small, epiphytic, caespitose, sometimes forming large clumps, roots slender. Ramicauls erect, slender, 5–10 mm long, enclosed by 2 close, tubular sheaths. *Leaf* erect, coriaceous, narrowly linear, acute, 15–25 mm long, 1–2 mm wide in the dry state, narrowed below to the base. *Inflorescence* single; 3–6 cm long, the raceme erect, successively many-flowered with several flowers open simultaneously, floral bracts oblique, acute, 1 mm long; pedicels 0.5 mm long; ovary 0.5 mm long; the peduncle 1–25 mm long, from a node from near the tip of the ramicaul; flowers greenish white; *sepals* glabrous, expanded, ovate, acute to subacute, 3-veined, connate basally, 1 mm long, 1 mm wide; *petals* obcuneate, thin, slightly thickened on the rounded margin, 0.4 mm long, 0.5 mm wide, 1-veined; *lip* subovate, 0.7 mm long, 0.5 wide, 0.3 mm deep, shallowly concave and acuminate below the middle to a narrowly obtuse tip, the disc filled with an low, elevated callus with a central, longitudinal depression that descends from the dorsum, the base truncate, hinged to the base of the column; *column* clavate, 0.5 mm wide, anther and the stigmatic lobes apical.

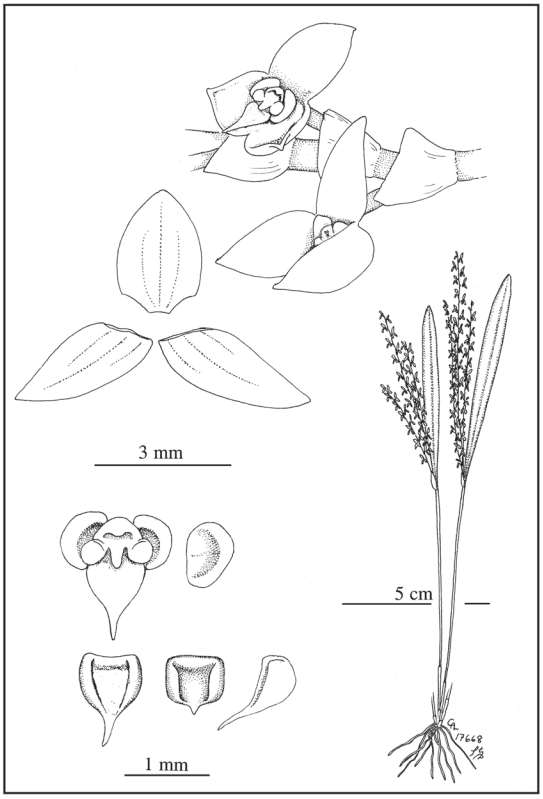

Figure 1. *Stelis acuminosa* Luer & R. Escobar.

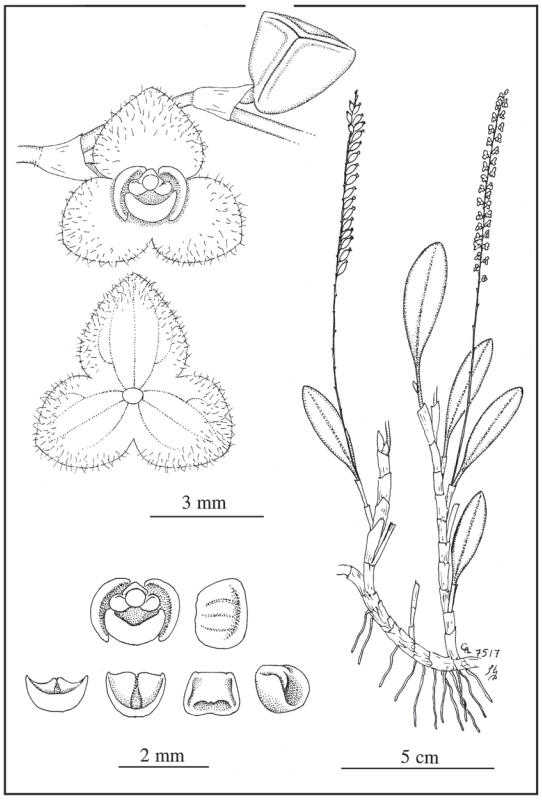

Figure 2. *Stelis alleyoop* Luer & R. Escobar.

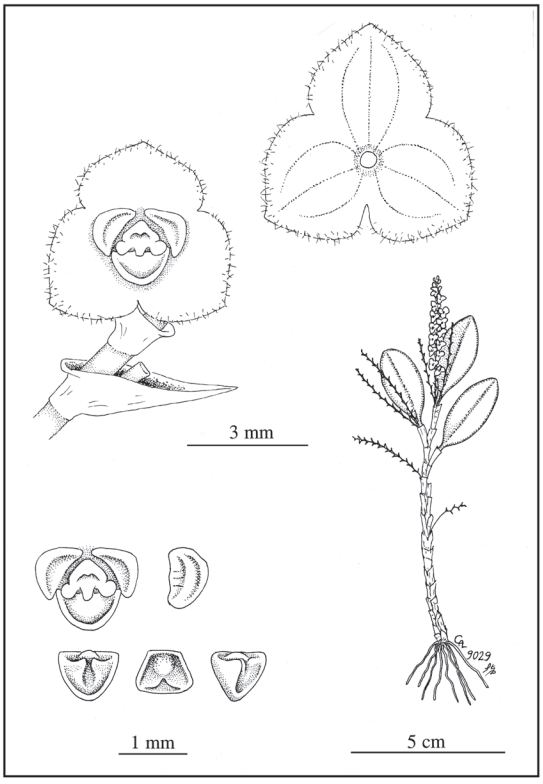

Figure 3. *Stelis arbuscula* Luer & R.Escobar

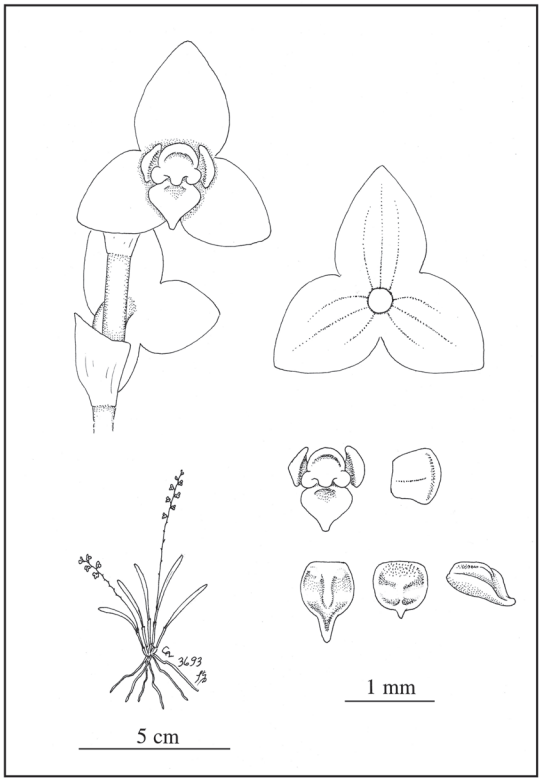

Figure 4. *Stelis atomacea* Luer & R.Escobar

Etymology: From the Latin *atomaceus*, "like an atom," referring to the minute floral parts.

This very small, slender, caespitose species with narrowly linear leaves sometimes forms large clumps. A successively many-flowered raceme bears tiny flowers with subacute sepals about one millimeter long, and petals less than half that size. *Stelis atomacea* is similar to the ubiquitous *Stelis pusilla* Kunth, but differs in morphology of the lip, in addition to subacute tips of the sepals, instead of obtuse. Instead of type A with a minute apiculum on a rounded apex, the lip is acuminate above the middle into a narrowly obtuse tip.

Stelis caespitula Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: El Retiro, above Colomborquídeas, coll. by Walter Teague, 17 April 1988, *C. Luer 13221* (Holotype: MO). Fig. 5.

This tiny, densely caespitose plant produces a many-flowered raceme with obtuse, three-veined sepals; thin, single-veined petals, and an ovoid, lip with a tall, broadly channeled callus that extends from the base to the acute tip.

Plant very small, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 3–4 mm long, enclosed by a tubular sheath and another sheath at the base. *Leaf* erect, coriaceous, elliptical, acute, 8–20 mm long, 2.5–4 mm wide, cuneate below to the base. *Inflorescence* single; 4–8 cm long; the raceme erect, sublax, distichous, many-flowered with most flowers open simultaneously; floral bracts oblique, acute, 1–1.5 mm long; pedicels 1 mm long; ovary 0.5 mm long; the peduncle ca. 2 cm long, from a node at the apex of the ramicaul; *sepals* yellow, more or less suffused with purple, microscopically cellular, connate in lower third, broadly ovate, obtuse, 3-veined, the dorsal sepal 1.2–2 mm long, 1.5 mm wide, the lateral sepals oblique, 1.2–1.4 mm long, 1–1.2 mm wide; *petals* yellow or green, thin, obcuneate, broadly obtuse, slightly thickened on the margin, without a transverse callus, 0.4 mm long, 0.6 mm wide, 1-veined; *lip* yellow or green, ovoid, acute, 0.6 mm long, 0.6 mm wide, 0.3 mm deep, with a thick, broadly channeled, ovoid callus from the base to near the tip, the base broadly truncate, hinged to the base of the column; *column* clavate, ca. 0.7 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *caespitulus*, "small-caespitose," referring to the tiny habit.

Additional specimens examined: COLOMBIA. Antioquia: El Retiro, above Colomborquídeas, 2280 m, 26 April 1983, *C. Luer & J. Luer 8837* (SEL).

This tiny, caespitose species occurs in the forest above Colomborquídeas in Retiro, Colombia. It produces a many-flowered raceme with little flowers that are superficially similar to those of *Stelis pyramidalis* O. Duque that is distinguished by erect, branching rhizomes. In both species the sepals are obtuse and three-veined, and the petals are thin and single-veined. The lip of *S. caespitula* is ovoid and acute with a tall, widely cleft callus that extends from the base to the acute, non-apiculate apex. The lip of *S. pyramidalis* is obovate with the apex broad and minutely apiculate, the callus is cleft with both halves rounded, and a microscopically pubescent callus is present above the base.

Stelis calculosa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Risaralda: Pueblo Rico, 2400 m, 14 May 1983, *C. Luer, J. Luer & R. Escobar 16838* (Holotype: MO). Fig. 6.

This small, caespitose species is distinguished by elliptical, petiolate leaves exceeded by a delicate, flexuous, successive, many-flowered raceme; obtuse, three-veined, cellular papillose sepals; single-veined petals; and a lip with a low callus surrounded by cavity within the margin.

Plant small, epiphytic, densely caespitose, roots slender. Ramicauls erect, slender, 5–10 mm long, with a tubular sheath from near the base. *Leaf* erect, coriaceous, narrowly elliptical, subacute, 15–25 mm long, 2–4 mm wide dry, gradually narrowed below to a subpetiolate base. *Inflorescence* single; 4–6 cm tall, the raceme erect, flexuous, distichous, successively many-flowered, with several flowers open simultaneously; floral bracts oblique, acute, 1–1.5 mm long; pedicels 0.75 mm long; ovary 1 mm long; the peduncle ca. 2 cm long, from a node at the tip of the ramicaul; *sepals* yellow-green, cellular papillose within, expanded, broadly ovate, obtuse, 3-veined, connate below the middle, the dorsal sepal 2.5 mm long, 2.8 mm wide; the lateral sepals 2 mm long, 2 mm wide; *petals* translucent tan, thin, transversely obovate, concave, slightly thickened on the margin of a rounded apex, 0.7 mm long, 1 mm wide, 1-veined; *lip* purple, subquadrate, 0.6 mm long, 0.6 mm wide, 0.6 mm deep, concave within the rounded apical margin, surrounding a large, low callus that extends from the base to within the apical margin, without a glenion, microscopically pubescent, the base truncate, hinged to the base of the column; *column* clavate, 0.6 mm wide, the anther and the bilobed stigma apical.

Etymology: From the Latin *calculosus*, "full of pebbles," referring to the cobblestone sepals.

This little, caespitose species is characterized by ramicauls shorter than elliptical leaves; an erect, delicate, flexuous, successively many-flowered raceme far exceeding the leaves; broad, yellow-green, minutely papillose, or cobble-stoned sepals; thin, single-veined petals; and a subquadrate lip with a large, low callus surrounded with a moat-like cavity within the margin.

Stelis caldodsonii Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: El Carmen, Alto de San Lorenzo, 2600 m, 17 September 1984, *C. H. Dodson & R. Escobar 15316* (Holotype: MO), C. Luer illustration 21946. Fig. 7.

This tall, caespitose species is distinguished by a long-pedunculate, congested, many-flowered raceme that far surpasses the leaf; acute, three-veined sepals; subcircular, one-veined petals; a thin, shallowly concave, rounded lip; and an elongated, clavate column that protrudes beyond the petals.

Plant large, epiphytic, caespitose. Ramicauls erect, slender, 4-6 cm long, with a tubular sheath below the middle and another 1-2 at the base. *Leaf* erect, coriaceous,

elliptical-ovate, acute to subacute, petiolate, 6-11 cm long, including a petiole 1.6-3 cm long, the blade 0.9-1.3 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* single: 20-30 cm tall, the raceme erect, distichous, crowded, simultaneously many-flowered, floral bracts tubular, obtuse, 3 mm long; pedicels 2.5 mm long; ovary 2 mm long; the peduncle 9-14 cm long, with distant bracts, subtended by a slender spathe 1.5 cm long, from a node below the apex of the ramicaul; *sepals* rose-colored, glabrous, ovate, acute, 3-veined, the dorsal sepal 4 mm long, 2.5 mm wide, the lateral sepals oblique, antrorse, 4 mm long, 2.8 mm wide. connate basally; *petals* thin, subcircular, shallowly concave, the margins not thickened, 1 mm long, 1 mm wide, 1-veined; *lip* thin, subcircular, 1.5 mm long, 1.5 mm wide, 0.5 mm deep, shallowly concave, the apex rounded, not thickened, the base truncate. narrowly thickened, hinged to the base of the column; *column* clavate 1.5 mm long and wide, protruding beyond the petals, the anther and the stigmatic lobes apical.

Eponymy: Named for Calaway H. Dodson, co-collector of this species.

This tall, slender species is characterized by a peduncle about as long as the leaf, and a many-flowered raceme about twice longer. The sepals are acute with the laterals antrorse. Small, rounded, single-veined petals flank the most unusual, longer shaft of the column. The lip is rounded and shallowly concave.

Stelis carnalis Luer & R.Escobar. *sp. nov.* TYPE: COLOMBIA. Antioquia: NE of Santa Rosa, above the Miraflores dam, 2050 m, 15 May 1985, *C. Luer & R. Escobar 11376* (Holotype: MO). Fig. 8.

This small, caespitose species is distinguished by obtuse, narrowly elliptical-obovate, fleshy leaves far exceeded by a subdense raceme of flowers with transversely ovate, deeply connate, three-veined sepals; three-veined petals; and an obtuse lip with a dorsal, rounded callus.

Plant small, epiphytic, densely caespitose, roots slender. Ramicauls erect, stout, 1–1.5 cm long, with a tubular sheath from below the middle and another 1–2 sheaths near and at the base. *Leaf* erect, thickly coriaceous, narrowly elliptical-obovate, obtuse, 3–5 cm long, 0.5–0.8 cm wide in dry state, gradually narrowed below to the base without a distinct petiole. *Inflorescence* single; 12–15 cm tall, the raceme erect, strict, distichous, subdensely many-flowered, with several flowers open simultaneously; floral bracts oblique, acute, 4–5 mm long; pedicels 2.5 mm long; ovary 2.5 mm long; the peduncle 4–9 cm long, from a node at the tip of the ramicaul, with a spathe ca. 1 cm long; *sepals* yellow, purple below the middle, glabrous, expanded, transversely ovate, obtuse, 3-veined, connate to near the middle, the dorsal sepal 3 mm long, 5 mm wide, the lateral sepals 3 mm long, 4.5 mm wide; *petals* purple, transversely ovate, concave, thickened on the margin of a rounded apex, 1 mm long, 1.5 mm wide, 3-veined, with a transverse carina; *lip* purple, subquadrate, 0.8 mm long, 1.3 mm wide, 0.7 mm deep, concave below the bar with an indistinct glenion, the apex obtuse, thickened, the dorsum with a small, central, hemispherical callus, the base truncate, hinged to the base of the column; *column* clavate, ca. 1 mm wide and long, the anther and the bilobed stigma apical.

Etymology: From the Latin *carnalis*, "fleshy," referring to the succulent-like leaves.

This little, caespitose species is characterized by thick, narrowly elliptical-obovate leaves borne by much shorter ramicauls. An erect raceme bears medium-sized flowers with transverse, three-veined sepals that are yellow above the middle and purple below the middle. The petals are three-veined, and the lip is type A with a small, rounded callus on the dorsum.

Stelis cochliops Luer & Hirtz, *sp. nov.* TYPE: COLOMBIA. probably Nariño: probably coll. by Aguirre, obtained from Orquídeas del Valle by Ecuagenera, cultivated at Ecuagenera, Gualaceo, Ecuador, 11 January 2004, *A. Hirtz 8562* (Holotype: MO), C. Luer illustration 20845. Fig. 9.

Planta perparva caespitosa, racemo laxe flexuoso folio elliptico excedenti, sepalis ellipticis obtusis, petalis reniformibus apice acuminatis, labello minutissimo oblongo apice lobato concavo anguste rotundo, infra lobum apicalem subquadrato incrassato, columna furcata stigmata pedunculata distinguitur.

Plant very small, epiphytic, caespitose; roots slender. Ramicauls erect, stout, 12–18 mm long, enclosed by 2 ribbed, tubular sheaths. *Leaf* erect, thickly coriaceous, elliptical, subacute to obtuse, 20–23 mm long including a petiole 3–5 mm long, the blade 6 mm wide, cuneate below into an ill-defined petiole. *Inflorescence* 2; 1-3 cm long, the raceme erect, loose, subflexuous, successively several-flowered; floral bracts oblique, acute, 1–1.5 mm long; pedicel 0.5 mm long; ovary 1 mm long; the peduncle 0.5–1 cm long, from near the apex of the ramicaul; *flowers* olive-black with olive borders; *sepals* glabrous, broadly elliptical, obtuse, 3-veined, free to near the base, the dorsal sepal 2.5 mm long, 1.8 mm wide, the lateral sepals oblique, 1.8 mm long, 1.5 mm wide; *petals* transversely ovate, the apex broad, acuminate into a thick, narrowly obtuse apiculum, 1 mm long with the apiculum, 1 mm wide, 1-veined, the margins thickened and minutely papillose; *lip* minute, oblong-subquadrate, trilobed, 0.5 mm long, 0.3 mm wide, 0.3 mm deep, concave below a thick, rounded bar between antrorse, rounded, lateral lobes, the apex contracted into a thick, narrowly obtuse lobe, the dorsum microscopically pubescent, the base truncate, hinged to the base of the column; *column* stout, 0.5 mm long, 0.6 mm wide across stigmatic processes, the anther and stigmatic lobes apical.

Etymology: From the Greek *cochliops*, "snail-eyes," referring to the stalked stigmatic lobes.

This tiny species is apparently endemic in southern Colombia. It is characterized by a petiolate leaf a little longer than the ramicaul. Two specimens are present, each with two racemes, one exceeding the leaf, the other, less than half the length of the leaf. The racemes are loose, flexuous and successively flowered. The sepals are broadly ovate and free nearly to the base. A thick apiculum projects from the margin of the petals. The lip is similar to that of

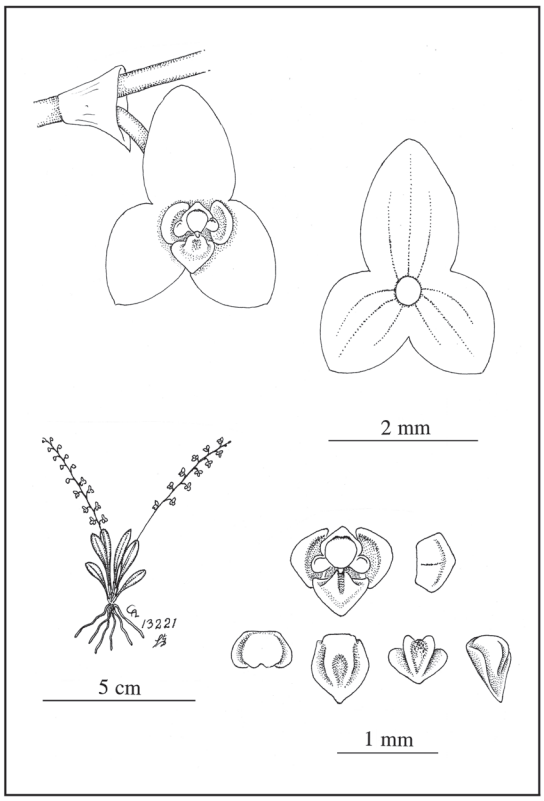

Figure 5. *Stelis caespitula* Luer & R.Escobar

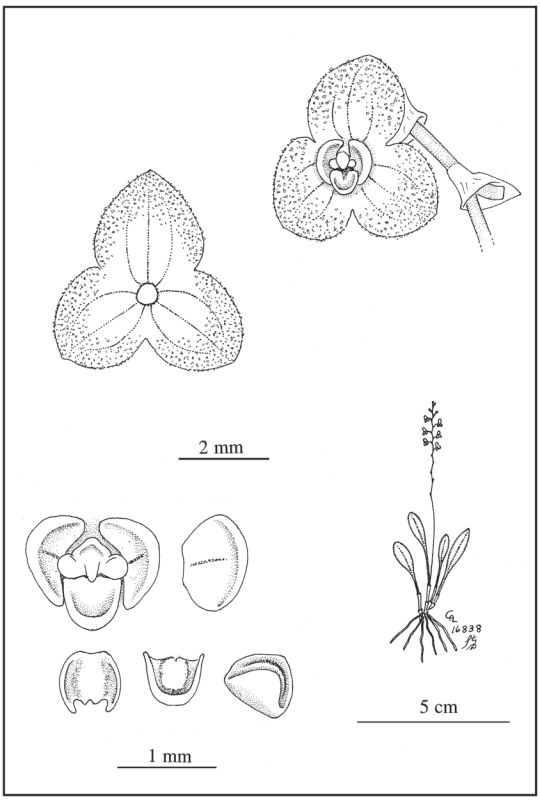

Figure 6. *Stelis calculosa* Luer & R.Escobar

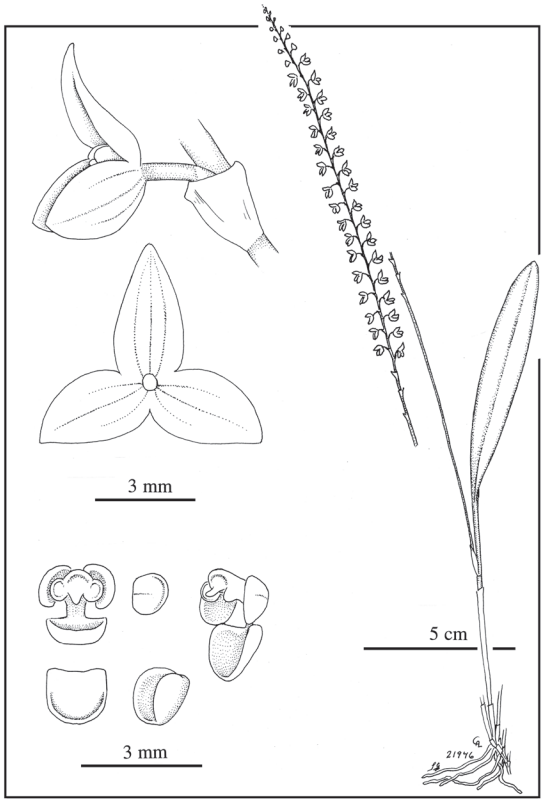

Figure 7. *Stelis caldodsonii* Luer & R.Escobar

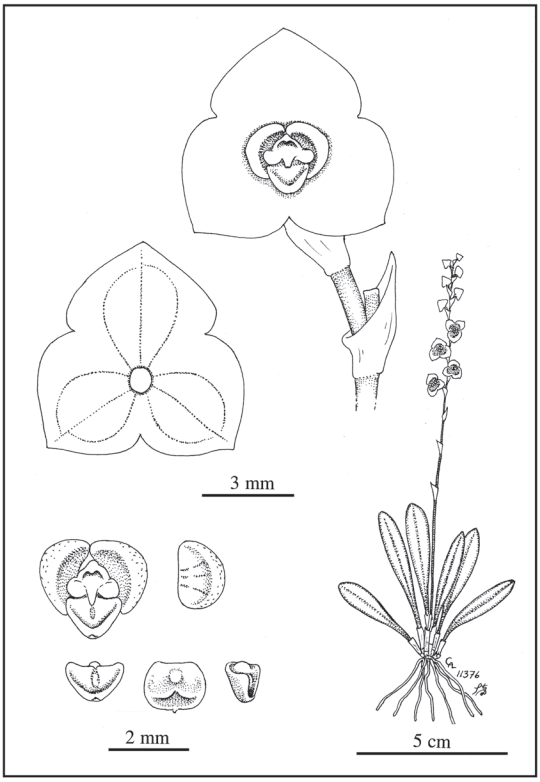

Figure 8. *Stelis carnalis* Luer & R.Escobar

S. spthulata, but the apical lobe is oblong and obtuse instead of acute. The elongated stigmatic lobes of the column are most remarkable as they protrude to either side, resembling the stalked eyes of a snail.

Stelis crascens Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Concepción. between Barbossa and Concepción, 2380 m, 12 April 1988, *C. Luer, J. Luer & R. Escobar 13173* (Holotype: MO). Fig. 10.

This caespitose species is characterized by very slender ramicauls that produce two to four many-flowered racemes about as long as acute, narrowly linear-ovate leaves; small flowers with a five-veined dorsal sepal and three-veined lateral sepals; three-veined petals; and a lip with rounded apex and a cleft bar.

Plant large, epiphytic, densely caespitose. Ramicauls erect, very slender, 5–14 cm long, with a close, tubular sheath from below the middle, another 2 sheaths below and at the base. *Leaf* erect, coriaceous, acute, narrowly linear-ovate, 6–10 cm long including a petiole, 1.5 cm long, the blade 0.5–0.7 cm wide in the dry state, narrowly cuneate below to the petiole. *Inflorescence* 2–4; 4–9 cm long, the racemes erect, congested, distichous, many-flowered with most flowers open simultaneously; floral bracts tubular, close, obtuse, 1.5 mm long; pedicels 1 mm long; ovary 1 mm long; the peduncle 5 cm long, subtended by a spathe 1.2 cm long, from a node below the apex of the ramicaul; flowers red-purple; *sepals* glabrous, ovate, subacute to obtuse, connate below the middle, the dorsal sepal 2.25 mm long, 2.5 mm wide, 5-veined, the lateral sepals 2 mm long, 2.25 mm wide, 3-veined; *petals* transversely semilunate, 0.75 mm long, 1.5 mm wide, 3-veined, concave below the rounded apex, with a transverse carina; *lip* subquadrate, 0.6 mm long, 0.8 mm wide, 0.6 mm deep, the apex rounded with thickened margin, concave below a cleft, protruding bar, the dorsum with a suborbicular callus, the base truncate, connate to the base of the column; *column* stout, ca. 0.8 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *crascens*, "slender, graceful," referring to qualities of the plant.

This slender, comparatively graceful species is related to *Stelis lindenii* Lindl., and distinguished by very slender, densely caespitose ramicauls with narrowly linear-ovate leaves, and fascicles of small-flowered, secund racemes about as long as the leaf. The petals are thick and three-veined, and the lip is type A with a cleft, more or less protruding bar.

Stelis curiosa Luer & R. Escobar, *sp. nov.* TYPE: COLOMBIA. Without collection data. probably collected near Pereira, Risaralda, flowered in cultivation by Shigenobu Tsubota, 10 May 1993, *C. Luer 16772* (Holotype: MO). Fig. 11.

This small, shortly ascending species is distinguished by an erect rhizome with closely spaced ramicauls with acute, narrowly ovate leaves with a few racemes of white flowers nearly as long; ovate, pubescent sepals; single-veined petals; and a subacute, cordate, minutely pubescent lip.

Plant small, epiphytic, shortly repent on an erect rhizome, ramicauls produced 1–3 mm apart, roots slender. Ramicauls ascending-erect, slender, 3–5 cm long, with a loose, tubular sheath from below the middle, and 1–2 other sheaths about the base. *Leaf* erect, coriaceous, narrowly ovate, acute, 4–6 cm long, including a petiole 1–1.2 cm long, the blade 1–1.3 cm wide in dry state, cuneate below into the petiole. *Inflorescence* 2–3; 3.5–4 cm long, the racemes erect, simultaneously many-flowered; floral bracts oblique, acute, acuminate, 2.5 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle ca. 1 cm long, from a node near the apex of the ramicaul; *flowers* white; *sepals* pubescent, expanded, ovate, subacute to obtuse, 3-veined, connate below the middle, the dorsal sepal 2 mm long, 1.75 mm wide, the lateral sepals, 2 mm long, 1.6 mm wide; *petals* broadly ovate, concave, the margin thickened at the obtuse apex, 0,5 mm long, 0.6 mm wide, 1-veined; *lip* subcordate, minutely pubescent, 0.6 mm long, 0.6 mm wide, 0.3 mm deep, shallowly concave below the bar, without a glenion, the apex thick, subacute to narrowly rounded, the dorsum with a low, central, rounded callus, the base truncate, hinged to the base of the column; *column* clavate, 0.5 mm wide and long, the anther and the bilobed stigma apical.

Etymology: From the Latin *curiosus*, "curious," referring to the unusual habit.

This small, shortly repent species is characterized by an erect rhizome that produces erect, ascending ramicauls only a millimeter or two apart. The leaves are acute and narrowly ovate, about as long as the two or three densely flowered racemes of white flowers that accompany it. The sepals are ovate and pubescent; the petals are single-veined; and the subcordate lip is minutely pubescent.

Stelis decipula Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Nariño: terrestrial on road embankment E of Ricaurte, 3000 m, 1 November 1979, *C. Luer, J. Luer & A, Hirtz 4506* (Holotype: SEL). Fig, 12.

This small, caespitose species is characterized by a secund, many-flowered raceme that far surpasses an oblong, obtuse leaf; minutely pubescent, subacute sepals; three-veined petals; and a rhomboid lip with a longitudinal callus that resembles a loop of rope used for a snare.

Plant small, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 2.5-3.5 cm long, with loose, tubular sheaths, one above the middle, one below the middle, and one at the base. *Leaf* erect, coriaceous, oblong, obtuse, 3–5.5 cm long, 1.5 cm wide in the dry state, cuneate below into a petiole ca. 1.5 cm long. *Inflorescence* single; 13–15 cm tall, the raceme erect, congested, secund, many-flowered with most flowers open simultaneously, floral bracts tubular, close, obtuse, 2 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle ca. 5 cm long, subtended by a spathe 8–10 mm long, from a node near the apex of the ramicaul; *sepals* light purple, expanded, minutely pubescent, similar, ovate, subacute to obtuse, 2.3 mm long, 2.3 mm wide, 3-veined, connate in lower quarter; *petals* yellow, transversely ovate, obtuse, concave, 3-veined, 1 mm long, 1.5 mm wide; *lip* yellow, rhomboid, 1.3 mm long, 1 mm

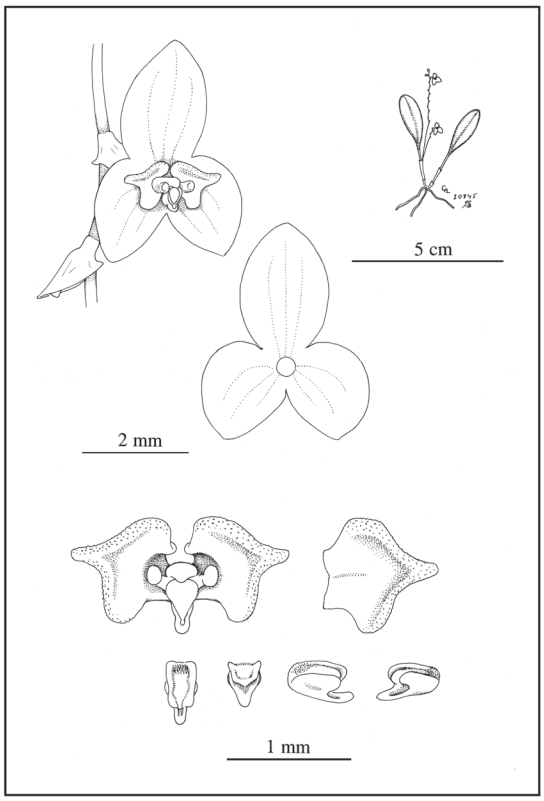

Figure 9. *Stelis cochliops* Luer & Hirtz

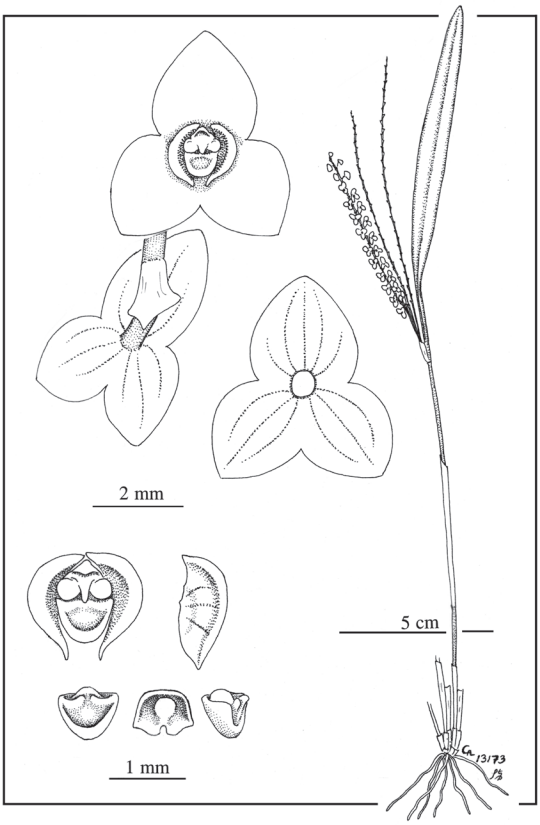

Figure 10. *Stelis crascens* Luer & R.Escobar

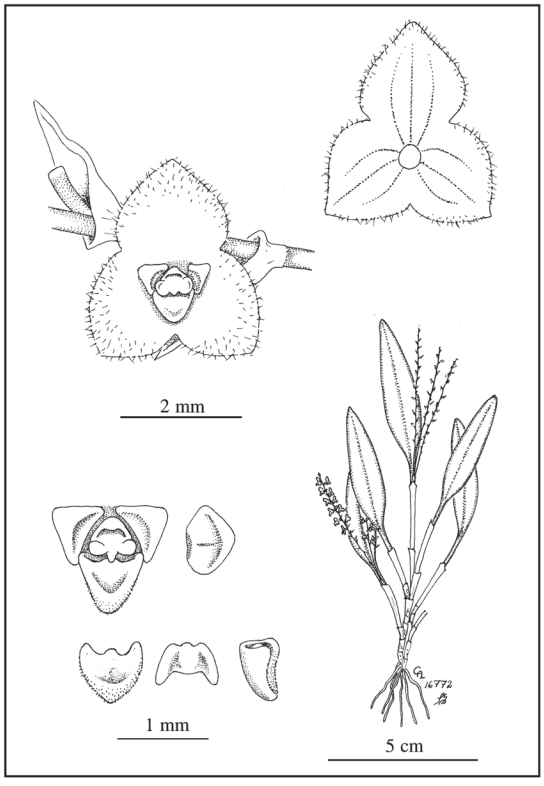

Figure 11. *Stelis curiosa* Luer & R.Escobar

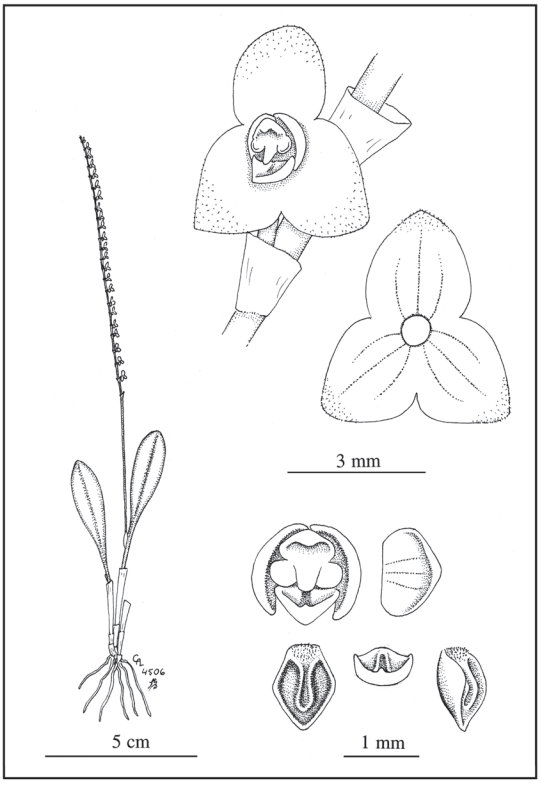

Figure 12. *Stelis decipula* Luer & R.Escobar

wide, 0.6 mm deep, shallowly concave with a thick, basal bar that bears a descending glenion with thick margins, now disguised as a callus that is concave medially, round toward the apex, appearing as a loop, or horseshoe, beginning at the minutely pubescent, basal callus, attached to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *decipula*, "a snare, a trap," referring to the callus of the lip.

This small, caespitose species is characterized by an elongated, secund raceme far exceeding oblong, obtuse leaves; minutely pubescent, subacute, three-veined sepals; and three-veined petals. Most distinctive is the rhomboid lip with a longitudinal callus resembling a loop of rope, similar to the horseshoe-shaped callus of *Stelis hippocrepica* Luer & R.Escobar described herein.

Stelis digitifera Luer & R. Escobar, *sp. nov.* TYPE: COLUMBIA: Antioquia: Yarumal, road to Briceño, Quebrada Río El Oro, 1850 m, 16 March 1989, *C. Luer, J. Luer, S. Dalström & W. Teague 14179* (Holotype: MO). Fig. 13.

This medium-sized, caespitose species is distinguished by a sublax raceme of flowers with an elongated dorsal sepal and short, rounded, semiconnate lateral sepals; single-veined petals; and an acute lip.

