AGRICULTURAL UNIVERSITY WAGENINGEN PAPERS
85-1 (1985)

REVISION OF THE GENUS PUERARIA DC. WITH SOME NOTES ON TEYLERIA BACKER

(LEGUMINOSAE)

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Received: 22-XI-1984
Date of publication 31-V-1985

Agricultural University Wageningen
The Netherlands 1985

CIP

ISBN 90-6754-066-8
ISSN 0169-345X

Printed in the Netherlands by Drukkerij Veenman b.v., Wageningen.

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1. INTRODUCTION

The genus *Pueraria* has not been the subject of a monograph since *Bentham's* revision of 1867. Since then, *Pueraria* has served more or less as a receptacle for species not easily classified elsewhere. 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. Because of its close affinity to *Glycine*, LACKEY (1977, 1981) inspected the genus in some detail in the course of his study of the *Phaseoleae*. Based on the holdings at Kew, he tentatively reorganized the genus and his infra-generic classification formed a solid base for the present revision. He excluded many species obviously belonging to other genera and simplified the synonymy.

The present author prepared this monograph while on sabbatical leave from ICRISAT, India, at the Crop Evolution Laboratory, University of Illinois, Urbana, Illinois, USA, upon the suggestion of Drs. J. R. HARLAN and T. HYMOWITZ. At Urbana the long-standing agricultural research program, is a major factor in the enormous increase in soybean, (*Glycine max* (L.) Merr.) production in the USA with the State of Illinois as the largest producer.

Since live material of only a few species of *Pueraria* was available, this study was first tackled as one of classical taxonomy. If and when more species become available, further biosystematic research should help to elucidate the infraspecific relationships of *Pueraria* spp. and those between *Glycine*, *Pueraria*, and other genera in *Glycininae*. When introgression of the related genera into *Glycine* proves possible, another germplasm pool can be created by tapping *Pueraria* spp. which might contribute valuable genes to the soybean. Some ethnobotanical aspects are touched upon in the notes, but for a detailed survey I refer to the paper by BODNER & HYMOWITZ.

The expertise available at the Department of Plant Taxonomy, Agricultural University, Wageningen, the Netherlands, was an important factor to getting this account published.

2. HISTORY OF THE GENUS PUERARIA DC.

DE CANDOLLE established the genus *Pueraria* in 1825 for two species, *Pueraria tuberosa* (Roxb. ex Willd.)DC. and *P. wallichii* DC., the former is generally accepted as the type species (HUTCHINSON, 1964). The genus was named after M. N. PUERARI, a fellow Swiss and friend of DE CANDOLLE, a Professor at Copenhagen and a pupil and friend of the botanist VAHL. In 1831, Wallich's Catalogue of the East Indian Herbarium listed some species names, which we now consider as *nomina nuda*, but which were used by BENTHAM and others. In 1852, BENTHAM

established the genus *Neustanthus* to accommodate *Dolichos phaseoloides* Roxb. and took in *P. wallichii* DC., since he thought the pod of *P. tuberosa* was articulate (see §4). Upon further investigation (BENTHAM, 1867) of the supposed articulations, the pods appeared to be contracted where an ovule had failed to develop, which is frequently so; therefore, BENTHAM merged his *Neusthanthus* into *Pueraria* with nine species at that time.

Many more names have been proposed by independent workers since Bentham's time but most become synonymous when more adequate material representing a wider range of diversity is studied. LACKEY (1977, 1981) stated that the genus was in need of revision, since Bentham's work was the most recent treatment of the genus in its entirety. In 1868 GOMES (MERRILL, 1935) validated a herbarium name of Loureiro, *Zeydora agrestis* Lour. ex Gomes, which is actually *P. montana* (Lour.) Merr., in the present revision referred to a variety of *P. lobata* (Willd.) Ohwi.

3. RELATIONSHIPS OF PUERARIA IN THE TRIBE PHASEOLEAE

AUGUSTIN PYRAME DE CANDOLLE placed his *Pueraria* in the tribu des Lotées, serie Clitoriées, near *Glycine* (1825). *Pueraria tuberosa*, earlier sent to him as *Hedysarum tuberosum* Roxb. ex Willd., did not actually have the articulated pod (§4) of the *Hedysarieae* as the casual observer might see it. BENTHAM (1867) found that incomplete fertilization frequently caused constrictions in the pods, which caused WIGHT and ARNOTT (1834) to revise their earlier opinion of placement in Clitorieae. They decided that *P. tuberosa* might have to be reduced to *Desmodium*, in Hedysarieae. BENTHAM (1865) referred *Pueraria* to Phaseoleae Benth., subtribe Dioclieae, followed by TAUBERT (1894) and HARMS (who spelled 'Diocleinae').

LACKEY (1977) revised the *Phaseoleae* and added *Pueraria* to the alliance of the *Glycininae* Benth., now consisting of 16 genera (LACKEY, 1981). The *Glycine* group (Lackey, 1977a) contains *Eminia* Taub., *Pseudeminia* Verdc., *Pseudovigna* Verdc., *Pueraria* DC., *Nogra* Merr., *Sinodolichos* Verdc., *Glycine* Willd., and *Teramnus* P. Br. The *Shuteria* group contains *Diphyllarium* Gagnep., *Mastersia* Benth., *Teyleria* Backer, *Shuteria* W. & A., *Dumasia* DC., *Cologania* Kunth. and *Amphicarpa* Nutt. *Neonotonia* Lackey (= *Glycine wightii* (W. & A.)Verdc.), established in 1977, belongs also in the *Shuteria* group (LACKEY, 1977c). Once described as a species of *Glycine*, it is obvious that *Teyleria* Backer seems closer to *Glycine* than *Pueraria*. All genera should be studied to establish their place in one of the gene pools of *Glycine*, in particular those of the *Glycine* group.

Some species of *Pueraria* are difficult to place. Anomalous in the genus, they fit nowhere else satisfactorily. Species like *P. stricta* Kurz, *P. brachycarpa* Kurz and *P. bella* Prain are possibly referable to *Neonotonia*, according to LACKEY (1977c).

4. MORPHOLOGY OF PUERARIA

As can be gleaned from the descriptions, *Pueraria* spp. are strong climbers, rarely *shrubs*, creeping in or over low vegetation or climbing high in tall trees. *Pueraria lobata* has the ability to smother forests, as in the southeast of the United States, while it apparently is not so aggressive in its native habitat, China, Indo China, Japan, and NE India. No other species is aggressive, but they are abundant at times. *The trifoliolate leaves*, flowers and flat to cylindrical long pods are typical of most Phaseoleae. *The stipules* may be attached at their base or below the middle, the basal lobe may be single, twin-lobed or fringed. *The inflorescence* provides important diagnostic characters, but often it is crowded and difficult to analyse in the herbarium. There are either 3, rarely 2, or 4 to 7 flowers per more or less thickened node (brachyblast). *Flowers* are mostly subsessile, or have short pedicels, tended by very caducous bracts and have 2 small persistent bracteoles near the calyx. The upper calyx lobes are partly or entirely connate. *The vexillum* base is clawed, auricled or not, but always inflexed near the base, with or without callosities. *Pueraria pulcherrima* and *P. mirifica* have very small flowers, *P. lobata* about the largest. Flower colour varies from pure white to all shades of blue and purple, sometimes with a green or yellow patch on the vexillum. The flowers are occasionally described as fragrant and beautiful. Indeed, *P. lobata* was and still is sold in the USA for gardening purposes. *Pods* are often flat, hairy or glabrous, pale brown to black, septate or aseptate. *The seeds*, up to 20 per pod, are flattened-oblong, seem smooth but are minutely pitted when viewed with a magnification of 40X or more.

5. GEOGRAPHICAL DISTRIBUTION AND ECOLOGY

The maps in this monograph indicate the Asian origin and distribution of *Pueraria* spp. Two species, *P. lobata* and *P. phaseoloides*, are widespread. Their varieties may be of rather restricted origin, but some have been carried around the world as green manure, fodder, and cover crops. *Pueraria* spp. inhabit forests, more often the forest edges, or scrub vegetations with varying moisture regimes. A few, including *P. peduncularis*, tolerate dense shade. *Pueraria lobata* is sometimes cultivated, and sometimes considered a weed. Wild species other than *P. lobata* or *P. phaseoloides* may be harvested for fibers.

Pueraria lobata inhabits temperate zones, or higher altitudes in the tropics (NE India). Other *Pueraria* spp. are adapted to low altitude monsoon forests of medium rainfall, some prefer wetter regimes. *P. peduncularis* occurs only at higher altitudes. Several species are confined to a restricted area and are only known from a small number of accessions. Burma, Thailand, Indo-China, Yunnan and the North Eastern Hill States of India appear the most interesting areas

for a search for seeds and specimens, which are now so woefully lacking. Other parts of India, Indonesia, the Philippines, and New Guinea are also areas where searches are warranted.

6. BIOSYSTEMATICS OF PUERARIA

At the moment nothing more than a few chromosome counts and some chemo-taxonomical data provide further insight in *Pueraria*. *Pueraria lobata* and *P. phaseoloides*, both of economic importance are the main species which have been studied to some extent. Only a very limited number of accessions are available as seed.

DARLINGTON & WYLIE (1945) listed three species without giving chromosome numbers, but in their 1955 edition 2n = 22 and 24 were listed for both *P. lobata* and *P. phaseoloides*. The latter count was not confirmed in two varieties (var. *javanica* and probably var. *phaseoloides*) of *P. phaseoloides* (FRAHM-LELIVELD 1953, 1957). BERGER et al. (1958) claimed both 2n = 22 and 24 for *P. javanica* (Benth.) Benth. Tixier (1965) counted n = 10 and 2n = 20 for a Vietnamese *P. phaseoloides*. The 2n = 24 counts in *P. lobata* refer to SUZUKA (1950) and Sakai (1951). HARDAS and JOSHI (1954) and SIMMONDS (1954) found 2n = 22 for *P. lobata* (as *P. hirsuta*). LARSEN (1971) found 2n = 20 for *P. collettii* Prain, however, NEWELL (pers. commun.) found 2n = 44, obviously a tetraploid, for specimen *Floto 931*. A diploid number of 2n = 22 seems therefore more likely. BIR & SIDHU (1966, 1967) established n = 11 for *P. tuberosa*. LACKEY (1977) concluded that the anomalous counts in *Pueraria*, at least 2n = 24, are probably wrong. The Glycininae almost always have basic chromosome numbers of 10 and 11.

Anatomically the Glycininae have no striking features. Paraveinal mesophyll is common, but it is lacking in *P. peduncularis* and *P. wallichii*, another reason to distinguish these two species from other *Pueraria* spp. (LACKEY, 1977).

Seed protein electrophoresis using polyacrylamide gels for *P. lobata*, *P. peduncularis* and *P. phaseoloides* was carried out in conjunction with other Phaseoleae, mainly Glycininae. *Pueraria peduncularis* has bands strikingly different from the others which are closer, and which have larger similarity index values (s) with *Glycine* spp. than *P. peduncularis*. *Pueraria lobata* has a high s value when paired with *Neonotonia wightii* (ARNOTT) LACKEY = *Glycine wightii* (ARNOTT) VERDCOURT (LACKEY, 1977*a*). Other chemical data on *Pueraria* are equally inadequate. WATT (1892) referred to the presence of inulin-allied saccharine matter, an easily oxidizable resin and a resin acid as analyzed in *P. tuberosa* for the Pharmacographia Indica. The presence of a kind of fish poison in some accessions of *P. tuberosa* (*Watt 9251*, in herb.) has not been elucidated in any publication, though CAMPBELL, cf. HAINES (1922) referred to its use by tribals in Manbhum (India). *Pueraria peduncularis* roots can also be used as fish poison (*Henry 12483A*, from the Szemao Mts in Yunnan) and some parts, probably

the roots, also have insecticidal properties (PERRY, 1980).

Pueraria mirifica contains a specific estrogen in its roots, miroestrol, which has rejuvenating properties (*Cain 1960*, see notes under *P. mirifica*). So far no other related species have been screened for estrogens. Canavanine has been found to be present in *P. collettii* and *P. wallichii*, and absent in *P. lobata, P. mirifica, P. peduncularis, P. phaseoloides* and *P. pulcherrima* (as *P. textilis*). In *Glycine*, as presently understood, canavanine is lacking (LACKEY, 1977). DARNLEY GIBBS (1974) lists some of the specific compounds found in *Pueraria: P. lobata* (as *P. thunbergiana*) contains Puerarin (Diadzein-8-C-glucoside) and Puerarin-?-xyloside, both isoflavones, in the roots. D-Pinitol, a cyclitol, is found in a species undisclosed (probably *P. lobata*) and also saponins and tannins. Chinese Pueraria (*P. lobata*) flowers were reported to contain Kakkatin (6,4'-dihydroxy-7-methoxy-isoflavone) by KUBO et al. (1977).

7. DESCRIPTION OF THE GENUS

Pueraria DC., Ann. Sci. Nat. Ser. 1-4: 97(1825); DC., Prodr. 2: 240(1825); Mém. Lég. 252-255(1825); Bentham & Hooker, Gen. Pl. 1-2: 537(1865); Bentham, J. Linn. Soc. Lond. Bot. 9: 121-125(1867); Baillon, Nat. Hist. Pl. 2: 200, 250 (1872); Baker in Hooker, Fl. Brit. India 2: 197-199(1876); Taubert in Engl. & Prantl, Nat. Pfl. Fam. 3-3: 370(1894); Prain, J. Asiat. Soc. Bengal 66: 419-421(1897); Gagnepain, Fl. Gen. Indo-Chine 2: 248-257(Apr. 1916); id., Lecomte Not. Syst. Paris 3: 201-205(Jun. 1916); Craib, Fl. Siam. Enum. 1-3: 448-452(1928); Lemée, Dict. descr. syn. 5: 681(1934); Kanjilal et al., Fl. Assam 2: 78-82(1938); Burkart, Legum. Argent. ed. 2: 405(1952); Hutchinson, Gen. Fl. Pl. 1: 426(1964); Lackey, Synops. Phaseol., Ph.D. Thesis Iowa State Univ., 69-79(1977); Baudet, Bull. Jard. bot. nat. Belgique 48: 183-220(1978); Nguyen Van Thuan, Fl. Cambodge, Laos, Viet-nam 17: 78-86, 91(1979); Lackey, Adv. Legume Syst. 1: 316 q.v.(1981).

Type species: *Pueraria tuberosa* (Roxb. ex Willd.) DC.

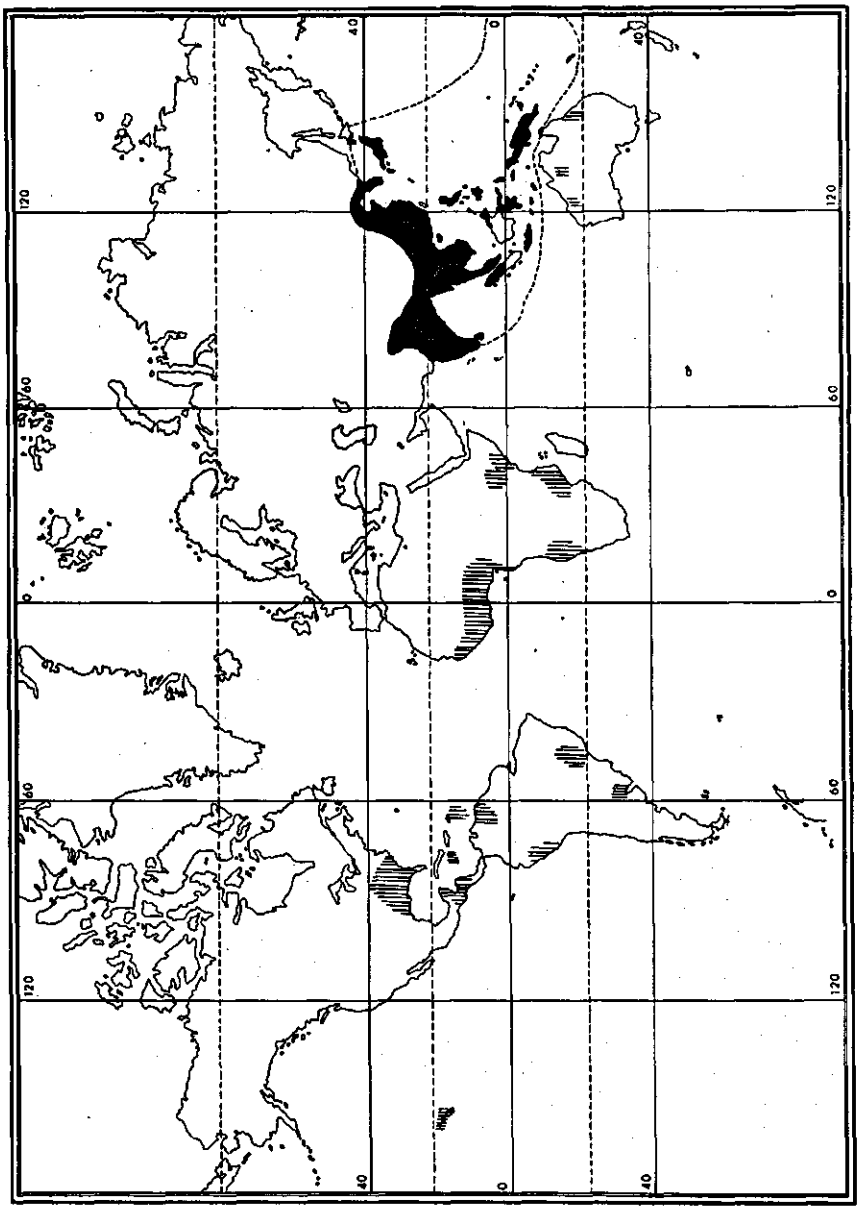
Synonyms: *Neustanthus* Benth. in Miquel, Pl. Jungh. 1: 235(1852); Benth., Fl. Hong Kong 86(1861).

Lectotype species: *Neustanthus phaseoloides* (Roxb.) Benth. (*lectotypus novus*).

Zeydora Lour. ex Gomes, Mem. Acad. Sci. Lisb. Cl. Sci. Pol. Mor. Bel.-Let. n.s. 4-1: 27(1868); Merrill, Trans. Am. Phil-Soc. n.s. 24-2: 210(1935).

Type species: *Zeydora agrestis* Lour. ex Gomes (= *Pueraria lobata* (Willd.) Ohwi var. *montana* (Lour.) van der Maesen *comb. et stat. nov.*).

Description: Robust, more or less pubescent *climbers* or *shrubs*; *stems* woody, rarely herbaceous, terete or angled, 0.2-10 cm diameter. *Leaves* alternate, pinnately trifoliolate; petiole long, pulvinus at base inconspicuous or thick-



MAP 1. Geographic distribution of *Pueraria* (Original area shown in black; introductions shaded).

ened; petiolules hardly thicker than petiole; *leaflets* large, ovate or rhomboid, entire, scalloped or palmately lobed, venation reticulate, ribs prominent, especially below, often more pubescent than lamina, lateral ribs opposite at the base, subopposite or alternate otherwise. *Stipules* herbaceous, in some species peltate, then often bifid below, caducous or not. *Stipellae* present, rarely produced below point of insertion, rarely paired.

Inflorescence an elongate pseudoraceme, unbranched or paniculate, sometimes with stipule-like bracts below; axis more or less nodose, flowering often above the middle; *bracts* narrow, very caducous; *bracteoles* small, subpersistent or minute and caducous. *Flowers* (2-)3 or 4-7 per node, in some species appearing before the leaves. *Calyx* campanulate, with 5 teeth, upper teeth halfway to entirely connate. *Petals* veined, white or mostly purplish or blue in various shades; vexillum sometimes with a yellow or green patch, and callosities, clawed, reinforced at the base and with or without 2 inflexed auricles; alae auricled above and often below, keel triangular to oblique, clawed, frontally adnate. *Vexillary* stamen connate, at least in the middle, to the others, in several species free when ovary expands, rarely quite free; anthers uniform, alternatively on long and short filaments, basidorsifix. Ovary elongate, pubescent, style filiform or on a broadened base, glabrous except near ovary. *Stigma* globular, short-papillose, often penicillate. *Pod* hairy or glabrous, elongate, in most species flattened, continuous or septate within, (1-)5-20 seeded. *Seeds* black or brown, flattened oblong or barrel-shaped, minutely punctate, bearing a small strophiole or rim aril around the hilum, positioned lengthwise in the pod. Germination epigeal, first two leaves simple and opposite, petioled.

Distribution: China, Indo-China, Japan, Malaysia, Oceania and the Indian subcontinent. Two species frequently introduced in Africa and America, and widespread.

8. SECTIONAL ARRANGEMENTS

BENTHAM (1876) did not name his three subdivisions of the genus; the nature of the stipules, the length of the calyx lobes and the pod shape deciding the arrangements. His second group, stated to cover species with non-peltate stipules, in fact includes three (out of four) with peltate stipules. BAKER (1876) distinguished three subgenera: subgen. *Pueraria* proper, subgen. *Neustanthus* Benth., a motley array not including *P. phaseoloides* for which BENTHAM intended the genus *Neustanthus* at first, and subgen. *Schizophyllon* Baker, in which he placed *P. phaseoloides* including the synonyms *P. javanica* and *P. subspicata*. Prain (1897) added some species to Baker's classification, while TAUBERT (1894) preferred to call the subgenera 'sections'. He used the name *Eupueraria*, as KURZ (1876) also did, a usage the Code now does not recommend (Art. 21). LACKEY

(1977) distinguished 4 groups (A, B, C, D) on the basis of flower number per node, stipule shape, the presence or absence of a slit in the united upper calyx lobes, the callosities of the vexillum and the pod shape and seed number. Group D, he advised, should be removed from *Pueraria* and groups B and C were distinct enough to form a genus of their own.

In the present treatment the sectional arrangements are an amalgamation of the criteria mentioned above, to arrive at more or less natural groups of species more closely related to each other than to those in different groups. The only division that could remain in its original concept is *Schizophyllon* Baker, although it is a misnomer since all three varieties of *P. phaseoloides* can have entire leaflets while var. *javanica* usually has lobed leaflets only.

8.1. Section Pueraria

Flowers (2-)3 per node. Stipules peltate, upper calyx teeth ± completely united. Vexillum with or without callosities. Pods flattened-oblong, coriaceous, seeds flattened-oblong, up to 15 per pod.

8.1.1. Subsection Pueraria
Species volubiles, flores praecox.
Flowers 3 per node, produced before the leaves develop.
P. tuberosa (Roxb. ex Willd.) DC.
P. sikkimensis Prain
P. candollei Grah. ex Benth.
P. mirifica Airy Shaw & Suvat.

8.1.2. Subsection Nonnudiflorae van der Maesen subsect. nov.
Species volubiles, flores synanthi.
Flowers (2-)3 per node, produced when in leaves.
P. lobata (Willd.) Ohwi
P. imbricata van der Maesen sp. nov.
P. edulis Pamp.
P. alopecuroides Craib
P. calycina Franch.
P. lacei Craib
P. bella Prain

8.1.3. Subsection Pulcherrima van der Maesen subsect. nov.
Species volubiles, flores parvi. Stipulae amplexicaulae caducae.
Flowers 3 per node, small, subsessile at first, peltate stipules amplexicaul, covering buds.
P. pulcherrima (Kds.) Merr.

8.2. Section Schizophyllon Baker

Flowers 4-6 per node, produced when leaves are present, stipules not produced at the base, upper calyx teeth distinct, vexillum without callosities, pod ± cylindrical with papery partitions between the 15-20 barrel-shaped seeds.

P. phaseoloides (Roxb.) Benth.

8.3. Section Breviramulae van der Maesen sect. nov.

Species erectae vel volubiles, nodi racemulorum parvi vel condensati, 4-10 flori.

Flowers 4 or more per node, on short or condensed racemuli, stipules not or hardly produced below the base, upper calyx teeth distinct or not, vexillum without callosities, pods flat, papery or sturdy, 4-10 seeded, seeds flattened-ovoid.

P. peduncularis Grah. ex Benth.

P. stricta Kurz

P. wallichii DC.

P. rigens Craib

9. KEY TO THE SPECIES OF PUERARIA

1a. Erect shrubs or rigid stragglers. shrubs. Flowers 4-10 together on brachyblasts (short laterals), short-pedicelled, inflorescence sometimes branched 2

1b. Vines, or shrubs with more or less straggling branches 3

2a. Corolla 3-5 times as long as the calyx, calyx lobes short-obtuse. Erect shrub, rarely straggling . . . . . **17. P. wallichii**

2b. Corolla less than twice as long as the calyx, calyx lobes acute to lanceolate. Rigid woody climber . . . . . **13. P. rigens**

3a. Vines 4

3b. Erect or straggling shrubs; pods flattened, ca 5-10 seeds per pod; bracts soft, more or less hooked at flowering, hard and hooked in fruiting stage, more or less pubescent . . . . . **15. P. stricta**

4a. Corolla 2-3 times as long as the calyx, slender and long-pedicelled. Flowers not crowded, 4-7 per node; pods flat, papery; inflorescences unbranched, 1-2 per axil . . . . . **10. P. peduncularis**

4b. Flower pedicels short, not very slender 5

5a. Flowers 2-3 per node, stipules peltate, upper calyx teeth almost or completely united; pods flat 6

5b. Flowers 4 or more per node, stipules not peltate, upper calyx teeth distinct; pods rounded, ca 20 barrel-shaped seeds per pod, papery partitions between the seeds . . . . . **11. P. phaseoloides**

6a. Flowers less than 7(-12) mm long; fruits hairy mainly on edges. Leaflets entire, lanceolate, stipules large, amplexicaul, covering buds, caducous, leaving a line scar . . . . . **12. P. pulcherrima**

6b. Flowers more than (10-)12 mm long; fruits, if hairy, both on edges and sides. Leaflets often lobed, stipules present, if shed leaving an oval scar 7

7a. Pseudoracemes unbranched or with 1-2 branches 8

7b. Pseudoracemes branched and/or with stipule-like bracts on the lower portion 10

8a. Stipellae 4 near petiolules of side leaflets, leaflets always prominently lobed; upper calyx lobes minutely distinct . . . . . **5. P. edulis**

8b. Stipellae 2 near petiolules of side leaflets, leaflets lobed or not; upper calyx teeth united or minutely distinct 9

9a. Leaflets long-elliptic, not lobed; calyx lobes obtuse . . . . . **2. P. bella**

9b. Leaflets ovate to orbicular, trilobed or not; calyx lobes acuminate . . . . . **8. P. lobata**

10a. Vine densely woolly-pubescent; calyx teeth long 11

10b. Vines slightly or short-pubescent; calyx teeth at most twice as long as the tube 12

11a. Leaflets 5-7 cuspidate; flowers 2 per node; calyx teeth 3-4 times the tube . . . . . **3. P. calycina**

11b. Leaflets ovate-rhomboid; flowers 3 per node; lower calyx tooth 4-6 times the tube . . . . . **7. P. lacei**

12a. Inflorescence with few branches, foxtail-like; flowers dense, bracts long, 10-15 mm, and long-hairy, 3 mm, caducous, bracteoles as long as the calyx tube, flowering when in leaves . . . . . **1. P. alopecuroides**

12b. Inflorescence more or less copiously branched; bracts up to 10 mm, hairs to 2 mm, caducous, bracteoles half as long as the calyx tube or less . . . 13

13a. Flowering when in leaves, or on old branches without leaves; calyx lobes lanceolate-acute, imbricate . . . . . **6. P. imbricata**

13b. Flowering when leafless; calyx lobes deltoid-obtuse 14

14a. Inflorescence crowded, rusty pubescent . . . . . **14. P. sikkimensis**

14b. Inflorescence long and open, yellow-brown pubescent or glabrous . . 15

15a. Vexillary stamen free, calyx yellow-brown or greyish pubescent; pods copiously hairy . . . . . **16. P. tuberosa**

15b. Vexillary stamen united, calyx grey or brown appressed-pubescent; pods almost glabrous 16

16a. Inflorescence often more than 30 cm long; calyx purplish green, sparsely pubescent; flowers 12-15 mm long . . . . . **4. P. candollei**

16b. Inflorescence up to 30 cm long; calyx quite densely short appressed-pubescent; flowers 8-10 mm long . . . . . **9. P. mirifica**

10. ALPHABETICAL TREATMENT OF THE SPECIES

1. **Pueraria alopecuroides Craib** ***(Map 2, p. 17; Plate 1, p. 16)**

Pueraria alopecuroides Craib, Kew Bull. 1910: 276; Craib, Kew Bull. 1911: 40; id., Contrib. Fl. Siam, Aberdeen Univ. Stud. 57: 64(1912); Gagnepain, Fl. Gén. Indo-Chine 2: 255(1916); Craib, Fl. Siam. Enum. 1-3: 448(1928); Handel-Mazzetti, Symb. Sinicae 582(1933); Lackey, Synops. Phaseol. 72, 75(1977).

Lectotype: Upper Burma, Shan Hills, Gokteik 600 m, *Meebold 8058* (K, holo), appointed by CRAIB (1928) from the two syntypes.

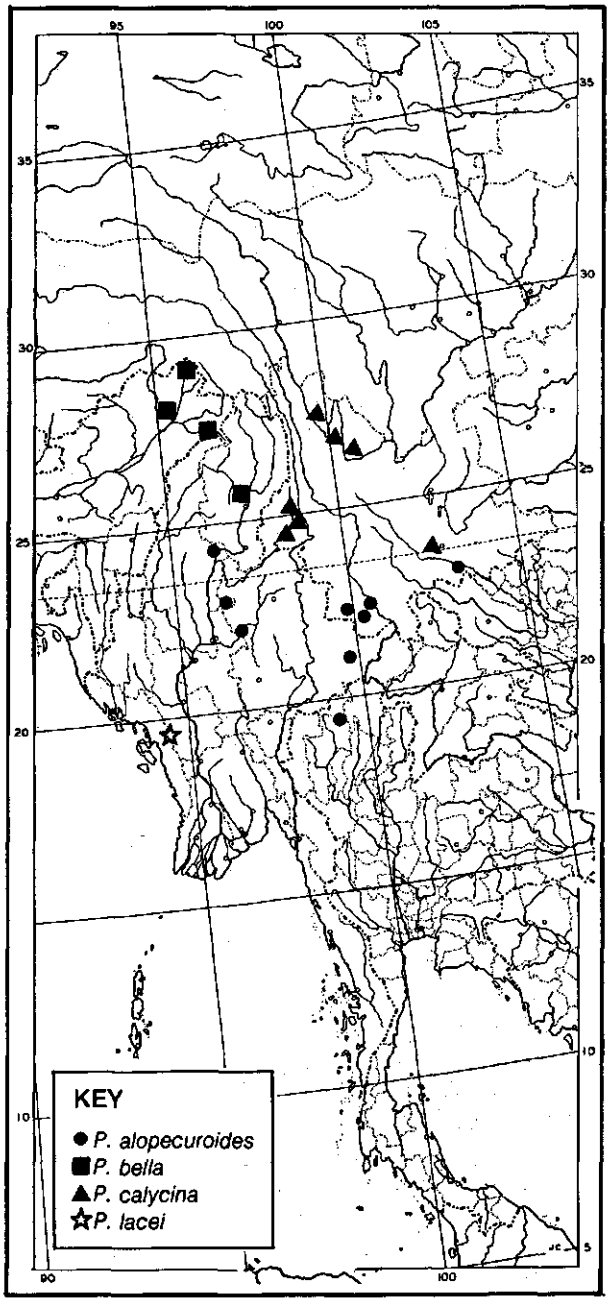
Paratype: China, S. Yunnan, Szemao to Chenlung, Mengwan?, *Bons d' Arty 255* (K).

Description: *Woody climber*, perennial. *Branches* strong, up to 6(-10) mm diameter, several m long, vaguely striate, covered with brown bulbous-based caducous hairs of ca 3 mm. Stipules peltate, sagittate, tips acute, papery, striate, with brown bulbous-based hairs, 2-3 cm long, 0.6-0.8 cm wide. *Leaves* pinnately trifoliolate; petiole canaliculately striate, with brown bulbous-based hairs, 5-14 cm long; rachis 1.5-5 cm long. *Leaflets* ovate-rhomboid, side leaflets obliquely so, 8-17 cm long, 4-13 cm wide, apex acuminate, base rounded to truncate, thinly bulbous-based pubescent above, densely adpressed-silky pubescent below, hairs brown to greyish; ribs prominent below, laterals irregularly paired, ca 10-12 each side; petiolules slightly thickened, 4-8 mm long; stipellae linear-lanceolate, striate, 4-15 mm long, ca 1 mm wide. *Inflorescences* foxtail-like, densely flowered at first, 10-35 cm long, branches few, striate, somewhat nodose, with grey dense short and brown sparse long hairs, bracts at the base stipule-like, 10-15 mm long, lower teeth short; pedicels short, up to 6 mm at maturity, flowers (2-)3 per node, bracts narrowly ovate-lanceolate, 10-15 mm long, 1-1.5 mm wide, with 3 mm long hairs, ventrally glabrous, very caducous, bracteoles 2 per flower, linear-lanceolate, long-pubescent, 6-8 mm long, ca 1 mm wide. *Calyx* pubescent, grey dense short and brownish sparse long hairs, glabrous inside, tube ca 4 mm long, teeth lanceolate, upper ones connate except at the tip, ca 7 mm long, side teeth ca 6 mm long, lowest tooth ca 8 mm long. *Vexillum* obovate, ca 13 mm long, 11 mm wide, apex emarginate, base clawed, auricles reinforced, violet or white with yellow spot. *Alae* obovate, base auriculate, purple, ca 12 mm long, 4 mm wide, keel petals oblique, clawed, ventrally adnate, purple, ca 12 mm long. *Ovary* elongate, grey silky appressed pubescent, ca 9 mm long, ca 6 ovules, style perpendicular to ovary, ca 3 mm, glabrous, stigma terminal, globular, penicillate at base. *Stamens* connate, vexillary filament free at base only, ca 13 mm long, free part 2-3 long upcurved, anthers uniform, dorsifix, alternatively on long and short filaments. Pods flattened-oblong, acuminate at base and apex, tipped with rest of style, constricted where ovules failed, with dense short grey and sparse long brown bulbous-based hairs, to 9 cm long and 7-10 mm wide. *Seeds* not available.

PLATE 1. *Pueraria alopecuroides* Craib (*Lace 5717*)

Distribution: Upper Burma, Yunnan-China and Thailand.

Ecology: Climber in mixed jungle or among grasses.



MAP 2. *Pueraria alopecuroides, P. bella, P. calycina,* and *P. lacei* in south Asia.

Altitude: 100-600 m.

Flowering: January-April. Fruiting: April.

Vernacular names: Not recorded.

Specimens examined:

BURMA: Katha, 100 m, Katha distr., *Lace 5717* (E, CAL, K); Loi Mwe, S. Shan State, *MacGregor 103* (E); S. Shan State, *id. 1273* (E, K); Gokteik, Shan State, *Meebold 8058* (K, holo); Shweli Valley, Ruby Mines distr., Mogok, *Rodger 146* (CAL).

CHINA: Szemao to Chenlung, Mengwan? S. Yunnan, *Bons d'Arty 255* (K, para); Hsishuang Panna, Yunkinghung, Manbulai, Yunnan, *K. M. Feng 20057* (KWA); Manhao nr Tonkin border, Yunnan, *von Handel-Mazzetti 1023* (K, W); betw. Muanghai and Kenghung, Cheli, valley of Nam Ha, *Rock 2499* (US).

THAILAND: Hills betw. Muang Prow and Chieng Dao, *Kerr 1044* (BM,U).

2. Pueraria bella Prain *(Map 2, p. 17; Plate 2, p. 19)

Pueraria bella Prain, J. Asiatic Soc. Bengal 67: 288(1898); Pottinger & Prain, Rec. Bot. Surv. India 1-11: 239(1898); Burkill, Rec. Bot. Surv. India 10-2: 271(1925); Lackey, Synops. Phaseol. 73, 76(1977).

Type: Burma, Kachin mts nr Myitkyina, *King's collectors (Shaik Mokim)* (CAL, holo; iso: CAL, K).

