



## Resolution of polyphyly in *Pueraria* (Leguminosae, Papilionoideae): The creation of two new genera, *Haymondia* and *Toxicopueraria*, the resurrection of *Neustanthus*, and a new combination in *Teyleria*

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### Abstract

Recent molecular phylogenetic studies (Egan *et al.*, in prep.) have demonstrated widespread polyphyly within the genus *Pueraria*. A new classification is presented here that delineates monophyletic groups previously considered congeneric with *Pueraria*. This taxonomic treatment provides several new species combinations and a more natural circumscription of *Pueraria* by reinstating the genus *Neustanthus*, transferring one species to *Teyleria* and establishing two new genera: *Haymondia* and *Toxicopueraria*.

**Key Words:** classification, Fabaceae, Glycininae, Phaseoleae, taxonomy

### Introduction

*Pueraria* de Candolle (1825: 97) belongs to the tribe Phaseoleae, subtribe Glycininae in the legume family (Leguminosae, Papilionoideae). The genus was first described to accommodate two species: *P. tuberosa* (Roxburgh ex Willdenow) de Candolle (1825: 97) and *P. wallichii* de Candolle (1825: 97). Since then, the genus has been expanded to include ca. 20 species native to southern, eastern, and Southeast Asia (geographical regions as ascribed by the United Nations statistical divisions). *Pueraria* includes two species that have been introduced widely outside their native ranges: kudzu, *P. montana* (Loureiro) Merrill var. *lobata* (Willdenow) Maesen & S.M.Almeida ex Sanjappa & Predeep (Sanjappa 1992: 288), is a notorious invasive species introduced from Asia to the United States in the 1800's, originally for fodder and soil erosion control; tropical kudzu, *P. phaseoloides* (Roxburgh) Benth (1865: 125) has been widely planted as a cover crop and used as a green manure pantropically. Various economic uses of *Pueraria* species have been documented since ancient times. References going as far back as 500 B.C. in Chinese literature (Keng, 1974) and 600 A.D. in Japanese literature (Shurtleff & Aoyagi, 1977) record uses in food, medicine, paper, clothing, cordage, and construction materials. More recently, van der Maesen (1985) summarized the importance of understanding the biodiversity in *Pueraria* when he said "Some species of *Pueraria* are important as fodder, green manure crops, or weeds; some produce edible tubers; some have medicinal or poisonous properties, but many are rare or only locally abundant and poorly collected."

Previous treatments have recognized the unnatural grouping that comprises *Pueraria*. In his unpublished dissertation and treatment of tribe Phaseoleae, Lackey (1977b) tentatively segregated his 20 recognized *Pueraria* species into four groups (A–D, Table 1) based on morphological characters and stated that his groups A–C should be retained within *Pueraria*. However, he also recognized that species in group C could potentially be removed from *Pueraria* and allied with his new genus *Neonotonia* J.A.Lackey (1977), erected for *Glycine wightii* (Graham ex Wight & Arnott) Verdcourt (1966: 35), an idea first proposed, twice, by Wight and Arnott (1834). Lackey also recognized that species in group B were distinct enough from group A to warrant the creation of a new genus. Lackey also suggested that group D should be excluded from *Pueraria* based on morphology (1977b) and, in particular, that *P. wallichii* was anomalous in the genus based on the presence of canavanine, a non-proteinogenic  $\alpha$ -amino acid (Lackey, 1977a). In spite of all these recommendations, Lackey did not formally revise the genus according to his groupings.

**TABLE 1.** *Pueraria* species recognized in three treatments; varietal epithets are not listed. Classification according Lackey (1977b) with spelling and authorships therefrom:

Group A	Group B	Group C	Group D
<i>P. alopecuroides</i> Craib	<i>P. phaseoloides</i> (Roxburgh) Bentham	<i>P. bella</i> Prain	<i>P. peduncularis</i> Graham
<i>P. calycina</i> Franchet	<i>P. subspicata</i> Bentham	<i>P. collettii</i> Prain	<i>P. stracheyi</i> Baker
<i>P. candollei</i> Graham		<i>P. brachycarpa</i> Kurz	<i>P. wallichii</i> de Candolle
<i>P. edulis</i> Pampanini		<i>P. stricta</i> Kurz	
<i>P. lacei</i> Craib			
<i>P. lobata</i> (Willdenow) Ohwi			
<i>P. mirifica</i> Airy, Shaw & Suvatabandhu			
<i>P. montana</i> (Loureiro) Merrill var. <i>montana</i>			
<i>P. montana</i> var. <i>lobata</i> (Willdenow) Maesen & S.M.Almeida			
<i>P. montana</i> var. <i>thomsonii</i> M.R. Almeida			
<i>P. pulcherrima</i> (Merrill) Merrill			
<i>P. sikkimensis</i> Prain			
<i>P. tuberosa</i> Candolle			

Other species recognized by van der Maesen (1994) or Wu & Thulin (2010):

*P. imbricata* Maesen; *P. rigens* Craib; *P. maesenii* Niyomdham; *P. bouffordii* H. Ohashi; *P. xyzhunii* H. Ohashi & Iokawa.

In the most recent monographic work based on Lackey's revision, van der Maesen outlined 15 species (and several varieties; Table 1) over the course of a series of botanical treatments (van der Maesen, 1985, 1994, 2002; van der Maesen & Almeida, 1988). Van der Maesen (1985) stated that the inflorescence (a pseudoraceme) was diagnostic of the genus, having "either 3, rarely 2, or 4 to 7 flowers per more or less thickened node (brachyblast)." Although van der Maesen stated that "*Pueraria* has served more or less as a receptacle for species not easily classified elsewhere", he did not revise the genus according to Lackey's groups, claiming that "further biosystematic research" was needed to understand the relationships of *Pueraria* species to other taxa within the Glycininae. Since van der Maesen's work, new species have been described (e.g. *Pueraria xyzhunii* H. Ohashi & Iokawa, 2006) and included in the published Flora of China (Table 1; D. Wu & Thulin, 2010). Van der Maesen did agree with Lackey that "...some species of *Pueraria* are difficult to place. Anomalous in the genus, they fit nowhere else satisfactorily" (van der Maesen, 1985).

Several contemporary molecular systematic studies have confirmed these hypotheses by demonstrating a polyphyletic *Pueraria*, and suggest that multiple distinct lineages exist within the genus (Cagle, 2013; Doyle, Doyle, & Harbison, 2003; Lee & Hymowitz, 2001; Stefanovic, Pfeil, Palmer, & Doyle, 2009). These studies represent a good beginning at investigating the evolutionary history of *Pueraria*, however, all were based on only four or five species and were produced using the same source material, the DNA extracted originally by Lee and Hymowitz (2001). In addition, the generic level sampling of these investigations was narrow compared to the generic diversity in the genus and tribe. In order to better understand the relationships of species placed within *Pueraria*, a greater sampling across the vast evolutionary and taxonomic landscape of legumes in the tribe Phaseoleae was needed. A.N. Egan *et al.* (in prep.) have produced a large-scale phylogeny, which confirms the existence of not four but five separate lineages assigned to *Pueraria s.l.* To resolve this extensive polyphyly, we herein describe two new genera, resurrect the genus *Neustanthus* Bentham and make the requisite combinations therein, and move *Pueraria stricta* Kurz (1873: 254) into *Teyleria* Backer (1939: 107).

## Materials and Methods

Herbarium research was conducted by A.N. Egan from 2011–2014 at 22 herbaria worldwide (AAU, BK, BKF, BM, C, CDBI, E, ECUH, G, GH, HUH, HZU, K, KUN, L, MO, NY, P, PE, QBG, WNU, US). A.N. Egan conducted fieldwork in August to November of 2012 and 2013 in China, Japan, Thailand, and the southeast United States to collect species of *Pueraria* throughout their range. B. Pan conducted fieldwork during 2011 and 2014 to collect species of *Pueraria* in China. *Pueraria* collections were identified using the considerable revisionary and treatment works of van der Maesen

(van der Maesen, 1985, 1994, 2002; van der Maesen & Almeida, 1988). The Flora of China accessed through the efloras website (efloras.org; Brach & Song, 2006) was also consulted for identification purposes. In addition to types listed below, over 1500 *Pueraria* and *Teyleria* specimens were examined from the above listed herbaria. Specimens examined concerning the taxa detailed herein are cited in Appendix 1 with morphological comparisons outlined in Table 2. Preliminary conservation assessments were generated for the widely occurring species using estimated ranges, and based on Criterion B of the IUCN Categories and Criteria (Version 3.1, 2001). A full IUCN assessment was not conducted. However, comments on conservation status are included for those taxa that have wide ranges (with EOO and AOO above the thresholds for threat categories) and are not of obvious conservation concern.

**TABLE 2.** Character state comparisons between *Pueraria s.s.*, the resurrected *Neustanthus*, *Teyleria*, *Toxicopueraria gen. nov.* and *Haymondia gen. nov.*

Character	<i>Pueraria s.s.</i>	<i>Neustanthus</i>	<i>Teyleria</i>	<i>Haymondia</i>	<i>Toxicopueraria</i>
<b>Habit</b>	Woody climber	Herbaceous climber	Scandent shrub or herbaceous climber	Scandent shrub	Woody climber
<b>Root tuberous</b>	Yes	No	No	No	No
<b>Stipule</b>	Medifixed, persistent	Basifixed, persistent	Basifixed, persistent	Basifixed, caducous	Basifixed, persistent
<b>Petiole</b>	Terete	Terete	Angular, sulcate	Terete	Terete
<b>Inflorescence</b>	Pseudoraceme, erect	Pseudoraceme, erect	Pseudoraceme, erect	Solitary pseudoraceme in axil or terminal panicle, erect or ascending	Pseudoraceme, long and pendulous
<b>Flowers per node</b>	(2*–)3	4+	(2–)3 or 4+	4+	4+
<b>Node structure</b>	Not nodose†	Nodose	Nodose	Nodose to short-branched	Slightly nodose
<b>Vexillary stamen</b>	Connate to the staminal column	Adherent to staminal column at first, becoming free with age	Connate to the staminal column	Connate to the staminal column	Adherent to staminal column at first, becoming free with age
<b>Stamens moving upward</b>	No	No	No	Yes	No
<b>Vexillum</b>	With callosities, base reflexed	Without callosities, base reflexed	Without callosities, base reflexed	Without callosities, base not reflexed	Without callosities, base reflexed
<b>Legume</b>	Chartaceous, oblong, flat, not twisting upon dehiscence	Chartaceous, cylindrical, septate, twisting upon dehiscence	Subcoriaceous, oblong, flat, septate, twisting upon dehiscence	Coriaceous, oblanceolate, twisting upon dehiscence	Chartaceous, oblong, flat, not twisting upon dehiscence

\*2 in *Pueraria calycina* Franchet; † nodose here refers to a highly compacted inflorescence branch or brachyblast (e.g. Figure 1P).

## Taxonomy

*Neustanthus* Benth., Pl. Jungh. 2: 234–235. 1852

**Type species:**—*Neustanthus phaseoloides* (Roxburgh) Benth., Pl. Jungh. 2: 235. 1852.

**Diagnosis:**—Perennial herbaceous climber or creeper. Stems hirsute with spreading hairs. Leaves pinnately trifoliolate. Leaflets entire or lobed. Stipules basifixed, open and reflexed. Nodose (hereinafter refers to a highly compacted inflorescence branch or brachyblast; e.g. Figure 1P) pseudoracemes axillary, several flowers clustered at each node. Calyx 5-lobed, the lower lobe longer, the upper two connate from the middle. Corolla blue or purple or white with

purple to pink stripe. Vexillum without callosities, apex slightly emarginate, base with incurved auricles. Vexillary stamen connate to the tube. Ovules many. Fruits subterete, valves twisting upon dehiscence. Seeds barrel-shaped to oblong-elliptic.

**Description:**—Perennial herbaceous climber or creeper. Stems slender but strong, fibrous, up to 10 m long, rooting at the nodes, pubescent with spreading hairs. Stipules basifixed, triangular to ovate, 4–12 mm × 2–3 mm, acuminate, deciduous or persistent. Leaves pinnately trifoliolate; petiole 3–12 cm long, somewhat pubescent with adpressed and spreading hairs; leaflets broadly ovate, rhomboid, or ovate-rhomboid, the terminal one broader and symmetrical, entire or lobed, 3–18 cm × 2–16 cm, margin entire or sinuate, lateral leaflets sometimes oblique, 3–14 cm × 3–12 cm, mucronate, leaflets adpressed pubescent above, more densely below, veins conspicuous below, strongly pubescent, 3 from the base, 5 pairs of primary lateral veins, opposite or not; petiolules 2–6 mm long with spreading hairs; stipels 3–10 mm long, linear to lanceolate, setaceous. Inflorescences solitary, axillary pseudoracemes, unbranched, (4–)10–35(–45) cm long, nodose (with brachyblasts), flowering above the middle with 4 or more flowers per node; bracts subtending the nodes, 2–5 mm long, caducous; pedicels 2–6 mm, pubescent; bracteoles 2 per flower, lanceolate, 3–4 mm × 1–2 mm. Calyx 4–9 mm long, hirsute on the outside, the tube 3–5 mm long, 5-lobed, the upper 2 lobes fused along half of their length or more but not entirely fused, 2–4 mm long, lateral lobes obtuse to acute, 1.5–3 mm long, the lower lobe acute to lanceolate-acuminate or subulate, longer than the others, 3–6 mm long. Corolla bluish-purple or white suffused with purple, pink, or bluish-purple, vexillum obovate, often with green or yellow patch at the base, 10–23 mm × 8–18 mm, base with 2 incurved auricles, without callosities; wing petals obovate-oblong, bluish-purple or white suffused with bluish-purple, slightly longer than the keel, 9–20 mm × 3–6 mm, one side of base with rounded auricle, claw slender, 3–4 mm long, basal margin lobed; keel petals falcate, bluish-purple or white with blue, green or purple tip, 10–21 mm long, base truncate, clawed, the claw 4–6 mm long. Ovary linear, hirsute, 10–15 mm long with ca. 20 ovules; style glabrous, 4–10 mm long, curving upward; stigma terminal, globose. Stamens diadelphous, the vexillary stamen adherent near the middle to the staminal column in bud but becoming free with age, 10–21 mm long; anthers basifixed, alternating on long and short filaments. Fruits leguminous pods, subterete, grey to black, first adpressed hirsute, glabrescent, 5–12 cm × 3–5 mm, valves twisting upon dehiscence, with papery partitions between the seeds. Seeds 15–20 per fruit, barrel-shaped to oblong-elliptic, 2.5–4 mm × 2–3 mm, 1.5–2 mm thick; funicle short, deltoid; arils elongate.