Plant medium in size, densely caespitose; roots slender. Ramicauls erect, 4–6 cm long, with a tubular sheath from below the middle, and another 2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical, acute, 6–9 cm long, including a petiole 1–2 cm long, the blade 1–1.3 cm wide. *Inflorescence* 1–2; 10-17 cm long, the raceme a erect, sublax, distichous, many-flowered raceme, with many nutant flowers produced simultaneously; floral bracts oblique, acute, acuminate, 6-7 mm long; pedicels 2 mm long; ovary 1.5–2 mm long; the peduncle 6–7 cm long, subtended by a spathe 7–8 mm long, from a node above the abscission layer; *sepals* glabrous, purple, the dorsal sepal oblong, obtuse, 6.5 mm long, 3 mm wide, 3-veined, connate basally, the lateral sepals transversely ovate, subcircular, oblique, obtuse, more or less antrorse, 3 mm long, 3.5 mm wide, 3-veined connate to near the middle; *petals* yellow, transversely ovate, concave, broadly rounded at the apex with the margin narrowly thickened, without a transverse callus, 0.7 mm long, 1 mm wide, 1-veined; *lip* yellow, triangular, 0.5 mm long, 0.8 mm wide, 0.6 mm deep, shallowly concave below shallowly sulcate bar, the dorsum elliptical, with a small, central, suborbicular callus, the base truncate, hinged to the base of the column; *column* semiterete, ca. 0.8 mm long and wide, the anther and the bilobed stigma apical.

Etymology: From the Greek *digitifer*, "finger-bearing," referring to the elongated dorsal sepal.

This species is remarkable for an oblong dorsal sepal far longer than little, rounded lateral sepals. The dorsal sepal is held horizontally in the nutant flower. The lateral sepals are partially connate and more or less antrorse, suggesting an incomplete synsepal. The petals are single-veined. The apex of the triangular lip is acute.

Stelis duquei Luer & R.Escobar, *nom. nov.* TYPE: COLOMBIA. Antioquia: Cocorná, between Santuario and Cocorná, 2000–2200 m, flowered in cultivation by O. Duque at his finca above Río Cocorná, 20 March 1989, *C. Luer 14328* (Holotype: MO). Fig. 14.

Stelis occulta O.Duque [as *S. oculta*], Orquideología 27(2): 131. 2011, *nom. inval.*

This large, caespitose species is distinguished by one or two many-flowered racemes much longer than elliptical, acute leaves; pale green flowers with dorsal sepal seven-veined and the synsepal deeply concave; thick, three-veined petals; and a subquadrate lip obtuse apex, a shortly cleft bar and a trilobed dorsum.

Plant large, epiphytic, densely caespitose; roots slender. Ramicauls erect, 10–12 cm long, with a tubular sheath on the middle third and another 1–2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical-ovate, acute, 12–15 cm long including a petiole 2 cm long, the blade 3–5 cm wide in the dry state. *Inflorescence* 1–2; 20–30 cm long, the racemes erect, strict, subcongested, distichous, many-flowered, with many flowers open simultaneously; floral bracts tubular, obtuse, 4 mm long, 5 mm wide; pedicels 3 mm long; ovary 3 mm long; the peduncle ca. 10 cm long, from a node below the apex of the ramicaul, with a slender spathe ca. 1 cm long; flowers greenish white; *sepals* glabrous or microscopically pubescent, the dorsal sepal erect, ovate, obtuse, 8–11 mm long, 7–10 mm wide, 7-veined, connate basally, the lateral sepals connate to the tip into a deeply concave synsepal, 8–10 mm long, 10–12 mm wide expanded, each sepal 4-5 veined; *petals* transversely ovate, concave, the apex rounded with a broad, rough margin, 1.5 mm long, 2 mm wide, 3-veined, with a transverse carina; *lip* subquadrate, 1 mm long, 1.3 mm wide, 1 mm deep, concave below a shortly cleft bar without an obvious glenion, the apex obtuse, more or less slightly acuminate at the tip, the dorsum with a transverse, trilobed callus, the base truncate, hinged to the base of the column; *column* clavate, ca. 1.3 mm wide and long, the anther and the bilobed stigma apical.

Eponymy: Named for the late Dr. Oscar Duque of Medellín, Colombia, who originally described it as *Stelis occulta* [as *S. oculta*], from the Latin *occultus*, "occult, hidden," referring to the author's claim that the species had escaped attention, in spite of being frequent in the "central Andes" of Colombia.

Additional specimens examined: COLOMBIA. Antioquia: Carmen de Viboral, 2400 m, collector unknown, flowered in cultivation at Colomborquídeas, 15 December 1992, *R. Escobar 5034* (MO); without collection data, flowered in cultivation at Colomborquídeas, 23 May 1995, *C. Luer 17578* (MO).

Oscar Duque found this robust species to be frequent, but not previously recorded. A long raceme of large, light green flowers with a deeply concave synsepal exceeds a large, elliptical leaf. The dorsal sepal is seven-veined, and the petals are thick and three-veined. The lip is type A with a shortly bifid bar, an obtuse apex, and with a three-lobed callus on the dorsum. The name *S. oculta* is invalid because the author did not specify where the type had been deposited.

Stelis euglossina Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Santander: Bucaramanga, E of Bucaramanga toward Berlin, 3000 m, 7 May 1984, *C. Luer, J. Luer & R. Escobar 10191* (Holotype: MO). Fig. 15.

This small, caespitose species is distinguished by elliptical leaves with shorter ramicauls exceeded by a strict raceme with prominent floral bracts; ovate, subacute, pubescent sepals; three-veined petals; and a proportionately large, protruding, elliptical lip.

Plant small, epiphytic, densely caespitose, roots slender. Ramicauls erect, slender, 1.5–2 cm long, enclosed by a loose, tubular sheath above the middle, another sheath below the middle, and 1 at the base. *Leaf* erect, coriaceous, elliptical, subacute, 2–2.5 cm long including a petiole ca. 5 mm long, the blade 5–8 mm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 4–5 cm tall, the raceme erect, strict, distichous, nearly simultaneously flowered; floral bracts oblique, acute, 5 mm long; pedicels 2 mm long; ovary 2 mm long; peduncle 1–3 cm long, from a node near the apex of the ramicaul; flowers yellow or purple; *sepals* expanded, pubescent within, ovate, acute to subacute, 3-veined, connate basally, 5 mm long, 3 mm wide low in the raceme to 3 mm long, 2 mm wide near the tip; *petals* thin, transversely ovate, concave, narrowly thickened on the broadly obtuse apical margin, 1.5 mm long, 2 mm wide, 3-veined; *lip* protruding, elliptical, 3 mm long, 2 mm wide, 2 mm deep, shallowly concave, with a widely cleft bar above the base, the apex shallowly bifid into a pair of obtuse tips, the dorsum narrow with a truncate base, hinged to the base of the column; *column* clavate, 1 mm long and wide, the anther with an elongated rostellum and the bilobed stigma apical.

Etymology: From the Greek *euglossina*, "with a good tongue," referring to the labellum.

Additional specimens examined: COLOMBIA. Santander: Bucaramanga, between Bucaramanga and Berlin, 3200 m, 27 April 1982, *C. Luer, J. Luer & R. Escobar 7603* (SEL).

This small, caespitose species is distinguished by prominently bracted, many-flowered racemes that exceed elliptical leaves, and medium-sized flowers. The sepals are pubescent, ovate, and varying from five millimeters long low in the raceme to three millimeters long near the tip; the petals are thin and three-veined; and the protruding, elliptical lip is three millimeters long. The lip is shallowly concave with the bar widely cleft, and the apex is shallowly notched.

Stelis euthema Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Frontino, El Plateado, near the gold mine, 2060 m, 5 May 1983, *C. Luer, J. Luer, R. Escobar et al. 9041* (Holotype: SEL). Fig. 16.

This small, caespitose species is distinguished by a loose, flexuous, several-flowered raceme about as long as, or a little longer than the leaves; ovate, obtuse, pubescent, three-veined sepals; three-veined petals with a verrucose margin; and an ovoid, shallowly concave lip with a descending dorsum.

Plant small, epiphytic, densely caespitose, roots slender. Ramicauls erect, slender, 8–15 mm long, enclosed by a tubular sheath and another 1–2 sheaths about the base. *Leaf* erect, coriaceous, elliptical, subacute to obtuse, 25–45 mm long including a petiole 5–12 mm long, the blade 5–7 mm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 3.5–4.5 cm tall, the raceme loose, flexuous, with 5–8 flowers; floral bracts oblique, acute, 2 mm long; pedicels 1.5 mm long; ovary 1.5 mm long; peduncle 5–12 mm long, from a node near the apex of the ramicaul; flowers dull white, suffused with purple; *sepals* expanded, ciliate and long-pubescent near the margins, ovate, obtuse, concave and connate in basal third, 3-veined, the dorsal sepal 3.5 mm long, 4 wide, the lateral sepals 3 mm long, 3.5 mm wide; *petals* purple, transversely elliptical, concave, the apex broadly obtuse, thickened and minutely verrucose on the margin, 1.3 mm long, 2.5 mm wide, 3-veined; *lip* purple, ovoid with the apex rounded, 1.5 mm long, 1 mm wide, 0.75 mm deep, shallowly concave and smooth below the bar (the upper margin of the lip), with a very small cleft or glenion, the dorsum deflexed to the base, hinged to the base of the column; *column* clavate, elongate, 2 mm long, 1.75 mm wide across the expanded stigmatic lobes, the anther and the stigmatic lobes apical.

Etymology: From the Greek *euthemos*, "well-arranged, neat," referring to the morphology of the plant.

This small, caespitose species is distinguished by a loose, flexuous, several-flowered raceme that often exceeds the leaves. The sepals are long-pubescent, obtuse and connate in their basal thirds to create a triangular cavity for the central apparatus. The petals are concave with a verrucose margin. The upper margin of the lip is the bar between the slightly concave anterior surface and the deflexed dorsum. The column exceeds the dorsum of the lip with expanded apical lobes overlying the petals.

Stelis exaltata Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Risaralda: Pueblo Rico, Alto de Linea, 2100 m, 11 May 1993, *C. Luer, J. Luer & R. Escobar 16791* (Holotype: MO). Fig. 17.

This large, densely caespitose species is distinguished by slender, fasciculate ramicauls about 40 centimeters long and thin leaves about 20 centimeters long and six centimeters wide; a many-flowered raceme only slightly longer; large flowers with multiveined dorsal sepal and synsepal; three-veined petals; and a subquadrate, shallowly concave, rounded apex.

Plant large, epiphytic, densely caespitose; roots slender. Ramicauls erect, fasciculate, slender, 35–45 cm long, with a close tubular sheath above the middle, another sheath below the middle and at the base. *Leaf* erect, thinly coriaceous, ovate, acute, acuminate, 15–20 cm long, 5–6 cm wide in the dry state, cuneate below into a petiole 2–2.5 cm long. *Inflorescence* solitary, to 22 cm long, the raceme erect, secund, densely many-flowered; floral bracts oblique, acute, 4–5 mm long; pedicels 3 mm long; ovary 2 mm long; the peduncle ca. 10 cm long, subtended by a spathe ca. 1 cm long, from a node below the apex of the ramicaul; *sepals*

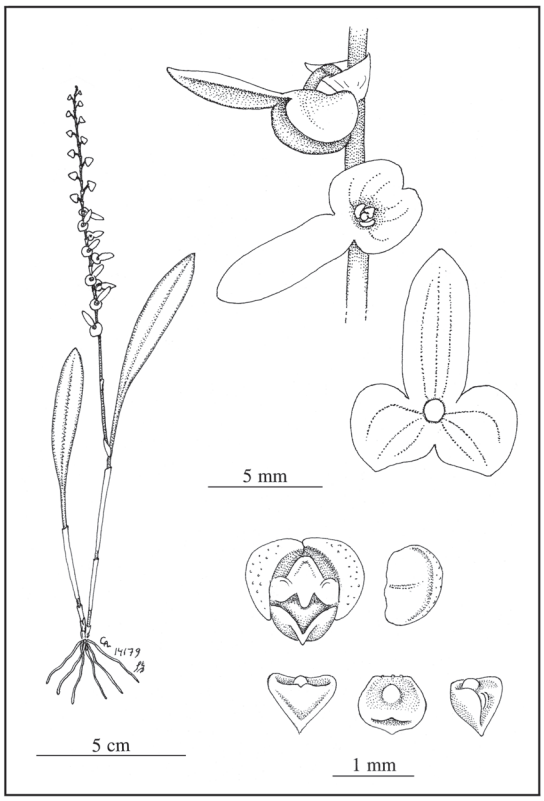

Figure 13. *Stelis digitifera* Luer & R.Escobar

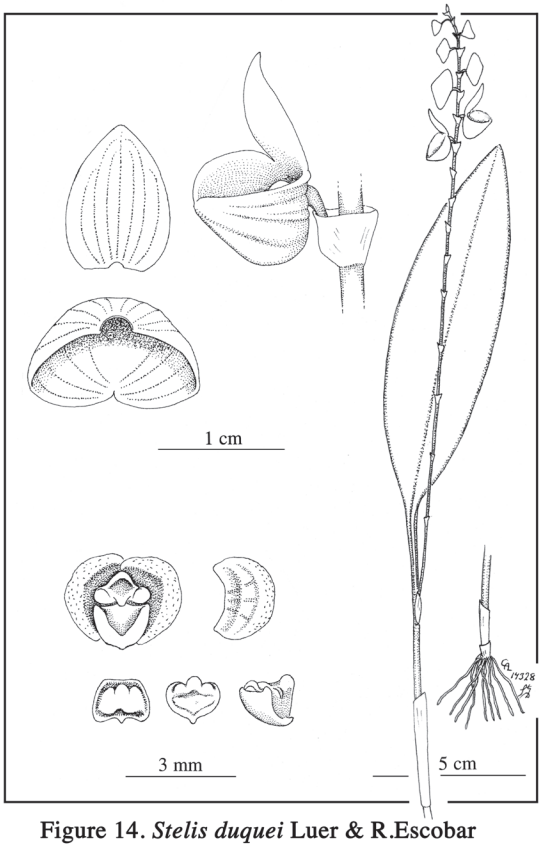

Figure 14. *Stelis duquei* Luer & R.Escobar

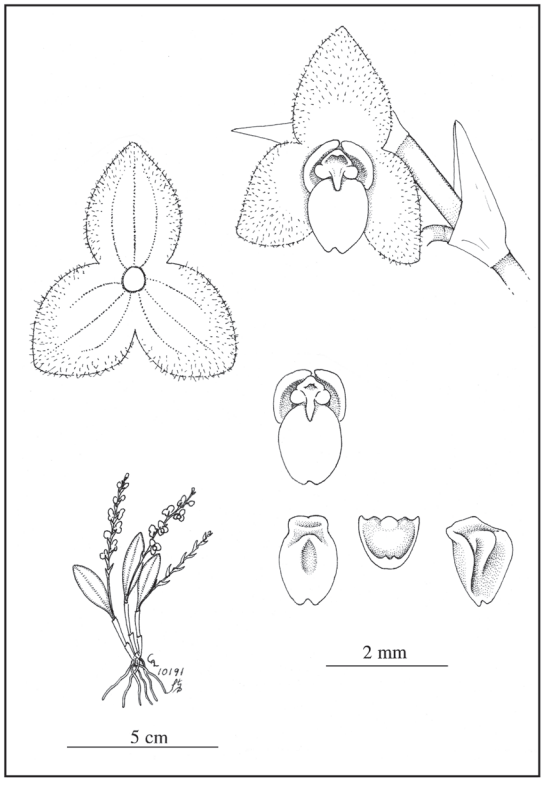

Figure 15. *Stelis euglossina* Luer & R.Escobar

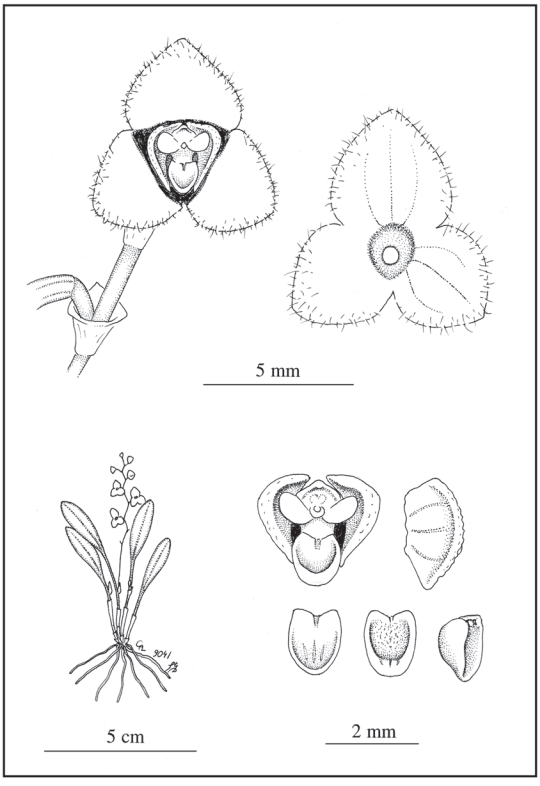

Figure 16. *Stelis euthema* Luer & R.Escobar

purple, glabrous, the dorsal sepal oblong-ovate, obtuse, 13 mm long, 7 mm wide, 9-veined, connate to the synsepal 2 mm, the lateral sepals connate into a concave, obtuse synsepal, 11 mm long, 11 mm wide, 11-veined; *petals* yellow, thick, transversely elliptical, 2 mm long, 2 mm wide, 3-veined, with the apical margin broadly thickened, obtuse, with a transverse callus; *lip* yellow, subquadrate, 0.8 mm long, 1.5 mm wide, 0.8 mm deep, shallowly concave below a thick bar with a glenion, round at the apex, the dorsum with three, rounded calli, the base truncate, hinged to the base of the column; *column* ca. 1 mm broad and long, the proportionately small anther and stigmatic lobes apical.

Etymology: From the Latin *exaltatus*, "very high," referring to the great height of the plant, excluding the inflorescence.

This species is one of the largest of the genus, standing over half a meter tall excluding the inflorescence. The leaves are nearly as large as the largest of *Stelis allenii* L.O. Williams, but they are petiolate and thinly coriaceous and acuminate, instead of sessile, thickly coriaceous and non-acuminate. The flowers are similar to those of *Stelis maxima* Lindl., the species differing mostly in their vegetative parts.

Stelis flagellifera Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Putumayo: between Sibundoy and Mocoa, 2200 m, 20 January 1979, *C. Luer, J. Luer & O. Ospina 3719* (Holotype: SEL). Fig. 18.

This large species is characterized by an acute, elliptical leaf longer than the ramicaul; a much longer, whiplike inflorescence; a five-veined dorsal sepal; three-veined petals; and an obtuse lip with a glenion and with three, rounded calli on the dorsum.

Plant large, epiphytic, caespitose. Ramicauls erect, relatively stout, 3–5 cm long, with a loose, tubular sheath from below the middle, and another 1–2 sheaths at the base. *Leaf* erect, coriaceous, ovate, acute, 5–12 cm long including a petiole 1–2 cm long, 2–2.5 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* single; 17–33 cm long, the raceme erect, strict, lax below, congested above, distichous, many-flowered with most flowers open simultaneously; floral bracts oblique, acute, 3–4 mm long; pedicels 2 mm long; ovary 1.5 mm long; the peduncle 10–18 cm long, subtended by a spathe 6–8 mm long, from a node below the apex of the ramicaul; *sepals* dull gray above the middle, dull purple below the middle, glabrous, expanded, broadly ovate, obtuse, connate to near the middle, the dorsal sepal 4 mm long, 4.5 mm wide, 5-veined, the lateral sepals 3 mm long, 4 mm wide, 4-veined; *petals* purple, semilunate, 1 mm long, 2 mm wide, 3-veined, the apex broadly rounded, thickened, concave below a transverse carina; *lip* subquadrate, 1 mm long, 1.4 mm wide, 0.8 mm deep, concave below the bar with a glenion, the apex obtuse, thickened, the dorsum slightly concave with a row of three small, rounded calli, the base truncate, connate to the base of the column; *column* stout, ca. 1.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *flagellifer*, "whip bearer," referring to the long inflorescence.

This large species is characterized by acute, ovate leaves borne by slightly shorter Ramicauls with loose, tubular sheaths. A whiplike inflorescence far exceeds the leaf. The flowers are medium in size with the dorsal sepal five-veined. The petals are three-veined, and the lip is type A with a glenion and three small calli on the dorsum.

Stelis flexuella Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Nariño: above abandoned Magnesium mine, E of Ricaurte, 1800 m, 1 November 1979, *C. Luer, J. Luer & A. Hirtz 4514* (Holotype: SEL). Fig. 19.

This small, caespitose species is distinguished by elliptical leaves; much shorter ramicauls; an elongating, flexuous raceme; broadly ovate, obtuse sepals; round, three-veined petals; and a subquadrate lip shallowly concave below the bar with a narrow glenion.

Plant small, epiphytic, caespitose, roots slender. Ramicauls erect, slender, 5–8 mm long, with a tubular sheath from near the base. *Leaf* erect, coriaceous, elliptical, obtuse, 10–25 mm long including a petiole 5–8 mm long, the blade 5–8 mm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 7 cm long, the raceme flexible, flexuous, successively flowering, often with a single flower; floral bracts oblique, acute, 1 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle 1.5-2 cm long, from a node from the ramicaul within the sheath; flowers purple; *sepals* glabrous, expanded, broadly ovate, obtuse, 3-veined, connate to below the middle, 1.5–3 mm long, 1.5–1.75 mm wide; *petals* transversely obovate, concave, slightly thickened on the margin of a rounded apex, 0.75 mm long, 1 mm wide, 3-veined; *lip* subquadrate, type A, 0.8 mm long, 1 mm wide, 0.75 mm deep, shallowly concave below the bar with a narrow glenion, the apex rounded with a narrow margin, the dorsum convex centrally around an extension of the glenion, the base truncate, hinged to the base of the column; *column* clavate, 1 mm wide, the anther and the bilobed stigma apical.

Etymology: From the Latin *flexuella*, "a little flexuous one," referring to the raceme.

This dainty, little species is characterized by ramicauls shorter than elliptical leaves; a flexuous, successively flowered raceme far exceeding the leaves, usually with only a single flower; purple flowers with obtuse, broadly ovate sepals; subcircular, three-veined petals; and a subquadrate, type A lip with a narrow glenion that extends from the bar both downward and backward onto the dorsum.

Stelis fornix Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Valle del Cauca: Alto de Los Galápagos, 2050 m, 13 May 1993, *C. Luer, J. Luer & R. Escobar 16802* (Holotype: MO). Fig. 20.

This medium-sized species is characterized by acute, elliptical leaves exceeded by a slender, secund, multiflowered raceme with shortly pubescent sepals; oblong, single-veined petals; and a deeply hollowed out lip that gapes to expose a thin, broadly incised bar.

Plant medium in size, epiphytic, caespitose. Ramicauls erect, slender, 2.5–4 cm long, with a loose, tubular sheath

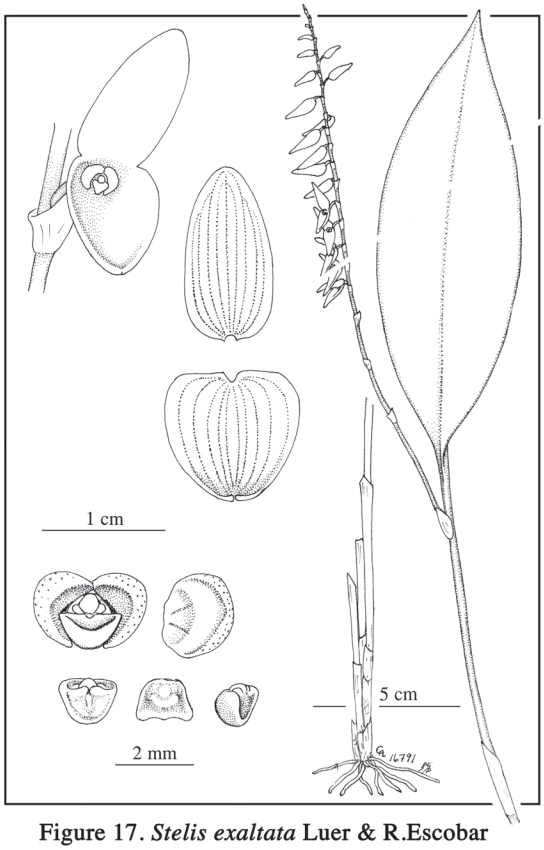

Figure 17. *Stelis exaltata* Luer & R.Escobar

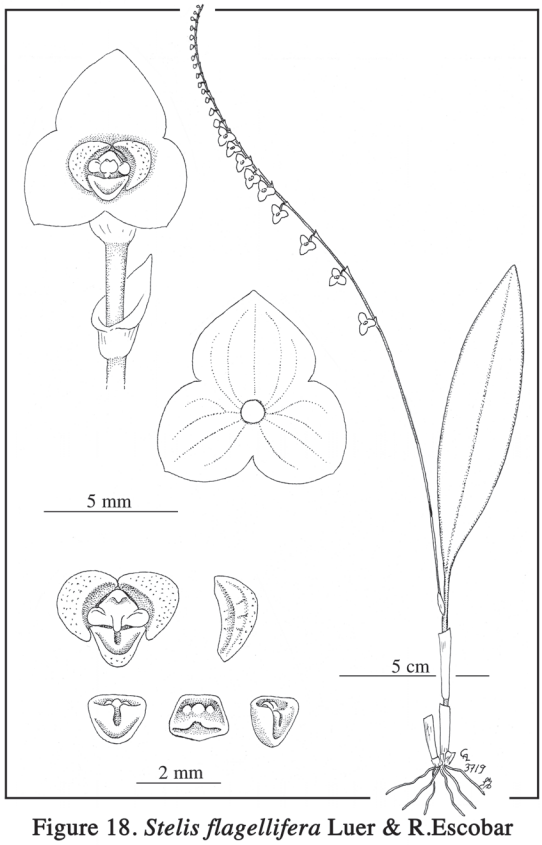

Figure 18. *Stelis flagellifera* Luer & R.Escobar

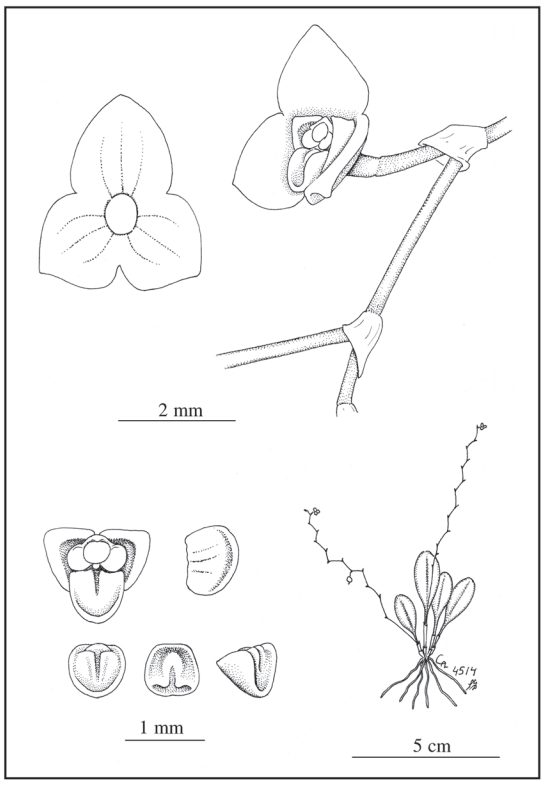

Figure 19. *Stelis flexuella* Luer & R.Escobar

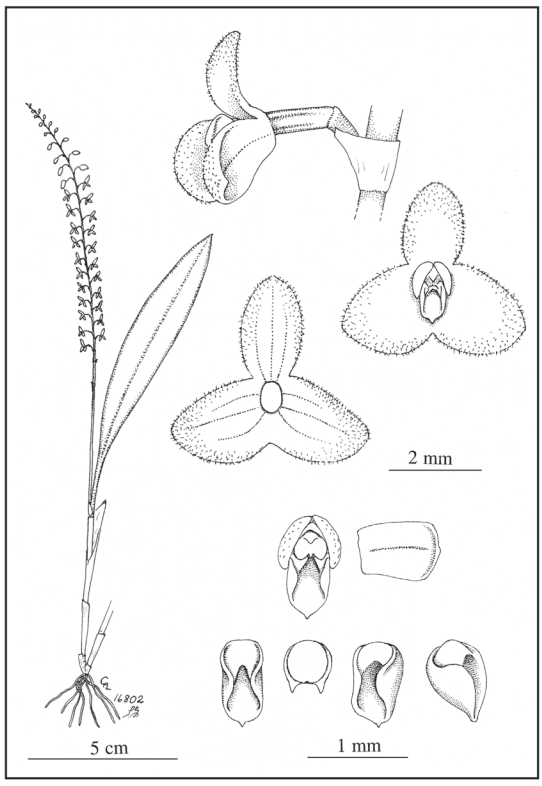

Figure 20. *Stelis fornix* Luer & R.Escobar

from below the middle, and another 1–2 sheaths at the base. *Leaf* erect, coriaceous, elliptical, acute, 8–11 cm long including a petiole 2.5–3 cm long, the blade 1.2–1.5 cm wide in the dry state, narrowed below into the petiole. *Inflorescence* 1–2; 15–18 cm tall, the raceme erect congested, distichous in liquid to secund when pressed and dry, many-flowered with most flowers open simultaneously, floral bracts oblique, acute, 1 mm long; pedicels 1.5 mm long; ovary 1.5 mm long; the peduncle 6 cm long, subtended by a slender spathe ca. 15 mm long, from a node at the apex of the ramicaul; flowers greenish white; *sepals* shortly pubescent within, ovate, obtuse, connate basally, 3-veined, the dorsal sepal 2 mm long, 1.1 mm wide, the lateral sepals antrorse, 2 mm long, 1.6 mm wide; *petals* thin, oblong, shallowly concave, 1 mm long, 0.75 mm wide, 1-veined, subverrucose on the truncate apex; *lip* subhemispherical, deeply hollowed out, 1 mm long, 0.5 mm wide, 0.5 mm deep, the sides erect with thin rounded, margins supporting a partially cleft bar above a deep cavity, the apex obtuse without thickening. the rounded base connate to the base of the column; *column* stout, ca. 0.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *fornix*, "a vault, or crypt," referring to the hollowed-out lip.

This medium-sized species with acute, elliptical leaves is exceeded by a slender, long-pedunculate raceme of crowded flowers. The sepals are shortly pubescent, three-veined and obtuse, the dorsal sepal being noticeably narrower than the lateral sepals. The petals are thin and single-veined. The lip is deeply concave between thin, erect, rounded margins, and below a convex, shortly cleft, shelf-like bar. The apex is thin and obtuse.

Stelis galapagosensis Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Valle del Cauca: Alto de Los Galápagos, 2050 m, at the pass between Valle del Cauca and Chocó, 13 May 1993, *C. Luer, J. Luer & R. Escobar 16816* (Holotype: MO). Fig. 21.

This tall, caespitose species is characterized by slender ramicauls much longer than acute, ovate leaves with two racemes as long, or a little longer; a five-veined dorsal sepal; three-veined petals; and a shallow lip with a broad, obtuse margin, and a suborbicular callus on the deflexed dorsum.

Plant medium to large, epiphytic, caespitose. Ramicauls erect, slender, 5–14 cm long, with a short, tubular sheath from near the middle, and another short, tubular sheath at the base. *Leaf* erect, coriaceous, ovate, acute, 6–9 cm long including a petiole 1.5 cm long, the blade 1–1.8 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* 2; 8–11 cm tall, the raceme erect congested, with opposite-facing rows, many-flowered with most flowers open simultaneously; floral bracts oblique, acute, 2 mm long; pedicels 1 mm long; ovary 1 mm long; the peduncle ca. 1 cm long, subtended by a slender spathe 7 mm long, from a node near the apex of the ramicaul; *sepals* expanded, shiny purple externally, greenish purple within, glabrous, ovate, obtuse, connate to near the middle, the dorsal sepal 3.5 mm long, 4 mm wide, 5-veined, the lateral sepals oblique, 3 mm long, 3 mm wide, 4-veined; *petals* purple, transversely semilunate, 0.75 mm long, 2 mm wide, the apex broadly rounded, concave below a wide, flat margin, 3-veined; *lip* purple, shallowly ovoid, shallowly concave below a narrow, transverse bar, the apex obtuse with a broad, flat margin similar to that of the petals, 1 mm long, 1 mm wide, 0.5 mm deep, the dorsum acutely deflexed, with a suborbicular callus at the base, the base connate to the base of the column; *column* stout, clavate, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Eponymy: Named for the Alto de Los Galápagos where this species was collected.

This caespitose species is characterized by long, slender ramicauls with shorter, acute, ovate leaves and a pair of racemes equaling or surpassing the leaves. The flowers with broadly ovate sepals are produced in two opposite-facing ranks. The petals are semilunate with wide. flat margins. The lip is remarkable with a narrow, transverse bar between the anterior surface and the acutely deflexed dorsum with a suborcicular callus.

Stelis giraffina Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. without collection data, flowered in cultivation at Colomborquídeas, 23 May 1995, *C. Luer 17581* (Holotype: MO). Fig. 22.

This small, long-repent species is distinguished by obtuse, three-veined sepals and a long, erect column that exceeds the thin, three-veined petals and the subdiscoid lip.

Plant small, epiphytic, long-repent, the rhizome stout, ascending, ca. 2 cm between ramicauls, roots slender. Ramicauls erect, slender, 2–3 cm long, with a tubular sheath from below the middle third, and another sheath at the base. *Leaf* erect, coriaceous, elliptical, subacute, 3.5–5 cm long including a petiole ca. 1 cm long, the blade 0.8–1.2 cm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 10–11 cm long, the racemes strict to subflexuous, successively many-flowered with ca. 10 flowers open simultaneously; floral bracts tubular, obtuse, 2 mm long; pedicels 2 mm long; ovary 1 mm long; the peduncle 4–5 cm long, from a node above the apex of the ramicaul; *sepals* similar, green, diffusely dotted with minute, purple cells, glabrous, expanded, ovate, obtuse, connate below the middle, 2.5 mm long, 2.5 mm wide. *Petals* green, thin. concave, transversely semilunate, the apex broadly obtuse and thickened on the margin, 0.6 mm long, 1.5 mm wide, 3-veined; *lip* green, shallowly subquadrate, 1.2 mm long, 1.6 mm wide, 0.4 mm deep, shallowly concave below a bar with a glenion, the apex broadly rounded with a narrow margin, the dorsum deflexed 180° down about half the length of the lip, where it is hinged to the base of the column; *column* erect, ca. 1.2 mm wide across the stigmatic lobes at the apex, the shaft terete, ca. 1.5 mm long.

Etymology: Named for the mammalian genus *Giraffa*, remarkable for an elongated neck.

This long-repent, ascending species is most remarkable for the terete, elongated shaft of the column that lifts the clinandrium and the pair of stigmatic lobes above the lip

and petals. The sepals are obtuse; the petals are thin and three-veined; and the lip is shallow and subdiscoid, with a rounded apex and a glenion descending from a narrow bar across the width, while the dorsum is acutely deflexed.

Stelis gravida Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Yarumal, along Río El Oro, 2700 m, 1 May 1984, *C. Luer, J. Luer & R. Escobar 10079* (Holotype: MO). Fig. 23–24.

Among the small, or medium-sized, caespitose species, this species is distinguished by narrowly linear leaves; ovate, three-veined sepals; single-veined, or faintly three-veined petals; and a minute, subquadrate lip with a proportionately large, smooth, ovoid callus.

Plant small to medium size, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 1–6 cm long, enclosed by a thin tubular sheath above the middle, another sheath below the middle, and at the base. *Leaf* erect, coriaceous, narrowly linear, acute, 3–7 cm long, 1–3 mm wide when dry, narrowed below to the base. *Inflorescence* single; 4-12 cm long, the raceme erect, strict, congested, many-flowered, with many flowers open simultaneously, flowering to near the base; floral bracts oblique, acute, 1–1.5 mm long; pedicels 1 mm long; ovary 0.75–1 mm long; the peduncle less than 1 cm long, from a node at the apex of the ramicaul; flowers light yellow-green; *sepals* glabrous, ovate, subacute to obtuse, 3-veined, the dorsal sepal 1.5 mm long, 1.25 mm wide, the lateral sepals oblique, 1 mm long, 1 mm wide; *petals* membranous, transversely elliptical, concave, broadly obtuse, slightly thickened along the apical margin, without a transverse callus, 0.4 mm long, 0.6 mm wide, single-veined or faintly 3-veined; *lip* subquadrate, 0.6 mm long, 0.6 mm wide, 0.4 mm deep, shallowly concave within the broadly obtuse, apical margin and surrounding a proportionately large, smooth, ovoid callus that fills the disc and extends to the base, the base broadly truncate, hinged to the base of the column; *column* ca. 0.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *gravidus*, "pregnant," referring to the appearance of the callus of the lip.

Additional specimens examined: COLOMBIA. Antioquia: La Union, along a stream 5 km W of Mesopotamia, 2400 m, April 1988, *C. Luer, J. Luer & R. Escobar 13076* (MO); Yarumal, Quebrada del Oro, 1850 m, *C. Luer, J. Luer, S. Dalström & W. Teague 14184*; Yarumal, along Río El Oro, N of Yarumal, 2700 m, 1 May 1984, *C. Luer, J. Luer & R. Escobar 10070* (MO).

This little, caespitose species with narrowly linear leaves, is variable in the length of the leaf, and the length of the inflorescence. The minute flowers are borne in strict, congested racemes. The sepals are glabrous and three-veined, and the petals are thin, faintly three-veined or with only one vein visible. The lip is filled with a proportionately large, smooth, ovoid callus with the rounded summit protruding upward beneath the column.

Stelis hansenacea Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Risaralda: E of and above Santa Rosa de Cabal. 2800 m, 12 May 1993, *C. Luer, J. Luer & R. Escobar 16796* (Holotype: MO). Fig. 25.

This medium-sized, caespitose species is distinguished by massive deposits of a granular substance in all floral parts; the flowers are produced in a crowded, secund raceme; the sepals are overlapping, broadly ovate and without visible veins; the petals are transversely ovate; and the lip is oblong, thick and shallowly concave above the middle.

Plant medium in size, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 5–6 cm long, enclosed by a tubular sheath from below the middle, another sheath below the middle, and another at the base. *Leaf* erect, coriaceous, elliptical, subacute, 6–8 cm long including a petiole 2 mm long, the blade 1.3–1.7 mm wide in the dry state, cuneate below to the petiole. *Inflorescence* single; 9–10 cm long, the raceme erect, congested, secund, many-flowered, with many, overlapping flowers open simultaneously; floral bracts oblique, acute, 3 mm long, pedicels 0.5 mm long; ovary 1 mm long; the peduncle 2–3 mm long, subtended by a slender spathe ca. 1 cm long, from a node at the apex of the ramicaul; *sepals* dull green, broadly ovate, obtuse, minutely ciliate, saturated with numerous, irregular clumps of an unknown substance, the dorsal sepal 2 mm long, 2.25 mm wide, the lateral sepals 1.5 mm long, 2 mm wide, without visible veins; *petals* transversely ovate, concave, broadly obtuse, thickened on the margin, 0.6 mm long, 0.9 mm wide, with few mysterious clumps, faintly 3-veined; *lip* type B, ovate, obtuse, 0.8 mm long, 0.8 mm wide, 0.6 mm deep, concave below a curved bar, with few clumps, the dorsum featureless, the base hinged to the base of the column; *column* ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: Named for the appearance of the superficially similar skin lesions of Hansen's disease, leprosy, to those of the floral parts of this species.