Description: *Woody climber*, perennial. *Branches* to at least 5 mm diameter, presumably several m long, terete, almost glabrous to slightly pubescent. *Stipules* caducous, leaving a lenticular rim, greyish. *Leaves* pinnately trifoliolate, petiole ribbed, canaliculate above, almost glabrous, 6-8 cm long, rachis 1.5-3 cm long. Top leaflets long-elliptic, side leaflets obliquely so, 8-18 cm long, 3.5-8 cm wide, apices long-acuminate, base cuneate-rounded, green above, greyish green below, sparingly short-pubescent both sides, veins prominent below, in ca 7 unequal pairs; petiolules barely thickened, 5-6 mm long; stipellae setaceous, to ca 7 mm long. *Inflorescence* axillary, to 35 cm long, unbranched, short-pubescent, slightly nodose, 3 flowers per node; bracts unavailable, bracteoles 2 per flower, caducous, broad-ovate, ca 2 mm long and wide, striate, short-hairy both sides, apex obtuse to acute. *Calyx* short velvety pubescent, inside also, margins longer hairy; tube ca 4-6 mm long, teeth obtuse, upper ones connate but clearly emarginate, to ca 3-4 mm long, side teeth ca 3-4 mm, lower tooth ca 2.5 mm, more acute than other teeth. *Vexillum* orbicular-ovate, white to pale violet, ca 14-17 mm long, ca 12 mm wide, apex emarginate, base clawed, auricles inflexed; alae elongate-obovate, pale violet, to ca 14-16 mm long, 4-6 mm wide, claw 3-4 mm, auricle 1 mm, base margin also lobed; keel petals rhomboid, auricled near claw, pale violet, to 13-16 mm long, 4-5 mm wide, ventrally and basally long-adnate. *Ovary* elongate, shortly adpressed pubescent, ca 9 mm long, ca 15 ovules; style short, upcurved, ca 2 mm long, stigma terminal, penicillate at

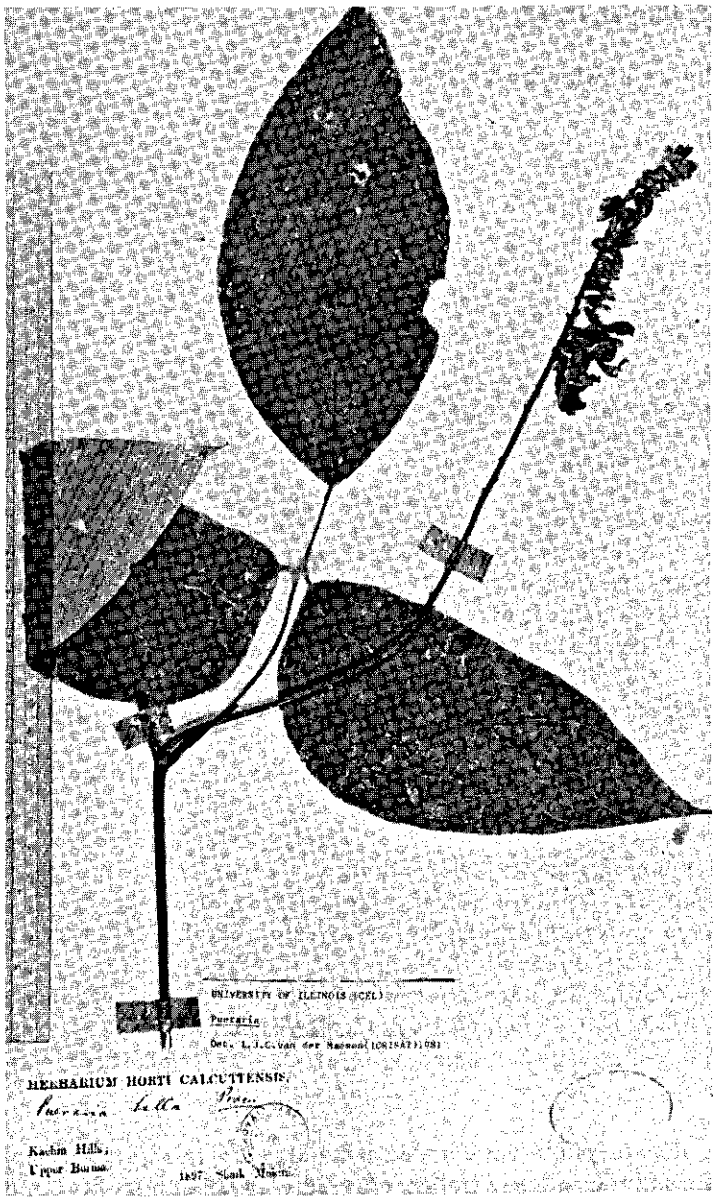


PLATE 2. *Pueraria bella* Prain (*Shaik Mokim s.n.*)

base. *Stamens* monadelphous, vexillary stamen free with age, filaments ca 14 mm, free part 2-3 mm, upcurved, anthers uniform, basidorsifix, alternately on long and short filaments. *Pods* unknown.

Distribution: Burma, India.

Ecology: In hills; sprawling over boulders in river bed.

Altitude: 200-1000 m.

Flowering: August, December. Fruiting: October, February?

Vernacular name: Not recorded.

Specimens examined:

BURMA: Kachin mts near Myitkyina, Shaik Mokim (CAL, holo; iso: CAL, K).
INDIA: Arunachal Pradesh: above the Dihang river, mouth of side river, Abor hills, *Burkill 36125* (CAL); Delei valley, Mishmi hills, *Kingdon-Ward 11062(BM)*; Chenglang to Khela, Tirap Frontier Div., *Panigrahi 14490* (CAL).

Note: Only four accessions are known, found ± 400 km apart. This species is very rare, and only known from areas difficult to reach. When better known, LACKEY (1977c) suggests a possible transfer to *Neonotonia*, but the shape of infloresence and flowers make it fit well in *Pueraria*. I presume an alliance to *P. candollei* may be likely, although *P. bella* keys out with *P. lobata*.

3. Pueraria calycina Franchet ***(Map 2, p. 17; Plate 3, p. 21)**

Pueraria calycina Franchet, Pl. Delav. 181(1890); Léveillé, Bull. Soc. Bot. France sér. 4 vol. 8, 55: 426(1908); Gagnepain, Fl. Gén. Indo-Chine 2: 249(1916); Lackey, Synops. Phaseol. 71, 73 (1977).

Type: China, Yunnan, calcareous hills along Long-teou-chan river above Hee-gni-tang nr Tapintze, *Delavaye 3590* (P, holo, not seen; iso: F, K).

Synonym: *Pueraria forrestii* Evans, Notes Roy. Bot. Gard. Edinburgh 13: 178(1921); Lackey, Synops. Phaseol. 73(1977).

Type: China, Yunnan, descent to Yangtze river from E boundary of Lichiang valley, lat. 27 15′N, 7-8000 ft, *G. Forrest 10732* (E, holo; iso: BM, E, K).

Paratype: China, Yunnan, Yung-peh Mts, lat. 26 40′N, 8000 ft, *Forrest 15312* (CAL, E, K).

Description: *Woody*, pubescent climber, perennial. *Branches* up to 6 mm diameter, up to 5.5 m long, vaguely ribbed, covered with spreading short and long golden-brown hairs, caducous with age, the long hairs ca 3-4 mm, base somewhat bulbous. Stipules peltate, striate, long and short pubescent, upper half ovate-obtuse, 10-20 mm long, 4-8 mm wide, base bilobed, linear to lanceolate, tips acute, lobes 5-10 mm long. *Leaves* pinnately trifoliolate; petiole ribbed, 5-12 cm long, with long and short spreading hairs; rachis 2-6 cm long, similar pubescent; leaflets suborbicular, unlobed or with 3 lobes, top leaflet broadly orbicular, side leaflets obliquely so, apices obtuse, margins 5-7 tufted-cuspidate,

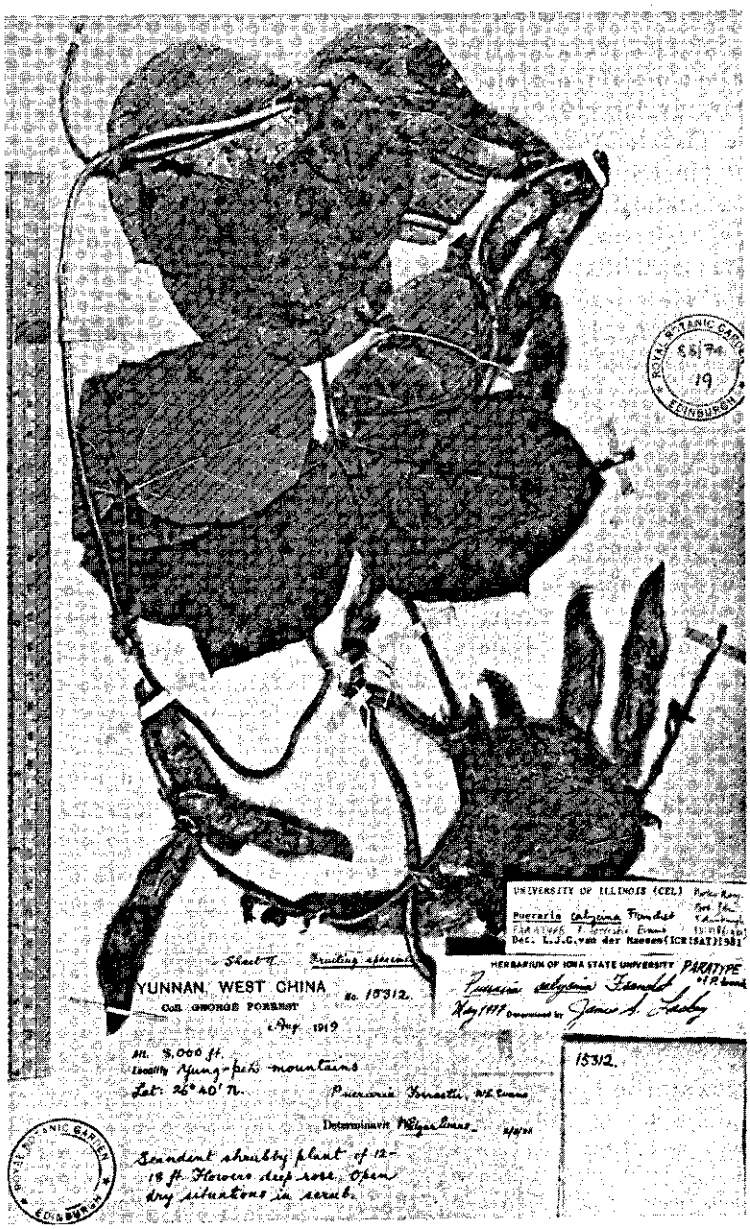


PLATE 3. *Pueraria calycina* Franchet (*Forrest 15312*)

base rounded-truncate, 7-16 cm long, 6-14 cm wide, semi-spreading grey-pubescent above, densely appressed grey-pubescent below, ribs prominent, more densely hairy as are the margins, laterals in 3-4 pairs, (sub)opposite, top leaflets

3-nerved at base, side leaflets with one basal vein less prominent; petiolules hardly thickened, somewhat more hairy than the rachis, ca 5-8 mm long. *Stipellae* lanceolate, long and short pubescent, 5-10 mm long, 4 at insertion of side-leaflets. *Inflorescences* axillary, 10-25 cm long, ribbed, unbranched, long-pubescent, slightly nodose; flowers 2 per node, purplish pink; bracts ovate-lanceolate to lanceolate, 5-10 mm long, ca 1-2 mm wide, caducous; pedicels short, ca 3 mm, up to 10 mm at maturity; bracteoles 2 per flower, ovate-lanceolate, 2-3 mm long, ca 1 mm wide. *Calyx* long-pubescent, interior short-appressed pubescent, tube 3-5 mm long, teeth long, 11-15 mm, lanceolate, upper ones connate except at the tip. *Vexillum* obovate, apex emarginate, base shortly clawed, auricules inflexed, ca 16 mm long, 13-15 mm wide. *Alae* obovate, base biauriculate, ca 15-17 mm long, 5 mm wide. Keel petals oblique, clawed, base rounded, ventrally adnate, ca 17 mm long, 5 mm wide. *Ovary* elongate, stipitate, grey silky adpressed pubescent, ca 12 mm long, ca 5 ovules, sutures thickened; style glabrous, ca 5 mm, upcurved; stigma terminal, globular, penicillate at base. *Stamens* diadelphous, vexillary stamen free, ca 16 mm long, free part 3-5 mm long, upcurved; anthers uniform, basidorsifix, alternatively on long and short filaments. *Pods* flattened-oblong, cuneate at base, obtuse at apex, hardly constricted where ovules fail, with dense spreading golden-brown hairs, up to 7-8 cm long and 8-12 cm wide, valves papery, puckered (base of hairs) and broad-reticulate. *Seeds* reniform, flat, reddish to black-brown, 7-9 mm long, 5-6 mm wide, 2.5-3 mm thick, strophiole scarcely raised, oval, 1 mm long.

Distribution: China (Yunnan).

Ecology: Climbing on scrub, calcareous slopes, open dry situations and near rivers.

Altitude: 2000-2600 m.

Flowering: July-August. Fruiting: July end, August.

Vernacular names: Not recorded.

Specimens examined:

CHINA, Yunnan: slopes of Long Teou Chan above Hee Gni Tang, nr Tapintze, *Delavay 3590* (P, holo; iso: CAL, E, K) ibid., *id. 4275* (P); ibid., *id. 4719* (P); descent to Yangtze river from E. boundary of Lichiang valley, 27 15 N, *Forrest 10732* (BM, E, K); Yung-peh mts, 26 40 N, *Forrest 15312* (E, K); nr Yunnan Tsu, *Myotte's collector s.n.*, herb. d'Aleizette (L); on Yangtze river nr Taku, betw. Chungtien and Lichiang, *Schneider 2161* (K).

Note: EVANS must have been unaware that FRANCHET had named this species earlier, the type specimens are almost identical (LACKEY, 1977).

4. Pueraria candollei Grah. ex Benth. ***(Map 3, p. 26; Plates 4,5, p. 24,25)**

Pueraria candollei Graham ex Bentham, Miquel, Pl. Jungh. 2: 235(1852) (as *P. candollei* Wall.); Benth., Bot. J. Linn. Soc., London 9: 123(1867); Baker in Hooker, Fl. Brit. India 2: 197(1876); Kurz, J. Asiatic Soc. Bengal 45-4: 253(1876); Collett & Hemsley, Bot. J. Linn. Soc., London 28: 47(1890); Prain, J. Asiatic Soc. Bengal 66-2: 419(1897); Pottinger & Prain, Rec. Bot. Survey India 1-11: 239(1898); Prain, Bengal Pl. 1: 282(1903, repr. 1963); Craib, Kew Bull. 1911: 40; id., Contrib. Fl. Siam, Aberdeen Univ. Stud. 57: 64(1912); Gagnepain, Fl. Gén. Indo-Chine 2: 255(1916); Brandis, Indian Trees 228(1921); Lackey, Synops. Phaseol. 72, 74(1977).

Type: Burma, Pegu, Ripa Saluan ad Phanoe, 1827, *Graham in Wallich Herb. 5355* (K, holo; iso: BM, G, K).

Paratypes: Burma, Pegu, *Lobb* s.n. (K); ibid., *MacLelland s.n.* (K).

Description: *Woody* climber, perennial. *Branches* strong, to ca 12 mm diam., (see note), up to 12 m long, terete, ribbed with age, sparsely clad with caducous adpressed light brown hairs, glabrous with age. *Stipules* peltate, elliptic, both ends fringed-obtuse, 3-6(-10) mm long, up to 5 mm wide, caducous, leaving a round scar. *Leaves* pinnately trifoliolate, petiole striate- canaliculate, glabrescent, 12-20 cm long, rachis ca 3 cm long. *Leaflets* ovate, side leaflets very obliquely so, 10-22 cm long, 8-18 cm wide, apex long-acuminate, base broadly cuneate to truncate or vaguely cordate, green and very thinly greyish-pubescent above, glabrous with age, lighter green and appressed grey-pubescent below; ribs prominent, in 6-8 unequal pairs; petiolules barely thickened, glabrescent, up to 11 mm long. *Stipellae* small ovate perules, whitish, striate, 3-5 mm long, 1-3 mm wide. *Inflorescences* narrow-branched, mainly at the base, sometimes unbranched, up to 30-80 cm long, branches usually many, ridged, at the top almost winged, clearly nodose, pendulous, covered with short grey hairs, bracts at the base stipule-shaped, striate, pubescent, ca 5-9 mm long, 3-5 mm wide, obtuse, pedicels short, up to 3-5 mm at maturity, flowers (2-)3 per node, bracts linear-lanceolate, up to 10 mm long, 1-2 mm wide, striate, dorsally long-pubescent, ventrally short-pubescent, sometimes (or always?) covering a second bract, ovate-obtuse or lanceolate, 1-2 mm long, 1 mm wide, both very caducous, bracteoles 2 per flower, ovate, tip obtuse, 1-3 mm long, 1-2 mm wide, pubescence long, hairs brown. *Calyx* purplish, very sparsely grey-pubescent, inside as well, margins of teeth and center of upper and lower teeth long-pubescent, tube ca 4-5 mm long, teeth short, deltoid, obtuse, upper teeth connate, 3-6 mm long, side teeth 2-5 mm, lower tooth 3-6 mm long. *Vexillum* orbicular-ovate, ca 12-18 mm long, 12-15 mm wide, apex emarginate, base clawed, auricles inflexed, with 2 callosities near the base, blue to dark purple or lilac, margins inflexed. *Alae* lanceolate, 12-17 mm long, 4-5 mm wide, claw 3-4 mm, auricle hooked, 1.5 mm. Keel petals rounded along base, ventrally adnate, ca 10-17 mm long. *Ovary* elongate, grey silky appressed pubescent, ca 8-10 mm long, ca 10 ovules, style almost glabrous, ca 2 mm as flattened extension of the ovary, ca 3 mm perpendicularly

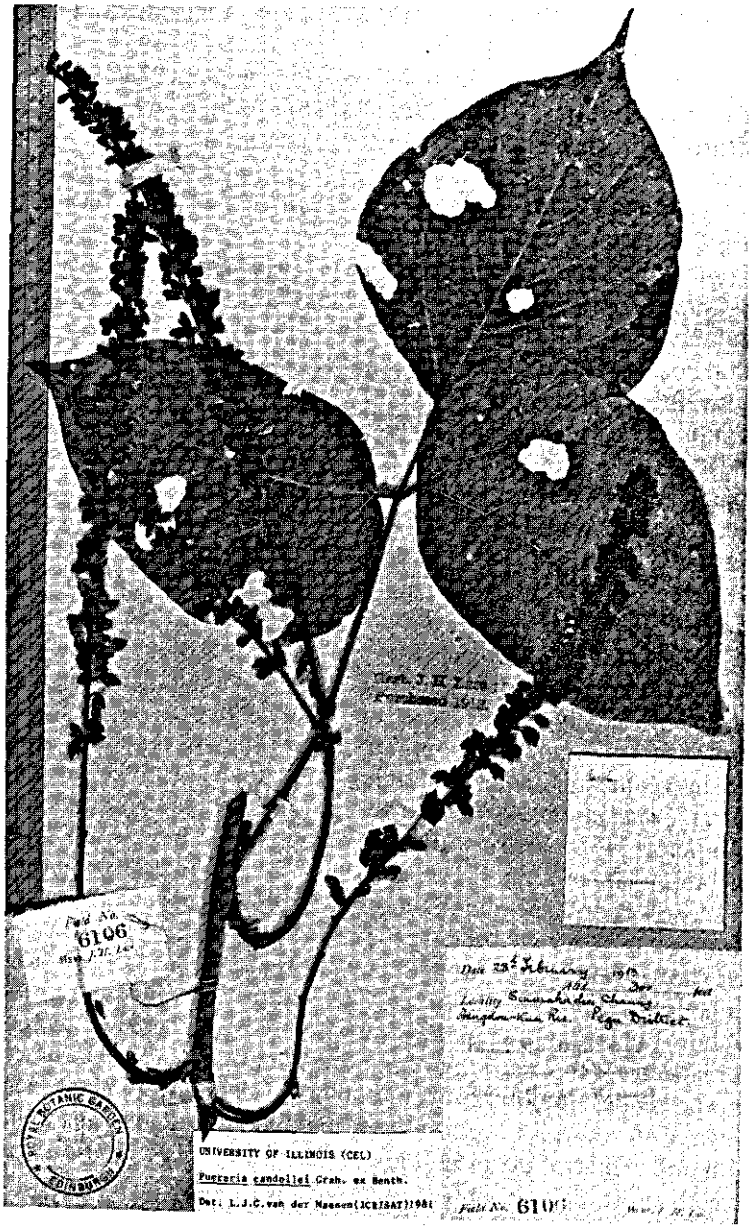


PLATE 4. *Pueraria candollei* Grah. ex Benth. (*Lace 6106*)

upcurved, stigma terminal, globular, penicillate at base. *Stamens* monadelphous, vexillary stamen attached in the middle, with a knee, ca 11-15 mm long, free part 1-4 mm, upcurved; anthers uniform, dorsifix below the middle, alternatively on long and short filaments. *Pods* flattened oblong, up to 8 cm long,

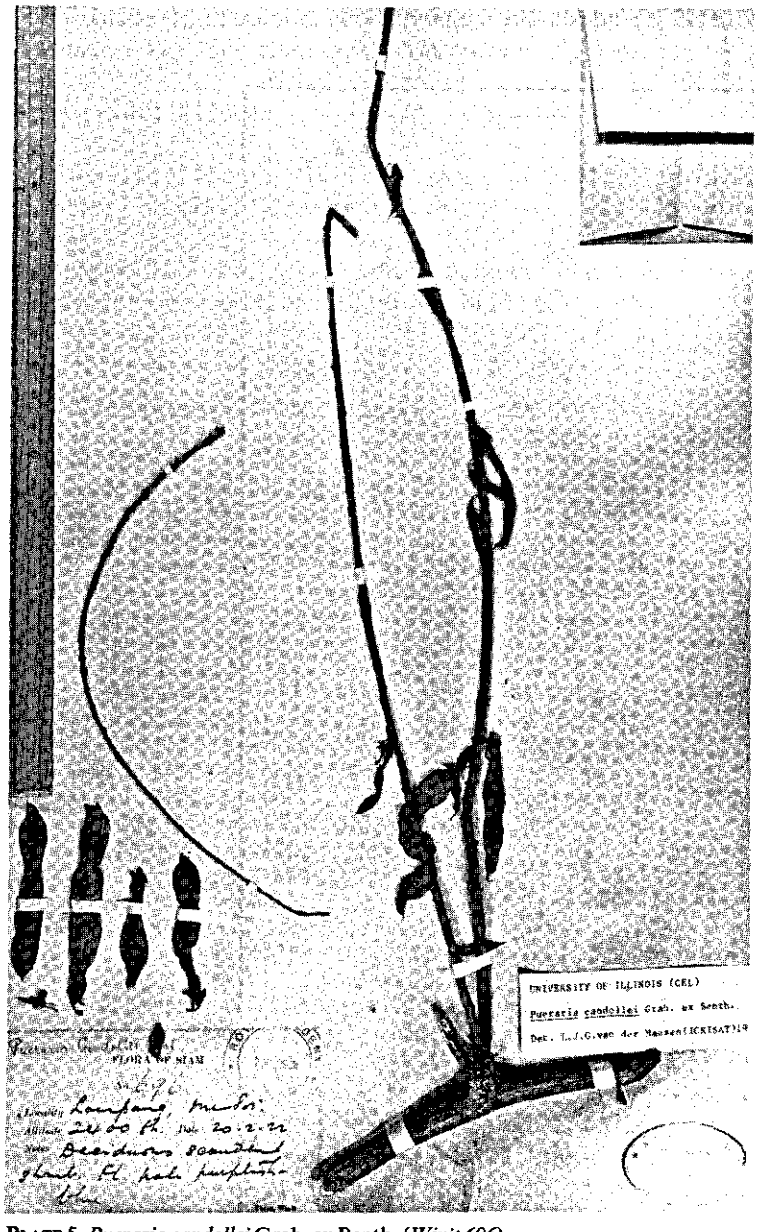
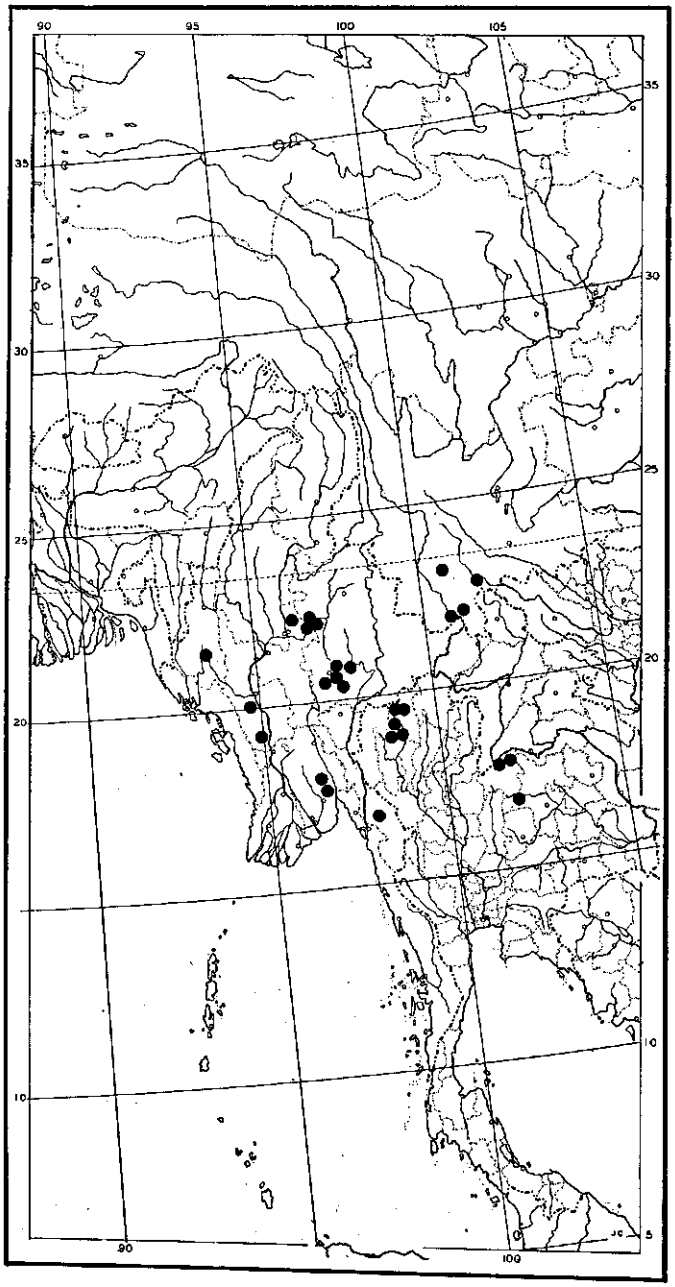


PLATE 5. *Pueraria candollei* Grah. ex Benth. (*Winit 696*)

1.1 cm wide, up to 8(-10) seeded, narrow-rounded at base, acuminate at apex, tipped with rest of style, constricted where ovules fail, sutures thickened, locule outline visible, glabrous or with age, valves reticulate. *Seeds* (immature) flattened ovoid, ca 2.5 mm long, 1.5 mm wide, 1 mm thick, reddish brown, minutely pitted, with a narrow strophiole.

Distribution: Bangladesh, Burma, India (the Andamans, Assam), Thailand.



MAP 3. *Pueraria candollei* in Burma and adjacent countries.

Ecology: In deciduous scrub jungle, on limestone rocks, open situations, stream or lake banks, climbing in shrubs or low trees.

Altitude: 0-1300 m.

Flowering: (January-) February-April, in Thailand also in September-October. Fruiting: February-April.

Vernacular names: Thailand: Kua ta lan, Kua kao pu (N. Lao), Kham-phi noi (NE); Kwao khrua (N). Burma: Ma U Nwè.

Specimens examined:

BANGLADESH: Seetakond Hills, Chittagong, *Clarke 6606* (BM, CAL, K); ibid., id. *19986A*(CAL, K); Demajin, *Lister 189* (CAL); Kaptai Lake shore, Chittagong Hill Tract, *van der Maesen 3728* (ICRISAT, K, WAG).

BURMA: Sindawng hill, Yaunghwe, Inle Lake, *Annandale 483* (CAL); Sami Valley, Arakan Yomahs, Minbu distr., *Aubert & Gage s.n.* (CAL); Siva Fuel reserve, N. Toungoo distr., *Bake 9364* (E); Tenasserim, *Beddome 2204* (BM); Shan Hills Terai, *Collett 364* (K); Haka, Sin Khua, *Dickason 7619* (E, L); Iaping valley, 24.35 N, *Forrest 12240* (E, K); Thoungshuyen, Tenasserim, *Gallatly 60* (CAL); Youngsaleen river, Tenasserim, *id. 479* (CAL); Kabaung reserve, bank of Thikangbauk stream, Toungoo distr., *Gilbert Rogers 227* (OXF); Sabyin reserve, compartm. 2, Toungoo distr, *id. 355* (CAL, OXF); nr Okshitlaing, Yamethin distr., *id. 565* (CAL); nr Thabyebin village, Magwe distr., *id. 911* (E); Hanalui, Upper Chindwin distr., *Kingdon Ward 11261* (BM); Martaban, *Kurz 1721* (CAL); Pegu, *Kurz 2533* (L, P); Auigdon-Kun reserve, Sinmakadin Chaung stream, Pegu distr., *Lace 6106* (CAL, E, K); Moulmein, *Lobb s.n.* (K, para); Myebon, on or nr beach, *McKee 6104* (K); King Tung, *Mac Gregor 1327* (CAL); Pegu, *McLelland s.n.* (K, para); 34 km SO of Bhamo, along Ledo rd, *McMillen 263* (US); Kyauktwin, Tenasserim, *Meebold 15181* (CAL); Myedaung, Henzada distr., Shaik *Mokim 1367* (CAL); Snapyoge, Henzada distr., *id. 1641* (CAL); Myauangtaga, Insein distr., *Parkinson 602* (CAL); Theinbun Chaung stream, Mai nam wat, S. Tenasserim, *Parkinson 1904* (K); Navilao, Kachin Hills, *Pottinger s.n.* (CAL); on Salween river nr Phanoe, *Wallich 5355* (K, holo; iso: BM, G, K).

INDIA: Assam: Kandlair, Lushai hills, *Parry 202* (K).

LAOS: Muong Pun, Sam Neua prov., *Poilane 1931* (P).

THAILAND: New Muang? *Kerr 992* (BM, CAL, K). Sisawat, Kanburi, *id. 10156* (BM, K); Wangka, Kanburi, *id. 10306* (BM, K); Ta Kanawon, Surat, *id. 12342* (BM, K); NW of Sai Yok, *Larsen 9049* (K); N. Lampang, Thoen, (Muang Tun), Mae Mawk, *Samaphuddi 23028* (L); Lampang misor, *Khoon Winit 696* (K); Lampang, Muang Laung, *id. 1609* (K).

Notes: *P. candollei* need not be lectotypified, as BENTHAM referred to the Graham specimen from Pegu in the Wallich Herbarium in the first instance, and quoted the paratypes at the end of his description. The herbarium number published is, however, erroneous: it should be *5355*, not *5353*, as corrected by BAKER (1876). Tubers have not been collected or reported, but are likely to be present.

5. Pueraria edulis Pamp. ***(Map 4, p. 31; Plate 6, p. 28)**

Pueraria edulis Pampanini, Nuov. Giorn. Bot. Ital. n.s. 17: 28(1910); Gagnepain, Fl. Gén Indo-Chine 2: 249 (Apr. 1916); id., Lecomte Not. Syst. 3: 202,

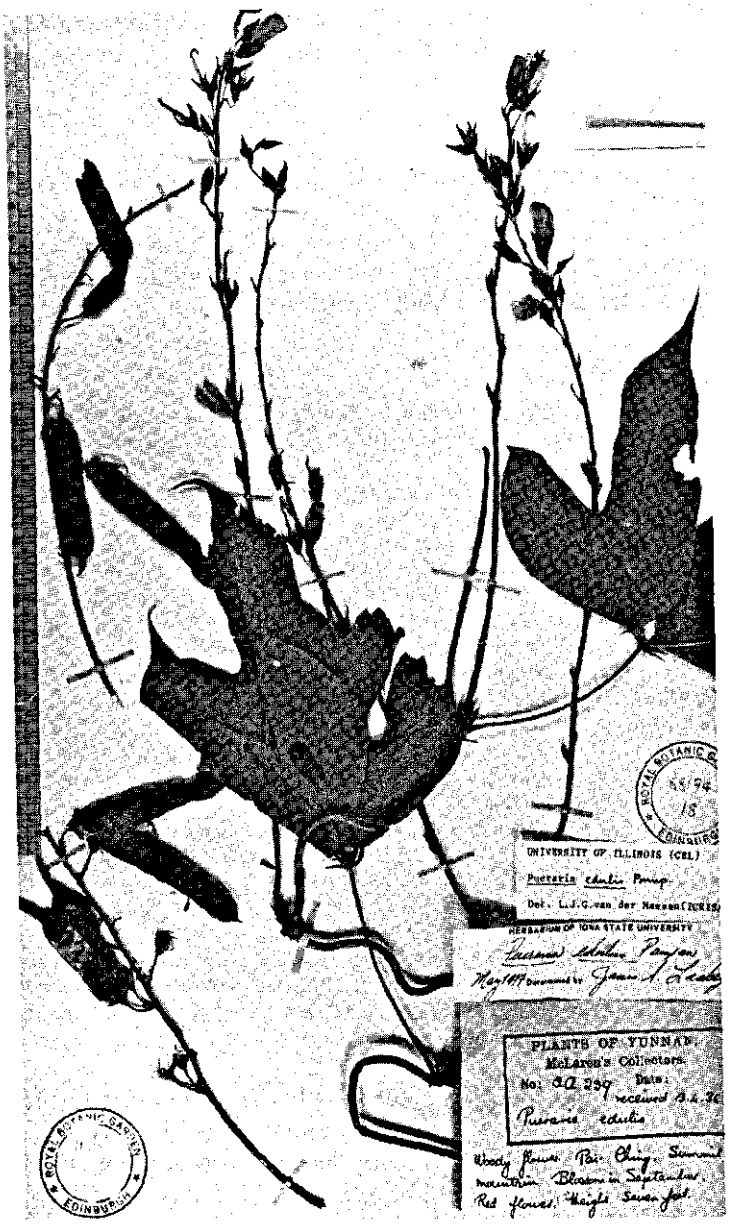


PLATE 6. *Pueraria edulis* Pamp. (*McLaren's collectors AA 239*)

204 (Jun. 1916); Handel-Mazzetti, Symb. Sinic. 582(1933); Lackey, Synops. Phaseol. 71, 74(1977) (as *edulus*); Anon., Icon. Corm. Sinic. 2: 500(1980).

Type: China, Yunnan, mountain forests near Yunnan-sen, *Maire 100* (FI, holo; iso: P).

Synonyms: *Pueraria quadristipellata* Clarke ex W. W. Smith, Rec. Bot. Surv. India 6-2: 36(1913); Lackey, l.c. 74(1977).

Type: Sikkim, Yoksun, 5000 ft, C. B. *Clarke 25147* (K, holo; iso: BM, CAL, K).

Pueraria bicalcarata Gagn., Lecomte, Not. Syst. 3: 201(Jun. 1916); id., Fl. Gén. Indo-Chine 2: 249 (Apr. 1916, *nomen, in clavi*); Handel-Mazzetti, Symb. Sinicae 581(1933); Lackey, l.c. 74(1977).

Lectotype: China, Yunnan. From the syntypes *Ducloux 6683, 6684* (nr Pin-tchuan (Pinchwan) and *5805* (Kiaokia region) a lectotype must be chosen. I have not seen this material (probably in P). *Ducloux 6687* (also from Pin-tchuan-tcheou (Pinchwan)) (BM, F, D, US) was determined as *P. edulis* Pamp. by GAGNEPAIN.

Description: *Woody* climber, perennial, with tuberous roots. *Branches* up to 3-5 (-9) mm diameter, to 3-7 m long, striate, glabrous or slightly pubescent. *Stipules* peltate, striate, upper part ovate-obtuse to acute, 5-11 mm long, lower part often bifid, apices entire, fringed or acute, 3-8 mm long, 3-6 mm wide at insertion, leaving an oval scar if lost, (sub)glabrous, margins hairy. *Leaves* pinnately trifoliolate, petiole ribbed, more or less hairy, quite hairy when unfolding, soon glabrous, 3.5-16 cm long, rachis canaliculate above, 2-4 cm long. *Leaflets* deeply lobed, occasionally ovate, top leaflet with 3 lobes and 3 basal veins, side leaflets with 2 lobes, occasionally a shallow third one, 7-18 cm long, 4-16 cm wide, apices obtuse to acuminate, base broad-cuneate, rounded or truncate, green and thinly short puberulous above, glaucous green and thinly adpressed-pubescent below, hairs greyish; ribs prominent below, in 5-7 irregular pairs, petioles slightly thickened, winged, 3-8 mm long; stipellae ovate to lanceolate, striate, sometimes bifid, inconspicuously produced below the base, 4-10 mm long, 1.5-3 mm wide, 4 near side leaflets in 2 often unequal pairs, broader than near top leaflet, glabrous to slightly hairy. *Inflorescences* axillary, to ca 30(-75) cm long, unbranched or with 1 branch, supported by a stipule-like bract, branches finely striate to ribbed, glabrous to slightly hairy, basal part without flowers, slightly nodose, 3 flowers per node, pinkish to dark purple; pedicels thin, up to 7 mm at anthesis, sturdier and up to 10 mm at maturity; bracts ovate-acuminate, striate, glabrous, or slightly hairy at margin, 4-6 mm long, 1-2(-3) mm wide, caducous; bracteoles 2 per flower, ovate-acute, 2-3 mm long, 1-2 mm wide, striate, both sides glabrous to slightly hairy. *Calyx* glabrous to thinly pubescent, inside pubescent; tube 3-5 mm long; teeth lanceolate, upper ones connate-emarginate at the obtuse or acute tip, 5-7 mm long, side teeth acute, 4-5 mm, lower tooth acuminate-cuspidate, 5-7 mm long, in bud longer than upper teeth. *Vexillum* obovate, ca 14-18 mm long, ca 12-14 mm wide, apex emarginate, base clawed, auricles inflexed, 2 callosities near base; alae long-obovate, to ca 16 mm long, 4.5 mm wide, claw ca 4 mm, upper auricle ca 1.5 mm, lower auricle couspicuous; keel petals abovate-oblique, ventrally and partially basal adnate, ca 17 mm long, 6 mm wide. *Ovary* elongate, thinly pubescent, ca 12

mm long, 12 ovules; style glabrous, 5 mm the broadened extension of the ovary, 5 mm upcurved, narrow; stigma terminal, globular, penicillate at the base. *Stamens* monadelphous, vexillary stamen attached except near the base and upper 6 mm, filaments to ca 18 mm, free part 3-5 mm, upcurved; anthers uniform, basidorsifix, alternately on long and short filaments. *Pods* flattened oblong, to 6-9 cm long and 1.1 cm wide rounded at base, acuminate at apex, tipped with rest of style, blackish, sparsely covered with bulbous-based spreading somewhat caducous hairs, valves reticulate, sutures thickened and densier pubescent, outline of the 9-12 seeds visible. *Seeds* flattened-ovoid, ca 4 mm long, 2.5 mm wide, 1.5 mm thick, reddish brown, strophiole slightly protruding, circular, ca 0.8 mm diameter.

