



## Additional notes on *Psychotria* (Rubiaceae) from the southern karst of Papua New Guinea: *P. defretesiana* comb. et stat. nov., *P. dieniensis* var. *banakii* var. nov., and *P. stevedarwiniana* sp. nov.

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### Abstract

*Psychotria dieniensis* var. *banakii* and *P. stevedarwiniana* are described from limestone environments in the Muller Range of Papua New Guinea. *Psychotria defretesiana* (formerly a variety of *P. leptothyrsa*) is reinterpreted as a distinct species.

**Key words:** doline karst, limestone, new species, Papua New Guinea, *Psychotria*, Rubiaceae

### Introduction

With an estimated 120 species, *Psychotria* is one of the ten largest tracheophytic genera in New Guinea (Takeuchi 2007a). Geographic endemism is unusually high among its East Malesian representatives—only two species are known to range outside the Papuan region (Sohmer 1988). All mainland *Psychotria* found predominantly in montane habitats (elevations above 1,000 m) are unique to New Guinea and its satellite islands.

*Psychotria* diversity arguably decreases from east to west across New Guinea. Range-limited endemics (e.g., with occurrences restricted to only one side of the island) are more prevalent in the eastern forests of the mainland as opposed to the west (48 spp. vs. 11 spp.; in Sohmer 1988). The numerical contrast is not necessarily attributable to the disparity in collection densities (CD) between the geographic halves (CD at least 3x higher for the eastern side) but may be related to obvious differences in the number of terranes comprising the mountainous interior (cf. Pigram & Davies 1987, Davies et al. 1997).

Modern exploration has consistently produced meager *Psychotria* inventories for Indonesian Papua (Richards in prep.). The genus is surprisingly depauperate in the Bomberai Peninsula, Foja Mountains, Mamberamo basin, and the Raja Ampat Archipelago, despite high expectations for taxonomic discovery from such districts (e.g., Takeuchi 2003, Takeuchi et al. 2003). Extensive fieldwork has yielded no new records (for *Psychotria*) from those areas. In contrast, a three-week reconnaissance of Papua New Guinea's (PNG) Muller Range has uncovered five previously unknown *Psychotria*, four of which were entirely new to science (i.e., with no prior collection or other documentation). In an earlier publication, *Psychotria stolonifera* (Takeuchi 2010) and *P. ternatifolia* (ibid.) were formally presented from the 2009 Muller Range RAP Expedition. The expeditionary coverage of this genus is now brought to conclusion with descriptions for *P. defretesiana*, *P. dieniensis* var. *banakii*, and *P. stevedarwiniana*.