Vegetatively, this medium-sized, caespitose species is similar to many, but it is distinguished by diffuse deposits of a granular substance in all floral parts. The identity of this substance is unknown. It seems to proliferate as seen in the formation of crystals, already noted in *Stelis coralloides* Luer & Hirtz, and seen in *Stelis leprina* Luer & R.Escobar described herein. Could it be an infection by a fungus?

The flowers of this "susceptible" species are produced in an extremely congested raceme of overlapping flowers facing the same direction. The sepals are ovate, obtuse, and filled with this mysterious substance, and without visible veins. The petals are three-veined with the veins "infected." The lip is a simple type A.

Stelis hippocrepica Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Norte de Santander: at the pass N of Villacaro, 2850 m, coll. 11 May 1984 by C. Luer, R. Escobar & D. Portillo, flowered in cultivation at Colomborquídeas, 11 May 1985, *C. Luer 11327* (Holotype: MO). Fig. 26.

This very small, caespitose species is characterized by leaves far surpassed by a subflexuous, successively flowered raceme; long-pubescent, ovate, three-veined sepals; thin, single-veined petals; and a lip with a horseshoe-shaped callus.

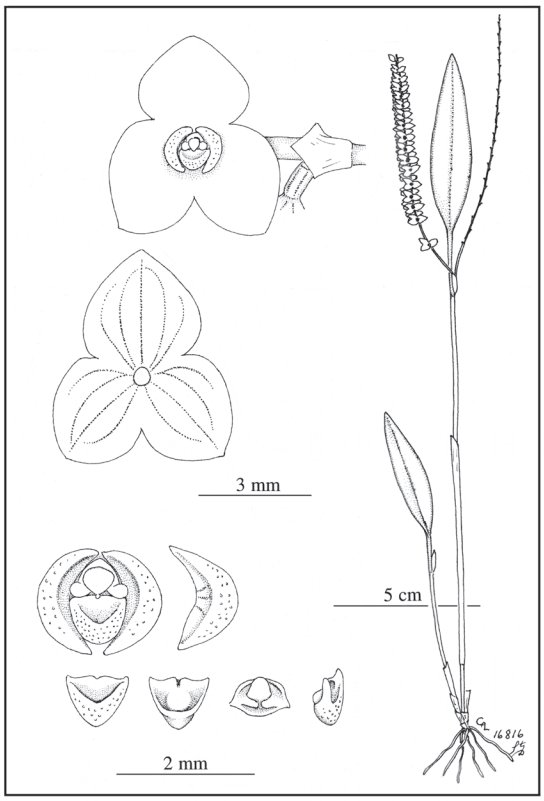

Figure 21. *Stelis galapagosensis* Luer & R.Escobar

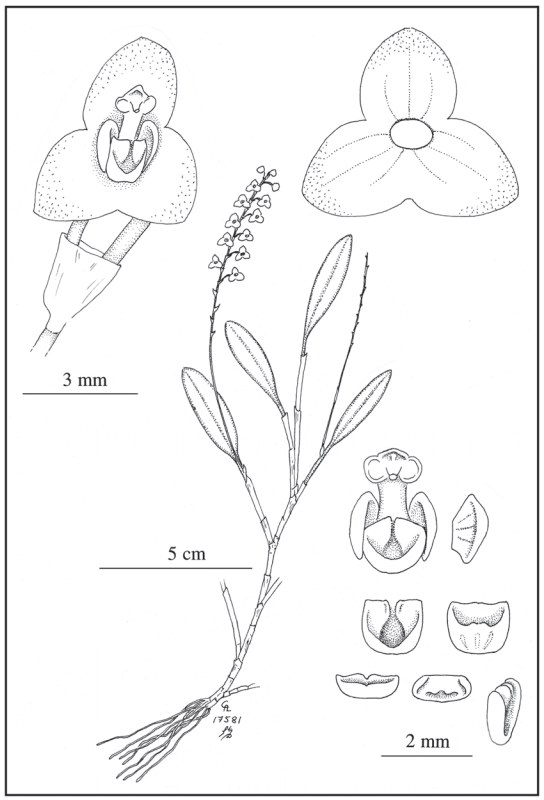

Figure 22. *Stelis giraffina* Luer & R.Escobar

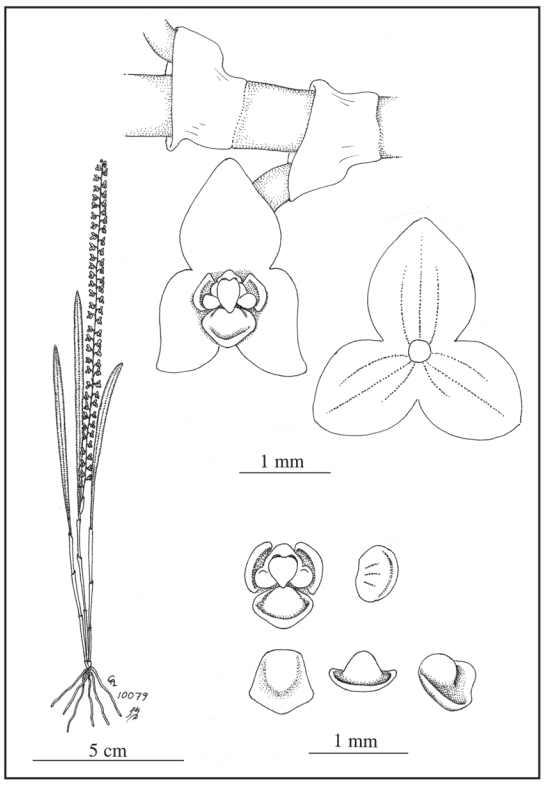

Figure 23, *Stelis gravida* Luer & R.Escobar

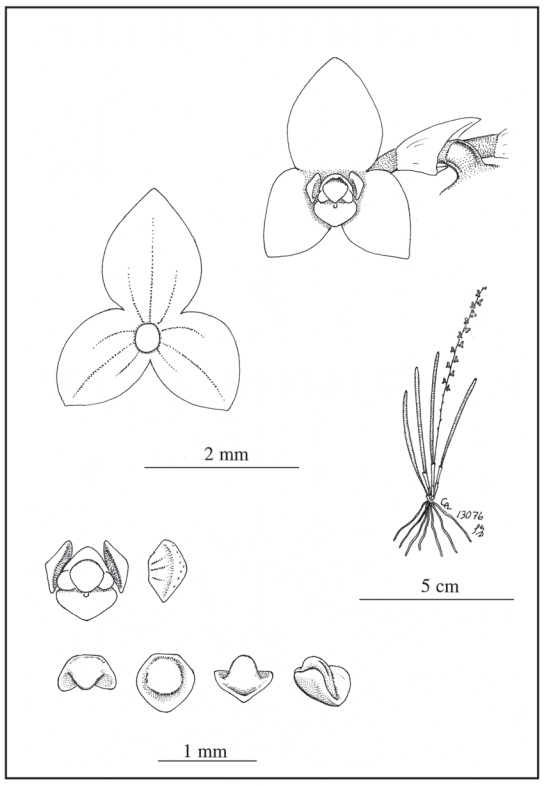

Figure 24, *Stelis gravida* Luer & R.Escobar

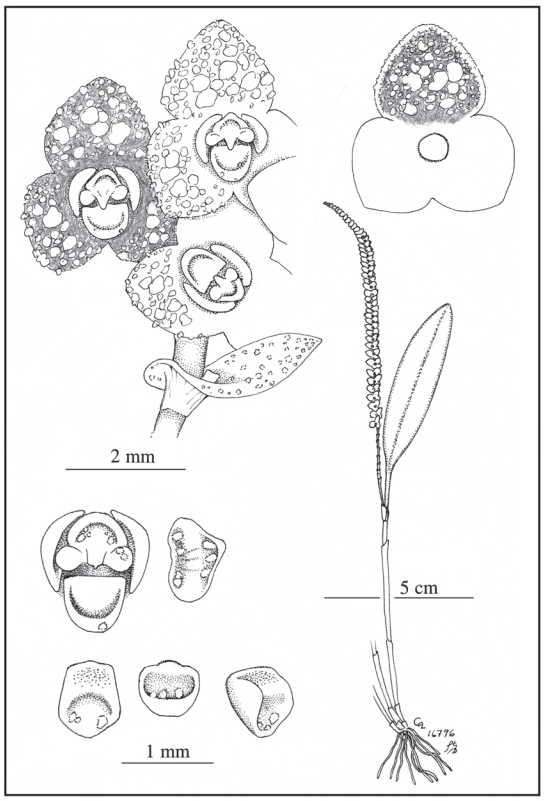

Figure 25. *Stelis hansenacea* Luer & R.Escobar

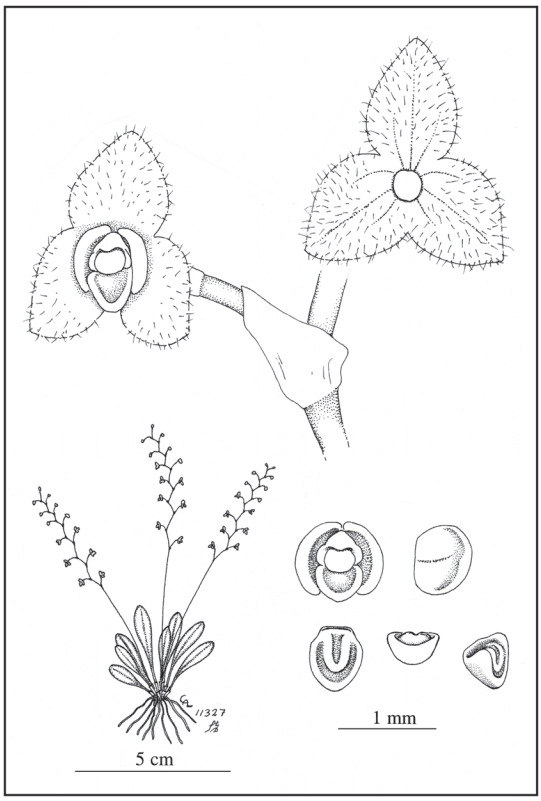

Figure 26. *Stelis hippocrepica* Luer & R.Escobar

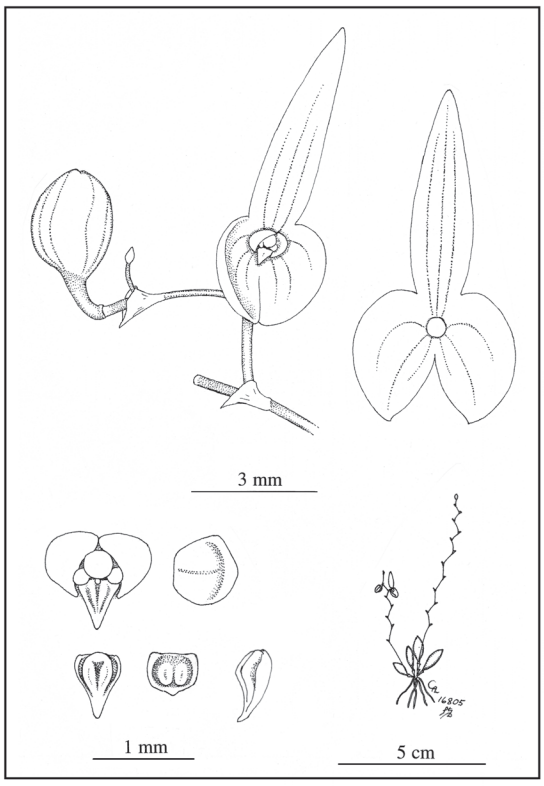

Figure 27. *Stelis index* Luer & R.Escobar

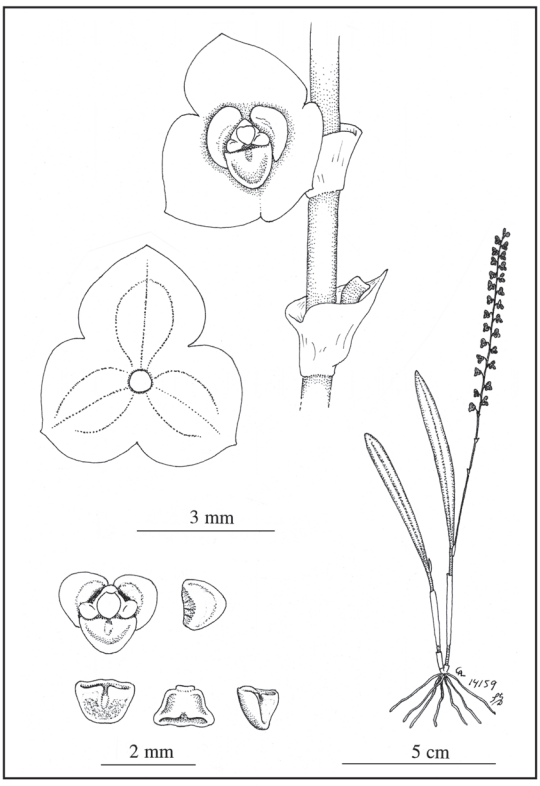

Figure 28. *Stelis ionantha* Luer & R.Escobar

Plant very small, epiphytic, caespitose; roots slender. Ramicauls slender, 10–15 mm long, enclosed by 1–2 thin, close, tubular sheaths. *Leaf* erect, coriaceous, narrowly elliptical-obovate, subacute to obtuse, 20–25 mm long including an indistinct petiole 5–10 mm long, the blade 2–4 mm wide in the dry state, narrowed below to the petiole and base. *Inflorescence* single; 5–8 cm long, the raceme erect, subflexuous, distichous, many-flowered; floral bracts oblique, acute, 1–1.5 mm long; pedicel 1.5 mm long; ovary 0.75–1 mm long; the peduncle 2–3 cm long, filamentous, from the apex of a ramicaul; *sepals* yellow, suffused with brown toward the base, long-pubescent within, elliptical-ovate, obtuse, 3-veined, the dorsal sepal 1.4 mm long, 1 mm wide, the laterals sepals 1 mm long, 1 mm wide; *petals* yellow, thin, transversely elliptical, concave, the apical margin rounded, thickened, 0.6 mm long, 0.6 mm wide, 1-veined; *lip* suffused with brown, ovoid, 0.6 mm long, 0.5 mm wide, 0.25 mm deep, concave within the round, thickened apical margin, surrounding the elevated, thickly margined, horseshoe-shaped glenion on the bar that extends onto the dorsum, the base truncate, hinged to the column-foot; *column* stout, 0.5 mm long and wide, the anther and small stigmatic lobes apical.

Etymology: From the Latin *hippocrepicus*, "horseshoe-shaped," referring to the callus of the lip.

Additional specimens examined: COLOMBIA. Norte de Santander: Páramo de Jurisdicciones, 2600 m, 10 May 1902, *C. Luer, J. Luer & R. Escobar 10218* (MO); Páramo de Jurisdicciones, 2600 m, coll. May 1982, flower in cultivation at Colomborquídeas, 21 April 1983, *C. Luer 8745* (SEL).

This very small, caespitose species is characterized by narrowly elliptical, long-petiolate leaves that become surpassed by a loose, distichous, many-flowered raceme with filamentous peduncle and rachis. The sepals are ovate, subacute and either coarsely or minutely dense-pubescent within, and the petals are single-veined. The lip is concave between the thickened margin of the round apex, and a narrow, horseshoe-shaped callus extending forward from the dorsum across the bar.

Stelis index Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Valle del Cauca: Alto de los Galapagos, at the pass between Valle del Cauca and Chocó, 2050 m, 13 May 1993, *C. Luer, J. Luer, R. Escobar & A. DeWilde 16805* (Holotype: MO). Fig. 27.

This minute species is distinguished by a flexuous, successively flowering raceme with flowers that bear a proportionately large, erect, narrowly ovate dorsal sepal, and free lateral sepals adherent into a synsepal.

Plant minute, epiphytic, caespitose; roots slender. Ramicauls erect, 2 mm long, enclosed by a loose, tubular sheath at the base. *Leaf* purple, erect, coriaceous, elliptical, acute, 7–8 mm long, 2.5 mm wide, 1.5 mm thick. *Inflorescence* solitary; 4–5 cm long, the raceme erect, flexuous, many-flowered, with 1–2 flowers produced successively; floral bracts oblique, acute, 1.5 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle ca. 1.5 cm long from the tip of the ramicaul; *sepals* dull purple, glabrous, the dorsal sepal erect, narrowly ovate, acute, 5 mm long, 1.5 mm wide, 3-veined, connate basally less than 1 mm, the lateral sepals ovate, concave, oblique, obtuse, free, but adherent to the tip to form a concave synsepal, 2.5 mm long, 2.5 mm wide unexpanded together, 6-veined; *petals* light yellow, transversely obovate, concave, 0.75 mm long, 0.75 mm wide, 1-veined, the apex broadly rounded with a slightly thickened margin, without a transverse callus; *lip* yellow-green, triangular-ovate, acute, 0.75 mm long, 0.5 mm wide, 0.4 mm deep, the bar modified into a longitudinal callus that occupies the lip from base to tip, shallowly channeled, the dorsum sightly convex, the base truncate, hinged to the base of the column; *column* semiterete, 0.5 mm long, 1 mm wide, the anther and the bilobed stigma apical.

Etymology: From the Latin *index*, "the forefinger," in allusion to the appearance of the dorsal sepal.

Additional specimens examined: Antioquia: Frontino, Alto de Caves, 2050 m, 4 May 1983, *C. Luer, J. Luer & R. Escobar 8944* (SEL).

This species is tiny with a proportionally large flower that is borne singly in a flexuous, successively flowering raceme. A long, narrow dorsal sepal stands above a synsepal composed of adherent lateral sepals; the petals are single-veined, and the lip is triangular with a large callus extending from the base to the acute tip.

Stelis ionantha Luer & R.Escobar. TYPE: COLOMBIA. Antioquia: Yarumal, along road to El Cedro, 1850 m, 15 March 1989, *C. Luer, J. Luer, S. Dalström & W. Teague 14159* (Holotype: MO). Fig. 28.

This small, caespitose species is characterized by small, purple flowers evenly spaced in a distichous raceme about twice longer than a narrowly elliptical leaf; obtuse, three-veined sepals; three-veined petals; and a lip with a rounded apex and a glenion.

Plant small, epiphytic, densely caespitose. Ramicauls erect, slender, 3–4 cm long, with a tubular sheath from below the middle, and 1–2 sheaths below and at the base. *Leaf* erect, coriaceous, subacute to obtuse, narrowly elliptical, 5–8 cm long including a petiole, ca. 1 cm long, the blade 0.4–0.5 cm wide in the dry state, narrowly cuneate below to the petiole. *Inflorescence* 1–2; 10–11 cm long, the raceme erect, congested, distichous, many-flowered with most flowers open simultaneously; floral bracts oblique, acute, 2–2.5 mm long; pedicels 1.5 mm long; ovary 1 mm long; the peduncle ca. 5 cm long, subtended by a spathe 6–7 cm long, from a node at the apex of the ramicaul; flowers purple; *sepals* glabrous, broadly ovate, obtuse, 3-veined, connate to near the middle, the dorsal sepal 2.6 mm long, 3 mm wide, the lateral sepals, 2.2 mm long, 3 mm wide; *petals* transversely ovate, 1 mm long, 1 mm wide, 3-veined, concave, the apex broadly obtuse, with the margin thickened, with a thick, transverse carina; *lip* subquadrate, 0.8 mm long, 1.3 mm wide, 0.8 mm deep, type A, the apex rounded with thickened margin, concave below the bar with a glenion, the dorsum smooth, slightly convex, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Greek *ionanthos*, "violet-colored flowers," referring to the purple flowers.

This small species is distinguished by narrowly elliptical leaves with the inflorescence twice as long. The raceme is erect and crowded with evenly spaced, purple flowers. The sepals are broadly to transversely ovate, obtuse and three-veined. The petals are three-veined below a thick, transverse carina. The lip is type A.

Stelis lancifera Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Nariño: near the pass between Pasto and La Cocha, 3000 m, 21 January 1979, *C. Luer & J. Luer 3733* (Holotype: SEL). Fig. 29.

This tall, caespitose species is characterized by ramicauls much longer than elliptical, petiolate leaves; a distichous raceme no longer than the leaf; flat flowers with transversely ovate, seven-veined dorsal sepals; thick. three-veined petals; and a short lip with rounded apex.

Plant large, epiphytic, caespitose; roots slender. Ramicauls erect, slender, 18–20 cm long, with a close, tubular sheath above the middle, and another 2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical, acute, petiolate, 11–13 cm long including a distinct petiole 1.5–2 cm long, the blade 2.5–3 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* solitary; 10–12 cm tall, the raceme erect, distichous, strict, many-flowered, with several flowers open simultaneously; floral bracts oblique, acute, 3 mm long; pedicels 1.5 mm long; ovary 2.5 mm long; the peduncle ca. 1 cm long, subtended by a spathe 1 cm long, from a node below the apex of the ramicaul; *sepals* yellow, suffused with purple, expanded, glabrous, transversely ovate, obtuse, connate below the middle, the dorsal sepal, 4.5 mm long, 5 mm wide, 7-veined, the lateral sepals oblique, 3.5 mm long, 4 mm wide, 4-veined; *petals* yellow, thick, transversely obovate, 1 mm long, 2 mm wide, 3-veined, concave below the broadly rounded apex with a thickened margin, with a transverse carina; *lip* yellow, shallowly obovoid, 0.6 mm long, 1.3 mm wide, 1 mm deep, concave below the bar with a glenion, the apex broadly rounded. the dorsum slightly convex with thickening of the three veins, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *lancifer*, "spear-bearing," referring to the lance-like appearance of the plant.

This large, tall, caespitose species is distinguished by slender ramicauls much longer than an elliptical, abruptly petiolate leaf; and racemes about as long as the leaf. The dorsal sepal is transversely ovate and seven-veined; the lateral sepals each 4-veined; the petals are thick, three-veined; and the lip is a short type A.

Stelis lappacea Luer & Teague, *sp. nov.* TYPE: COLOMBIA. Antioquia: El Retiro, above Colomborquídeas, 2400 m, collected by Walter Teague, 17 April 1988, *C. Luer 13224* (Holotype: MO). Fig. 30.

Among the small, caespitose species, this species is distinguished by a secund raceme with the lateral sepals concave and antrorse, single-veined petals, and a lip with the basal half covered by a burr-like callus.

Plant small, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 5–7 mm long, enclosed by a loose, tubular sheath and another sheath at the base. *Leaf* erect, coriaceous, elliptical, acute to subacute, 2–4 cm long including a petiole ca. 5 mm long, 6–7 mm wide when dry, cuneate below into the petiole. *Inflorescence* single; 5–6 cm long, the raceme erect, subcongested, many-flowered, secund, with most flowers open simultaneously; floral bracts tubular, obtuse, 1.5 mm long, pedicels 1 mm long; ovary 1 mm long; the peduncle ca. 2 cm long, from a node at the apex of the ramicaul; *sepals* light yellow, glabrous, connate in lower quarter, ovate, subacute, 3-veined, the dorsal sepal 2.5 mm long, 1.6 mm wide, the lateral sepals oblique, more or less concave, antrorse, 2 mm long, 1.5 mm wide; *petals* yellow, thin, concave, transversely elliptical, slightly thickened across the broadly obtuse apex, without a transverse callus, 0.5 mm long, 0.7 mm wide, 1-veined; *lip* yellow, subquadrate, 0.5 mm long, 0.5 mm wide, 0.3 mm deep, shallowly concave below an indistinct, bifid bar to the acute tip, the dorsum with a thick, burrlike callus below the middle, the base broadly truncate, hinged to the base of the column; *column* ca. 0.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *lappaceus*, "like a burr," referring to the callus of the lip.

This little, caespitose species is distinguished by elliptical leaves and a twice longer, secund raceme with light yellow flowers. The lateral sepals are antrorse, ovate, slightly concave and three-veined, and the membranous petals are single-veined. The basal third of the subquadrate lip is covered by a burrlike callus.

Stelis lijiae Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. without collection data, flowered in cultivation at Colomborquídeas, 23 May 1995, *C. Luer 17602* (Holotype: MO). Fig. 31.

This large, repent species is distinguished by a stout, flexuous rhizome; elliptical leaves with an abruptly acuminate tip; an elongated, nearly simultaneously many-flowered raceme of yellow flowers with broadly ovate, minutely pubescent sepals; three-veined petals; and a subquadrate lip with a minute apiculum.

Plant large, epiphytic, repent, the rhizome stout, flexuous, 1.5 cm long between ramicauls; roots slender. Ramicauls erect, slender, 6–7 cm long, enclosed by a tubular sheath from near the middle, and another sheath from near the base. *Leaf* erect, coriaceous, elliptical, subacute, acuminate at the apex, 8–10 cm long including a petiole 2.5 cm long, the blade 2.5–3 cm wide, cuneate below to the petiole. *Inflorescence* solitary, 15-18 cm long, the raceme strict, distichous, nearly simultaneously many-flowered with most flowers open simultaneously; floral bracts tubular, obtuse, 3 mm long; pedicel 1.5 mm long; ovary 1 mm long; the peduncle ca. 7 cm long, subtended by a spathe 8–9 mm long, from a node below the apex of the ramicaul; flowers yellow; *sepals* expanded, minutely pubescent, broadly

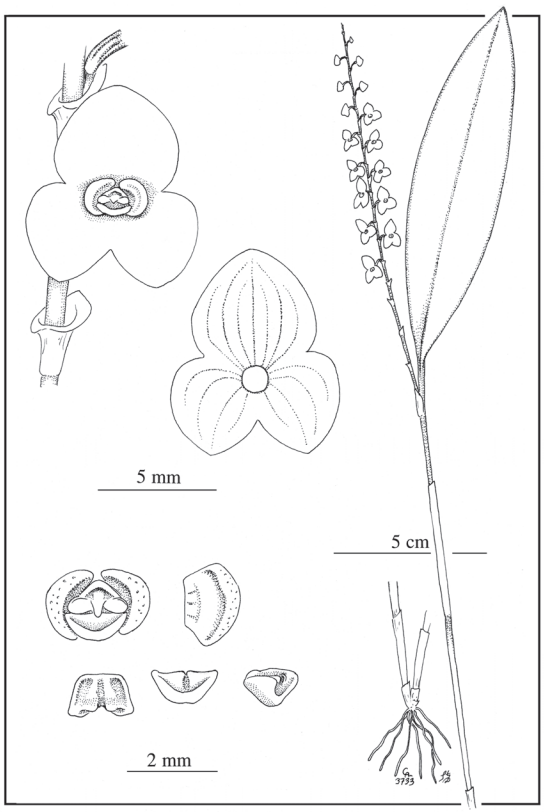

Figure 29. *Stelis lancifera* Luer & R.Escobar

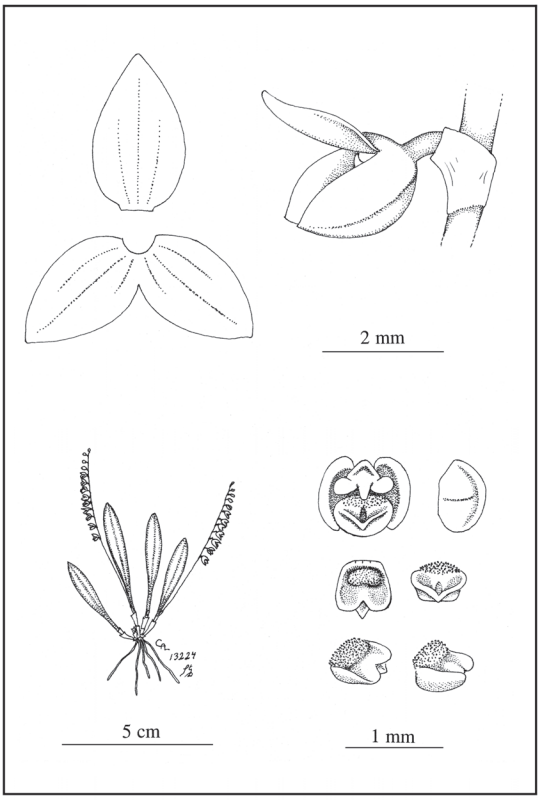

Figure 30. *Stelis lappacea* Luer & Teague

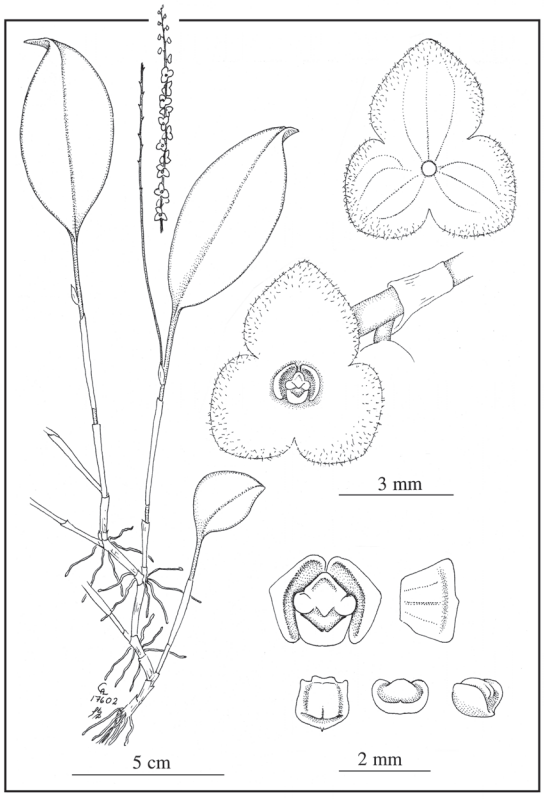

Figure 31. *Stelis lijiae* Luer & R.Escobar

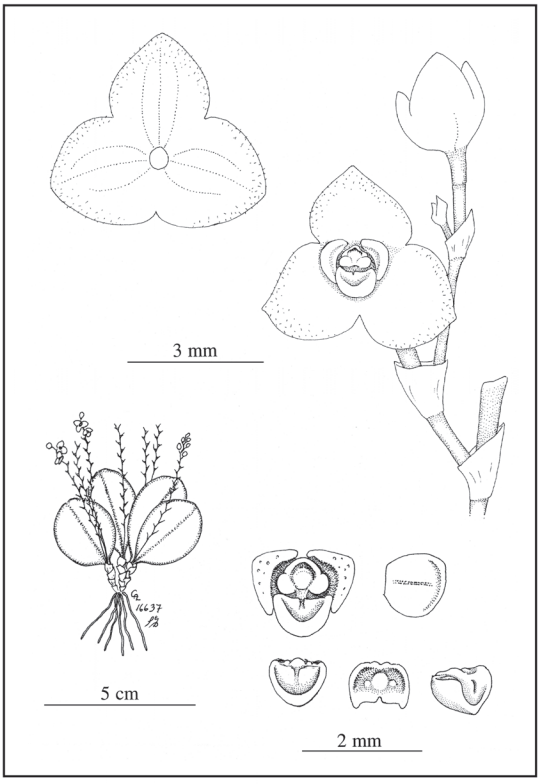

Figure 32. *Stelis monetaria* Luer & R.Escobar

ovate, obtuse, 3-veined, the dorsal sepal 3 mm long, 3 mm wide, the lateral sepals 2.2 mm long, 2.75 mm wide, connate below the middle; *petals* thin, cuneate, concave, the apex truncate, the margin slightly thickened, 0.6 mm long, 1 mm wide, 3-veined; *lip* subquadrate, 0.5 mm long, 0.6 mm wide, 0.3 mm deep, concave below a shallowly cleft, rounded bar, the apex broadly obtuse with a minute, triangular apiculum, the dorsum with a broad, low, microscopically pubescent callus, base truncate, hinged to the column-foot; *column* stout, ca. 0.6 mm long and wide, the anther and stigmatic lobes apical.

Eponymy: Named for Lijia Posada who cultivates this unusual species at Colomborquídeas.

This large, repent species is characterized by a stout, markedly flexuous rhizome with an erect ramicaul at each angle about one and a half centimeters apart. The leaves are broadly elliptical with an abruptly acuminate tip. A many-flowered raceme exceeds the leaf; the petals are thin and three-veined; and the lip is subquadrate, type A, with a minute apiculum.

Stelis monetaria Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: El Retiro, above Colomborquídeas, 2400 mm, coll. by H. Arroyave, flowered in cultivation at Colomborquídeas, 5 May 1993, *C. Luer 16637* (Holotype: MO). Fig. 32.

This small, caespitose species is distinguished by subcircular, glaucous leaves borne by short ramicauls with large, loose sheaths; a successively single-flowered raceme; broadly obtuse, semiconnate sepals; single-veined petals; and thick lip round at the apex and with a dorsal callus.

Plant small, epiphytic, densely caespitose; roots slender. Ramicauls relatively stout, 8–10 mm long, enclosed by 3–4 loose, ribbed, tubular sheaths. *Leaf* erect, coriaceous, glaucous, broadly obovate to circular, broadly obtuse to rounded at the apex, 20–28 mm long, 15–20 mm wide, abruptly contracted at the base. *Inflorescence* 2–8; 3–4 cm long, the racemes flexuous, successively single-flowered, floral bracts acute, oblique, 2 mm long; pedicels 2–2.5 mm long; ovary 2.5–3 mm long; the peduncle ca. 0.5 cm long, subtended by a spathe ca. 7 mm long, from a node at the apex of the ramicaul; flowers purple; *sepals* microscopically pubescent, broadly ovate, obtuse, connate to near the middle, 3-veined, the dorsal sepal 2.5 mm long, 2.3 mm wide, the lateral sepals 2.5 mm long, 2.5 mm wide; *petals* thin, subcircular, 1 mm long, 1 mm wide, 1-veined, the apex broadly rounded, thickened, concave; *lip* type-A, thick, subquadrate, 0.75 mm long, 1 mm wide, 0.75 mm deep, shallowly concave below a thick bar with a minute glenion, the apex broadly rounded with a thickened margin, the dorsum with a low, rounded callus and a small callus at either side, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the bilobed stigma apical.

Etymology: From the Latin *monetarius*, "of the mint," referring to the round, coin-like leaves.

This small species is distinguished by round, glaucous, overlapping leaves borne by short ramicauls clothed by three or four loose, ribbed sheaths. A single, purple flower is produced successively in a flexuous raceme that exceeds the leaf. Broad, obtuse sepals are connate to near the middle; membranous, rounded petals are single-veined; and a thick lip is type A.

Stelis monetaria was made from a plant cultivated by Colomborquídeas. It is possible that it was pendent in its habitat.

Stelis mystrion Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Yarumal, road to Briceño, Quebrada El Oro, 1850 m, 16 March 1989, *C. Luer, J. Luer, S. Dalström & W. Teague 14180* (Holotype: MO). Fig. 33–34.

This medium-sized, caespitose species is characterized by narrowly elliptical leaves with shorter ramicauls; a distichous raceme that exceeds the leaf; three-veined sepals with the lateral sepals antrorse; single-veined petals; and a concave lip with a minute apiculum.

Plant medium in size, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 2–6 cm long, with a tubular sheath from below the middle, and another 1–2 sheaths at the base. *Leaf* erect, coriaceous, narrowly elliptical, acute, 6–8 cm long including an ill-defined petiole 1–2 cm long, the blade 0.5–0.9 cm wide in the dry state, narrowed below to the base. *Inflorescence* single; 9–12 cm tall, the raceme erect, strict, distichous, nearly simultaneously many-flowered; floral bracts oblique, acute, 1.5–2 mm long; pedicel 1.5 mm long; ovary 1 mm long; the peduncle 1–2 cm long, subtended by a spathe ca. 1 cm long, from a node below the apex of the ramicaul; flowers purple; *sepals* glabrous, ovate, subacute, 3-veined, the dorsal sepal 3 mm long, 2.5 mm wide, the lateral sepals antrorse, 2.5 mm long, 2.25 mm wide, connate above the base; *petals* thin, transversely elliptical, concave, the apex broadly obtuse, the margin slightly thickened, 0.8 mm long, 1 mm wide, 1-veined; *lip* ovate, 1 mm long, 1 mm wide, 0.5 mm deep, concave below a narrow bar, the apex subacute, slightly incurved, with the tip shortly acuminate and minutely apiculate, the dorsum narrow, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and stigmatic lobes apical.

Etymology: From the Greek *mystrion*, "a little spoon," referring to the concave lip.

Additional specimens examined: COLOMBIA. Antioquia: Yarumal, N of Santa Rosa de Osa, 14 March 1989, 2580 m, *C. Luer, J. Luer, S. Dalström & W. Teague 14151* (MO).

This caespitose species is characterized by narrowly elliptical leaves and a many-flowered raceme that exceeds the leaf. The sepals are three-veined sepals with the lateral sepals antrorse. The petals are single-veined. The lip is spoon-shaped with a minute apiculum at the tip.

Stelis palimmeces Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Risaralda: road to TV antenna S of Pueblo Rico, 2400 m, 14 May 1993, *C. Luer, J. Luer, R. Escobar et al. 16832a* (Holotype: MO). Fig. 35.

This large, caespitose species is characterized by

ramicauls longer than acute, narrowly elliptical leaves, and a much longer, many-flowered raceme; broadly ovate, minutely sparsely pubescent sepals; thick, three-veined petals; and an ovoid lip with the dorsum tricallous.

Plant large, epiphytic, densely caespitose; roots slender. Ramicauls erect, stout, 10–20 cm long, enclosed by a tubular sheath from below the middle, and another 1-2 sheaths below and at the base. *Leaf* erect, coriaceous, narrowly elliptical, acute, petiolate, 9–11 cm long including a petiole 1.5–2 cm long, the blade 1–1.8 cm wide in dry state, cuneate below into the petiole. *Inflorescence* 1–2; 30–32 cm tall, the raceme erect, strict, distichous, many-flowered with many flowers open simultaneously; floral bracts oblique, acute, 4 mm long; pedicels 3 mm long; ovary 1.5 mm long; the peduncle stout, 18–20 cm long, from a node near the apex of the ramicaul; *sepals* color notes lost, sparsely minutely pubescent, transversely ovate, obtuse, 3-veined, connate to near the middle, the dorsal sepal 4 mm long, 4.5 mm wide, the lateral sepals 3.75 mm long, 4.23 mm wide; *petals* transversely ovate, 1.5 mm long, 2.3 mm wide, 3-veined, obtuse with a thickened margin, with a sulcate transverse carina; *lip* ovoid, 1.5 mm long, 1.5 mm wide, 1 mm deep, shallowly concave below the bar with a small glenion, the apex obtuse, the dorsum with a transverse, minutely trilobed callus, the base truncate, hinged to the base of the column; *column* clavate, ca. 1.5 mm wide and long, the anther and stigmatic lobes apical.