Distribution: Bhutan, China (Yunnan), India (Manipur and Sikkim).

Ecology: Climbing over dwarf bushes or oak trees, on hill slopes, in forests, near streams, on schistaceous, sandy, and rocky soils.

Altitude: 1300-3300 m.

Flowering: July-August (Bhutan), June-September (China), September-October (Sikkim). Fruiting: August-September (Bhutan), September-October (China), October-November (Sikkim).

Vernacular names: Not recorded.

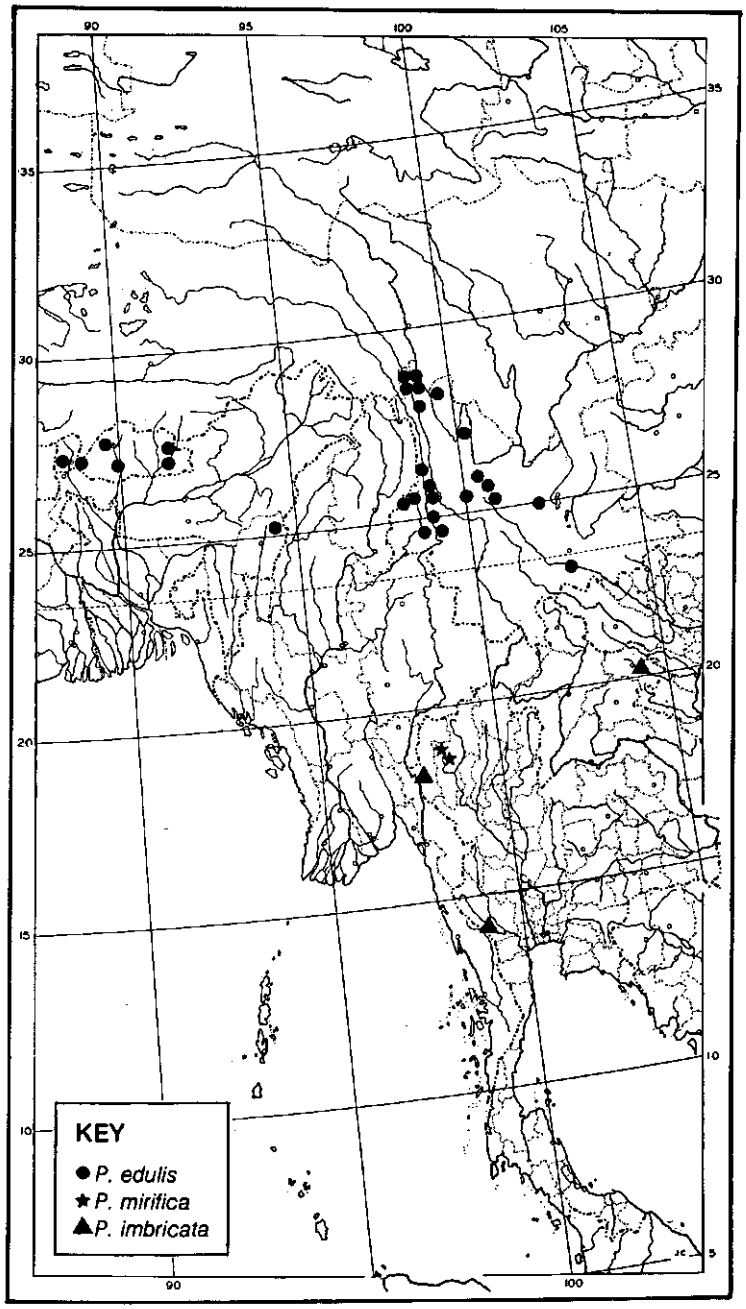
Uses: MAIRE (cf. Pampanini's protologue) mentioned that the tuber is edible. FORREST suggested that a specimen he collected (*no 149*) was probably an escape from the plant commonly grown for food in the valleys. He may have mistaken this species for the quite similar *P. lobata*.

Specimens examined:

BHUTAN: Doteria Timpu, *Cooper 3306* (E); Sali Kurted, id. 4479 (BM); Bagla la, Kurmed, *id. 4596* (BM, E); Lometsawa, W of Wangdu Phodrang, *Grierson & Long 2689* (E).

CHINA, Yunnan: nr Tapintze, *Delavay s.n., 506* (P); Ta Long Tan forest nr Tapintze, *id. 3566* (P); Chong Shan valley, *Ducloux 399* (NY); Y dje nr Loulan, *id. 3759* (P); Pinchwan-cheou, id. *6887* (BM, F, P, US); 25.28 N, *Forrest 149* (E); NE of Tengyueh, *id. 8232* (E, K); S of Tengyueh, *id 8778* (E); Chungtien mts, *id. 10827* (BM, E, K); Chienchuan-Mekong divide, *id. 22022* (E); betw. Tsuyung & Gwangdung, *Handel-Mazzetti 4851* (K, W,); Ludsagu nr Likiang on Yangtze river, *id. 6998* (E, K, US, W); Yunnan mts, *Maire s.n.* (FI, holo; iso: P); Tsekou, *Monbeig s.n.* (E, K, P); Tali, middle Siao Tseng mts, *McLaren's collectors C63* (BM, E); top of Lien Wang mt, Likiang range, *id. L143* (BM, K); Paiching, mountain top, *id. AA239* (C, E); Likiang range, *id. 308D* (BM); W slopes of Likiang Snow range, Yangtze watershed, *Rock 5412* (NY, P, US); Tsekou bridge, *Soulie 1100* (P); ibid., *id. 1001* (K, P); Chihtselo, HT *Tsai 54166* (PE); Kangpu, Weisi hsien, *C. Wang 74375* (P); Molangpo nr. Yuenjiang, *von Wissmann 429* (W).

INDIA: Manipur: Ukhrul, *Kingdon Ward 17918* (BM, NY); Sikkim: Yoksun, *Clarke 25157* (K, holotype of *P. quadristipellata* C. B. Clarke ex W. W. Smith, iso: BM, CAL, E, K); Pingleng, *id. 25437* (BM, CAL, K); Karpouang, *Ribu & Rhomoo 4653* (CAL).



MAP 4. *Pueraria edulis, P. imbricata,* and *P. mirifica* in south Asia

Notes: The heterotypic synonyms resulted from three independent studies on material described in Florence, Kew or Calcutta, and Paris in 1910, 1913, and 1916 respectively (LACKEY, 1977). The syntypes of *P. bicalcarata* were not seen, so no lectotype could be chosen. When GAGNEPAIN described his *P. bicalcarata*, he also had material of the closely related *P. edulis* Pamp. at his disposal, including the type. GAGNEPAIN added descriptions of fruits to PAMPANINI'S protologue of *P. edulis*, where no fruits are described, but he had no fruits of his own *P. bicalcarata*. The differences quoted are compact, hairy inflorescences and sharp upper calyx teeth for *P. bicalcarata*, elongate (glabrous) and obtuse upper calyx teeth for *P. edulis* (GAGNEPAIN, in Fl. Gén. Indo-Chine). The bifid lower stipule parts of *P. bicalcarata* are not compared with those of *P. edulis*, but the illustrations of PAMPANINI shows this clearly bifid, and the description is also clear, while GAGNEPAIN claims exclusivity for these stipules in *P. bicalcarata*. PAMPANINI did not see or describe bracts, GAGNEPAIN observed that they are similar in length to the bracteoles, but so is the case in *P. bicalcarata*. In both instances the calyx lobes are similar in length, while the upper connate teeth may be obtuse to acute. The vexillum is shortly auriculate, so the differences are not significant, and are probably due to ecological diversity. If genotypic variation can be observed, it is not at species level.

Phenotypic diversity encompasses leaflet size, size of inflorescence and flowers, and pubescence. The width and indentation of the stipellae varies, but there are always two pairs near the petiolules of the side leaflets. Apparently the availability of water influences leaf size; specimens from Bhutan and Tsekou, China, are more lush than usual when collected from other areas.

6. Pueraria imbricata van der Maesen sp. nov. ***(Map 3, p. 26; Plate 7, p. 33)**

Pueraria imbricata van der Maesen *sp. nov.*

Type: Laos, Sam Neua prov., betw. Muong Pun and Xieng Mene, *Poilane 1931* (P, holo).

Paratypes: Thailand, NW of Sai Yok, *Larsen 9049* (K; also in C, not seen); THAILAND, Maehongson, Khun Yuam, *Larsen & Larsen 34073* (K; also in AAU, not seen).

Caulis volubilis vel serpens, pubescens, deinde glaber. Foliola ovata-rhomboidea, subtus adpresse canescens, stipulae peltatae, pilosae. Pseudoracemi racemosi, ad basim stipulata, bracteae lineari-lanceolatae, bracteoleae minoribus vel subaequantes, bracteoleae late ovatae. Calyx pubescens, dentibus imbricatus, lanceolatus; vexillum elliptica-ovatum, apice emarginata, basi auriculata; alae elongata-obovatae, auriculatae; carina naviculara; ovarium elongatum, 10-14 ovulatum; staminae diadelphae, stamina vexilla a priori adnata, ad basim geniculata. Legumen ignotum.

Description: *Trailing* or climbing perennial. *Branches* ca 4 mm diameter, striate, 2-5 m long, pubescence spreading when young, bark glabrous and grey

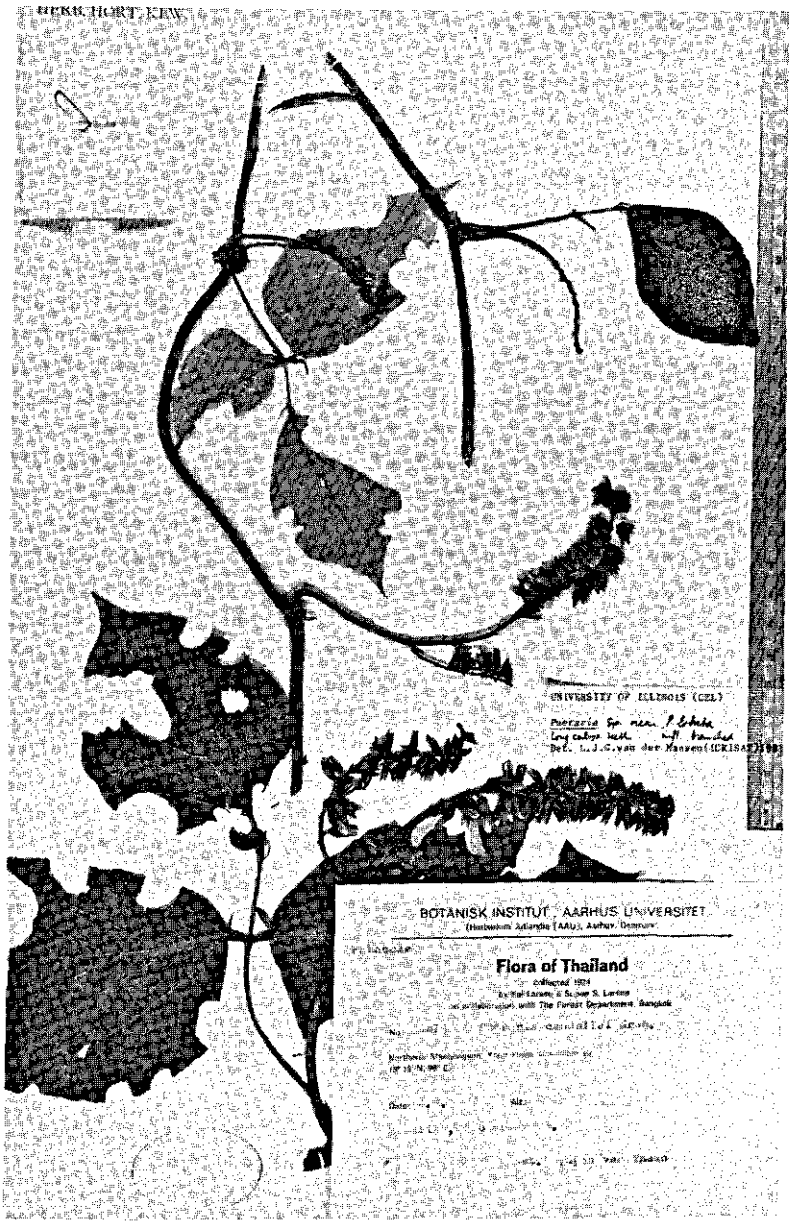


PLATE 7. *Pueraria imbricata* van der Maesen, paratype (*Larsen & Larsen 34073*)

when old, with small lenticels. *Stipules* peltate, 14-17 mm long, ca 5 mm wide at point of insertion, acuminate or fringed both ends, leaving a round scar when fallen. *Leaves* pinnately trifoliolate, petiole striate-canaliculate, golden-brown

and spreading pubescent, ca 8 cm long, rachis 3-4 cm long. *Leaflets* ovate-orbicular, side leaflets obliquely so, ca 9-13 cm long, ca 6-8 cm wide, apex acute to acuminate, base broad-cuneate to rounded, green and pubescent above, light green and densely grey-pubescent below, ribs prominent, in ca 6-7 unequal pairs, petiolules barely thickened, ca 5 mm long. *Stipellae* linear-lanceolate, striate, 7-13 cm long, 1-1.5 cm wide, dorsally pubescent. *Inflorescence* branched, sometimes unbranched, branches flowering quite near the base, (6-)12-47 cm long, more or less ribbed, brown pubescent, hardly nodose, bracts at the base and supporting branches stipule-like, but narrower than those, striate, dorsally pubescent, bracts supporting bud pedicels linear-lanceolate, half to equal the size of the bracteoles, dorsally pubescent, caducous, 1-2.5 mm long, 0.5 mm wide; flowers blue, 3 per node or short (7 mm) lateral, pedicels short, 0.5-3 mm, *bracteoles* 2 per flower, ovate, apex acute, 1.5-2.5 mm long, ca 1 mm wide, striate, pubescent, fairly persistent. *Calyx* purplish green, pubescent, tube 3-5 mm long; teeth lanceolate-acute, imbricate, apices often curved upwards, upper teeth almost entirely connate, 5-7.5 mm long, often longer than the lowest tooth, side teeth 3.5-5.5 mm long, lower tooth 3-7.5 mm long. *Vexillum* elliptic-ovate, 10-17 mm long, 7-12 mm wide, apex emarginate, base clawed, auricles reinforced, inflexed, callosities present near base. *Alae* elongated-obovate, 9-17 mm long, 2.5-3.5 mm wide, upper auricle hooked, 1-2 mm, claw 2-3 mm. *Keel* petals boat-shaped, 8.5-17 mm long, 3-4 mm wide, long-adnate. *Ovary* elongate, appressed pubescent, 5-10 mm long, 10-14 ovules, style glabrous except at the base, 4-7 mm long, ca 3 mm perpendicularly upcurved with time, stigma terminal, globular, penicillate at the base. *Stamens* diadelphous, vexillary stamen attached at first, geniculate near the base, 7-16 mm long, upper 2-3 mm free, upcurved, anthers uniform, basidorsifix, alternatively on long and short filaments. *Pods* and *seeds* unknown.

Distribution: Laos and Thailand.

Ecology: Trailing and twining in shrubs.

Altitude: 600-700 m.

Flowering: September, December.

Specimens examined: type and paratype material (*vide supra*).

Note: *Pueraria imbricata sp. nov.* is related to *P. lobata*, but has the branched inflorescences of *P. candollei*, to which a specimen had been assigned earlier (THUAN, in herb.). *P. candollei* has much shorter calyx lobes, those of *P. imbricata* are long and overlapping to some extent. The leaves are similar to those of *P. lobata* var. *montana*, but the flowers are larger (19 mm). The holotype has been earlier referred to var. *montana* (THUAN, 1979). The flowers of the Thai specimens are larger than those from Laos.

7. Pueraria lacei Craib ***(Map. 2, p. 17; Plate 8, p. 36)**

Pueraria lacei Craib, Kew Bull. 1915: 399; Lackey, Synops. Phaseol. 72, 75(1977).

Type: Burma, Shandatgyi, Thayetmyo distr., 800 ft, *Lace 2685* (K, holo; iso: CAL, E, 2 specimens).

Description: *Woody* climber, perennial, *branches* 4 mm diam., vaguely ribbed, densely spreading rusty-pubescent, hairs up to 3-4 mm long. *Stipules* peltate, 20-25 mm long, 5-7 mm wide, upper part ovate-obtuse, 8-10 mm long, sometimes torn, lower part bifid, sometimes fringed, 5-15 mm long. *Leaves* pinnately trifoliolate, petiole almost terete, hairy as the branches, 5-8 cm long, leaflets ovate-rhomboid, side leaflets obliquely so, 6-11 cm long, 4.5-7.5 cm wide, apex long-acuminate, base rounded to broad-acuminate, green and adpressed pubescent above, greyish green and densely woolly adpressed-pubescent below, ribs prominent, in 6-7 unequal pairs, petiolules barely thickened, pubescent, 4-7 mm long. *Stipellae* linear-lanceolate, striate, 12-16 mm long, 1-1.5 mm wide. *Inflorescence* axillary-solitary or terminal-branched, basal part with several stipule-like bracts, flowers (2-)3 per node, pedicel supporting bracts linear-lanceolate, 12-15 mm long, up to 2 mm wide, dorsally spreading long-pubescent, ventrally short-grey-pubescent, caducous; pedicels ca 3 mm, *bracteoles* 2 per flower, ovate-lanceolate, tip acute, ca 4 m long, ca 1.5 m wide, striate, pubescent, rather persistent. *Calyx* spreading pubescent, interior sparsely so, tube ca 4 mm, teeth lanceolate, upper teeth connate except at the tip, ca 10-12 mm long, side teeth ca 10-12 mm long, lower tooth ca 12-15 mm long. *Vexillum* ovate-orbicular, 15-17 mm long, 10-12 mm wide, base clawed, auricles inflexed, without callosities, color not recorded. *Alae* lanceolate 14-18 mm long, ca 5 mm wide, claw 5 mm long, auricle 2 mm long. *Keel* petals rounded along the base, ventrally adnate, ca 15-17 mm long, ca 5 mm wide. *Ovary* elongate, greyish silky appressed pubescent, ca 10 mm long, ca 9 ovules. *Style* glabrous, ca 2 mm as flattened extension of the ovary, ca 3 mm perpendicularly upcurved, stigma terminal, globular, penicillate at the base. *Stamens* diadelphous, vexillary stamen adhering at first, ca 15-16 mm long, free part 3-4 mm long, upcurved, anthers uniform, basidorsifix, alternatively on long and short filaments. *Pods* not known.

Distribution: Burma.

Ecology: not recorded, presumably climbing in shrubs and trees.

Altitude: ca 300 m.

Flowering: December. Fruiting: January?

Vernacular names: not recorded.

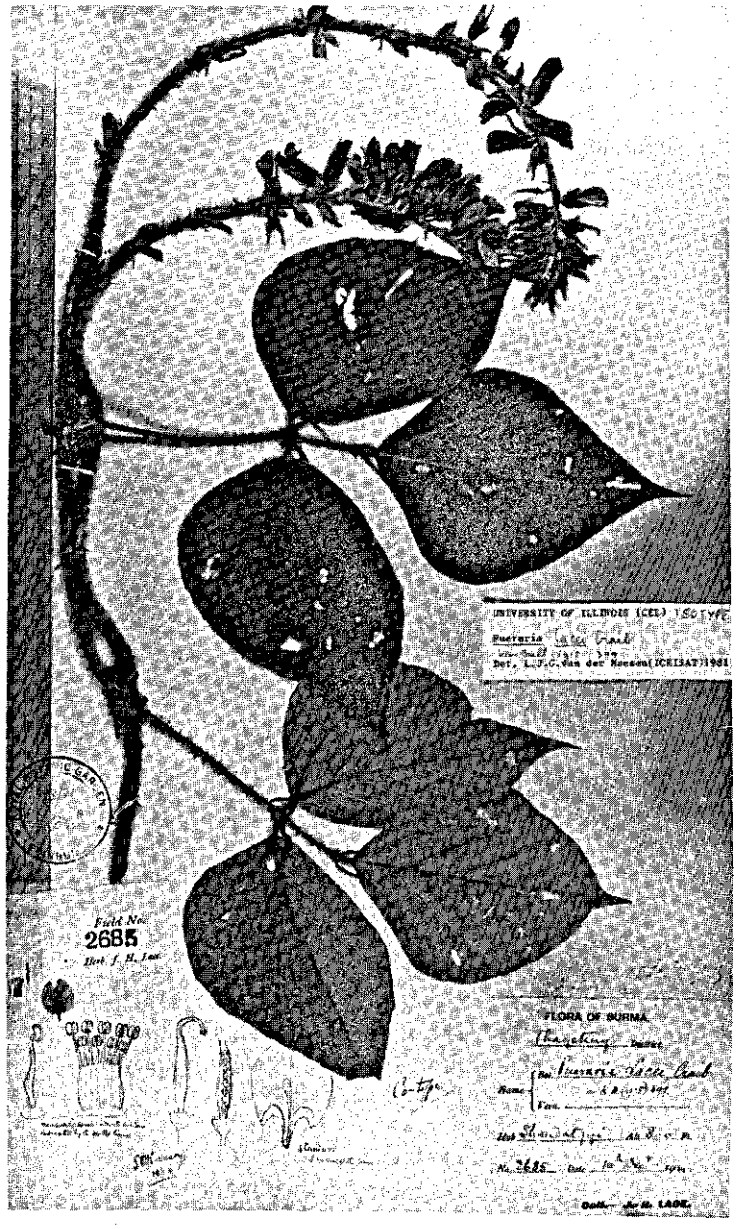


PLATE 8. *Pueraria lacei* Craib, isotype (*Lace 2685*)

Specimens examined: only known from the type specimens.

Note: Craib compared *Pueraria lacei* with his *P. alopecuroides*, with which

it has the leaves and hairiness in common. The calyx lobes are much longer, and the vexillary stamen is free, making it also close to *P. calycina*, as LACKEY (1977) suspected. *Pueraria lacei*, as *P. alopecuroides*, has no lower alae spurs like those in *P. calycina*. Overall facies is more that of *P. alopecuroides* and not of *P. calycina*, as claimed by LACKEY (l.c.).

I suspect that the branches will grow thicker than 4 mm, that the flowers are purplish as is most common in *Pueraria*, and that the fruits will be flat and hairy.

8. Pueraria lobata (Willd.) Ohwi

***(Map 5-7, p. 40, 41, 48, 49; Plates 9-12, p. 44, 54, 55, 59)**

Pueraria lobata (Willdenow) Ohwi. For typification, literature and synonymy see varieties.

Description: Extensive *woody climber*, perennial, with very large tubers up to 2 m long and 18-45 cm wide or up to 180 kg when old. *Branches* strong, ca 0.6-2.5(-10) cm diameter, up to 30 m long, striate when young, bark vertically ribbed with age, adpressed to spreading, grey to brown pubescence, glabrescent with age. *Stipules* peltate, entire to bifid or fringed below the point of insertion, 8-16(-25) mm long, 2.5-6 mm wide, obtuse to acute above, striate, variously pubescent, leaving an oval scar. *Leaves* pinnately trifoliolate, petiole striate, grey to golden brown-hairy, hairs appressed to spreading, 8-13(-21) cm long, rachis (1.5)2.5-7 cm long, pulvinus thickened. *Leaflets* ovate to orbicular, unlobed to trilobed to various degrees, 8-20(- 26) cm long, 5-19(-22) cm wide, side leaflets obliquely so and often somewhat smaller, apex long-acuminate, straight or bent in plane of leaflet, base narrow to wide-acuminate or truncate to somewhat cordate, green and thinly appressed pubescent above, light to greyish green and thinly appressed pubescent below; ribs prominent, basal pair of the laterals opposite, other laterals not opposite, total 5-6 each side, petiolules barely thickened, 4-10 mm long. *Stipellae* ciliate to lanceolate, striate, 5-18(-30) mm long, 0.5-1.5 mm wide. *Inflorescence* mostly unbranched, occasionally with a lateral, flowering from near the base, (5-)10-25(-35) cm long, vaguely angled-striate, densely short grey appressed-pubescent to spreading golden-brown pubescent, slightly nodose, upright, few *bracts* at the axis base ovate-acuminate, striate, thinly pubescent, remaining or falling, 6-12 mm long, 2-4 mm wide, bracts supporting bud pedicels ovate-acuminate to linear-lanceolate, or setaceous, glabrescent to densely hairy, early caducous, 4-10(-13) mm long, 0.5-1(-2) mm wide, flowers 3 per node, pedicels short, up to 6-10 mm at maturity; *bracteoles* 2 per flower, ovate, apex acute, 2-4 mm long, 1-2 mm wide, striate, pubescent both sides, rarely glabrous, fairly persistent.

Calyx variously grey to golden-brown pubescent, hairs longer along the margin of teeth, inside pubescent, tube 3-5 mm long, teeth more or less overlapping, unequal, broad-acute to narrow lanceolate-acuminate, upper teeth connate or split at the top, 3.5-9 mm long, at base 3-5 mm wide, side teeth 3-7 mm long, 1.5-3 mm wide, lowest tooth 4.5-13 mm long, 1.5-4 mm wide, curved. *Vexillum*

ovate to rounded, 10-25 mm long, 9-16 mm wide, apex emarginate (or rounded), base clawed, auricles reinforced, inflexed, callosities present, purplish to blue or pink often with a yellow or green spot. *Alae* lanceolate-obovate, 12-19 mm long, 3-6.5 mm wide, variously auricled, upper auricle triangular to short or long (5 mm) hooked, basal auricle triangular to absent, claw up to 5 mm. *Keel* petals rounded along base to perpendicularly angled, long-adnate, 11-22 mm long, 3.5-7 mm wide. *Ovary* elongate, appressed pubescent, 8-15 mm long, ca 12-17 ovules, style almost glabrous, 2-4 mm as flattened extension of the ovary, ca 3-4 mm perpendicularly upcurved; stigma terminal, globular, more or less penicillate round the base. *Stamens* monadelphous, or vexillum stamen free with time, 9-22 mm long, in fruit even more expanded, upper 1-5 mm free and upcurved; anthers basidorsifix, alternatively on long and short filaments. *Pods* flattened oblong, straight to falcate, 4-13 cm long, 0.6-1.3 cm wide, ca (5-)10-15 seeded, rounded at base, acute or bent at apex, tipped with the rest of the style, occasionally constricted where ovules fail, valves densely spreading pubescent, hairs golden brown, somewhat bulbous-based, not curling when ripe, outline of seeds visible. *Seeds* flattened-ovoid, reddish brown with black mosaic, ca 4-5 mm long, 4 mm wide, 2 mm thick, hilum small, strophiole elliptic, 1 mm longest diameter, seed coat minutely pitted. Seedling epigeal, first two leaves simple and opposite, ovate to orbicular, 12-16 mm long and wide, apex obtuse, base truncate to cordate.

Distribution: Japan, China, E. India, Indo China and SE Asia, Papua-New Guinea and Pacific Islands, now widely spread into other tropical and subtropical areas, common in SE USA.

Taxonomic notes: *Pueraria lobata* (Willd.) Ohwi, the Kudzu, the most common and widespread species of the genus is very variable, hence the formidable synonymy. Variants have been described as species on account of differences in vigour, leaf shape (which may vary within one plant), inflorescence and flower size, indumentum and geography. Several *nomina nuda* were given and some combinations have been made more than once by different authors, when publication was obscure. The nomenclatural difficulties, interwoven with the identities of *Dolichos trilobus* L. and *D. trilobatus* L. (now *Vigna trilobata* (L.) Verdc.) are discussed by VERDCOURT (1968).

LINNAEUS' epithet *D. trilobus* (1753) concerns three elements: a) a plant growing in Clifford's garden from American seed, not conserved (Hort. Cliff. 360), b) a specimen in the Linnean herbarium (900.12) labelled 'trilobus 7' from China which is, judging from the microfiche, certainly *Pueraria lobata* but var. *lobata* or *thomsoni* rather than *montana*, and c) a drawing of a plant published by PLUKENET, which VERDCOURT determined as *Dolichos falcatus* Klein ex Willd. Because of this confusion it is preferable as Verdcourt also did, to lectotypify *Pueraria lobata* by the unmistakable plate of Houttuyn. Willdenow's valid name under *Dolichos, D. lobatus*, has perhaps been overlooked because its origin is stated to be the Cape of Good Hope. The original Houttuyn reference states that the

specimen from which the figure was drawn came from Japan, while a similar plant came from the Cape. The German translation of the Dutch work, Natuurlijke Historie, by PANZER, quoted by WILLDENOW, mentions that *Dolichos lobatus* looks like plants from the Cape (OHWI 1947, STEWARD 1958).

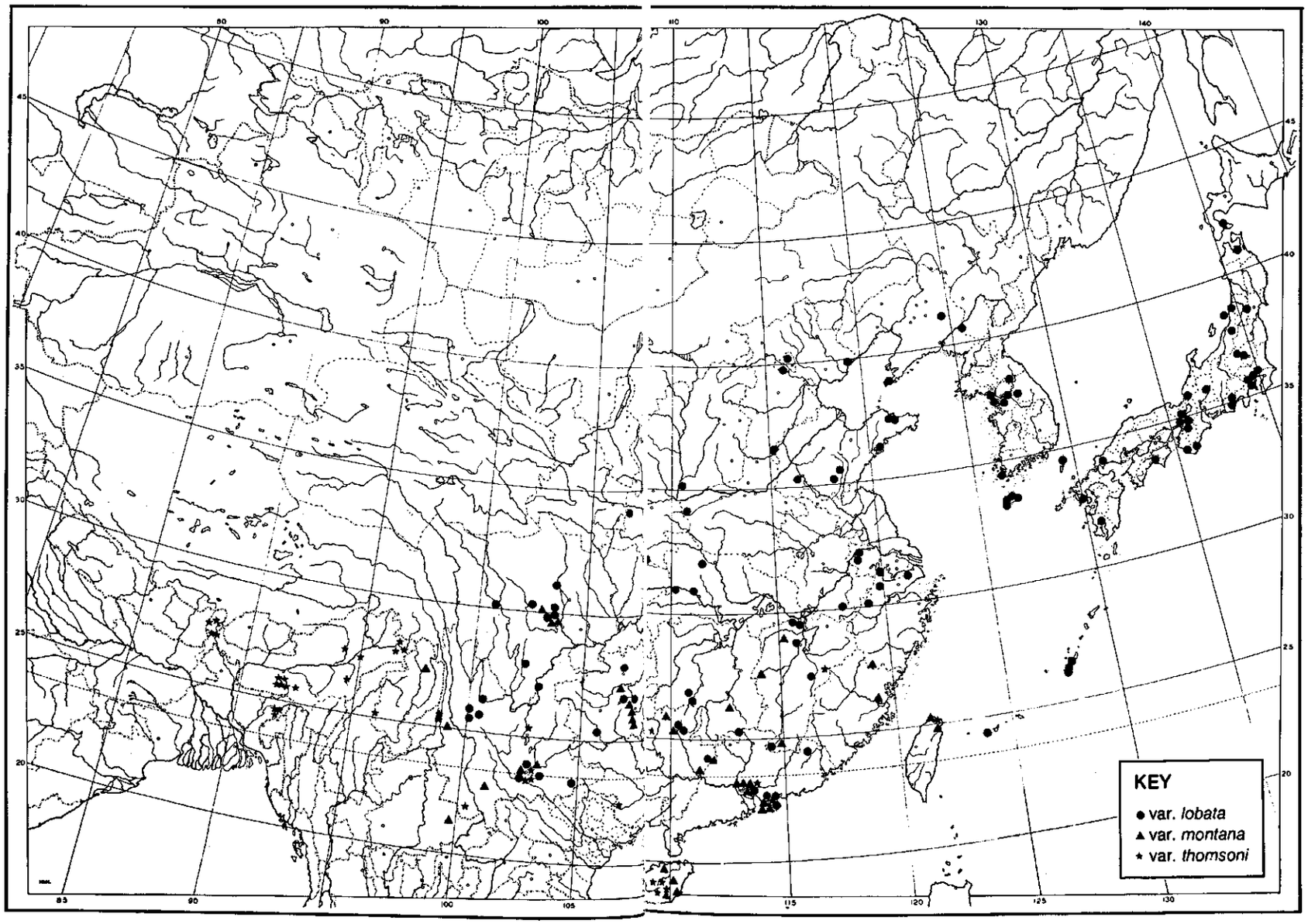
The epithet *hirsuta* (*Dolichos hirsutus* Thunb., 1794) which predates *lobata*, cannot be used because of the existence of a heterotypic homonym, *Pueraria hirsuta* Kurz (1873), whereas the combination was not made until 1902 by MATSUMURA, and the later homonym cannot be accepted (Art. 55, 64, of the Code) despite the fact that *P. hirsuta* Kurz is now referred to *Ophrestia* (LACKEY, 1977a).

Most of LÉVEILLÉ'S segregates (1908) from *Pueraria lobata*, were described from single accessions, admittedly phenotypically different. These were confined to synonymy quite early by GAGNEPAIN (1916b). Leaflet size, presence or absence of lobes, flower colour (blue vs. purple), length of inflorescence and density of pubescence were the characters on which Leveille based his species. They are, however, all *Pueraria lobata*. Peculiarly enough LÉVEILLÉ placed his species into two distinct sections. See also LAUENER (1970).

The ethnobotanist BARRAU (1965), describing the confusions with ethnological consequences in Kudzu, erroneously lists *Dolichos tuberosus* Lamarck (= *Pachyrhizus tuberosus* (Lam.) Spreng.), and *Pachyrhizus trilobus* DC. as synonyms for Kudzu. If his paper is read superficially, also *Pachyrhizus angulatus* Rich. ex DC. would seem a synonym for Kudzu, but BARRAU quoted this latter name as an error in UPHOF (1965), where Kudzu, the Fijian wa-yake, is named *Pachyrhizus angulatus* Rich. *Pachyrhizus montanus* Rich. should be (Rich.) DC. refers to *Pueraria montana* (Lour.) Merr., not, as earlier quoted by Merrill to *Pueraria phaseoloides* (MERRILL 1935, resp. 1910, 1918, 1923), but now referred to *P. lobata* var. *montana* (Lour.) VAN DER MAESEN comb. et stat. nov.

The different varieties of Kudzu are recognized in the markets and folklore botany, although vernaculars (q.v.) overlap. In 1977, KUBO et al. and TAKI et al. obtained three kinds of accessions of 'Gehua' the Chinese crude drug made from Kudzu flowers. Using flower size and morphology, the Chinese accession from Hong Kong was determined to be *Pueraria chinensis* (Benth.) OHWI (= var. *thomsoni*), the Taiwanese appeared to be *P. montana* (Lour.) MERRILL (= var. *montana*) and those obtained from Korea and Japan were *P. lobata* (Willd.) OHWI (= var. *lobata*). The pollen grains of the three forms differ by dimension, lumina number per unit area and shape of exterior configurations. OHWI (1936), KUBO et al. and TAKI et al. (1977) therefore distinguished three species in the *lobata* complex.

In conclusion, after having studied a large range of geographically widely scattered accessions of Kudzu and Taiwan Kudzu, it appears most convenient and probably closest in line to their natural alliances, to distinguish one species *(Pueraria lobata)* with three varieties. The varieties are: var. *lobata* (the typical Kudzu) from China and Japan, spread to Oceania and the USA, probably the only variety introduced elsewhere; var. *montana* from Indo-China, S. China, Taiwan and the Philippines (= *Pueraria montana* (Lour.) Merr., and var. *thom-*



MAP 5. *Pueraria lobata* in northeast Asia.

soni (= *Pueraria thomsoni* Benth.) from NE India, Indo-China and some Malesian locations.

For some detailed notes see under varieties.

Uses: *Pueraria lobata*, the kudzu, produces tubers with starch, stem fibers, silage and hay, is useful as an erosion-controlling soil cover and shade plant, and has medicinal properties. SHURTLEFF and AOYAGI (1977) presented a vivid description of the uses of kudzu. Their references include ancient Japanese

sources, such as poems dating back to 600 AD, when kudzu first appeared in literature. Other sources of reference are the USDA Bulletins (e.g. BAILEY, 1939, 1958), HEYNE (1927), BURKILL (1938), BURKART (1950), Wealth of India (1969), KAY (1973) and DUKE (1981).