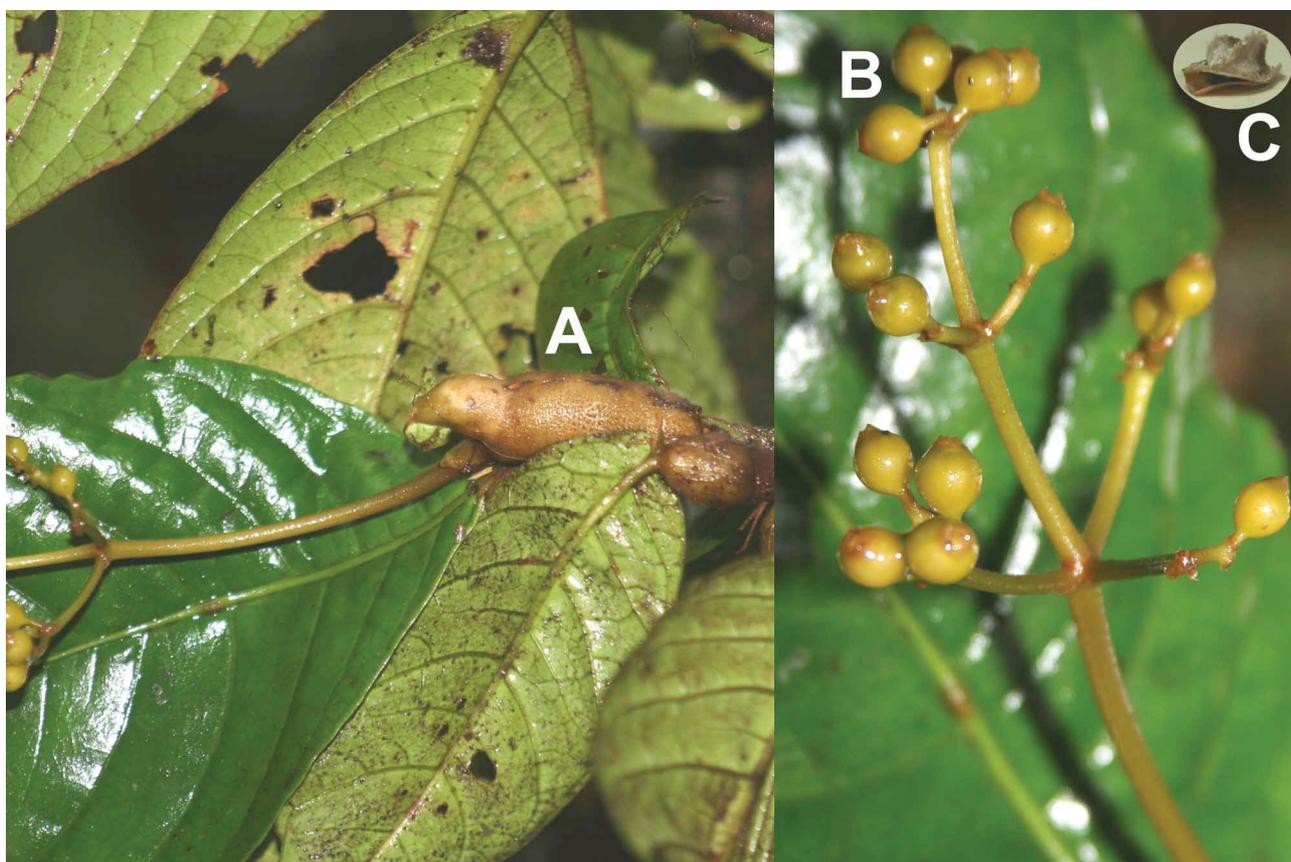
## Methods

The following diagnoses and taxonomic descriptions are based on *ex sicco* characters from herbarium specimens. "Field characters" are observations from living plants *in situ* and include only the data obtained from recent Muller Range collections. Because of the frequent absence of field information from older specimens, apparent discrepancies can arise with the herbarium-based measurements given here (e.g., the reported size range for dry fruits can seemingly exceed the living dimensions if *in situ* data are incomplete).

## Taxonomic treatments

### *Psychotria defretesiana* (Takeuchi) Takeuchi, *comb. et stat. nov.* (Fig. 1)

Basionym: *Psychotria leptothyrsa* Miq. var. *defretesiana* Takeuchi, Harvard Pap. Bot. 14: 176. 2009. Type:—INDONESIA. Papua Province: Baitanisa (Kwaneha), margin of swampy forest, 2°13'53"S, 137°19'10"E, 20 m, 10 May 2007, Takeuchi & Mogeia 21645 (holotype: BO; isotypes: A, K).