Etymology: From the Greek *palimmekes*, "as long again," referring to the length of the inflorescence.

This large, caespitose species is distinguished by stout ramicauls to 20 centimeters long; acute, narrowly elliptical leaves; and a stout, strict inflorescence to 30 centimeters tall with the peduncle about half the height. The sepals are broader than wide, three-veined, deeply connate, and with a sparse, short pubescence. The petals are thick with the transverse carina sulcate and bigibbous. The lip is type A with a transverse, minutely trilobed, dorsal callus.

Stelis papposa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: W of Boquerón, W of Medellín, 2180 m, 22 April 1983, *C. Luer, J. Luer, R. Escobar et al. 8755* (Holotype: SEL). Fig. 36.

This large, caespitose species is characterized by ramicauls much longer than elliptical-oblong leaves; one to three racemes of minute, crowded flowers barely as long as the leaves; ovate, obtuse, minutely pubescent sepals; thin, single-veined petals; and an ovoid lip with the dorsum convex and microscopically short-pubescent.

Plant large, epiphytic, densely caespitose; roots slender. Ramicauls erect, slender, 10–18 cm long, with a short, close tubular sheath on the middle third, and another 1–2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical-oblong, subacute, petiolate, 7–11 cm long including a petiole 1.5–2 cm long, the blade 1.3–1.6 cm wide in dry state, cuneate below into the petiole. *Inflorescence* 1–3; 3–9 cm tall, the raceme erect, strict, secund, many-flowered with many flowers open simultaneously; floral bracts oblique, obtuse, 1.5 mm long, 1.5 mm wide; pedicels 1 mm long; ovary 1 mm long; the peduncle 1–2.5 cm long, from a node very near the apex of the ramicaul; flowers yellow; *sepals* minutely pubescent, broadly ovate, obtuse, 3-veined, connate in lower fourth, the dorsal sepal 1.8 mm long, 1.6 mm wide, the lateral sepals 1.5 mm long, 1.6 mm wide; *petals* transversely ovate, 0.8 mm long, 0.9 mm wide, 1-veined, broadly obtuse, concave with a thickened, sparsely pubescent margin, without a transverse carina; *lip* ovoid. 0.8 mm long. 0.8 mm wide, 0.5 mm deep, concave below a rounded bar with an indistinct glenion, the apex obtuse, the dorsum convex, microscopically sparsely pubescent, the base truncate, hinged to the base of the column; *column* clavate, ca. 0.8 mm wide and long, the anther and stigmatic lobes apical.

Etymology: From the Latin *pappus*, "down," referring to the diffuse, minute pubescence of the sepals.

This large, caespitose species is distinguished by slender ramicauls to 18 centimeters long and bearing shorter, elliptical-oblong leaves. One to three crowded, many minutely-flowered racemes are shorter than, or slightly surpass the leaves. The sepals are obtuse, three-veined and minutely pubescent, and the single-veined petals are sparsely pubescent on the margin. The lip is type A with the dorsum convex and microscopically pubescent.

Stelis pauxilla Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Cauca: Páramo de Las Barbillas, 3150 m, 13 November 1082, *C. Luer & R. Escobar 8365* (MO). Fig. 37.

This medium-sized, caespitose species is characterized by oblong, obtuse leaves and a few, shorter, many-flowered racemes; ovate, obtuse sepals; thin, single-veined petals; and an obtuse lip concave below a thick, bifid bar that is pubescent at the base.

Plant medium in size, epiphytic, caespitose; roots slender. Ramicauls erect, slender, 4–9 cm long, with a tubular sheath from below the middle, and another 1–2 sheaths at the base. *Leaf* erect, coriaceous, oblong, obtuse, 6–8 cm long, 1–1.8 cm wide in the dry state, cuneate below into a petiole 1–1.5 cm long. *Inflorescence* 2–4; 2–3.5 cm long, the raceme erect, congested, distichous, many-flowered; floral bracts tubular, obtuse, 1.5 mm long and wide; pedicels 1 mm long; ovary 1.25 mm long; the peduncle less than 1 cm long, subtended by a spathe ca. 5 mm long, from a node below the apex of the ramicaul; flowers purple; *sepals* glabrous, ovate, obtuse, connate near the base, 3-veined, the dorsal sepal 2 mm long, 2 mm wide, the lateral sepals more or less antrorse, 2 mm long, 1.75 mm wide; *petals* subcircular, concave, minimally thickened, if at all, at the rounded apex, 1 mm long, 1 mm wide, 1-veined; *lip* subquadrate, type A, 1.75 mm long, 1 mm wide, 0.75 mm deep, concave below a thick, shallowly cleft bar, the apex obtuse, the dorsum densely short-pubescent on the basal half, the base broadly truncate, connate to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *pauxillus*, "a few," referring to the few racemes in the inflorescence.

Vegetatively, this species is similar to others with a

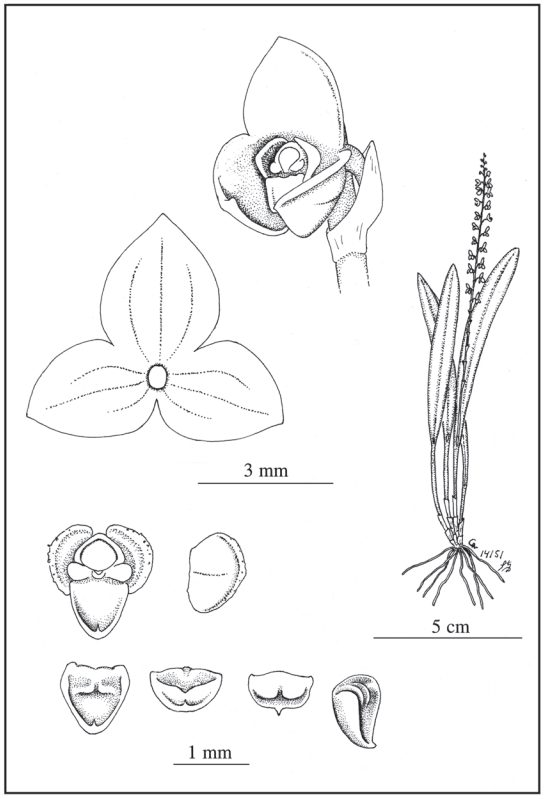

Figure 33. *Stelis mystrion* Luer & R.Escobar

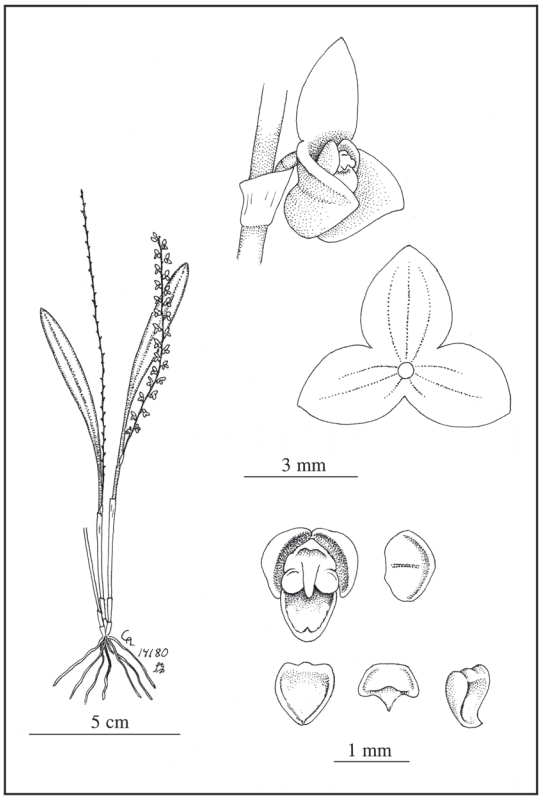

Figure 34. *Stelis mystrion* Luer & R.Escobar

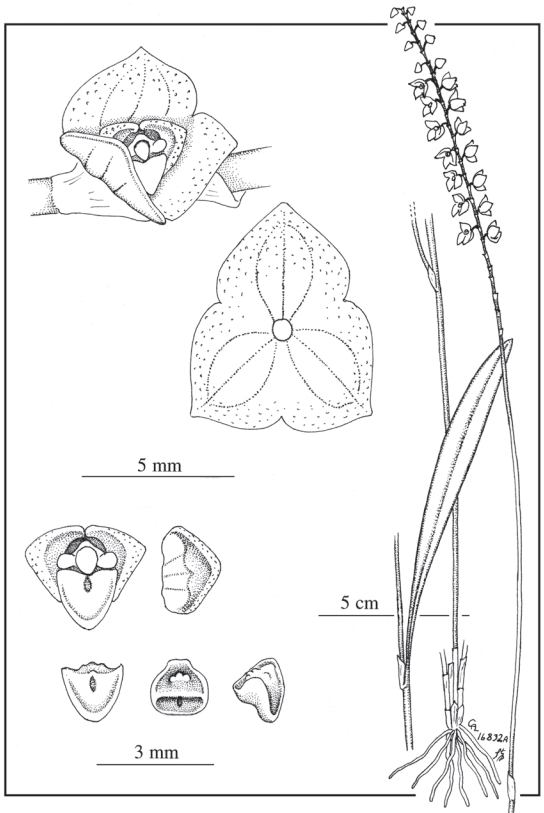

Figure 35. *Stelis palimmeces* Luer & R.Escobar

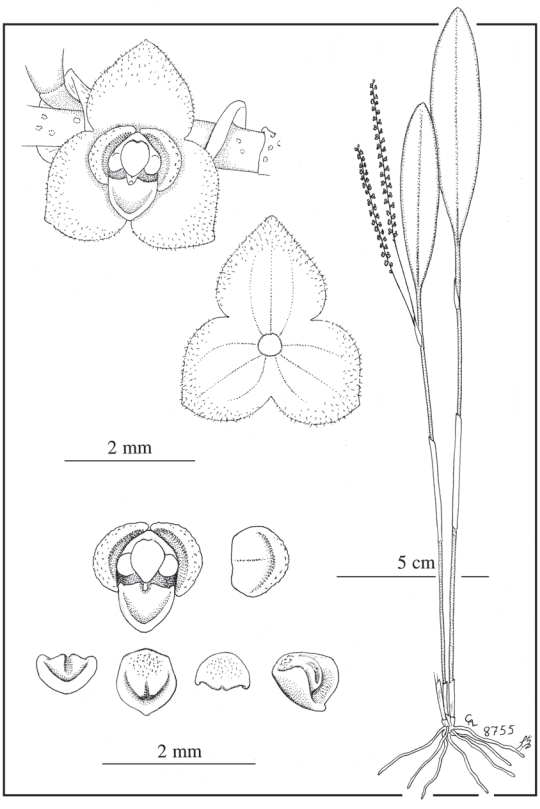

Figure 36. *Stelis papposa* Luer & R.Escobar

fascicle of racemes shorter than an oblong, obtuse leaf. However, *Stelis pauxilla* is distinguished from them by thin, single-veined petals, and a type A lip concave below a bifid bar, and shortly pubescent on the basal half of the dorsum.

Stelis pauxilla is similar to *Stelis tenuilabris* Lindl., but differs with a thick lip with a bifid bar, densely short-pubescent on the dorsum; and a column with large, exposed stigmatic lobes.

Stelis perbona Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Sonsón, Quebrada Oscura, between La Ceja and Sonsón, 2250 m, 29 April 1983, *C. Luer, J. Luer, R. Escobar et al., 8901* (Holotype: SEL). Fig. 38.

This small, caespitose species is characterized by acute, narrowly elliptical leaves exceeded by a many-flowered raceme; ovate, obtuse sepals; three-veined petals much wider than long with acuminate corners; and a subacute lip with a suborbicular callus on the anterior surface.

Plant small, epiphytic, densely caespitose. Ramicauls erect, slender, 3–6 cm long, with a close, tubular sheath from below the middle, and 1–2 sheaths below and at the base. *Leaf* erect, coriaceous, narrowly elliptical, acute, 5–8 cm long including a petiole 1–2 cm long, 0.7–1 cm wide in the dry state, narrowly cuneate below to the base. *Inflorescence* single; 5–8 cm long, the raceme erect, strict, distichous, many-flowered; floral bracts tubular, obtuse, 2 mm long; pedicels 1 mm long; ovary 1 mm long; the peduncle ca. 1.5 cm long, subtended by a spathe 5–7 mm long, from a node at the apex of the ramicaul; *sepals* light purple, darker toward the base, glabrous, broadly ovate, obtuse, connate for lower fourth, 3-veined, the dorsal sepal 3 mm long, 2.3 mm wide, the lateral sepals, 2.6 mm long, 2.5 mm wide; *petals* dark purple, transversely semilunate, 1 mm long, 2.25 mm wide, 3-veined, the corner angles acute, acuminate, the apex broadly rounded with the margin thickened and with protruding crystals, concave below in indistinct transverse carina; *lip* dark purple, subquadrate, a modified type A, 0.8 mm long, 1 mm wide, 0.75 mm deep, shallowly concave below an elevated, minutely sulcate bar, with a suborbicular callus between the bar and the subacute tip, the dorsum slightly convex centrally, the base broadly truncate, connate to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *perbonus*, "very nice," referring to both floral and vegetative features.

This densely caespitose, little species is distinguished by very slender ramicauls with acute, narrowly elliptical leaves about equally long, and a purple-flowered raceme more or less that exceeds the leaf. The sepals are obtuse and glabrous. The petals are transversely semilunate, more than twice wider than long with the corners acuminate. The broadly rounded apical margin is thick with more or less protruding crystals. The type A lip is subacute with a suborbicular callus on the surface below the bar.

Stelis pertenuis Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Chocó: Baudo, 400 m, collected by Ahrend de Wilde, flowered in cultivation at his home above Pereira, *A. de Wilde s.n.* (Holotype: MO), C. Luer illustration 16855. Fig. 39.

This small, caespitose species is characterized by narrowly linear-elliptical leaves far surpassed by one or two lax, many-flowered racemes; ovate, obtuse, minutely pusticulate sepals; thick, three-veined petals; and an obtuse lip with a low callus on the dorsum.

Plant small, epiphytic, caespitose. Ramicauls erect, 1.5 cm long, with a loose, tubular sheath from below the middle, and another at the base. *Leaf* erect, coriaceous, narrowly linear-elliptical, acute, 3–3.5 cm long, 0.3 cm wide in the dry state, gradually narrowed below to the base. *Inflorescence* 1–2 erect, loose, distichous, many-flowered racemes with many flowers open simultaneously, 10–11 cm long including the peduncle 3–5 cm long, subtended by a spathe ca. 4 mm long, from a node at the apex of the ramicaul; floral bracts tubular, obtuse, 1 mm long and wide; pedicels 1.5 mm long; ovary 1.25 mm long; flowers light yellow; *sepals* glabrous externally, sparsely pusticular within, broadly ovate, obtuse, connate to near the base, 3-veined, the dorsal sepal 1.6 mm long, 1.5 mm wide, the lateral sepals, 1.5 mm long, 1.6 mm wide; *petals* obcuneate, subtruncate, thickened and minutely roughened externally, concave without a transverse carina, 0.5 mm long, 0.75 mm wide, 3-veined; *lip* subhemisphercal, type A, 0.4 mm long, 0.6 mm wide, 0.3 mm deep, concave below a low bar with a glenion, the apex obtuse with a thick margin, the dorsum slightly convex centrally, the base broadly truncate, connate to the base of the column; *column* stout, ca. 0.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *pertenuis*, "very slender," referring to the habit.

This slender, densely caespitose, little species from a low altitude of the Western Cordillera is distinguished by narrow leaves and shorter ramicauls with loose sheaths. One or two loose, weak, many-flowered racemes far exceed the leaves; the obtuse sepals are sparsely pusticular within; the petals are thick and three-veined; and the type A lip is obtuse, the bar with a glenion.

Stelis pinguis Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: road to Boquerón NW of Medellín, 2380 m, 22 April 1983, *C. Luer, J. Luer, R. Escobar et al. 8747* (Holotype: SEL). Fig. 40.

This species is remarkable for thick, linear leaves that are barely surpassed by a many-flowered raceme with large floral bracts that surround a small, subspherical flower with obtuse, three-veined sepals, thin, three-veined petals, and a rounded, concave lip.

Plant medium in size to large, epiphytic, densely caespitose. Ramicauls erect, terete, stout, 4–5 mm thick, 3–6 cm long, with a tubular sheath from below the middle, and 1–2 other sheaths below. *Leaf* erect, thickly coriaceous, linear, subacute to obtuse, sessile, 7–10 cm long, the blade 1.5–1.7 cm wide, 0.5 cm thick, narrowed below into the ramicaul. *Inflorescence* 1–2 erect; 8–15 cm long, the racemes congested, distichous, many-flowered, large-bracted, with

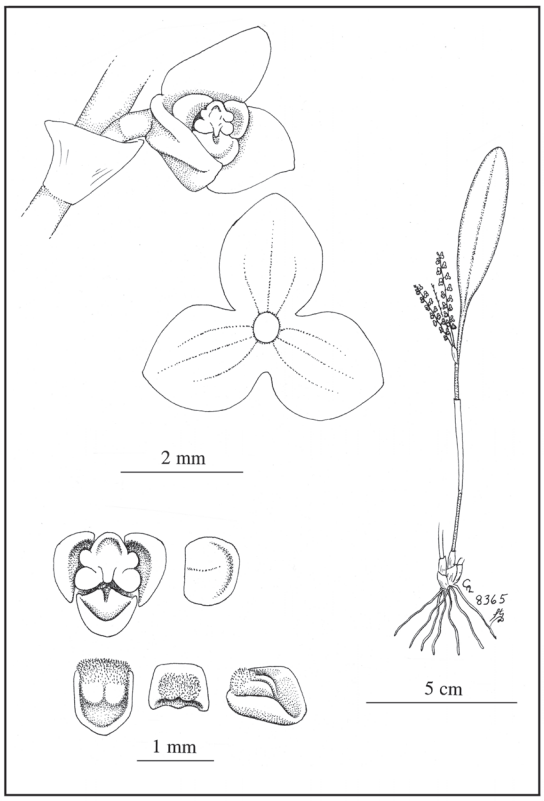

Figure 37. *Stelis pauxilla* Luer & R.Escobar

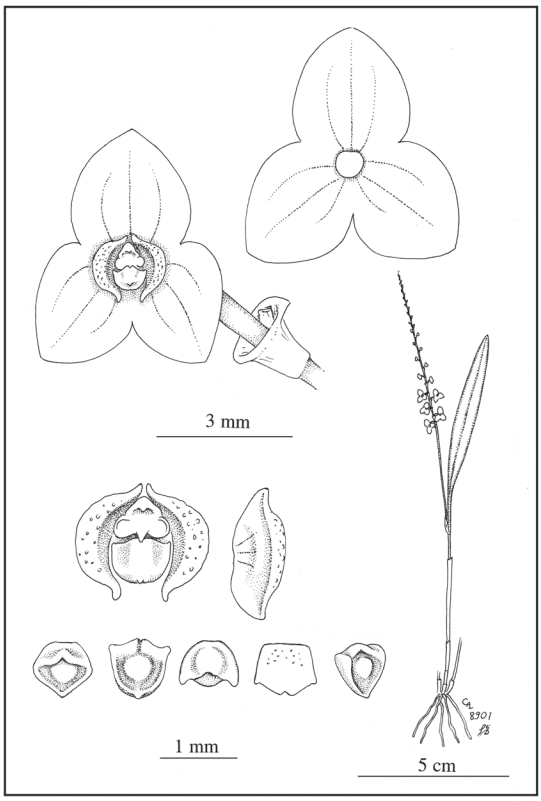

Figure 38. *Stelis perbona* Luer & R.Escobar

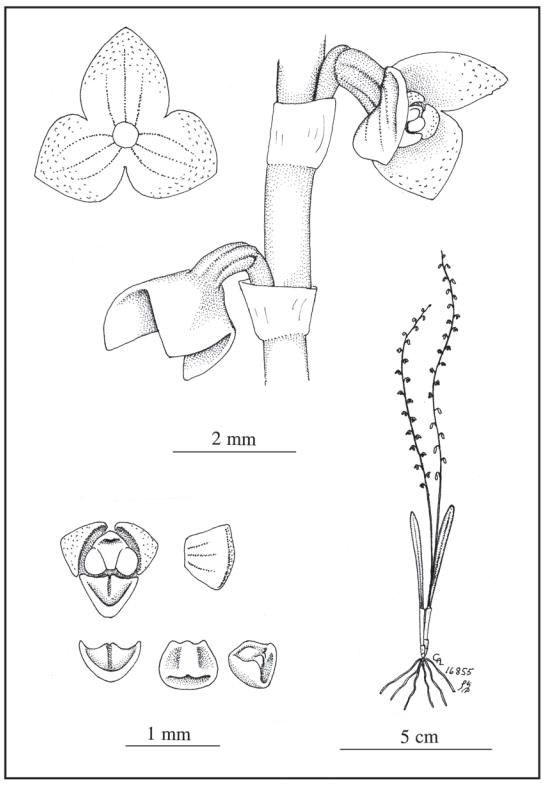

Figure 39. *Stelis pertenuis* Luer & R.Escobar

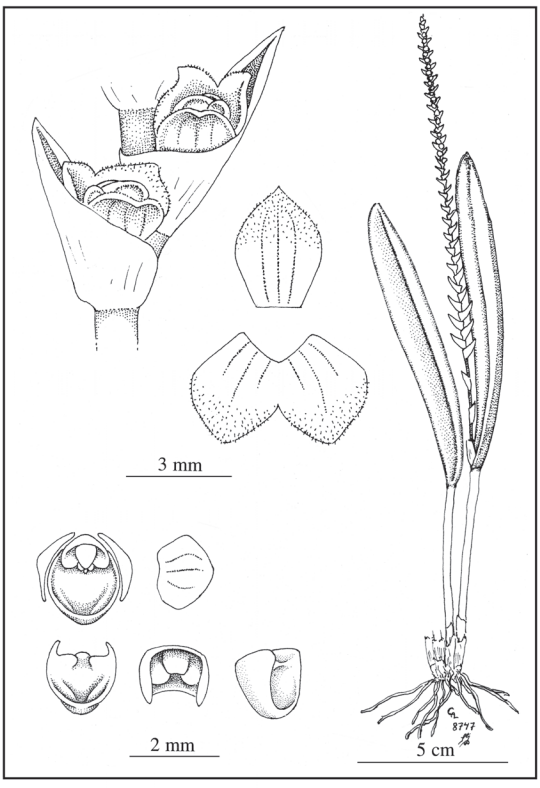

Figure 40. *Stelis pinguis* Luer & R.Escobar

many flowers open simultaneously; the peduncle ca. 1 cm long, subtended by a spathe 0.8–1 cm long, from a node at the apex of the ramicaul; floral bracts oblique, conduplicate, acute, 8 mm long low in the raceme to 3 mm long above; pedicels 1.5 mm long; ovary 1 mm long; *sepals* dull rose brown, thick, rigid, glabrous externally, pubescent within, concave, connate to near the middle, into a subspherical flower, the dorsal sepal obovate, obtuse, 3.5 mm long, 2.5 mm wide, 3-veined, the lateral sepals ovate, oblique, obtuse, 3.25 mm long, 2.5 mm wide, 3-veined; *petals* thin, transversely ovate, broadly obtuse, slightly thickened on the margin, shallowly concave, without a transverse carina, 1.25 mm long, 1.5 mm wide; *lip* subspherical, 1.5 mm long, 1.5 mm wide, 1 mm deep, concave below a thin bar with a broad cleft to a rounded callus on the dorsum, the apex obtuse, concave, the base broadly truncate, fixed to the base of the column; *column* stout, ca. 1.5 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *pinguis*, "fat, plump," referring to the leaves.

The very thick, linear leaves and the little suborbicular flowers nestled within large floral bracts are distinctive. The sepals are concave and pubescent within; the petals are membranous and three-veined; and the rounded lip is concave below a thin bar.

Stelis pulchra Luer & R.Escobar, *sp. nov.* COLOMBIA. Tolima: S slope of Mt. Tolima, N of Ibagué, 2930 m, 21 April 1982, *C. Luer, J. Luer & R. Escobar 7506* (Holotype: SEL). Fig, 41.

This caespitose species is distinguished by obtuse, elliptical leaves barely exceeded by a red-bracted raceme; semiconnate, five-veined lateral sepals; three-veined petals; and an obtuse lip with three calli on the dorsum.

Plant medium in size, epiphytic, densely caespitose, roots slender. Ramicauls erect, stout, 5–8 cm long, with a loose, tubular sheath from below the middle, another 2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical, obtuse, 5–10 cm long including a petiole 1.5 cm long, the blade 2–2.3 cm wide in the dry state, broadly cuneate below into the petiole. *Inflorescence* single; 8–9 cm long, the raceme erect, congested, strict, distichous, flowers in 2 opposite-facing ranks, with many flowers open simultaneously; floral bracts red, oblique, acuminate, acute, 8-10 mm long below to 5 mm long toward the tip; pedicels 2–3 mm long; ovary 2 mm long; the peduncle 1–2.5 cm long, from a node near the apex of the ramicaul; *sepals* light yellow-brown, glabrous, ovate, subacute, connate in basal quarter, 5-veined, the dorsal sepal 6 mm long, 5.5 mm wide, the lateral sepals semiconnate, 5 mm long, 4–4.5 mm wide; *petals* yellow-green, transversely semilunate, 1.5 mm long, 2.5 mm wide, 3-veined, concave, the apex broadly rounded, the margin thickened, with a transverse carina; *lip* yellow-green, subquadrate, 1 mm long, 1.3 mm wide, 1 mm deep, shallowly concave below the bar with a narrow glenion, the apex rounded with thickened margin, the dorsum with three, low, parallel calli, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *pulcher*, "pretty," referring to the raceme with red floral bracts.

This caespitose species is distinguished by obtuse, elliptical leaves slightly exceeded by a raceme with two rows of crowded, opposite-facing flowers. Most remarkable are the long, red, acuminate floral bracts. The sepals are yellow-brown and five-veined with the lateral sepals semiconnate into an imperfect synsepal. The petals are three-veined, and the lip is type A with the three veins thickened on the dorsum as low, parallel calli.

Stelis punicea Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Tolima: S slope of Mt. Tolima, N of Ibagué, 2600 m, 21 April 1982, *C. Luer, J. Luer & R. Escobar 7500* (Holotype: SEL). Fig. 42.

This large, caespitose species is related to the frequent and variable *Stelis purpurea* (Ruiz & Pav.) Willd., but differs with elliptical leaves obtuse to rounded at the apex leaves; short, acute, diverging floral bracts, instead of long, acuminate, appressed; an obtuse or subacute dorsal sepal instead of acute; and an obtuse lip with the dorsum simply convex.

Plant large, epiphytic, densely caespitose, roots slender. Ramicauls erect, stout, 7–12 cm long, with a tubular sheath from below the middle, another 2 sheaths below and at the base. *Leaf* erect, coriaceous, elliptical, obtuse to rounded at the tip, 8–11 cm long including a petiole 2 cm long, the blade 2.5–3.5 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* single; 25–30 cm long, the raceme erect, subcongested, strict, distichous, with many flowers open simultaneously; floral bracts oblique, acuminate, acute, 5–6 mm long below to 4 mm long toward the tip; pedicels 5 mm long; ovary 4 mm long; the peduncle ca. 15 cm long, from a node below the abscission layer; flowers deep red-purple; *sepals* glabrous, the dorsal sepal ovate, subacute, connate in basal quarter, 7-veined, 10 mm long, 8 mm wide, the lateral sepals connate into a concave synsepal, 8 mm long, 11 mm wide, 12-veined; *petals* transversely semilunate, 1 mm long, 2.3 mm wide, 3-veined, concave below a thick transverse carina, the apex broadly rounded, the margin thickened; *lip* subquadrate, 1 mm long, 1.4 mm wide, 1 mm deep, concave below the bar with a narrow glenion, the apex obtuse, the dorsum convex, the base truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Etymology: From the Latin *puniceus*, "deep red-purple," referring to the flowers.

Additional specimens examined: COLOMBIA. Cundinamarca: above Gutierrez, 2700 m, 19 May 1984, *C. Luer, J. Luer & R. Escobar 10369* (MO); Antioquia: La Union, El Chuscal, E of La Union, 2650 m, 13 September 1984, *C.H. Dodson & R. Escobar 15287* (MO), C. Luer illustration 21945, flowers poor.

Stelis punicea is a large, caespitose species with elliptical leaves that are subacute to rounded at the tip, and many-flowered racemes of dark purple flowers that are similar to those of *Stelis purpurea* (Ruiz & Pav.) Willd. The floral

bracts of the latter are long, acuminate and appressed to the rachis, while those of *S. punicea* are much shorter and diverge from the rachis.

Stelis reptata Luer & R.Escobar. *sp. nov.* TYPE: COLOMBIA. Putumayo: between La Cocha and Sibundoy, 3000 m, 19 January 1979, *C. Luer, J. Luer & R. Escobar 3706* (Holotype: SEL). Fig. 43.

This small, long-repent species is similar to *Stelis scansor* Rchb.f., but differs with a proportionately longer Inflorescence; broader, shortly pubescent sepals; and three-veined petals.

Plant small, epiphytic, scandent, long-repent, the rhizome slender, 1–3 cm long between ramicauls; roots slender. Ramicauls ascending, slender, 2–3.5 cm long, enclosed by a 2–3 tubular sheaths. *Leaf* erect, coriaceous, elliptical, subacute to obtuse, 2–3.5 cm long including the petiole 0.5–0.8 cm long, the blade 0.9–1.1 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* single; 3–4 cm long, the raceme erect, congested, distichous, many-flowered, with many flowers open simultaneously; floral bracts oblique, acute, 2.5–3 mm long; pedicels 1 mm long; ovary 1 mm long; the peduncle ca. 1 cm long, from a node below the apex of the ramicaul; flowers red-purple; *sepals* shortly pubescent, broadly ovate, obtuse, connate basally, 3-veined, the dorsal sepal 2 mm long, 2.25 mm wide, the lateral sepals 1.75 mm long, 1.75 mm wide; *petals* transversely ovate, the apex broadly rounded with a narrow, thickened margin, 0.5 mm long, 1 mm wide, 3-veined, with a transverse callus; *lip* thick, subquadrate, 0.8 mm long, 0.8 mm wide, 0.8 mm deep, concave below the bar with a small glenion, the apex broadly rounded, concave within the thickened margin, the dorsum featureless, the base truncate, hinged to the base of the column; *column* stout, 0.8 mm long and wide, the anther and the bilobed stigma apical.

Etymology: From the Latin *reptatus*, "crept," referring to the creeping habit.

Additional specimens examined: COLOMBIA. Antioquia: Medellín, between San Pedro and Don Matius, 2500–2700 m, *C. Dodson & R. Escobar 15307* (MO), C. Luer illustration 21944.

This apparently uncommon little species, similar to the relatively frequent and widely distributed *Stelis scansor* Rchb.f., has been found in two distant localities in the departments of Putumayo and Antioquia. *Stelis reptata* is distinguished by a long, repent rhizome with petiolate, elliptical leaves. An erect, congested raceme with little red-purple flowers surpasses the leaf. The sepals are broadly ovate and pubescent; the petals are transversely semilunate with a thickened, rounded margin, a transverse callus, and three veins; and the lip is a thick, type A. *Stelis reptata* differs with a proportionately longer raceme, glabrous sepals, and thin, single-veined petals.

Stelis rodrigoi Luer, *sp. nov.* TYPE: COLOMBIA. without collection data, flowered in cultivation at Colomborquídeas, 27 December 1992, *R. Escobar 5141* (Holotype: MO). C. Luer illustration 21937. Fig. 44.

This rather large, caespitose species is distinguished by a large, elliptical leaf borne by an even longer ramicaul; three many-flowered racemes slightly longer than the leaves in the present specimen; transverse, five-veined sepals with acuminate tips; three-veined petals; and a lip concave below a bar with a glenion.

Plant rather large, epiphytic, caespitose; roots slender. Ramicauls erect, slender, 20–25 cm long, partly enclosed by a close, tubular sheath above the middle, another tubular sheath below the middle, and another at the base. *Leaf* erect, coriaceous, elliptical, subacute, 15–17 cm long, 2.5–4 cm wide in the dry state, cuneate below to the a petiole 1.5 cm long. *Inflorescence* 3 from two ramicauls of the present specimen; 16–18 cm long, the ramicauls erect, distichous, densely and simultaneously many-flowered; floral bracts oblique, acute, 3–4 mm long; pedicels 2 mm long; ovary 1.5 mm long; the peduncle 4–5 cm long, with distant bracts, subtended by a spathe 1.2 cm long, from a node below the apex of the ramicaul; *sepals* light yellow-green, suffused with red toward the tips, expanded, glabrous, transversely ovate, broadly obtusely acuminate at the tips, 5-veined, connate to near the middle, the dorsal sepal, 2.5 mm long, 4.2 mm wide, the lateral sepals 3 mm long, 4.2 mm wide; *petals* yellow, transversely oblong, 0.75 mm long, 1 mm wide, 3-veined. broadly rounded at the apex, concave within a thickened margin, and below a transverse carina; *lip* green, type A, subquadrate, 0.75 mm long, 1 mm wide, 0.6 mm deep, concave below the bar with a glenion. the apex rounded with a thickened margin, the dorsum with a low, rounded callus, the base broadly truncate, hinged to the base of the column; *column* stout, ca. 1 mm long and wide, the anther and the stigmatic lobes apical.

Eponymy: Named for the late Rodrigo Escobar Restrepo who preserved a specimen of this species being cultivated at Colomborquídeas.

A specimen of this unusually large species was made from a plant without collection data cultivated by Colomborquídeas. It is distinguished by long ramicauls and large, petiolate leaves. Two of the three ramicauls bear three racemes that barely equal or surpass the leaf. Rather small flowers are produced in abundance. The sepals are transversely ovate, much broader than long, with acuminate tips. The petals are three-veined, and the lip is type A.

Stelis samson Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Santander: Landázuri, W of Velez, road to Landázuri, 2500 m, 4 May 1984, *C. Luer, J. Luer & R. Escobar 10098* (Holotype: MO). Fig. 45.

This large, robust, repent species is characterized by a thick rhizome; erect ramicauls; large, petiolate leaves exceeded by a much longer raceme with medium-sized flowers with, three-veined, glabrous sepals; three-veined petals; and an ovoid lip with a subacute apex with a minute apiculum.

Plant large, epiphytic, repent, the rhizome stout, 3–5 mm thick, 1–3 cm long between ramicauls. Ramicauls erect, rather stout, 8–12 cm long, with a tubular sheath from below the middle, and another 1–2 sheaths below and at the base.