**Phenology:**—Flowering and fruiting various, dependent upon locality (see Table 2 of van der Maesen 1985 for detailed information).

**Distribution:**—Native to southern, eastern, and Southeast Asia: Australia, Bangladesh, Bhutan, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, N. Borneo, Nepal, New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand, Vietnam. Introduced widely to other tropical areas.

**Vernacular:**—三裂叶葛 san lie ye ge (Chinese), ถั่วเขียนป่า thua sian pa (Thai), ผักพืด phak phit (Thai).

**Discussion:**—*Neustanthus* is phylogenetically close to *Sinodolichos* (Egan *et al.*, in prep.; Cagle 2013), a genus of similar geographic distribution. Both genera are perennial, herbaceous climbers or creepers, with spreading hirsute hairs and basifixed stipules. Both have long, acuminate calyx lobes and linear, somewhat compressed, subterete fruit. However, they differ in their inflorescence structure, with *Neustanthus* having a pseudoraceme whereas *Sinodolichos* has a true raceme. *Neustanthus* has ca. 20 seeds per pod that are usually barrel-shaped whereas *Sinodolichos* has 3–10 seeds that are oblong. The most recent treatment of *P. phaseoloides* by van der Maesen (2002) recognized three varieties: var. *phaseoloides*, var. *javanica*, and var. *subspicata*. These taxa have been variably recognized at the species level (e.g. as *Neustanthus javanicus* by Bentham (1832)), varietal levels (e.g. van der Maesen, 1985, 1994, 2002), or in synonymy under *P. phaseoloides*. A comprehensive sampling coupled with morphometric and/or molecular genetic work will be necessary to determine the best level at which to recognize these taxa. Pending further investigation, we choose to continue with the current recognition of these taxa at the varietal level. Resurrected names and new combinations are presented below. For a full list of synonyms and a key to the varieties and descriptions thereof, see van der Maesen (1985).



**FIGURE 1.** *Neustanthus phaseoloides*. **A.** Habit, Inflorescence. **B.** Upper leaf surface (detail). **C.** Lower leaf surface (detail). **D.** Stipules. **E.** Stipels. **F.** Calyx, inner view. **G.** Flower, lateral view. **H.** Flower, face view. **I.** Vexillum. **J.** Wing petal. **K.** Keel. **L.** Androecium, lateral view, surrounding stigma and apex of style. **M.** Fused stamens and free stamen. **N.** Gynoecium. **O.** Fruit. **P.** Nodes (brachyblast) of pseudoraceme. **Q.** Seed, lateral view. **R.** Seed, dorsal view. Voucher used for illustrations: A–E: A.N. Egan & Xu Bo 13-0817 (US); F–N: A.N. Egan *et al.* 13-0715 (US); O–R: Shiu Ying Hu 5764 (US). Illustrations by Alice R. Tangerini.

**New and resurrected combinations in *Neustanthus***

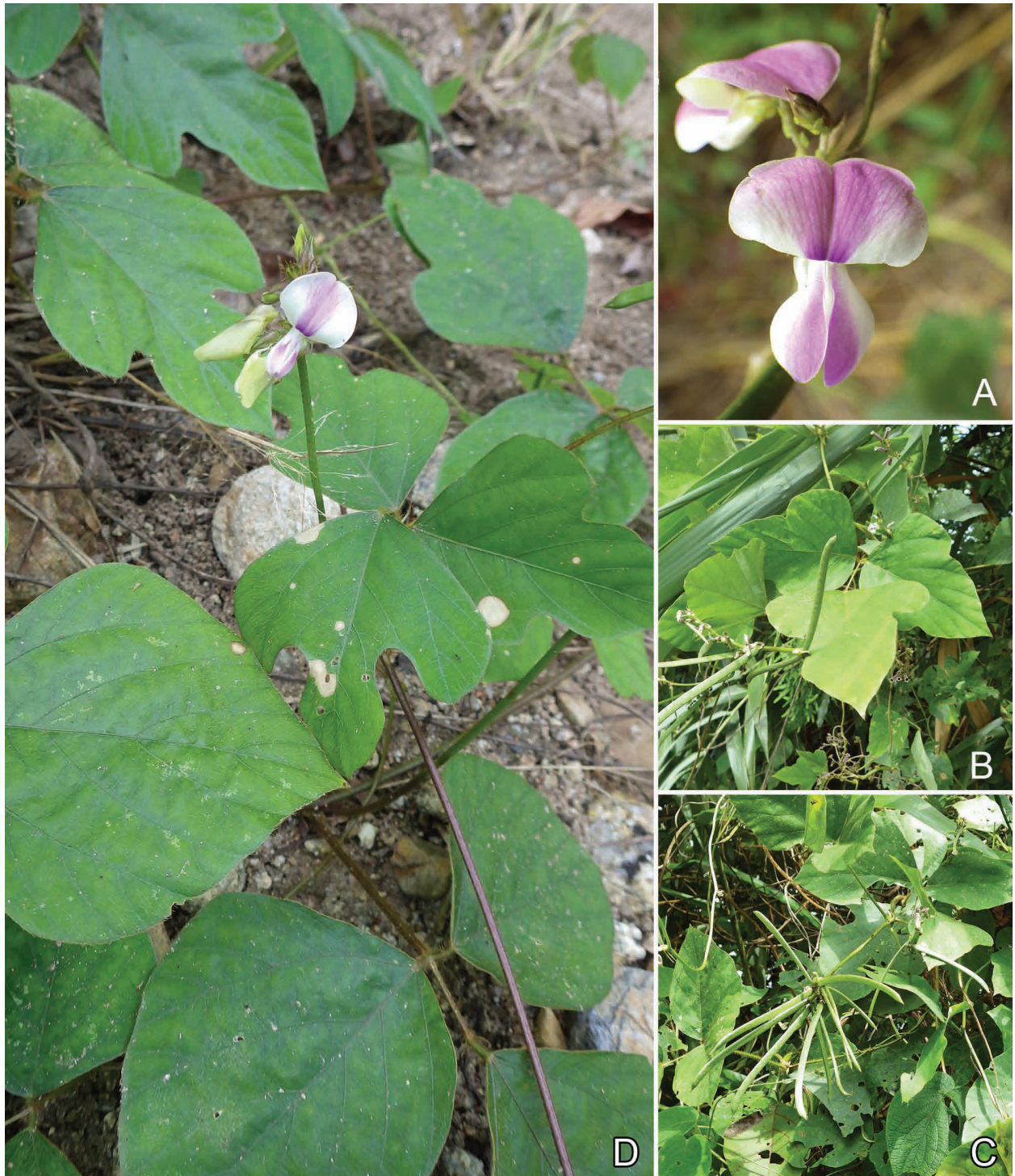
*Neustanthus phaseoloides* var. *phaseoloides* (Roxburgh) Bentham in Miquel, Pl. Jungh. 2: 235. 1852.

**TYPE:**—INDIA. Calcutta Bot. Garden, grown from seeds received from Kerr at Canton, China (holotype: CAL).

**Basionym:**—*Dolichos phaseoloides* Roxburgh, Fl. Ind., ed. 1832, 3: 316. 1832. *Dolichos phaseoloides* Roxburgh, Hort. Bengal.: 55. 1814, *nom. nud.*

**Selected Synonyms:**—*Pueraria phaseoloides* (Roxburgh) Bentham, J. Linn. Soc. Bot. 9: 125. 1865.

**Images:**—Illustration: Figure 1; Photo Plate: Figure 2.



**FIGURE 2.** *Neustanthus phaseoloides* var. *phaseoloides*. A. Flowers. B. Leaves. C. Fruits. D. Habit. Photographs by A.N. Egan of (A–C) A.N. Egan *et al.* 13-0715 (US) and (D) A.N. Egan *et al.* 13-0817 (US).

*Neustanthus phaseoloides* var. *javanica* (Bentham) A.N.Egan & B.Pan, *comb. nov.*

**TYPE:**—INDONESIA. Java, Merapi, R. Kuning, *Junghuhn s.n.* (holotype: K, not seen; Verdcourt (1971) describes Roxburgh drawing 1890 as a syntype at K, designated as a holotype by van der Maesen (1985)).

**Basionym:**—*Neustanthus javanicus* Bentham in Miquel, Pl. Jungh. 2: 235. 1852.

**Selected Synonyms:**—*Pueraria javanica* (Bentham) Bentham, J. Linn. Soc. Bot. London 9: 125. 1865. *Pueraria phaseoloides* var. *javanica* (Bentham) Baker in Hooker, Fl. Brit. India 2: 199. 1876.

*Neustanthus phaseoloides* var. *subspicata* (Bentham) A.N.Egan & B.Pan, *comb. nov.*

**TYPE:**—BANGLADESH. Mountains near Sylhet, *Wallich 5557A* (lectotype: K[barcode K000264080!]; isolectotypes: E[barcode E00301515!], G[barcode G00370593!]).

**Basionym:**—*Neustanthus subspicatus* Bentham in Miquel, Pl. Jungh. 2: 234. 1852.

**Selected Synonyms:**—*Pueraria subspicata* (Bentham) Bentham, J. Linn. Soc. Bot. London 9: 125. 1865. *Pueraria phaseoloides* var. *subspicata* (Bentham) Maesen, Agr. Univ. Wageningen Papers 85(1): 84–88. 1985.

*Teyleria* Backer, Jard. Bot. Buitenzorg Bul. (ser 3) 16:107. 1939

**Type species:**—*Teyleria koordersii* (Backer) Backer, Bull. Jard. Bot. Buitenzorg ser. 3 16:108. 1939 *syn nov.* (*Teyleria tetragona* (Merrill) Maesen, Agric. Univ. Wageningen Papers 85,1: 119. 1985.)

**Diagnosis:**—Vine or scandent shrub, perennial. Stems angular to terete, sulcate in upper parts. Leaves pinnately trifoliolate. Leaflets entire. Stipules basifixed. Petioles angular to canaliculate. Nodose pseudoracemes axillary, rachis 4-angled, bract at the base of node persistent, pair of bracteoles at the base of the calyx. Calyx 4- or 5-lobed, the top two connate for more than half their length or entirely connate. Corolla white or bluish-purple. Stamens monadelphous, vexillary stamen connate to the tube in the middle. Fruits compressed, septate between the seeds. Seed coat tuberculate.

**Description:**—Herbaceous or woody climber or scandent shrub, perennial. Young stems angular, pubescent, the older, woody stems becoming terete and glabrate. Stipules basifixed, lanceolate to broadly lanceolate, persistent. Leaves pinnately trifoliolate, petiole angular to canaliculate, pubescent; terminal leaflet rhomboid to ovate, lateral leaflets smaller, obliquely ovate, apices acute to acuminate, bases rounded to cuneate, veins prominent below, not in pairs, 4–6 laterals on each side; petiolules 2–7 mm long, pubescent; stipels lanceolate, persistent. Inflorescence either a terminal panicle or more commonly an axillary pseudoraceme with the rachis single or with one branch, peduncle and rachis strongly angular, pubescent, more densely hairy on the angles, nodose with thickened, condensed racemules persistent on the rachis, 3 or more flowers per node; bracts subtending nodes, lanceolate, curved upward towards apex of inflorescence, persistent; bracts subtending pedicels, lanceolate, curved upward towards apex of inflorescence, persistent to late-caducous; pedicels 1–3 mm long, pubescent; bracteoles 2 per flower, attached at base of the calyx. Calyx pubescent, 4- or 5-lobed, upper 2 lobes entirely or nearly entirely connate from the base. Corolla bluish-purple, white, or white suffused with purple; vexillum obovate to ovate, apex obtuse to emarginate, wing petals obovate, clawed; keel petals clawed. Ovary elongate, pubescent or not; style glabrous, stigma terminal, globular, pubescent at base. Stamens monadelphous, the vexillary stamen connate to staminal column in middle, free below; anthers basidorsifixed, alternately on long and short filaments. Fruits leguminous pods, flattened-oblong, glabrous to pubescent, apex acuminate, apiculate with persistent style, base cuneate, sutures thickened, septate. Seeds ovoid to nearly quadrate with rounded edges, compressed, reddish-brown to black, seed coat finely tuberculate; funicle deltoid; aril elongate.

**Distribution:**—Cambodia, China (Yunnan and Hainan provinces), Indonesia, Laos, Malaysia, Myanmar, Thailand, and Vietnam.

**Discussion:**—*Teyleria stricta* contains canavanine, a free amino acid not usually found in subtribe Glycininae, to which *T. stricta* is allied (Lackey, 1977a). Because of this, Lackey (1977b) suggested that *T. stricta* was anomalous in the genus *Pueraria* and likely allied with *Neonotonia* J.A.Lackey (J. Lackey, 1977). Van der Maesen (1985) acknowledged Lackey's opinion, but disagreed with its removal from the genus, stating "morphologically the species fits better in *Pueraria*, as differences in habit, inflorescence size, calyx shape, flower size and shape, pod size and shape separate it from *Neonotonia wightii* (Arnott) J.A.Lackey." Phylogenetic affiliations support Lackey's hypothesis of a relationship

between *T. stricta* and *Neonotonia* (Lackey, 1977b), with a clade comprised of *Neonotonia* and *Teyleria*, including *T. stricta* nested within *Teyleria*, strongly supported by both nuclear and chloroplast data (Egan *et al.*, in prep.). This clade is supported by chemistry via the presence of canavanine in a subtribe otherwise devoid of it (Bell, Lackey, & Polhill, 1978; Lackey, 1977a, 1977b). *Pueraria stricta* is here transferred to *Teyleria*, a group sharing morphological features including angular petioles, quadrangular stems, small flowers along an erect rachis, monadelphous stamens, septate fruit, and a sculptured seed coat.

Following the advice of (1977b), van der Maesen (1985) moved *Pueraria tetragona* Merrill from *Pueraria* to the genus *Teyleria*, creating the new combination *Teyleria tetragona* (Merrill) J.A.Lackey ex Maesen, stating in his key that *T. tetragona* has fruits 4–7 cm × 0.5 cm, whereas *T. koordersii* has fruits ca. 3 cm × 0.3 cm. However, in our review of several specimens, including all of the specimens examined by van der Maesen (1985), for *Teyleria*, we note that fruits from *T. koordersii* rarely approach 5 mm in width, but are more usually 4 mm. Furthermore, fruits range from 3–5 cm in length, with most between 3–4 cm for both *T. koordersii* and *T. tetragona*. In reality, no character states delineate the two. Based on the original descriptions of the two species as well as comparison of the holotype and isotypes of *T. koordersii* and isotypes (holotype not seen) of *T. tetragona*, we assert that the two entities are conspecific. Even though the type of the genus is *T. koordersii* Backer (1939) based on *Glycine koordersii* Backer (1911), *Pueraria tetragona* Merrill (1910) is the earliest name at specific rank within the genus *Teyleria*, a name later synonymized under *Teyleria* as *T. tetragona* (Merrill) Maesen (1985). We therefore recognize *T. koordersii* as a synonym of *T. tetragona*.