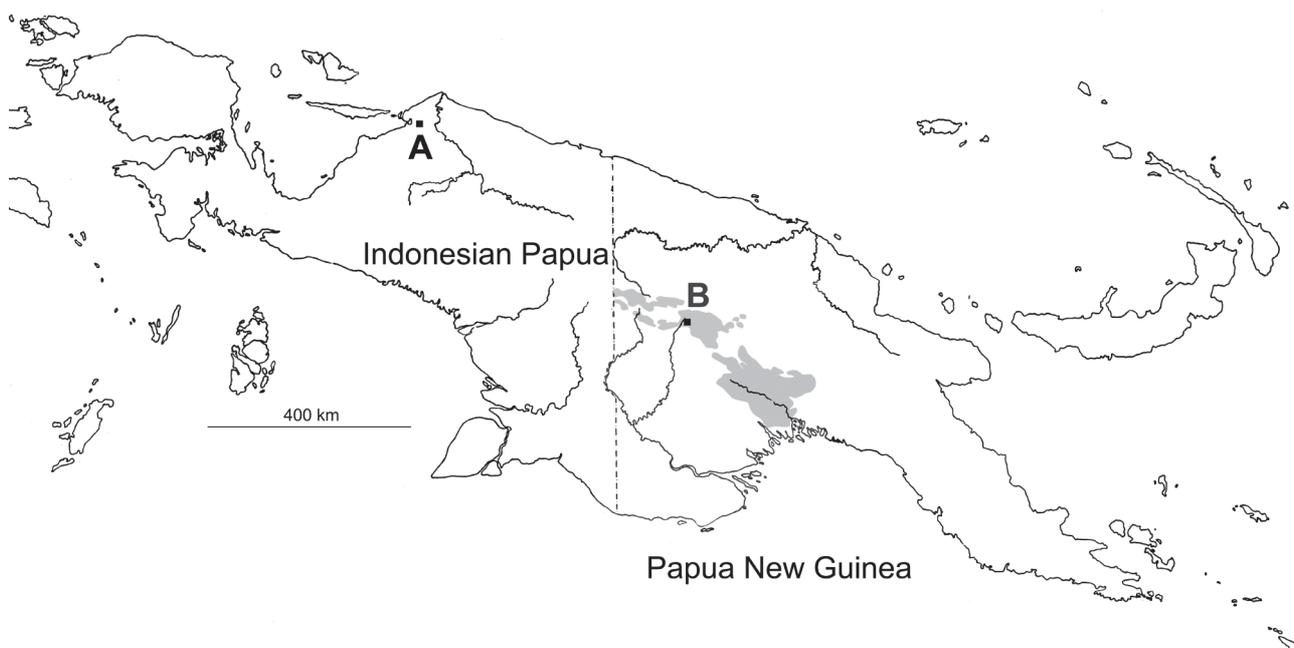
**FIGURE 1.** *Psychotria defretesiana*. **A**, fruiting stem with galled vegetative structures; **B**, immature fruits; **C**, pyrene (9.5 × 7 mm) in proximal-oblique view, the preformed germination slits appearing as a mouthlike orifice. Each of the (2–)3–4 dorsal ridges is abruptly narrowed to a linear crest extending to the exocarp. **A–B** from Takeuchi *et al.* 24571; **C** from Takeuchi & Mogeia 21578.

Unbranched subshrubs, 10–60 cm tall, glabrous. *Stems* erect, terete, 1–8 mm diam.; surfaces longitudinally (to transversely) wrinkled, brownish black, prominently marked by discoid abscission scars or not, lacking lenticels, periderm usually not flaking; internodes 4–20(–60) mm long. *Leaves* cauline, 4–10 per stem, equal, horizontally spreading; stipules ovate-deltate, 3.5–6.5 × 2–4 mm, often attenuate, caducous; petioles 5–35(–55) × 0.5–2 mm, planoconvex; leaf-blades oblanceolate-obovate (or elliptic), 5.4–15(–22) × (2.2–)4.2–12.5 cm, chartaceous; base cuneate; margin entire, reflexed or not; apex acuminate, obtuse or

truncate; lamina surfaces brown or fuliginous, dull; raphides pusticulate; domatia absent; venation usually camptodrome, secondaries (5–)8–13 per side, arcuate, (3–)7–31 mm apart, at the lamina center with divergence angles of (50–)60–85°; reticulum irregular, coarsely areolate; midribs prominulous on both sides; higher order nerves weakly raised (or impressed) above, more raised beneath. *Inflorescence* terminal, narrowly paniculate, ca. 10.5 × 6 cm, solitary (rarely 2–3 together), erect, axes compressed or angulate, nigrescent; peduncle 30–63 × 0.4–1.5 mm; primary axis 9–37(–53) × 0.2–0.7 mm; lateral branches 3–4 verticillate, 5.5–15(–22) × 0.3–0.6 mm; primary bracts early-falling, the scarious base or its abscission scar persisting; floral bracts (if present) scalelike, triangular; pedicels 1–2.5 mm long, not articulated. *Flowers* 4(–5)-merous, heterostylous, black; calyx discoid-cupuliform, 0.5–1 × 1.5–2 mm, truncate or obscurely denticulate; corolla infundibular, tube length 2.5–3 mm, proximal tube diameter 0.7–1.2 mm, distal tube diameter (1.2–)2–2.5 mm, pilose at the throat (hair-band 0.6–1.1 mm wide) otherwise glabrous, lobes triangular-ovate, ca. 1 × 1 mm, reflexed; stamens antesepalous, filaments 0.5–0.6 mm long, inserted within the hair-band, anthers oblongoid, 0.6–0.7 × 0.1–0.2 mm; disk dome-shaped, ca. 0.5 mm across, fleshy; style cylindrical, ca. 1.5 mm long, with stigma below the hair-band (short-styled form), or ca. 2.5 mm long and exserted (long-styled form); stigma 2-lobed, the lobes longer in the long-styled flower. *Infructescence* ca. 15.5 × 9 cm; pedicels ca. 3 × 0.3 mm. *Fruits* arranged in loose cymules, obovoid, (6–)8–10 × 5.5–8 mm; exocarp black, usually furnished with pale raphides; calyx residue 4–5-toothed; pyrenes 2, conspicuously (2–)3–4-ridged on the back; preformed germination slits 2, marginal, extending ca. 1/2 the pyrene length starting from the base; seed coat without ethanol soluble pigments; endosperm not ruminant.