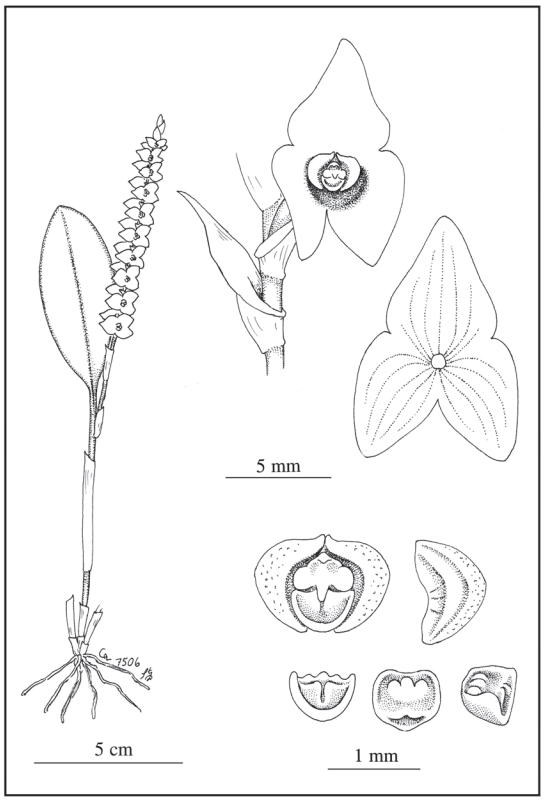

Figure 41. *Stelis pulchra* Luer & R.Escobar

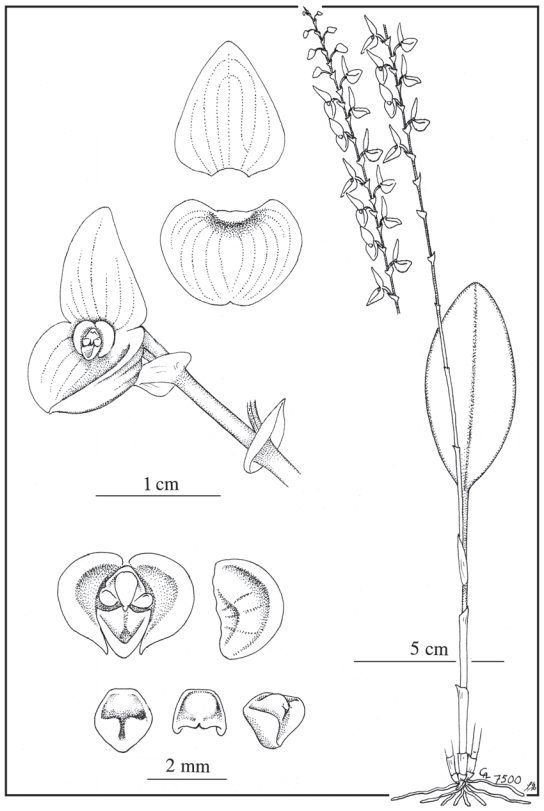

Figure 42. *Stelis punicea* Luer & R.Escobar

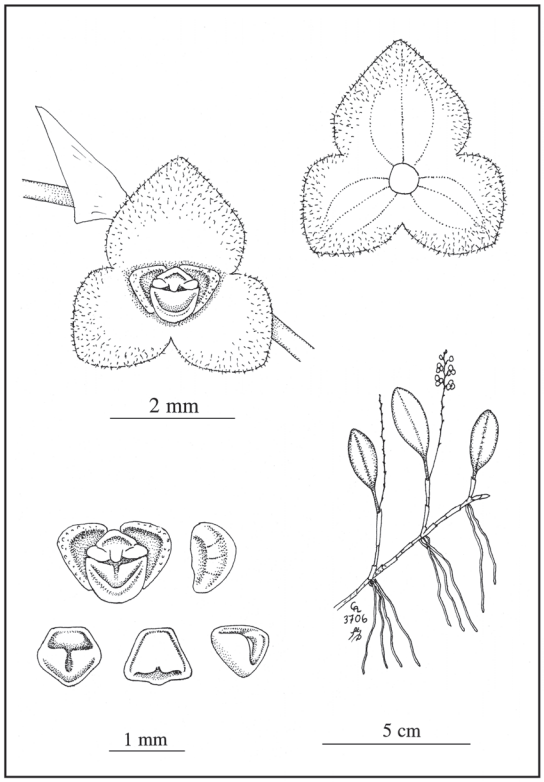

Figure 43. *Stelis reptata* Luer & R.Escobar

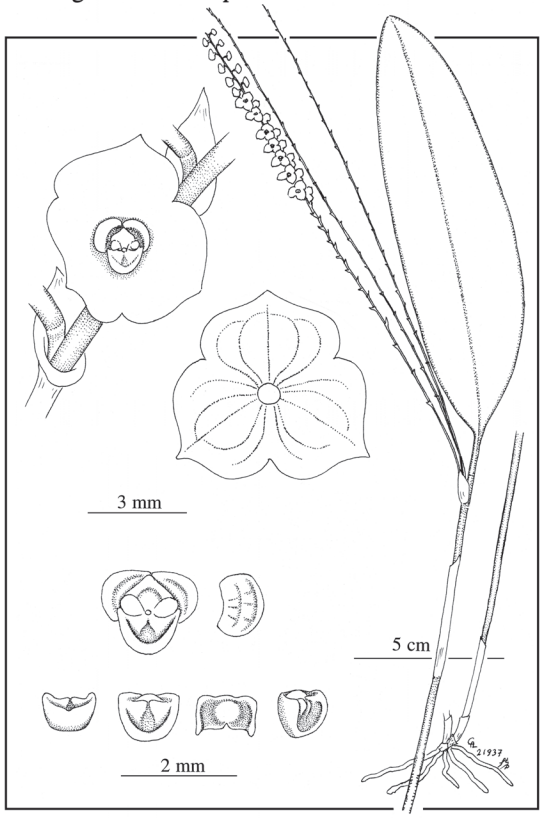

Figure 44. *Stelis rodrigoi* Luer & R.Escobar

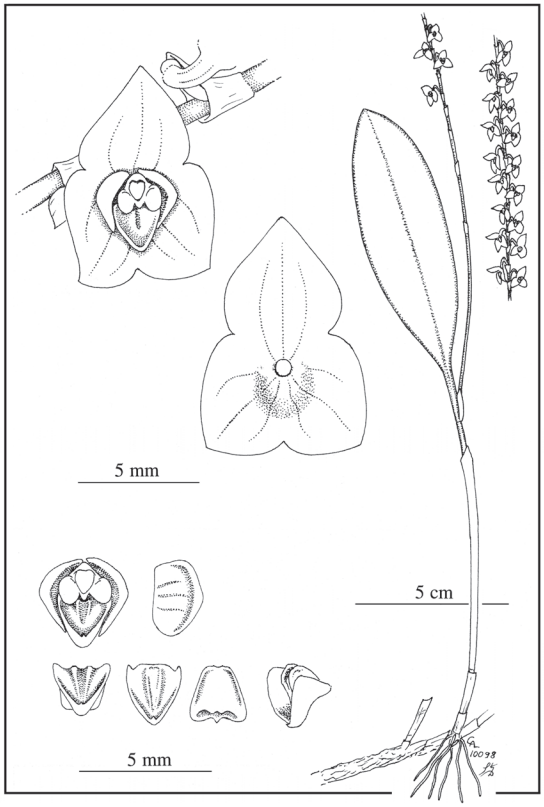

Figure 45. *Stelis samson* Luer & R.Escobar

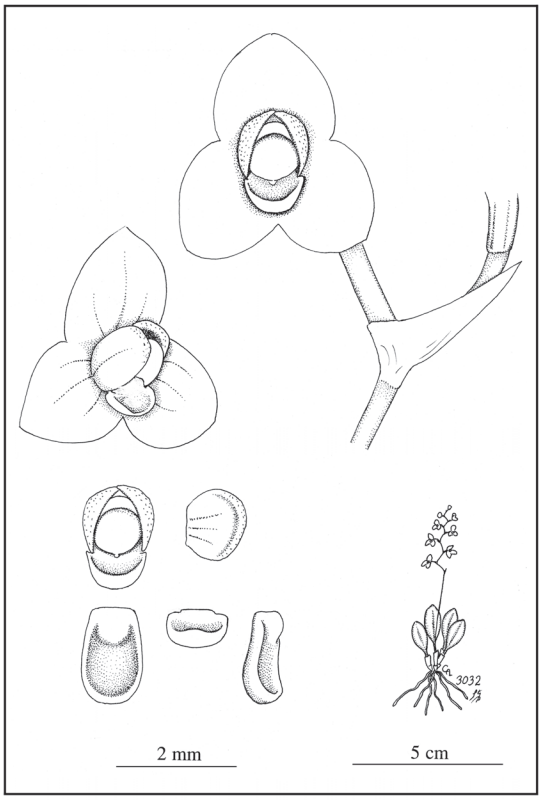

Figure 46. *Stelis trullilabia* Luer & R.Escobar

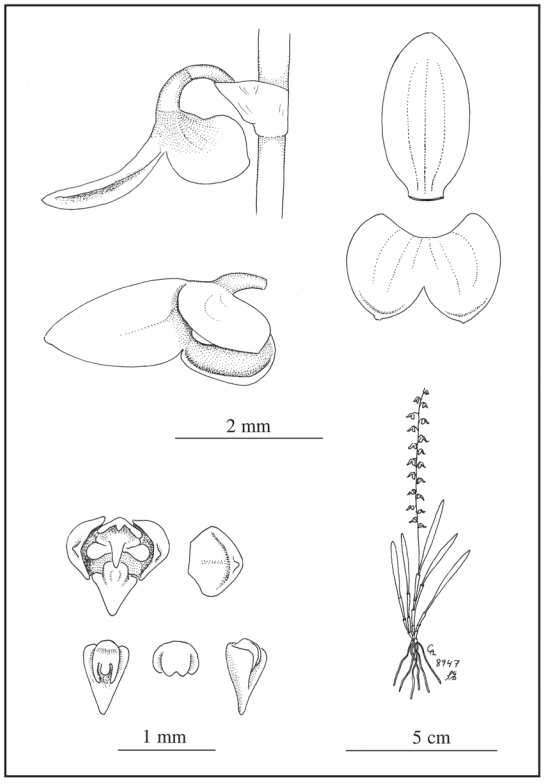

Figure 47. *Stelis tryssa* Luer & R.Escobar

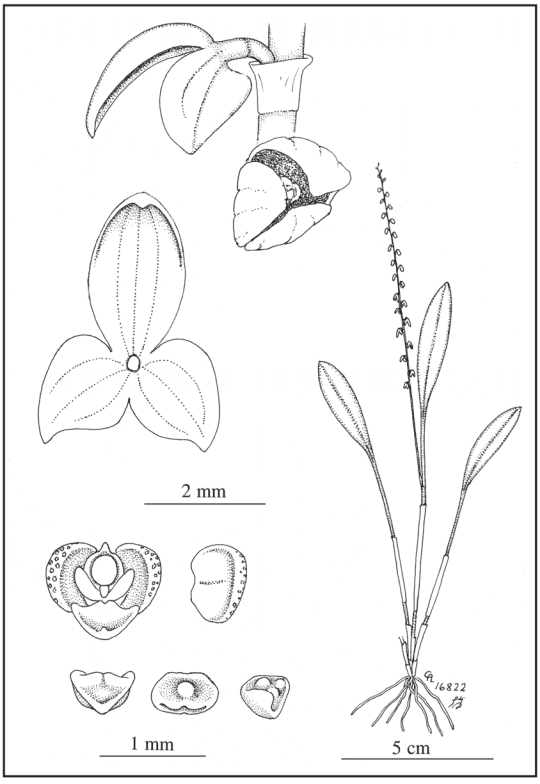

Figure 48. *Stelis valvulosa* Luer & R.Escobar

Leaf erect, coriaceous, elliptical, subacute, 11–14 cm long including a petiole 2–4 cm long, the blade 2.5–3 cm wide in the dry state, cuneate below into the petiole. *Inflorescence* single; 18–30 cm tall, the raceme erect, loose, distichous, many-flowered; floral bracts oblique, acute, 4 mm long; pedicels 3 mm long; ovary 2 mm long; the peduncle 6–10 cm long, subtended by a slender spathe 1.2 mm long, from a node below the apex of the ramicaul; flowers light yellow; *sepals* glabrous, ovate, connate below the middle, concave in the basal quarter, 3-veined, the dorsal sepal subacute, 4.5 mm long, 5 mm wide, the lateral sepals obtuse, 4 mm long, 5 mm wide; *petals* transversely oblong, the apex rounded with a narrowly thickened margin, concave, with a minimal transverse carina, 2 mm long, 3 mm wide, 3-veined; *lip* ovoid, 2 mm long, 2 mm wide, 2 mm deep, concave within the subacute apex with a minute apiculum, the disc filled with a thick, glabrous callus, with a central depression limited on either side by a thin callus, the base truncate, hinged to the base of the column; *column* clavate, ca. 2.5 mm long, 2 mm wide. connate to the base of the column, the anther and the stigmatic lobes apical.

Eponymy: Named for Samson, a biblical character noted for his great strength, referring to the robust habit.

Vegetatively, this large, robust, repent species of the Eastern Cordillera is indistinguishable from *Stelis hercules* Luer & R.Escobar, published herein, of the Central Cordillera, but it differs with glabrous, instead of long-pubescent sepals, and a glabrous lip with a minute apiculum at the subacute tip.

Stelis trullilabia Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Cauca: Páramo de Barbillas, SE of Popayan, 3070 m, 27 July 1978, *C. Luer, J. Luer & R. Escobar 3032* (Holotype: SEL). Fig. 46.

This very small species is noted for elliptical leaves; a much shorter ramicaul clothed by a loose sheath; a flexuous raceme; ovate, obtuse sepals; round, three-veined petals; and an oblong lip concave below a basal callus.

Plant very small, epiphytic, caespitose, roots slender. Ramicauls erect, slender, 5–6 mm long, with a loose, tubular sheath from near the base. *Leaf* erect, coriaceous, elliptical, obtuse, 15–20 mm long including a petiole 2–4 mm long, the blade 5–6 mm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 3–4 cm long, the raceme erect, flexuous up to 2.5 cm long with up to 10 flowers, many flowers open simultaneously; floral bracts oblique, acute, 3 mm long; pedicels 1.5–2 mm long; ovary 1 mm long; the peduncle 2–2.5 cm long, from a node from the ramicaul within the sheath; flowers brown; *sepals* glabrous, expanded, broadly ovate, obtuse, 3-veined, connate basally, 2.5–3 mm long, 2–2.5 mm wide, the lateral sepals, 2–2.5 mm long, 2 mm wide; *petals* circular, concave, slightly thickened on the rounded apex, 1 mm long, 1.2 mm wide, 3-veined; *lip* oblong, 1.5 mm long, 1 mm wide, 0.4 mm deep, concave below a smooth, basal callus, the apex rounded with thin margins, the base truncate, hinged to the base of the column; *column* clavate, 1.2 mm wide, anther cap proportionately large, the anther and the bilobed stigma apical.

Etymology: From the Latin *trullilabius*, "with little spoon," referring to the shape of the lip.

This graceful, little species is characterized by tiny ramicauls enclosed by inflated sheaths; a flexuous raceme shorter than the peduncle; brown flowers with obtuse, ovate sepals; round, three-veined petals; and an oblong, concave lip with the tip rounded like a spoon.

Stelis tryssa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Frontino, Alto de Cuevas, 2050 m, 4 May 1983, *C. Luer, J. Luer, R. Escobar et al. 8947* (Holotype: SEL). Fig. 47.

This very small species is distinguished by narrow, linear leaves; semiconnate, lateral sepals in apposition; single-veined petals; and an ovoid lip acute at the tip and with a rounded callus filling the basal half that is cleft apically into three parts.

Plant very small, epiphytic, caespitose; roots slender. Ramicauls erect, fasciculate, 10–15 mm long, enclosed by two tubular sheaths. *Leaf* erect, coriaceous, narrowly linear, acute, 20–25 mm long, 1.5–2 mm wide in the dry state. *Inflorescence* single; 6 cm tall, the raceme erect, sublax, distichous, simultaneously many-flowered; floral bracts oblique, acute, 1 mm long; pedicels 1 mm long; ovary 0.5 mm long; peduncle ca. 1 cm long from near the apex of the ramicaul; flowers light purple; *sepals* glabrous, the dorsal sepal erect, elliptical, obtuse to rounded at the apex, 2.25 mm long, 1.25 mm wide, 3-veined, connate basally 0.5 mm, the lateral sepals antrorse, broadly ovate, oblique, obtuse to rounded at the apex, connate to about the middle, 1.25 mm wide and long, each 3-veined; *petals* broadly ovate, 0.3 mm long and wide, 1-veined, concave, broadly obtuse with the margin narrowly thickened, with a microscopic, acute, central apiculum, without a transverse carina; *lip* narrowly ovoid-triangular, acute at the tip, 0.6 mm long, 0.3 mm wide and deep, filled with a rounded callus that is cleft into three microscopic parts at the apical margin, the base truncate, hinged to the base of the column; *column* semiterete, ca. 0.5 mm long and wide, the anther with elongated stigmatic lobes apical.

Etymology: From the Greek *tryssos*, "dainty, delicate," referring to the habit.

This minute, caespitose species is characterized by narrowly linear leaves exceeded by an erect raceme of tiny, nutant flowers along a thread-like rachis. The sepals are broadly ovate, obtuse and three-veined; the lateral sepals are connate to the middle and more or less in apposition, more or less forming a concave synsepal. The single-veined petals are minutely apiculate. The lip is triangular with a rounded callus that is trifid at the tip.

Stelis valvulosa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Risaralda: road to TV antenna S of Pueblo Rico, 2400 m, 14 May 1993, *C. Luer, J. Luer, R. Escobar et al. 16822* (Holotype: MO). Fig. 48.

This medium-sized, caespitose species is characterized by a many-flowered raceme about twice longer than narrowly elliptical leaves with petioles nearly as long as

the blades; a concave, antrorse dorsal sepal above smaller, connivent, valve-like lateral sepals; single-veined petals; and a short lip with a dorsal callus.

Plant small, epiphytic, densely caespitose. Ramicauls erect, slender, 4–5 cm long, with a close, tubular sheath from below the middle, and another 1–2 sheaths below and at the base. *Leaf* erect, coriaceous, narrowly linear-elliptical, acute, 6–7 cm long including a petiole 2–3 cm long, the blade 1–1.3 cm wide in the dry state, cuneate below to the petiole. *Inflorescence* single; 9-11 cm tall, the raceme erect, strict, distichous, many-flowered, with many flowers open simultaneously; floral bracts tubular, obtuse, 1 mm long and wide; pedicels 1 mm long; ovary 0.5 mm long; the peduncle 2–3 cm long, subtended by a spathe ca. 5 mm long, from a node at the apex of the ramicaul; *sepals* glabrous, connate basally, 3-veined, the dorsal sepal red-purple, antrorse, elliptical, obtuse, concave, 2.5 mm long, 1.8 mm wide, the lateral sepals green, ovate, oblique, subacute, concave, connivent, 1.75 mm long, 1.75 mm wide; *petals* green, elliptical, concave, the apical margin rounded, thickened with numerous, minute crystals, 0.5 mm long, 0.75 mm wide, 1-veined; *lip* subquadrate, type A, 0.4 mm long, 0.6 mm wide, 0.4 mm deep, concave below a bar with a shallowly incised glenion, the apex obtuse with a narrow margin, the dorsum with a central, subspherical callus, the base truncate, connate to the base of the column; *column* stout, ca. 0.5 mm long and wide, the anther and oblique stigmatic lobes apical.

Etymology: From the Latin *valvulosus*, "with markedly developed valve," referring to the converging valve-like sepals.

This slender species is distinguished by narrowly elliptical leaves with petioles nearly as long as the blade. A single, much longer raceme bears small, nutant flowers with an elliptical, red-purple dorsal sepal overlying a pair of smaller, green, connivent lateral sepals. The petals are single-veined, and the lip is type A with an obtuse apex and a round callus in the center of the dorsum.

Stelis vigax Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Sonsón, between Sonsón and La Ceja, 2400 m, 19 April 1983, *C. Luer, J. Luer, R. Escobar et al. 8884* (Holotype: SEL). Fig. 49.

This large, vigorous, caespitose species is distinguished by stout ramicauls with elliptical leaves surpassed by a single, many-flowered raceme of medium-sized, glabrous flowers with a seven-veined sepals, three-veined petals, and a subquadrate lip with minute apiculum on a subtruncate apex.

Plant large, epiphytic, densely caespitose; roots slender. Ramicauls erect, stout, 8–10 cm long, with a loose, tubular sheath from below the middle and 2 tubular sheaths below and at the base. *Leaf* erect, thickly coriaceous, elliptical, subacute, 10–18 cm long. 2–2.8 cm wide in dry state, narrowly cuneate below into a subpetiolate base. *Inflorescence* single; 10–25 cm tall, the raceme erect, strict, many-flowered, loose below to congested above, distichous; floral bracts oblique, acute, 5 mm long below to 3 mm long toward the apex; pedicels 3 mm long; ovary 3 mm long; the peduncle ca. 10 cm long, with a spathe 1.5 cm long, from a node below the apex of the ramicaul; *sepals* green, suffused with purple, glabrous, ovate, connate in lower quarter, the dorsal sepal acute, 7-veined, 4 mm long, 3.5 mm wide, the lateral sepals obtuse, 7-veined 3.5 mm long, 3 mm wide; *petals* light purple, transversely obovate, fleshy, 1.3 mm long, 2 mm wide, 3-veined, the apex broadly obtuse, concave below a broad, thick margin continuous with the transverse carina; *lip* subquadrate, 1 mm long, 1.3 mm wide, 0.6 mm deep, shallowly concave below a broad, rounded bar with a narrow glenion, from near the base, concave at the subtruncate apex, minutely apiculate, the dorsum shallow, featureless except for the glenion, the base truncate, hinged to the base of the column; *column* stout, ca. 1.5 mm wide and long, with the anther and the bilobed stigma apical.

Etymology: From the Latin *vigax*, "tending to be vigorous," alluding to the strong habit.

Stelis vigax is a large, densely caespitose species with stout ramicauls and large, acute, elliptical, subpetiolate leaves and a long raceme that is loosely flowered below. A flower remaining at the apex of a maturing ovary, gradually doubles in size. The sepals are ovate and seven-veined, the petals are thick and three-veined. The lip is a shallow type C with a narrow glenion extending from near the base over the rounded bar. The apex is subtruncate with a minute apiculum.

Stelis voluptuosa Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: Cerro Padre Amaya, 2800 m, 22 April 1983, *C. Luer, J. Luer, R. Escobar et al. 8769* (Holotype: SEL). Fig. 50.

This large, shortly repent species is distinguished by a thick rhizome; stout ramicauls; oblong, obtuse leaves; a long raceme with prominent floral bracts; five-veined sepals and petals; and a subquadrate lip with rounded apex and hemispherical callus on the dorsum.

Plant large, epiphytic, shortly repent, the rhizome 5–6 mm thick, ca. 5 mm between ramicauls; roots coarse. Ramicauls erect, stout, 8–9 cm long, with a loose, tubular sheath from below the middle and 2 tubular sheaths below and at the base. *Leaf* erect, thickly coriaceous, elliptical-oblong, obtuse, 11–13 cm long including a petiole 1–1.5 cm long, the blade 2–2.5 cm wide in dry state, cuneate below into the petiole. *Inflorescence* single; 25–32 cm tall, the raceme erect, strict, congested, distichous, many-flowered, with many flowers open simultaneously; floral bracts oblique, acute, 6 mm long below to 3 mm long toward the apex; pedicels 2 mm long; ovary 2 mm long; the peduncle 6–8 cm long, with a thin spathe 1 cm long, from a node below the apex of the ramicaul; *sepals* brown externally, green within, glabrous or microscopically (pubescent-

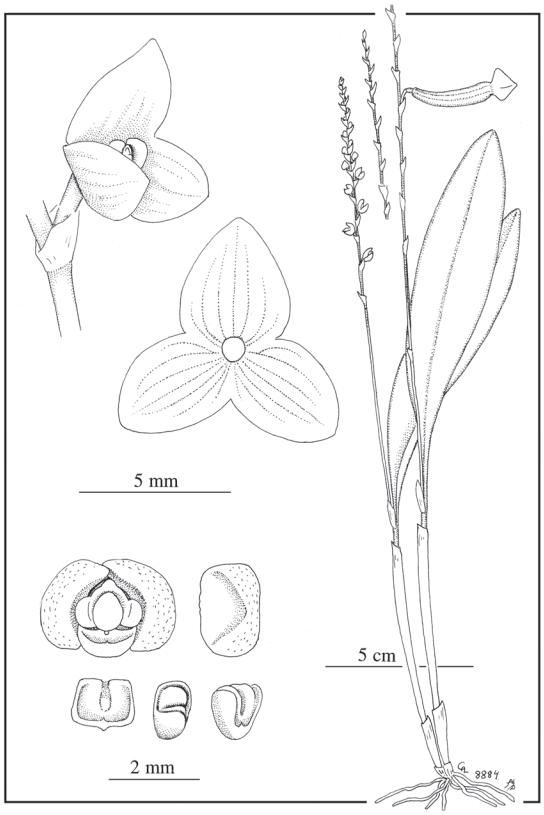

Figure 49. *Stelis vigax* Luer & R.Escobar

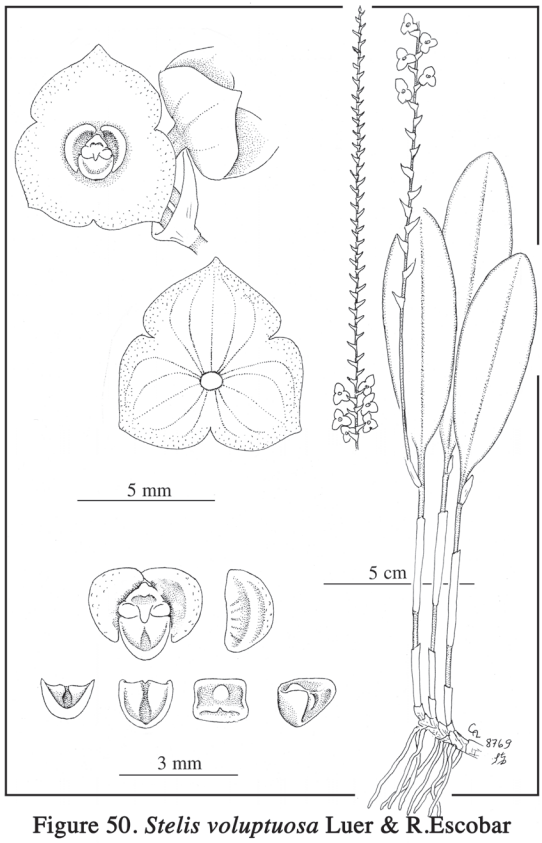

Figure 50. *Stelis voluptuosa* Luer & R.Escobar

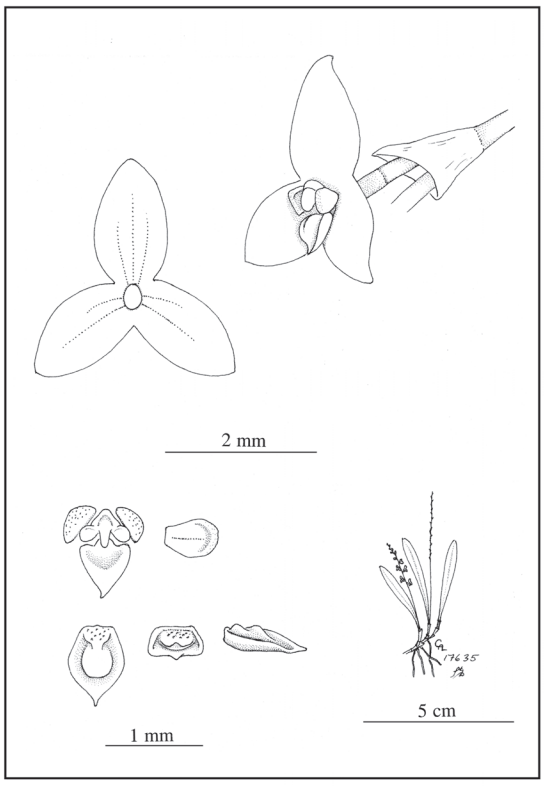

Figure 51. *Stelis vulpecula* Luer & R.Escobar

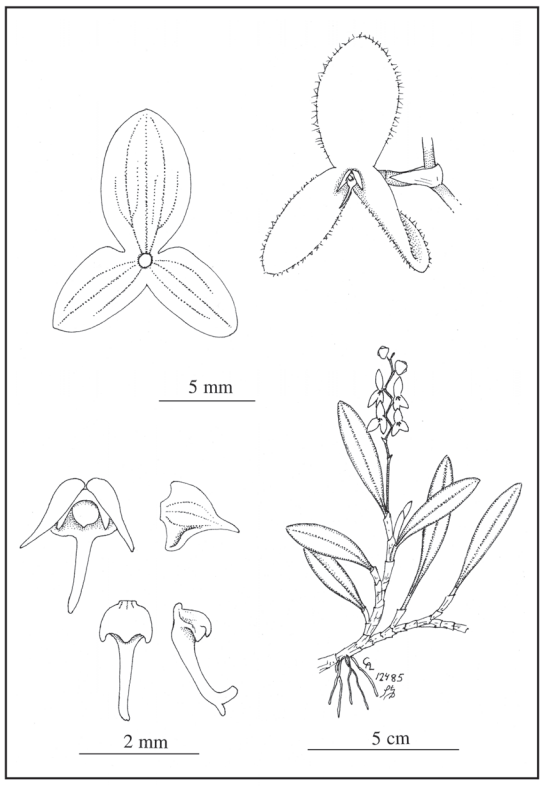

Figure 52. *Stelis xenica* Luer & R.Escobar

cellular), expanded, transversely ovate, obtuse, 5-veined, connate to near the middle, the dorsal sepal 4 mm long, 5 mm wide, the lateral sepals 3 mm long, 5 mm wide; *petals* transversely semilunate, fleshy, 1.3 mm long, 1.6 mm wide, 5-veined, the apex rounded, shallowly concave below the broad, thick margin continuous with the transverse carina; *lip* subquadrate, 1.3 mm long, 1.3 mm wide, 1 mm deep, concave below the bar with a glenion, the apex rounded, minutely apiculate, the dorsum with a central, hemispherical callus, the base truncate, hinged to the base of the column; *column* clavate, 1.3 mm wide and long, with the anther and the bilobed stigma apical.

Etymology: From the Latin *voluptuosus*, "voluptuous," alluding to the delightful appearance of the plant.

Stelis voluptuosa is a large, shortly repent species with the rhizome five or six millimeters thick bearing stout ramicauls about five millimeters apart. The leaves are thickly coriaceous, elliptical-oblong and obtuse, and far surpassed by a many-flowered raceme with prominent floral bracts and large, five-veined sepals. The petals are proportionately large with a thick, rounded apex and five-veined. The lip is type A with round apex, a glenion, and a rounded callus on the dorsum.

Stelis vulpecula Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Antioquia: at the pass between Urrao and Carmen de Atrato, 2700 m, 30 May 1995, *C. Luer, J. Luer & R.Escobar 17635* (Holotype: MO). Fig. 51.

This small, shortly repent, ascending species is characterized by a strict, many-flowered raceme that exceeds narrowly elliptical leaves with short ramicauls; nearly free, elliptical sepals; single-veined petals longer than wide; and an ovate, flattened lip with an acuminate tip.

Plant small, epiphytic, shortly repent-ascending, roots slender. Ramicauls erect, slender, 3–10 mm long, with 1–2 close, tubular sheaths. *Leaf* erect, coriaceous, narrowly elliptical, acute, 2–3.5 cm long, 3–4 mm wide, narrowed below the base. *Inflorescence* single; 2-4 cm long, erect, strict, many-flowered with several flowers open simultaneously; floral bracts oblique, acute, 1.5 mm long; pedicels 1 mm long; ovary 1 mm long; the peduncle ca. 1.5 cm long, from the apex of the ramicaul; *sepals* rosy white, glabrous, elliptical, subacute, connate basally, 1.5 mm long, 1 mm wide, 3-veined; *petals* rose, obovate, concave, slightly thickened on the rounded apex, 0.5 mm long, 0.4 mm wide, 1-veined; *lip* rose, shallowly ovate with thin margins, 0.75 mm long, 0.5 mm wide, 0.3 mm deep, shallowly concave surrounding a low, rounded callus, the apex obtusely acuminate, acute, the base thickened, microscopically pubescent, truncate, hinged to the base of the column; *column* clavate, 0.5 mm wide, with the anther and the bilobed stigma apical.

Etymology: From the Latin *vulpecula*, "a little fox," referring to features of the flower.

This little species is distinguished by narrowly elliptical leaves borne by much shorter ramicauls that become surpassed by a delicate raceme of tiny flowers. The elliptical sepals, about one millimeter long, are nearly free; the petals are concave and longer than broad; the acuminate tip of the lip is reminiscent of the pointed nose of a fox.

Stelis xenica Luer & R.Escobar, *sp. nov.* TYPE: COLOMBIA. Nariño: near La Planada, above Ricaurte, collector unknown, 1600 m, flowered in cultivation at La Planada Orquideario, 25 January 1987, *C. Luer 12485* (Holotype: MO). Fig. 52.

This small, repent species is characterized by a flexuous, several-flowered inflorescence with ciliate sepals rounded at the tips; sagittate petals acuminate at the tip; and a lip that is terete above a broad, basal third with a pair of marginal lobes.

Plant small, epiphytic, repent, the rhizome stout, branching, ca. 1 cm long between ramicauls; roots slender. Ramicauls ascending, erect, stout, 0.5–1.5 cm long, enclosed by a loose, tubular sheath above the middle, another sheath below at the base. *Leaf* erect, coriaceous, elliptical, acute, 3–5 cm long, 0.7–1 cm wide in the dry state, narrowed below into an ill-defined petiole ca. 0.5 mm long. *Inflorescence* single; 8 cm long, the raceme erect, lax, flexuous, several-flowered with most flowers open simultaneously; floral bracts oblique, acute, 2.5-3 mm long; pedicels 2-2.5 mm long; ovary 1.5 mm long; the peduncle ca. 2 cm long, subtended by an inconspicuous spathe within the sheath, from a node below the apex of the ramicaul; flowers dark purple; *sepals* expanded, minutely ciliate, the dorsal sepal elliptical, rounded at the apex, 7 mm long, 4.5 mm wide. with 3 primary veins, and a pair of incomplete accessory veins rising from below the middle of both lateral veins, for a total of 7 incomplete veins, the lateral sepals elliptical, obtuse to rounded at the tip, 5.5 mm long, 3 mm wide; *petals* sagittate-triangular, 1.5 mm long, 1.25 mm wide, 3-veined, the apex acute, acuminate; *lip* thick, tomahawk-shaped, 4 mm long, 0.8 mm wide in the subquadrate, basal third, with a pair of antrorse, marginal lobes, terete below the basal third with the tip incurved and with a small, posterior lobule, the base truncate, connate to the base of the column; *column* ca. 1 mm long and wide, the anther and stigmatic lobes apical.

Etymology: From the Greek *xenikos*, "foreign," referring to the strange and curious morphological features.

This small species is characterized by a stout, creeping and branching rhizome and elliptical leaves borne by shorter ramicauls. A several-flowered raceme of relatively large, dark purple flowers with finely ciliated sepals passes the tip of the leaf. The dorsal sepal is proportionately large, elliptical and more or less seven-veined, while the three-veined lateral sepals are nearly free and widely spread. The petals are long-acuminate at the tip. The basal part of the lip is broad with a pair of antrorse lobules; the thrice longer, terminal part of the lip is terete with the tip incurved beyond a minute lobule beneath.

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SCROPHULARIA KOLLAKII (SCROPHULARIACEAE), A NEW SPECIES FROM KURDISTAN, IRAQ

SAMAN A. AHMAD[1, 2]

Abstract. *Scrophularia kollakii* (Scrophulariaceae), a new species from Kurdistan Iraq, is described, and its distinguishing characters from nearest relatives are discussed. It is easily separated from *S. olympica* by its taller (30–75 vs. 20–30 cm) stems, 4–12-flowered (vs. 3-flowered) cymes, lanceolate (vs. linear to narrowly oblong), shorter (1–2 vs. 1.7–5 mm) bracteoles, scarious and usually purplish or dark yellow (vs. pale brown) margin of calyx, dark pink corolla 7–9 mm (vs. ca. 6 mm), and dark pink (vs. dark purple) upper corolla lip 3.5–5 mm (vs. 3 mm). It differs from *S. sosnowskyi* by having usually purplish or dark yellow (vs. white) scarious margin of calyx, dark pink (vs. greenish yellow with upper lip purple or violet) corolla, and obcordate (vs. obovate) staminode.

Keywords: Scrophulariaceae, *Scrophularia,* Azmar-Goihza Mountains, Kurdistan, Iraq

During the past two years, the Kurdistan Botanical Foundation conducted extensive floristic study in Azmar-Goizha Mountain (Kurdistan, Iraq). This mountain, which is part of the extensive Zagros Mountain Range, overlooking Sulaimani City and occupying an area of about 250 km^2 between 35˚29' to 35˚42'N and 45˚26' to 46˚33'E.

During recent studies in Hawraman region (Ahmad, 2013a), the present author discovered four new species to science (Ahmad, 2013b–c, 2014a–b) and 18 species new to the flora of Iraq (Ahmad, 2013d). Among those was *Scrophularia sulaimanica* S.A.Ahmad (Ahmad, 2014b). The present botanical survey of the Azmar-Goizha Mountain also yielded several novelties and additions to the flora of Iraq, including the following species of *Scrophularia* L.

Scrophularia kollakii S.A.Ahmad, *sp. nov*. TYPE: IRAQ. Kurdistan, Sulaimani Province, Azmar Mt., on the road to Khamza village, dry sandy place, grassland, slope 25–35%, sun exposure SE to NW, 1570 m, 35˚38'57"N, 45˚27'20"E, 25 April 2015, *S. A. Ahmad A. Hama, S. Babarasul, & S. R. Fayaq 15–1227* (Holotype: KBFH; Isotype: KBFH). Fig. 1.

The new species is easily separated from *S. olympica* by its taller stems (30–75 vs. 20–30 cm), 4–12-flowerd (vs. 3-flowered) cymes, lanceolate (vs. linear to narrowly oblong), shorter (1–2 vs. 1.7–5 mm) bracteoles, scarious and usually purplish or dark yellow (vs. pale brown) margin of calyx, dark pink corolla 7–9 mm (vs. ca. 6 mm), and dark pink (vs. dark purple) upper corolla lip 3.5–5 mm (vs. 3 mm). It differs from *S. sosnowskyi* by having usually purplish or dark yellow (vs. white) scarious margin of calyx, dark pink (vs. greenish yellow with upper lip purple or violet) corolla, and obcordate (vs. obovate) staminode.

Herbs perennial, glandular. *Stems* 30–75 cm tall, several to many from woody caudex, erect to ascending, solid, terete or subterete at base, becoming quadrangular upwards, glabrous, glandular. *Basal leaves* forming a rosette, petiole 1–4 cm; lamina ovate to ovate-oblong, 2–4 × 1–2 cm, crenate, sparsely to densely glandular; lower and middle cauline leaves ovate to oblong-lanceolate in outline, usually opposite, deeply incised to pinnatifid, 1.5–3 × 0.7–1.5 cm, sparsely to densely glandular; upper cauline leaves alternate, lanceolate, slightly pinnatifid, double serrate, 1–5 × 1–2 cm. *Thyrse* branched, 20–45 cm; cymes 4–12-flowered, alternate, glabrous; peduncle 0.5–1.5 cm; lowermost bracts leafy, short petiolate, ovate, 10–15 × 2–4 mm, becoming elliptic upwards; bracteoles lanceolate, 1–2 × 0.4–0.7 mm; flowering pedicels slender, 1–5 mm, substantially longer than subtending bracteoles; fruiting pedicels of central flower somewhat thick, angled, 3–7 mm, sparsely glandular. *Calyx* lobes suborbicular to broadly reniform, 3–5 × 3.5–5 mm, glabrous; scarious margin undulate, lacerate, 1–1.6 mm wide, usually purplish or dark yellow; corolla urceolate, 7–9 mm, dark pink; lateral lobes pinkish, truncate; upper lip emarginate, 3.5–5 mm, lobes suborbicular; lower lip pinkish, obtuse; corolla tube white, ca. 3 mm; staminode subsessile, obcordate, 0.4–0.5 × 0.4–0.6 mm, slightly exerted from corolla throat; filaments of fertile stamens ca. 3.5 mm, glandular; anthers 1–1.5 mm; ovary ovate, 1–2.5 × 1.5–2 mm, glabrous; style 1.4–2 mm, glabrous. *Fruit* globose, 2-lobed, 3.5–5 mm in diam., glabrous; seeds oblong, black, slightly curved, ca. 2 × 1 mm, transversely sulcate.

Eponymy: This novelty is named after Mr. Fayaq Kollak of Sulaimani city in recognition to his financial support of the Azmar-Goizha project.

Distribution: Known thus far only from Azmar Mt., where it is restricted to a small area near the road to Khamza Village.

Additional specimen examined: Paratype: Azmar Mt., 1570 m, 35˚38'57"N, 45˚27'20"E, 07 Nov. 2015, *S. A. Ahmad & S. R. Fayaq 15-1448* (KBFH).

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FIGURE 1. *Scrophularia kollakii* S.A.Ahmad. **A**, plant; **B**, part of inflorescence. Scales: A = 5 cm; B = 1 cm.

IUCN Red List Category: *Scrophularia kollakii* is extremely rare; its IUCN Red List category (IUCN 2001) remains uncertain and is currently assessed as Data Deficient (DD).

A comparison of the above novelty with all known species of *Scrophularia* from SW Asia, especially in Turkey, Iran, and neighboring countries (e.g., Grau, 1981; Lall and Mill, 1978), clearly showed that it is not very closely related to any known species. *Scrophularia kollakii*, is somewhat related to Anatolian-Caucasian *S. olympica* Boiss. and Anatolian-endemic *S. sosnowskyi* Kin.-Nath.. From the former, it differs by the taller 30–75cm (vs. 20–30cm) stems, 4–12 flowered (vs. 3-flowered) cymes, lanceolate (vs. linear to narrowly oblong) bracteoles 12 mm (vs. 1.7–5 mm), scarious and usually purplish or dark yellow (vs. pale to brown) margin of calyx dark pink (vs. pale brown to pink) corolla, 7–9 mm (vs. ca. 6 mm), and dark pink (vs. dark purple) upper corolla lip. From *S. sosnowskyi*, the new species differs by having usually purplish or dark yellow (vs. white) scarious margin of calyx, dark pink (vs. greenish yellow with upper lip purple or violet) corolla, and obcordate (vs. obovate) staminode.