### Key to Species:—

1. Scandent shrub with older stems and branches woody and rounded at base, with short, gray adpressed pubescence; flowers white suffused strongly with bluish-purple, 7–9 mm long.....*T. stricta*.
- Herbaceous or rarely woody climber with stems strongly angled, the angles densely hirsute with brown, appressed, retrorse hairs; flowers predominantly white, 4–7 mm long.....2.
2. Terminal leaflet rhomboid, leaflets densely pubescent below, stem angles with long pubescence, hairs 2–3 mm long; legume straight.....*T. barbata*.
- Terminal leaflet ovate, leaflets minutely strigulose below, stem angles with short pubescence, hairs 1–2 mm long; legume concave along the ventral suture.....*T. tetragona*.

### New combinations and synonymy in *Teyleria*

***Teyleria stricta* (Kurz) A.N.Egan & B.Pan, *comb. nov.***

**TYPE:**—MYANMAR. Pegu, Kurz 2557 (lectotype: CAL; isolectotype: K[barcode K000264084]).

**Basionym:**—*Pueraria stricta* Kurz, J. Asiatic Soc. Bengal, Pt. 2, Nat. Hist. 42-2: 254. 1873.

**Selected Synonyms:**—*Pueraria brachycarpa* Kurz, J. Asiatic Soc. Bengal 42-2: 232,254. 1873. *Pueraria hirsuta* Kurz, J. Asiatic Soc. Bengal 42-2: 254. 1873. *Pueraria collettii* Prain, J. Asiatic Soc. Bengal 66-2: 420. 1897 (lectotype: CAL; isolectotype: K[barcode K000797408!]). *Pueraria siamica* Craib, Kew Bull. 1911(1):40–41. 1911 (holotype: K[barcode K000797404!]); isotypes: E[barcode E00275914!], K[barcodes K000797402!, K000797403!], TCD[barcode TCD0016063!]). *Pueraria longicarpa* Thuan, Adansonia Ser. 2, 16-4: 509. 1977 (holotype: P[barcode P00507989]).

**Images:**—Illustration: Figure 3; Photo Plate: Figure 4.

***Teyleria tetragona* (Merrill) Maesen, Agric. Univ. Wageningen Papers 85(1): 119. 1985.**

**TYPE:**—PHILIPPINES. Palawan, near Puerto Princesa, Bermejos, Bur. Sci. 295. January 1906.

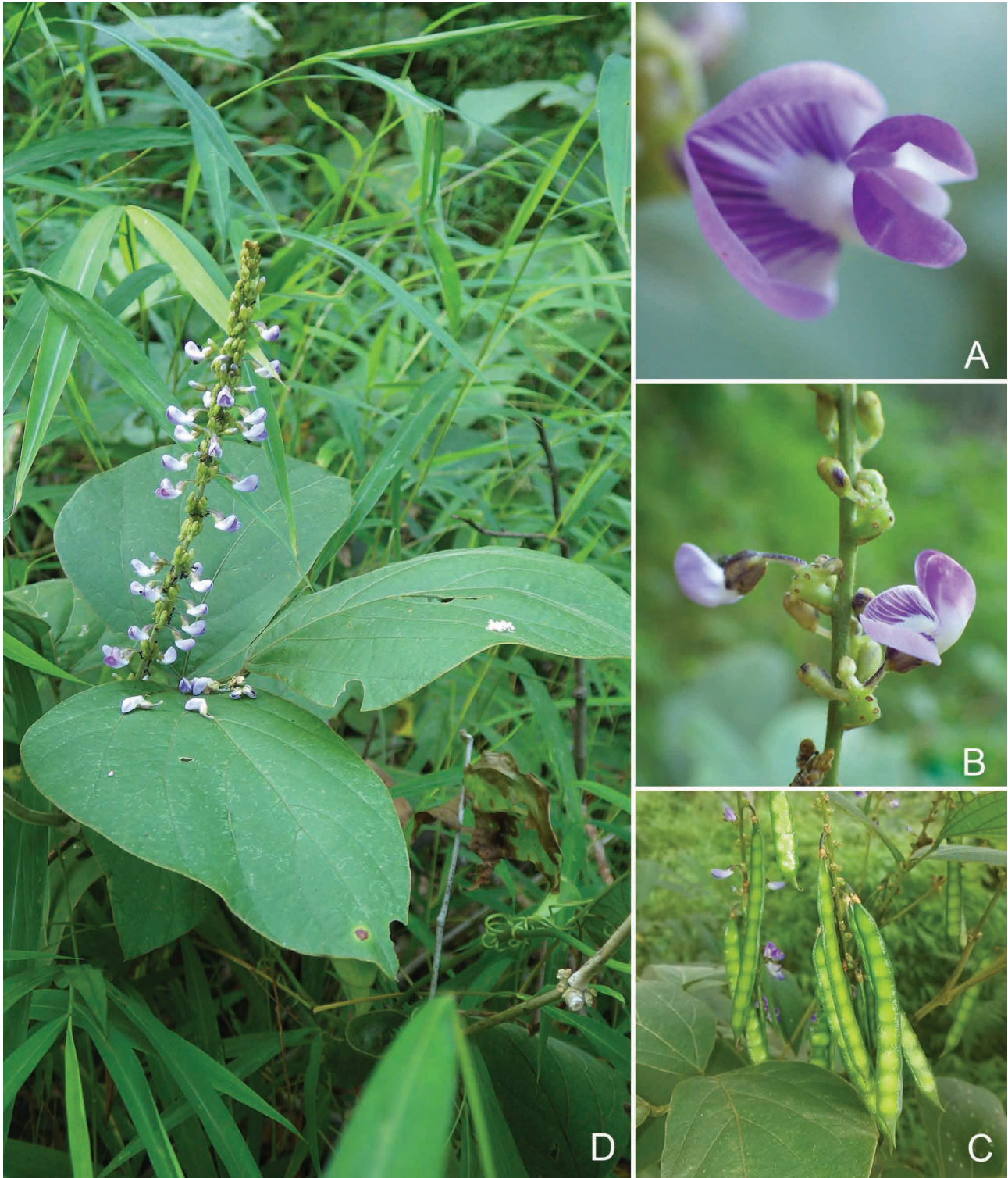
**Basionym:**—*Pueraria tetragona* Merrill, Philipp. J. Sci. 5: 122. 1910 (holotype: PNH; isotype: NY[barcode NY00026869!], US[barcode US00004642!]).



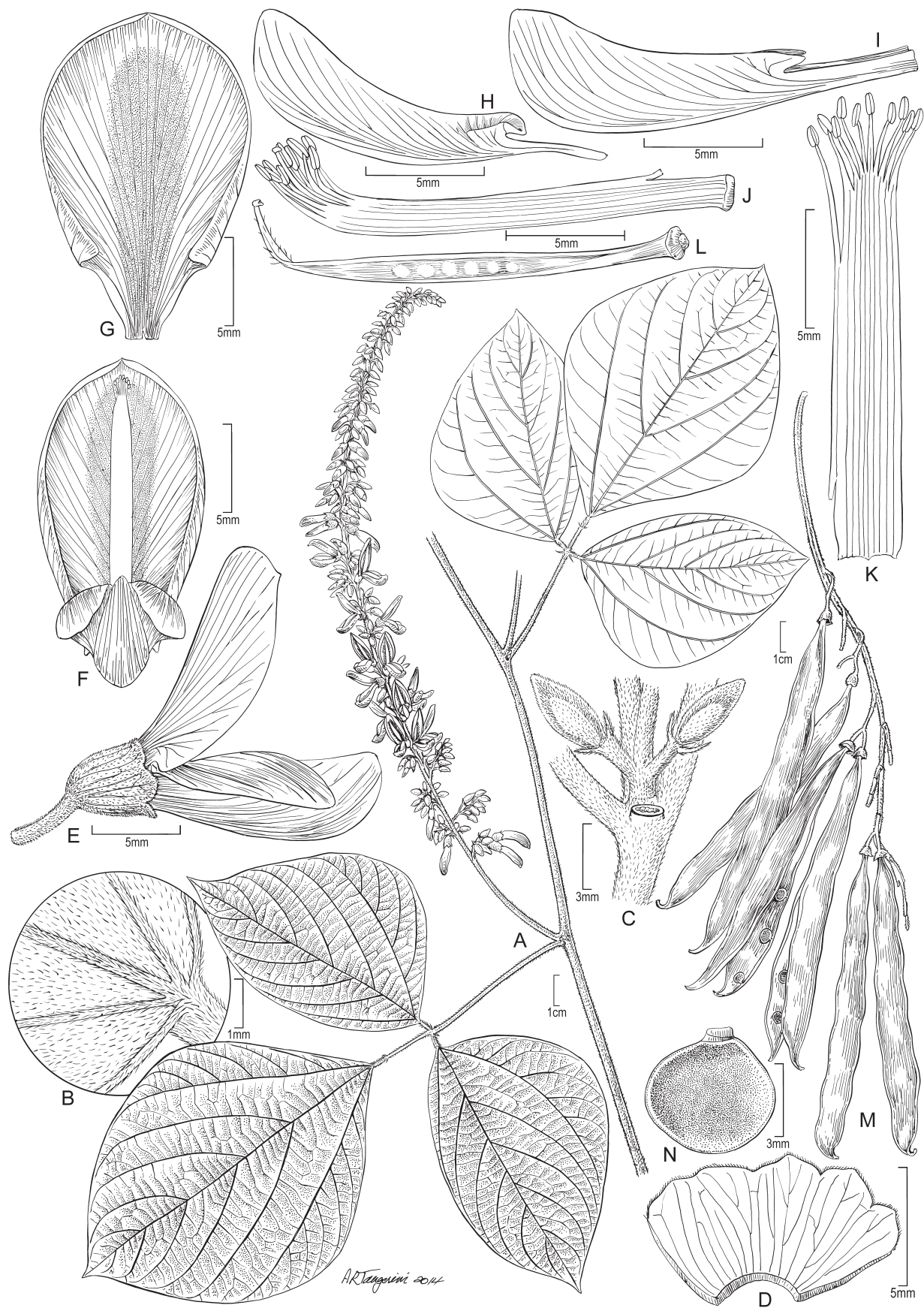


**FIGURE 3.** *Teyleria stricta*. **A.** Habit and inflorescence. **B.** Stipules. **C.** Stipels. **D.** Lower leaf surface. **E.** Cross section of inflorescence rachis. **F.** Stem pubescence (detail). **G.** Close up of nodose inflorescence with buds and buds scars. **H.** Bracts. **I.** Calyx, inner view. **J.** Flower, lateral view. **K.** Flower, face view. **L.** Vexillum. **M.** Wing petal. **N.** Keel. **O.** Fused stamens. **P.** Gynoeceum, ovary occasionally glabrous. **Q.** Fruits. **R.** Seed. Voucher used for illustrations: A: J.H. Lace 4903 & A. Rodger 615 (E); B–N: A.N Egan *et al.* 13-0749 (US); O: J.H. Lace 5938 (K); P: H.S. McKee 5891 (K). Illustrations by Alice R. Tangerini.

**Selected Synonyms:**—*Glycine koordersii* Backer *syn. nov.*, *Schooflora* voor Java 358. 1911. *Teyleria koordersii* (Backer) Backer *syn. nov.*, *Bulletin du Jardin Botanique de Buitenzorg*, sér. 3, 16: 108. 1939 (holotype: BO; isotypes: L[barcodes L0906816!, L0906817!, L0906818!]; paratypes: *Koorders 28959B* L[barcode L0906820!], *Beumee 1799* L[barcode L0906822!], *Koorders 21260B* L[barcode L0906817!]). *Glycine hainanensis* Merrill & P.F.Metcalf, *Lingnan Sci. Jour.* 16: 194. 1937 (holotype: SYS[barcode SYS00040713!]; isotypes: NY[barcode NY00011891!], BM[barcode BM001118522!]; paratypes: *Liang 65132* PE[barcode PE00217043], *Liang 65132* IBSC[barcode IBSC0734204!], *Liang 66411* IBSC[barcodes IBSC0197748!, IBSC0197749!], DAO, not seen).



**FIGURE 4.** *Teyleria stricta*. **A.** Flower. **B.** Nodose inflorescence with flowers. **C.** Fruits. **D.** Inflorescence and leaf. Photographs by A.N. Egan of (A, B, D) A.N. Egan *et al.* 13-0749 (US) and by Bo Pan (C), no voucher.



**FIGURE 5.** *Haymondia wallichii*. **A.** Habit. **B.** Upper leaf surface. **C.** Stipule scar budding, axillary inflorescence. **D.** Calyx, inner view. **E.** Flower, lateral view. **F.** Flower, face view. **G.** Vexillum. **H.** Wing petal. **I.** Keel. **J.** Androecium. **K.** Fused stamens. **L.** Gynoecium. **M.** Fruits. **N.** Seed. Voucher used for illustrations: A–C, E–L: A.N. Egan *et al.* 13-0750; D: J.D.A. Stainton 8462 (E); M–N: A. Henry 11568 (K). Illustrations by Alice R. Tangerini.

*Haymondia* A.N.Egan & B.Pan, *gen. nov.*

**Type species:**—*Haymondia wallichii* (de Candolle) A.N.Egan & B.Pan (*Pueraria wallichii* de Candolle, Ann. Sci. Nat. (Paris) 4: 97. 1825.)

*Haymondia wallichii* (de Candolle) A.N.Egan & B.Pan, *comb. nov.*

**TYPE:**—NEPAL. 1821, *Wallich 5353a* (holotype: G!; isotypes: BM[barcode BM000958610!], C[barcodes C10012332!, C10012333!, C10012334!], K[barcode K001120653!]).



**FIGURE 6.** *Haymondia wallichii*. **A.** Terminal, branching inflorescence with newly-opened flowers. **B.** Fruits. **C.** Mature flowers. **D.** Habit and leaves. Photographs by Bo Pan.

**Basionym:**—*Pueraria wallichii* de Candolle, Ann. Sci. Nat. (Paris) 4: 97. 1825.

**Selected Synonyms:**—*Pueraria composita* Graham ex Wallich nom. nud., Cat. Herb. Ind. no. 5570, based on Burma, Taong Dong, Wallich 5570. *Neustanthus wallichii* (de Candolle) Bentham, in Miquel, Pl. Jungh. 2: 234. 1852. *Pueraria wallichii* de Candolle var. *composita* (Graham ex Wallich) Bentham, J. Linn. Soc. Bot. London 9: 124. 1867 (holotype: K[barcode K001121317!]; isotypes: BM[barcode BM000958611!], G[barcodes G00370594!, G00370591!], K[barcodes K000264070!, K000264071!]). *Dolichos frutescens* Hamilton, in Don, Prodr. 240. 1825.