Esteemed for its fine starch in Japan and China, the kudzu has become less important because harvest and extraction are laborious, but its unique properties still make it a speciality food and medicine. In Japan production is still ca 338 tons annually (1977). Inhabiting fences, roadsides and warm places, it needs hardly any attention and is one of Japan's most honoured wild plants and its finest cooking starch and jelling agent. Kudzu starch is used for sauces, soups, jelled salads, deep-fried preparations, noodles, porridges, jelly puddings, confectionary, and beverages. BURKILL (1938) mentioned that the starch was freely marketed all over eastern Asia. Kudzu leaves, shoots, and flowers can be steamed or pickled and eaten as a vegetable.

In Chinatown markets in the USA, the tubers were sold (PORTERFIELD, 1951) and perhaps still are. Before World War I kudzu starch was in little demand in SW China except in times of scarcity and no medicinal uses were quoted (WILSON, 1929). Elsewhere in SE Asia, kudzu is used in times of famine, but in the highlands of New Guinea and New Caledonia the kudzu is still cultivated. In these and surrounding areas kudzu is of ancient introduction and was probably a staple before yams, taro and more recently sweet potatoes became increasingly important. As a food for rituals or special persons, or as an emergency food source, its role is considerable in some highland areas (BARRAU, 1958, 1961, 1965). A search was made for vernacular names and data on usage in different highland tribes of Papua and erstwhile Dutch New Guinea, where remnant cultivation still persists (WATSON, 1968). STRATHERN (1969) further elucidated the linguistic-ethnological relations between sweet potatoes (*Ipomoea batatas* L.) and kudzu in the Central New Guinea highlands. 'Oka' is the term for sweet potato, kudzu and related vines, but not a generic term for tuber, edible tuber or tuberous vines. There is a wild 'Oka', 'Oka kweka', with a small tuber, but neither Watson nor Strathern (l.c.) identify this vine botanically. MONTROUZIER (1860) distinguished the cultivated 'bat' and wild 'jalé' in New Caledonia as two varieties of '*Dolichos tuberosus*' where he meant *Pueraria lobata*. Both varieties were eaten boiled or grilled, and provided good stem and root fibres for ropes.

Medicinal uses of kudzu starch in Japan include the restoration of health by alkalinizing the bloodstream and fighting intestinal and digestive disorders. The starch is then mainly taken in soups or teas. As a diet food it is soothing, nutritious and easy to digest. Root teas in China are said to be effective in colds, fevers, influenza, diarrhea, dysentery and hangovers. The Chinese use the flower buds as a diaphoretic (agent inducing sweating) and febrifuge (antipyretic, removing fever) medicine, and e.g. in Malaysia they are found among drugs in local pharmacies (BURKILL, 1938). The buds are called 'Gehua' and also used for treatment of hangovers (KUBO et al., 1977).

Another role of kudzu is the supply of stem fibers, woven into durable and supple cloth ('kappu' in Japanese, fashioned into the 'katsui' or kudzu kimono)

as well as coarser uses as fishing lines or head baskets, or for paper (China, New Guinea).

As green fodder or as an erosion-controlling agent kudzu is a successful species. Introduced into America from Japan in 1876, kudzu (var. *lobata*) was popular as a decorative and shade plant, with fragrant flowers, that grew well on any soil. From ca 1910 its use as pasturage, fodder and hay was popular, until around 1935 when emphasis shifted to its main use in soil erosion control. A vigorous Soil Conservation Service (USDA) campaign led to a coverage of over 3 million ha in 1950. This somewhat overenthusiastic approach overlooked the kudzu's negative aspects, the agressive growth when uncontrolled leading to the coverage of entire forests, uncultivated areas, killing trees and smothering electricity poles. The cultivated area, therefore, declined and by 1970 only ca 30,000 ha was covered by kudzu in the USA. In 1954 kudzu was removed from the list of acceptable cover crops and eradication became the focus of research. In 1981, the plant was about to be declared a pest, constituting a $10 million problem in Georgia where it affected 22,000 ha of commercial forest (Anon., 1982). In Zanzibar kudzu suppressed *Imperata* grass (PADWICK, 1951).

DUKE (1981) lists pests and diseases, which include nematodes, leaf caterpillars, fungal leaf spots and stem rot, and bacterial blights, mostly non-specific, except *Mycosphaerella puericola*, angular leaf spot. Bees act as pollinators and kudzu is said to be cross-pollinated, although seed set is often poor outside its native area.

Key to the varieties:

1a. Flowers large, corolla (18-)20 mm or longer, calyx (15-)17 mm or longer, appressed grey-pubescent, lobes 2-4 mm wide, overlapping; leaflets often trilobed, fruits large, 8-13 cm long, 9-13 mm wide . . . . . **var. thomsoni**

1b. Flowers smaller 2

2a. Flowers small, corolla up to 12(-15) mm long, calyx 8-11 mm long, lobes 1-2 mm wide, short brown pubescent or almost glabrous, leaflets mostly entire, often narrower than long, more or less hairy, coriaceous fruits small, 4-10 cm long, 6-9 mm wide . . . . . **var. montana**

2b. Flowers medium, corolla 12-20 mm long, calyx 10-18 mm long, hairs spreading, brown, lobes 2-3.5 mm, lower one narrow-elongate, conspicuously longer than the others, leaflets trilobed, occasionally entire, about as wide as long, membranaceous, fruits medium to large, 5-13 cm long, 7-12 mm wide . . . . . **var. lobata**

8a. Pueraria lobata (Willd.) Ohwi var. lobata, Ohwi, Bull. Tokyo Sci. Mus. 18: 16(1947); Merrill, Chron. Bot. 14-5/6: 218(1954); Hu, Handb. Econ. Pl. 2: (1957); Kitamura & Okamoto, Col. Illustr. Trees Shrubs Japan 255(1958); Steward, Vasc. Pl. Lower Yangtze Valley 195(1958); Mansfeld, Vorl. Verzeichn. Landw. gart. kult. Pflz.arten 214(1959); Barrau, Ethnology 4: 282-294(1965); Ohwi, Fl. Japan 570(1965); Chuang & Huang, Legumin. Taiwan 87(1966); Verdcourt, Taxon 17: 170-173(1968); Watson, Ethnology 7: 268-279(1968); Wealth

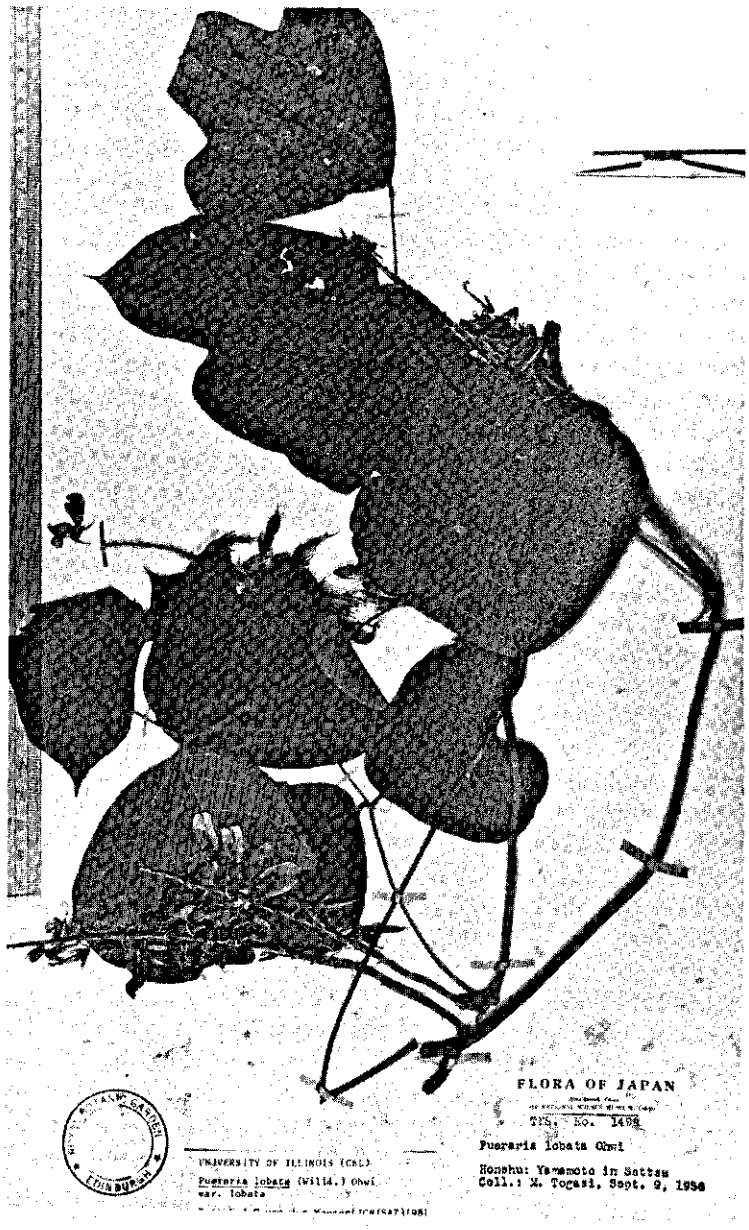


PLATE 9. *Pueraria lobata* (Willd.) Ohwi var. lobata (*Togasi 1498*)

of India 8: 313(1969); Lauener, Notes Roy. Bot. Gard. Edinb. 30: 239-294(1970); Herklots, Vegetables SE Asia 468(1972); Kay, TPI Crop & Prod. Digest 2. Root Crops 87-88(1973); Tanaka, Tanaka's Cyclop. Edible Pl. World 602(1976);

Walker, Fl. Okinawa 588(1976); Ali, Fl. W. Pakistan 100: 235(1977); Lackey, Synops. Phaseol. 72, 74(1977); Ohashi, Fl. Taiwan 3: 367(1977); Shah, Fl. Gujarat 1: 237(1978); Kitagawa, Neo-lineamenta Fl. Manshur. 412(1979); Verdcourt, Manual N. Guinea Legumes 485(1979); Perry, Medic. Pl. E. SE Asia 224(1980); Iconogr. Cormoph. Sinic. 2: 502(1980); Duke, Handb. Legum. 211(1981).

Basionym: *Dolichos lobatus* Willd., Sp. Pl. 3-2: 1047(1802) based on *Dolichos trilobus* Houtt. non L., i.e. *D. trilobus* L. p.p., Natuurlijke Historie 10: 153, t. 64 f.1(1779).

Lectotype: Illustration in Houttuyn, Natuurlijke Historie 2 Plate 64 Fig. 1(1779) text p. 153, and Pantzer's edition of the same (1782) text 8 p. 560 (see OHWI, 1947; STEWARD, 1958; VERDCOURT, 1968).

Synonyms: *Dolichos hirsutus* Thunb., Trans. Linn. Soc. 2: 339(1794); DC., Prodr. 2: 397(1825); Merrill, Trans. Am. Philos. Soc. n.s. 24-2: 211(1935) (sphalm. *hirtus*).

Type: Japan, the 'Kudsu', *Thunberg 16757* (UPS, holo; microfiche seen). Illustration in Kaempfer's Iconogr. Select. table 41 (1791).

Phaseolus trilobus (L.) Ait., Hort. Kew. 3: 30(1789); id. ed. 2, 4: 290(1812), based on *Dolichos trilobus* L., Sp. Pl. 1021, and Hort. Kew. Cult. ex East Indies, introduced by Sir Joseph Banks in 1777, no specimen found.

Pachyrhizus thunbergianus Siebold & Zuccarini, Abh. Acad. München 4-3: 237(1846), based on *Dolichos hirsutus* Thunb.

Neustanthus chinensis Benth., Fl. Hongk. 86(1861).
Type: Hong Kong, Harland (K, holo, not seen).

Pueraria thunbergiana (Sieb. & Zucc.) Benth., J. Linn. Soc. Bot. 9: 122(1867); Miquel, Prol. Fl. Iap. 240(1866-67); Franchet & Savatier, Enum. Pl. Jap. 1: 109(1875); Hemsley, J. Linn. Soc. Bot. 23: 191(1887); Franchet, Pl. Delavayanae 181(1889-90); Taubert in Engl. & Prantl. Nat. Pflzfam. 3-3: 371(1894); Prain, J. Asiatic Soc. Bengal 66: 419(1897); Pottinger & Prain, Rec. Bot. Surv. India 1-11: 239(1898); Matsumura, Tent. Fl. Lutchuensis 426(1899), J. Coll. Sci. Imp. Univ. Tokyo 12-4(1900); Matsumura & Hayata, Enum. Pl. Formos. 111(1906); Lévéille Bull. Soc. Bot. France sér 4,8-55: 425(1908); Merrill, Philipp. J. Sci. Bot. 3: 410(1908); Nakai, Fl. Koreana 1: 165(1909); Merrill, Philipp. J. Sci. Bot. 5: 123(1910); id., Fl. Manila 253(1912); Leveille, Fl. Kouy-Tcheou 241(1914); Gagnepain, Fl. Gén. Indo-Chine 2: 249(1916); id. in Lecomte, Not. Syst. 3: 205(1916); Crevost & Lemarié, Cat. Prod. Indochine 133-135(1917); Brandis, Indian Trees 228(1921); Merrill, Enum. Philipp. Fl. Pl. 2: 312(1923); Hosokawa, J. Soc. Trop. Agric. Taih. 4: 309(1932); Handel-Mazzetti, Symb. Sinicae 582(1933); Degener, Fl. Hawaii 2: 10-12-1934; Merrill, Trans. Am. Philos. Soc.

n.s. 24-2: 211(1935); Ohwi, Acta Phytotax. Geobot. 5: 62(1936); Merrill, J. Arnold Herb. 19: 348(1938); Kanjilal et al., Fl. Assam 2: 81(1938); Smith, Sargentia 1: 39(1942); Guillaumin, Fl. Anal. Synopt. Nouv. Calédonie 149(1948); Burkart, Rev. Fac. Agron. Univ. La Plata 3a ep. 27: 141-146(1950); id., Legum. Argent. ed. 2: 407(1952); Merrill, Chron. Bot. 14-5/6: 218(1954); Guillaumin, Terre et la Vie 3: 174-176(1954); Li, Woody Fl. Taiwan 359(1963); Maheswari, Fl. Delhi 130(1963); Hutchinson, Gen. Fl. Pl. 1: 426(1964); Rao & Joseph, Bull. Bot. Surv. India 7: 144(1965); Purseglove, Trop. Crops Dicot. 220(1968); Makino, Makino's List Jap. Pl. new ed. 181(1972); Anon., Fl. Hainanica 2: 319(197?).

Basionym: *Pachyrhizus thunbergianus* Sieb. & Zucc., Abh. Acad. München 4-3: 237(1846), vide supra.

Dioclea odorata Montrouzier, Fl. de l'Ile Art, Mém. Acad. Sci. Bell.-Lett.-Arts Lyon 2: 173-254(1860) *teste* Barrau, Ethnology 4: 283(1965). Material of Herbier Montrouzier destroyed at Lyon (Faculty of Medicine).

Pueraria novo-guineensis Warburg, Engl. Bot. Jahrb. 13: 235(1891); Taubert in Engl. & Prantl, Nat. Pflzfam. 3-3: 371(1894); Schumann, Fl. Neu-Pommern, Notizblatt Königl bot. Garten u. Mus. Berlin 2: 123(1898); Schumann & Lauterbach, Fl. deutsch. Schutzgeb. Südsee 1: 368(1901); Baker, Trans. Linn. Soc. Bot. 9: 34(1916); Hosokawa, Trans. Nat. Hist. Soc. Formosa 28: 62(1938).

Type: New Guinea, *Warburg?* (not seen).

Paratype: NEW GUINEA, *Hollrung 231* (not seen).

Pueraria hirsuta (Thunb.) Matsumura non Kurz, Bot. Mag. Tokyo 16: 33(1902); Kirtikar & Basu, Indian Medic. Pl. 2nd ed. 1: 792(1935); Makino, Illustr. Fl. Japan 401(1949). Basionym: *Dolichos hirsutus* Thunberg, vide supra.

Pueraria hirsuta (Thunb.) Schneid., Illustr. Handbuch Laubholzkunde 2: 114-115(1912). Basionym: *Dolichos hirsutus* Thunberg, vide supra.

Pueraria neo-caledonica Harms, Engl. Bot. Jahrb. 39: 136(1906); Guillaumin, Fl. Anal. Synopt. Nouv. Calédonie 149(1948); id., Terre et la Vie 3: 174-176(1954).

Type: New Caledonia, N. area, Mts nr Oubatche, 800 m, *Schlechter 15484*(B, holo? not seen; iso: BM, G, K, W).

Pueraria argyi Lévl. & Vaniot, Bull. Soc. Bot. France 55: 426(1908); Léveillé Mem. Real Acad. Cienc. Art. Barcelona Serv. 3-12: 555(1916); Lauener, Notes Roy. Bot. Gard. Edinburgh 30: 239(1970).

Type: China, Kiangsu/Jiangsu, *d'Argy 51* (E, holo; iso: E, d'Argy 52).

Pueraria bodinieri Lévl. & Vaniot, Bull. Soc. Bot. France 55: 425(1908); Léveillé Fl. Kouy-tcheou 241(1914); Gagnepain in Lecomte Not. Syst. 3: 205(1916); Lauener, Notes Roy. Bot. Gard. Edinburgh 30: 239(1970).

Type: China, Kouy-tcheou (Kweichow prov.), environs of Kouy-yang (Kweiyang), College Hill, *Bodinier 2489* (E, holo; iso: P).

Pueraria caerulea Lévl. & Vaniot, Bull. Soc. Bot. France 55: 427(1908); Gagnepain in Lecomte, Not. Syst. 3: 205(1916); Lauener, Notes Roy. Bot. Gard. Edinburgh 30: 239(1970).
Type: Hong Kong, Chay-Ouan (Wanchai?) bay, *Bodinier 1358* (E, holo; iso: P).

Pueraria koten Lévl. & Vaniot, Bull. Soc. Bot. France 55: 426(1908); Gagnepain in Lecomte, Not. Syst. 3: 205(1916); Lauener, Notes Roy. Bot. Gard. Edinb. 30: 239(1970).
Type: China, Shantung prov., Tche-fou, *Bodinier 239* (E, holo).

Pueraria harmsii Rech., Denkschr. Akad. Wiss. Wien, Math.-Nat. 85: 292(1910).
Type: Samoa Islands, Upolu Island, nr. Motootua, *Rechinger 78*(W, holo).
Paratype: Samoa Islands, Apolima Island, *Rechinger 180*(W, holo).

Pueraria triloba (Houtt.) Makino in Iinuma, Somoku-Dzusetsu ed. 3 fasc. 3: 954; vol. 13.t.22(1912); Verdcourt, Taxon 17: 170-173(1968). *Pueraria triloba* Makino, Merrill, J. Arn. Arb. Herb. 19-4: 348(1938); Makino, Illustr. Fl. Japan 401(1949). *Pueraria triloba* (Houtt.) Makino, Ohwi, Fl. Japan 570(1965). *Pueraria triloba* sensu Makino non (L.) Makino, Verdcourt, Manual New Guinea Legumes 485(1979), based on *Dolichos trilobus* Houtt. non L. *vide supra* (not a synonym to *Pueraria thomsoni* as quoted by Merrill, 1935 & Mansfeld, 1959).

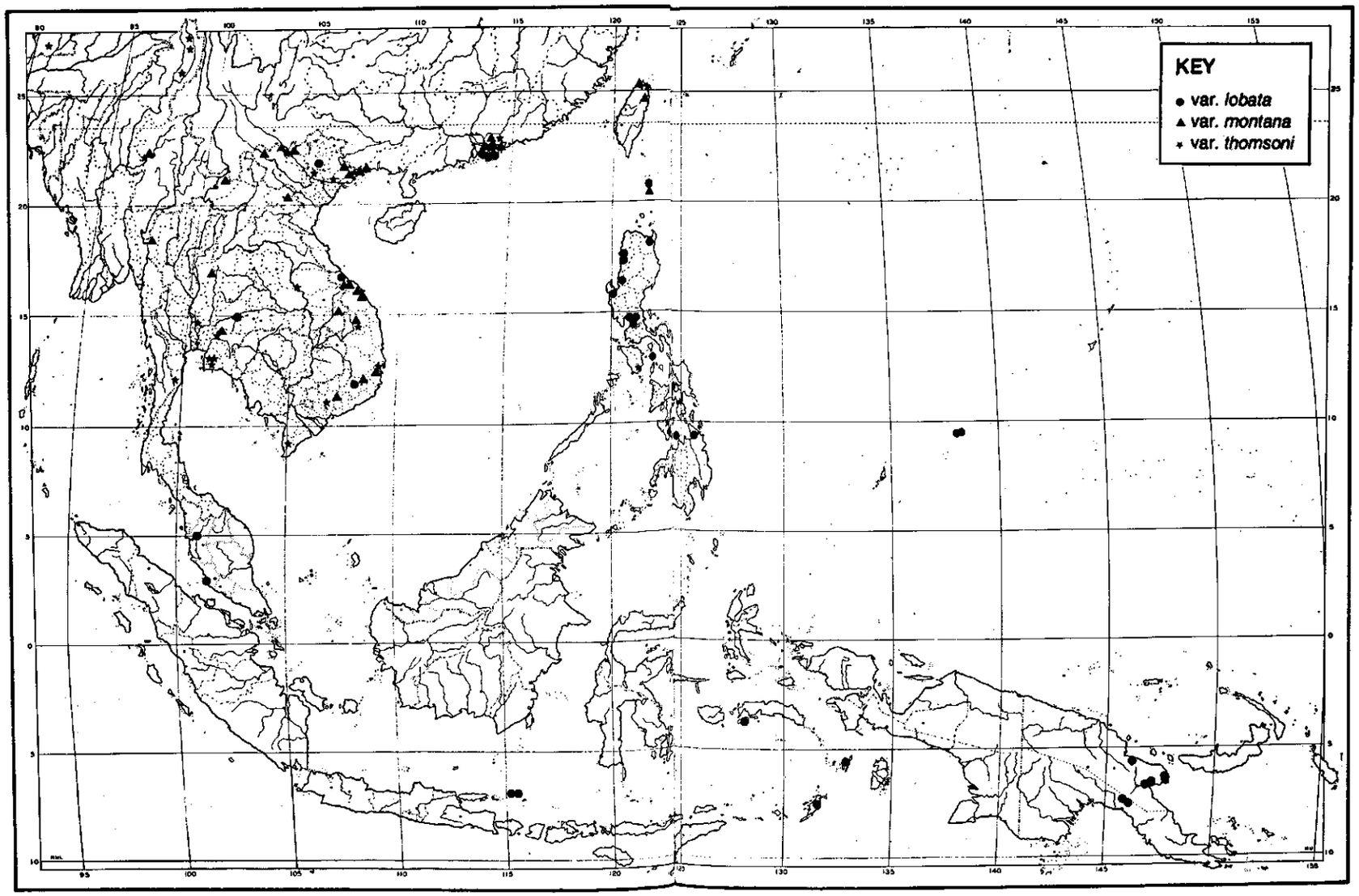
Dolichos japonicus Hort. *nom. nud.*, Bailey, Manual Cult. Pl. 400(1924) (as *japonica*); Borisov, Fl. USSR 13: 531(1948 & transl. 1972) as synonym. Base material unknown.

Pueraria triloba Backer in Heyne, Nuttige Pl. Nederl. Indië 829(1927), based on *Pachyrhizus trilobus* (Lour.) DC. and *Pueraria thunbergiana* Benth. (should have been (Lour.) Backer).

Pueraria volkensii Hosokawa, Trans. Nat. Hist. Soc. Formosa 28: 62(1938).
Type: Yap, at Datyakal, *Hosokawa 8885* (TAI, holo, not seen).

Pueraria triloba (Lour.) Makino ex Backer, Fl. Java 1: 632(1963), based on *P. lobata* (Willd.) Ohwi and *P. thunbergiana* (Sieb. & Zucc.) Benth., obviously citation hybrid of *P. triloba* (L.) Makino (1912) and *Dolichos trilobus* Lour. (1790).

Pueraria pseudo-hirsuta Tang & Wang, nom. nud.
Hu & Hsun, Native Forage Plants (1955).

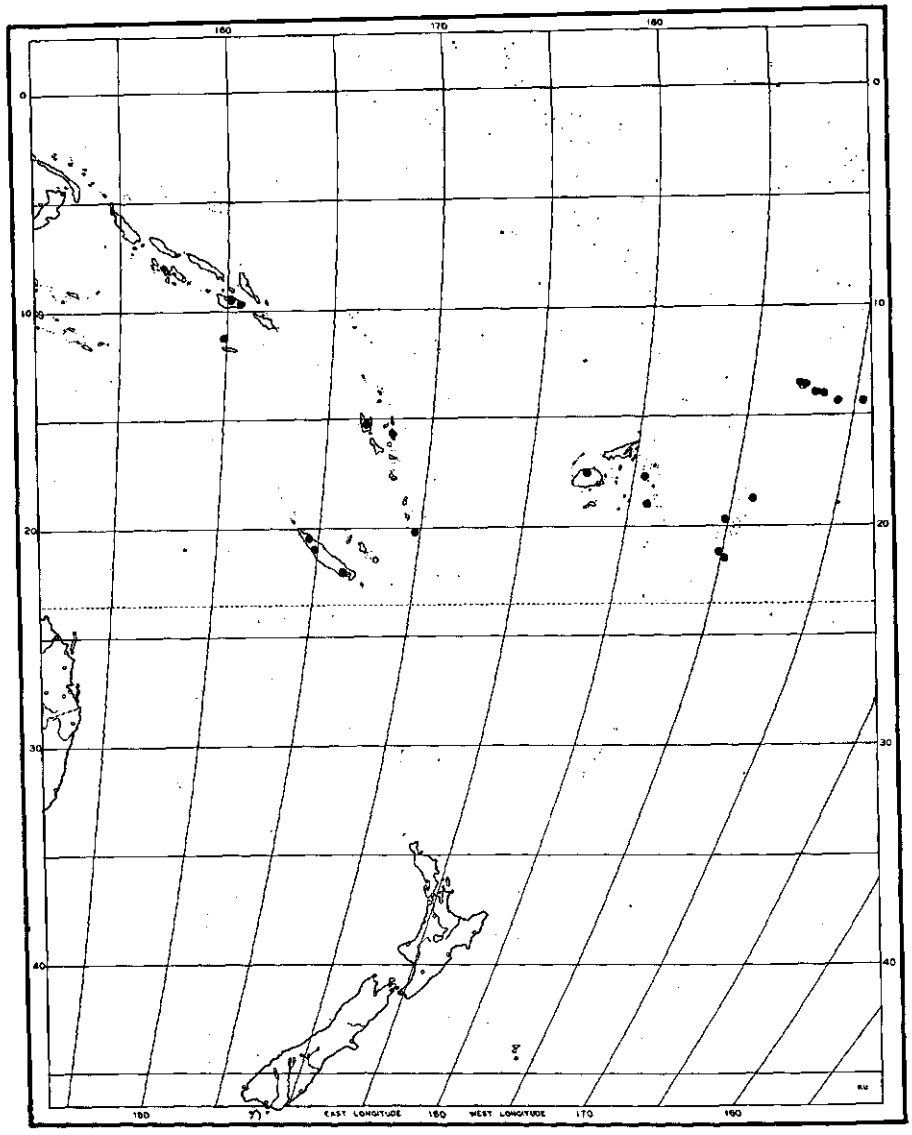


MAP 6. *Pueraria lobata* in southeast Asia.

Distribution: Australia, (N. Queensland), Carolina Islands, China, Fiji, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Caledonia, New Hebrides, Papua-New Guinea, Philippines, Samoa, Solomon Islands, Taiwan, Thailand, Tonga Islands, USA, Vietnam. Introduced to many other subtropical areas. BECHERER (1934) quoted *P. lobata* as naturalized in Switzerland, near Ascona and Brissago, on Lago Maggiore. The kudzu did not become established in Africa, as far as is known, but was more successful in S. America and extremely so in the USA, where it is considered a pest in the Southeastern States (see uses).

Ecology: Climber in scrub, forests.

Altitude: 0-1500(-2000) m, more frequent at lower altitudes.



MAP 7. *Pueraria lobata* var. *lobata* in Oceania.

Flowering and fruiting: see Table 1.

Vernacular names: *Pueraria lobata*, in particular var. *lobata*, is most widely known as kudzu, its most common Japanese name. The other varieties, vars. *montana* and *thomsoni*, could be popularly named kudzu too, but Taiwan kudzu and Thomson's kudzu respectively is more specific. Area or language are listed alphabetically together:

Chinese: Ko, Ko t'eng (Hupeh, Szechwan), Koten, Gue, Fen ge teng.

Dutch: Driekwabbige slingerboon (HOUTTUYN, 1779).

English: Kudzu, Kudzu-vine, Thunberg kudzu vine, Kudzu bean, Ko-hemp, Japanese arrowroot, Mason-Dixon vine.

Fiji: Aka, Yaka, Wa-yake.

French: Koudzou, Koudsou.

German: Kopou-bohne.

Indonesia: Bitok (Madurese), Tobi (Sundanese), Tebi (Kangean), Ngu lok (Buang).

Japan: Kudzu, Kuzu, Saitzu mame, Fusi maki kadsura, Katsi maki, In ken maki, Daisumame.

Korea: Chik, Chuk, Cheulk.

New Caledonia: Magnana Rkerku, Quechoc.

New Guinea: Wowitu, Owitu (Asaro area), Op, Muntamagana (Banz) Sifu (Bena), Goruma (Chimbu), Gosima (Chuave), Korono (Enga-Mendi), So'onea (Gahaku), Kohena (nr Goroka), Ko'pitu, Ngko-ko, Ngko'ahi (Kainantu), Hgedafo, Sifu, Mudja (Kamano), Nggonduma, Nggondumu (Kundiawa), Nggaoka (Medlpa- Kakoli), Oka mapumb, Oka moi (Medlpa), Mapumb (Mt. Hagen), Kenangia, Kagomba (Watabung).

Philippines: Baai (Igorot), Tahaunon (Manubo).

Solomon Islands: Lebu.

Thailand: Tum yaa krua.

Tonga: Aka, Fue'ae puaka, Fue alpuaka.

Spanish: Kudzu, Kudzu comun, Kudzu ordinario.

Vietnam: Cu Nang (Annamese), Cu San day (Tonkin).

Specimens examined (a representation):

AUSTRALIA: Queensland, Thursday Isl., *Podenza s.n.* (BM).

CAROLINE ISLANDS: E. Yap, nr Dugor village, *Cushing & Giliganamin 650* (US); Koror, Palau, Skillangs pasture, Imulsubech village, Aimelik, *Timberlake & Johannes 3056* (US).

CHINA: Anhwei/Anhui prov.: Hwang Shan mts, S.S. *Chien 1242* (W); Chiuhwa Shan, Yunchieng hsien, *C.L. Sun 1256* (NY, US), Chekiang/Zhejiang prov.: Mokan Shan mts, *Cheo & Wilson 12778* (C, NY); Changhwa, *Migo s.n.* (NAN). Fukien/Fujian prov.: Yeuping, Chaping, *HH Chung 2839* (K, W): Heilungkiang/Heilongjiang prov.: sine loc., *Anon. 1043*(NAN): Honan prov.: Tshi river, Lushih county, *J.C. Fu 737* (NAN); Kikung Shan, *Steward 9728* (NY): Hopeh/Hebei prov.: Peitaiho, Temple Bay & Lotus Hills, *Read 356*(K), Hunan prov.: Malingtung, Sinning, *Fan & Li 633* (W); Yun Shan mts nr Wukang, *Handel-Mazzetti 12383* (US, W). Hupeh/Hubei prov.: Patung hsien, *H.C. Chow 946* (NY); Nanto, *Wilson 1406* (NY, US, W); Paokang, *Silvestri 4761* (FI). Kiangsi/Guangxi prov.: Kuling, along stream, *C. Y. Chiao 18530* (NY, US); Sai Hang Cheung, nr Tung Lei village, Kiennan distr., *S. K. Lau 4358* (US). Kiangsu/Giangsu prov.: Oxhead hill, Nankin, *C. Y. Chiao 12067* (C); Thing, *Courtois 33073* (NAN). Kirin/Gilin prov.: Tang Ho, Pei Nin Ting mt, *Clemens 6200* (E). Kwangsi/Guangxi prov.: Tong Shan, nr Sapuk Po village, Waitsap dist., *WT Tsang 22743* (W); Hsi Chang village, Chifeu Shan, Kweilin distr., id. *28402* (US). Kwangtung/Guangdong prov.: Nankun hill, Yonghan, Lungmin county, *S.C. Lee 200071* (KWA); Hainan, White Sand/Bai Sha, Yanmendong, Bei Kweng, *S.K. Lau 26038* (KWA). Kweichow/Guizhou prov.: nr Kweiyang, *Bodinier 2489* (E, P); Pinfa, *Cavalerie 206* (W); Liang Feng Yah, Tsunyi hsien, *Steward et al. 287* (NY, US); Lungli, *Y. Tsiang 4461*; (NAN). Liaoning prov.: Vanfangoo, nr temple, Liaotung peninsula, *Litwinov 1802* (NY); Aushan, Qiau hill nr Zuyne temple; *Y.L. Chou et al. 2738* (NAN); Peking/Beijing: E. Mei Ssu, W. Tomb, *J.C. Liu s.n.* (K); Nankow Pass, *Wawra 991* (W). Shanghai: Fangwang

hills nr city, *de Poli 57* (P). Shansi/Shanxi prov.: Howangho river, Yunhua hill, Xiai yu (I shi?) county, *Anon. 378* (NAN); Hiyang hsien, Laoping, *Chanet 780* (W); Tsinling Shan, Tsinfeng Shan betw. Sancha and Feng hsien, *Fenzel 116* (W). Shantung/Shandong prov: Feihsein, Meng Shan mts, *Cheo & Yen 215* (W); Lao Shan, Ming Sha Tung, *C.Y. Chiao 2957* (C, F, NY, US). Szechuan/Sichuan prov: Mt Omei, *Cheo & Hsien 74* (NAN); Kwan Hsien, *W.P. Fang 2159* (NY); Chengkow? Tin; *Farges 41* (BM, F, NY, P, US). Yunnan prov.: Kiang yn, *Delavay 2163* (P), Joukoula, nr Pinchwan, *Ducloux 6683/4* (P); Kinkiang, *Forbes 199* (BM); Tali valley & range, *Forrest 7002 II, 28066* (E); Mengtze, *Henry 9248* (E, US).

FIJI: Viti Levu: Tholo north, *Degener 14942* (NY, US); Naitasiri, Nasinu, Togavu, *Koroiveiban s.n.* (K, US); Kambara, *Smith 1268* (NY, US); Viti Levu: Serua, hills betw. Wainiggere & Waisese creek, Ngaloa to Waininyambia, id. *9668* (K, US).

HONG KONG: Chay-wan bay, *Bodinier 1358* (E, P); Jubilee reservior, New Territory, *S.Y. Hu 8399* (US); Ping Chow Isl., id. *9244* (US).

INDONESIA: Kangean Isl., Ardjasa, *Backer 26777* (P); ibid. id. *27213* (L); Tanimber Isls, Timor Laut, Jamdena Isl, Saumlaki to Olili, *Buwalda 4037* (K, L, NY); Roga, Endeh, Flores, *Elbert 4344* (L); Tual, Key Isls, *Jensen 31* (C); Ambon, *Warburg 17735* (NY); Java sine loc., *Zollinger 577* (P).

JAPAN: Honshu: 40 km W of Hiroshima, *Charette 1392* (US); nr Itsetogi, *Dorsett & Morse 900* (US); betw. Sotumba & Fujima, id. *670* (US) Aomori, *Faurie 1477* (K); Mt. Misen, Nara pref., *Hiroe 12795* (W); S foot of Mt. Takinama, Gifu pref., *Inamasu 424* (C, NY, P, U, US); Awa Isl., *Inokuma s.n.* (NY); Shindo to Futasuya, Fukui pref., *Kanai 731279* (NY); Mt. Ushiogama Yamashina, SE of Kyoto, *Konta 5354* (C, E, U); Yokohama, *Maximowicz s.n.* (C, NY, US). Hokkaido: nr Hakodate, *Faurie 1387* (P). Kyushu: mt side betw. Kagoshima & Miyakonojo-Kagoshima-ken, *Kent Beattie & Kurikura 11199* (US); Himi mt, Shirataka, Shimoagata-gen, Tsushima Isl., Nagasaki pref., *Ohashi et al. 77* (US); ibid., Himi-komoda, id. *151* (US); Yamadera, Yusenkyo, Yamagata pref., *Ohashi et al. 101* (WAG); Nagasaki, *Oldham 357* (C, CAL, G, W); Homan Dake Mt, *Pierot s.n.* (L). Riukyu Islands: Okinawa, Kumigami, Tanyu- dake, *Sonohara et al., 6328* (US); ibid, *Walker et al., 5793* (US); Nakagami, Shuri Castle Hill, id. *5930a* (US); Iriomote Isl., Yaeyama Gunto, Nakara river region, id. *7166* (US).

KOREA (S): Tokyon, Tonguae-up, S. Kyongsang, *Chandler 77* (BM); Kwangnung, *Cheng-In-Cho 3095* (F); Hoang-hai-to mts, *Faurie 442* (E, G, W); Quelpaert-Cheju Do Isl., Id. *1707* (E); Umidong, Kangwon prov., *Lee & Lee 518* (US); Kumwha, *McClatchie 64* (US); Ponkhan-San nr Seoul, Kyonggi-Do (Nat. *Forest Exp. Stn. 5807* (F); Sorai Beach, Whanghai prov., *R.B. Smith s.n.* (US); Kanghwa Isl., *R. K. Smith s.n.* (US).

