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) Bentham (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 α-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:

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. alopecuroides</em> Craib</td>
<td><em>P. phaseoloides</em> (Roxburgh) Bentham</td>
<td><em>P. bella</em> Prain</td>
<td><em>P. peduncularis</em> Graham</td>
</tr>
<tr>
<td><em>P. calycina</em> Franchet</td>
<td><em>P. subspicata</em> Bentham</td>
<td><em>P. colletti</em> Prain</td>
<td><em>P. stracheyi</em> Baker</td>
</tr>
<tr>
<td><em>P. candel lei</em> Graham</td>
<td></td>
<td><em>P. brachycarp</em> Kurz</td>
<td><em>P. Wallichii</em> de Candolle</td>
</tr>
<tr>
<td><em>P. edulis</em> Pampanini</td>
<td></td>
<td><em>P. stricta</em> Kurz</td>
<td></td>
</tr>
<tr>
<td><em>P. lacei</em> Craib</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. lobata</em> (Wildenow) Ohwi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. mirifica</em> Airy, Shaw &amp; Suvatbandhu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. montana</em> (Loureiro) Merrill var. montana</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. montana</em> var. lobata (Wildenow) Maesen &amp; S.M. Almeida</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. montana</em> var. thomsonii M.R. Almeida</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. pulcherrima</em> (Merrill) Merrill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. sikkimensis</em> Prain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. tuberosa</em> Candolle</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

**Taxonomy**


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

**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), ถิ่นลาย sa thua sian pa (Thai), พักพินห์ 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 base, 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).
New and resurrected combinations in *Neustanthus*


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


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

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

![Flowers](A.png), ![Leaves](B.png), ![Fruits](C.png), ![Habit](D.png)
Neustanthus phaseoloides var. javanica (Bentham) A.N.Egan & B.Pan, **comb. nov.**

**TYPE:** — INDONESIA. Java, Merapi, 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 Miqiel, Pl. Jungh. 2: 235. 1852.


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

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

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


**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 basidosified, 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, sepaloid 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]).


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


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

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


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!]).


**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. Apex 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, 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 pseudoracemences, branched or not, (4–)10–40(–55) cm long, node (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 adpressed 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. 5.7–3.6 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:**— kończly xu mi ge (Chinese), มะเปาป่าของ (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 *Breviramulæ*, 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 Phaseolaeae, but found no close 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 Bentham) A.N. Egan & B. Pan (*Neustanthus peduncularis* Graham ex Bentham, in Miqel, Pl. Jungh. 2: 235. 1852).


**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 strigulate 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 nodeless (with swollen nodes or brachylasts), 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 lobes 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 clavate, 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 vexillar 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 septic, (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 Bentham) 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!]).


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 or pink or flowers purple, blue, or mauve; 4–7 flowers per node; pedicels slender, 6–9 mm long. Calyx papyraceous, 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:—㤜㪑 ku ge (Chinese), Ӈ঍㪑㰚 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).
Toxicopueraria yunnanensis (Franch.) A.N. Egan & B. Pan, comb. nov.


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


**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/collection, 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 (Ducloix, n. 377); [sine loco] (Maire, n. 210).” A search of Ducloix collections at Paris showed that Ducloix numbers 362–399 were collected from “Environs de Yun Nan Sen” during August and September of 1897, suggesting that Ducloix 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 Ducloix (no. 2301) on 8 May 1904 from “Yun-Nan: environs de Yun nan-sen”, written in Ducloix’s own hand. A survey of Paris’ Ducloix 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 its 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 where 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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**References**


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 WALCHII**—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 An 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: Loprok, Buri, Gandaki, 6000 ft, 14 October 1951, 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, Bjornland 553 (AAU, C); Between Pang Kia and Me Kh Cha Chan, basin of the Me 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. Suvannakoses 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. Niyomdharm 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. Sorensen 5857 (C); Doi Sutep, 450 m, 26 October 1958, Th. Sorensen 5914 (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); Phahom Pok, 1100 m, 25 February 1958, Th. Sorensen 1659 (C); Payap, Doi Buak Ha, W of Chiangmai, 1575 m, 18 50 9 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. Chamchumroon 1914 (BKF); S. of Pang Faen 5 km along Rd. 1252, a side-road to 118, 1000
(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 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 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 773 (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); Mangalda / Bhutan Border, October 1974, Yandell 331 (L, K); Singia, May 1902, A.C. Chatterjee s.n. (P). **M 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). **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, Melelland 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 2633 (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 Bahn 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, C.B. Clarke 95-1005 (L). **Lampoon:** 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 roadssides on hills, 90 m, 1978, K.S. Chow 78227 (AAU, NY); Jiafnegling, 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 2653 (K, TCD); **Khasia, 22 October 1871, C.B. Clarke 7980 (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, Melelland s.n. (K).

**TEYLERIA STRICTA:**—**CHINA.** Yunnan: Baoshan, Mangkuan Xiang, Laomianchong, 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, Baoshan, 218 (3) © 2015 Magnolia Press • 223

THAILAND. Chiang Mai: Me Pa Tang, left side near foot of Doi Chiengdao, 1140 m, 11 January 1941, Garrett 1226 (K, TCD).


CHINA. Sichuan: Mountains south of Muli, Muli Gibboh, 3050 m, August 1928, J.F. Rock 16936 (US); West of the Yalong River, between Mutirong and Wandzanzor 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 temperatae, 1850–2150 m, 6 September 1914, Handel-Mazzetti 773 (US); Beyond Chieou 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); Genna, Chuichayko, 2450 m, 10 August 1938, T.T. Yu 17302 (A); Geyentsin, collector unknown s.n. (C); Kunming, Dongchuan Distr., Shekuaui 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); Miennung, 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, Tesheling, 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: Dongshiang Xian, Qingcating, 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, A. Henry 9177 (P); Tong-tchouan, 2700 m, June, E.E. Maire s.n. (P); Tong-tchouan, 2500 m, 10 June 1905, Delavay s.n. (P); Tong-tchouan, 2600 m, June, E.E. Maire s.n. (P); W. Yunnan, Delavay B88 (K); W. Yunnan, 6700–7500 ft, 25 40 N, June 1906, G. Forest 4259 (E); West of Talifu, Meckong watershed, en route to Yuangcheg 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, even March 13, 1936, McClaren’s Collectors 223F.AA (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).


TOXICOPUERARIA PEDUNCULARIS:—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.