**Images:**—Illustration: Figure 5; Photo Plate: Figure 6.

**Diagnosis:**—Scandent shrub, erect, or climbing when in shade or associated with other trees or shrubs. Roots not tuberous. Leaves pinnately trifoliolate. Stipules basifixed, lanceolate and caducous. Stipels bristle-like. Pseudoracemes or panicles with many flowers on short branches, ascending or pendulous. Calyx campanulate, lobes 5, the upper two fused, short and blunt or minutely bifid. Corolla large. Vexillum apex rounded, without callosities, sides not reflexed, green spot and white rays in the center. Vexillary stamen connate to the staminal column. Staminal column moves up to touch vexillum in late blooming. Fruits coriaceous, glabrous, valves twisting upon dehiscence. Seeds orbicular and compressed.

**Description:**—Perennial scandent shrub, erect or climbing. Stems woody, up to 7 cm in diameter, 2–4(–7) m tall, sparsely pubescent with adpressed hairs, glabrescent with age. Stipules basifixed, linear-acuminate, 4–11 mm × 2 mm, quickly caducous, stipule scar narrowly elliptic. Leaves pinnately trifoliolate; petiole striate, 5–18 cm long; terminal leaflets broadly ovate, rhomboid-elliptic, to suborbicular, 8–28 cm × 8–26 cm, lateral leaflets smaller, oblique, 7–23 cm × 4–16 cm, apex acuminate, rarely obtuse, base cuneate, leaflets green and glabrous above, grey-green and sparsely adpressed pubescent below, veins conspicuous below, in ca. 7 pairs; petiolules 4–10 mm long with spreading hairs; stipels small, 1–3 mm long, bristle-like, falling with age. Inflorescences solitary, axillary or terminal pseudoracemes, branched or not, (4–)10–40(–55) cm long, nodose (with brachyblasts) to short branched, 4 or more flowers per node; bracts subtending the nodes, 2–5 mm long, caducous; pedicels 2–6 mm, pubescent; bracteoles 2 per flower, ovate to lanceolate, 0.5–3 mm long, caducous. Calyx 4–6 mm long, short appressed hairs on the outside, the tube 3–5 mm long, 5-lobed, the upper two lobes fused entirely or nearly so, other lobes obtuse, 0.5–1 mm long. Corolla white to pink; vexillum obovate, green spot and white rays in the center, (10–)16–19(–23) mm × 8–15(–18) mm, apex rounded, auricles not reflexed, without callosities at base; wing petals white or pink, darker than vexillum or keel petals, 15–17 mm × 2–3 mm; keel petals strongly curved, ventrally and basally fused, white to light pink, 14–18 mm × 3 mm. Ovary elongate, finely hirsute, 8–12 mm long; style 4–6 mm long, the last 2–3 mm strongly upcurved, glabrous, stigma terminal, globose. Stamens monadelphous, the vexillary stamen connate to staminal column in the middle, free below, 14–15 mm long, the free end 1–2 mm, upcurved, stamens and style move up to touch vexillum in late blooming; anthers dorsifixed, alternately on long and short filaments. Fruits leguminous pods, flattened, oblanceolate, tan to medium brown, glabrous, coriaceous, ca. 5–8 ovuled, not septate, 6–13 cm × 0.8–1.2 cm, acuminate at both ends, style persistent, dehiscent when mature, valves twisting. Seeds orbicular to oblong, ca. 5–7 mm × 3–6 mm, ca. 2.5 mm thick, compressed, brown or with black mottling; funicle broad, triangular in shape; aril elongate.

**Phenology:**—Flowering July to October (to February at lower elevations). Fruiting October to February.

**Distribution and Ecology:**—Bangladesh, Bhutan, China (Tibet, Yunnan), India (E Himalayas, Meghalaya), Myanmar, Nepal, Thailand. Elevation 180–2000 (–2300) m; in hills and forest margins of dry evergreen forests where it is often associated with Dipterocarpaceae, particularly *Shorea robusta*, or with *Quercus*; in open grassy vegetation, on slopes, along rivers.

**Conservation:**—*Haymondia* is fairly common in Thailand and Burma throughout dry dipterocarp forests and occurs within or near the borders of several national parks. It is less common in China and areas at the edge of its range. It is assessed here as Least Concern (LC) according to the criteria of IUCN (2001) based on frequency within its range and presence within protected areas.

**Etymology:**—This genus is named after Welby Dean Haymond and Mildred Winona Davies Haymond, maternal grandparents of author Ashley N. Egan, who instilled and cultivated a love of nature and science in her by the simple act of allowance.

**Vernacular:**—演弥葛 xu mi ge (Chinese), มะเป๊าะเป๊าะ ma paep wo (Thai)

**Discussion:**—*Haymondia wallichii*, which commemorates Dr. Wallich who sent it, along with a number of other plant specimens, to de Candolle from Nepal (its type locality), was originally described by de Candolle in 1825 along with *Pueraria tuberosa* (the type species for *Pueraria*). The two species resemble each other superficially, both having large trifoliolate leaves, twining habit, and long, pendulous inflorescences. However, careful examination confirms that the two species are strikingly different. Lackey (1977b) tentatively separated members of genus *Pueraria* into four groups based on morphological differences such as number of flowers per node, stipule type, calyx type, callosities

on the vexillum, and fruit type, with *P. wallichii*, *P. peduncularis*, and *P. stracheyi* comprising his group D. Lackey's (1977b) group D admittedly comprised those species which he felt were "surely anomalous in the genus but fits nowhere else." Lackey also found that *P. wallichii* contains the free amino acid canavanine, a chemical that most species of subtribe Glycininae lack. In fact, Lackey (1977b) went so far as to suggest that *P. wallichii* was not only anomalous in the genus, but perhaps in the tribe as well: "all *Pueraria* species studied have paraveinal mesophyll, except for *P. peduncularis* and *P. wallichii*. This substantiates the morphological data which indicates that these two species are probably generically, and perhaps subtribally or tribally misplaced". Van der Maesen (1985) revised the genus *Pueraria* into three sections: *Pueraria*, *Schizophyllon*, and *Breviramulae*, placing *wallichii* into the latter, a motley group including the two new genera presented here. In spite of their observations, neither Lackey nor van der Maesen took action to describe new genera for or move the anomalous species, largely due to uncertainty as to true relationships. Lee and Hymowitz (2001) were the first to substantiate the hypotheses of these authors using phylogenetic evidence. Their *rps16* phylogeny included *P. pulcherrima*, *P. phaseoloides*, *P. lobata*, *P. stricta*, and *P. wallichii*. Their findings support the exclusion of *P. wallichii* from *Pueraria s.s.*, but they, also, did not take revisionary action, suggesting that "more taxa of *Pueraria* that represent all four groups should be included in a rigorous molecular investigation." Cagle (2013) and Egan *et al.* (in prep.) included a comprehensive sampling of *Pueraria* as well as many other genera to ascertain how these anomalous species were related to other phaseoloid genera and found that *Haymondia* is a distinct phylogenetic lineage at the base of tribe Phaseoleae, but found no clear affinity of *Haymondia* for any other genera. A key feature of *Haymondia* is the position of stamens throughout flowering. At the onset of anthesis, the staminal column is positioned within the keel petals (Figure 5A), but later moves upward until the stamens and stigma are touching the vexillum or nearly so and are fully reflexed from the wing and keel petals (Figure 5C). This feature is shared with several other genera to which *Haymondia* is loosely affiliated in phylogenies, including *Apios*, *Mucuna*, *Cochlianthus*, and several members of tribe Desmodieae (Egan *et al.*, in prep.).

***Toxicopueraria* A.N.Egan & B. Pan, gen. nov.**

**Type species:**—*Toxicopueraria peduncularis* (Graham ex Benth) A.N.Egan & B. Pan (*Neustanthus peduncularis* Graham ex Benth, in Miquel, Pl. Jungh. 2: 235. 1852).

**Diagnosis:**—Woody lianas, roots not tuberous. Leaves pinnately trifoliolate. Leaflets entire. Stipules basifixed, lanceolate, open. Pseudoracemes long and pendulous, 3-several flowers clustered at each node. Bracts and bracteoles setaceous, quickly caducous. Pedicels slender. Calyx 4- or 5-lobed. Vexillum without callosities. Vexillary stamen adherent to the tube, but detaching with age. Fruits linear, flat, subchartaceous, valves not twisting upon dehiscence. Seeds elliptic, compressed.

**Description:**—Perennial twining, woody climber. Roots not tuberous. Stems to 40 cm in diameter when mature. Branches robust, up to 10 m long. Stipules basifixed, ovate to lanceolate, 4–10 mm × 1–3 mm, striate, persistent to caducous, leaving a raised scar. Leaves pinnately trifoliolate; petiole striate, pubescent or glabrous, 4–13 cm long; leaflets ovate to rhomboid, lateral leaflets obliquely so, glabrous to strigulose on both sides, 5–14(–23) cm × 2–8(–14) cm, base rounded-cuneate, apex long-acuminate, margins entire, veins prominent below, pubescent, in 6 or 7 unequal pairs with basal pair opposite; petiolules pubescent, 3–7 mm long; stipels short, 1–3 mm long, persistent. Inflorescences axillary, solitary pseudoracemes, 1 or 2 per axil, pendulous, 10–40(–60) cm long, slightly nodose (with swollen nodes or brachyblasts), with (2–)4–7 flowers per node; bracts subtending the nodes, 1–3 mm long, quickly caducous; pedicels slender, thickening in fruit, to 14 mm long; bracteoles 2 per flower, hirsute, minute, caducous. Calyx 4- or 5-lobed, with short, adpressed hairs on outside, glabrous on inside, tube 3–5 mm long, gibbous above base, lobes shorter than the tube, acute to broadly so, upper two lobes connate or only almost entirely so, 1–3 mm, lateral lobes triangular, 1–2 mm long, lower lobe narrowly triangular, 1–1.5 mm long. Corolla purplish-blue to violet or white suffused with purple or pink at the tips; vexillum orbicular-ovate to obovate, apex emarginate, base clawed, auricles inflexed or truncate, without callosities; wing petals oblong; keel petals ventrally fused. Ovary elongate, pubescent, 5–8 mm long, ca. 7 ovules; style glabrous, 2–5 mm, with terminal 2–3 mm inclined towards the vexillum; stigma terminal, globose, pubescent at the base. Stamens diadelphous, the vexillary stamen adherent to staminal column at first, becoming free with age, 10–14 mm long, the free part ca. 2–3 mm, inclined upward; anthers basi-dorsifixed on alternately long and short filaments. Fruits leguminous pods, flattened-oblong, black, purple-brown, or tan, glabrous, chartaceous, (3–)5–7 cm × 0.5–1 cm, not septate, (1–)4–7 seeded, cuneate at base, acuminate at apex, style persistent, sutures robust. Seeds compressed; funicle elongate-triangular in shape; arils elongate.

**Etymology:**—*Toxicopueraria* is derived from the latin *toxicus* (“poisoned”) due to the use of ground stems and roots as an insecticide and fish poison in Yunnan, China (Perry & Metzger, 1980) and in deference to its former name, *Pueraria*.

**Discussion:**—As with *Haymondia wallichii*, several botanists have recognized the anomalous placement of *T. peduncularis* within *Pueraria* (see discussion under *Haymondia*). Lackey (1977b) placed *P. peduncularis* in his group D, citing the absence of paraveinal mesophyll as evidence that the species did not belong to *Pueraria*, in addition to the minute bracteoles, a puckered calyx base and flat papery fruit. In spite of this, he did not create a new genus or offer any suggestions as to its affinity. Van der Maesen (1985) acknowledged these differences, but distinctly stated that he favored keeping *P. peduncularis* within *Pueraria*, stating “Even if biosystematic research would establish more distance from the other species, or even an anomalous position in the genus, it is not at all uncommon to admit within a genus a more or less anomalous species.” Although keeping *P. peduncularis* within *Pueraria* would mean fewer nomenclatural issues, it does not represent a natural or evolutionary grouping, and so we remove it and provide a new generic name here.

### Key to Species:—

1. Leaves and stems densely pubescent, becoming glabrous with age; no spurs at the base of stipules; flowers white with petal tips suffused with purple to pink or flowers purple, blue, or mauve; vexillum obovate..... *T. peduncularis*.
- Leaves and stems glabrous or thinly pubescent or glabrescent; with two short spurs flanking the base of the stipules; flowers white or cream, not suffused with purple or pink; vexillum orbicular-ovate..... *T. yunnanensis*.

### *Toxicopueraria peduncularis* (Graham ex Benth) A.N.Egan & B.Pan, *comb. nov.*

**TYPE:**—NEPAL. *Graham, Wallich Cat. No. 5354* (holotype: K[barcode K001120656!]; isotypes: K[barcode K000264081!], BM[barcodes BM000958608!, BM000521674!, BM000958607!], CAL, G[barcodes G00370586!, G00370595!]).

**Basionym:**—*Neustanthus peduncularis* Graham ex Benth in Miquel, *Pl. Jungh. 2: 235. 1852.*

**Selected Synonyms:**—*Pueraria peduncularis* (Graham ex Benth) Benth, *J. Linn. Soc. Bot. London 9: 124. 1867*; *Pueraria peduncularis* (Graham ex Benth) Benth var. *violacea* Franchet, *Pl. Delav. 182. 1890.* (lectotype: P[barcode P00500995]; isolectotype: A[barcodes A00228287!, A00228289!], K[barcode K000264082!]).

**Images:**—Illustration (*T. peduncularis*): Figure 7; Photo Plate (*T. peduncularis* & *T. yunnanensis*): Figure 8.

**Description:**—Woody climber to 10 m. Leaves and stems densely pubescent, becoming glabrate with age. Petioles 4–13 cm; stipules without small spur-like projections beneath; leaflets hirsute on both surfaces, rarely glabrous adaxially, apex acuminate, base acute. Pseudoracemes slightly nodose, 20–50 cm long. Flowers white, tinged with purple to pink or flowers purple, blue, or mauve; 4–7 flowers per node; pedicels slender, 6–9 mm long. Calyx papery, adpressed pubescent; upper 2 lobes connate or nearly so. Vexillum obovate, 11–15 mm × 8–10 mm, auricles truncate, inflexed; wings oblong, 8–14(–15) mm × 3–5 mm, claw ca. 3 mm long, apex obtuse; keel petals obovate, 8–12(–14) mm × 3–5 mm, claw 3–4 mm long. Fruits linear, tan to black when mature, 3–8 cm × 6 mm. Seeds elliptic, 2–3 × 3–4 mm, compressed, dark mahogany to black, sometimes with a red streak.