KOREA (N): S of Heijo, Chosen, in Botandi section, *Dorsett & Morse 6213* (US).

MALAYSIA: Malaya: Perak, Ipoh, towards Taujing Rambutan, *Huellia? 1603* (K); Selangor, Teluk Merbau, *Franck 1097* (C); Sarawak: *Anon. 204* (BM).

NEW CALEDONIA: Tchiaor, *Balansa 3330* (BM, FI, K, US); nr. Noumea, Franc 734 (G); Kone, *McKee 4249* (E, K, L); mts nr Ubatche, *Schlechter 15484* (BM, G, K, W).

NEW HEBRIDES: Nueha, Hog Harbour, *Baker 288* (K); Aneityum Isl., Anelgauhat bay, *Kajewski 895* (NY, US); Espirito Santo, Tabwe-masana mts, *Oxford Univ. Exp. 18* (BM).

PAPUA-NEW GUINEA: Rona, Laloki riv., Central Div., *Brass 3570* (BM, NY); Rouna, *Carr 12406* (BM, K, NY); Sattelberg, Morobe distr., *Clemens 1729* (L); Busu, nr Lae, Morobe distr., *Coode 29885* (E); 8 km from Sialium to Kalasa, Finschhafen subdistr., *Hentz & Katik 49796* (C); Matupi Isl., nr Simpsonhafen, New Britain, *Rechinger 4124* (W).

PHILIPPINES: Luzon: Pinagteponan riv., Cagayon prov., *Edano 2003* (NY); Pasig, *Loher 2280* (P, US); Bangued, id. *2281* (K, US); Pasay, *Merrill 184* (US); Fort McKinley, Rizal prov., id. *28070* (CAL, F, NY); Negros oriental: Dumaguete, Cuernos mts, *Elmer 10310* (E, F, NY, U, US); Mindanao: Cabadbaran, Mt. Urdaneta, Agusan prov., id. *13518* (CAL, F, NY, U, US, W), Babuyanes, Camiguin Isl., *Fenix 4116* (NY, US); Banton Isl., *McGregor 347* (US); Basco, Mt. Iraya region, Batan Isl., Batanes prov., *Ramos 321* (NY).

SAMOA: Savaii Isl., nr Samalaeuta, *Christophersen 862* (K, NY); Tau, nr Luma on plateau, *Garbir 651* (K, NY); Upolu Isl., *Rechinger 78* (W); Apolima Isl., id. *180* (W); Savaii Isl., Sassina to Aopo, id. *1932* (W); Safotu (Savari), *Vaupel 169* (US, W); Tutuila, *Whistler 1288* (US).

SOLOMON ISLANDS: Belona, Dgova, *Brown W/288* (BM); Belona, *Christophersen 3236, 3238, 3239, 3336, 3439* (C). Guadalcanal: Kokumbona, *Brown 1671* (BM); Vavaea ridge nr Honiara, *Leach*

13258 (K); Luova: Graciosa bay, *D. E. Yen 19920* (K).

TAIWAN: Sine loc., *Oldham 178* (W); Musya, *Tanaka 350* (US); Nankustashan, Nanshan (Pianan), *Yamazaki et al. 1010* (BM).

THAILAND: Muok Lek, *Marcan 1884* (C); E. Nakhon Ratchasima, Kao Yai Nat. Park, *Murata et al. 16436* (L).

TONGA ISLANDS: Vavau Isl., *Moore 529* (US); Tofua, *Scarth-Johnson 12* (K); nr Lavatoga village, *Yuncker 15176* (U, US); Eua Isl., E ridge, id. *15556* (US); N of Tonga Isl., id. *15984* (U, US).

USA: Alabama, Florida, Georgia, Illinois, Mississippi, Missouri, N. Carolina, Oklahoma, Pennsylvania, Tennessee, Texas, S. Carolina, Virginia.

VIETNAM: Longbian Dran mts, *Chevalier 40310* (P); Dan Chust, Tonkin, *Duport 132* (P); Km 20 of Route 9, Quangtri prov, *Poilane 27899* (P).

8b. Pueraria lobata (Willd.) Ohwi var. montana (Lour.) van der Maesen comb. et stat. nov.

Basionym: *Dolichos montanus* Loureiro, Fl. cochinchin. 440(1790); Fl. cochinchin. ed. Willd. 536(1793).

Type: Vietnam, Cochinchina, habitat in sylvis montanis Cochinchinae, *Loureiro s.n.* (P, holo, photograph seen).

Synonyms: *Glycine javanica* L. Sp. Pl. 754 (1753) non *Pueraria javanica* (Benth.) Benth. vide Verdcourt, 1968.

Type: Linn. Herb. 901.8 (LINN, photograph seen).

Pachyrhizus montanus (Lour.) DC., Prodr. 2: 402 (1825), based on *Dolichos montanus* Lour.

Stizolobium montanum (Lour.) Spreng., Syst. 3: 352(1826), based on *Dolichos montanus* Lour.

Zeydora agrestis Lour. ex Gomes, Mem. Acad. Sci. Lisb. Pol. Mor. Bel.-Let. n.s. 4-1:27(1868); *teste* Merrill, Trans. Am Philos. Soc. n.s. 24-2:10, 210(1935).

Type: not seen.

Pueraria tonkinensis Gagnep. in Lecomte, Not. Syst. 3: 202(Jun 1916); id. Fl. Gén Indo-Chine 2: 250(Apr 1916); Merrill, Trans. Am. Philos. Soc. n.s. 24-2: 210(1935); Ohwi, Acta Phytotax. Geobot. 5: 63(1936); Chuang & Huang, Legumin. Taiwan 88(1966).

Lectotype: Vietnam, Tonkin, from Lang Son to Nuoc Binh, *Lecomte & Finet 387*(P, holo) (*lectotypus novus*).

Paratypes: ibid., id. *314* (P), id. 318 bis (P); Vietnam, Tonkin, Cha Pa, *Hautefeuille 183* (P); Vietnam, Hanoi prov., But Son, Elephant Mt, *Bon 2737* (P); China, Yunnan, nr Lou-lan, *Ducloux 3771* (P); CHINA, Hainan, *Katsumata 7813* (P); China, Kouang-tcheou (Kwangchow, Canton, Guangdong), *Decker 113* (P); Hong Kong, ravine forest of Fort Victoria, *Bodinier 871* (E, P).

Pueraria montana (Lour.) Merrill, Trans. Am. Philos. Soc. n.s. 24-2: 210 (1935); Tanaka, Tanaka's Cyclop. Edible Pl. World 602(1976); Ohashi, Fl. Taiwan 3: 367(1977); Lackey, Synops. Phaseol. 72,74(1977); Thuan, Fl. Cam-

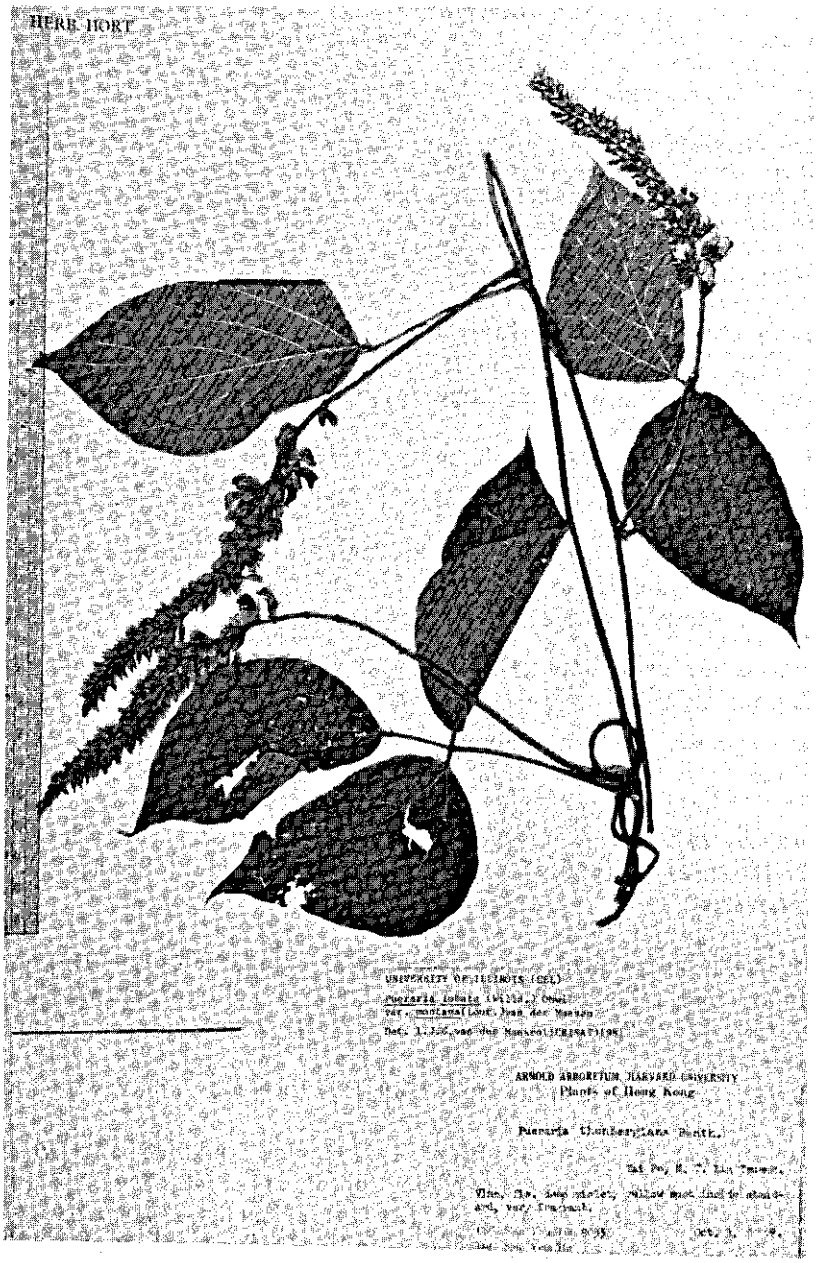


PLATE 10. *Pueraria lobata* (Willd.) Ohwi var. *montana* (Lour.) van der Maesen (*Shiu Ying Hu 8035*)

bodge, Laos, Viet-nam 17: 80(1979); Iconog. Cormoph. Sinic. 2: 501(1980), based on *Dolichos montanus* Lour.

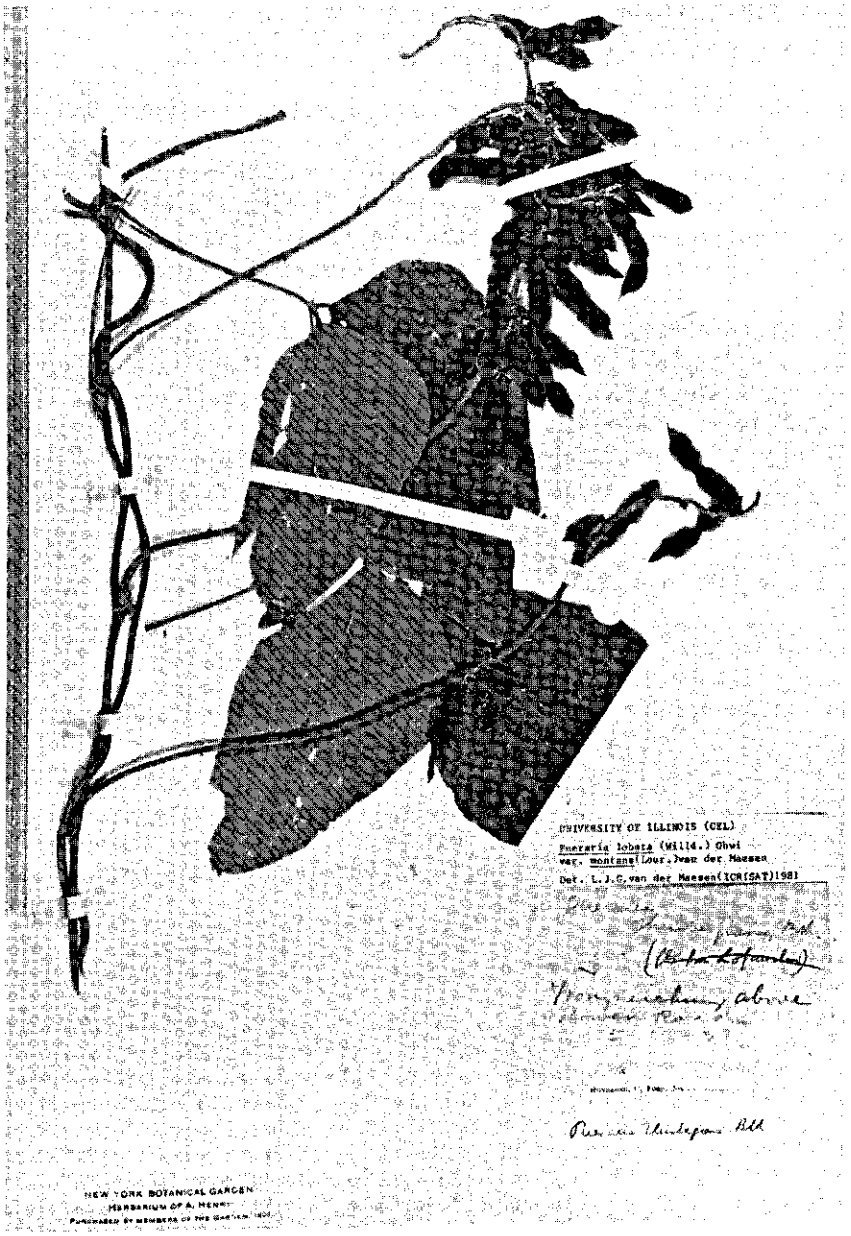


PLATE 11. *Pueraria lobata* (Willd.) Ohwi var. *montana* (Lour.) van der Maesen (*Ford s.n.*)

Pueraria thunbergiana (Sieb. & Zucc.) Benth. var. *formosana* Hosokawa, J. Soc. Trop. Agr. Taih. 4: 310(1932).

Type: Taiwan, Urai, pref. Taihoku, *Suzuki 3297* (TAI, not seen).
Paratypes: see protologue.

Pueraria omeiensis Wang & Tang *nom. nud.*, protologue not traced, Iconogr. Cormoph. Sinic. 2: 501(1980).
Type: not traced. Chinese *Pueraria* material of the *lobata* complex on Mount Omei include both var. *lobata* and var. *montana*. Judging from the illustration in the Iconographia, *P. omeiensis* is very similar to var. *montana*. Both varieties from Mt. Omei have been determined as *P. omeiensis* in Chinese Herbaria.

Distribution: Burma, China (Chekiang/Zhejiang, Kwangsi/Guangxi incl. Hainan, Hupeh/Hubei, Kweichow/Guizhou, Kiangsi/Jiangxi, Kwangtung/Guandong, Szechwan/Sichuan, Yunnan), Hong Kong, Japan, (Riukiu Isls), Laos, Philippines, Taiwan, Thailand, Vietnam.
Ecology: Climber in thickets, forests, on dry slopes or in moist places, in sandy or loamy soils, valleys, roadsides, open pastures, hedges, river sides, swamps.

Altitude: 100-1500 (-2000) m.

Flowering and fruiting: see table 1.

Vernacular names: China: Kot ma mo, Kot ma t'ang, Kot t'ang fa, Ye wang kot tang, Ye wong kok (Hainan).
Laos: Chua tan cung, (Khua) Khao Piet (Houa Phan); Ma sum (Lai Chan, Hmong).
Taiwan: Taiwan kudzu.
Vietnam: (Day) Cae Lan (Quang Nam), Day dan, San rung (Annamese), San day (Ha Nam Ninh), Surum.

Specimens examined:

BURMA: Mausam Falls, N. Shan State, *Lace 5463* (K); Maymyo Plateau, id. *5960* (K); Keng Tung, Shan State, *MacGregor 937* (CAL); Kachin Hills, *Shaik Mokim s.n.* (CAL).
CHINA: Chekiang/Zhejiang prov: King Yuan region, 20 li SW of Lung Chuan (Dragon Spring), *R.C. Ching 2444*(US). Fukien/Fujian prov.: Kuliang, Foochow, *Carles 664*(E). Hunan prov.: Mang Hill, Xingguaikeng, Yizhang county, S.G. *Chen 2467*(PE); Yang Shan, Changning Hsien, *Fan & Li 303* (W). Hupeh/Hubei prov: Hong Qi Xiang (Red Flag Town), *Fu & Chang 1897* (NAN); sine loc., *Henry 3045* (CAL, E). Kiangsi prov: Ziyan palace, Wugong Hill, *Acad. Sci. 1106* (PE); Oo Chi Shan, nr Lam Uk village, Lungnan distr., *S. K. Lau 47098* (US); Tsingan mts from Ciping to Shuang Ma Kou along highway Kwangsi/Guangxi prov.: Yeo Mau Shan, N. Hin Yen, *R.C. Ching 7157* (US); Taoshan, no 2 region, Lungsheng county, *Kwangfu Exped. 656* (KWA); Xinzhai, Linggui county, no 2 region, *C. F. Liang 30951* (KWA); To Tro Tauen, Yung Esien, *C.S. Yang 730518* (KWA); *Steward & Cheo 1125* (G, NY, P, W); Ton Ngok Shan nr Tung Chun village, Waitsap distr. *Tsang 23122* (W); Ta Chiang Yuan, Chin Kang Shan, Kwei Lin distr., *W.T. Tsang 28255* (US). Kwangtung/Guangdong prov: Canton, *Decker 113* (P, paratype of *P. tonkinensis*); Honam Isl., *Levine 415* (F, US); Guangzhou (Canton) & vicinity, *Levine 1526* (US); ibid, id. *1666* (US, W); ibid. id. *1841* (US); nr Minying coop. Tafu county, *L. Teng 5402* (KWA); Ting Wu Shan,

Ting & Shih 1048 (L); sine loc., *Y. Tsiang 1418* (PE); Yang Shan & vicinity, S of Linchow, *T.M. Tsui 603* (K, L, NAN, NY, P, PE, US, W); Shiliugang in Kwangchow S of Pearl River, *S. Wang 160403* (KWA); Hainan Isl: Dung Ka, *Chun & To 43823* (F, NAN, NY, US); Manning, *F.C. How 71512* (BM, CAL); Po ting, *id. 72447* (BM. G); sine loc., *Katsumata 7813* (P, paratype of *P. tonkinensis*); Ka Chik Shan & vicinity, Changkiang distr. *S.K. Lau 1649* (BM, NY); Yeung Lam Shan nr Yeung Lam village, Yai Hsien distr. *id. 6382* (KWA); Pak Shik Ling & vicinity, Ku Tung village, Chingmai distr., *C.I. Lei 601* (K, NY, PE, US, W); Taitoo, Seven Finger Mts, *H.Y. Liang 61720* (E, F, NY, US); sine loc., *McClure 9633* (C, NY, W); Beguchangtian, Chungdung county, *L. Teng 3456* (KWA); Na Lin Sham, Taam Chau distr., *W.T. Tsang 158* (K, NY, US); Hung Mo Shan & vicinity, Lai area, *Tsang & Fung 195* (K); Ta Tsat village, Tam county, Tsang, *Tang & Fung 17726* (NY); sine loc., in forests, *C. Wang 35144* (NY). Kweichow/Guizhou prov: Gudong betw. Duyun and Gweiding, *Handel-Mazzetti 10673* (C); Sihfeng to Yanglungsi (Yanglungchan?) *S.W. Teng 90552* (KWA); Tuyun, *Y. Tsiang 5736* (NY); Tuhshan, *id. 6532* (NY, PE). Szechwan/Sichuan prov: Tienchuan Hsien, *FC Tai & class 4185* (US); Mt. Omei, *Y.H. Tan 50839* (KWA); Tuhshan, *Y. Tsiang 6532* (PE); Mt. Omei, *FT Wang 23573a* (PE). Yunnan prov: Y dje nr Lou Ray, *Ducloux 3771* (P), paratype of *P. tonkinensis*); Mengtze woods, *Henry 10047* (BM, CAL, E, K, US); sine loc. *id. 10047C* (CAL, NY); Szemao, S. Rane to Myli?, *id. 12521* (NY); Szemao forests, *id. 12521A* (E, US); W of Mekong, Pingpo to Yungchang and Tengyueh, Salween watershed, *Rock 6985* (E, K, NY, US); Meng-Him, Yenn Yeh Hsien mt. *C.W. Wang 80013* (KWA).

HONG KONG: Ravine forests of Fort Victoria, *Bodinier 871* (E, P paratypes of *P. tonkinensis*); Wouyzeichung above Bowen Rd, *Ford s.n.* (NY); Central Isl., New Territory, *S.Y. Hu 5999* (US); Tai Pi, New Territory Lin Tsueng, *id. 8035* (K, US); Central Isl., *id. 12169* (US); Lanlao Isl., Tungchung & vicinity, Shanlao, *Y.W. Taam 1833* (F, G, NY, US).

JAPAN: Yoronjima Isl., *Uyehara s.n.* (US).

LAOS: Mong Hsing, *Kingdon Ward 8906* (F); Sam Neua, *Poilane 2109* (P); nr Nong Het, Tranninh prov, *id. 16827* (P); betw. Tateng and Pakson, *id. 15561* (P).

PHILIPPINES: Batanes Isl., *Fenix 3833* (US), San Pedro Macata, Rizal prov., Luzon, *Merrill 277* (U, US).

TAIWAN: Tamsui, *Faurie 1206* (G); Bankensing, *Henry 510, 510A* (CAL, NY); foot of Taiton (Daiton) mt, Taihoku Praefecturate, *Hosokawa 3353*, (NY, paratype); sine loc., *Oldham 178* (OXF); Tien Hsiang, *van Steenis 20616* (L); Tonita-tyo, Taikoku-si, *Tanaka & Shimada 17868* (C, CAL, F, NAN, NY, US, W); Arisan, Kagi prov., *Wilson 10834* (K, US).

THAILAND: Ban Mae La Noi, 25 km N of Mae Sariang, *Larsen et al. 2284* (E); Nang Rong Falls at Nakhon Nayok, *id. 3347* (E, L); Phu Miang, *S.P. et al. 51* (P).

VIETNAM: Tonkin: Tu Phap, *Balansa 2278* (G, P); But Son, Elephant mt., *Bon 2737* (P, paratype of *P. tonkinensis*); Cha Pa, *Hautefeuille 183* (P, paratype of *P. tonkinensis*); Lang Son to Nuoc Binh, *Lecomte & Finet 387* (P, lecto); ibid., *id. 314 & 318* bis (P, para); ibid., *Petelot 3085* (K); Le Phou Nhou nr Lai Chau, *Poilane 27036* (P); Pac Si & vicinity, NE of Mon Cay, WT *Tsang 26903* (C, K); Taai Wong Mo Shan & vicinity, Chuk Phai, Ha Coi, *id. 27155* (C, P); ibid., Tong Fa Market, Ha Coi, *id. 29602* (C, K); Kau Nga Shan & vicinity, *id. 30505* (C, G, K, KWA, L); Ho Yung Shan & vicinity, Tien Yen, *id. 30753* (K). Annam: Tang Bian mts betw. Xongom & Dran, *Chevalier 38545* (P); ibid., Dran, *id. 40377* (P); ibid., *id. 40851* (P); Mt. Bani ca 25 km from Tourane, *Clemens 3741* (BM, C, G, K, NY, P, U); Dong Tsang nr. Nhatrang, *Evrard 466* (P); Dran, *Hayata 869* (P); W of Khatrang, *Poilane 4203* (P); Lien Chieu nr Tourane, *id. 7796* (P); betw. Dak Ha & Dak To, Kontum prov., *id. 18476* (P); High Donai, km 80.5 of Rd 20, Bienhoa prov., Djipinh, *id. 19786* (P); Nui Bach Ma S of Hue, *id. 27570* (P); Cau Hai Station S of Hue, *id. 27846* (P); High Donai, N of Dalat, *id. 30344* (P).

COCHINCHINA: *Loureiro s.n.* (P, holo); Botao, *Schmid s.n.* (P).

Note: *Pachyrhizus montanus* Blanco is a synonym of *Pueraria phaseoloides* (Roxb.) Benth. (MERRILL, 1918).

GAGNEPAIN refers in the Flore Générale de l'Indo-Chine to the protologue of his *Pueraria tonkinensis* in Notulae Systematicae, which happened to be published a few months later than the fascicle of the Flore. GAGNEPAIN noted the

close relation of this *Pueraria tonkinensis* to *P. lobata*, as he mentioned *Neustanthus chinensis* Benth.? in synonymy, with a question mark. LACKEY (1977) remarked that *Pueraria montana* is very close to *P. lobata* but seemingly distinct by its smaller habit. In fact, leaflet size sometimes approaches the upper limits of the other varieties, but flowers of var. b. *montana* are smaller. I did not find enough consistency in relative length of petals and auricle presence in the alae, characters used by BENTHAM (1867), OHWI (1936) and OHASHI (1977) to accept *P. montana* as specifically distinct from *P. lobata*. Differences are decidedly more of a varietal level, hence the reduction of this taxon to *P. lobata* var. *montana*. Moreover, the geographic distribution of the varieties overlaps. Var. *montana* is not only confined to mountains.

MERRILL (1935) did not state whether a LOUREIRO specimen of *Dolichos montanus* is still extant, but a LOUREIRO sheet in P (photograph in F) fits the population characteristics. Description and Annamese name of *Dolichos montanus* Loureiro fit the modern specimens received by MERRILL under that name. Thuan, however, in his *Phaseoleae* volume of the Flora of Laos, Cambodia and Vietnam (1979) states that the type is not conserved.

I have not been able to obtain more information about *Zeydora agrestis* Lour. ex Gomes and its type, a name reduced by MERRILL (1935) to *Pueraria montana*.

8c. Pueraria lobata (Willd.) Ohwi var. thomsoni (Benth.) van der Maesen comb. et stat. nov.

Basionym: *Pueraria thomsoni* Benth., J. Linn. Soc. Bot. 9: 122(1867); Baker in Hooker, Fl. Brit. India 2: 198(1876); Taubert in Engler, Nat. Pflzfam. 3-3: 371(1894); Prain, J. Asiat. Soc. Bengal 66-2: 419-420(1897); Gagnepain, Fl. Gen. Indo-Chine 2: 251(1916); id., Lecomte, Nat. Syst. 3: 203(1916); Craib, Fl. Siam. Enum. 1-3: 451(1928); Merrill, Trans. Am. Philos. Soc. n.s. 24-2: 211(1935); Wealth of India 8: 315-316(1969); Tanaka, Tanaka's Cyclop. Edible Pl. World 602(1976); Anon., Fl. Hainanica 2: 320(197?), Thuan, Fl. Laos, Cambodge, Vietnam 17: 79,81(1979); Iconogr. Cormoph. Sinic. 2: 502(1980).

Type: India, Meghalaya, Khasia Regio temp. 5-7000 feet, Hooker & Thomson s.n. (K, holo; iso: C, CAL, FI, G, L, NY, OXF, P, U, US, W).

Synonyms: *Dolichos trilobus* Lour., Fl. cochinchin. 439(1790) non L. (1753) teste Merrill(1935).

Type: cultus in Cochinchina and China, Loureiro (P? not seen).

Pachyrhizus trilobus (Lour.) DC., Prodr. 2: 402(1825), based on *Dolichos trilobus* Lour.

Dolichos grandifolius Grah. ex Wall. nom. nud., Wallich Cat. no 5556(1831), based on *Neustanthus chinensis* Benth., Fl. Hongk. 86(1861).

Type: Hong Kong, Harland (K, holo; not seen).

Pueraria chinensis non Benth., sensu Ohwi non *Neustanthus chinensis* Benth.,

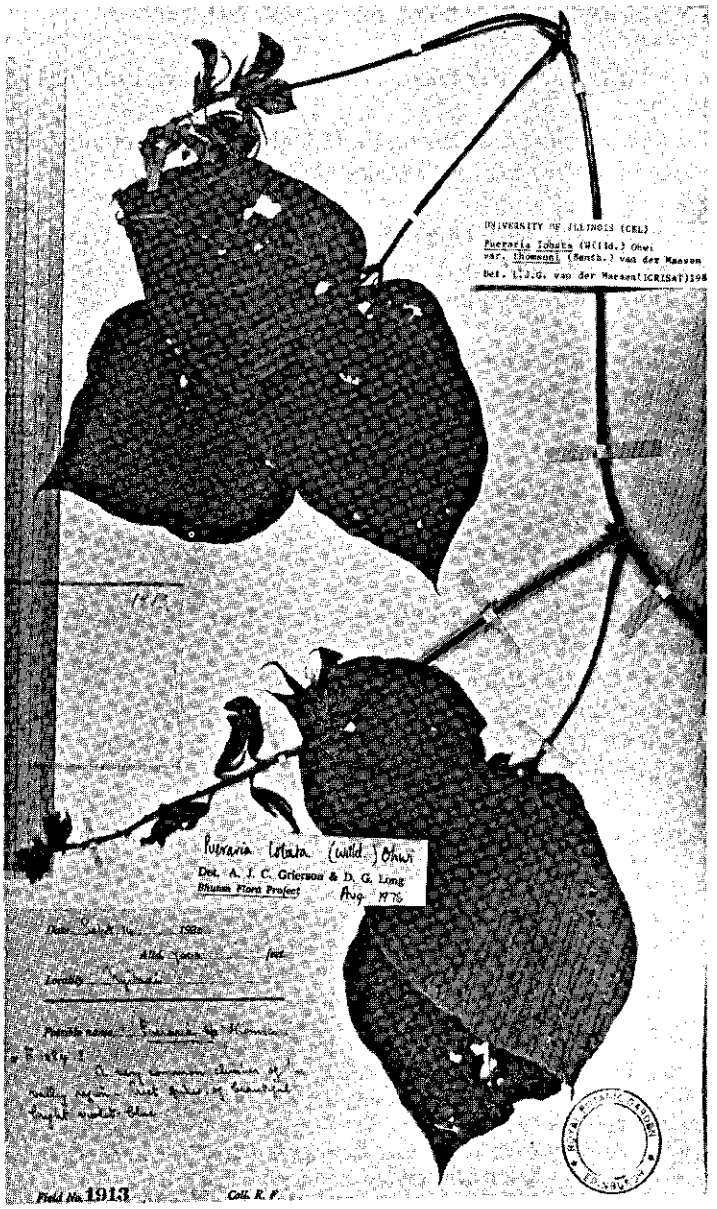


PLATE 12. *Pueraria lobata* (Willd.) Ohwi var. *thomsoni* (*R.R. 1913*)

Acta Phytotax. Geobot. 5: 63(1936), Kubo et al., Syoyakugahu Zasshi 31-2: 136-144(1977), Tahi et al., ibid. 145-150(1977).

Basionym: *Neustanthus chinensis* Benth. Fl. Hongk. 86(1861), which is actually var. *lobata*.

Lectotype: China, Kwangtung/Guangdong prov., Hainan, Wong Kam

Shan, Ngai distr., *S.K. Lau 552*(KWA, holo; iso: NY, US, W).

Pueraria lobata (Willd.) Ohwi var. *chinensis* (non Benth.) Ohwi, Bull. Tokyo Sci. Mus. 18: 16(1947).

Basionym: *Neustanthus chinensis* Benth., Fl. Hongk. 86(1861) actually var. *lobata*. Typification under *Pueraria chinensis* (non Benth.) Ohwi.

Distribution: Bhutan, Burma, China (Kiangsi/Jiangxi, Kwangsi/Guangxi, Kwangtung/Guangdong incl. Hainan, Yunnan), Hong Kong, India (Meghalaya, Nagaland, Sikkim), Laos, Philippines, USA (Hawaii), Vietnam.

Ecology: Tall climber in thickets, forest fringes, secondary growth, along rivers, on level or sloping terrain, moist or dry, in sun or shade, can form a thick cover.

Altitude: 100-2300 m (in India and Burma above 1000 m).

Flowering and fruiting: see Table 1.

Vernacular names: China: Da jiezi ting (big jiezi vine), Ge tang, Ye San Kot (wild pink-coloured vine).
India: Kaikangru (Assam), Suting, Suting-rit (Khasi).
Vietnam: San day (deai) cu, Cay day, Cat can (Annam), Sa ma nia (Nha Trang), San day (Tonkin), (Day) cat can (Minh Hai), (Day) San (Ninh Binh), San dai (Nam Ha), Tonk gia (Moi, Lam Dong).

Specimens examined:

BHUTAN: Nyitadi, *R.F. 1913* (E).
BURMA: U yawm Uka, *Kaulback 384* (BM), valley of Nam Tamai, *Kingdon-Ward 13079* (BM), N. Triangle, Hbinhum, *id. 21246* (BM), Maymyo plateau, *Lace 5887* (K).
CHINA: Kiangsi/Jiangxi prov: Wugong hill, Zhen Shan Kwan, *Acad. Sci. 904* (PE). Hangaodsu mt betw. Ningdu & Tjingan (Kian), *W.T. Hui 485* (C,W). Kwangsi/Quangxi prov: Me-kon, Seh-Feng Dar Shan, S. Nanning, *R.C. Ching 8403* (KWA, NY, US); Daxing shan hill 20 km S of Lungzhou, *H.Y. Liang 65849*(KWA); Li village, Yong county, *T.M. Rei 40165* (KWA), Kwangtung/Guangdong prov: Da cheng, Renhua county, *L. Tang 7658* (KWA). Tung Koo Shan, Tapu county, *W.T. Tsang 21720* (KWA, NY), Chik Sha village, Hainan, *McClure 13533* (NAN); Hainan Isl.: Wong Kam Shan, Ngai county, *S.K. Lau 552* (KWA, NY, W, US); middle slope of Nanluling hill, Dingan county, *S.K. Lau 28415* (KWA); Yaichow, *H.Y. Liang 63107* (NY); in forest, *C. Wang 34049* (NY, US); ibid., *id. 34095* (NY). Kiangsi/Jiangxi prov.: Hangaodsu mt between Ningdu and Tjingan (Ki-an), *Wang-te-Hui 485* (C, W). Yunnan prov.: Man Hao region, *d'Alleizette s.n.* (L); W flank of Shweli-Salween divide, 2520N, *Forrest 8917* (E, K); ibid., *id. 9117* (E, K); Mengtze, on way up to By river, Hsinku rd, *Henry 9248* (CAL, NY); Mengtze, SE mts, *Henry 11041* (CAL, NY, US); Xishuangbonna forest, S. Ru Shan Exp. Stn, *P.I. Mao 7098* (KWA).
HONG KONG: Lantao, *Ford 10* (US).
INDIA: Arunachal Pradesh: behind Wakroo Inspection Bungalow, Lohit distr., *Joseph 48434* (CAL); Khuni Pahad to Petepol, Subansiri Frontier Div. *Panigrahi 19631* (CAL);Old Hayuliangs, Assam Rifles, *A.S. Rao 48168* (CAL). Manipur: Arunchal Pradesh: behind Wakroo Inspection Bungalow, Lohit distr., *Joseph 48434* (CAL); Ukhrul, *Kingdon Ward 17918* (BM); Karong, *Koelz 26376*

Table 1. Flowering and fruiting of *P. lobata*

Var. lobata	*Flowering*	*Fruiting*
Australia	Feb	*
Caroline Islands	*	*
China	(May)Jun-Sep(Oct)	(Jul)Sep-Nov(Dec)
China, Hainan	Mar	*
Fiji	Dec, Mar-Apr, Aug	*
Hong Kong	Oct	Oct-Dec
Indonesia	Feb-Mar	*
Japan	Jul-Oct	Sep-Nov
Korea	Jul-Oct	Aug-Oct
Malaya	Jul	*
New Hebrides	Jan, Mar, Oct	*
Papua-New Guinea	Feb, Apr, May, Dec	*
Philippines	May-Aug, Oct	*
Samoa	Nov-Jan	*
Solomon Islands	Feb, Mar, May, Nov, Dec.	*
Taiwan	Aug, Sep	*
Thailand	Jul, Nov	*
Tonga Islands	Dec-Jan, Mar	Mar
USA	Jul-Oct	Sep-Oct
Vietnam	Apr	*
Var. montana		
Burma	Sep-Oct	*
China	Jul-Oct	Aug-Nov
China, Hainan	Mar-May, *	Apr-May, Nov-Dec
Hong Kong	Sep-Oct	Dec
Japan	Aug	*
Laos	May, Sep	Sep, Oct
Philippines	Jun-Aug	*
Taiwan	Aug, Oct, Jan	Aug
Thailand	Jul-Aug	*
Vietnam	Mar, Jun-Oct	Sep-Nov, Jan
Var. thomsoni		
Bhutan	Aug, Sep	*
Burma	Aug, Sep	*
China	Jun, Sep-Oct	Oct-Nov
Hong Kong	Jul	*
India	Aug-Oct	Sep-Jan
Laos	Oct	*
Philippines	Jun-Sep	*
Thailand	Aug	Dec
USA, Hawaii	Oct	*
Vietnam	May, Aug-Oct	Nov-Dec

* not reported on herbarium labels.