**Field characters:**—Monocaulous dwarfs to 60 cm tall; stems often contorted-torulose, firm, black; leaf-blades chartaceous to fleshy-subcoriaceous, adaxially dark dull green, abaxially pale green or yellow-green; panicles terminal, erect, axes green or brownish green, verticillately branched; corolla barrel-shaped, obtuse in bud, white, lobes 4–5, reflexed at anthesis, white-hairy at the throat; styles dimorphic; fruits obovoid-subglobose, ca. 6 × 7 mm (Muller Range only—living drupes apparently larger in Mamberamo populations), green turning red when ripe; pyrenes (2–)3–4-ridged on the back, each ridge abruptly narrowed to a linear crest extending to the exocarp.

**Distribution:**—Originally discovered in the lower Mamberamo drainage of Papua Province (Indonesia) and more recently recorded from the Muller Range of PNG (**Fig. 2**).



**FIGURE 2.** Island of New Guinea. Collection localities. **A**, Baitanisa (lower Mamberamo basin), type locality for *Psychotria leptothyrsa* var. *defretesiana*; **B**, Muller Range, type locality for *P. dieniensis* var. *banakii* and *P. stevedarwiniana*. Overlay (shaded area) shows distribution of the southern karst formations.

**Habitat and ecology:**—Alluvial swamp understories at 20–50 m (Mamberamo), and lowland hill forest from 420–535 m (Muller Range). Occurring on seasonally inundated substrates, often rooted in mud, but also distributed across well-drained slopes. Restricted to densely shaded understories.

**Phenology:**—Fruiting in May (Mamberamo drainage); flowering and fruiting in September (Muller Range).

**Additional specimens examined:**—PAPUA NEW GUINEA. Western Province: Muller Range, Gugusu (Expedition Camp 1), lowland hill forest, 5°43.947'S, 142°15.973'E, 450 m, 7 September 2009, *Takeuchi, Ama & Gamui 24504* (A, LAE); 5°43.786'S, 142°15.669'E, 420 m, 8 September 2009, *Takeuchi et al. 24525* (A, K, LAE); 5°43.575'S, 142°15.630'E, 535 m, 9 September 2009, *Takeuchi et al. 24560* (A, K, LAE); 5°43.780'S, 142°15.813'E, 505 m, 10 September 2009, *Takeuchi et al. 24571* (A, LAE).

When *P. defretesiana* was first described as a variety of *P. leptothyrsa*, only fruiting collections were available for study. The stipules and inflorescence were unknown. With recent acquisition of complete specimens from the Muller Range, the former assignment to the *leptothyrsa* complex has been reassessed. In the material now in hand, the short pedicels (1–2.5 mm long) and small flowers (corolla 2.5–3 mm long) are incompatible with any presumed relationship to *P. leptothyrsa*. Because of the differences now accruing, the former variety should stand as a separate species (see Table 1).

**TABLE 1.** Summary of the principal distinctions between *Psychotria defretesiana* and the species (*Psychotria leptothyrsa*) to which it was formerly assigned.