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NEW COMBINATIONS AND TRANSFERS TO *ODONTOGLOSSUM* ONCIDIINAE (ORCHIDACEAE): AVOID CREATING NEW NAMES

Stig Dalström[1] and Wesley E. Higgins[2, 3]

Abstract. A generic transfer of eight species from *Oncidium* to *Odontoglossum* is made here, supported by molecular and morphologic evidence. Homotypic synonyms are listed. These transfers make it possible to maintain a monophyletic genus *Odontoglossum* without creating any new generic names. Quotes from authors that favor a larger and morphologically indefinable *Oncidium* are included and responded to by the authors of this paper, who are in favor of maintaining a more conservative and traditional, as well user-friendly and visually workable taxonomic classification.

Keywords: Oncidiinae, *Odontoglossum*, *Oncidium*, species transfers, taxonomy

Many attempts have been made by various authors to solve the complicated taxonomy in Oncidiinae in general, and to classify or delineate the genus *Odontoglossum* Kunth in particular, but without lasting or entirely convincing results; Kunth (1816: 350), Lindley (1852), Beer (1854: 274–295), Pfitzer (1887: 106–107), Bockemühl (1984: 213–218; 1989: 15–29), Chase et al. (2008), Pridgeon et al. (2009: 212–220), Neubig (2012), and Kolanowska and Szlachetko (2016). For a variety of reasons and from a taxonomic point of view, this is not an easy group of plants to deal with. Traditionally, in this particular case, taxonomists have focused on a few morphologic features, generally associated with some flower details, particularly the angle between the column and the lip. Species with similar looking flowers, with regards to the chosen important taxonomic features favored at the time, have ended up in the same genus despite displaying many different-looking features otherwise, such as vegetative and micro-morphologic structures. Since molecular research focusing on DNA sequencing has arrived on the scene as an additional tool for systematists, we realize that vegetative features are very important in revealing close or distant relationships. Also micro-morphology has an important role to play here, while flower color, odor and general shape can be misleading and appear to be evolutionary plastic adaptations to available pollinators.

Pollination syndromes

Very little is documented about pollination of *Odontoglossum* species. Van der Pijl and Dodson (1966: 80–81; figure 53 on page 80) report the following: "In the case of *Odontoglossum kegeljani* E.Morren [= *Odontoglossum lehmannii* Rchb.f.; authors' note] in Ecuador, male bees of *Bombus robustus* var. *hortulans* Friese come to the flowers and attempt to reach nectar in the false nectarines. The teeth of the callus act to impede the advance into the flower and in their struggles they detach the viscidium of the pollinarium with their heads. The stipe curves downward, carrying the pollinia to a position in front of the head and in visiting a subsequent flower they leave the pollinia on the sticky surface of the stigma."

This may be the only photographically supported report of the pollination of an *Odontoglossum* species. But it probably represents what happens to most "typical" odontoglossums since the basic flower morphology is very similar. In the case of the "*Cochlioda* Lindl., group" in *Odontoglossum* (members of the former genus *Cochlioda*, Dalström, 2012), however, the brightly rosy red to magenta or orange-colored flowers suggest a different pollination syndrome, and hummingbird pollination of *Odontoglossum* (as *Cochlioda*) *vulcanicum* (Rchb.f.) Dalström is reported by van der Pijl and Dodson (1966: 89, 95). These authors continue: "A point which has been generally overlooked in taxonomy in the orchids is that the characters which result from adaptations to bird-pollination are often striking. These characters are commonly employed by taxonomists in separating genera, with the result that closely related species may be placed in distinct genera. Examples are the *Cochlioda-Odontoglossum-Oncidium* and the *Sophronitis-Laelia-Cattleya* complexes where the enormous numbers of artificial hybrids are mute evidence of the failure of taxonomists to understand the ecological background of speciation in these groups." (van der Pijl and Dodson, 1966: 94). The conclusion is that we should widen our generic concepts and be ready to accept that groups of species with rather different looking flowers may still be rather closely related. A true close relationship, however, can generally be seen in similar vegetative features.

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Another case of a deviating pollination syndrome for a small species complex within a larger complex is represented by the "*Solenidiopsis* Senghas group" in *Odontoglossum* (members of the former genus *Solenidiopsis*, Dalström 2012). These miniature *Odontoglossum* species are vegetatively indistinguishable from their larger "cousins," but have developed very different looking flowers. Actually, the flowers are structurally similar to members of the "*Cochlioda* group," but are non-resupinate and rather drab in yellow to dark brown colors. While flowers of "cochliodas" display color as an attractant, the members of the "*Solenidiopsis* group" have distinct flower odors, which suggest an entirely different pollination syndrome, probably performed by smaller bees. Hence members of different but still closely related *Odontoglossum* groups or sub-genera can co-exist sympatrically without interspecific cross-pollination. Cross-pollination among similar-looking members within the same group of the more typical species complexes, however, is a different story altogether and rather frequent (Rolfe, 1893; Dalström, 2003).

When Chase and others (2008) transferred orchid genera *Cochlioda*, *Odontoglossum*, *Sigmatostalix* Rchb.f., and *Solenidiopsis* to *Oncidium* Sw., based on molecular evidence, a rather strange situation developed, seen from a taxonomic point of view. Many plants with very different vegetative features as well as floral features ended up in the same genus, together with some members of what clearly belong to the genus *Cyrtochilum* Kunth, such as *Odontoglossum contaypacchaense* D.E.Benn. & Christenson, *Odontoglossum machupicchuense* D.E.Benn. & Christenson, *Odontoglossum pseudomelanthes* D.E.Benn. & Christenson and *Odontoglossum rubrocallosum* D.E.Benn. & Christenson. In fact, even without these mistakenly transferred *Cyrtochilum* species (which probably were transferred without molecular evidence), the members of the generously extended *Oncidium* (sensu Chase et. al., 2008) are so different from each other that it becomes virtually impossible to visually define the genus *Oncidium* and to separate it from many other genera in the Oncidiinae. Therefore, some of the arguments used by Chase et al. (2008), Pridgeon et al. (2009), and later Neubig et al., (2012) to justify this transfer are worth analyzing.

> "If *Odontoglossum* is to be maintained as a distinct genus, then many more genera will need to be created or some long-known species with typical *Oncidium* floral morphology (e.g., *O. chrysomorphum* Lindl., *O. obryzatum* Rchb.f.) will have to be transferred into *Odontoglossum*, which removes any hope of morphological distinctiveness for *Odontoglossum*." (Chase et al., 2008).

No additional new names are needed to maintain *Odontoglossum* as a distinct genus once the vegetative *Odontoglossum*-looking "*Oncidium chrysomorphum*" and "*O. obryzatum*" complexes are transferred into *Odontoglossum*. This is clearly a more conservative and stabilizing alternative than lumping everything into *Oncidium*, which will effectively eliminate any possibility of distinguishing it as a genus. What DNA research has taught us is that flower morphology is not entirely reliable as a basis for taxonomic decisions, but vegetative features are.

> "After these changes [the removal of many *Cyrtochilum* species from *Odontoglossum* by Dalström (2001a)], there still remains a core group of *Odontoglossum* species that DNA studies have indicated are monophyletic, but these are deeply embedded in *Oncidium*." (Chase et al., 2008).

By studying the "…single maximum likelihood tree resulting from analysis of the combined five-region data set for 736 individuals" (Figure 8, in Neubig *et al*. 2012). We can see that an extended *Odontoglossum* is not actually "deeply embedded" in *Oncidium* at all, but a monophyletic sister-group to *Oncidium* (*sensu stricto*), even when the latter includes other distinguishable and monophyletic groups that have been described as separate genera, such as *Heteranthocidium* Szlach., Mytnik & Romowicz, *Chamaeleorchis* Senghas & Lückel, and *Sigmatostalix* Rchb.f.

> "In addition, *Cochlioda* Lindl. and *Symphyglossum* [as "*Symphyloglossum*"] Schltr. are hummingbird-pollinated species of *Oncidium* and also deeply imbedded in *Oncidium*/*Odontoglossum*, so these too are transferred." (Chase et al., 2008).

Symphyglossum sanguineum (Rchb.f.) Schltr., as the sole species from that genus was transferred to *Odontoglossum* in 2001 based on molecular evidence and vegetative features, and is not deeply embedded in *Oncidium* (*sensu stricto*). It is, however, deeply embedded in the monophyletic and extended *Odontoglossum* (Dalström 2001b). The other former *Symphyglossum* species; *S. distans* (Rchb.f.) Garay & Dunsterv., and *S. umbrosum* (Rchb.f.) Garay & Dunsterv., belong in *Cyrtochilum*. Whether *Odontoglossum sanguineum* is hummingbird-pollinated or not is probably pure speculation. We are not aware of any scientific documentation for this phenomenon.

> "*Sigmatostalix* is another such case. These often-tiny plants produce oil on their lip calli and are recorded to be pollinated by oil-collecting bees, as are the great majority of species in *Oncidium*. Size alone is not suitable for generic delimitation, and in all other ways the species of *Sigmatostalix* are similar to those in *Oncidium*. These also we transfer to *Oncidium*." (Chase et al., 2008).

Sigmatostalix Rchb.f., is a monophyletic complex of species that are easily distinguished from the bulk of *Oncidium* species (*sensu stricto*), and from most other Oncidiinae members for that matter, by the combination of a miniature growth, strongly flattened pseudobulbs generally with papery thin leaves, and the morphologic unique and rather bizarre–looking flowers. It makes sense to maintain this genus for the same reasons as for maintaining *Odontoglossum*.

> "We feel that it is better to use vegetative features in combination with few floral traits to define broader genera… *Oncidium* is perhaps the best example of our contention that floral morphology must be foregone in Oncidiinae as a basis for generic Characters… Floral traits in Oncidiinae are highly plastic and reflect evolutionary shifts in pollinators." (Neubig et al., 2012).

We agree that vegetative features can and should be used in defining genera, in combination with molecular evidence, and where possible also floral and any other available traits. The species transferred to *Odontoglossum* in this paper share more vegetative and molecular features with other species in that genus than with members of *Oncidium* (*sensu stricto*), but have switched to different pollination syndromes and therefore form a separate group within the genus, just like the "*Cochlioda* group" and the "*Solenidiopsis* group." The "when" and "why" this switch has taken place are unknown of course, but some indications suggest that ancient hybridization between members of genus *Heteranthocidium* (the "*Oncidium heteranthum* Poepp. & Endl., complex") and some *Odontoglossum* species may have taken place. Members of both genera are frequently sympatric in the Andean region and flower simultaneously, where few *Oncidium* (*sensu stricto*) species occur. The species that are transferred from *Oncidium* to *Odontoglossum* in this paper (the "*Oncidium chrysomorphum"* and "*O. obryzatum*" complexes) display features from both *Heteranthocidium* and *Odontoglossum*. They sometimes, but apparently not always, produce abortive flowers. The flowers in general and the pollination apparatus in particular of the transferred species are very similar to *Heteranthocidium* flowers, with an elongate, elephant-trunk-like rostellum and very narrow stipe on a minute ovoid viscidium. The inflorescence shapes are similar to some *Heteranthocidium* species, but the glossy, strongly flattened and the generally purple-mottled pseudobulbs are common *Odontoglossum* characteristics (Fig. 1). Members of the "*Oncidium chrysomorphum*" and "*O. obryzatum*" complexes are also characterized by having strictly unifoliate pseudobulbs, which makes them easily identified as a group even without flowers. Molecular evidence demonstrates that the here transferred species belong to the "base" of an extended *Odontoglossum* clade (Neubig et al. 2012). These hybridization speculations may seem far-fetched at first but we need to keep in mind that natural hybridization in *Odontoglossum* (Rolfe, 1893) is quite common and may be a much more active factor in the speciation process than we previously have acknowledged.

In addition to the already DNA sequenced species, which are transferred to *Odontoglossum* below, there are a few other taxa that may have to be transferred as well. It is unclear at this time, however, whether they really represent valid species or are just synonyms of the ones treated in this paper. In other words, more work is needed to complete this task.

Nomenclature

Odontoglossum boothianum (Rchb.f.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium boothianum* Rchb.f., *Bonplandia* (Hannover) 2: 14. 1854. TYPE: VENEZUELA. Carabobo: *H. Wagener s.n.* (Holotype: W-48679). Fig. 2.

Homotypic synonyms: *Heteranthocidium boothianum* (Rchb.f.) Szlach., Mytnik & Romovicz. Polish Bot. J. 51: 54. 2006.

Vitekorchis boothianus (Rchb.f.) Romovicz & Szlach., Polish Bot. J. 51: 46 (2006).

The identification of the DNA voucher representing this species (*Whitten 1732, 2447* and *2505*, FLAS) was verified by Dalström.

Odontoglossum chrysomorphum (Lindl.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium chrysomorphum* Lindl., Fol. Orchid. 6: 54. 1855. TYPE: "Caraccas" (Lindl., 1855) Probably Colombia: Santa Martha, *W. Purdie s.n.* (holotype: K, not seen).

The identification of the DNA voucher representing this species (*Whitten* 1671, FLAS) was verified by Dalström.

Odontoglossum obryzatoides (Kraenzl.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium obryzatoides* Kraenzl., in H.G.A.Engler (ed.), Pflanzenr., IV, 50(80): 240. 1922. TYPE: COSTA RICA. *A. R. Endres 325* (holotype: W-13227).

The identification of the DNA voucher representing this species (*N 639 = Chase 11754*, K) was not verified. However, the vegetative features in particular and floral features in general of this species correspond very well with the other species included here to justify the transfer.

Odontoglossum obryzatum (Rchb.f. & Warsz.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium obryzatum* Rchb.f. & Warsz., Bonplandia (Hannover) 2: 108. 1854. TYPE: PERU. *J. von Warscewicz s.n.* (Holotype: W-48672).

Vitekorchis obryzata (Rchb.f. & Warsz.) Romovicz & Szlach., Polish Bot. J. 51: 46. 2006.

The identification of the DNA voucher representing this species (*Whitten 2343,* at FLAS) was verified by Dalström. The floral features of this species are very similar to the lesser known but earlier described species that follows immediately below, and they may prove to be synonymous when more material has been analyzed.

Odontoglossum pictum (Kunth) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium pictum* Kunth in F.W.H.Humboldt, A.J.A.Bonpland & K.S.Kunth, Nov. Gen. Sp. 1: 346. 1816. TYPE: COLOMBIA. Cauca: Popayan, between El Naranjo and Roldanilla, alt. 540 m, *A. J. A. Bonpland & F. W. H. von Humboldt 1893* (Holotype: P). Fig. 3.

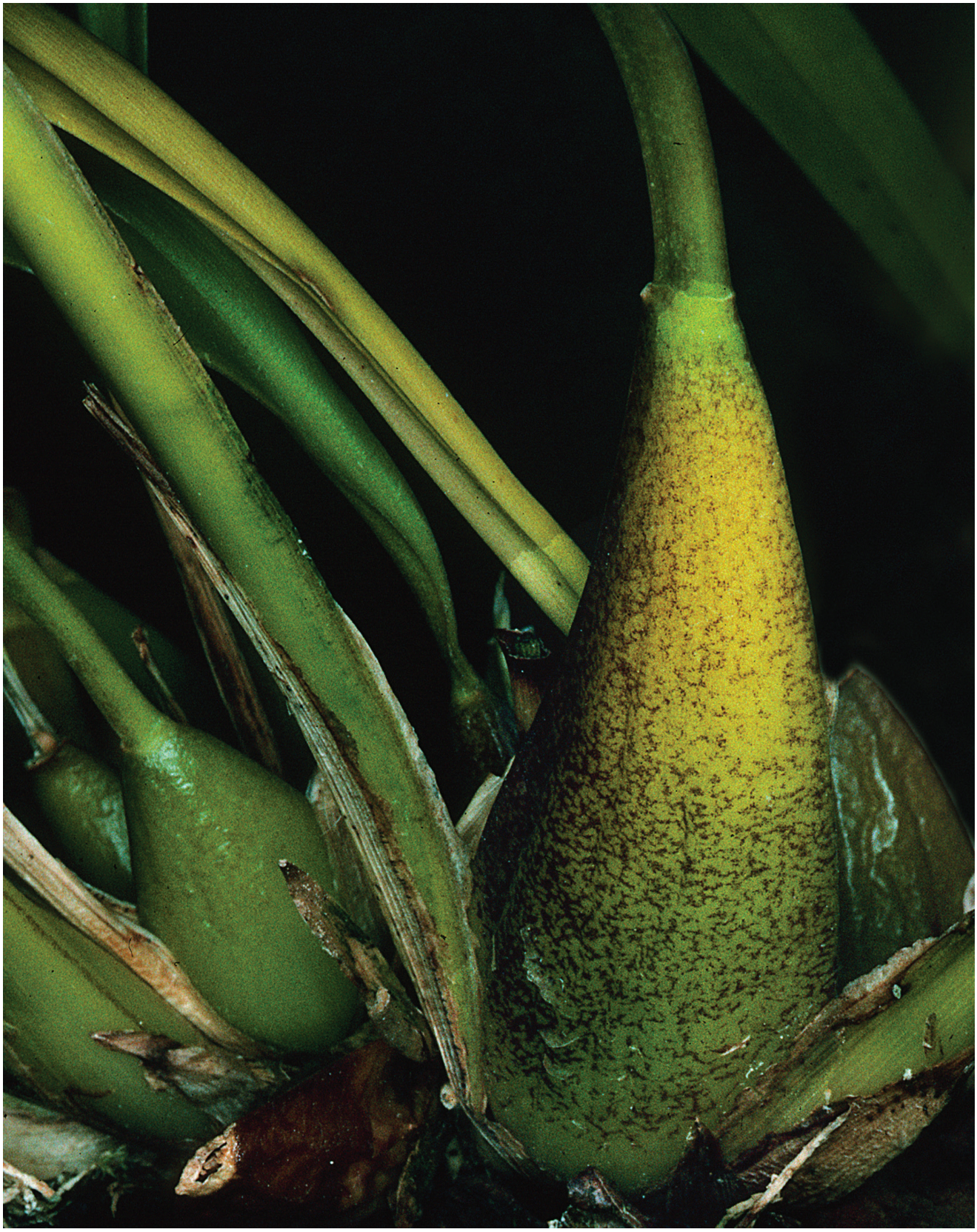

FIGURE 1. *Odontoglossum hirtzii* Dalström, displaying purple mottling on a typical cultivated *Odontoglossum* pseudobulb (no specimen made). Photograph by Stig Dalström.

FIGURE 2. *Odontoglossum boothianum* (Rchb.f.) Dalström & W.E.Higgins (based on *S. Dalström 3716* (USM). Photograph by Stig Dalström.

No DNA sample of this species is known to us or has appeared in any published phylogenetic analysis, but it may prove to be an older name for *O. obryzatum*. The illustration of *Odontoglossum pictum* (as "*Oncidium*") that appears in the original publication (Kunth 1816: t. 81) shows a bifoliate pseudobulb. The type specimen in Paris from which the drawing is made has a unifoliate pseudobulb (Fig. 3), however, which appears to be typical for this group of species.

Odontoglossum tipuloides (Rchb.f.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium tipuloides* Rchb.f., Bot Zeitung (Berlin) 10: 856. 1852. TYPE: PERU. Huanuco: Cuchero, January 1830, *E. F. Pöppig 1635* (Holotype: W). Fig. 4.

The identification of the DNA vouchers representing this species (*Whitten 1676* and *2421*, FLAS, both previously incorrectly identified as cf. "*schmidtianum*") was verified by Dalström.

Odontoglossum trinasutum (Kraenzl.) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium trinasutum* Kraenzl., in H.G.A.Engler (ed.), Pflanzenr., IV, 50(80): 194. 1922. TYPE: ECUADOR. Pichincha: *W. Jameson s.n.* (Holotype: W-44522).

The identification of the DNA voucher representing this species ("*N335*" = *Williams 335*, FLAS) was verified by Dalström.

Odontoglossum zelenkoanum (Dressler & Pupulin) Dalström & W.E.Higgins *comb. nov.*

Basionym: *Oncidium zelenkoanum* Dressler & Pupulin, Lankesteriana 8: 37. 2003. TYPE: PANAMA. Bocas del Toro: Culebra (Velorio), 1000 m, November 2000, flowered in cultivation July 2001, *A. Maduro & E. Olmos 195* (Holotype: MO; Isotype PMA). Fig. 5.

The identification of the DNA voucher representing this species ("*N 552*" = *Whitten 3471*, at FLAS) was verified by Dalström.

FIGURE 3. *Oncidium pictum* Kunth. Holotype (P). Photograph by Muséum National d'Histoire Naturelle (P), provided by SEL.

FIGURE 4. *Odontoglossum tipuloides* (Rchb.f.) Dalström & W.E.Higgins (based on *S. Dalström 2358* (SEL). Photograph by Stig Dalström.

FIGURE 5. *Odontoglossum zelenkoanum* (Dressler & Pupulin) Dalström & W.E.Higgins (based on *S. Dalström 3791* (USM). Photograph by Stig Dalström.

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MORPHOLOGY AND ANATOMY OF *GUACAMAYA SUPERBA* (RAPATEACEAE) AND SCHOENOCEPHALIEAE WITH NOTES ON THE NATURAL HISTORY OF THE *FLOR DE INÍRIDA*

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Abstract. Rapateaceae are a monophyletic family of 17 genera with greatest species diversity on the mountains and savannas of the Guiana Shield. The family has intrigued botanists because of their interesting and unusual inflorescence and leaf morphologies. The small tribe Schoenocephalieae (three genera and seven species) are regionally prized for their showy inflorescences that are harvested as everlasting flowers. Here, we report on local cultivation efforts to minimize harvesting from wild populations and examine vegetative morphology and anatomy, reporting for the first time the presence of a lateral thickening meristem in Rapateaceae. Schoenocephalieae exhibit possible adaptations to their oligotrophic, open, and fire-prone habitats such as abundant mucilage, idioblasts containing a tannin-like substance, leaf fibers, presence of epidermal silica, the formation of telmata in *Guacamaya*, and vesicular-arbuscular mycorrhizal fungi.

Keywords: Guiana Shield, *Kunhardtia*, oligotrophic, phytotelmata, Rapateaceae, secondary thickening meristem, white-sand savanna

Rapateaceae (Poales) are a remarkable family due to their unusual leaf morphology, inflorescence structure, anatomy, and phylogenetic and biogeographic histories (Arber, 1925; Maguire, 1958; Carlquist, 1961, 1966, 1969; Venturelli and Bouman, 1988; Stevenson et al., 1998; Givnish et al., 2000; Crayn et al., 2001). The family is considered monophyletic (Givnish et al., 2000; Davis et al., 2004; Givnish et al., 2006; Bouchenak-Khelladi et al., 2014) comprising 16 or 17 genera and about 100 species (Stevenson et al., 1998; Berry, 2004), the placement of which within early-diverging Poales is not yet clear (Givnish et al., 2000; Bremer, 2002; Michelangeli et al., 2003; Bremer and Janssen, 2004; Davis et al., 2004; Chase et al., 2006; Givnish et al., 2006; 2010; Bouchenak-Khelladi et al., 2014). The family is thought to have evolved in the late Cretaceous, with estimates of about 36–80 million years before present (Givnish et al., 2000; Bremer, 2002; Janssen and Bremer, 2004; Bouchenak-Khelladi et al., 2014).

Rapateaceae are hypothesized to have evolved in wet, open habitats (Bouchenak-Khelladi et al., 2014) in the flooded lowlands on the Guiana Shield (Givnish et al., 2000; 2004), where they are presently most diverse (Stevenson et al., 1998; Berry, 2004; Stevenson, 2004). Most species occur in savannas, on *tepui* slopes and summits, inselbergs, or in low elevation forests on the Guiana and Brazilian Shields of northern South America (Stevenson et al. 1998; Berry, 2004, 2012) as lithophytic or understory plants, but most distinctively as dominants in herbaceous communities (Huber, 1995a, 2006; Fig. 1A). Rapateaceae exhibit elevation (on the Guiana Shield; Huber, 1987) as well as geographical disjunctions. The epiphytic genus *Epidryos* is distributed in Panama (Davidse, 1994), the Andes (Berry, 2004), as well as on the Guiana Shield (Givnish et al., 2004; Rodrigues and Flores, 2010), and the single amphiatlantic species, *Maschalocephalus dinklagei* Gilg and K. Schum., is known from tropical Africa (Liberia and Sierra Leone) presumably through a recent long-distance dispersal (Givnish et al., 2000, 2004).

Two subfamilies of Rapateaceae were recognized in the past, supported by pollen morphology and vegetative anatomical studies (Carlquist, 1961; Shoichi Kawano in Maguire, 1965; Carlquist, 1966, 1969): Rapateoideae and Saxofridericioideae, each with two tribes (Maguire, 1958; Stevenson et al., 1998). In the current infrafamilial classification Givnish and Berry (in Givnish et al., 2000) segregated Monotremeae from Rapateoideae, recognizing it as a third subfamily and erected a new tribe: Stegolepideae for all of Saxofridericieae except the type genus. In both the traditional and current classifications, Saxofridericioideae include the tribe Schoenocephalieae, which consists of three genera: *Guacamaya* (1 sp.), *Kunhardtia* (2 spp.), and *Schoenocephalium* (4 spp.; Fig. 1B–D).

Rapateaceae are perennial herbs; many are rhizomatous and have long-pedunculate inflorescences with colorful bracts. Among the principal morphological and anatomical characteristics known in the family are: highly thickened endodermal cell walls in the root (Carlquist, 1966); presence of aerenchyma in the roots and peduncles; and broad stems, usually with inconspicuous internodes, and ground tissue with sclerenchyma, slime canals (Schoenocephalieae), and starch (Carlquist, 1966, 1969; Stevenson et al., 1998; Ferrari et al., 2014). The leaves have conspicuous, conduplicate

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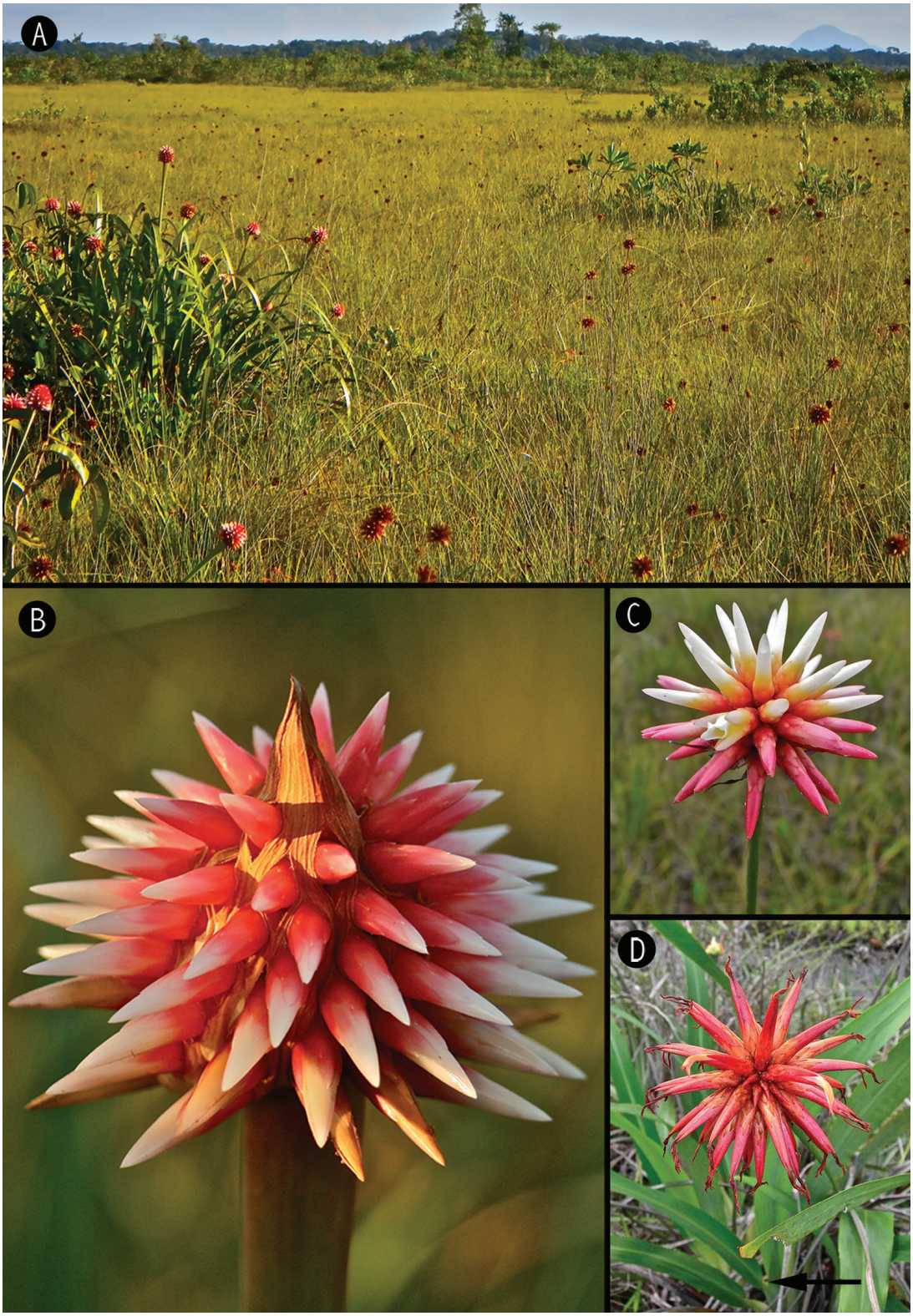

FIGURE 1. Species of Schoenocephalieae (Rapateaceae) and their habitat. **A**. White-sand savanna in Inírida, Colombia (Guainía state). A broad savanna landscape with isolated inselbergs (one seen at the right in the background). *Guacamaya superba* is blooming at the left, and dried infructescences of *Schoenocephalium teretifolium* are at the right. **B**. Detail of the conical inflorescence of *G. superba*, with a pair of involucral bracts (brown) that are pierced at maturity by the individual flowers. **C**. Globose inflorescence of *S. teretifolium*, note the open flower. **D**. Globose inflorescence of *Kunhardtia radiata*, the petals withered. The constriction between the conduplicate sheath and lamina can be seen below. (See arrow; photograph by G. A. Romero-González).

leaf sheaths (Boubier, 1895; Arber, 1922, 1925; Solereder and Meyer, 1929; Pilger, 1930; Carlquist, 1969), paracytic stomata, silica bodies in the adaxial epidermis, a hypodermis is sometimes present (Solereder and Meyer, 1929; Carlquist, 1969; Ferrari et al., 2014), subdermal fiber strands (Carlquist, 1969), buttressed vascular bundles surrounded by a fibrous sheath (Carlquist, 1969; Ferrari et al., 2014), large colorless cells in the mesophyll, and, in some genera, uniseriate, slime-secreting trichomes associated with vegetative and floral structures (Carlquist, 1969; Oriani and Scatena, 2013). Peduncle anatomy appears to have taxonomic utility in Rapateaceae (Carlquist, 1969; Oriani and Scatena, 2013), although it has not been exhaustively studied. In addition to silica bodies, idioblastic tannin cells are found in various organs (Carlquist, 1969; Ferrari et al., 2014). Both the inflorescences and flowers are bracteate, the anthers dehiscence by apical or subapical pores, and the seeds have silica bodies (Tiemann, 1985; Venturelli and Bouman, 1988; Oriani and Scatena, 2013).

The white-sand savanna habitats of many Rapateaceae are complex ecosystems that occur in tectonically stable regions although the massive sandstones are constantly eroding (Goodland, 1966; Kroonenberg, 1985; Gibbs and Barron, 1993). This ecosystem experiences a bimodal seasonality. Heavy precipitation causes flooding during the rainy season (Domínguez, 1985; Huber 1995b), although many savannas drain quickly limiting water availability (Campbell and Stevenson, 2005). High temperatures and insolation make the vegetation vulnerable to scorching when a shallow layer of water remains on the savanna (pers. obs.), and accentuate the effects of natural and anthropogenic fires in the dry season (Hernández, 1987; Huber, 1995a; Biddulph and Kellman, 1998; Rodríguez, 2004. The hydrologic regime; high insolation; and the soil acidity (Medina et al. 1990; Cárdenas, 2007), with low concentration of essential nutrients, and often high levels of aluminum (Huber, 1995b) are profound physio-ecological challenges for plants occurring in white-sand savannas (Klinge and Medina, 1979; Medina et al., 1990).

Symbiotic mycorrhizae improve plants' ability to endure environmental stress, influencing nutrition (Fitter et al., 1987; Sylvia, 1990) and seed germination (Dickison, 2000). Although a symbiotic relationship has not been demonstrated, the mycorrhizal fungus *Scutellospora* sp. has been reported from soil samples taken from areas occupied by populations of Rapateaceae (Walker et al., 1998) and the endophytic fungus *Stegolerium kukenani* Strobel, Hess & Ford was isolated from *Stegolepis* leaves (Rapateaceae; Strobel et al., 2001).

Among the most locally common Schoenocephalieae, *Guacamaya superba* Maguire (Fig. 1B), *Schoenocephalium cucullatum* Maguire, and *S. teretifolium* Maguire (Fig. 1C; 9B, C) often occur in sympatric populations, and are known locally as *Flor de Inírida* in Colombia (Avellaneda and Herrera, 1998) or *Flor de Maroa* in Venezuela (Stevenson, 2004; *M. Colella et al. 1275*, NY). These species are restricted to white-sand savannas of the western Guiana Shield, in southeastern Colombia (Amazonas and Guainía states; ICN, 2014) and southwestern Venezuela (Guainía and Amazonas states; GBIF, 2012). Generally, *Schoenocephalium* grows in more exposed sites where *G. superba* is not successful, but sometimes inhabits marshy places with *G. superba*. Due to their differing phenology, *G. superba* and *Schoenocephalium* are further distinguished in Colombia as *Flor de Inírida de invierno* and *Flor de Inírida de verano*, respectively (Avellaneda and Herrera, 1998; Rojas et al., 2001). Less easily differentiated are the two species of *Schoenocephalium*, which are thought to hybridize in zones of contact (Berry, 2004). The red floral bracts, whitish perianth, and long peduncles give *Guacamaya* inflorescences their appealing beauty that inspired Maguire (1958, 1982) to use the local name for the beautiful and revered scarlet macaw (*Ara macao*) in naming the genus. Often occurring in dense populations, with the inflorescences held above other savanna vegetation (Fig. 1A), many Rapateaceae are iconic of Guiana Shield savannas, and it is not surprising that the inflorescences of *Guacamaya* are an important emblem for local people (see Maguire, 1958; Fig. 9D, E), who harvest Schoenocephalieae for decorative bouquets (Schultes, 1954; Berry, 2004; Fig. 9A, D, F). The larger dried infructescences of *Kunhardtia* are likewise collected, but are relatively unknown because the remoteness of where they occur.

In spite of the regional and scientific interest, information on many biological aspects (Avellaneda and Herrera, 1998) of some Rapateaceae is scanty due to the difficult access for researchers to regions where many species are endemic (see Funk and Hollowell, 2007), making long term field studies difficult. Schoenocephalieae have been examined anatomically; however, material was limited (Carlquist, 1966).

The objective of this paper was to examine the morphology and anatomy of *Guacamaya* in comparison with other Schoenocephalieae and to characterize their habitats and possible adaptations to them, as well as natural history information.

Materials and Methods

Study Sites

Intensive descriptive fieldwork was conducted documenting morphological and ecological features of *Guacamaya superba* in white-sand savannas of Inírida (Guainía state, Colombia, in the Orinoco river basin), supplemented by years of observations there and in the vicinity of Maroa (Municipio Autónomo Maroa, Amazonas state, Venezuela, in the Río Negro and therefore the Amazon river basin). Both sites (3°49.129'N, 67°53.894'W and 37°25.8'N, 122°05.36'W) are below 120 m, and are characterized by isolated savannas within *bana* or Amazonian *caatinga* (see Prance, 1996; Huber, 1995a; Fig. 1A). The geomorphology of the upper Río Negro also includes numerous inselbergs, or *lajas* (Fig. 1A). Annual averages for Inírida are 83–85% relative humidity, over 3000 mm rain, and 26°C (for 1972–2010, IDEAM—Instituto de

Hidrología, Meteorología y Estudios Ambientales, pers. com.; Mejía and Mejía, 1980; Cárdenas, 2007). Both study sites experience greater evapotranspiration in December–March (Huber, 1995b; Cárdenas, 2007); however, Maroa, located approximately 100 km to the southeast of Inírida, is in a region with greater precipitation (Mejía and Mejía, 1980; and "…a barely pronounced" (Huber, 1995b: 13) and much shorter dry season. Details of the specimens collected are presented in Table 1.

Plant Samples and Preparations

Individual plants of *Guacamaya superba* were excavated, dissected, measured, and photographed *in situ*. Data were obtained to characterize growth patterns, morphology, and general ecological features. Samples (Table 1) were fixed in formalin-propionic acid-alcohol (FPA; 1:1:18 v/v, 50% EtoH; Johansen, 1940) and then transferred to 70% EtoH. Some samples of *G. superba* were directly collected into ethanol. Observations were also made on herbarium specimens at NY, and some material was rehydrated with Aerosol®OT solution (10%; Fisher Scientific Inc.; Ayensu, 1967). A free-hand peel of leaf epidermis was stained with Johansen´s safranin (Johansen, 1940). For sectioning, samples were paraffin embedded (Paraplast®X-Tra, M^{c}Cormic™) using standard procedures, except for some hard tissues that were resin embedded (Technovit H7100). Sections were cut 4–11μm thick using a rotary microtome (AO Spencer 820). Paraffin samples were stained with Johansen´s safranin and counterstained with astrablue (Roeser, 1962), whereas Toluidine Blue O (O'Brien et al. 1964) was used for resin embedded sections. The presence of lignin was detected with saturated phloroglucinol, acidified with HCL (Jensen, 1962). To evaluate the presence of mycorrhizae in roots and root nodules, roots were cleared with 10% KOH and stained with Trypan blue (Phillips and Hayman, 1970) and cotton blue (Aniline blue W.S.; Rawlins, 1993). Leaves of *G. superba* were cleared modifying the protocol of Vasco et al. (2014); stained with Safranin in 95% EtOH and mounted in Caroplastick® (Carolina®, Burlington, North Carolina). Slides were observed on a Zeiss Axioplan light microscope and photographed with a Nikon digital camera (DXM1200c) using the ACT-1 software (Nikon Instruements, Inc.®). For scanning electron microscopy, samples were dehydrated in a series to 100% acetone and then critical point dried in a DCP-1 apparatus (Denton Vacuum, LLC). Samples were coated with gold palladium in a sputter coating system (Hummer 6.2, Anatech USA, Union City, CA) and observed at 10 kV in a JEOL JSM-5410LV microscope (JEOL USA, Inc., Peabody, MA). Images were obtained using ORION software (ver. GA02870/1, ©2000–2004 JEOL USA, Inc.) and edited using Adobe Photoshop. Terminology follows Barthlott et al. (1998) for wax. Abbreviations are used for longitudinal and transverse sections (l.s.; t.s.) and vascular bundle(s) (v.b.; v.bs.).