(L). Meghalaya: Shillong, *Clarke 38251* (CAL); ibid., Bishop's Falls, *id. 42598* (CAL); Khasi mts, Normai (Nyrmai), *id. 40100* (CAL, F, G); Khasi mts, *Griffith s.n.* (BM, P); Khasia regio temp. *Hooker & Thomson s.n.* (K, holo; iso: C, CAL, FI, G, K, L, NY, OXF, P, U, US, W); Assam (probably Meghalaya hills), Jenkins s.n. (BM, CAL, K); Mawryngkneng, Khasi hills, *Koelz 28341* (L); Mokokchung, *Hutton s.n.* (CAL); Suting, Beadon Falls, *Kanjilal 2381* (CAL); Khasi hills, *Kurz 325* (W?); Way to Sonapur, *Panigrahi 4463* (CAL). Nagaland: Jotsoma, Naga hills, *Bor 6249* (BM?); Ghukiya, Assam, *Bor 16313* (L); Kohima, *Clarke 40933* (CAL, FI, G), Munghoo, *Kari s.n.* (CAL). Sikkim: L. Munghoo Reshap, *Anon. 26, 28* (K); Tista, *Cave s.n.* (BM, E); Sikkim Himalaya, *Treutler 786* (K). West Bengal: Kalimpong, Darjeeling distr., *Clarke 9172* (K); ibid., *id. 9206* (CAL).

LAOS: Savannakhet, *Poilane 28036* (P).

PHILIPPINES: Negros Isl., *Curran 17339* (US); Biliran Isl., *McGregor 18522* (US); ibid., *id. 18773* (US); Masanganbahi, Catanduanes Isl., *Ramos & Edaño 75206* (CAL, NY); Mt Yagaw E slope, Mindoro, *Sulit & Conklin 17621* (BM, E, L).

TAIWAN: not seen, reported from Keelung (Chilung?), *Chimada s.n.* (OHWI, 1936).

THAILAND: Sriracha, *Collins 490* (K); Muak Lek, Saraburi, *Kerr 9088* (BM, E, K); Nong Bon 25 km E of Makham, *Larsen et al. 32267* (K).

USA: Hawaii: Kauai, vacant lot nr Kumui-o-Kalani, *Derral Herbst 2219*(F).

VIETNAM: Tonkin: Ouonbi, *Balansa 1183* (P); Tu-Phap, in hedges, *Balansa 2277* (P); Phue Nhae, *Bon 38* (P); Huong-thung, Thua-thien prov., *Eberhardt 2276* (P); Seven Pagodas, *Mouret 54* (P); Phu Ho, *Petelot 1515* (NY, P, US); Se Phue Yen, Pagoda of Soc Son, *Petelot 5568* (P, US); Phu Lu nr Laokang, right bank of Red River, *Poilane 24982* (P); Long-tcheou, *Simond 306* (P); Kan Nga Shan & vicinity, Tien-yen, *W.T. Tsang 30537* (C, G, K, KWA, L). Annam: Thoi binh, N of Camau, Baclieu prov., *Poilane 508* (P); Nha Trang, *id. 3255* (P); Ta Bai, Kontum prov., *id 18212* (P); Dran, Haut Donai prov., *id. 30190* (P); Cho- quan nr Saigon Ho Chi Minh City, *Lefèvre 46* (P).

Notes: BENTHAM (1867) quoted his *Neustanthus chinensis* as a synonym of *P. thunbergiana* (Sieb. & Zucc.) Benth. OHWI (1936) made the combination *P. chinensis* (Benth.) OHWI with BENTHAM'S species as basionym. However, neither Ohwi nor I saw the type (HARLAND, from Hong Kong, K?) and he quotes material which is definitely var. *thomsoni*. Var. *thomsoni* also occurs in Hong Kong, but BENTHAM would have quoted his *N. chinensis* as synonym under his *P. thomsoni* if the type belonged there. KUBO et al. (1977) and TAKI et al. (1977) use *P. chinensis* in the sense of OHWI, that is var. *thomsoni*.

BAKER (1876) listed *Dolichos spicatus* Wall. Cat. 5557 C (nom. nud.) as synonymous to *P. thomsoni*. However, the material at G and NY is *P. phaseoloides* var. *subspicata*, just as Wall. Cat. 5557A and B, except for a loose var. *thomsoni* inflorescence on the NY sheet, which apparently got mixed up. This may also be the case in the original Wallich Herbarium in Kew.

PRAIN (1897) put *P. thomsoni* Benth. into synonymy with *P. thunbergiana* (Sieb. & Zucc.) Benth., now *P. lobata* (Willd.) Ohwi. With the material then available, more abundant than in Bentham's time, he could not separate Bentham's species even as varieties. However, despite the difficulty of distinguishing some of the largest flowering, most vigorous specimens of var. *lobata* from those which I consider to be var. *thomsoni*, varietal rank is appropriate in my opinion. Wealth of India (1969) and Chinese Floras kept *P. thomsoni* as a separate species.

THUAN (1979) states that var. *thomsoni* appears to be cultivated or escaped from cultivation in its area of distribution. So far it appears mainly var. *lobata*, rather than var. *thomsoni*, which is the widespread introduction in areas outside SE Asia.

9. Pueraria mirifica A. Shaw. & Suvat. ***(Map 4, p. 31)**

Pueraria mirifica Airy Shaw. & Suvatabandhu, Kew Bull. 1952: 550; Cain, Nature 198: 774-777(1960); Lackey, Synops. Phaseol. 72, 74(1977); Perry, Medic. Pl. East Southeast Asia, Cambridge-Mass./London 225(1980).

Lectotype: Thailand, Doi Sutep nr Chiengmai, 300-800 m, 21 March 1949, *Suvatabandhu s.n.* (K, hololecto, sheet 2, inflorescence & leaf; isolecto: K, sheet 5, flowers).

Paratypes: ibid., 28 May 1947, *Suvatabandhu s.n.* (not seen); ibid., 2 March 1949, *id. s.n.* (K, with tuberous roots).

Description: *Woody* climber, perennial, with tubers up to 15 cm long, 6 cm wide. *Branches* strong, to ca 7 mm in diameter, 5 m or longer, terete, striate, clad with adpressed grey hairs, more or less glabrous with age. *Stipules* peltate, elliptic, both ends obtuse, up to 5 mm long, 2 mm wide, caducous, leaving a round scar. *Leaves* pinnately trifoliolate; petiole canaliculately striate, almost glabrous, up to 12(-?) cm long, rachis 2-7.5 cm long. *Leaflets* broadly ovate, side leaflets obliquely so, 12-20 cm long, 8-14 cm wide, apex long-acuminate base truncate or broadly cuneate, green and thinly grey-pubescent above, grey-green and adpressed grey pubescent below, ribs prominent, in 6-7 unequal pairs; petiolules thickened, pubescent, 5-8 mm long; *stipellae* subulate, pubescent, striate, ca 3-5 mm long, 1 mm wide. *Inflorescence* narrow-branched, mainly at the base, short, up to 30 cm long, *branches* many, ridged, at the tip almost winged, clearly nodose, covered with adpressed short greyish hairs, bracts at the base small perules; pedicels short, ca 1 mm; flowers (2-)3 per node; bracts linear-lanceolate, ca 5 mm long, 1 mm wide, striate, dorsally long-pubescent, ventrally short-pubescent, very caducous; *bracteoles* 2 per flower, triangular, tip obtuse, brown-pubescent, ca 1 mm long and wide. *Calyx* with short brown adpressed hairs, inside only where calyx teeth join at end of tube, tube ca 2.5 mm long, teeth short, triangular, obtuse, upper ones connate, ca 2 mm long, side teeth ca 1 mm long, lowest tooth ca 1.5 mm long. *Vexillum* orbicular-ovate, apex emarginate, base clawed, auricles inflexed, with two callosities near base, bluish purple, ca 9-10 mm long, ca 8 mm wide, margins inflexed. *Alae* lanceolate, ca 8-9 mm long, 2.5 mm wide, claw 2 mm long, auricle hooked, 1 mm. *Keel* petals rather sharply curved along the base, ventrally adnate ca 8-9 mm long. *Ovary* elongate, grey silky, adpressed pubescent, ca 5 mm long, ca 7 ovules; style almost glabrous, ca 1.5-2 mm flattened extension of ovule, ca 2 mm perpendicularly upcurved; stigma terminal, globular, penicillate at base. *Stamens* monadelphous, vexillary stamen attached at the middle with a knee, ca 9 mm long, free part 1-2 mm long, upcurved; anthers uniform, dorsifix below the middle, alternatively on long and short filaments. *Pods* (teste protologue) flattened-oblong, to 3 cm long, 7 mm wide, constricted where ovules fail, sutures thickened, short adpressed-pubescent. *Seeds* (*teste* protologue) suborbicular, flattened, base intruded, 2-5 mm diameter, brown purple.

Distribution: Thailand.

Ecology: deciduous forest, hill slopes.

Altitude: 300-800 m.

Flowering: February-March. Fruiting: April.

Vernacular names: Thailand: Kwao keur, Kwao Kua.

Specimens examined:

THAILAND: type material (*vide supra*); Kok Charoen, 13.5 km N of Chaibadan, Lopburi prov., *Loofs 1* (L); N. Lampang, Thou, Mae Hawk, *Samaphuddi BKF 23028* (C).

Uses: The tubers have a reputation of rejuvenating effects (KERR, 1932; PHYA WINIT, 1933). Estrogenic substances have been found (VANIJVATAMA, 1938). Its use has remained localized until renewed interest by Thai and British workers (CAIN, 1960). Upon further investigation the name 'miroestrol' was given to the estrogen and its chemical and physical properties determined. Preliminary clinical trials showed that miroestrol produced marked estrogenic effects but the doses tried caused rather disagreeable toxic effects (CAIN, 1960). In Thailand preparations are much less purified and the dried root is taken with honey. The plant has earlier been referred to as *Butea superba* Roxb., because only old plants flower and the leaves do superficially resemble *Butea* leaves. *Butea* does not produce tubers which facilitate identification of sterile plants. *Pueraria mirifica* and *B. superba* are both common near Chiengmai (LAKSHNAKARA KASHEMSANTA et al., 1952).

This species is closely related to *P. candollei*, if not just a variety. Differences are slight: flower size smaller, lower surface of leaves greyish, both of which can be accounted for by a small genetic diversity; a similar variation is found e.g. in *Cajanus cajan* (L.) Millsp. Study of live material may solve this problem.

Vernacular names in Thailand for *P. candollei* and *P. mirifica* are similar, if not exactly the same, while the name is also applied to several other tuberous plant species (CAIN, 1960).

10. Pueraria peduncularis (Grah. ex Benth.) Benth.

***(Map 8, p. 69; Plates 13, 14, p. 94, 98)**

Pueraria peduncularis (Graham ex Bentham) Bentham, J. Linn. Soc. Bot. London 9: 124(1867); Baker in Hooker, Fl. Brit. India 2: 167(1876); Taubert, in Engl. & Prantl, Natürl Pflzfam. 3-3: 371(1874); Pampanini, Nuovo Giorn. Bot. Ital. n.s. 17: 29(1910); Smith, Rec. Bot. Surv. India 4-5: 187(1911); id., ibid., 4-7: 363(1913); Gagnepain, Fl. Gén Indo-Chine 2: 250(1916); Handel-Mazzetti, Symb. Sinicae 581(1933); Kanjilal et al., Fl. Assam 2: 80(1938); Rao & Joseph,

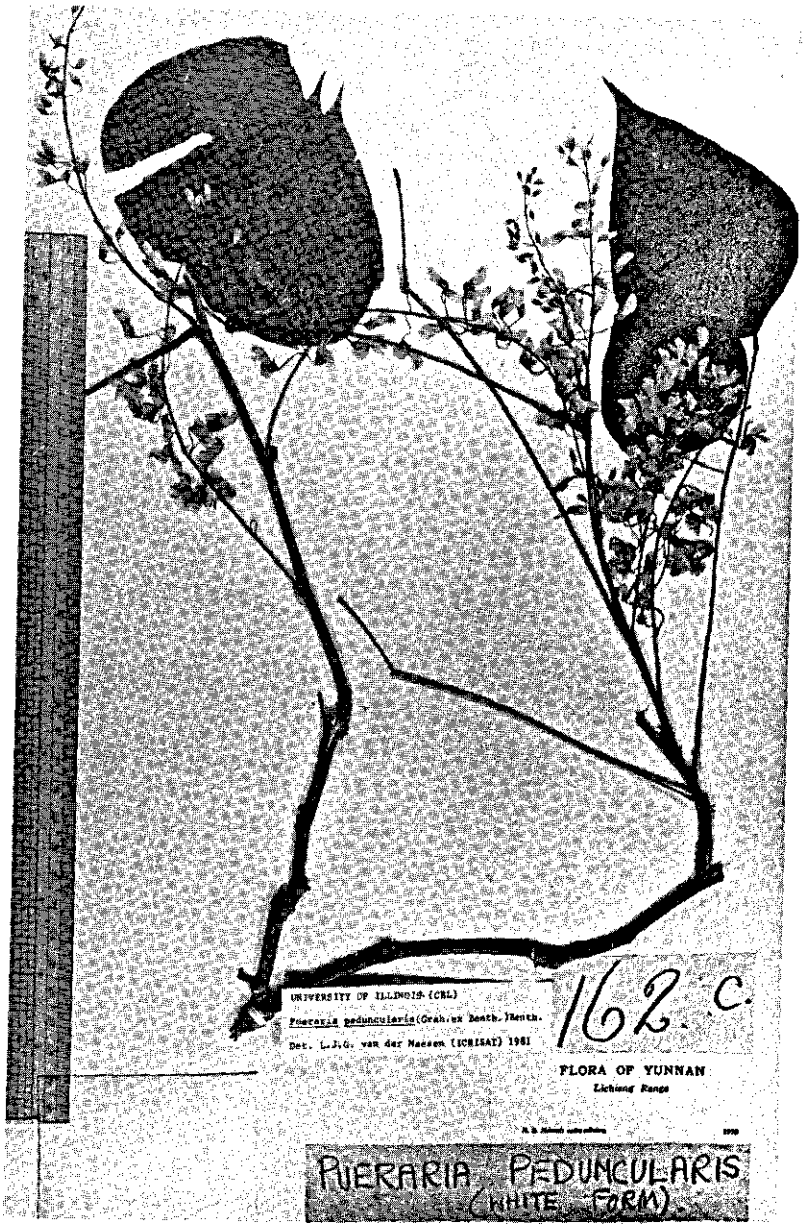


PLATE 13. *Pueraria peduncularis* (Grah. ex Benth.) Benth. (*McLaren's collectors 162C*)

Bull. Bot. Surv. India 7: 144(1965); Biswas, Pl. Darjeeling Sikkim Himalayas 1: 291(1966); Hara, Fl. E. Himalaya 162(1966); Thothathri, Rec. Bot. Surv. India 20-2: 81(1973); Lackey, Synops. Phaseol. 76(1977); Hara & Williams, Enum. Fl. Pl. Nepal 2: 218(1979); Thuan, Fl. Cambodge, Laos, Viet-nam 17: 84, 86(1979); Anon., Icon. Corm. Sinic. 2: 503(1980).

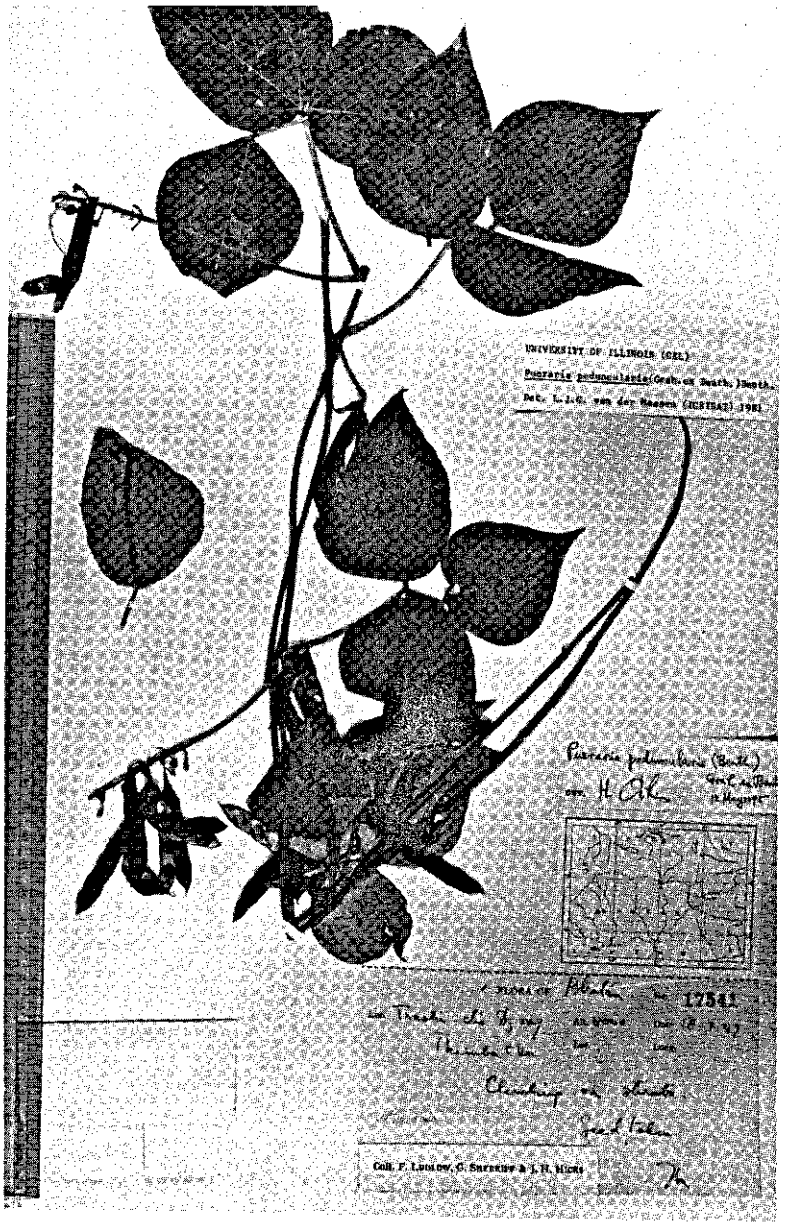


PLATE 14. *Peuraria peduncularis* (Grah. ex Benth.) Benth. (*Ludlow et al. 17541*)

Basionym: *Neustanthus peduncularis* Grah. ex Benth. in Miquel, Pl. Jungh. 2: 235(1852); Miquel, Fl. Ind. Bat. 1-1: 219(1855).

Type: Nepal, Graham, Wallich Cat. No. 5354 (K, holo; iso: BM, CAL, G, K), (*Pueraria? peduncularis* Grah. ex Wall. nom nud).

Synonyms: *Pueraria yunnanensis* Franchet, Pl. Delav. 181(1890); Gagnepain, Fl. Gen. Indo-Chine 2: 249(1916); id., Lecomte, Not. Syst. 3: 205(1916); Handel-Mazzetti, Symb. Sinicae 581(1933); Lackey, Synops. Phaseol. 76(1977); Perry, Medicinal Pl. E. & S.E. Asia, Cambridge, Mass. 225(1980).

Type: China, Yunnan, woods nr Tapintze, *Delavaye 506*(P, holo; iso: P).

Pueraria peduncularis (Grah. ex Benth.) Benth. var. *violacea* Franchet, Pl. Delav. 182(1890).

Lectotype: China, Yunnan, in the woods of Hoang-li-pin, above Tapintze, *Delavay 1983* (P, holo, lecto; iso: K).

Paratypes: ibid., above Chaong-che-teou, near Tapintze, *Delavay 3588* (P, US); ibid., in woods of Ta-long-tan, *Delavay 3567* (P, also at K, US).

Derris bonatiana Pampanini, Nuov. Giorn. Bot. Ital. 17: 8(1910); Gagnepain, Lecomte, Not. Syst. 3: 205(1916).

Lectotype: China, Yunnan-sen, source of the Pe-long-tan river, 8 May 1904, *Ducloux 377* (FI, holo, not seen).

Paratype: China, without location, *Maire 210* (FI, not seen).

Description: *Woody* climber, perennial. *Branches* strong, to ca 4(-10) mm diameter, up to 5-10 m long, rooting on the nodes, striate, grooved and pubescent when young, terete and glabrous when full grown; stipules peltate, basal part very short, fringed, ovate to lanceolate, (2-)4-10 mm long, 1-3 mm wide, striate, adpressed pubescent, leaving an elevated irregular scar when fallen, *leaves* pinnately trifoliolate, petiole canaliculately striate, pubescent or glabrous, 10-20 cm long, rachis 3-5 cm long. *Leaflets* ovate to rhomboid, side leaflets (very) obliquely so, (5-)9-12(-23) cm long, (3-)5-14 cm wide, apex long-acuminate, base rounded-cuneate, green and thinly short pubescent above, grey green and short pubescent below, *ribs* prominent, pubescent, in 6-7 unequal pairs, basal pair opposite; *petiolules* not thickened, more pubescent than the petiole, 3-7 mm long. *Stipellae* setaceous, short, 2-5 mm long, quite persistent. *Inflorescence* axillary, occasionally paired, axis (5-)10-40-(-68) cm long, mostly flowering well below the middle, striate, pubescent, very slightly nodose, or with 1-20 mm long slender pubescent laterals; flowers (2-) 4-7 per node, purple or mauve, purplish blue, pink, violet, blue, lilac or white with purple tipped keel, or pure white (China); bracts lineate- setaceous, pubescent, 4-8 mm long, caducous; pedicels very slender, sturdier in fruit, up to 13 mm, pubescent or glabrescent; *bracteoles* 2 per flower, setaceous-hairy, less than 1 mm long, caducous. *Calyx* thinly and shortly adpressed-pubescent, glabrous inside, tube 3-5 mm, gibbous above the base, rimmed at the base, folding slightly over top of pedicel, teeth shorter than the tube, (broad) acute, upper ones connate or almost connate, 1-3 mm, side teeth triangular, 1-2 mm long, lower tooth narrow triangular, 1-1.5 mm long. Vexillum obovate, 11-15 mm long, 7.5-9 mm wide, apex emarginate, base clawed, not auriculate but reinforced and inflexed, no callosities. *Alae* lanceo-

late, 10-14 mm long, 3-4 mm wide, claw ca 3 mm, upper margin with a triangular lobe, not hooked, base straight. *Keel* petals triangular, ca 12-14 mm long, 5 mm wide, ventrally adnate. *Ovary* elongate, ca 5-8 mm long, very thinly pubescent, mainly along the ventral suture, ca 7 ovules; style glabrous, ca 2-4 mm as extension of ovary, ca 2-3 mm upcurved; stigma terminal, globular, densely penicillate at the base. *Stamens* diadelphous, vexillary stamen quite free, but adherent at first, ca 10-14 mm long, free part ca 2-3 mm, upcurved; anthers basidorsifix, alternatively on long and short filaments. *Pods* flattened-oblong, glabrous, papery, outline of seeds visible, (3-)5-7 cm long, 0.5-0.7(-1) cm wide, black, purple-brown or pale brown, (1-3)4-6(-7) seeded, cuneate at base, acuminate at apex, tipped with rest of style, sutures strong, somewhat sinuate. *Seeds* flattened-ovoid, ca 4 mm long, 2 mm wide, 1.5 mm thick, minutely punctate, strophiole irregular-rimmed, round, diameter ca 1 mm.

Distribution: Bhutan, Burma, China (Yunnan, Szechuan), India (E. Himalaya, Khasi Hills), Pakistan.

Ecology: Scandent or pendulous on shrubs and trees, in open or shady situations, on hill slopes or ravines, medium wet forest, near streams, waterfalls, and jungle edges or clearings, bamboo forests, hill tops, on well-drained or sandy soils, scree and rocks.

Altitude: (1200-)1700-3000(-3600) m.

Flowering: April-October (China), July-October (India). Fruiting: April-May, July, September-November (China), September-November (India).

Vernacular names: Ko ken (Chinese), Ting Khla (Khasi).

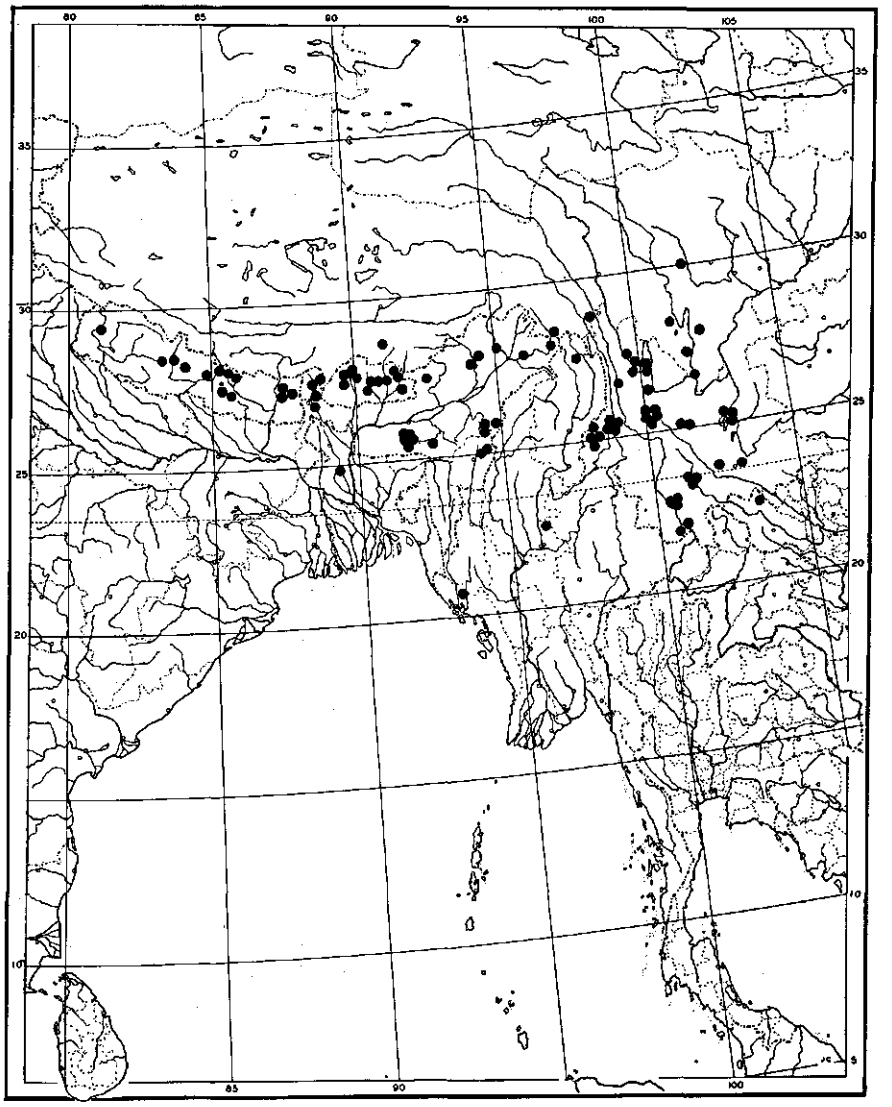
Uses: *Pueraria peduncularis* is used as an insecticide in China (PERRY, 1980, listed as *P. yunnanensis*) named Chung kuo t'u nung yao chih, no. 75. Its roots can be used as fish poison (HENRY 12483 A, specimen from the Szemao Mountains in China).

Specimens examined (selected specimens):

BHUTAN: Thaisa Kha, Tang Chu, *Bowes Lyon 15011* (BM); Lamakka, Thimpu, *Cooper 1332* (E); Tilagong Punakha (Thimpu), *id. 2674* (BM); Sawang Kurted, *id. 4339* (BM); Kole La Kurted, *id. 4662* (BM); Chendebi, Gould 707 (K); Gamri Chu, Trashigong, *Ludlow & Sheriff 1097* (BM); Yuto La, betw. Bumthang & Trongsa (Tongsa?), *id. 17007* (BM, E); Trashi-cho Dzong, Thimbu Chu, *id. 17541* (BM); Shabjetang, Bumthang Chu, *id. 19290* (BM); Trongsa Dzong, Yuto La, *id. 19554* (BM, E); Denchung, Khoma Chu, *id. 20897* (BM).

BURMA: Bhamodir, Sinlum, *Cubitt 293* (CAL); The Triangle, Kachin state, Hbinhum, *Kingdon Ward 21355* (BM); Esakan, Mt. Victoria, *id. 22658* (BM); Kabaing to Kyatpyin, Ruby Mines distr., *Lace 5993* (E, K).

CHINA: Szechwan/Sichuan: nr Tatsienlu/Kangting, *Cunningham 173* (E); nr Ningyuen, Lushan, Sichang, *Handel-Mazzetti 1307* (E, P); Yalung to Yenyuen above Lumapu, *id. 2059* (W); mts S



MAP 8. *Pueraria peduncularis* in south Asia.

of Muli, Mt Gibboh, *Rock 16936* (NY, US); W of Yalung riv., betwn Mutirong & Wandzanron Pass, Muli-Chiulung hsien border, in Yatsa Kong, nr. 17425 (US, W); S of Muli Gomba, mt Gibboh, *id. 24177* (E). TIBET: Salween-Kui Cheang divide, Tsarong, *Forrest 19259* (BM, E); Rima/Chayu, *Kingdon-Ward 20168* (BM). Yunnan: above Choang Che Teu, nr Tapintze, *Delavay 3588* (P, US); nr Pien-kio, *id. s.n.* (K, P); nr Yunnan-sen/Kunming, *Ducloux 2301* (BM, F, K, P) and many other collectors; Tong Tshuan, *id. 5599* (F); Tengyueh-Talipe rd, S end of Yung Chang Fu valley, Paoshan, *Forrest 1058* (E); E flank of Tali range, *id. 4259* (BM, CAL, E, K); W of Tengyueh/Tengchung, *id. 7564* (E); Yangpi valley, *id. 9933* (BM, E, K); Shweli valley, *id. 11995* (BM, E); Mengtze & mts around, *Hancock 275* (K) and many other collectors; rd from Yunnan fu to Dali/Talifu/Tali betw. Gwangdung, Maojing & Schedse, *Handel-Mazzetti 1629* (US, W); Feng Clen Lin mt, *Henry*

9177D (CAL, E); Szemao N mts, *Henry 10628D* (CAL, E, K, NY); Laloshan, Szemao W mts, *id. 12483* (& A) (CAL, E, K, NY, US); E mts, *id. 12483B* (E, K, US); mts behind Tong-tshuan, *Maire s.n.* (W); Mahong, *id. s.n.* (W); Tatshai, *id. 448* (E); Leang Wong mt, *McLaren's collectors 47A* (C, E); Likiang range, *id. 62A* (BM); Iao-Chou, *id. FAA 233* (C); Mekong river banks in Keng Hung, *Rock 2557* (US); Keng Hung/Cheli to Muang Hing, *id. 2604* (E, US); Likiang to Talifu, *id. 6563* (K, NY, US); W of Talifu, Mekong watershed, rd to Tengyueh, *id. 6663* (US); Ludu mts, NW of Likiang, *id. 18508* (US, W); Siao Lo Teou, Pe Yen Tsin, *Simeon Ten 77* (E); ibid. *id. s.n.* (C); Kienshui, *H.T. Tsai 53039* (PE); Lauping hsien, *id. 56113* (PE); Chetselo, *id. 58339* (PE).

INDIA: Arunachal Pradesh: Lohit distr., nr Tihun, forest, *Joseph 48150* (CAL); Subansiri Frontier Division; nr Palin, *Sastry 40606* (L); ibid., Nyapin, Panyu riverbanks, *id. 40892* (L). Assam: Laktang, *Kingdon Ward 3711* (E); Lohit valley, *id 8720* (K); Bomte La, *id. 13917* (BM); Senge Dzong, *id. 14102* (BM); sine loc., *Mann 363* (K). Manipur: Ukhrul, *Kingdon-Ward 18023* (BM, NY); Hungdung, Naga Hills, *Meebold 6848* (CAL). Meghalaya: Khasi hills; Pomlana, *Clarke 5829* (BM); Nunklow, *id. 15762* (CAL, BM); Shillong, *id. 38695* (CAL, US) & other gatherings; Boga Pani, *id. 40362* (CAL, G); Suvareen, *id. 40424* (FI, G); Mairung, *id. 44759* (K); Vale of Rocks, *id. 45477* (CAL, FI, G); Shillong, *Collett 95* (CAL, K); Mowphlang, *Griffith 1732* (K); Kala Pauce/Pomrang/Khasia regio temp., *Hooker & Thompson s.n.* (BM, C, CAL, G, K, L, NY, OXF, P, U, W); Shillong Peak, *Kingdon-Ward 18838* (BM, NY). Nagaland: Dzulake, *Bor 6230* (K); Lekwera, *id. 6607* (K); Kegwina, Kohima, *Clarke 41773* (BM, CAL, FI); Japvo ridge, *Kingdon Ward 19021* (NY); Takubama, *Thakur Rup Chand 3437* (L). Sikkim: Yoksun, *Clarke 25146* (BM, K); Chunthang, *Hooker s.n* (K); Laitrong, *id. s.n.* (K). West Bengal: Kalimpong, *Clarke 26434* (BM, CAL, K).

NEPAL: Kading, *Bailey's collectors 166* (BM): Wabak Khola, *Beer 9481* (BM); Aglochua Dada, Tistung, *Bista 3659* (BM); Shiar Khola nr Tumje, *Gardner 1413* (BM); Minchin Dhap to Mul Pokhari nr Taplejung, *Hara et al. 6301734* (BM, NY); Phulchoki S of Kathmandu, *id. 72715* (BM); Baroya Khimty to Thakma Khola, *Kanai et al. 6301735* (BM); Kalingchok, *id. 672801* (BM); Langtang valley, *id. 676173* (BM); Shimbhanjyang, *Malla et al. 38* (CAL, US); Syabrubensi to Syarpagoan, *Polunin 1300* (BM); betw. Paulotbas & Ranga, Chantlaha, S of Chehwe Lehl, *id. et al. 5535* (BM); Arun valley, Maghang Khola E. of Num, *Stainton 815* (BM, E); Satsae Khola S of Ghanesh Himal, *id. 6001* (BM); nr Humsum, *id. et al. 3525, 4322* (BM); Setikhola, *id. 6511* (BM); Lete, S of Kukucha, Kali Gandahi, *id. 7874* (BM); above Siklis S of Annapurna, *Troth 998* (BM, US); Tinjure Danda, *Williams et al. 8392* (BM, K); Mupong, *Woj 03982* (BM).

PAKISTAN: Murree, *Saxton 1593* (CAL).

VIETNAM: Yao San, N of Phong Tho, Lai Chan (Lao Kay) prov., *Poilane 26797* (P).

Notes: FRANCHET considered his *P. yunnanensis* distinct from *P. peduncularis* because of the long filiform pedicels and small glabrescent membranous calyx, but these are only minimal differences, and fall completely within the range of variability of *P. peduncularis*. Var. *violacea* Franch. of *P. peduncularis* is presumably based on relatively few genes, as flower colour usually is, hence do I not consider this material as a separate taxon.

LACKEY (1977) detected that *P. yunnanensis* and *P. peduncularis* were conspecific. In his thesis, he also listed *P. assamica* (nom. nud.), a name not effectively published. This name is pencilled on the sheet GUSTAV MANN 363 collected from ASSAM (K) as aff. *P. peduncularis* Grah.? initialled by NS.

Pueraria peduncularis is such a distinct species, that its nomenclatural history is quite uncomplicated. LACKEY (1977) included it in his group D, which in his opinion ought to be transferred from the genus. He quotes as differences the minute bracteoles, a puckered calyx base and flat papery pods. The latter are, however, also present in *P. candollei, P. collettii*, and *P. edulis*, and are perhaps somewhat sturdier in *P. wallichii*, the other anomalous species in *Pueraria*. Nevertheless, *P. peduncularis* fits the generic descriptions of DE CANDOLLE, BEN-

THAM, HUTCHINSON and LACKEY himself. LACKEY did not indicate any genus to accomodate *P. peduncularis*, although he considered each of the groups within *Pueraria* sufficiently distinct to represent a genus. LACKEY wrote that tradition and stability of nomenclature are better served by maintaining one genus, and I consider *P. peduncularis* to belong in *Pueraria*. 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.

Specimens from India, Nepal and Bhutan tend to be more luscious than those from China.

11. Pueraria phaseoloides (Roxb.) Benth.

***(Maps 9-11, p. 74, 77, 82; Plates 15-18, p. 72, 79, 80, 84)**

Pueraria phaseoloides (Roxburgh) Bentham. For typification, literature and synonymy see under varieties.