<i>Psychotria defretesiana</i>	<i>Psychotria leptothyrsa</i> <sup>a</sup>
lowland habitats from 20–535 m.	lowland and montane habitats to 2600 m.
monocaulous dwarfs to 60 cm tall.	branching shrubs or trees, 1–10 m tall.
stipules not basally united, apex often attenuate.	stipules basally united into a short tube, apex short.
flowers 4(–5)-merous; pedicels 1–2.5 mm long.	flowers 5–6-merous; pedicels 5–10 mm long.
corolla tube 2.5–3 mm long.	corolla tube 5–7 mm long.
pyrene ridges abruptly narrowed, crests linear, extending to the exocarp.	pyrene ridges not abruptly narrowed, without linear crests.

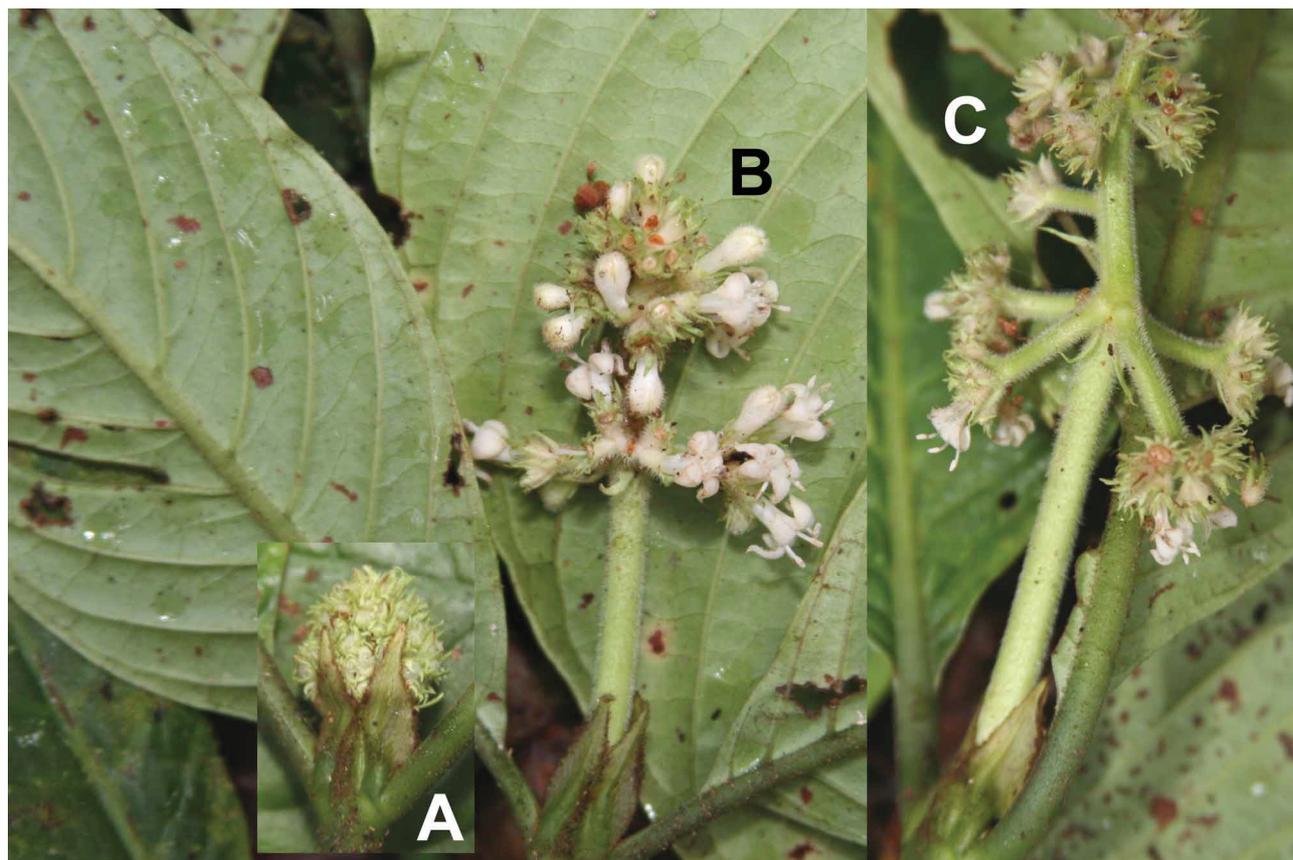
a. entries from Sohmer (1988: 157–168).