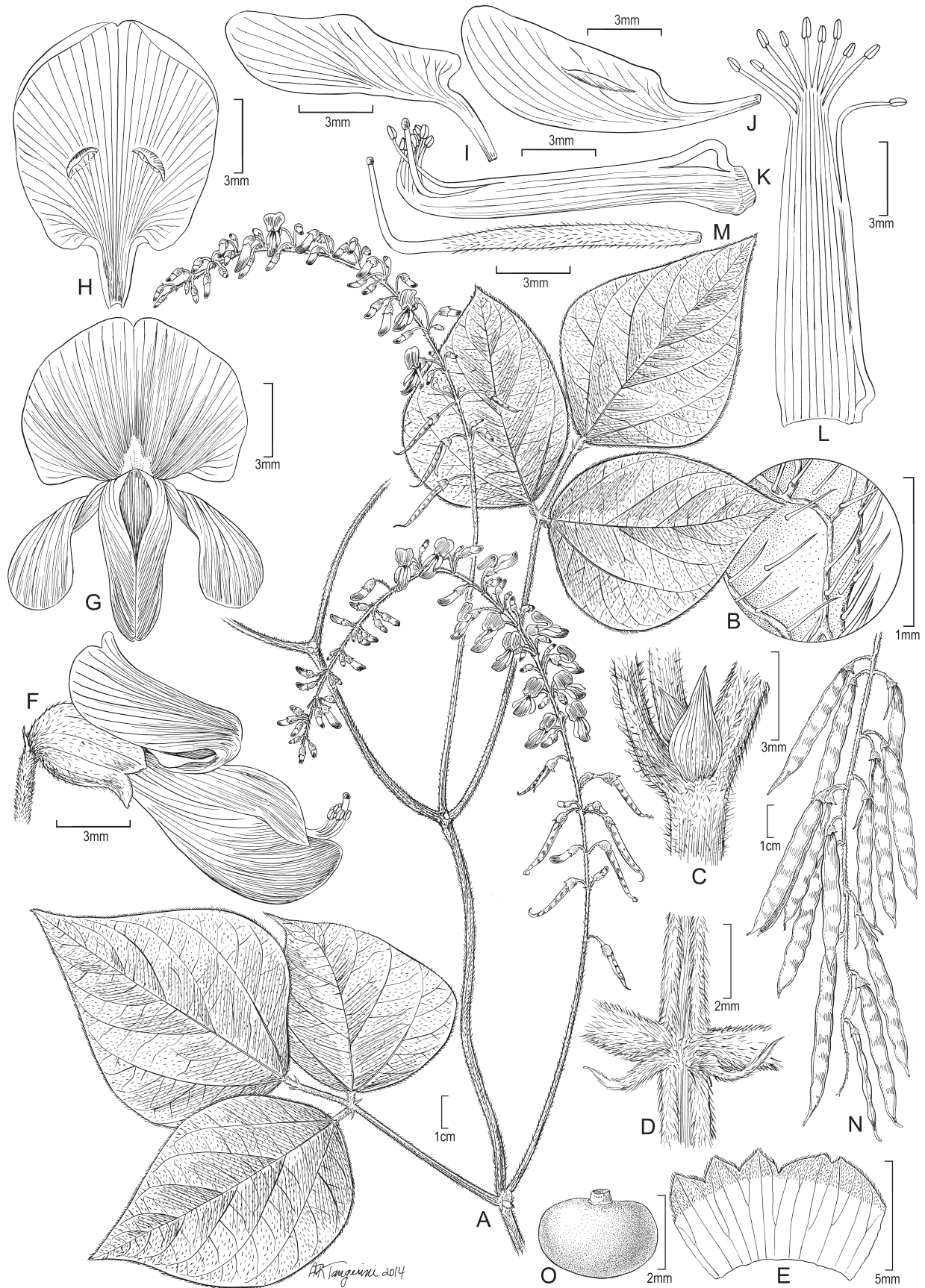
**Phenology:**—Flowering June to October; fruiting August to December.

**Distribution and Ecology:**—Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan, and S & SW China. Forests or forest margins or in thickets. Elevation 1000–4300 m.

**Conservation:**—*Toxicopueraria peduncularis* is assessed here as Least Concern (LC) according to the criteria of IUCN (2001) due to its fairly wide distribution, although a detailed study would be beneficial.

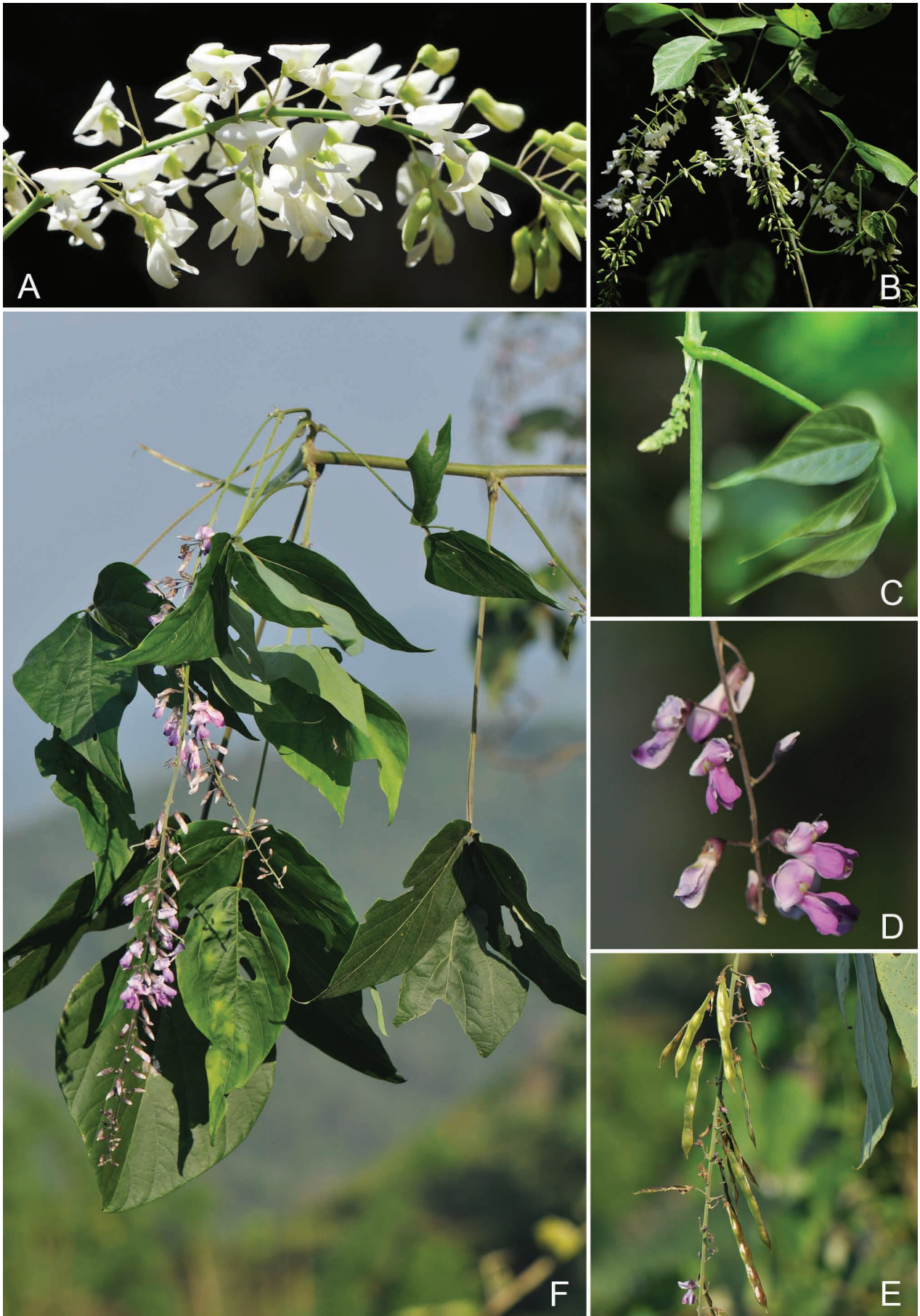
**Vernacular:**—苦葛 *ku ge* (Chinese), 云南葛藤 *Yun nan ge teng* (Chinese), ting khla (Khasi).

**Discussion:**—*Toxicopueraria peduncularis* has been documented for use by various indigenous peoples. The Nyishi (Daffla) tribe of Arunachal Pradesh in northeastern India are said to eat the fruits, either fresh or boiled (Srivastava *et al.* 2010), whereas the roots are crushed up and thrown into lakes and streams a fish poison in Yunnan, China (Perry & Metzger, 1980).



**FIGURE 7.** *Toxicopueraria peduncularis*. A. Habit. B. Lower leaf surface (detail). C. Stipules. D. Stipels. E. Calyx, inner view. F. Flower, lateral view. G. Flower, face view. H. Vexillum. I. Wing petal. J. Keel. K. Androecium, lateral view. L. Fused stamens. M. Gynoeceum. N. Fruits. O. Seed. Voucher used for illustrations: A–B, E–M: A.N. Egan & Bo Xu 12-233 (E); C: F. Kingdon-Ward 3711 (E); D: F. Kingdon-Ward 18838 (NY); N–O: Camillo Schneider 2587 (K). Illustrations by Alice R. Tanagerini.





**FIGURE 8.** *Toxicopueraria yunnanensis* (A–C) & *T. peduncularis* (D–F). **A.** Flowers. **B.** Inflorescences. **C.** Young, axillary inflorescence, leaf, and appendages flanking the stipule. **D.** Flowers. **E.** Young fruits. **F.** Habit, inflorescence, and leaves. Photographs by Bo Pan.

*Toxicopueraria yunnanensis* (Franch.) A.N.Egan & B.Pan, *comb. nov.*

**TYPE:**—CHINA. Yunnan. woods near Tapintze. April 1883 *Delavay 506* (lectotype: P[barcode P00507990!]; isolectotypes: P[barcodes P02961048!, P00507992]) Lectotype designated by Z. F. Le and X. Y. Zhu (Ann. Bot. Fenn. 46: 419–424. 2009).

**Basionym:**—*Pueraria yunnanensis* Franchet, Pl. Delav. 181. 1890.

**Selected Synonyms:**—*Derris bonatiana* Pampanini, Nuovo Giorn. Bot. Ital., n.s. 17(1): 8. 1910 (lectotype: NY[barcode NY00007612!]; paratypes: *Maire 210* P[barcode P02961022!])

**Images:**—Photo Plate (*T. peduncularis* & *T. yunnanensis*): Figure 8.

**Description:**—Woody climber. Leaves and stems glabrous or thinly pubescent or glabrescent. Petioles 3–8 cm; stipules with two small spur-like projections below the stipules, 1–2 mm, these becoming woody with age; leaflets with sparse hairs, apex caudate-acuminate, base rounded. Pseudoracemes 10–25 cm long. Flowers white or cream, not suffused with purple or pink, (2–)3–6(–7) flowers clustered at nodes of rachis; pedicels slender, 2–8 mm. Calyx membranaceous, subglabrate, sparsely villous; upper 2 lobes connate entirely, apex of lobes obtuse. Vexillum orbicular-ovate; 11–13 mm × ca. 8 mm; auricles inflexed; wings oblong, (7–)9–13 mm × 3–4 mm, claw ca. 4 mm long; keel petals (6–)7–12 mm × 3–4 mm, claw ca. 4 mm long, apex obtuse. Fruits linear, tan when mature, 4–8 cm × 7–11 mm. Seeds kidney-shaped to elliptic, ca. 5 × 3 mm, compressed, red-brown to black.

**Phenology:**—Flowering April to June; fruiting May to July.

**Distribution and Ecology:**—Endemic to Southwest China (Chongqing, Guangxi, Guizhou, Sichuan, Yunnan). Forests and forest margins or in thickets. Elevation 800–2300 m.

**Conservation:**—*Toxicopueraria yunnanensis* is endemic to five provinces in southwestern China and is less common than its congener. It is assessed here as Least Concern (LC) according to the criteria of IUCN (2001) due to its fairly wide distribution, but a more detailed study would be beneficial to accurately determine the conservation status.

**Discussion:**—*Toxicopueraria yunnanensis* has been synonymized with *T. peduncularis* by a number of taxonomists (Lackey, 1977b; van der Maesen, 1985, 1994, 2002; D. Wu & Thulin, 2010; T. L. Wu, 1995) because of their morphological similarities. However, they differ in indumentum, flower color, petal shape, projections below the stipules, and phenology (Figure 8). In addition, Le and Zhu (2009) found leaf epidermis and seed coat micro-characters to support the separation of these two species. From experience, the authors can easily determine *T. yunnanensis* from *T. peduncularis* in both live and pressed specimens, particularly in flower. *Toxicopueraria yunnanensis* tends to have a more upright vexillum with sides reflexed backwards whereas in *T. peduncularis* the whole vexillum is strongly reflexed, often to touch the calyx. *Toxicopueraria yunnanensis* has wing petals that are equal to or slightly longer than the keel, with the wings often displayed in a plane more perpendicular to the sides of the keel and with the ends curving backwards, presenting a more open display. In comparison, *T. peduncularis* has wing petals that are equal to or slightly shorter than the keel, and that are usually straight or slightly curved outward but more often in a plane parallel to the sides of the keel (compare Figure 8A and 8C). Furthermore, *T. yunnanensis* has small, spur-like projections that flank the stipule or stipular scar, these often becoming woody with age (see Figure 8C). These are lacking in *T. peduncularis*.

Several issues concerning types of *T. yunnanensis* or its synonyms exist. Van der Maesen (1985) designated one collection at P as the holotype of *Pueraria yunnanensis* (barcode P00507990), listing another as an isotype. Le & Zhu (2009) found issue with van der Maesen's designation of a holotype because there is no specification by the author/collector, J.M. Delavay, as to which of his collections, all designated under number 506 but collected during April or August 1883 or 1885, was to act as the holotype. Therefore, Le & Zhu (2009) correctly determined the specimen selected by van der Maesen as the lectotype, relegating all other sheets of *Delavay 506* (albeit with different dates) as isolectotypes.