Description: *Perennial* herbaceous creeper or climber. *Stems* strong, fibrous, up to 5, mm diameter, up to 10 m long, rooting on the nodes, striate, thinly pubescent hairs spreading, 1 mm long, on a small bulbous base, somewhat deciduous. *Roots* tuberous. *Stipules* triangular to ovate, 4-11 mm long, 2-3 mm wide, ape, acuminate, striate, pubescent. *Leaves* pinnately trifoliolate; petiole ribbed canaliculate above, 3-11 cm long, more or less pubescent, hairs adpressed and spreading, bulbous-based; rachis 1-4 cm long. Top leaflets symmetrical, (broad-) ovate to rhomboid, entire or more or less lobed, 3.5-17.5 cm long, 2.5-16 cm wide, sometimes wider than long, margin entire or sinuate, side leaflets obliquely so, 4-14 cm long, 3-12 cm wide, always longer than wide, apices acuminate, acute or sometimes obtuse, mucronate, bases cuneate to rounded, sometimes truncate, green and adpressed pubescent above, dull green and quite densely adpressed-pubescent below, hairs grey, bulbous based; ribs prominent below, pubescent, three at the base, another 5 major primary laterals, in pairs or not; *petiolules* as thick as or thinner than petiole, 2-5 mm long, pubescence spreading; stipellae lanceolate to setaceous, 3-7 mm long. *Inflorescences* axillary, flowering above the middle, (10-)15-36(-46) cm long, unbranched, more or less thinly adpressed-pubescent, appearing densely pubescent in late flowering, bracts 2-5 mm long, 1-2 mm wide, striate, pubescent, ventrally glabrous, caducous; *pedicels* 2-6 mm, pubescent; bracteoles 2 per flower, ovate-lanceolate, 3-5 mm long, 1-2 mm wide, striate, thinly pubescent both sides, calyx pubescent outside, tube 3-5 mm, upper teeth acute to acuminate, halfway connate or only split at apex (var. *javanica*) 2-4 mm long, side teeth obtuse (var. *javanica*) to acute (vars. *phaseoloides* and *subspicata*), 1.5-2.5 mm long, lower tooth acute (var. *javanica*) to lanceolate-acuminate or subulate, 3-6 mm long. *Vexillum* obovate, 10-23 mm long, 8-18 mm wide, purplish or blue with green or yellow patches, blue-green, blue, pale pink, white with purple tinge, veins sometimes marked purple, or white with blue at base, rose red or mauve, apex emarginate, base shortly clawed,

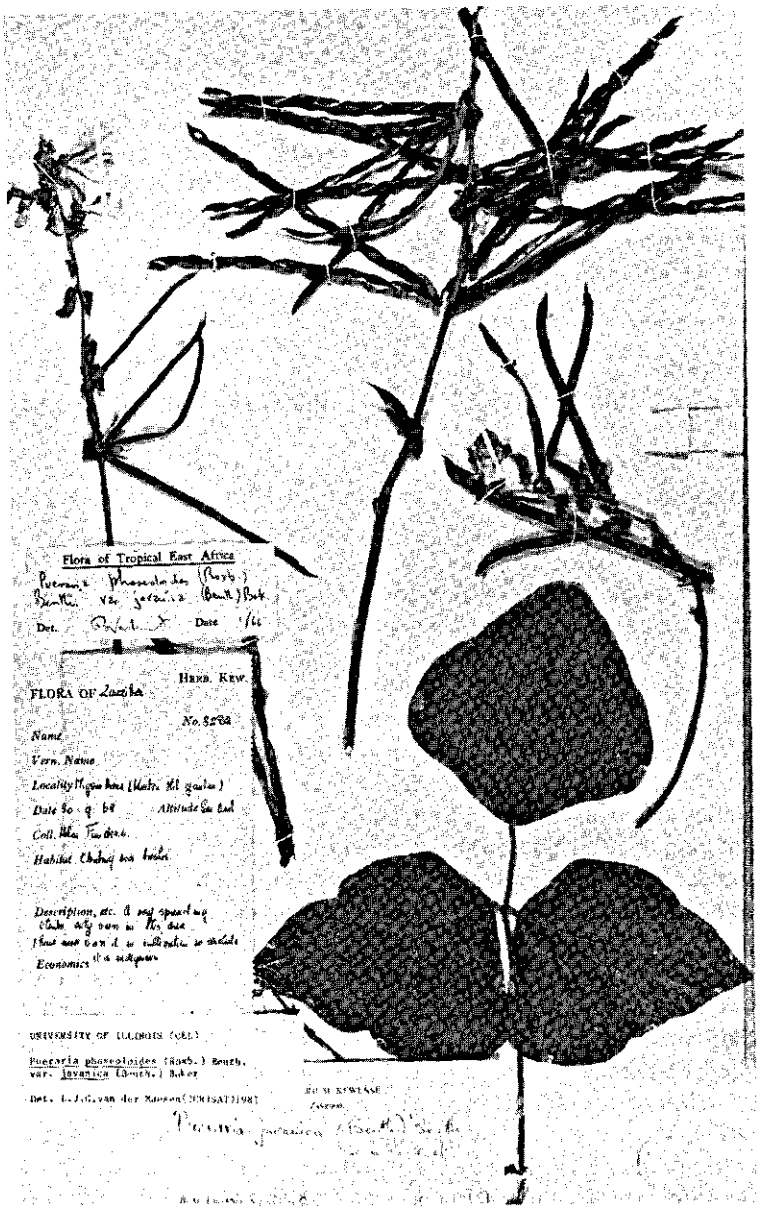


PLATE 15. *Pueraria phaseoloides* (Roxb.) Benth. var. javanica (Benth.) Baker (*Faulkner 3282*)

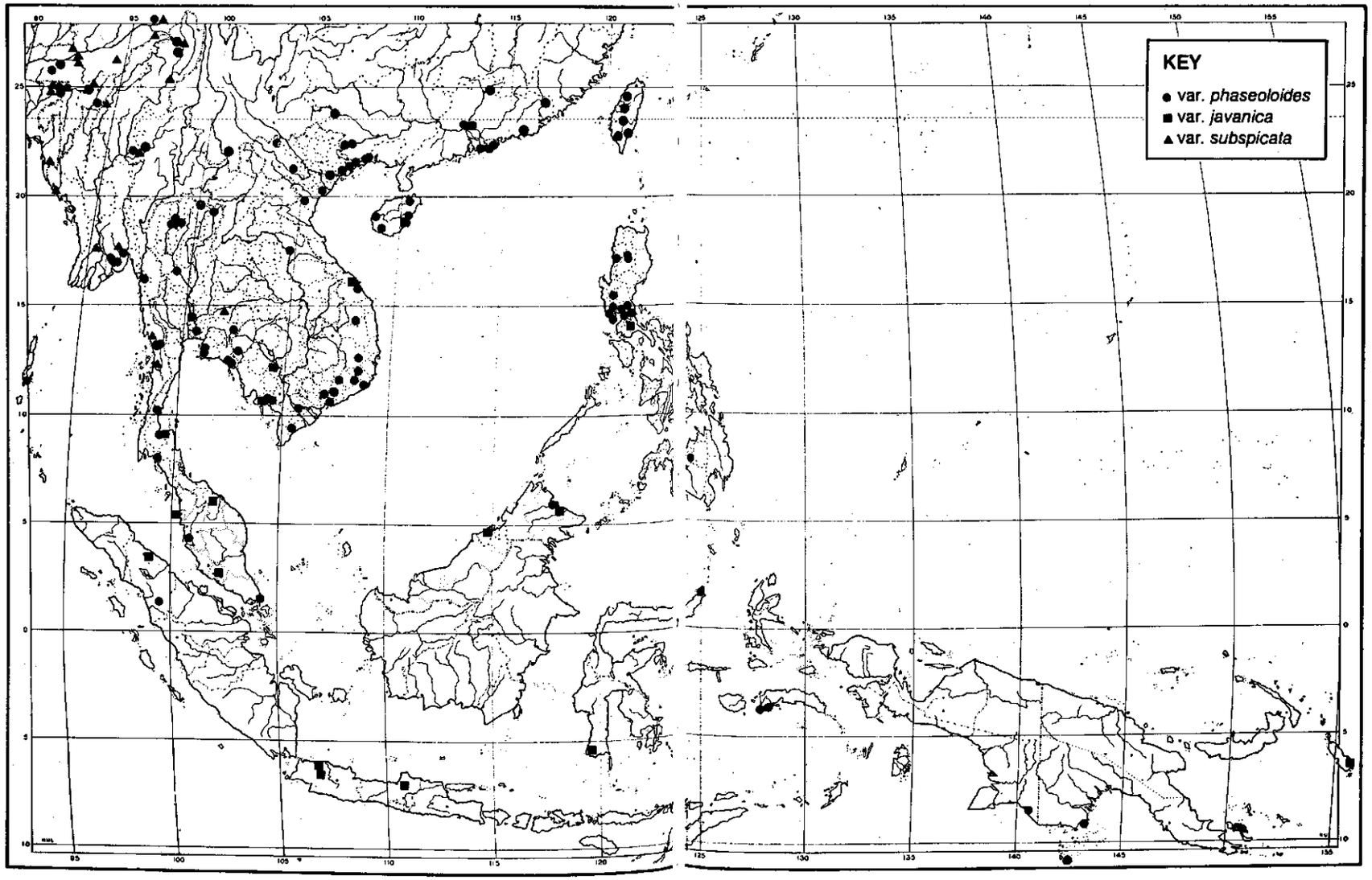
auricles short but broadly inflexed, no callosities. *Alae* long-obovate, almost reniform, 9-20 mm long, 3-6 mm wide, purplish blue or white with blue or purple tip, claw ca 3-4 mm, auricle 0.5 mm, (more pronounced in var. *javanica*), basal margin lobed. *Keel* petals triangular-clawed, ventrally adnate, 10-21 mm long, claw 4-6 mm long, purplish blue or white with blue, green, or purple tip. *Ovary*

elongate, grey silky adpressed pubescent, ca 10-15 mm long, ca 20 ovules; style glabrous, 4-9 mm, upcurved, basal part as broadened pubescent extension of ovary (var. *javanica*); stigma terminal, globular, penicillate at base. *Stamens* diadelphous, vexillary stamen free, earlier attached in bud, 11-21 mm long, free part alternatively on long and short filaments. *Pods* cylindric, round or somewhat flattened, grey to blackish, (5.5-)7-12.5 cm long, 3-5 mm wide, (10-)14-20 seeded, thinly adpressed-pubescent, apex acute, base cuneate, valves curling when ripe, showing papery partitions between seeds, sutures thickened, especially the dorsal one. *Seeds* barrel-shaped or rounded, brown or grey, 2.5-4.5 mm long, 2-3.5 mm wide, 1.5-2 mm thick, seed coat minutely tubercled or pitted, strophiole white- or red-brown, very thin, round to elliptic, 1 mm diameter. Seedling epigeal, first 2 leaves simple and opposite, ovate, 15-18 mm long, 15-16 mm wide, apex obtuse, base cordate.

Distribution: South, Southeast and East Asia, now widely spread into other tropical areas.

Uses: *Pueraria phaseoloides*, tropical kudzu, is quite successful as a fodder, green manure or cover crop in tropical tree plantations such as rubber, coconut or citrus (Wealth of India, 1969; HEYNE, 1927; BURKART 1950; DUKE 1981, where more references can also be found). Propagation of tropical kudzu is by cuttings or seeds. Seeds are produced if the plants are allowed to climb or grow in areas with a distinct dry period, in some other areas seed set may be poor. It is more suited to tropical lowlands than *P. lobata*, the kudzu. Especially var. *javanica* is widespread in the tropics, it is in general more vigorous than var. *phaseoloides*. Var. *subspicata* is probably (PRAIN 1897) the common variety in NE India, as is also confirmed by the distribution of its specimens. The edible roots are rarely consumed, where the plant is abundant (CREVOST & LEMARIE, 1917; BURKILL, 1938; Wealth of India, 1969; TANAKA, 1976; DUKE, 1981). No herbarium specimen that I saw made mention of the tubers. The fibers can be used for twines or ropes (KANJILAL et al., 1938; CREVOST & LEMARIÉ, 1917), sometimes as rough-and-ready string (BURKILL, 1938). In Malaya *P. phaseoloides* was used as a remedy for boils and foul-smelling ulcers, taken as a decoction or as a poultice for children (BURKILL, 1935). POWELL (1976) lists a medicinal use of the crushed bark: an extract to aid birth in New Britain.

Tropical kudzu can be grazed; but cattle, goats and poultry have to get used to it. As for kudzu, care has to be taken not to overgraze the canopy. Tropical kudzu (mainly var. *javanica*) was apparently introduced into South and Central America in the (late) nineteen thirties. I have not seen specimens collected earlier than 1934 (var. *phaseoloides* in Surinam). Telford s.n. from Puerto Rico (collected 13-12-1945) has a statement on the label that seed was brought to Puerto Rico in 1940 by Dr. W. F. STEWART of the Boyce Thompson Institute, New York, from the Rubber Research Institute of Malaya at Kuala Lumpur. Similarly, specimens from Africa are rather recent. On Zanzibar *P. phaseoloides* has established itself in the wild.



MAP 9. *Pueraria phaseoloides* in southeast Asia.

Key to the varieties:

1a. Flowers small, corolla 7-13(-15) mm long; bracts and calyx more or less pubescent, hairs not very long; lateral calyx lobes acute-acuminate, lower calyx lobe acuminate-lanceolate; leaflets entire, lobed or sinuate; fruit 5-9 cm long, 3-4 mm wide . . . . . **var. phaseoloides**

1b. Flowers large, corolla 15-23 mm long 2

2a. Bracts and calyx pubescent, lateral calyx lobes obtuse, lower calyx lobe acute; leaflets mostly entire, rarely somewhat lobed; fruits 7-11 cm long, 4-5 mm wide . . . . . **var. javanica**

2b. Bracts and calyx densely long-pubescent, lateral calyx lobes acute-acuminate, lower calyx lobe lanceolate-subulate; leaflets large, entire to deeply lobed; fruits 7-12.5 cm long, 4-5 mm wide . . . . . **var. subspicata**

11a. Pueraria phaseoloides (Roxb.) Benth. var. javanica (Benth.) Baker in Hooker, Fl. Brit. India 2:199 (1876); Pottinger & Prain; Rec. Bot. Surv. India 1-11: 239(1898); Verdcourt; Fl. Trop. E. Africa; Leguminosae 4-2: 594-596 (1971); id.; Manual New Guinea Legumes 487(1979); Thuan, Fl. Cambodge, Laos, Viet-nam 17: 81, 84(1979).

Basionym: *Neustanthus javanicus* Bentham in Miquel, Pl. Jungh. 2: 235 (1852); Miquel, Fl. Ind. Bat. 1-1: 218, t.4(1855).

Type: Java, Merapi, R. Kuning, Junghuhn s.n. (K, holo; not seen, *teste* Verdcourt, 1971). There is a 19th century sheet communicated by Herb. Lugd. Batav. from Java, without collector, which may be this type (NY, W, U).

Synonyms: *Pueraria javanica* (Benth.) Benth., J. Linn. Soc. Bot. London 9: 125(1867); Koorders, Excursionsfl. Java 402 (1912); Heyne, Nutt. Pl. Nederl. Indië 829(1927); Burkart, Rev. Fac. Agron. Univ. La Plata (3) 27: 141(1950); id., Legum. argent. ed. 2: 407(1952), Verdcourt, Manual New Guinea Legumes 487(1979), based on *Neustanthus javanicus* Benth.

Pachyrhizus mollis Hasskarl, Beibl. Flora Bot. Zeitschr. 25-2: Beibl. 74(1842), Miquel, Fl. Ind. Bat. 1-1: 218(1855).

Type: Java, not seen, probably at BOG.

Neustanthus sericans Miquel Fl. Ind. Bot. 1-1: 218(1855). (Non *Pueraria sericans* K. Schum., a synonym of *P. pulcherrima* (Kds.) Merr.).

Type: Java, nr Surakarta, Horsfield L 121 (K, holo, iso: U).

Distribution: Brunei, Indonesia (Java, Sulawesi), Malaysia (Malaya, N. Borneo), Philippines (Luzon), Sri Lanka, New Guinea, Solomon Islands, further introduced into Africa, South and Central America.

Ecology: Along rice fields, rivers, roads, on bushes, in evergreen forest or cleared patches, in grass vegetations, as a cover crop in plantations, occasionally an escape, on sandy (black) soil, sandy loams and heavy clays.

Altitude: 0-1100 m.

Flowering and fruiting: See table 2.

Vernacular names: English: Tropical kudzu, Puero (Australia).

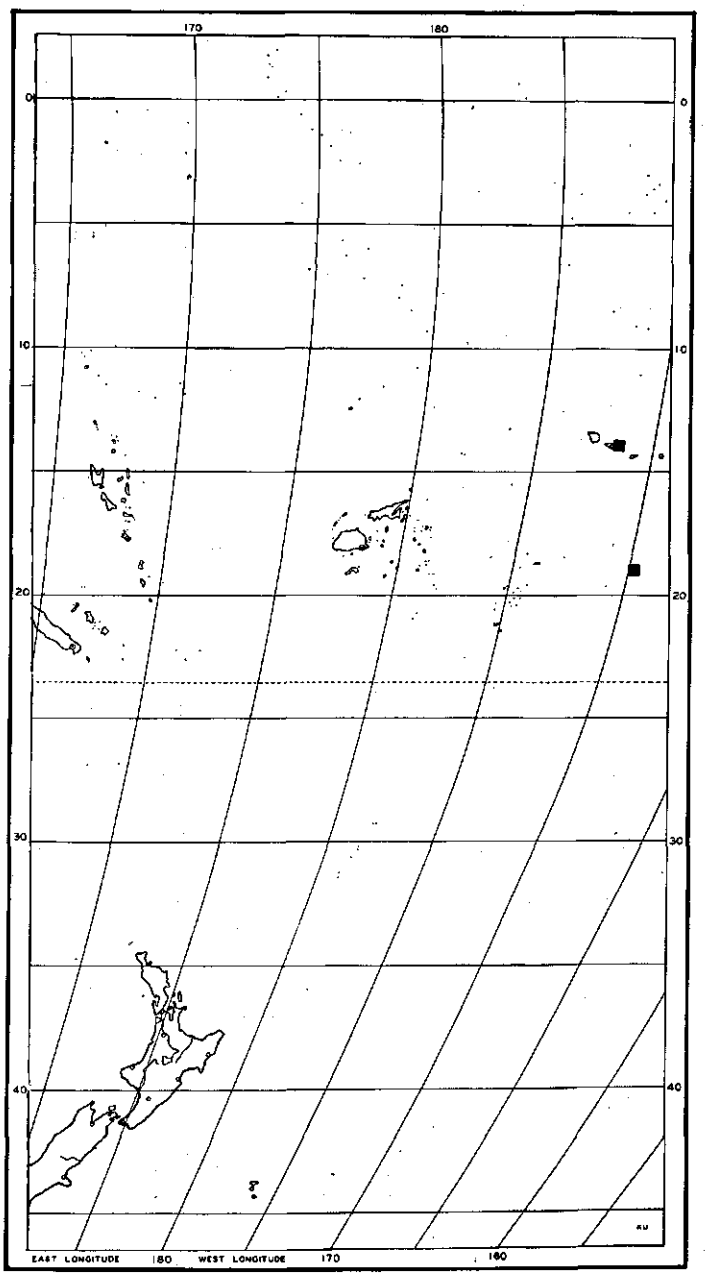
Indonesia: Kachang uchi(s), Kachang monyet (Sundanese), Kachang ruji; Krandang (Javanese); Otok buwa, Otok ghangan (Madurese); Kachang panjang (Ambon, usually for cowpea); Fuo banga (Ternate).

Malaysia: Kachang-kachang; Kachang hijan hutan; Tampong urat, Ulan susu, Suloh.

New Caledonia: Quéchot.

Spanish: Kudzu tropical.

Vietnam: Dan ma (Dong Nai), Bu cho a tau (Thuan Hai); Xuat (Dong Nai); Röta tokvih (Jorai).



MAP 10. *Pueraria phaseoloides* var. *javanica* in Oceania.

Specimens examined:

BRUNEI: nr Kampong Sungei Liang, Tutong distr., *van Niel 4283* (L).

CAMBODIA: Cam Chai forest nr Kampot, *Poilane 23225* (P); Kompong Smach, *id. 22920* (P).

CHINA: Guangdong prov., Hainan: Manning, *F.C. How 73949* (F).

INDIA: Kerala: Neyyar dam, Trivandrum distr., *Remanandan 4811* (ICRISAT). Tamil Nadu: Thadikarakonum - Valluvankal - Balmore rd. Kanyakumari distr., *Remanandan 4815* (ICRISAT); Balmore, *id. 4823* (ICRISAT). Uttar Pradesh: 13 km N. of Karnaprayag, Chamoli distr., *van der Maesen 4377* (ICRISAT). S. Andamans: Wright Myo to Wyssen Skyline, *Balakrishnan 756* (L).

INDONESIA: Java: Anon. (Miquel? Junghuhn?) sine loc. (NY, U, W); Jakarta, *Backer s.n.* (U); Bogor to Tegalsari, *Bakhuizen 1521* (U); Puger, *Boschproefstation 2904* (WAG); Subah, *id. 4259* (WAG); sine loc., *Horsfield s.n.* (BM); *id. L 121* (K, holo; iso: U); Bogor, *Keuchenius s.n.* (WAG); Cibelong, *Kuntze 4968* (NY); Purwodadi, *Molhuijsen s.n.* (BM); Panarukan, *id. s.n.* (WAG); Muma-Simpang Cidadap, S of Cibebek, *van Winckel 881* (U); sine loc., *Zollinger 240* (P). Sulawesi: S of Ujung Pandang (Makassar), *Monod 406* (L). Sumatra: Lampongs, *Forbes 1795* (CAL); Aceh, Payajorok, *Jeswiet 1676* (WAG); Medan, *Lorzing 12985* (P).

NIUE ISL: Vaiola, *Sykes 150552* (L).

MALAYSIA: Malaya, Penang, Ayer Hitam Dam Reserve, *Hardial & Samsuri 243* (K); Negri Sembilan: Seremban, Bukit Tanga Forest Reserve, *Lewis 206* (K); N. Borneo, Sandakan, Sibuga rd nr Kebon China Forest Reserve, *Meijer San 41120* (K).

PAPUA NEW GUINEA: above Everill junction, Fly river, *Jeswiet 121* (WAG); Beyond Subitana, Javarere rd, Sogeri subdistr, Central distr., *Womersley & van Royen 4217* (K).

PHILIPPINES: Luzon: Lamao river, Mt. Mariveles, Bataan prov., *Borden 2340* (CAL, E, K, NY, US); Mt. Makiling, Laguna Prov., *Sulit 34073* (BM, US); Pandacan, Manila, *Vera Santos 6322* (US);

SAMOA: Upolu, Vailele, *Whistler 185* (US); Upolu, Tonitoniga, *id. 217* (US).

SOLOMON ISLANDS: Malaita: Bannani, *E. S. Brown W/253* (BM); Guadalcanal, Reae, *id. W/277* (BM); Leunga, *id. 778* (BM); Ilu, *id. 3859* (BM), BOUGAINVILLE: Numa Numa, *id. 5237* (BM); Panguna S, Kieta distr, *Womersley 48637* (L).

SRI LANKA: W. Prov: Pelawatte, Kalutara distr., *Cramer 2807* (US); Labugama Forest Res., Reservoir, Avissawella Rd. 48 km from Colombo, *Rudd & Jayasinghe 3326* (US). C. Prov.: Kandy, *Fairchild & Horsett 372* (US); Peradenya, *de Silva 124* (NY); Doluwa nr. Kandy, *Rudd & Albert 3159* (K, NY, US); NW of Galagedera rd to Mawatagama, Kandy distr., *Rudd 3315* (NY, US); ibid., *id. 3334* (US).

THAILAND: Peninsula, Naratiwat, Sungei Kolok, Nikom Waeng, *Larsen 32862* (K).

VIETNAM: Tourane, *Poilane 28892* (P). Some of the specimens seen and quoted by Thuan (1979) are really var. *phaseoloides*.

Other specimens seen were collected in ANGOLA, BRAZIL, CAMEROON, DOMINICAN REPUBLIC, GHANA, HONDURAS, JAMAICA, LIBERIA, MARTINIQUE, MEXICO, NIGERIA, PERU, PUERTO RICO, SURINAM, TANZANIA, TRINIDAD.

11b. Pueraria phaseoloides (Roxb.) Benth. var. phaseoloides, J. Linn. Soc. Bot. 9: 125(1867). Baker in Hooker, Fl. Brit. India 2: 199(1876); Hemsley, J. Linn. Soc. Bot. 23: 191(1887); Taubert in Engl. & Prantl Natürl. Pflzfam. 3-3: 371(1894); King, J. Asiat. Soc. Bengal 66-1: 61(1897); Prain, J. Asiat. Soc. Bengal 66-2: 420(1897); Duthie, Fl. Upper Gang. Plain 234(1903); 216(repr. 1960); Prain, Bengal Pl. 282(1903, repr. 1963); Perkins, Fragm. Pl. Philipp. 1-3: 212(1904); Merrill, Enum. Philipp. Legum., Philipp. J. Sci. Bot. 5: 123(1910); Burkill, Rec. Bot. Surv. India 4-4: 106(1910); Hyata, Icon. Pl. Formos. 1: 198(1911); Koorders, Exkursionsfl. Java 403(1912); Merrill, Fl.Manila 254(1912); Gagnepain, Fl. Gén. Indo-Chine 2: 253(1916); Crevost & Lemarié, Cat. Prod. Indochine 1: 135(1917); Merrill, Interpr. Rumph. Herb. Amboin.

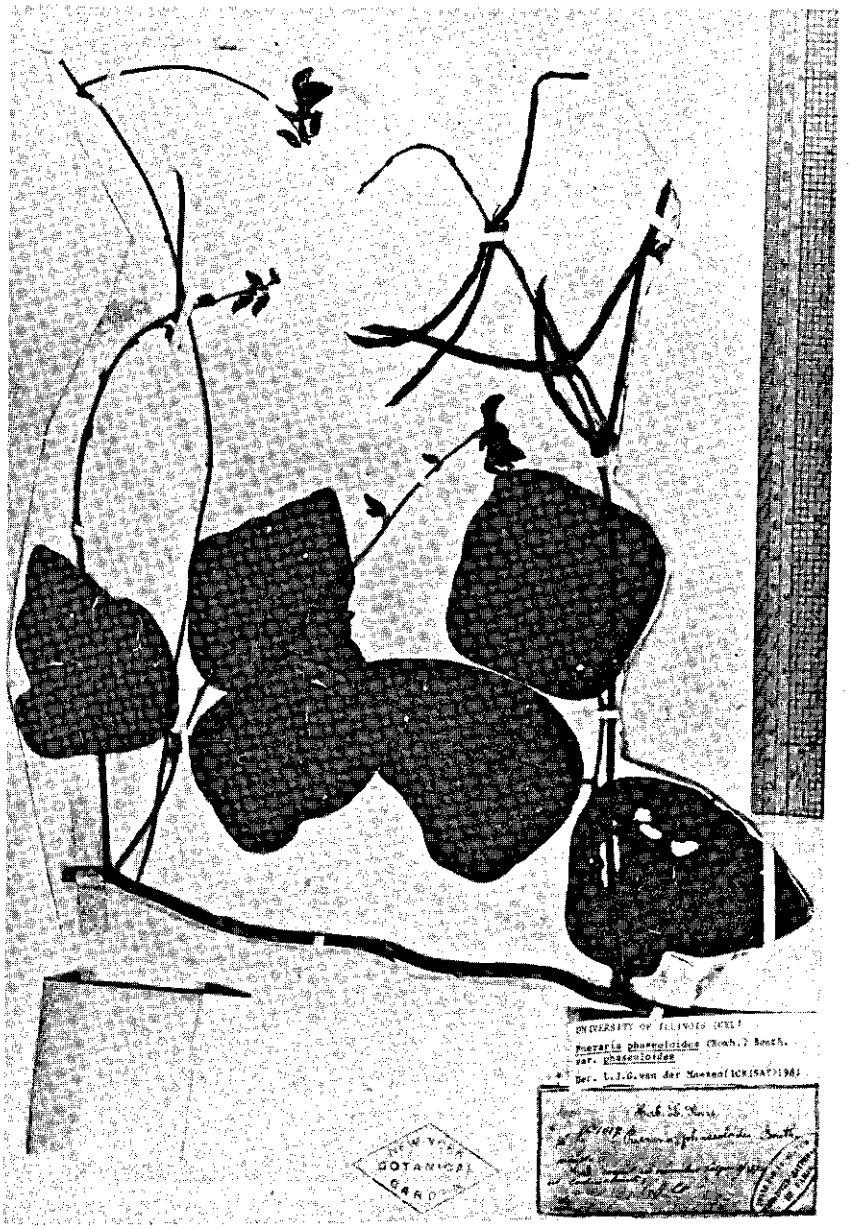


PLATE 16. *Pueraria phaseoloides* (Roxb.) Benth. var. *phaseoloides* (*Pierre 1017*)

282(1917); Merrill, Sp. Blancoanae 189(1918); Ridley, Fl. Malay Penins. 1: 571(1922); Haines, Bot. Bihar Orissa 3: 304(1922); repr 2: 295(1961); Merrill, Enum. Philipp. Fl. Pl. 2: 311(1923); Heyne, Nuttige Pl. Nederl. Indië 829(1927);

PLATE 17. *Pueraria phaseoloides* (Roxb.) Benth. var. *phaseoloides* (*van der Maesen 4871* in situ, West Bengal, India)

Craib, Fl. Siam. Enum. 1-3: 450(1928); Kanjilal et al., Fl. Assam 2: 82(1938); Amshoff, Fl. Suriname 2-2: 209(1939); Guillaumin, Fl. Anal. Synopt. Nouv. Calédonie 149(1948); Backer, Fl. Java 1: 362(1963); Rao & Joseph, Bull. Bot.

Surv. India 7: 144(1963); Biswas, Pl. Darjeeling, Sikkim Himalayas 1: 291(1966); Verdcourt, Fl. Trop. E. Afr. Legum. 4: 596(1971); Thothatri, Rec. Bot. Survey India 20-2: 81(1973); Anon., Fl. Hainanica 2: 320(1977?); Lackey, Synops. Phaseol. 72, 75(1977); Ohashi, Fl. Taiwan 3: 370(1977); Thuan, Fl. Cambodge, Laos, Viet-nam 17:83, 83(1979); Verdcourt, Manual New Guinea Legum. 485(1979); Hara & Williams, Enum. Fl. Pl. Nepal 2: 128(1979); Anon., Icon. Corm. Sinic. 2: 503(1980); Perry, Medicinal Pl. E & SE Asia, Cambridge Mass. 224-225(1980); Duke, Handb. Leg. World Econ. Importance 214(1981).

Basionym: *Dolichos phaseoloides* Roxb., Fl. Indica 3: 316(1832).

Type: India, Calcutta Bot. Garden, grown from seeds received from Kerr at Canton, China (CAL? not seen). VERDCOURT (1971) included as syntype *Roxburgh's drawing no. 1890* (K, not seen).

Synonyms: *Dioscorea bolojonica* Blanco, Fl. Filip. 800 (1837); ed. 2: 551(1845); Llanos & Fernandez-Villar, Fl. Filip. ed. 3, 3: 208(1879); Merrill, Sp. Blancoanae 189(1918).

Neotype: Philippines, Pasay, Rizal prov., Luzon, Merrill Sp. Blanco. 195 (US, holo; iso: F, NY, W).

Dolichos viridis Hamilton ex Wallich nom. nud., based on Wallich Cat. No. 5559 (K, also at BM); Benth. in Miq. Pl. Jungh. 2: 235(1852); id., J. Linn. Soc. Bot. 9: 125(1867); Baker in Hooker, Fl. Brit. India 2: 199(1876).

Phaseolus barbatus Graham ex Wallich nom. nud., based on Wallich Cat. No. 5559 B(1831); Bangladesh, Sylhet (K, also at BM).

Phaseolus decurrens Graham ex Wallich nom. nud., Wallich Cat. No. 5612(1831), (*teste Prain*). In the E. I. Herbarium actually written as *P. decurrens*. Bentham, J. Linn. Soc. Bot. London 9: 125(1967); Baker in Hooker, Fl. Brit. India 2: 199(1876); Ind. Kew. (1895); Prain, J. Asiatic Soc. Bengal 66-2: 420(1897), based on Wallich 5612 (K, not seen) from Penang, coll. G. Porter. Not misquoted as stated by Prain (l.c.), but intended to be *Pueraria decurrens*.

Neustanthus phaseoloides (Roxb.) Benth. in Miquel, Pl. Jungh. 2: 234(1852); Miquel, Fl. Ind. Bat. 1-1: 219(1855); Bentham, Fl. Hong Kong 88(1861); id., J. Linn. Soc. Bot. 9: 125(1867), based on *Dolichos phaseoloides* Roxb.

Pachyrhizus montanus Blanco (non(Lour.)DC.), Fl. Filip. ed. 2: 406(1845); Llanos & Fernandez-Villar, Fl. Filip. ed. 3, 2: 380(1879); Merrill, Enum. Philipp. Legum., Philipp. J. Sci. Bot. 5: 123(1910); id., Sp. Blancoanae 189(1918); id., Enum. Philipp. Fl. Pl. 2: 311(1923). Merrill reduced this name since description and Tagalog vernacular fully agree with *Pueraria phaseoloides*, commonly available on Luzon. Blanco's herbarium was lost.

Pachyrhizus teres Blanco, Fl. Filip. 580(1837); Merrill, Enum. Philipp. Le-

gum., Philipp. J. Sci. Bot. 5: 123(1910); id. Sp. Blancoanae 189(1918); id. Enum. Philipp. Fl. Pl. 2: 311(1923). The description and vernacular given by Blanco apply unmistakenly to *P. phaseoloides*, hence the reduction by Merrill. No type material extant.

Distribution: China, Vietnam, India, Bangladesh, Nepal, Philippines, Indonesia, Thailand, Burma, Sri Lanka, Taiwan, Malaya, New Guinea, occasionally introduced, e.g. Liberia, Cameroon, Nigeria, Suriname.

Ecology: Trailing in savannah grasses, open grounds in scrub, roadsides, in mixed forests in shade, bamboo forests, on trees and shrubs in open jungle, near paddy fields, stream margins, sandy or clayey soils, low hills, widely cultivated in plantations.

Altitude: 0-1600 m.

Flowering and fruiting: see table 2.

Vernacular names:
CHINA: Yie g(u)e teng, Ye sha kot.
BURMA: Pe ying pin.
VIETNAM: Dau dai, Dan ma, Ci rung, Dau rung (Tonkin).
PHILIPPINES: Bahay (Tagalog); Bahai, Bajai (Cebu Bisaya); Sinkamas aso (Tagalog); Vai (Ivatan).
JAPAN: Kuzu-ingen.
GERMANY: Knollengrische (Gerth van Wijk, 1911).

Specimens examined (majority of sheets seen):

BANGLADESH: Bholagange, Sylhet, *Clarke 17430* (BM, CAL): Rangpur, *id. 26830* (CAL, K); Jaintiapur, Sylhet, *id. 42438* (US); Sylhet, *Wallich 5559* B (BM).

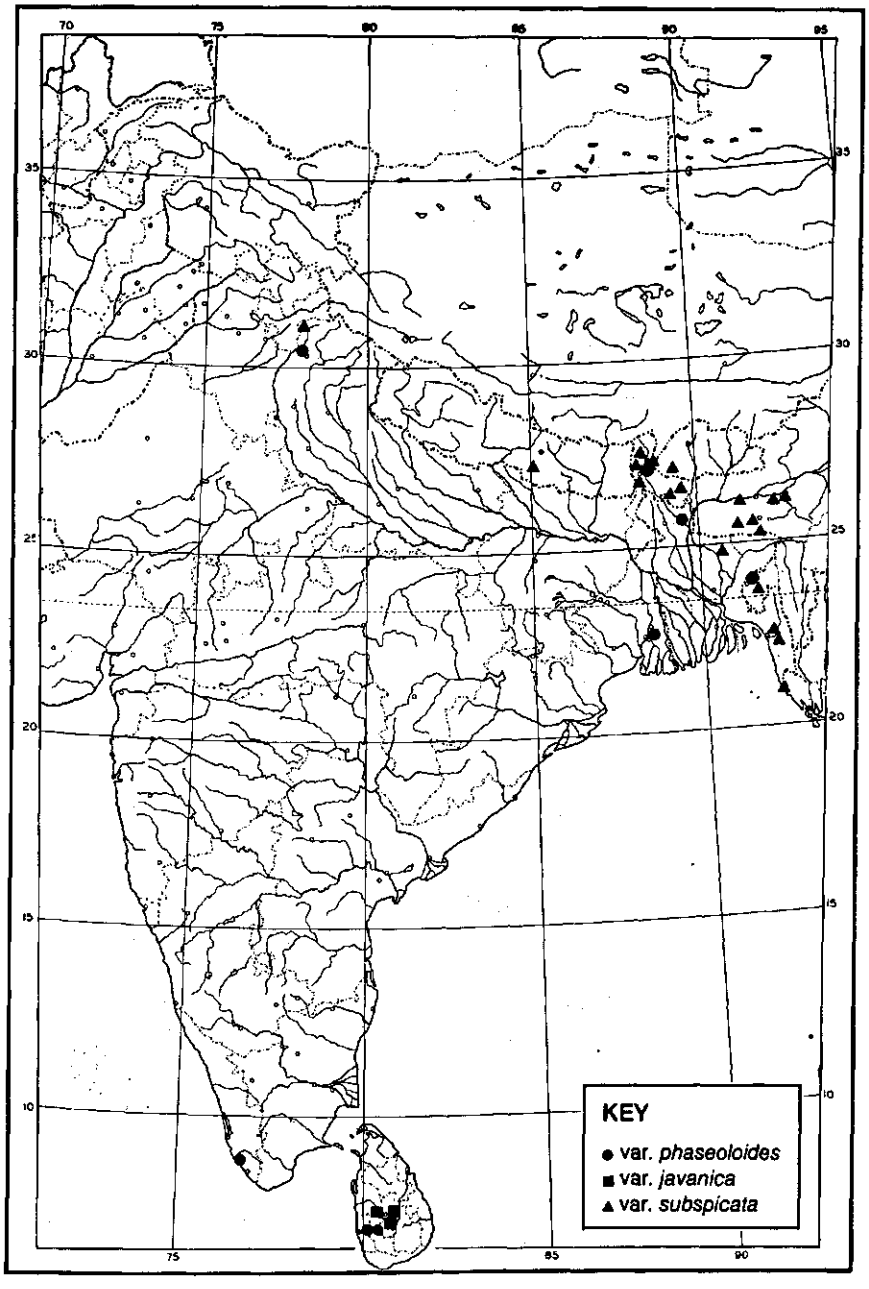
BURMA: Rangoon, *Dickason 6591* (CAL, E, L); Moulmein, *Kuntze 6288* (NY); Pegu, *Kurz 1726* (W); Maymyo, *Lace 4329* (CAL, E); Mingaladon nr Rangoon, *Vogt BU-52* (US).