*Psychotria* is currently represented in New Guinea by at least seven monocaulous species, usually growing as subshrubs less than 1 m tall. The monocaulous-dwarf habit is less common among east Malesian *Psychotria*—for example in the Philippines there is only one species of similar stature and aspect to *P. defretesiana* and its allies (*P. pygmaea* Merr.; in Sohmer & Davis 2007: 94). Architectural reduction and simplification are frequently seen in other Papuasian genera (e.g., *Ardisia hymenandroides* [Takeuchi 2009a], *Cyathea lamoureuxii* [Takeuchi 2007b], *Dysoxylum middletonianum* [Takeuchi 2009c], *Harpullia*

*mabberleyana* [Takeuchi 2011 in press], *Zanthoxylum novoguineensis* [Hartley 1975], etc.) and are nearly always associated (though perhaps only coincidentally) with restricted geographic distributions.

***Psychotria dieniensis* Merr. & Perry var. *banakii* Takeuchi, var. nov. (Fig. 3)**

*A varietate typica arboribus 4–5 m altis (nec fructibus 0.5–2 m); laminis chartaceis subglabris (nec coriaceis pilosis) majoribus (10–)15.5–26 × (3.5–)6–10.5 cm plerumque obovato-oblongatis (nec ellipticis) nervis lateralibus utrinsecus 12–17 (nec 8–11); inflorescentiis majoribus usque ad 96 × 45 mm; corollis tubis extus glabris (nec pilosis); fructibus ellipsoideis (nec globosis) usque ad 9 × 5.5 mm differt.*



**FIGURE 3.** *Psychotria dieniensis* var. *banakii*. Developmental stages of the inflorescence. **A**, immature inflorescence prior to peduncle elongation, partly enclosed by apically bifid stipules; **B**, anthesis, 4(–5)-merous flowers disposed in capitate clusters; **C**, post-anthesis, 3–4-verticillate branching of the lateral axes (mostly opposite branching in var. *dieniensis*). The linear, primary bracts are fragile and easily lost in the press, with only the bract bases or their abscission scars remaining on exsiccatae. The white indument on living plants invariably turns reddish-brown after drying. **A–C** from Takeuchi *et al.* 24549.

**Type:**—PAPUA NEW GUINEA. Western Province: Strickland drainage, Muller Range, Gugusu (Expedition Camp 1), lowland hill forest, 5°43.575'S, 142°15.630'E, 535 m, 9 September 2009, Takeuchi, Ama & Gamui 24549 (holotype: LAE; isotypes: A, BO, CANB, K, L, MO).

**Etymology:**—Named after Banak Gamui of the PNG Institute of Biological Research.

**Field characters:**—Trees 4–5 m tall; branchlets fleshy, smooth, green; stipules foliaceous, notched or cleft, light green; leaf-blades rugose, dark green above, pale green beneath; panicle axes light green, canescent; flowers sessile; calyx lobes elongate, linear-deltate; corolla obtuse in bud, lobes 5, white, recurved at anthesis, throat white-hairy; stamens 5, exserted, white; style included, much shorter than the filaments; stigma 2-fid; fruit (immature) ellipsoid, whitish green.

**Distribution:**—Known only from the type locality (**Fig. 2**).

**Habitat and ecology:**—Lowland hill forest, natural-growth communities at 535 m.

**Phenology:**—Flowering and fruiting in September.

**Additional specimen examined:**—PAPUA NEW GUINEA. Western Province: Muller Range, Gugusu (Expedition Camp 1), lowland hill forest, 5°43.635'S, 142°15.733'E, 535 m, 6 September 2009, *Takeuchi, Ama & Gamui 24471* (A, BO, CANB, K, L, LAE, MO).