In addition, there is some confusion surrounding the types of *Derris bonatiana*. The protologue states the type as “Yunnan-sen, source du Pe-long-tan. 8 May, 1904 (Ducloux, n. 377); [sine loco] (Maire, n. 210).” A search of Ducloux collections at Paris showed that Ducloux numbers 362–399 were collected from “Environs de Yun Nan Sen” during August and September of 1897, suggesting that *Ducloux 377* would have been collected during this time frame as well. While doing research for this manuscript, A.N. Egan came across a specimen from Paris [P02961736] collected by Ducloux (no. 2301) on 8 May 1904 from “Yun-Nan: environs de Yun nan-sen”, written in Ducloux's own hand. A survey of Paris' Ducloux numbers from 2273 to 2504 includes specimens collected from January to May of 1904, a range that includes that stated in the protologue. Because the institution of deposition of the specimen cited in the protologue was not named (Pampanini, 1910), van der Maesen (1985) designated a lectotype: “China, Yunnan-sen,

source of the Pe-long-tan river, 8 May 1904, *Ducloux 377* (FI, holo, not seen).” This is the same information stated in the protologue, but with the addition of a location (FI, a place of employment of R. Pampanini, author of *Derris bonatiana*). Note that van der Maesen did not actually see the specimen he designated as the lectotype. Attempts by author A.N. Egan to contact curators at FI concerning a *Ducloux 377* collection in their herbarium were unsuccessful. As of 18 May 2015, JStor Global Plants includes a type specimen of *Derris bonatiana* from NY [NY00007612], but the kind of type is not specified. The typed label of the NY *Ducloux 377* collection states: “*Derris botaniana* Pampanini n.sp., Yunnan Sen, source de Pé, 377 (E.E. Maire ?)” The typed font of “E.E. Maire ?” is crossed out in pencil with “*Ducloux!*” handwritten above it. E.E. Maire was a French contemporary of F. Ducloux who spent time in Yunnan as a missionary and began collecting plants in 1905. Thus, there is confusion concerning the type information stated in the protologue and how it matches with various collections in herbaria around the world. The above body of research suggests that Ducloux and Maire collections may have been mixed up or either the date of collection or the collection number or the collector were misstated in the protologue. Until it can be determined whether a *Ducloux 377* specimen exists in FI, the type designations of *D. bonatiana* are dubious.

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**APPENDIX 1.** List of specimens examined in the course of this study. First collector name is listed. Specimens are listed by taxon alphabetically. Within taxa, specimens are organized first by country alphabetically, and within country by primary division (Province/State), alphabetically, but with locality of unknown province/state listed first. Each specimen is separated by a semicolon (;). **TAXON:**—**COUNTRY.** **Province/State:** Locality, elevation, date collected, *Collector number* (herbarium code).

**HAYMONDIA WALLICHII:**—**BANGLADESH. E. Bengal:** *Griffith 1733* (P). **CHINA. Yunnan:** Talang, 5000 ft, *A. Henry 11568* (A, K, MO); Talang, *A. Henry 13233* (NY, US); Xishuangbanna Tropical Botanical Garden, *A.N. Egan 12-253* (US); Xishuangbanna, near Mengkhan, 21 54 54.11 N 101 5 53.61 E, 30 August 2012, *A.N. Egan 12-256* (US); Xishuangbanna, west of Manzhang on county road X179, 21 54 29.91 N 101 10 26.12 E, 31 August 2012, *A.N. Egan 12-270* (US). **INDIA. Meghalaya:** Khasia, 2000–4000 ft, *J.D. Hooker s.n.* (K, P, US); Khasia, Tserapindzi near Mairong, 2800–4500 ft, 30 October 1855, *Schlagintweit s.n.* (BM); Mawryngkneng, Khasi Hills, 4000 ft, 21 October 1951, *T.R. Chand 5085* (L); Mawryngkneng, Khasi Hills, 4000 ft, 9 September 1951, *W.N. Koelz 28421* (L). **MYANMAR.** Maymyo Plateau, near Ani Sakan, 15 October 1911, *Lace 5510* (E); Upper Burma, 3 December 1900, *J.C. Prazer 32* (US). **Chin:** Kanpetlet Township, along the trail between Kanpetlet and yelong Pan village, 1262–1450 m, 21 11 47.1 N 94 03 14.8 E, 13 February 2012, *Fujikawa 86644* (QBG); Kanpetlet Township, Yelong Pan Village, 4000 ft, 22 March 2011, *Ling Shein Man 87208* (QBG); Kanpetlet Township, Yelong Pan Village, 3000 ft, 17 December 2011, *Ling Shein Man 88008* (QBG); Kanpetlet Township, Yelong Pan Village, 4500 ft, 15 January 2012, *Ling Shein Man 88225* (QBG); Mindat area, Natma Taung National Park, 21 November 2011, *Law Shein 88305* (QBG); Mindat area, Natma Taung National Park, 21 November 2011, *Law Shein 88306* (QBG); Mt. Victoria, 5500 ft, 17 November 1956, *F. Kingdon Ward 22871* (BM). **Mon:** Martaban, *S. Kurz 1724* (US). **N. Shan State:** 2775 ft, 11 November 1909, *Lace 4975* (E). **S. Shan State:** Kunglung, 4000 ft, 9 October, *R.W. MacGregor 950* (E). **SE Shan State:** Banpin, 5500 ft, 2 April 1889, *G. Watt. 10732* (E). **Shan:** Southern Shan states, Taunggyi, 4700–5000 ft, 15 December 1952, *G.B. Vogt BU-417* (US). **NEPAL.** Arun valley, at the mouth of the Choyang Khola into Arun, 3 November 1972, *L.H.J. Williams 471* (BM); Hari, Harpor, Garhi, 1500 ft, 19 December 1980, *Stainton 8234* (E); Sattewati, 6000 ft, 12 October 1954, *Stainton 8896* (E); 1927, *Clive Wigram 214* (E); 2–3000 ft, 1852, *J.D. Hooker s.n.* (K); 3000–5000 ft, *J.D. Hooker s.n.* (P). **C. Nepal:** Laprok, Buri, Gandaki, 6000 ft, 14 October 1981, *Stainton 8462* (E); Trisuli, Syabru, 6000 ft, 23 September 1974, *Stainton 7242* (E). **E. Nepal:** Dhankuta, 1200 m, 21 October 1963, *H. Hara 6301728* (E); Khebang, below Siling Tzokupa, 20 November 1963, *H. Hara 6301730* (E, NY). **Sagarmatha:** Udayapur Distr., Beltar-Simule, 160–600 m, 24 October 1995, *M. Mikage 9554103* (E). **THAILAND.** Doi Chiangdao, 31 December, *Put 4436* (AAU, E); Doi Ingka, Me Ka Pak drainage, 1070 m, *H. Garrett 313* (E); Khun Tan Mountains, 4000 ft, 22 November 1928, *H.M. Smith 454* (US); Tapoh, 4 January 1962, *Kai Larsen 9144* (C, K). **Chiang Mai:** Amphoe Mae Rim, Ban Kong, 700–1100 m, 21 December 1978, *Bjørnland 553* (AAU, C); Between Pang Kia and Meh Kha Chan, basin of the Meh Lao, 750–900 m, 2 January 1922, *J.F. Rock 1620* (US); Camp Hoi Chan Kiang, Doi Sootep mountain range, 600 m, 26 October 1920, *J.F. Rock 116* (US); Chiang Dao, 12 December 1954, *P. Suvarnakoses 976* (AAU); Doi Sutep, 1000–1700 ft, 4 July 1905, *C.C. Hosseus 207* (C); Doi Sutep, 5000 ft, 31 December 1909, *A.F.G. Kerr 878* (P); Doi Sutep, 5000 ft, 4 January 1910, *A.F.G. Kerr 878* (K); Doi Sutep, 10 February 1926, *Mrs. D.J. Collins 1222* (US); Doi Sutep, 500 m, February 1987, *C. Niyomdham 1358* (P); Doi Sutep, 540–1700 m, 8 November 1911, *W.G. Craib 1554* (E); Doi Sutep, 15 November 1910, *A.F.G. Kerr 1556* (US); Doi Sutep, 1150 m, 23 October 1958, *Kai Larsen 5857* (P); Doi Sutep, 1150 m, 23 October 1958, *Th. Sørensen 5857* (C); Doi Sutep, 450 m, 26 October 1958, *Th. Sørensen 5914* (C, L); Doi Sutep, 1250 m, 29 October 1958, *Kai Larsen 5972* (C, E); Doi Sutep, below the Puping Royal Palace. Near the helicopter area, 1275 m, 26 December 1987, *J.F. Maxwell 87-1633* (L); Kew Mae Pan, Doi Inthanon NP, Chom Thong, 900–1200 m, 29 November 1996, *W. Nanakorn 7966* (QBG); Mae Cham district, Ban Mae Tala Nuea, Mae Dad Subdistrict, 1350 m, 18 55 18 N 98 28 45 E, 10 December 2007, *N. Tanaka HN8060* (QBG); Pah Hom Pok, 1100 m, 25 February 1958, *Th. Sørensen 1659* (C); Payap, Doi Buak Ha, W of Chiangmai, 1575 m, 18 50 N 98 55 E, 30 November 1965, *E. Hennipman 3175* (C, K, L, P); Queen Sirikit Botanic Garden, Mae Rim, 700 m, 12 November 1993, *W. Nanakorn 128* (QBG); Roadside to Khun Huai Ma Kok checkpoint, Doi Chiangdao wildlife Sanctuary, 1400 m, 25 February 2003, *V. Chamchumroom 1914* (BKF); S. of Pang Faen 5 km along Rd. 1252, a side-road to 118, 1000

m, 19 1 N 98 20 E, 25 November 1993, *Kai Larsen 44817* (AAU); Western flank of Doi Inthanon, Mae Pau, 1000 m, 18 40 N 98 25 E, 6 December 1969, *van Beusekom 2359* (AAU, C, E, P); western part of Doi Chiang Dao, 1270–1350 m, 29 November 1984, *H. Koyama T39873* (L); 8 January 1911, *A.F.G. Kerr 1556* (C); 12 November 1911, *A.F.G. Kerr 1556B* (P). **Kanchanaburi:** Tham Pha, 29 December 1961, *C. Phengkhilai 344* (K). **Lampun:** Mi li, pe forest, 410 m, 3 November 1925, *Winit 1521* (K). **Loei:** Phu Kradung, Loi, 1300 m, 27 December 1971, *van Beusekom 4620* (C, K, P); Phu Kradung, S. of Loi, 1100 m, 16 53 N 101 53 E, 10 November 1970, *Ch. Charoenphol 4850* (AAU, C, P). **N. Pro.:** Mae Hong Son: Kiewlom, border between Pai and Muang Distr., 1490 m, 16 January 1983, *H. Koyarra 32566* (BKF); Mae Hong Son: Kiewlom, border between Pai and Muang Distr., 1490 m, 16 January 1983, *H. Koyarra 32640* (BKF). **Nan:** 50 km W. of Nan, W. of Ban Luang. Deciduous dipterocarp forest, 600 m, 18 51 N 100 21 E, 22 November 1993, *Kai Larsen 44733* (AAU); Pua, along road from Pua to Doi Phu Kha NP, 750 m, 9 11 6 N 101 0 17 E, 31 October 2013, *A.N. Egan 13-0750* (US). **NE Pro.:** **Loei:** Phu Kradung National Park, 1200 m, 14 November 1979, *T. Shimizu T22661* (L). **Phayao:** Doi Pha Dam, Ban Pang Tham, Ciang Kham, 1030 m, 19 30 30.17 N 100 27 10.76 E, 14 December 2012, *W. La-onsri 2592* (QBG). **Phre:** Phra Vanpruk, 180 m, *Collector unknown 478* (K).

**NEUSTANTHUS PHASEOLOIDES VAR. JAVANICA:**—ANGOLA. **Lunda Norte:** Dundo, near luachimo river, 750 m, 26 October 1946, *Collector unknown s.n.* (US). **BRUNEI. Tutong:** near Kampong, Sungei Liang, 5 m, 24 December 1967, *Van Niel 4283* (L). **CAMBODIA. Kampot:** 13 December 1903, *Geoffray 254* (P). **FRENCH POLYNESIA. Society Islands:** Tahiti. Arue, km 5.8, branche gauche de la Pohaiatera, 300 m, 17 32 S 149 31 W, 16 July 1986, *J. Florence 7726* (K, NY). **GUAM.** Roadside below Navy housing on main road over Nimitz Hill, 26 January 1986, *L. Raulerson 12157* (US). **INDIA. Kerala:** Neyyar dam, Island. Trivandrum Dt., 100 m, 30 January 1981, *P. Remanandan 4811* (K). **INDONESIA. East Java:** Gerbo, 750 m, 1913, *Mousset 836* (L). **Java:** Tjibelong, 200 ft, 6 December 1875, *O. Kuntze 4968* (NY); *Collector unknown s.n.* (L); 1963, *I.K. s.n.* (L); September 1864, *Collector unknown s.n.* (K); *Collector unknown 10907* (L). **LIBERIA. Firestone:** Firestone village, 13 July 1965, *A. Jacques-Georges 21717* (MO). **PHILIPPINES. Luzon:** Bataan, Lamao River, Mt. Mariveles, December 1904, *T.E. Borden 24037* (US); Laguna, Mt. Makiling, 26 December 1955, *M.D. Sulit 34073* (BM, US); Los Banos, open roadside bank in gully, 12 December 1922, *J.P.M. Brenan 14977* (K); Manila, Forage Demonstration Gardens, Bureau of Animal Industry, Pandacan, 8 December 1955, *J.V. Santos 6322* (US). **SAMOA. Upolu:** Roadside in coconut plantations in Vaialele, 21 July 1972, *A. Whistler W185* (US). **SRI LANKA. Central:** Doluwa, near Kandy, Kandy district, 26 February 1970, *V.E. Rudd 3159* (K, US); Galagedera, Kandy district, climbing on fence, 3 April 1970, *V.E. Rudd 3334* (US); Kandy, 13 January 1926, *Fairchild s.n.* (US). **Western:** Labugama Forest Reserve, Reservoir, Avissawella Road (30 miles from Colombo), Colombo district, 1 April 1970, *V.E. Rudd 3326* (US); Pelawatte, Kalutara district, 21 January 1970, *L.H. Cramer 2807* (US). **THAILAND.** Foot of hill Khao Kaa, *A.F.G. Kerr 519* (BM). **VIETNAM. Tourane (D Nang):** 18 February 1939, *Poilane 28892* (P).