TABLE 1. Samples, their vouchers, and the structures used for this anatomical research.

SAMPLE	ROOT	STEM	LEAF	PEDUNCLE
Guacamaya superba Maguire *Campbell et al. 505* (NY)				X
G. superba Maguire *Fernández-L. 104* (ANDES)	X	X	X	X
Kunhardtia radiata Maguire & Steyerm. *Campbell et al. 684* (NY)				X
K. radiata Maguire & Steyerm. *Maguire et al. 31834* (NY)*			X	
K. rhodantha Maguire *Campbell et al. 767B* (VEN)	X	X	X	
Schoenocephalium teretifolium Maguire *Campbell s.n.* (NY)				X
S. teretifolium Maguire *Huber 5957* (NY)*	X	X	X	

* Denotes herbarium samples rehydrated with a 10% Aerosol®OT solution (Fisher Scientific Inc.; Ayensu, 1967), otherwise samples were originally collected in fluid.

Morphological and Anatomical Observations

Schoenocephalieae

The three genera studied are perennial herbs of oligotrophic savannas or rock surfaces (*Kunhardtia*) with erect stems; open, conduplicate leaf sheaths; no evidence of Kranz anatomy; and long, distally compressed peduncles.

Guacamaya

Guacamaya superba has a terminal inflorescence and sympodial renewal shoots (Fig. 2A). Mature individuals (leaves and peduncles) ranged from 50 cm to 180 cm high. Impounding phytotelma, composed of marcescent leaf sheaths that persist for years, were observed. Up to 25% of juvenile shoots were found dead in the leaf axils before the bud elongated (n = 16 individuals; Fig. 3E). A community of other plant species (Fig. 3F), invertebrates, and small vertebrates were observed in the phytotelma.

Root. 9–11 mm diam., endogenous, grows laterally through the cortex (Fig. 4A), before piercing the leaf sheaths, growing closely along the stem providing mechanical support (Fig. 3H, 4A). Plagiotropic growth and root branching (Fig. 4B) begins in less than 20 cm of substrate, some negatively or more-or-less horizontal roots, to 15 mm diam., occur inside the phytotelma, branching and producing root nodules (Fig. 3D, 4B, C). Roots with nodules were also found piercing through the marcescent leaf sheaths.

A velamen is present during development, and is later sloughed off (Fig. 4G). Exodermis of 3 or 4 cell layers (Fig. 4G), cell walls lignified. Cortex broad, a narrow band of irregular, densely compact cells below the exodermis, middle cortex composed of large arm parenchyma, many cells collapsed, parenchyma towards the central cylinder more regular in shape and progressively smaller near the endodermis. Tannin cells scattered throughout the ground tissue, denser near the central cylinder, which they nearly completely surround in 3 or 4 layers. Endodermis uniseriate, cells narrow and anticlinally elongate. Pericycle bilayered, cells periclinally broad, squarish to irregular in shape, stele polyarch with over 30 poles, cells of the pith highly lignified, except those immediately surrounding the metaxylem vessels (Fig. 4D, E).

Fungal hyphae present as vesicular-arbuscular endomycorrhizae were in parenchyma near the periphery of the root cortex and mycelia also in parenchyma cells of roots and root nodules (Fig. 4E).

Stem. Covered by indurate leaf sheaths, tightly surrounded by shoot-borne roots (Fig. 3H, 4A), ca. 3–5 cm diam. when mature. Cortical cells small and densely arranged, elliptical to spherical, with abundant starch (Fig. 2G), and scattered tannin idioblasts (Fig. 5), slightly less abundant in the stele of younger stems. Large slime cavities with uniseriate, multicellular trichomes in the outer cortex. Endodermis apparently biseriate. Radial files of cells produced from meristematic activity near the pericycle (Fig. 5). Vascular bundles are amphivasal and coalesced (Fig. 5).

Leaf. 35–185 cm long, sheath ca. ¼ the length of the leaf, phyllotaxis spirodistichous, sheath open, asymmetrically conduplicate (Fig. 6D, F), the fold conspicuous, edge hard, tapered to a constriction below the lamina (Fig. 6A, B).

Leaf sheath with mucilage-secreting hairs on the adaxial surface, wax covered spherical glands (Fig. 7G), and coiled tubules (Fig. 7F) more abundant on the sheath, lamina also with wax plates and granules (Fig. 7E) in the medial region of the lower surface, and arachnoid crystaloids over some guard cells (Fig. 7A). In surface view epidermal cells squarish, intercostal and costal cells of similar size, the anticlinal walls sinuous (Fig. 2C). In t.s. the cells short, of similar size on both surfaces of the lamina (Fig. 2D); silica bodies present. Predominantly hypostomatic, occasionally distally amphistomatic, stomata paracytic, in randomly arranged rows (Fig. 2C). Cuticle thick on the adaxial surface (Fig. 2D). Hypodermis of small, densely compact cells and large tannin filled cells on the adaxial surface of the sheath, tannin filled cells continuous on the abaxial surface except where interrupted by v.b. buttresses, in the lamina subepidermal tannin cells continuous in one or more layers in the underside, interrupted by v.b. buttresses on the upper side. Remaining mesophyll of the sheath composed of mostly isodiametric cells with abundant starch, those of the adaxial surface small and compact, centrally some small lysigenous cavities and arm parenchyma, and scattered tannin filled cells. Cavities becoming regularly spaced air canals in the lamina (Fig. 6H). Phloem with a cap of fibers, buttress sclerenchyma cells with a very small lumen. Conduplication narrower than the rest of the sheath, with a small v.b., the midvein off center. Other v.bs. more or less at two levels, those toward the abaxial surface large and small, toward the adaxial large. Vascular bundles collateral, surrounded by a sheath of parenchyma and tannin filled cells. Vessel elements with sclariform plates.

Peduncle. 40 to 180 cm long. Easily detached from the rhizome, base slimy (Fig. 2A). Ovate medially in t.s., 0.5–1 cm diam., distally flattened, more than twice the median width, twice as wide as thick (Fig. 8A). Epidermis narrow, uniseriate, cells radially elongate, silica bodies present, stomata paracytic, in longitudinal grooves. Hypodermis a single layer of colorless or tannin filled cells (Fig. 8A, D–F), subdermal layer interrupted by sclerenchyma of v.b. buttresses and substomatal chambers. Subdermal chlorenchyma larger than the epidermal cells, isodiametric, lobed and larger toward the center at the base, lobed and becoming stellate and aerenchymatous towards the center in the medial portion of the axis, distally nearly all subepidermal cells lobed (Fig. 8F). Starch grains present in the base, idioblastic tannin more abundant proximally (Fig.8F). Vascular bundles numerous, collateral, phloem with a cap of fibers, peripherally the v.bs. solitary, smaller, in a single subdermal ring, buttressed with sclerenchyma, towards the center the bundles coalesced or solitary, without a common sheath, but surrounded by a few lignified cells (Fig. 8 A, 8D–F).

Kunhardtia

Root. Endogenous, piercing the leaf sheaths, growing closely along the stem providing mechanical support. Exodermis 3 or 4 cell layers. Cortex broad, below the

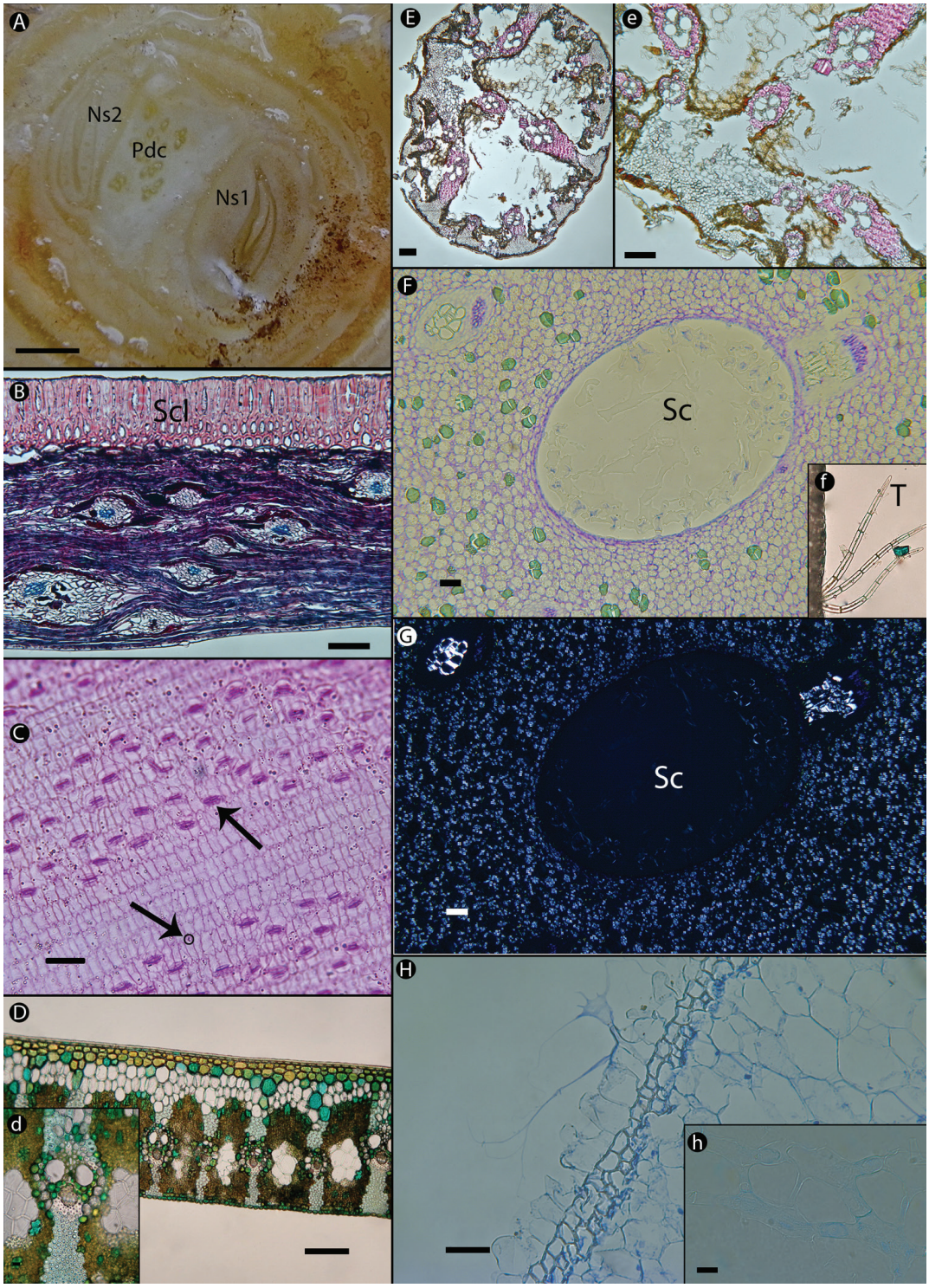

FIGURE 2. Sections of stems and leaves of *Guacamaya superba* (A, C, D, F–H), *Kunhardtia radiata* (B), and *Schoenocephalium teretifolium* (E). **A**. A transverse (t.s.) section of the slimy stem apex. Note the terminal position of the peduncle (Pdc), with visible vascular bundles, and two shoots (Ns1, Ns2). **B**. Transverse section of a base of a marcescent leaf sheath from a tank, with elongate, highly lignified sclerenchyma (Scl). **C**. Leaf epidermis. Note the nearly linear arrangement of the intercostal stomata, and the presence of silica bodies (downward arrow). **D**. Transverse section of the leaf blade showing arrangement of the buttressed vascular bundles, large colorless parenchyma, and tannin cells. Detail of a vascular bundle (d). **E**. Transverse section through the proximal portion of an elliptic, terete *Schoenocephalium* lamina. **F**. Stem (t.s.) with a wide slime canal lined with uniseriate trichomes (f). **G**. The same section as F as viewed under polarized light revealing abundant cortical starch. **H**. Fungal infection of a root; a hypha is evident, penetrating the epidermis and terminating as an external arbuscule. A branched hypha inside an arm-parenchyma cell (h). Abbreviation: t.s., transverse section. Ns, renewal shoot; Pdc, peduncle; Sc, slime canal; Scl, sclerenchyma. Scale bars: A: 5 mm; B, D, E: 0.1 mm; C, F–H: 50 μm; d, h: 10 μm.

FIGURE 3. Aspects of the morphology and habitat of *Guacamaya superba*. **A**. A termite mound in a white-sand savanna that burned during the previous year. In the rainy season this individual of *G. superba* and other species resprouted. **B**. A partially disected plant showing the spirodistichous phyllotaxis and water impounding leaf sheaths. Mature individuals can have up to 50 shoots, and dead leaves remain attached to the stem for several years forming a massive tank system. **C**. A fallen inflorescence decomposing in the phytotelma. **D**. Branched root system in an impounding tank (removed). Note the mucilage from the stem cortex. **E**. Buds of many shoots were found decomposing inside the phytotelmata. **F**. Plants of various species utilize the habitat inside the phytotelmata, in this case an orchid in the favorable, moist conditions. **G**. A termite mound associated with *G. superba*, an association that is common among plants in oligotrophic, white-sand savannas. **H**. A stem with old leaves removed. Roots emerge from the cortex, piercing the leaf sheaths, and course vertically, firmly adhering to the stem, providing mechanical support, even when dead (dark roots).

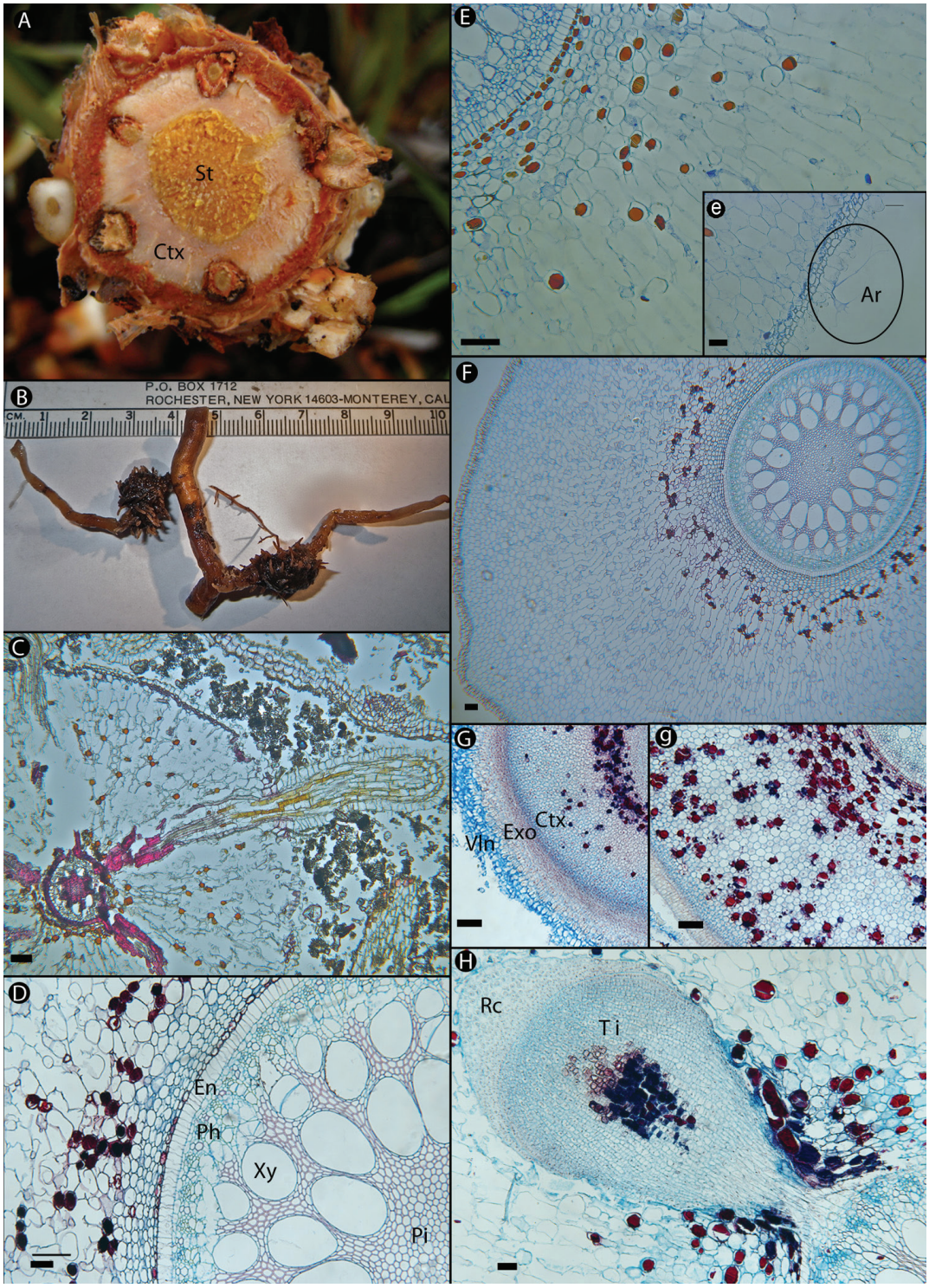

FIGURE 4. Roots of *Guacamaya superba* (A–E, G, H) and *Kunhardtia rhodantha* (F). **A**. Medial portion of a rhizome (t.s.), with roots emerging from the cortex (Ctx). Note the yellow stele (St). **B**. A branched root with nodules excavated from a phytotelma. **C**. Root nodule (t.s.) showing rootlets and the lignified endodermis (darkly stained). **D**. Detail of a vascular cylinder, pericycle, and endodermis. **E**. Root (t.s.) with mychorrhizal arbuscules (e). **F**. Mature root (t.s.) of *Kunhardtia* with tannin containing cells concentrated near the vascular cylinder. **G**. Transverse section of a young root, note the tannin cells becoming more dispersed with age (g) and presences of a velamen (Vln) present during early stages of development. **H**. Early stage of root branching (l.s.). Abbreviations: l.s., longitudinal section; t.s., transverse section. Ar, arbuscular mychorrhiza; Ctx, cortex; En, endodermis; Exo, exodermis; Ph, phloem; Pi, pith; Rm, root cap overlying the meristem; Ti, tannin idioblasts; Vln, Velamen; Xy, xylem. Scale bars: C, E, F, G: 0.1 mm; D, H: 50 μm.

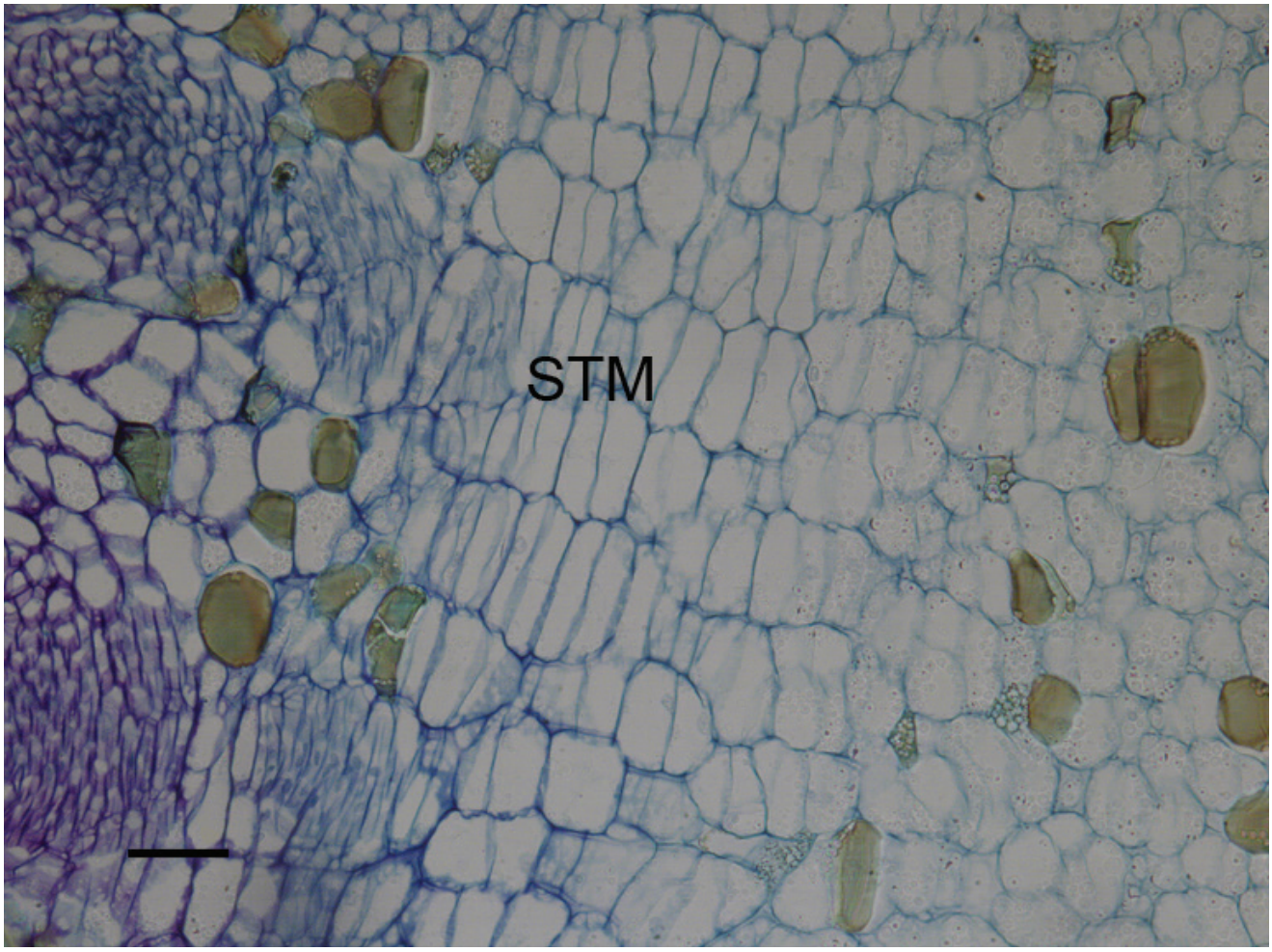

FIGURE 5. Stem of *Guaycamaya superba*, showing radial files of cells of the secondary thickening meristem (STM; scale bar: 0.1 mm).

exodermis cells isodiametric, densely compact, cells grading into arm parenchyma, many collapsed. Tannin idioblasts present in a ring near the periphery of the cortex, 4–7 layers of elliptic, densely compact cells surround the endodermis. Endodermis uniseriate, cells anticlinally elongate. Cells of the pericycle large, periclinally broad, stele polyarch, phloem scanty, cells of the pith highly lignified, except those immediately surrounding the metaxylem vessels (Fig. 4F).

Stem. Epidermis with silica bodies. Cortex with slime cavities lined with uniseriate trichomes, abundant starch in young tissue.

Leaf. Distichous, equitant. Sheath evenly conduplicate, with uniseriate, multicellular mucilage-secreting hairs on the adaxial surface, epidermis multilayered, sclerotic, silica bodies present, hypodermal cells lignified, vascular bundles large and small, with a cap of phloem fibers, often a partial tannin sheath, fiber buttresses to one or both surfaces. Vascular bundles of the lamina amphivasal, buttressed to one or both surfaces.

Peduncle. Distally broad, flattened and elliptic in t.s. Epidermis narrow, uniseriate, cells radially elongate, with silica bodies, hypodermis a single layer of tannin filled cells, cortex fibrous at the periphery, sometimes a greater number of fiber layers present above v.bs. Distally, most chlorenchyma lobed, becoming stellate toward the center. Vascular bundles numerous, collateral, phloem with a cap of fibers, v.bs. surrounded by lignified cells, a single ring peripherally of smaller v.bs. with fibrous buttresses, bundles toward the center coalesced.

SCHOENOCEPHALIUM

Root. Exodermis bilayered, cells sclerified. Cortex wide, aerenchyma radially arranged throughout, innermost parenchyma radially elongate, thick-walled, deeply stained, endodermal cells highly lignified, the walls evenly thickened, lumen extremely narrow. Pith lignified.

Stems. Narrower than the other species examined, cortex with slime canals and abundant starch.

Leaf. Spirodistichously inserted. Sheath conduplicate, broad, tapered to a terete lamina, less than 1 cm diam. (Fig. 2E). Cuticle thick, epidermis of the lamina compact, cells darkly stained. Mesophyll cells isodiametric near the periphery, arm-cells toward the center forming aerenchyma with large air spaces. Vascular bundles collateral, surrounded by a fibrous sheath, larger ones buttressed to the epidermis by an obdeltoid patch of sclereids.

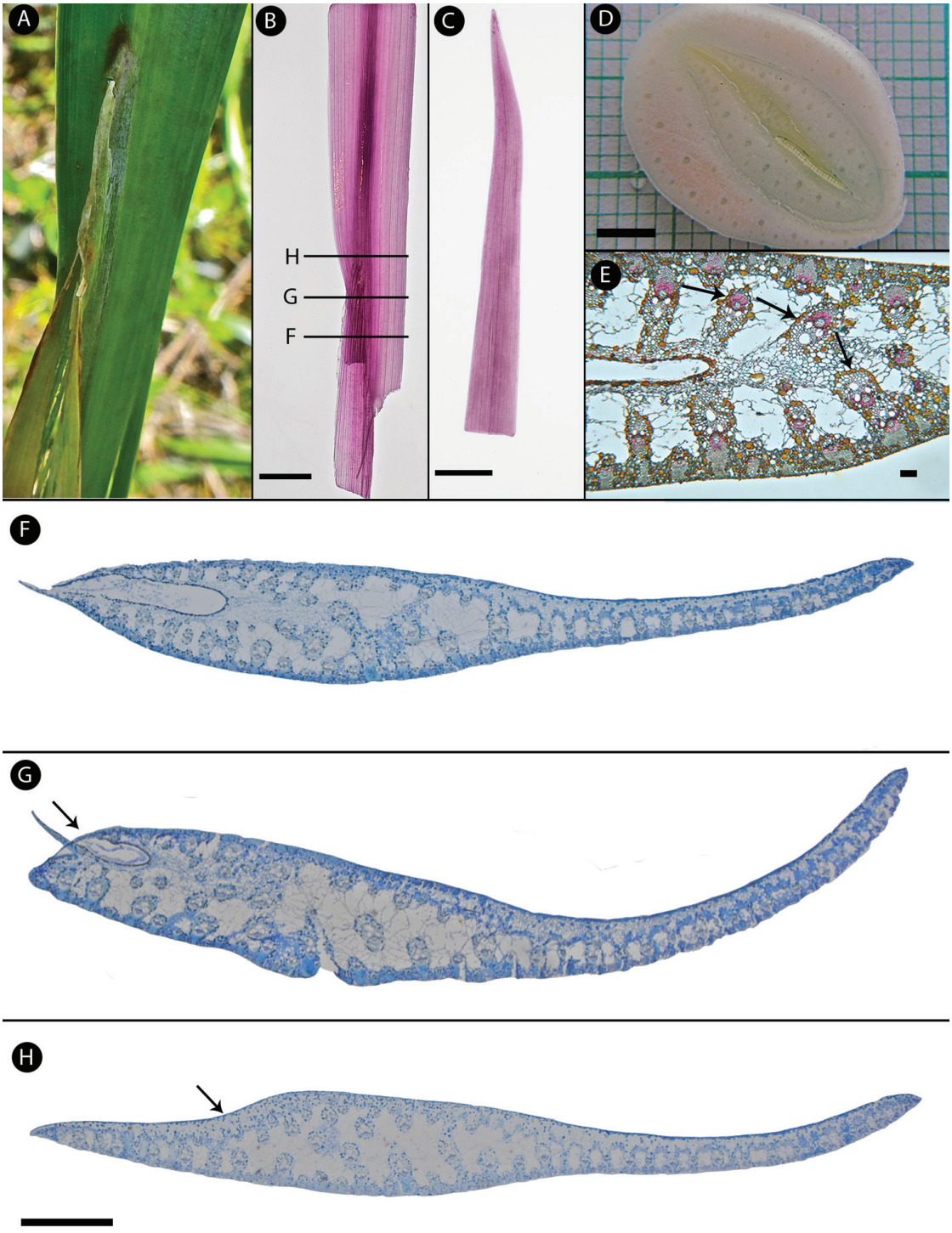

FIGURE 6. Leaves of *Guacamaya superba*. The asymmetric conduplicate sheath tapers to a constriction beneath the transition to an isolateral lamina. **A**. Leaf in situ. B, C. A cleared leaf. **B**. In the region shown in A. Lettered bars refer to sections in F–H. **C**. The dorsiventral lamina with the midvein central in the apex, and a characteristic distal curve. **D**. Juvenile leaves showing equitant insertion of the conduplicate sheath, and vascular bundles in more than one series. **E**. Orientation of the vascular bundles near the fold in the region near F. Note the aerenchyma. F–H. Transverse sections through the constricted region and broadened lamina (see B). **F**. The asymmetrical conduplicate sheath. **G**. The asymmetry continues in development. **H**. Base of the lamina where both surfaces are of abaxial origin. Scale bars: B: 2 cm; C: 1 cm; D: 0.3 cm; E: 0.1 mm ; F–H: 1 mm.

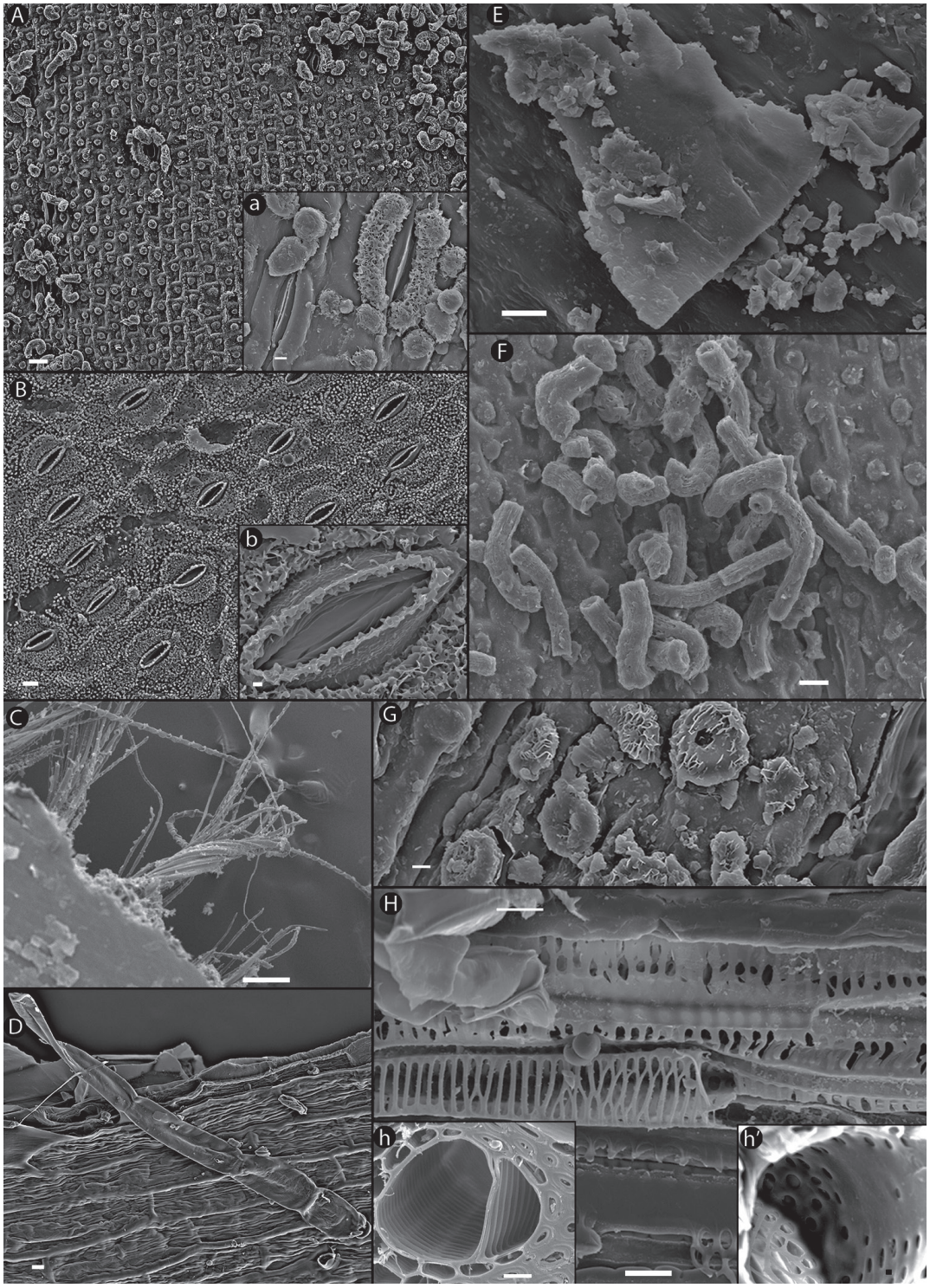

FIGURE 7. Scanning electron micrographs of leaves of Schoenocepahlieae (*Guacamaya superba*, A, C–G; *Kunhardtia radiata*, B; *Schoenocephalium teretifolium*, H) **A**. Lamina with glands and epicuticular waxes, as coiled tubules and crystaloids, (a) forming a dense, arachnoid covering on the guard cells of the paracytic stomata. **B**. Linear arrangement of stomata on a lamina with abundant epicuticular waxes, including crystaloids on the guard cells (b). **C**. Abundant fibers that surround the vasculature (t.s.). **D**. Uniseriate, multicellular, slime-secreting trichome on a leaf sheath. **E**. Wax plates and granules on the lower surface of a median region. **F**, **G**. The adaxail surface of a leaf sheath. F. Wax in the form of coiled tubules on. G. Detail of *g*landular trichomes covered with wax. **H**, h. Sclariform vessel elements and (h') pitted walls. Abbreviation: t.s., transverse section. Scale bars: A: 20 μm; a, G: 3 μm; B, C: 0.1 mm; b, h, h': 1 μm; D–F, H: 10 μm.

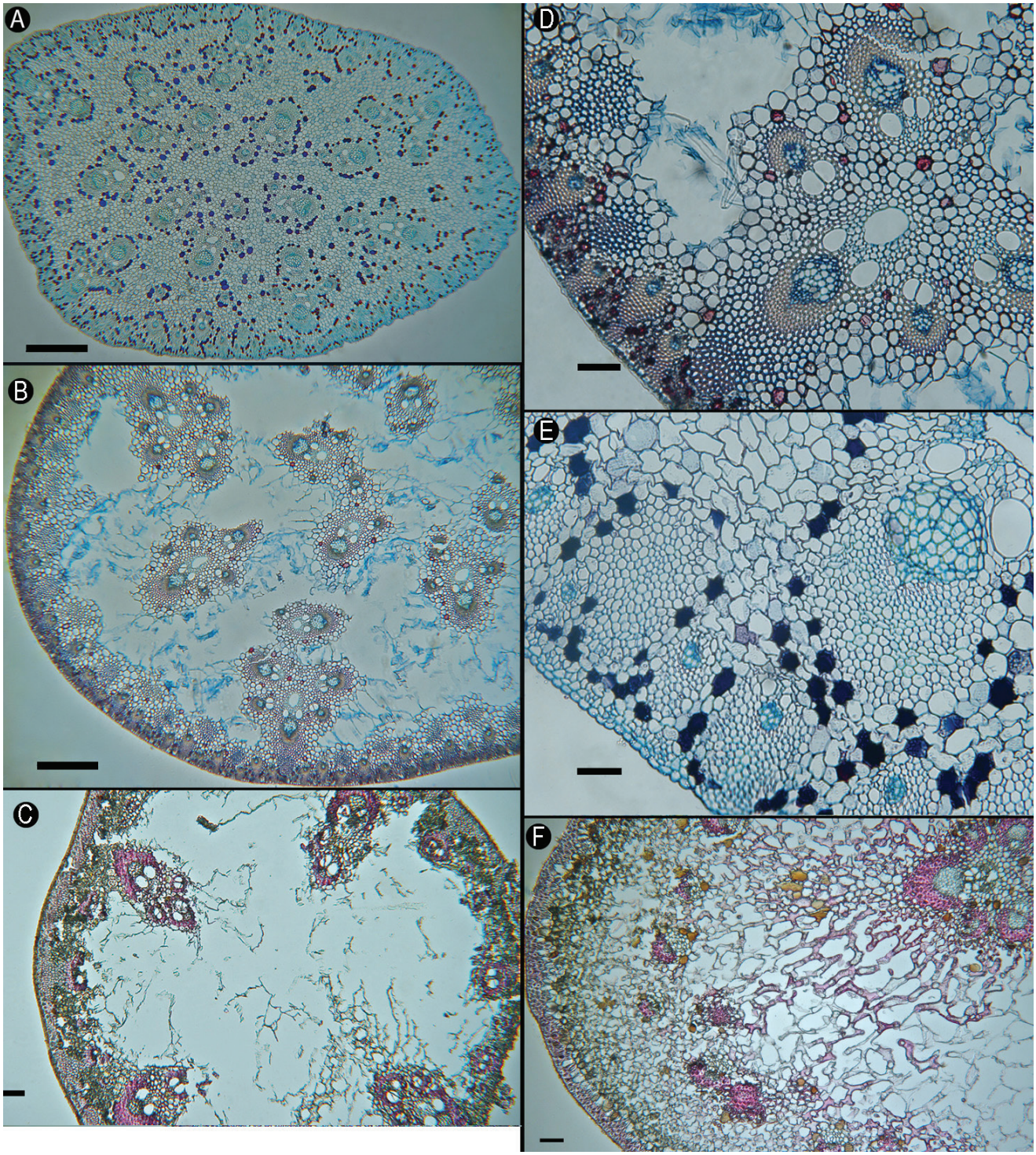

FIGURE 8. Peduncle anatomy of Schoenocepahlieae. A, D–F. *Guacamaya superba*. B. *Kunhardtia radiata*. C. *Schoenocephalium teretifolium*. **A**. Asymmetric base (t.s.) with tightly packed parenchyma and tannin idioblasts associated with the v.bs. **B**. Distal region of a peduncle (t.s.) below where it is compressed, with collapsed parenchyma forming air canals, scattered tannin idoblasts, and a single layer of lignified cells beneath the epidermis. **C**. Distal region of a peduncle (t.s.) showing large air spaces, fibrous v.bs., and subdermal sclerenchyma. **D**. Medial region (t.s.) showing 1 (2) layers of in compact, isodiametric subdermal parenchyma cells, interrupted by v.b. buttresses. **E**. Tannin idioblasts are more abundant in the proximal regions. **F**. Distal portion (t.s.) where the peduncle is elliptic and the periphery of the cortex is lignified. Abbreviations: t.s., transverse section; v.bs., vascular bundles. Scale bars: A, B, C: 0.5 mm ; D, E, H: 0.1 mm; F, G: 50 μm.