The new variety is clearly connected to *P. dieniensis* (Merrill & Perry 1946). Except for the distinctions specified by diagnosis, the vegetative and reproductive characteristics of var. *banakii* agree reasonably well with those in var. *dieniensis*. The differences argue for recognition only at infraspecific level. In comparison with *P. leptothyrsa* var. *defretesiana* (Takeuchi 2009b), the newly established variety is unlikely to require future consideration as a separate species.

*Psychotria dieniensis* sens. str. is represented mainly by subshrubs with commensurately small structures. Although the type (for *P. dieniensis*) was taken from a lowland environment (500 m; Merrill & Perry 1946), an overwhelming majority of conspecific collections are from montane habitats straddling the Central Divide. The high-elevation populations have attributes typical of such areas (e.g., firm-textured leaf-blades, dense indument, contracted internodes, and low-bushy architectures). Unlike these earlier gatherings, the Muller Range collections are arborescent plants with correspondingly larger parts. The glabrate leaves of var. *banakii* for example, are substantially above the previous measurement range for *P. dieniensis* (reported as 4.5–14.5 × 1.5–4.5 cm in Sohmer 1988: 82). The var. nov. also has panicles and fruits suggestive of changes in structural form (viz., towards verticillate branching in the inflorescence and fruits decidedly longer than broad).

The robust features of var. *banakii* cannot be explained entirely by differences in elevation, given that the type for *P. dieniensis* was also taken from a lowland habitat. Despite its presumed status as a discrete variant from limestone, the perception of varietal distinction is complicated by geographic gaps in existing documentation, particularly from colline environments below 1000 m. The possibility of morphological discontinuities being removed by future collections cannot be discounted. Although additional sampling from the Southern Escarpment would be undoubtedly rewarding, the logistical and financial obstacles are severely limiting. In light of the operational and budgetary difficulties experienced by recent surveys on the karst, it is very unlikely that such localities can be revisited anytime soon.

### ***Psychotria stevedarwiniana* Takeuchi, sp. nov. (Figs. 4–5)**

*Inter speciebus congeneribus Papuasiae stipulis connatis magnis usque ad 8.5 × 1.7 cm (in vivo) tubis cum 4 appendicibus apicalibus 4–8 × 0.3–3 mm statim distinguitur.*

**Type:**—PAPUA NEW GUINEA. Western Province: Muller Range, Sawetau (Expedition Camp 2), *Nothofagus*-emergent montane forest on doline karst, 5°39.638'S, 142°18.018'E, 1460 m, 15 September 2009, *Takeuchi, Ama & Gamui 24688* (holotype: LAE; isotypes: A, K, L).

Understory subshrubs, 0.5–1 m tall, monoaxial or sparingly branched, erect. *Stems* compressed near the top, 1.5–3 mm diam., fuliginous, hollow or pithy, often furrowed, with or without adventitious roots; indument pilose, dense, reddish-brown (white *in vivo*), persisting, longest hairs ca. 1.5 mm long; older axes terete, transversely cicatricose, lenticels absent; internodes 2.5–9.5(–12) cm long. *Leaves* cauline or in 1–4 pairs on short branches, equal, obliquely diverging; stipules ovoid-conoid (or subfusiform), (9–)20–60 × (2–)4–12 mm, connate, tubular, caducous, disclosing a nodal ring of appressed colleters after falling, surfaces black, glabrous inside, pilosulous outside, apically (2–)4-lobulate (lobules 4–8 × 0.3–3 mm); petioles 10–32 × 1–2.5 mm, planoconvex or subcylindrical, indument as on stems; leaf-blades subcoriaceous, ovate-elliptic (or obovate), (7–)9.2–15.6 × (2.8–)4–8(–9.9) cm, base mostly obtuse, margin revolute, apex acuminate (acumen to ca. 1.5 × 1 cm); lamina surfaces fuliginous to rufescent; adaxially rugose, bullate, barbate at the petiole insertion otherwise glabrous; abaxially pilose on veins, velutinous between veins; raphides not seen; domatia