**NEUSTANTHUS PHASEOLOIDES VAR. PHASEOLOIDES:**—BANGLADESH. **Syhet:** Jaintiapur, 300, 11 December 1885, *C.B. Clarke 42438* (US). **CAMBODIA. Kampot:** 13 December 1903, *Geoffray 253* (P). **CHINA. Guangdong:** Canton and Vicinity, 8 November 1917, *C.O. Levine 1837* (US); **Hong Kong:** Lantao Island, Tungchung and vicinity, 22 September 1940, *Y.W. Taam 1753* (US); Ma On Shan, 9 January 1969, *Shiu Ying Hu 6479* (US); Tai Mo Shan, N.T., 10 October 1969, *Shiu Ying Hu 8138* (US); Tai-po, N.T., 17 September 1968, *Shiu Ying Hu 5620* (US); Tolo-side, 18 November 1969, *Shiu Ying Hu 8787* (US). **Yunnan:** Xishuangbanna Tropical Botanical Garden, *A.N. Egan 12-254* (US). **INDIA. Assam:** Sylhet Station, 22 November 1872, *C.B. Clarke 18003c* (BM). **Manipur:** Kanglatongbi, 3000, 7 October 1945, *A.A. Bullock 655* (K). **Meghalaya:** Khasia, 11 October 1886, *C.B. Clarke 44995* (US). **West Bengal:** India orientalis, in Bengalica circa Calcuttam, 1936–38, *J.W. Helfer s.n.* (US). **MALAYSIA. Borneo:** Segalind Elopura Sandakan. Water shed of Segalind River, 14 November 1947, *A. Cuadra A1083* (K, US). **Perak:** November 1883, *Dr King's Collector 5717* (US). **MYANMAR. Rakhine:** Mingaladon, on southern spur of Pegu Yomas, 11 mi. from center of Rangoon, Mingaladon ravine, 100–200 ft, 20 October 1951, *G.B. Vogt BU-52* (US). **Tanintharyi:** Shan Hills Terai, 2000 ft, February 1888, *H. Collett 42* (K). **PAPUA NEW GUINEA. Papua:** Soputa, June 1943, *DeKalb s.n.* (US). **PHILIPPINES. Luzon:** Bataan, Lamao River, January 1904, *E.D. Merrill 3778* (BM, US); Dinalupijan, Bataan, February 1903, *E.D. Merrill 1547* (US); Rizal, San Pedro Macati, November 1909, *E.D. Merrill 19* (US). **SOCIETY ISLANDS. Tahiti:** Papara, south coast, in Agriculture and Forestry Experiment Station, 7 June 1982, *F.R. Fosberg 62758* (US). **SURINAM.** Scotelweg, 12 November 1934, *W.A. Archer 2661* (K). **THAILAND. Bangkok:** 16 April 1912, *A. Marcan 733* (BM); 29 October 1922, *A. Marcan 1034* (BM). **Chanthaburi:** Makhm, 26 November 1930, *A.F.G. Kerr 549* (BM, K). **Chonburi:** Sriracha, 25 October 1927, *Mrs. D.J. Collins 1646* (US); Sriracha, 25 November 1927, *Mrs. D.J. Collins 2030* (US). **Chumphon:** Chumphon, 30 m, 26 January 1927, *A.F.G. Kerr 11637*

(BM, K); 130 m, 26 January 1927, *A.F.G. Kerr 11641* (BM, K). **Nan:** near village of Pa Sing, 25 km N of Nan, west side of Nan river, 5 December 1957, *E.H. Walker 7965* (US); Pua, along rd from Pua to Doi Phu Kha NP, 1035 m, 19 11 18.4 N 101 2 19.8 E, 31 October 2013, *A.N. Egan 13-0751* (US). **Phitsanulok:** Chat Trakan, Namtok Chat Trakan NP, along overgrown trail, 279 m, 17 18 1 N 100 41 1 E, 29 October 2013, *A.N. Egan 13-0721* (US); Nakhon Thai, Ban Nam Khlat, in forest just off Hwy 1143 about 0.7 km NW of Nam Tak Forest Park, 201 m, 17 10 1 N 100 41 52 E, 28 October 2013, *A.N. Egan 13-0715* (US); Nakhon Thai, Phu Hin Rong Kla NP, disturbed area just off Hwy 2331, 562 m, 17 1 10 N 100 57 29 E, 28 October 2013, *A.N. Egan 13-0696* (US); Nakhon Thai, Phu Hin Rong Kla NP, creeping in mowed roadside off Hwy 2331, 885 m, 17 1 8 N 100 59 6 E, 28 October 2013, *A.N. Egan 13-0703* (US). **Tak:** Sam Ngao district, Mae Tuen Wildlife Sanctuary, trail near streambed, 272 m, 17 11 27.86 N 98 56 31.1 E, 10 November 2013, *A.N. Egan 13-0817* (US). **VIETNAM.** Barior, September 1866, *L. Pierre s.n.* (US); Rota-Tokuih, December, *J. Dournes s.n.* (P). **Ho Chi Minh:** Saigon, February 1871, *L. Pierre 1017* (US). **Tonkin:** 13 September 1887, *Balansa 2283* (P). **Tourane:** July 1928, *J. Clemens 3421* (US). **COUNTRY UNKNOWN.** Amboina, July 1913, *C.B. Robinson 565* (US).

**NEUSTANTHUS PHASEOLOIDES VAR. SUBSPICATA:**—**BANGLADESH.** Chittagong: Chittagong Hill Tracts, 1886, *Dr. King's Collector ?73* (P). Dhaka: Mymensingh, 5 November 1868, *C.B. Clarke 7980* (K). **Sylhet:** 1000 ft, 28 November 1850, *J.D. Hooker s.n.* (K). **INDIA.** February 1832, *Wallich 5557c* (NY). **Assam:** assam plains, 1843, *W. Hooker s.n.* (P); Mangaldai / Bhutan Border, October 1974, *Yandell 331* (L, K); Singia, May 1902, *A.C. Chatterjee s.n.* (P). **Manipur:** Baraka, 3–4000 ft, November 1907, *A.E. Meebold 6295* (K); Kanglatongbi, 3000 ft, 9 October 1945, *A.A. Bullock 663* (K). **Meghalaya:** Eastern Circle, Shillong. Foot hills of Badoum to Soneodam., 1000 m, 10 November 1957, *Ras 10314* (L); Khasia, before 1867, *J.D. Hooker 168* (K); Khasia, 22 October 1871, *C.B. Clarke 15610c* (BM); Khasia, 4000 ft, before 1867, *J.D. Hooker s.n.* (K); Khasia, 3–4000 ft, *J.D. Hooker s.n.* (K). **Sylhet:** Bholagung, 12 December 1871, *C.B. Clarke 14341A* (K). **MYANMAR.** Chindwin, December 1907, *Meebold 7523* (E). **Kachin:** Kachin Hills, Upper Burma, 1897, *S. Mokim s.n.* (US). **Rakhine:** Bay of Bengal, Arakan Coast, Akyab Island, Thechaung, less than 100 ft, 27 October 1951, *G.B. Vogt BU-242* (US). **Yangon:** Rangoon, *McLelland s.n.* (K). **THAILAND.** **Bangkok:** 12 November 1924, *A.F.G. Kerr 9360* (BM). **Chiang Mai:** Mueang district, Doi Suthep-Pui NP, 699 m, 18 49 1.3 N 98 55 31.3 E, 5 November 2013, *A.N. Egan 13-0785* (US); 500 m, 29 October 1922, *A.F.G. Kerr s.n.* (BM). **Phitsanulok:** Chat Trakan, Namtok Chat Trakan NP, along edge of spill pool at waterfall, 17 17 55 N 100 40 57 E, 29 October 2013, *A.N. Egan 13-0737*. **COUNTRY UNKNOWN.** Tasia, *Imperial Forestry Institute 24394* (NY); *R J Cott 350* (BM); October 1850, *Collector unknown 395* (US); *Wallich 5557a* (BM); *Wallich 5563a* (BM); before 1867, *Hooker s.n.* (K).

**TEYLERIA BARBATA:**—**THAILAND.** **Chiang Mai:** Doi Sutep, 914 m, 4 August 1914, *A.F.G. Kerr 2653* (K, TCD); Doi Sutep-Pui National Park, NE side of the Park below Doi Pui, Ban Mae Sah Mai 12, Huay Mae Nai area, 1200 m, 2 December 1989, *J.F. Maxwell 89-1478* (L); Doi Sutep-Pui National Park, Ru-See valley, 1050 m, 22 September 1991, *J.F. Maxwell 91-767* (L, P); Doi Sutep, NE side, Ban Mae Sah Mai 12, Huay Mae Nai, 1200 m, 17 August 1988, *J.F. Maxwell 88-1004* (L). **Lampang:** Jae Sawn National Park, near Mae Bahn stream at Bah Miang village, 1000 m, 23 October 1995, *J.F. Maxwell 93-978* (L); Jae Sawn National Park, northern part, Pah Ngahm (Nahn Kaht) Cave/Mountain, 525 m, 25 October 1995, *J.F. Maxwell 95-1005* (L). **Lampon:** Doi Kuhn Dahn National Park, west side above Yaw 3, 1325 m, 2 September 1994, *J.F. Maxwell 94-971* (L); Mae Teh District, Doi Kuhn Dahn National Park, off the trail to Daht Muey Falls, 850 m, 25 December 1993, *J.F. Maxwell 93-1546* (L).

**TEYLERIA KOORDERSII:**—**CHINA.** **Hainan:** Janfengling, by roadsides on hills, 90 m, 1978, *K.S. Chow 78227* (AAU, NY); Jinafengling, in woods, 200 m, 2 April 1987, *D.X. Zhang 44* (AAU). **INDONESIA.** **Flores:** Sunda Islands, Ende, 50 m, 13 June 1927, *Rensch 1040* (L). **Java:** Baniremas, September 1925, *Collector unknown s.n.* (L); Kediri, 5 June 1896, *S.H. Koorders 22997* (L); Kesoeki, 19 October 1895, *S.H. Koorders 21260* (L); Kesoeki, 22 October 1895, *S.H. Koorders 21283* (L); Kesoeki, 6 September 1897, *S.H. Koorders 28959* (L); Pekalongan, Margasari, 100 m, 25 March 1918, *Dr. Beumee 1799* (L); Terrein N. van Kiara Pajoeng. N van Fjiandjoer, 500 m, 29 March 1918, *C.S. Backer 23717* (K, L). **VIETNAM.** **Annam:** Northern Ninh Hoa Province, Nha Trang coast south of the Massif of the Mother and Child, 25 June 1923, *Poilane 6289* (L); June 1909, *Ch. D'Alleizette s.n.* (L). Phu Hu: Nha Trang entre Nha Trang et Ninh Hoa, 19 January 1923, *Poilane 5335* (BKF, K).

**TEYLERIA STRICTA:**—**CHINA.** **Yunnan:** Baoshan, Mangkuan Xiang, Laomiancheng, S of Mangkuan on the E side of Gaoligongshan, 1350 m, 25 23 46 N 98 51 30 E, 18 October 1998, *Li Heng 10548* (E, HUH); Baoshan,