Peduncle. In t.s. round nearly throughout, distally slightly wider and elliptic. Cuticle thick, epidermis narrow, cells radially elongate, and tannin filled, underlain by several layers of fibers. Distally, chlorenchyma isodiametric, densely arranged with tannin idioblasts scattered near the periphery, parenchyma becoming arm-cells towards the center, stellate with large air spaces in the pith. Vascular bundles collateral, large and small bundles form a ring near the periphery, some buttressed to the epidermis.

Natural History

The beautiful infructescences of the *Flor de Iniríd*a and *Flor de Maroa* are prized by residents of the upper Río Negro, where the species are endemic. They have a history of cultural importance (see Schultes, 1954; pers. obs.) and appear as icons in Inírida's anthem, legends, souvenir carvings, and a symbolic statue of the *Schoenocephalium* was erected along the river in Inírida (Fig. 9B, C, E). As mentioned above, the fresh inflorescences with colorful bracts of *Guacamaya superba*, and dried infructescences of Schoenocephalieae (Schultes, 1954; Berry, 2004; pers. obs.) are harvested for everlasting bouquets (Fig. 9A, D, F). Schultes (1954: 191) reported that inflorescences of *S. martianum* Seub. (*Estrellitas del sur*) were used to decorate a rural Christmas altar, and abundant bouquets from Caquetá state, Colombia were sold in Bogotá. In recognition of the cultural and floristic importance of the *Flor de Iniríd*a, the Instituo Amazónica de Investigaciones Cientificas uses *Guacamaya* in its insignia (Instituto SINCHI, 2011).

Conservation, management, and cultivation

Although not included in the IUCN Red List of Threatened Species (IUCN, 2014; see SIB, 2012), the extractive practices and natural and anthropogenic fires, coupled with the restricted distribution and edaphic specificity of *Guacamaya superba*, have caused extirpation of some populations (pers. obs.). Conservation concerns lead to the Colombian environmental authority (Corporación Para el Desarrollo Sostenible del Norte y el Oriente Amazónico—CDA) to prohibit the harvest, transport, and commercialization of species of *Flor de Inírida* (resolution 526 of November 29 of 1998).

Environmental and social concerns prompted the creation of a grassroots organization in Inírida (Asociación Para el Desarrollo Integral, Humano y Sostenible—AKAYÚ; CDA, undated). A management plan for wild harvesting and propagation of *Guacamaya* and *Schoenocephalium* was developed with technical assistance from the Instituto Amazónico de Investigaciones Científicas—SINCHI, and permits for controlled, local harvesting of the *Flor de Inírida* was granted to AKAYÚ. Species from these habitats with particular edaphic conditions are known to be difficult to cultivate (G. Romero-G., pers. comm.) and attempts to grow *S. martianum* (Schultes, 1954) and *S. teretifolium* (Avellaneda and Herrera, 1998) from seed ex situ were unsuccessful. However, the project in Inírida developed species-specific protocols to propagate *G. superba* and *Schoenocephalium teretifolium* from lateral shoots, including the required size of the shoot, spacing in raised beds, and water regimes (PRONATTA, undated). Cutting with secuters rather than pulling inflorescences was used to harvest, minimizing damage to the plants (PRONATTA, undated). A mortality rate of less than 1% in the local nursery was achieved, and some threatened populations were successfully re-established.

Discussion

Schoenocephalieae (Saxofridericioideae) have erect stems and branch sympodially following production of a terminal inflorescence, as in some other Rapateaceae (e.g., *Duckea,* Rapateoideae; Colella, 1999). Roots grow along the stem protected by the leaf sheaths, providing mechanical support, a pattern frequent in monocots (e.g., Juncaceae, Velloziaceae; Weber, 1953), rather than through the cortex, as in many Bromeliaceae (Weber, 1954). We suggest this is likely the common architecture in Rapateaceae as it has been observed in other genera (e.g., *Stegolepis*; pers. obs.).

Roots of Rapateaceae have a sclerotic velamen (Solereder and Meyer, 1929), generally a well developed exodermis, and a conspicuous endodermis of thick walled sclerotic cells (Solereder and Meyer, 1929; Carlquist, 1969). A persistent root epidermis and starch sheath (Carlquist, 1969) were not observed here, perhaps due to the maturity of the material. The number of pericycle layers varies within the family (Carlquist, 1969); Schoenocephaleae are characterized by a bilayered pericycle. Carlquist (1969) found the pericycle in *Guacamaya* to be slightly lignified, which was not observed in our material. The ground tissue in the stele is sclerotic in Saxofridericoideae (Carlquist, 1969). In Schoenocephaleae the outer cortex contains irregular arm parenchyma with air spaces (Solereder and Meyer, 1929; Carlquist, 1969; Stevenson et al., 1998).

Stem thickening through lateral meristematic activity is known from several families of Poales (see Rudall, 1991), and is reported here for the first time in Rapateaceae as a secondary meristem (i.e., distal from the apex). A lateral meristem is likely also present in *Kunhardtia* (see Fig. 1D)—as well as other large-stemmed Rapateaceae—although it may not be present in the narrower stems of *Schoenocephalium*.

A variety of plant structures such as tree cavities (Kitching, 1983, 2000); inflorescence bracts (e.g., *Heliconia caribaea* Lam.; Machado Allison et al., 1993); closely inserted, laterally broadened or inflated leaf bases (e.g., *Cochliostema*; Troll, 1961; Hardy, 2001); or leaves individually fused creating a container (e.g., *Nepenthes*; Bell, 2008); impound water, forming an aquatic habitat (Kitching, 2000). In addition to water, these structures may passively accumulate insects and other small animals, soil particles, as well as plant (Fig. 3C) and animal debris (Fish, 1983; Kitching, 2000), and may provide a habitat for other plants as was observed in *Guacamaya* (Fig. 3F). The phytotelm environment and the organisms occurring there may be

FIGURE 9. Regional cultural importance of Schoenocepahlieae (*Flora de Inírida* and *Flora de Maroa*). **A**. A fresh bouquet of *Guacamaya superba*. B, C. *Schoenocephalium teretifolium*. **B**. Statue in Inírida, Colombia. **C**. The state flag of Guainía, Colombia. D–F. *Guacamaya superba*. **D**. A bouquet including *Lycopodiella* sp. on the door to the air terminal welcomes travelers in Maroa, Venezuela. *Guacamaya* occurs in the savanna (the type locality) that is used as the airstrip. **E**. Iconography inside the air terminal. **F**. Harvesting inflorescences from wild populations of *Guacamaya*.

part of complex food webs (Beaver, 1983; Kitching, 2000), and some tank-producing plant species secrete digestive enzymes, deriving nutritional benefit from their contents (Fish, 1983; Benzing, 2000). Impounding phytotelma in *Guacamaya*, composed of enlarged, marcescent leaf sheaths that may persist for years, contain mycorrhizal roots, other organisms (Fig. 3B), water, and debris. The impounding leaf bases in the rosulate genus *Cochliostema* similarly protect masses of entangled roots consisting of primary shoot-borne roots that are shorter than the secondary ones (Troll, 1961).

Unequally conduplicate leaf sheaths has been associated with leaf phyllotaxis in Rapateaceae (Stevenson et al., 1998); our interpretation of an equal conduplication and spriodistichous arrangement in Schoenocephalium warrants further examination. Leaves of Rapateaceae are generally described as hypostomatic (Boubier, 1895; Solereder and Meyer, 1929; Carlquist, 1969; Stevenson et al., 1998); however, *Monotrema* leaves are amphistomatic (Ferrari et al., 2014), and distally the leaves of *Guacamaya* are weakly so. Rapateaceae are characterized by randomly arranged, paracytic stomates (Solereder and Meyer, 1929; Carlquist, 1969), or tetracytic stomates (*Monotrema*; Ferrari et al., 2014). Previous examination of the family for epicuticular wax relied on herbarium material and found unordered crystaloids (Barthlott and Frölich, 1983), eroded wax (*Guacamaya*), or apparently none (Frölich and Barthlott, 1988). Epicuticular waxes may form an impervious boundary layer and are often interpreted as an adaptation to reduce water loss (Barthlott et al., 1998). The hydrophobic waxes on the surface of the leaf sheath in *G. superba* may have a protective function against microbial activity and the continuous contact with water (Cutter, 1978). Isolated surface wax was thought to facilitate trapping insects in a digestive container system (Martin and Juniper, 1970). Schoenocephaleae and *Monotrema* leaves have air canals (Carlquist, 1966; Ferrari et al., 2014), and layers of clear subdermal cells are common in Rapateaceae leaves; this tissue is often interrupted by fiber strands (Carlquist, 1969; Ferrari et al., 2014) or tannin filled cells.

Schoenocephalieae, and nearly all other Rapateaceae, have an elongate and photosynthetic peduncle that elevates the inflorescence above the leaves, *Maschalocepahalus* Gilg & K. Schum. and most species of *Rapatea* Aubl. being notable exceptions (Pilger, 1930; Maguire, 1958; Stevenson et al., 1998). In Schoenocephalieae the inflorescence is usually red (yellowish in other Rapateaceae) and the peduncle is distally flattened, where stellate cells forming aerenchyma, are more pronounced. A hypodermis of sclerenchyma or parenchyma is present in the peduncle (Solereder and Meyer, 1929; Carlquist, 1969) and may be present on both or only the abaxial leaf surface (Carlquist, 1966; Ferrari et al., 2014).

Rapateaceae are characterized by having amphivasal and smaller, collateral vascular bundles (Carlquist, 1966, 1969; Stevenson et al. 1998), or all bundles collateral (Ferrari et al., 2014). Vascular bundles are sheathed by fibers or thin-walled cells, and may be buttressed to the lower or both leaf surfaces. Cheadle and Kosakai (1982) found all levels of tracheary element specialization in a large sampling of Rapateaceae, with vessels with sclariform perforation plates, the form observed here in leaves, to be the most common; imperforate tracheary element also occur in Schoenocephalieae leaves (Carlquist, 1969).

Our observations on cellular inclusions are consistent with those previously reported (Solereder and Meyer, 1929; Carlquist, 1966, 1969; Stevenson et al., 1998; Ferrari et al., 2014). Epidermal silica bodies are characteristic of Rapateaceae (Carlquist, 1966, 1969; Stevenson et al., 1998) and occur in some other families of Poales including Bromeliaceae, but not Typhaceae (Prychid et al., 2004), two families suggested to be related to Rapateaceae (Givnish et al., 2000; Givnish et al., 2006; Bouchenak-Khelladi et al., 2014). Furthermore, silica bodies are associated with drought resistance and tolerance to metal accumulation (Hodson et al., 2005). The contents of Rapateaceae idioblasts have been referred to as tannins since Solereder and Meyer (1929; Carlquist, 1966, 1969; Stevenson et al., 1998; Ferrari et al., 2014); however, further characterization of these constituents is needed because their staining properties are not always consistent (Carlquist, 1966). Both tannins and mucilage may prevent desiccation.

Many Rapateaceae produce copious mucilage from roots, stems, and leaves (Carlquist, 1966; Stevenson et al., 1998; pers. obs.), which was observed in this study secreted from external, uniseriate, trichomes and in vertically-oriented cortical cavities that also occur horizontally in *Guacamaya* (Carlquist, 1966).

Fire has an important role in the ecology of savannas (Gillon, 1983; Hernández, 1987). Plant species that inhabit savannas exhibit structural and life history strategies enabling tolerance or resistance to periodic fires (e.g., Soderstrom, 1981; Appessato da Gloria and Cury, 2011; Marais et al., 2014). Mucilage contains a high water content (Roth and Lindorf, 1991) and has been suggested as an adaptation in Rapateaceae for withstanding fires (Givnish et al., 2000). The humidity and thermal isolation provided by the telmata should also protect meristems against fires, as do the persistent leaf bases in *Bulbostylis paradoxa* (Spreng.) Lindm. (pers. obs.), and tightly arranged leaves of *Vellozia* (Kubitzki, 1998).

Plants occurring in the oligotrophic white sand may experience flooding, although ample available water may be temporarily limited, even during the rainy season due to the high drainage capacity of the sandy substrate. Thus, they may exhibit a combination of characters associated with both flooded and drought prone habitats (see Campbell, 2004). Aerenchyma is common in wetland plants (Jung et al., 2008), and is well-documented in Poales. Although Carlquist (1969) considered this tissue common only in stems and peduncles of Rapateaceae, lysigensous air spaces, as we found particularly in the sheath, are known in leaves of the tribe (Solereder and Meyer, 1929), as well as in some *Monotrema* species (Ferrari et al., 2014).

Documentation of modern uses of tropical plants has focused on agricultural crops; timber; and extraction of non-timber forest products, such as fibers, building materials, medicinal plants, gums, and latex (ACTI, 1975; Mejía and Mejía, 1980; Nepstad and Schwartzman, 1992; Cárdenas López and López Camacho, 2000; van Andel et al., 2003), whereas there is little in the literature about extraction or cultivation of tropical plants for ornamental

purposes (Burman, 1991; Giulietti et al., 1996; Cárdenas López and López Camacho, 2000; Huber and Foster, 2003; van Andel et al., 2003; Schmidt et al., 2006; Oliveira et al., 2014). Forest species have been emphasized and little has been described for savanna plant species (Burman, 1991; Giulietti et al., 1996; Schmidt et al., 2006; Oliveira et al., 2014), although use of *Mauritia flexuosa* L.f., a forest species that also occurs as isolated stands (*morichales* or *buritizais*) or as gallery forests in savannas is well known (Pittier, 1926; ACTI, 1975; Padoch, 1988; Ponce et al., 2000). In the upper Río Negro region, local cultivation programs are usually aimed at promoting agroforestry practices (e.g., Vélez and Vélez, 1999). The experiments observed in this study to cultivate and sustainably extract *Guacamaya* show promise not only for Schoenocephalieae, which has a long history of regional use (Schultes, 1954; Fig. 9), but also for other native species. The edaphic specificity of species endemic to white-sand savannas have generally rendered them unsuitable for ex situ cultivation, but the success in using local soil, likely combined with the presence of vesicular-arbuscular mycorrhizae (see St. John, 1988) may serve as an example for other re-introduction programs in an ecologically important habitat that has little or no other agricultural use but that is often degraded for other purposes (Hernández, 1987; Fölster and Dezzeo, 1994; Huber, 1995c; Huber and Foster, 2003; Rodríguez 2004; see Miranda et al., 2002; Cook and Corbett, 2003; Ferreira et al., 2013). Cultivation and/or the management of harvesting inflorescences of Schoenocephalieae is critical because the removal of wild plants for handicrafts and other decorative uses raises conservation concerns, in part due to depletion of the seed bank (e.g., Burman, 1991; Giulietti et al., 1996; Schmidt et al., 2006; Oliveira et al., 2014).

Aspects about the biology of Schoenocephalieae that remain to be addressed include characterization of the telmata habitat, their use, and dynamics; a possible nutritive association with termites (Fig. 3A, G; Avellaneda, M. and C. A. Herrera, 1998); characterization of endophytic fungi, and their possible economic value (see Strobel et al., 2001), and the role, if any, of mycorrhizae in aluminum accumulation in Rapateaceae (see Chenery, 1949); whether aluminum or phenolics deter herbivory of the starchy roots and stems; and the species' potential in bioremediation of aluminum contaminated soils. Further examination of liquid-preserved material may reveal a greater distribution of surface wax, which may have taxonomic value (see Frölich and Barthlott, 1988). As noted by Carlquist (1966), the chemistry of tannin-like substances remains unknown in Rapateaceae.

Although hummingbird visitation is known in *Guacamaya* (Berry, 2004; pers. obs.), the number of phoric mites we observed was low (unpubl. data) and pollination, dispersal, germination, and phenology have never been documented for species in the tribe.

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NEW SPECIES OF *PODANDROGYNE* (CLEOMACEAE) II. TWO SPECIES ENDEMIC TO THE SOUTHWESTERN AND NORTHERN COLOMBIAN ANDES[1]

THEODORE S. COCHRANE[2]

Abstract. Two new species, *Podandrogyne laplanadae* from the department of Nariño and *P. nutibarana* from the department of Antioquia are described from the montane cloud forests of Colombia. Species descriptions, illustrations, specimen citations and eco-geographical information are presented, as well as notes about their conservation status.

Resumen. *Podandrogyne laplanadae* (departamento de Nariño) y *P. nutibarana* (departamento de Antioquia) de los bosques montanos nublados de Colombia son descritas, ilustradas y sus relaciones morfológicas con sus especies afines son discutidas. Se proveé infomación eco-geográfica, y datos acerca del grado de conservación de esta región de los Andes Colombianos.

Keywords: Cleomaceae, *Podandrogyne*, new species, Colombia

The genus *Podandrogyne* Ducke was last revised by Woodson (1948), at which time only nine species were recognized. Currently, 21 species are accepted, taking into account those that have been published or reinstated since then (Cochrane, 1977, 1978, 1997, 2011, 2015; Iltis and Cochrane, 1989). The Colombian and Ecuadorian Andes are the evolutionary center of this genus, 20 species presently being recognized for Colombia (Iltis and Cochrane, 2016) and 11 for Ecuador (Iltis and Cochrane, 1999). An additional 16 new species, all occurring in the northern Andes of Ecuador and Colombia, have been identified but remain unpublished, including the two clearly delimited species of subsection *Podandrogyne* (Cochrane, 2011) described herein. Their discovery contributes not only to the unexpected diversity in this genus but also to the renown of the tropical Andes for their rich biodiversity (Mittermeier et al., 1999; Myers et al., 2000; Rodríguez-Maecha et al., 2004; see Bernal et al., 2016) and high rate of endemism (Hernández-Camacho et al., 1992; Mittermeier et al., 2008; Joppa et al., 2011; Bernal et al., 2016). Apparently, both are rare or at least very local species: more collections are needed, because flowering material is almost unknown. Both are from areas from which many new and apparently endemic plant and animal species are being described. Fortunately, like *P. caucana* Cochrane and *P. chocoensis* Cochrane (cf. Cochrane, 2011) both have been collected in cloud forests protected by a reserve or national park; this is no guarantee for survival, however, given Colombia's history of unlawful coca plant production and guerilla group rapprochement with coca.

Podandrogyne laplanadae Cochrane, *sp. nov.* TYPE: COLOMBIA. Nariño: La Planada Reserve, near Ricaurte, 00˚05'N, 78˚01'W [sic], 1800 m, "Spindly shrub 1.5 m, flowers red," 21 December 1987 (fl), *A. H. Gentry, O. S. de Benavides, and P. Keating 59645* (Holotype: MO [6669498, barcode MO-2561913; WIS digital image]; Isotype: WIS [barcode v0325283WIS]). Fig. 1.

Herbae vel frutices impariter exiles saepe scandentes, omnino glabri; folia persaepe unifoliolata; flores zygomorphi, in racemos longissimos non particulatim dense dispositi, pedicellis brevibus in angulo recto divergentibus; petala cardinalia vel fuchsina, 6–9 mm, sessilia; flores masculini: androgynophorum 12–20 mm, filamentis 3–10 (14) mm et antheris violaceis pollen auribruneum continentibus; fructus penduli, juniores rubiginosi vetustiores atrosanguinei vel purpurei, anguste oblongi, modice ad latus compressi, apiculati vel rostrati, basi gynophoro 7–10 (13) mm et androgynophoro 13–18 (28) mm instructi, pedicello rigide divergenti vel ad angulum exiguum vel latum deorsum curvato.

Spindly *herbs, subshrubs*, or *shrubs*, often scandent, to 1.5 m, glabrous except for young shoots and petioles. *Leaves* evenly distributed along the stems, 1-foliolate (rarely 2- or possibly 3-foliolate), blades pale beneath, elliptic to narrowly elliptic, 6–24 × 2–11 cm, obtuse or less often broadly cuneate at base, acuminate to long-acuminate or seldom subcaudate-acuminate, membranous, glabrous, with 8–13 (16) lateral veins on either side of the midrib, these ± prominently raised beneath when fresh; petioles 1–14 cm, variegated with garnet-red, irregularly and sparsely glandular-papillate, distally with short stiff, straight or crumpled, gland-tipped hairs 0.05–0.5 mm. *Racemes* almost subspicate, neither loosely nor densely flowered, elongating to 50 cm in fruit; peduncle 1–12 cm, rachis dark brownish-red, 8–39 cm, curved or flexuous, becoming very elongate, producing up to ca. 216 flowers [pedicels plus pedicel scars], bearing 0 to 60 buds (depending on the age of the inflorescence) and only

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[1] The previous article in this series was Cochrane (2011).

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FIGURE 1. *Podandrogyne laplanadae* Cochrane. **A**, flowering branch; **B**, teratologic leaf; **C**, functionally staminate flower; **D**, flowering portion of inflorescence in staminate phase; **E**, array of immature fruits, showing range of variation. A, C from *Gentry et al. 59645* (isotype, WIS); B from *Betancur et al. 3940* (MO); D from *Gentry et al. 59645* (holotype, MO); E left end fruit from *Croat 71379* (MO), all others from *Restrepo CR515* (WIS).

0 to 6 open flowers at any one time. *Bracts* 0 to 1, leaf-like, 1-foliolate, narrowly elliptic, narrowly oblong-elliptic, or lanceolate, 3–9 × 0.5–2 cm, borne on distinct short petioles 2–7 mm. *Flowers* falling easily, monosymmetric, borne on spreading to spreading-ascending pedicels 7–14 mm (30 mm on *Vargas 5251*); *sepals* dark red, united for 0.5–1.3 mm at base, ovate (ovate-triangular in bud), sharply acute to acuminate, 2.5–4.5 × 1.5–2.5 mm; *petals* fire-engine red ("fuccia," sub *Betancur et al. 3940*), ± equal in shape and size, obliquely ovate-oblong or narrowly so (abaxial pair) to oblong or narrowly oblong (adaxial pair), 6–9 × 2.5–3.5 mm, sessile, obtuse to narrowly rounded at apex. Disk a nectariferous adaxial gland, shallowly 3-lobed, in flower the two lateral lobes circular to widely ovate-elliptic in outline, in fruit (when dried) usually oblong in side view, 1.5–2.3 (3) × 2.3–2.9 × 1.3–1.8 mm, persisting and ± conspicuous in fruit. *Pistillate flowers*: not seen. *Staminate flowers*: androecium exserted, androgynophore reddish, 12–20 mm, filaments normally all fertile, subequal, 3–10 (14) mm; anthers green or violet, 2.6–3.2 mm, pollen golden-brown. *Fruits* dark red or "purple," pendent, narrowly oblong, (2) 4–6 (9) × 0.7–1.2 cm, somewhat compressed, cuneate at base, acute and apiculate at apex, glabrous; stigma barely differentiated from the style, 0.7–1 mm in diam., true style

0–1.6 mm, forming with the apices of the valves a definite tapering beak 1–4 mm; gynophore 7–10 (13) mm, wiry, continuous and straight with the androgynophore, glabrous; androgynophore 13–18 (27) mm; pedicel typically short, stiffly divergent or usually slightly to widely down-curved, 7–14 (31) mm. *Seeds* (mature seeds not seen) ca. (7) 50–70 per capsule, when young brown (when dried), orbicular, 3.1–3.5 × 2.6–2.8 × 1.3–1.7 mm, evenly compressed (barely beveled), lineate and transverse-rugulose; aril thin-textured, translucent.

Distribution and ecology: *Podandrogyne laplanadae* is locally endemic to southwestern Colombia. With one exception the collections are from or very near La Reserva Natural La Planada (01˚09'37"N, 77˚9'13"W), located in the Department of Nariño near Ricaurte. A single collection from the Reserva Agua Bonita in the vicinity of the Village of Bitaco in the Department of Valle del Cauca, approximately 310 km to the north-northeast, appears to be this species. According to collectors' notes (the majority of collections are without habitat or frequency data), *P. laplanadae* is "escaso" in "cloud forest," "bosque bajo," and "sotobosque" at 1300–1900 m, but plants are most common at 1800 m. Lying on a ridge that extends from the western flank of the Andean Cordillera, the La Planada reserve ranges between 1200–2300 m in elevation and supports a mosaic of primary and secondary forest surrounded by recently abandoned pastures. The natural vegetation is montane wet forest sensu Holdridge (1967) or "bosque subandino" of Van der Hammen and Rangel-Ch. et al. (1997). More information about the reserve is given in Croat (1992), Orejuela (1987), Rangel-Ch. et al. (1997), Restrepo and Gómez (1998), and Vallejo et al. (2004).

Phenology: Flowering in December and February, fruiting in December, March, and April. Further collecting will show whether flowering occurs during the main dry period (July through August).

Eponymy: The species is named after the Reserva Natural La Planada, the locality where the majority of collections have been made.

Additional specimens examined: COLOMBIA. Dept. Nariño: Mpio. de Ricaurte, Reserva Natural La Planada, 1800 m, without date (fl), *M. Amaya 315* (COL [WIS photo, digital image]); Mpio. de Ricaurte, Reserva Natural La Planada, entre Santa Rosa y la reserva, 01˚14'N, 77˚58'W, 1300–1700 m, 20 February 1993 (bud, fl), *J. Betancur et al. 3940* (COL [WIS digital image], MO); Reserva Natural La Planada, between Tuquerres and Ricaurte, 7 km above Chucunés along Sendero La Rosa to Potrero de Hermógenes, 01˚06'N, 77˚53'W [sic], 1800–1850 m, 13 March 1990 (fr), *T. Croat 71379* (MO); Reserva Natural La Planada, 7 km de Chucunés, 01˚10'N, 77˚58'W, 1800 m, 13 December 1987 (fl), *O. de Benavides 9049* (MO); Reserva Natural La Planada, 7 km de Chucunés, Trocha de Las Cañadas, 01˚10'N, 77˚58'W, without alt., 16 December 1991 (fr), *R. Giraldo 70* (HUA [WIS photo]); Mpio. de Ricaurte, Reserva Natural La Planada, 1800 m, 1 April 1992 (y fr), *C. Restrepo CR515* (WIS). Dept. Valle del Cauca: Mpio. La Cumbre, Correg. Bitaco, Reserva Agua Bonita, 1700–1900 m, 10–15 December 1998 (fl, fr), *W. Vargas 5251* (HUA [WIS photo], ? Herb. [WIS digital scan]).

Podandrogyne laplanadae is characterized by its often scandent habit, nearly always unifoliolate leaves, and elongated slender inflorescences, as well as by the short-pedicillate, dark red flowers and fruits. In habit *P. laplanadae* appears similar to *P. nutibarana* Cochrane (see the following species), but any seeming relationship between these two species on this basis may well be superficial. They differ from most other species of the genus in having consistently unifoliolate, often small leaves (i.e., 7–12 cm but largest leaves to 15 or 20 cm); often elongate, slender racemes (to 50 cm); and small flowers (floral envelopes 6–15 mm). The two species, however, can be readily distinguished by flower and fruit color, *P. nutibarana* having orange flowers with cream-colored pollen and green to reddish- or yellowish-green fruits. It is less clear from herbarium material in fruit or in which colors have been lost that the two are distinct from one another. In *P. laplanadae* the pedicels are shorter (8–13 instead of 16–20 mm as in *P. nutibarana*) and the flowers a bit smaller (sepals 2.5–4.5 vs. 4.0–6.5 mm, petals 6–9 vs. 8–14 mm, androgynophores 12–20 vs. 26–28 mm). The filaments are the same length in the two species, and the ranges of these measurements, especially for *P. nutibarana*, should not be considered to be completely representative, based as they are on so few flowers. Shapes and dimensions of the fruits are also the same (only two fruiting specimens have been seen for each) except that *P. laplanadae* has a short but definite style, a feature lacking altogether in *P. nutibarana*. Note, however, that parallel variation—the presence or absence of a distinct style—is not necessarily significant in other species of *Podandrogyne*.

Podandrogyne nutibarana Cochrane, *sp. nov.* TYPE: COLOMBIA. Antioquia: Mpio. Frontino, Correg. Nutibara, Nutibara-La Blanquita road, region of Murrí, Alto de Cuevas, 06˚45'N, 76˚20'W, 1700–1800 m, "heavily disturbed, premontane forest. Thin-stemmed (4 cm diam.) tree to 5 m. Petals red-orange. Stamens green. Fruit green suffused maroon. Rare," 19 April 1988 (fl, fr), *J. L. Luteyn, R. Callejas & O. Escobar 12006* (Holotype: HUA [52599; WIS digital images]; Isotypes: NY [WIS digital images], WIS-2 sheets [barcodes v0325583WIS, v0325587WIS]). Fig. 2.

Herbae vel frutices (fortasse scandentes) vel arbusculae graciles, omnino glabrae; folia plerumque unifoliolata; flores zygomorphi, in racemos probabiliter pendulos elongatos non particulatim dense dispositi, rhachidibus prasinis plus minus sigmoideis vel flexuosis vel arcuatis; petala aurantiaca vel cinnabarina, 8–14 mm, sessilia vel subsessilia; flores masculini: androgynophorum viride, 26–28 mm, filamentis 7–10 mm, antheris viridibus pollen cremeum continentibus; fructus penduli, virides vel virides suffusi castanei (juniores flavovirentes), anguste oblongi, sine rostro non nisi per stigmata apiculati, basi gynophoro 6–8 mm et androgynophoro 20–22 mm instructi, pedicello curvatim ascendenti ad declinato.

FIGURE 2. *Podandrogyne nutibarana* Cochrane. **A**, fruiting branches; **B**, trifoliolate leaf; **C**, flowering portion of inflorescence in staminate phase (note pistillode at arrow). A from *Luteyn et al. 12006* (holotype, HUA); B from *Pedraza-P. et al. 2191* (WIS); C from color photos taken in the field by María F. González.

Herbs, *shrubs* (possibly scrambling), or *thin-stemmed trees*, 0.8–5 m, to 4 cm dbh, glabrous. *Leaves* evenly distributed, 1- or occasionally 3-foliolate, blades elliptic, narrowly elliptic, or narrowly oblong-elliptic, less often narrowly oblong, oblong-lanceolate, or lanceolate, 5–18 × 1–5 cm, cuneate to obtuse at base, acuminate to long-acuminate or seldom caudate-acuminate, membranous, glabrous, venation brochidodromous with main lateral veins 7–13 on either side of the midrib; petioles tinged purplish, (0.5) 1–9 cm. *Racemes* probably divergent or possibly pendent, loosely flowered below, variable in length and not particularly floriferous, peduncle 3–9 cm, rachis a clear lively green, ± straight when young, soon becoming sigmoid, flexuous, or arcuate, if elongate upswept, usually sharply bent upward at the flowering tip, 3–29 cm, producing 26 to 30 flowers and buds [including pedicel scars] during pistillate phase and eventually anywhere from 32 to ca. 95 flowers in staminate or fruiting phase but with only 0 to 4 open flowers at any one time. *Bracts* 0 to 6, leaf-like unless very small, 1-foliolate, narrowly elliptic, narrowly oblong-elliptic, or lanceolate to oblong-elliptic or lanceolate-elliptic, 0.2–14 × 0.1–4 cm, if more than four the distal ones tiny (ca. 0.5–3 mm), quickly reduced upward to microscopic, dark-tipped, hair-like processes or obsolete, obtuse to cuneate or seldom

attenuate at base, acuminate to subcaudate-acuminate or attenuate at apex, borne on short petioles 1–10 mm or if minute, sessile. *Flowers* monosymmetric; pedicels reddish-orange, ascending to spreading (or in fruit declining), 16–24 mm; *sepals* yellow to bright orange, united for ca. 1 mm at base, ovate to ovate-oblong, 4–7 × 1.5–3.5 mm, acute, sinuses between them acute; *petals* (very few available) "red," red-orange, or bright orange, nearly equal in shape and size, lower (abaxial) pair obliquely elliptic, upper (adaxial) pair elliptic, 8–10 × 3–4 mm (pistillate flowers) or 9–14 × 4–6 mm (staminate flowers), sessile or subsessile (narrowed to a broadly cuneate base or short claw ca. 1–2 mm), obtuse to narrowly rounded at apex. Disk a 3-lobed nectariferous adaxial gland, in lateral view depressed obovate in outline but squared off adaxially, 2.1–2.3 mm (including abaxial band of practically obsolete tissue) × 1.4–1.7 mm thick, in top view transversely trapezoidal in outline, 2.4–2.6 mm across × 1.8 mm wide, furrowed in apposition to the adaxial petals and androgynophore, persisting and somewhat conspicuous in fruit. *Pistillate flowers* (four seen): ovary green, narrowly oblong, 4–5 × 1–2 mm thick, beakless; stigma sessile (i.e., style 0.0–0.3 mm), capitellate, 0.7–1.3 mm in diam.; androgynophore 17–21 mm; gynophore 4–7 mm. *Staminate flowers* (three seen, all mashed): androecium green, well exserted, androgynophore 26–28 mm, filaments all fertile, subequal, proximal pair divaricate in a plane perpendicular to the vertical orientation of the flower as a whole and the shorter, sharply upcurved, median and distal pairs, 7–10 mm; anthers green, 3.8–4.5 mm, pollen cream-color. *Fruits* green or green suffused with maroon, pendent, narrowly oblong, 2–5.5 × 0.7–1.1 cm, slightly compressed, cuneate or broadly so at base, acute to obtuse or rounded and beakless or nearly so (beak a blunt nubbin ca. 0.5–2.5 mm, style undifferentiated and stigma truncate), glabrous; gynophore 6–8 mm, wiry, slightly deflexed (17–42°) relative to the androgynophore, glabrous; androgynophore 20–25 mm; pedicel 18–26 mm, curved-ascending to declined. *Seeds* (mature seeds not seen) ca. 25–115 per capsule, when young brown, orbicular, scalariform; aril (when dried) buff, opaque.

Distribution and Ecology: *Podandrogyne nutibarana* is endemic to the Department of Antioquia, Colombia, being known only from the northern Cordillera Occidental in the area between Nutibara and La Blanquita and in the Parque Nacional Natural Las Orquídeas, in little to heavily disturbed, tropical premontane rain forest at 1000–1850 m. It has been collected equally frequently in both areas, which, in fact, are no more than 40 km apart (straight line distance between Murrí, Frontino, and La Encarnación, Urrao), but in the Frontino region, where, according to collectors, it is rare (sub *Callejas et al. 6826*, *9928*; *Luteyn et al. 12006)*, the premontane forests are not protected and face deforestation pressure (Myers et al., 2000). These forests are described in Luteyn and Sylva S. (1999).

Phenology: *Podandrogyne nutibarana* has been collected in flower in February, April, and July and in fruit in April and July.

Etymology: The epithet nutibarana is taken from the name of the Corregimiento of Nutibara, where about half of the specimens, including the type, were collected.

Additional specimens examined: COLOMBIA. Dept. Antioquia: Mpio. Frontino, Correg. La Blanquita, región de Murrí, Alto de Cuevas, 14.5 km O [WSW] de Nutibara en la vía a La Blanquita, 06°45'N, 76°25'W, 1850 m, 14 July 1988 (bud), *R. Callejas et al. 6826* (Topotypes: HUA [WIS photo], MO [WIS photo]); Mpio. Frontino, Correg. Nutibara, zona de Murrí, vía Nutibara-La Blanquita, 5–8 km S de Alto de Cuevas, 06°39'N, 76°25'W, 1000–1850 m, 15 February 1995 (bud), *R. Callejas et al. 9928* (Topotype: HUA [WIS digital images]); Parque Nacional Natural Las Orquídeas, Sector Venados arriba, margen izquierda del Río Venados, 06°34'N, 76°19'W, 1090–1215 m, 28 July 1988 (fr), *A. Cogollo et al. 3572b* (JAUM [WIS photo]); Parque Nacional Natural Las Orquídeas, camino de Venados arriba hacia Carauta, margen derecho del Río Venados, 06°33'N, 76°17'W, 1680 m, 15 February 1989 (bud), *A. Cogollo et al. 4018* (COL, MO); Mpio. Urrao, Correg. La Encarnación, Parque Nacional Natural Las Orquídeas, entre el Río Polo y el Páramo del Almorzadero, without alt., 4 February 2011 (fl), *P. Pedraza-P. et al. 2191* (NY [WIS digital image]); Mpio. Frontino, Correg. Nutibara, cuenca alta del Río Cuevas, 1790 m, 15 April 1987 (fl), *D. Sánchez et al. 1208* (Topotype: MEDEL [WIS photo]).

Podandrogyne nutibarana is characterized by its nearly always unifoliolate leaves, elongate slender inflorescences, and bright orange or red-orange flowers as well as by the green rachis, short pedicels, cream-colored pollen, and green to dark-reddish-green (yellowish-green when young) fruits. In contrast, *P. laplanadae* has dark red to purple rachises, flowers, and fruits as well as green or violet anthers with golden-brown pollen (one dried flower seen). Study of herbarium specimens has not turned up any dramatic quantitative differences between the two species, but comparison of the shapes and dimensions of the leaves, flower parts, and fruits, as well as the pedicels and the dried nectar glands, has yielded differences, albeit small, in pedicel length and staminate flower size that may show valid discrimination between the two species (see notes under *P. laplanadae*, above). A level of uncertainty is associated with these distinctions, based as they are on such a small number of flowers. However, no deliberation was required before deciding to recognize each as a new species, because the color differences between the two as shown in photographs (i.e., http://www.tropicos.org/31315; María F. González MG8520, MG8521, MG8523, unpubl.) are emphatic.

The androgynophores of *Podandrogyne nutibarana* are long for such small flowers. Unlike the predominant condition in the genus, in which the stamens are quite uniform in length and orientation, there is relatively strong differentiation within the compact androecium of *P. nutibarana* as revealed in the photographs by González. The filaments of the proximal pair of stamens diverge from the androgynophore at right angles (70–90°) and in a plane perpendicular to the vertical orientation of the flower as a whole. They are straight and up to twice as long as those of the four verticillate terminal stamens, which spread (in

top view) much less widely (45–70˚ or 15–30˚, median or distal pairs, respectively) and are sharply upcurved, orienting themselves (in side view) in parallel in a plane (in front view) more nearly vertical (Fig. 2C). Whether this arrangement occurs in *P. laplanadae* is unknown. Although the distances separating the stamen pairs and the relative lengths of the filaments are the same as in *P. nutibarana*, any distinctive pattern is ruined in pressing.

IUCN Conservation Status

Occurrences of presumably healthy populations of *Podandrogyne laplanadae* within the Reserva Natural La Planada and *P. nutibarana* within the Parque Nacional Natural Las Orquídeas offer the best hope for survival of these species, assuming slash-and-burn agriculture, illegal lumbering, mining, or cropping, or other habitat perturbation can be controlled. Their conservation status must be considered Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001). Although both are known from fewer than 10 collections, which in each case represent only three localities, no information is available about population sizes or trends or plausible threats to the plants, which are needed to assess them against the Red List criteria.

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