absent; venation brochidodrome or camptodrome-reticulate, secondaries (6–)8–14 per side, (2–)6–16(–21) mm apart, at the lamina center straight-diverging (40–)50–70° from midribs, ± parallel, closing by gradually looping nerves (or anastomosing to the margin); partial intersecondaries often present; crossing (tertiary) nerves subscalariform; all veins impressed on the upper side, prominent beneath; reticulum conspicuous, coarsely areolate, tessellate. *Inflorescence* not seen. *Infructescence* terminal (or subapical by shoot overtopping), paniculiform, 35–60 mm long, ascending, ebracteate; primary axes 2–5 together, 20–45 × 0.8–1.5 mm, terete; surfaces nigrescent, densely pilose; cymes 1–6 per primary axis, loose; secondary axes verticillately inserted or not; pedicels cylindrical, 2–4.5(–6.5) × 0.5–0.8 mm, not articulated. *Fruits* (immature) obovoid, 6.5–10 × 5–7.5 mm (exclusive of calyx), often asymmetric, hairy on all parts; exocarp jet black, raphides not seen; calyx persisting, united in the lower 0.2–1(–1.5) mm, lobes 5, triangular, 1–2 × 1.2–1.5 mm, erect or reflexed; pyrenes hemispherical, dorsally ± smooth; preformed germination slits 2, marginal, extending the full length of the pyrene or ending just below the apex; seed coat with ethanol soluble pigments; endosperm ruminant.



**FIGURE 4.** *Psychotria stevedarwiniana*. **A**, stem with mature stipule; **B**, inset, upper left, stipule with circular cutout revealing the immature leaves (green) inside the tube; **C**, inset, lower left, nodal colleters (brown) uncovered by stipule abscission. **A–C** from *Takeuchi et al.* 24688.

**Etymology:**—Named after Prof. Steven P. Darwin (Tulane University), an authority on Pacific floras and the author's former associate in Hawaiian botany. The alternative epithet "*darwiniana*" has been preempted (in Cheek et al. 2008).

**Field characters:**—Miniature subshrubs 0.5–1.0 m tall; indument of white hairs on nearly all parts; stems monocaulous or at most with 1–3 branch pairs; stipules to 85 × 17 mm, inflated or not, off-white to light green, (2–)4-lobulate at the top (lobules 7–10 mm long); leaves thickly fleshy-coriaceous, rugose, bullate; fruits obovoid, epicarp entire, green.

**Distribution:**—Known only from the type locality (**Fig. 2**).

**Habitat and ecology:**—*Nothofagus*-emergent montane forest on doline karst, 1425–1495 m. Occurring as scattered colonies restricted to dark understories, often in spatial association with *P. stolonifera* and *P. ternatifolia*.

**Phenology:**—Fruiting in September. Populations sterile except for the expedition's two collections.

**Additional specimen examined:**—PAPUA NEW GUINEA. Western Province: Muller Range, Sawetau (Expedition Camp 2), *Nothofagus*-emergent montane forest on doline karst, 5°39.638'S, 142°18.018'E, 1460 m, 15 September 2009, *Takeuchi, Ama & Gamui 24671-B* (A, BO, CANB, K, L, LAE, MO).

Even in a genus noted for morphological variation, the tubular stipules of *P. stevedarwiniana* are remarkable for their size and structure. The elongate-conoid (or subfusiform) stipule attains dimensions up to 85 × 17 mm *in vivo*, and is surmounted by four foliaceous lobes at the apical orifice. The process of stipule maturation is characterized by such pronounced changes in size, texture, and color, that the immature and mature stages look like structures from different species (**Fig. 4**).

Among the 19 Papuasian congeners with connate stipules, *P. stevedarwiniana* is further distinguished in having conspicuously rugose-bullate leaves and basally branching panicles (the latter both terminal and subapical). The distinctive vegetative features allow for instant recognition whenever sterile plants are encountered.

Although its flowers are still unknown, the pyrenes of *P. stevedarwiniana* are characteristic of *Psychotria* in the sense established by modern study of the Psychotrieae (*sensu* Davis & Bridson 2001, 2004, Davis et al. 2001, Sohmer & Davis 2007). Despite the novelty's atypical qualities, compelling support for the generic assignment is provided by the paired pyrenes with preformed germination slits (2) confined to the margins.



**FIGURE 5.** *Psychotria stevedarwiniana*. **A**, vegetative habit, plants (3 shown) to ca. 30 cm tall; **B**, immature fruiting panicle. **A–B** from *Takeuchi et al. 24688*.

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