Mangkuan Xiang, Laomiancheng, S of Mangkuan on the E side of Gaoligongshan, 1000 m, 25 23 46 N 98 51 48 E, 18 October 1998, *H. Li 10575* (E, HUH); Between Keng Hung and Muang Hing, 25 February 1922, *J.F. Rock 2604* (E, US); Geyentsin, 17 June, *Collector unknown s.n.* (C); Nujiang Lisu Aut. Pref. Lushui Co., Road from Liuku to Fugong, west bank of Salween, 816 m, 25 57 48 N 98 50 25 E, 7 September 1997, *Li Heng 8581* (MO); Simao, 5000 ft, *A. Henry 13431* (BM, K); Yuanchiang, 5000 ft, *A. Henry 11579* (K, US); Yuanchiang, 5000 ft, 25 October, *A. Henry 13254* (K, US); Xishuangbanna Tropical Botanical Garden, *A.N. Egan 12-255* (US). **LAOS. Laoten:** Kho Khi mak, 2 November 1920, *Aug. Chevalier 3338* (P); **Luoang Prabang:** *Collector unknown s.n.* (P). **Sam Neua:** Hoa Muong and Muong Lap, 18 October 1920, *Poilane 2106* (AAU, K, L). **Tranninh:** Muong Soui and Muong You, 1400–1500 m, 2 October 1932, *Poilane 20107* (AAU, K, L). **Xiangkhouang:** 1000–1200 m, 15 February 1932, *Poilane 20163* (P). **MYANMAR.** Maymyo Plateau, 3500 ft, September 1912, *Lace 5938* (E, K); December 1927, *C.E. Parkinson 3642* (K). **Chin:** Kanpetlet Township, Ma Kyauk Ah Village area, 4500 ft, 24 December 2011, *Ling Shein Man 88053* (QBG); Mindat, 3000–4000 ft, 22 July 1956, *F. Kingdon Ward 22514* (BM, E). **Mandalay:** Lower Madaya Res. Singu Rau?, 1100 ft, 25 November 1926, *Saw Maung Mya 3642* (K); Maymyo, 1888, *Nadalkhan 104* (K); Myingyan district. Popa Hill. E side. 2500–3000 ft, 5 August 1909, *J.H. Lace 4903* (K). **Shan:** Fort Stedman. November 1892, *Abdul Huk s.n.* (K); Maik chi ya, 4000 ft, January 1910, *W.A. Robertson 8* (K); Taunggi hillside, 1450–1600 m, 21 December 1957, *H.S. McKee 5891* (K); Taunggyi, Cragg, 5000–5818 ft, 1 November 1952, *G.B. Vogt BU-445* (K, US); Taungyi, 1893, *Khalil s.n.* (L). **THAILAND. Chaiphaphum:** Thung Kra Mang, 800–900 m, 16 15 N 101 30 E, 1972, *K. Larsen 31571* (AAU). **Chiang Mai:** along the road from Check Point to Mae Pan waterfall (RS-24), Doi Inthanon, 1000–1300 m, 2 August 1988, *Shunsuke Tsugaru T-61822* (AAU); Chang Khian, Mueang, 1200 m, 28 October 1994, *W. Nanakorn 2415* (QBG); Chiang Dao, Mae Tamaan, 1300 m, 27 September 1994, *W. Nanakorn 1817* (QBG); Chom Thong District, from Vachirathern Waterfalls to the Park Checkpoint along the main mountaineering road in Doi Inthanon National Park, 16 December 1998, *Fumihiko Konta 4577* (BKF); Doi Chieng Dao, 1000 m, 16 February 1958, *Th. Sørensen 1227* (CEL); Doi Chieng Dao, 25 December 1931, *Put 4534* (BM, K); Doi Muang Awn, west side area, 500 m, 17 November 1995, *P. Palee 335* (L); Doi Sutep, 2400 ft, 10 October 1909, *A.F.G. Kerr 831* (BM); Doi Sutep, 5200 ft, 4 September 1910, *A.F.G. Kerr 1384* (BM); Doi Sutep, 2200 ft, 27 November 1910, *A.F.G. Kerr 1604* (BM); Doi Sutep, 3000 ft, 12 November 1911, *A.F.G. Kerr 2224* (BM); Doi Sutep, 1450 m, 13 July 1958, *Th. Sørensen 4061* (C, E, L); Doi Sutep, 1400 m, 11 September 1958, *F. Floto 4942* (C, E, L); Doi Sutep, 1180 m, 18 September 1958, *Th. Sørensen 5105* (C, E, L); Doi Sutep, 1150 m, 18 September 1958, *Th. Sørensen 5106* (C, E, L); Doi Sutep, 600 m, 6 October 1958, *Th. Sørensen 5472* (C, E, L); Doi Sutep-Pui National Park, east Palaht Temple area, 730 m, 10 October 1993, *Arom Phuakam 54* (A, L); Doi Sutep-Pui National Park, Puping village, 1400 m, 17 September 1992, *Maxwell 92-548* (P); Doi Sutep, east side, below Doi Sutep temple, 950 m, 7 January 1987, *J.F. Maxwell 32478* (L); Doi Sutep, summit ridge at Sahn Goo, 1600 m, 25 July 1988, *J.F. Maxwell 88-898* (AAU); Mae Rim, Monlong, 1360 m, 18 September 1995, *W. Nanakorn 4531* (QBG); Mae Sei Ridge, Mae Sei Subdistrict, Ban Bah Gluay (Mao village) area, 1475 m, 20 July 1991, *Maxwell 91-691* (E, P); Maetuen Watershed Improvement Station to Nang Kruan Waterfall, Bo Luang Tableland, Om Koi Distr., 950–1100 m, 18 October 1979, *Tatemi Shimizu T-19160* (BKF); Middle elevation of Doi Chiang Dao, 600–1300 m, 25 September 1971, *Murata 14980* (K); Middle elevation of Doi Chiang Dao, 600–1300 m, 25 September 1971, *Gen Murata T-14980* (AAU, C, E, L); Mueang, Chiang Dao NP, 19 20 12 N 98 54 50 E, 6 November 2013, *A.N. Egan 13-0792* (US); Payap, Doi Chiengdao, 1000–1400 m, 19 25 N 98 55 E, 5 December 1965, *E. Hennipman 3224* (K, L, P, WAG); Pong taa hoen, Pong Yeang, Maerim, 900 m, 8 September 1995, *W. Nanakorn 4150* (QBG); Queen Sirikit Botanic Garden, Mae Rim, 800 m, 18 November 1993, *W. Nanakorn 191* (QBG); Queen Sirikit Botanic Garden, Mae Rim, 700 m, 15 September 1995, *W. Nanakorn 4215* (QBG); Rock Tower Mountain, Mae Sa, N. of Chiang Mai. Open pine forest, 1300–1400 m, 18 55 N 98 50 E, 18 September 1995, *Kai Larsen 46624* (AAU); Sangampang, Muang Awn Cave, 525 m, 12 October 1989, *J.F. Maxwell 89-1211* (MO). **Kanchanaburi:** W of Sri Sawat, 600–700 m, 14 40 N 99 10 E, 28 June 1974, *K. Larsen 33885* (AAU, K). **Lampang:** Doi Luang National Park, west side of and below Doi Nawk, 1100 m, 7 November 1998, *O. Petrmitr 347* (L); Doi Luang National Park, west side of and below Doi Nawk, 1250 m, 27 October 1997, *J.F. Maxwell 97-1245* (L). **Maehongson:** Khun Yuam, 600–700 m, 18 15 N 98 E, 4 September 1974, *K. Larsen 34078* (AAU). **Nan:** 50 km W. of Nan, W. of Ban Luang, Deciduous dipterocarp forest, 600 m, 18 51 N 100 21 E, 22 November 1993, *Kai Larsen 44747* (AAU); Bo Kluea district, roadside, along Hwy 1081, 839 m, 19 10 12 N 101 10 11 E, 31 October 2013, *A.N. Egan 13-0764* (US); Pua, along road from Pua to Doi Phu Kha NP, 750 m, 9 11 6 N 101 0 17 E, 31 October 2013, *A.N. Egan 13-0749* (US). **Phayao:** Ban Huak Nature Trail, Ban Huak, Phu Sang, 785 m, 19 43 00.37 N 100 25 24.33 E, 12 December 2012, *W. La-ongsri 2544* (QBG). **Phetchabun:** Naam Naao, 760 m, 18 September 1994, *W. Nanakorn 1669* (QBG); Nam Nao, National Park, trail to Tam Pha Hong, 24 August 2006, *P. Krachai 311* (QBG). **Tak:** 19 September 2003, *Sawai 398* (QBG).



**TEYLERIA TETRAGONA**:—**PHILIPPINES**. **Palawan**: near Puerto Princesa, January 1906, Bermejós 39771, Bureau of Sci. 295 (NY, US). **THAILAND**. **Chiang Mai**: Me Pa Tang, left side near foot of Doi Chiengdao, 1140 m, 11 January 1941, *Garrett 1226* (K, TCD).

**TOXICOPUERARIA PEDUNCULARIS**:—**BANGLADESH**. **East Bengal**: *Griffith 1731* (P). **BHUTAN**. 13 km S of Riserboo, N of Samdrup Jongkhar, 2200 m, 27 5 N 91 25 E, 25 June 1979, *A.J.C. Grierson 2260* (E); Chendebe, 7500 ft, 30 June 1938, *B.J. Gould 707* (K). **Bumthang**: Yutola Pass, between Bumthang and Trongsa, 9500 ft, 4 August 1945, *F. Ludlow 17007* (BM). **Thimphu**: Thimphu Chu. Trashi-Chio, 8000 ft, 18 October 1949, *F. Ludlow 17541* (BM). **Chukka**: between Jumudag and Chasilakha, 1950 m, 26 57 N 89 33 E, 21 February 1982, *A.J.C. Grierson 3105* (E, K). **Dagana**: 8000 ft, 31 July 1914, *R.E. Cooper 2507* (E). **CHINA**. **Sichuan**: Mountains south of Muli, Mount Gibboh, 3050 m, August 1928, *J.F. Rock 16936* (US); West of the Yalung River, between Mutirong and Wandzanron pass (Muli-Chiu-Lung-Hsien border), in Yatsa Kong, 3400 m, July 1929, *J.F. Rock 17425* (US). **Yunnan**: Above Chaong-che-teou, near Tapintze, 20 July 1888, *Delavay 3588* (US); Ad viam Yunnanfu-Dali (Talifu), in regionis calide temperate, 1850–2150 m, 6 September 1914, *Handel-Mazzetti 773* (US); Beyond Chieu Chan, between Likiang and Talifu, 13–18 September 1922, *J.F. Rock 6563* (US); Dali, September 1983, *Sino-British Expedition 161* (A); Dali, 1850–2150 m, 6 September 1914, *Handel-Mazzetti 4873* (K); Dali Range, 1929, *G. Forest 28071* (E); Genma, Chuichayko, 2450 m, 10 August 1938, *T.T. Yu 17302* (A); Geyentsin, collector unknown s.n. (C); Kunming, Dongchuan Distr., Shekuai Town, Lugongshan to Jiulong Village, 2800 m, 26 July 2008, *Peng Hua 8155* (K); Mengzi. N. mts., 8500 ft, 23 November *A. Henry 9177* (K, NY, US); Mienning, Poshang, 2500 m, 7 October 1938, *T.T. Yu 17929* (E); Mountains of Ludu, northwest of Li-Kiang, west of the Yangtze, in pine forest, 3080 m, August 1929, *J.F. Rock 18508* (US); Pien Kio, 11 November 1887, *Delavay s.n.* (K, P); Shunning, Tehseling, 2100 m, 11 September 1938, *T.T. Yu 17619* (E); Simao, 5000 ft, *A. Henry 12483* (A, K); Talongtan, 29 October 1878, *Delavay s.n.* (P); Tchong-chan, 6 September 1905, *Delavay 399* (NY); Tchong-chan, 6 September 1909, *Delavay 3763* (P); Tengchong, Jietou Xiang, Shaba Cun, Tiantaishan, W side of Gaoligongshan, 2130 m, 25 24 13 N 98 43 4 E, 28 October 1998, *Li Heng 11098* (A, E); **Tengchong**: Dongshan Xiang, Qingcaitang, on the old road from Tengchong to Baoshan, 2000 m, 25 1 10 N 98 34 43 E, 2 November 1998, *Heng Li 11311* (A, E); Tengyue, 6–9000 ft, 25 5 N, September 1905, *G. Forest 1058* (E); Tien-sin, 2800 m, July, *E.E. Maire s.n.* (P); Tong-tchouan, 2600 m, June, *E.E. Maire s.n.* (P); Tong-tchouan, 2700 m, June, *E.E. Maire s.n.* (P); W. Yunnan, *McLaren B88* (K); W. Yunnan, 6700–7500 ft, 25 40 N, June 1906, *G. Forest 4259* (E); West of Talifu, Mekong watershed, en route to Youngchang and Tengyueh, 5800 ft, September–October 1922, *J.F. Rock 6663* (US); woods of Ta-long-tan, 24 October 1888, *G. Forest 15840* (US); Xiashuanglongtan, off Dayan section road X035/X213, 25 27 28 N 102 52 0 E, 4 September 2012, *A.N. Egan 12-287* (US); Yao-Chou. Grows in the middle part of the mountain, 13 April 1936, *McLaren's Collectors 223FAA* (C); *E.E. Maire 2307* (US); *G. Forest 6949* (K); 1917–1919, *G. Forest 15840* (K); 1910, *Delavay s.n.* (P); *G. Forest s.n.* (E). **INDIA**. **Assam**: Khonoma, Naga Hills, 6000 ft, 10 October 1935, *N.L. Bor 6610* (K); *F. Kingdon Ward 8720* (K); **Khasi Hills**: Shillong Peak, 6000 ft, 8 September 1949, *F. Kingdon Ward 18838* (NY); **Khasia**: *J.D. Hooker s.n.* (K). **Meghalaya**: Khasi Hills, Shillong, 6000 ft, 30 October 1890, *H. Collett s.n.* (US); Shillong, 6000 ft, 10 August 1885, *C.B. Clarke 38695* (US). **Sikkim**: September 1903, *Prain s.n.* (E). **MYANMAR**. Japvo ridge, 7250 ft, 11 November 1949, *F. Kingdon Ward 19021* (BM); **Kachin hills**: *S.M. Toppins 6097* (K); **Kachin State**: North Triangle (Hkinlum), 4000 ft, 22 September 1953, *F. Kingdon Ward 21355* (E); Ruby Mines Distr.: Kabacug & Kyatpyin, 3000 ft, 21 October 1918, *J.H. Lace 5993* (E). **NEPAL**. Langtang Valley, Kanging, 2300–2800 m, 11 July 1970, *H. Kanai s.n.* (E); Lete, S. of Tukucha, Kali Gandaki, 8000 ft, 16 September 1954, *Stainton 7874* (E); Near Lumsum, 9000 ft, 17 July 1954, *Stainton 3525* (BM); Nr. Lumsum, 9000 ft, 10 September 1954, *Stainton 4322* (E); *Clive Wigram 80* (E). **Central**: Bagmati Zone, Lalitpur & Kabhrepalanchok Distr., Mt. Phulchoki-Godawari, 1540–2762 m, 24 34 29 N 85 24 22 E–27 35 36 N 85 22 53 E, 14 November 1995, *M. Mikage 9558372* (E); Sim Bhanjyang, 8200 ft, *S.B. Malla 38* (US). **Dhawalagiri**: Myagdi District., 1820–2360 m, 28 33–37 N 83 23 E, 10 September 1996, *M. Mikage 9685303* (BM). **E Nepal**: Tinjure Danda, 7500 ft, 27 10 N, 6 September 1967, *Williams 8392* (K). **Tamuwan**: Satsaekhola. S of Ganesh Himal., 8500 ft, 28 15 N 85 5 E, 4 October 1967, *J.D.A. Stainton 6001* (BM). **Western**: South of Annapurna, above Siklis, 2670 m, 28 7 N 84 6 E, 28 August 1976, *R.G. Troth 998* (US). **THAILAND**. Bomte La, 7000–8000 ft, 14 July 1938, *F. Kingdon Ward 13917* (BM). **Chiang Mai**: Chom Thong District, Doi Inthanon National Park, 1800 m, 18 32.3 N 98 29.4 E, 18 September 2008, *D.J. Middleton 4487* (BKF).

**TOXICOPUERARIA YUNNANENSIS**:—**CHINA**. **Sichuan**: Ningyuan fu, Lushan, 17 April 1914, *Camillo Schneider 924* (A). **Yunnan**: Cha-fang-he?, Yang-bi valley, 5500 ft., 25 N 100 5 E, May, *J. Kingdon Ward 3813* (E); Dali, Xiashanhe, above Yangbi, 1850 m, 2 May 1981, *Sino-British Expedition 25* (E, K); E. Yunnan. Leang Wong Mt.

Summit of Mountain, April 1936, *McLaren's Collectors U 7A* (C); Geyentsin, *Collector unknown s.n.* (C); Hoanglipin, Tapintze, 23 July 1889, *Delavay 212* (P); Leangwong mt., April 1936, *McLaren L21A* (A); Li Tsu Mu, 29 March 1933, *McLaren 162* (A); Liao ho teou, Pe yen tsin, 20 April 1916, *Pater Simeon Ten 77* (A, C, E, L); Lichiang Range, 1933, *McLaren 162C* (BM); Lijiang, 1933, *McLaren s.n.* (BM); Mengzi, 12 May 1895, *W. Hancock 275* (K); Mengzi, 5000 ft, 11 April 1898, *A. Henry 10628* (A, E, K, MO, NY, US); On Yulongshan, Yulonghu, 10000 ft, August 1913, *G. Forest 10811* (E, K); Shweli-Salween Divide, 8000 ft, 25 25 N 98 58 E, May 1924, *G. Forest 24130* (E); Simao, 4500 ft, *A. Henry 10628D* (K); Slopes of the Shweli Valley, 7–8000 ft, 25 6 N 99 E, April 1931, *G. Forest 29517* (E); Talongtan, 17 July 1888, *Delavay 1888* (P); Xishuangbanna, on limestone mountain above Yinchang village, 21 59 8.23 N 101 13 53.86 E, 30 August 2012, *A.N. Egan 12-263* (US); Yunxian, Kongxian Bridge, 9 May 1935, *McLaren L62A* (E); 28 October 1912, *E.E. Maire 1981* (BM, K, US); *E.E. Maire 1982* (BM); *Fr. Ducloux 2301* (P); 8 May 1904, *Delavay 2301* (P); *Fr. Ducloux 2301* (BM); 18 August 1905, *Fr. Ducloux 3772* (P, US).