CAMBODIA: Kampot, *Geoffray 253* (P); between Benteai Chmai and Ton Choum, Battambang and Siem Reap prov., *Poilane 14427* (P); Cam Chai nr Kampot, *id. 22847* (P).

CHINA: Kwangtung/Guangdong prov.: Wu Pua, Hainan, *Anon. 68189* (NAS); Canton vicinity, *Levine 1837* (BM, C, E, US); Tingwu Sham, *Ting & Shih 992* (L); Tung Koo Shan, Tapu distr., *W.T. Tsang 21600* (NY); Ba Wan Tang, Haifeng county, *Z.F. Wei 121340* (NAS); Wushan to Colored Metal Factory Yard, Guangzhou city, *H.G. Yip 196* (KWA). Kwangsi/Guangxi prov.: Longtcheou/Lungching, *Beauvais s.n.* (P); ibid., Simond s.n. (P); Bako Shan, W. Poseh, *R.C. Ching 7609* (NAN).

INDIA: Kerala, Quilon, *Wight 755* (CAL, K). Manipur: Kanglatongbi, *Bullock 627; 655* (K). Meghalaya: Theria, *Clark 44995* (US); Jowai, *King's collector s.n.* (BM); 27 km from Raliong to Garampani, *Remanandan 4696* (ICRISAT); Dawki market & vicinity, *Panigrahi 4678* (L). Uttar Pradesh: Dehra Dun & vicinity, *Umrao Singh 410* (NY). West Bengal: near Calcutta, *Helfer 116* (BM, C, F, NY, US, W); nr Teesta river suspension bridge, *van der Maesen 4854* (ICRISAT); 9 km S of Sevoke, *id. 4871* (ICRISAT).

HONG KONG: Tai-O, New Territory, *W.Y. Chun 3101* (F, NY): Peak to Taitam Tuk, *id. 7522* (NY); above Happy Valley, *id 7459* (NY, W); Chung Chi College, *Shiu Ying Hu 5589* (US); Ma



MAP 11. *Pueraria phaseoloides* in south Asia.

On Shan, *id. 6479* (US); Lantao Isl., *Y.W. Taam 1753* (F, NY, US).

INDONESIA: Sula Mangoli, Sula Isls, Moluccas, *Bloembergen 4679* (NY); nr Menado, Sulawesi, *Nielsen 778* (C); Amboina, *Robinson 565* (US); ibid., *id. 607* (NY); Tapianuli, Padang Sidempuan Div., *Rahmat Si Toroes 4905* (NY); Mopa Airstrip near Merauke, N. Guinea, *van Royen 4541* (K).

LAOS: Thakhet, Cummon prov., *Poilane 28173* (P).

MALAYSIA: Malaya, Sungei Tukong, Johore, *Gordon Spane F 692* (K); Perak, *King's Collector 5117* or *5717* (BM, P, US): Segaliud, Elopura Sandakan, North Borneo, *Cuadra 1083* (US).

NEPAL: Tilhar, *Stainton et al. 7042* (BM).

PAPUA NEW GUINEA: Daru Isls., W. Div., *Brass 6037* (US?); Mapamoiwa, Fergusson Isls., Milne Bay Distr., *id. 25147* (L); Laloki River, *Carr 12935* (NY); Soputa, *Kalk Russell s.n.* (US).

PHILIPPINES: Luzon: Manila, *Barthe s.n.* (P); U.P. Diliman, Quezon City, *Dizon 29* (US); San Andales, Rizal prov., *Edaño 48830* (W); Mt. Mariveles, Bataan prov., *Elmer 6719* (E, NY); Conception, Tarlac prov., *Merrill 3620* (K, NY, US); Bontoc subprov., *Vanoverbergh 1878* (P); Sablan, Benguet prov., *Williams 139 Y* (NY). Mindanao: Camp Keithly, Lake Lanao, *Strong Clemens 640* (F).

SRI LANKA: Deraniyagala, *Douglas Simpson 9144* (BM).

TAIWAN: Bankensing Mts., *Henry 1503* (K, NY).

THAILAND: Ban Si Racha, *Collins, 646* (US); Doi Sutep, *Kerr s.n.* (BM); Chiangmai, *id. 1468* (C, CAL, K); Bangkok, *id. 9360* (BM, E); Surat, *id. 11294* (BM); Chumpawn, *id. 11641* (BM); Aranya Praket, *Put 2006* (K); between Trang & Krabi, *Sørensen et al. 767* (C, E); 25 km N of Nan, W of Nan River, *Walker 7965* (US).

VIETNAM: Ha Son Binh prov.: Bat-Bac, *Balansa 2283* (P); Quang Ninh prov.: Uong Bi, *id. 1188;*(CAL, P) & *1195* (P); Thanh Hoa prov.: Quang Yen, *id. 1194* (P); Ha Nam Ninh prov.: Khang Thuong, *Bon 562* (P); Dong Nai prov.: Mt Chau Chang, *Chevalier 29842* (P); Tourane & vicinity, *J. & M.S. Clemens 3421* (BM, C, NY, U, US); Dalat, *Evrard 1305* (P); Hoang Lien Son, Yen Bay, *Lecomte & Finet 614* (P); Dong Nai prov.: Mt. Dinh, *Pierre s.n.* (BM, NY, P, US); Ho Chi Min City-Saigon, *id. 1017* (BM, NY, P, US); Thanh Hoa prov.: Lung Van, *Poilane 18891* (P); Pong Tho to Ye Yen Sun, *id. 26718* (P); Quang Ninh Prov.: Taai Wong Mo Shan, *W.T. Tsang 30360* (C, E).

11c. Pueraria phaseoloides (Roxb.) Benth. var. subspicata (Benth.) van der Maesen stat. nov.

Basionym: *Neustanthus subspicatus* Bentham in Miquel, Pl.Jungh. 2: 234(1852); Miquel, Fl. Ind. Bat. 1-1: 219(1855).

Lectotype: Bangladesh, mountains near Sylhet, *Wallich 5557A* (*Dolichos spicatus* Wall. nom. nud.) (K, holo; iso: BM, E, G, K, W).

Paratypes: India: Goalpara, Hamilton, *Wallich 5557B* (not seen); Bangladesh: Sylhet; *Wallich 5557C* (K, G, NY).

Synonyms: *Dolichos spicatus* Wall. nom. nud., Wallich 5557 (l.c.); Benth. in Miq. Pl. Jungh. 2: 234(1852); id., J. Linn. Soc. Bot. 9: 125(1867); Baker, in Hooker, Fl. Brit. India 2: 199(1876).

Dolichos ficifolius Grah. nom. nud., Wallich Cat. No. 5563, based on Wallich 5563a: Burma, Prome 1826(K, BM, G) and 5563b: Burma, Tavoy W.G. 447(K, G).

Pueraria subspicata (Benth.) Benth., J. Linn. Soc. London 9: 125(1867); Baker in Hooker, Fl. Brit. India 2: 199(1876); Kurz, J. Asiatic Soc. Bengal 45-4: 253(1876); Prain, J. Asiatic Soc. Bengal 66: 420(1897); Pottinger & Prain, Rec.

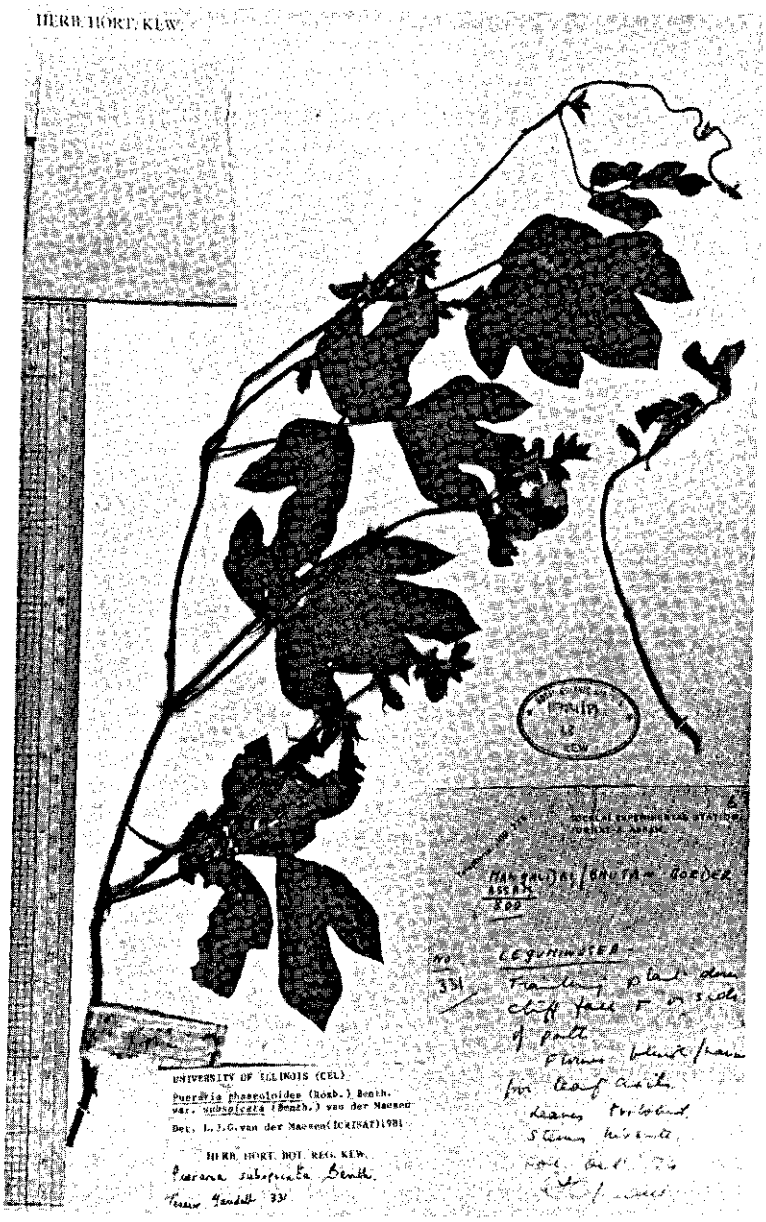


PLATE 18. *Pueraria phaseoloides* (Roxb.) Benth. var. *subspicata* (Benth.) van der Maesen (*Yandell 331*)

Bot Surv. India 1-11: 239(1898); Prain, Bengal Pl. 1: 282(1903, repr. 1963); Craib, Fl. Siam. Enum. 4-3: 455(1928); Kanjilal et al., Fl. Assam 2: 82(1938); Thothathri, Rec. Bot. Surv. India 20-2: 81(1973); Lackey, Synops. Phaseol. 72, 75(1977). Based on *Neustanthus subspicatus* Benth.

Distribution: Bangladesh, Burma, India (Assam, Meghalaya, Sikkim, Bengal), Thailand.

Ecology: Mixed deciduous forest, scrub vegetation, along roads, tanks.

Altitude: 0-1300 m.

Flowering and fruiting: See table 2.

Vernacular names: India: Jermei-kyn-saw, Jermei-soh-gonsoh (Assamese, Khasi) Nepali: Bon Kalai.

Specimens examined:

BANGLADESH: Bholagunj, Sylhet, *Clarke 14341* (CAL, K); Thavia, Sylhet, *id. 18502* (BM, CAL); East Bengal, *Griffith 1713* (C); Sylhet, *Hooker s.n.* (K, W); Teknaf, *M.S. Khan 621* (CAL); Chittagong Hill Tracts, *King's collector 586* (CAL, K); Signal Hill, Cox's Bazar, *Sinclair 328* (CAL, E); Sylhet & mountains nearby, *Wallich 5557a* (K, hololecto; iso: BM, E, G, K, W).

BHUTAN: Sarbhang div., Kalikhola forests, Gaylegphug, *Sen Gupta 816* (CAL).

BURMA: Tenasserim, *Helfer 1713* (P); Maymyo, *Lace 4247* (E); Tamu, Upper Chindwin, *Meebold 7523* (E); Kachin hills, *Shaik Mokim s.n.* (CAL, E, US); ibid., Myitkyina, *id. 95* (CAL, W); Pegu, *Scott 350* (BM); Thechaung, Akyab Isl., Arakan coast, *Vogt BU 242* (US); Prome, *Wallich 5563A* (BM, G, K); Tavoy, *Wallich 5563B* (G, K).

INDIA: ? Gowhatty Ghat, *Anon. 395* (CAL, US); sine loc., *Anon. 1506* (NY); E. Himalaya, Farseng, *Cave s.n.* (E). Arunachal Pradesh: Lohitpur, *A.S. Rao 47945* (CAL); Siang Frontier Div., West of Tuting, *R.S. Rao 17036* (CAL); Tirap Frontier Div., Nampong to Pangsu Pass, *id. 20009* (CAL); ibid, Namsang to Soha, *id. 20339* (CAL). Assam: Singra, *Chatterjee s.n.* (P); Assam plains, *Hooker s.n.* (P); sine loc., *Jenkins s.n.* (G); Gaurisagar, Sibsagar distr., *Kanjilal 1819* (CAL); Sonari, ibid., *id. 2023* (CAL); Nowgong, *Simons 168,169* (K); Mangaldai, nr Bhutan border, *Yandell 33* (K). Manipur: Barak, *Meebold 6295* (CAL, K); Ukhrul, *Mukerjee 3122* (CAL). Meghalaya: Khasi hills, Sharla, *Clarke 14919* (K); Sohra, *id. 15610* (BM,K); regio trop., Hooker & Thompson(K); Isamati, *Kanjilal 6244* (CAL). Nagaland: Dimapur, *Clarke 40819* (BM,CAL, K). Sikkim: Terai, Dulkajhar, *Clarke 36916* (BM); Selim, *id. 36867* (CAL); lower hills, *Hooker s.n.* (K); Terai, *id. s.n.* (K); regio trop., *id. s.n.* (K); Rungbee, *W.W. Smith 268* (CAL). West Bengal: Jaldakar, Darjeeling distr., *Cave 37* (CAL); Siliguri, *Clarke 27027* (K); West Duars, *Haines 513* (K); Alipur Duars, *Heawood 116* (CAL); 1 km S. of Sevoke, 16 km N. of Siliguri, *van der Maesen 4870* (ICRISAT); Nagurhat to Cooch Behar, *Mukerjee 4657* (CAL); Sukna, *id. 6218* (CAL); Bankura, Joypur forest, *Sanyal 812* (CAL).

NEPAL: Pursona betw. Birganj & Hettoura, *Burkill 19381* (CAL).

THAILAND: Pak Thong Chai, Sakaerat Forest Res. along Nuai Krae stream, *van Beusekom & Charoenpol 1986* (E); Hui Taleng, Korat, *Put 2253* (K).

Notes: Some authors (BAKER, 1876; Index Kewensis, 1895; and in herb.) considered *P. subspicata* as conspecific with *P. phaseoloides*, but PRAIN (1897) strongly opposed this: the leaflets are almost always more deeply lobed, the flowers much larger, the pods usually longer, with dorsal sutures thickened, while he found no intermediate forms in the Calcutta Herbarium. KANJILAL et al. (1938) described *P. subspicata* as very similar to *P. phaseoloides*, CRAIB (1928), THOTHATHRI (1973) and LACKEY (1977, quoting PRAIN, 1897) kept the species apart. BENTHAM remarked that the habitus and leaves conformed with his *P. javanica*. This is precisely the point, all three taxa differ, and can be keyed

Table 2. Flowering and fruiting of *P. phaseoloides*

	Flowering	*Fruiting*
Var. phaseoloides		
Bangladesh	Oct, Nov	Oct-Dec
Burma	Oct-Nov	Oct-Nov
Cameroon	Jan	Feb?
China	(Aug) Sept-Nov	Sept-Jan, Mar
India	Oct, Nov	Oct-Dec
Indonesia	Jul	Aug?
Liberia	Dec	Jan
Malaya	Jan, Nov	Nov, Feb?
Nepal	Sept	Oct
New Guinea	Mar-Apr, Aug-Nov	Mar, Nov
Philippines	Jul, Nov-Dec	Aug? Nov-Jan
Sri Lanka	Jan	Jan
Suriname	Jun, Nov-Jan	Jul, Nov-Jan
Thailand	Oct-Jan	Nov-Jan
Vietnam	Sept-Dec	Sept-Dec
Var. javanica		
Angola	Sept	Oct
Brazil	May	May
Cameroon	Jan	Feb
Caribbean Islands	Dec-Feb	Dec-Feb
China, Hainan	Oct	Oct
Ghana	Dec	Jan
Indonesia	Jun-Sept	Jun-Sept
Kenya	Jul-Sept	Aug, Oct
Liberia	May	May, Jun
Malaya	Mar, Aug	Mar, Aug
Mexico	Dec	Dec
New Guinea	Jun	Jul
Nigeria	Mar	Mar
N. Borneo	Dec	Jan
Philippines	Dec	Dec, Jan
Peru	Jul	Jul
Solomon Islands	May-Aug, Oct	Jul-Aug, Oct
Sri Lanka	Feb-Mar, Oct	Feb, Oct
Suriname	Nov, Jan	Nov, Jan
Tanzania	Jul-Sept	Aug, Oct
Thailand, S.	Mar, Aug	Mar, Aug
Var. subspicata		
Bangladesh	Oct-Dec	Oct-Dec
Burma	Aug	Aug, Dec
India	Sept-Nov, Feb	Oct-Dec, Feb
Thailand	Nov	Dec

out easily if not too many parts are missing, but approach each other either sizewise or they have overlapping morphological characters. Now that many more specimens are available for inspection, the sharp boundaries PRAIN saw at CAL in 1897 have disappeared. The three taxa are much more conveniently

placed as varieties and biosystematic research may confirm conspecificity e.g. by producing viable hybrids. It appears plausible that var. *phaseoloides* originated or developed in SE China, var. *javanica* in Java and Malaya, var. *subspicata* in NE India. It could be argued that the varieties, or at least var. *subspicata* can better be ranked as subspecies, but their geographical distribution is now overlapping. The ecology of all three varieties of *P. phaseoloides* is virtually the same.

12. Pueraria pulcherrima (Kds.) Merr. ***(Map 12, p. 91)**

Pueraria pulcherrima (Koorders) Merrill in Koorders-Schumacher, Syst. Verz. 2: 132(1914); id., Enum. Philipp. Fl. Pl. 2: 312(1923); Lackey, Synops. Phaseol. 71, 75(1977); Verdcourt, Manual New Guinea Legumes 487(1979).

Basionym: *Mucuna pulcherrima* Koorders, Meded. Lands Plantentuin 19: 440/630(1908);

Type: Indonesia, Sulawesi (Celebes); Minahasa, Menado along Ranoyapo River nr Amurang, *Koorders 17699*(BOG, holo, not seen; iso: L).

Synonyms: *Pueraria warburgii* Perkins, Fragm. Fl. Philip. 1: 87(1904); Merrill, Enum. Philipp. Legum., Philipp. J. Sci. Bot. 5: 124(1910).

Type: Philippines, Mindanao Isl., Taumo, *Warburg 14664*(B, holo, not seen).

Glycine warburgii (Perk.) Merr., Philipp. J. Sci. Bot. 3: 231(1908); id., ibid. 5: 124(1910); based on *Pueraria warburgii* Perkins.

Pueraria novo-guineensis sensu Pulle non Warb., Nova Guinea 8-2: 382(1910); Verdcourt, Manual N. Guinea Legumes 487(1979); based on Irian Jaya, *Versteeg 1202*(L, U).

Pueraria pilosissima Baker f., Trans. Linn. Soc. Bot. 2nd series 9: 33(1916); Verdcourt, Manual New Guinea Legumes 487(1979).

Type: Indonesia, W. New Guinea, Canoe Camp 150 ft(BM, holo? see notes).

Pueraria sericans K. SCHUMANN (non BENTHAM, non *Neustanthus sericans* Miquel), Fl. Kaiser Wilhelmsland 99(1889); Karnbach, Beibl. 37, 15, Engler Bot. Jahrb. 16(1892).

Type: New Guinea, Kuliku-mana nr Constantinhafen, *Hollrung 566*(K, *lectotypus novus*, ex B).

Paratype: New Guinea, Uassa nr Boja river nr Finschhafen, *Hollrung 231* (not seen).

Pueraria textilis Lauterbach & K. Schumann, Schumann & Lauterbach, Fl. deutsch. Schutzgeb. Südsee 368(1910).

Lectotype: New Guinea, Finschhafen, on Bumi river, *Lauterbach 636*(B, holo? not seen; iso: CAL, L).

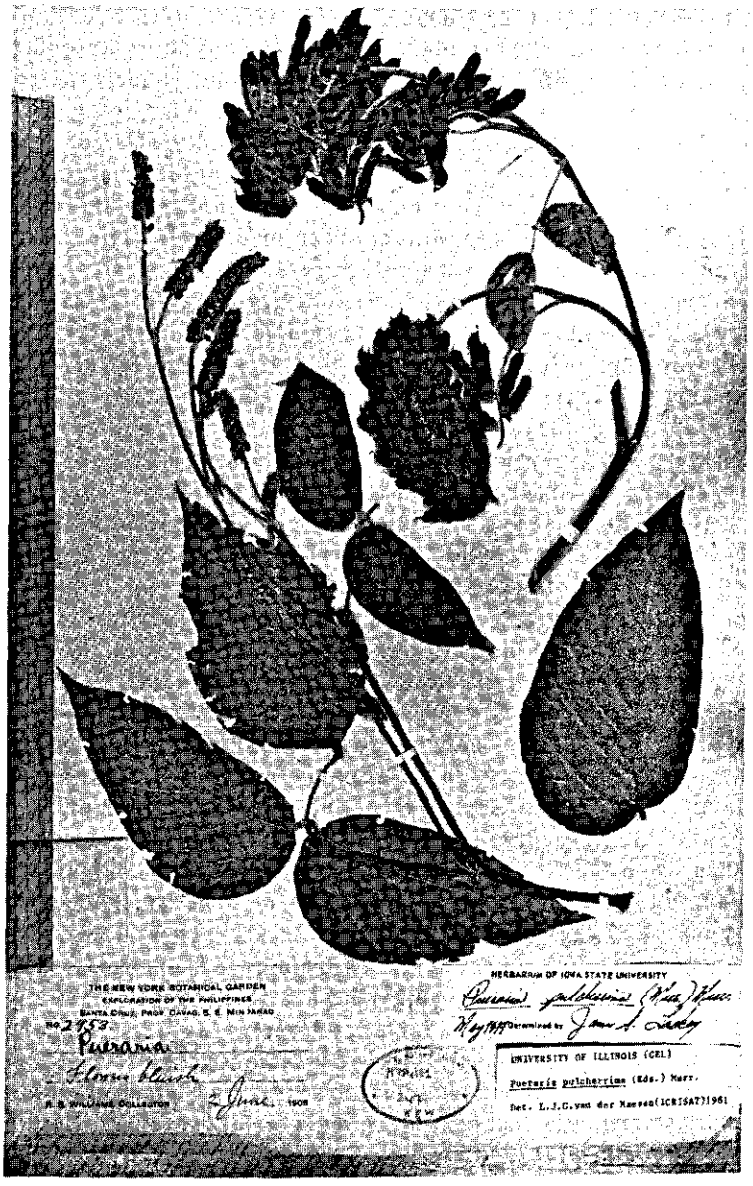
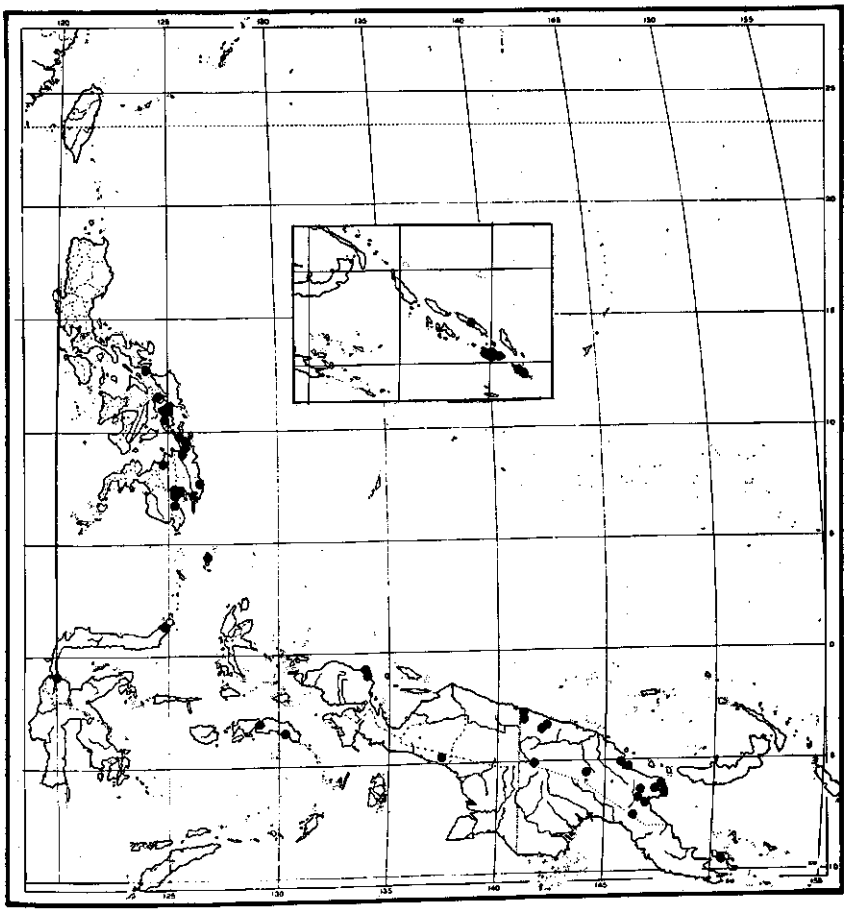


PLATE 19. *Pueraria pulcherrima* (Kds.) Merr. (*Williams 2953*)

Paratypes: New Guinea, Finschhafen, Uassa nr Bonga river, *Hollrung 231*(B? not seen); Oertzen mts, in tall forest and on rocks in Nowulja river, *Lauterbach 2072, 2100*(B? not seen); Bismarck-Archipelago, New Britain, Gazelle peninsula, *Warburg s.n.* (B? not seen).

Description: *Woody* climber, perennial. *Branches* woody, to ca 2.5 cm diameter, up to 10 m long, terete when young, covered with many short grey hairs and fewer or no brown-tinged spreading long hairs up to 3-4 mm, vaguely striate, glabrous with age, older stems with yellowish or grey-brown bark, irregularly ribbed when dried, with many horizontal lenticels of 1-2 mm. *Stipules* amplexicaul, peltate, bract-like, containing the vegetative and inflorescence buds (5-)25-60 mm long above insertion, ca 5 mm below insertion, 3-7 mm wide, dorsally adnate, ventrally valvate, top obtuse, lower end acute or bifid, long and short grey-pubescent outside, brown striate puberulous inside, early caducous, leaving a linear scar; axillary buds supported by filiform stipules, ca 5-15 mm long, pubescent. *Leaves* pinnately trifoliolate; petiole striate, densely short grey and long brown hairs, 6-10 cm long, rachis similar, 3-4 cm long. Leaflets rhomboid to lanceolate, side leaflets obliquely so, 10-23 cm long, 4-14 cm wide, apex long-acuminate, base cuneate to rounded-truncate or cordate, green and thinly grey-pubescent above, hairs long and short, glabrous with age, grey-green and densely silvery grey- pubescent below, ribs prominent, in ca 6-8 irregular pairs, with long and short hairs. *Stipellae* linear to filiform, up to 25 mm long, 0.5-1 mm wide, very caducous, petiolules thickened, densely pubescent, ca 7-10 mm long, slightly winged. *Inflorescences* few-branched, axillary or terminal, 10-25 cm long, flowering axis grey-pubescent, peduncles striate, nodose, sometimes supported by stipules; pedicels 0.5-2 mm, densely grey-pubescent, flowers 3 per node, usually crowded; *bracts* linear, 2-17 mm, long, 0.5-2 mm wide, long-pubescent, caducous before anthesis; pedicels 0-2.5 mm *bracteoles* 2 per flower, ovate-lanceolate, tip obtuse, densely grey-pubescent, up to 1 mm long, 0.5 mm wide. *Calyx* shortly grey-pubescent; tube 1.5-2.5 mm long; teeth short, obtuse, upper ones connate, apex truncate, slightly emarginate or incised, 1-2 mm long, side teeth acute to obtuse, 1-1.5 mm long, lower tooth acute, 1.5-2.5 mm long. *Vexillum* orbicular blue, purple, violet with yellow, green or cream spot, or white, ca 6-10 mm long, 6-10 mm wide, apex emarginate, base hardly clawed, auricles slightly inflexed or not, callosities near base hardly pronounced; *alae* long-obovate, purple or white, ca 6-10 mm long, 2-5 mm wide, claw ca 2 mm, auricle ca 1 mm, lower margin wavy or straight; keel petals rhomboid, ventrally adnate, purple or white, ca 6-10(-12) mm long, 2.5-4 mm wide. *Ovary* elongate, silky pubescent, ca 6 mm long, (4?)-8(-11) ovules; style almost glabrous, ca 3-4 mm long, upcurved; stigma terminal, globular, not penicillate. *Stamens* monadelphous, vexillary stamen attached from the middle downwards, ca 6-10 mm long, free part 1-2 mm, upcurved; anthers uniform, dorsifix to almost basifix, alternately on long and short filaments. *Pods* flattened-oblong, 1.5-4 cm long, 0.5-0.6 cm wide, 8-11 seeded, rounded at both ends, tipped with rest of style, dark brown to black, short pubescent or spreading long-pubescent, sutures thickened, straight, long-pubescent, hair light brown, valves reticulate, sometimes hairs short. *Seeds* flattened-ovoid, 2-3 mm long, ca 1.5 mm wide, 1 mm thick, brown or black, strophiole slightly protruding, circular, ca 0.6 mm diameter.



MAP 12. *Pueraria pulcherrima* in southeast Asia. Inset: Solomon Islands.

Distribution: E. Indonesia, Philippines, Papua New Guinea, Kei Islands, Solomon Islands.

Ecology: Climbing in shrubs or trees, open rain forest, primary or secondary, *Imperata* grassland, flatlands or on rocks near rivers, on muddy or well-drained soil, coral.

Altitude: 0-1300 m.

Flowering: Throughout the year (New Guinea); Jan-Oct (Philippines, Indonesia); May-Oct (Solomon Islands). Fruiting: Jan, Jun-Aug (New Guinea); Apr-Dec (Philippines, Indonesia); Jun-Jul, Nov? (Solomon Islands).

Vernacular names: Indonesia: Bage (Sangi & Taland Isl.).
New Guinea: Muno (Orne language, Walwali), Oomay (Ossima, Sepik distr.), Bungweb (Buang dialect, Morobe distr.).
Solomon Islands: Sa'a, Fai Sa'a, Kewalo Sa'a (Kwara'e language).

Uses: In Papua New Guinea *P. pulcherrima* is used for binding material and as one of the climbers employed to make carrying bags or nets. The fiber is called 'seleng' and the carrying bags 'bilum' (*Karnbach, 1892; Schumann & Lauterbach, 1901; Hoogland 9010* in herb.)

Species examined:

Indonesia: Sulawesi: Peana? *Kaudern 280*(L); Manado, Minahasa, *Koorders 17699*(L, iso!); betw. Palu & Parigi 35 km from Palu, *Meyer 9382*(L); Seram: Wai Kaba (SE, Seram), *Kornassi 867*(L, U); Wae Matakabo, *Rutten 329*(L, U); Sangi & Taland isl, Korakelang, S slope of Gunung Duata, Taland, *Lam 2718*(K, L); Irian Jaya-New Guinea: Utakwa riv. to Mt Carstenz, *Boden Kloss s.n.*(BM); Beri Creek nr Andai, *Koster 11966*(L); Andai, *Teysmann 17476*(L); Nova Guinea neerl. meridionalis, *Versteeg 1202*(L, U);

Papua-New Guinea: Fergusson Isl., Iamele no. 1., *Brass 25934*(K, L); Rakua riv., Opaigwani, Milne Bay distr., *id. 24244*(K, L, US); Sattelburg, Morobe distr., *Clemens 587*(L); nr Kajabit Mission, Morobe distr., *id. 40781*(E); Boana, Morobe distr., id. 41730(E); along Pieni riv. nr Walwali village, Aitape subdistr., Sepik distr., *Darbyshire & Hoogland 7979*(BM, L); upper Tami riv., *Gjellerup 60*(K, L, U); Boana, Morobe distr., *Henty 11559*(BM, L); Busu riv., *id. 12442*(K, L); Telefomin, Sepik distr., *id. 20625*(L); Constantinhafen, *Hollrung 566*(K); along Kua riv., N of Zalimpa, Huon peninsula, Morobe distr., *Hoogland 9010*(L); Finschhafen, on Bumi riv., *Lauterbach 636* (type of *P. textilis*, L, iso!); rd to Amele, Madang distr., *Millar 22651*(G, L); Ossima village, Sepik distr., *Sayers 13281*(L, US); Leitu village, Sepik distr., *id. 18948*(L); Torricelli mts, *Schlechter 14406*(BM, K, P); forest nr Wengi, *id. 16107*(P); Alexishafen, Admosin Isl, *Vandenberg 42175*(L); Mambump village, Buang region, Herzog range, Morobe distr., *Womersley 17807*(K, L, US); Tagan river valley, id. & *Miller 8509*(BM, L);

Philippines: Luzon: Albay-Sorsogon, *Curran 12392*(K, NY, US); Irosin, Mt. Bulusan, Sorsogon prov., *Elmer 16724*(BM, C, CAL, F, G, L, NY, U, US). Leyte Isl: *Wenzel 427*(BM, F, G); ibid., *id. 210*(E, F, G, US); ibid., Dagami, *Ramos 15208*(BM, K, US). Biliran, *McGregor 18869*(P, US). Mindanao: Mt. Apo, Davao prov., *Clemens 15579*(E, KWA, NY); ibid., *DeVore & Hooper 368*(US); ibid., Todaya, *Elmer 10655*(BM, CAL, E, F, FI, G, K, L, NY, U, W); Cabadbaran, Mt. Urdaneta, Agusan prov., *Elmer 13336*(BM, E, F, FI, G, L, NY, P, U, US, W); Davao distr., *Fenix 15856*(E); Baganga, Surigao prov., *Merrill 5430*(K, L, NY, P, US); Camahalan riv., Agusan prov., *Ramos & Convocar 483*(NY); Maluko & vicinity, Bukidnon subprov., *Ramos & Edano 38454*(BM, L, P, US); Mati, Davao prov., *id. 49244*(BM, NY); Placer, Surigao prov., *Wenzel 1864*(K); Surigao, *id. 2665*(G, NY); Todaya, Mt. Apo, *Williams 2592*(NY); Santa Cruz, Davao prov., *id. 2953*(K, NY, US).

Solomon Islands: Santa Isabel; Molofuru Bay, *Beer's collectors 7379*(L); San Cristobal: Kirakira, *E. S. Brown W/271*(BM); San Cristobal riv., *Hunt 2253*(K, L); Guadalcanal: Makina area, Marau, *Gafui et al. 9492*(K); Dudui riv., W. coast, *id. 10038*(L); Kombito, Mt. Austen rd, *Leach 15528*(K, L); Wanderer bay area, *Mauriasi et al. 12293*(L); Honiara, valley N of Vavaya ridge, *Morrison 237*(L); Honiara, from along Skyline rd. *id. 295*(K, L); headwaters of Tenaru riv., path from Betilonga to Tenaru Mission, *Whitmore & Corner 4394*(K, L).

Notes: If the type of *Pueraria warburgii* Perkins was burnt at the Berlin Herbarium during the Second World War, and if no isotypes are extant (which, as yet, I could not verify) a neotype can be chosen from the material cited by Merrill (1908).

The type material of *Pueraria pilosissima* Bak. f. is from the Wollaston Expedition to W. New Guinea in 1912-1913. The sheet in BM collected by C. BODEN KLOSS during the expedition does not bear the location 'Canoe Camp' but 'Utakwa river to Mt Carstensz', and may be accepted as the intended type.

Diversity in *P. pulcherrima* includes the length of the bracts and stipellae, the indumentum of branches and pods and the leaf colours which are difficult to judge from dried specimens. Subtle variation exists in the auricles of the vexillum and base margin of the alae: e.g. inflexed and straight in *Williams 2453* (Philippines) and flat and wavy in *Leach 15528* (N. Guinea) respectively. VERDCOURT (1979) suggests distinct subspecies may be involved, there would be a typical form from the Philippines and the more hairy material from New Guinea with longer bracts, stipellae and larger flowers (*'P. textilis', 'P. pilosissima'*). However, the caducous nature of bracts, stipules, stipellae and hairs points to the need to study live material to see if these characters are consistently limited with geography. The material does corroborate this view to some extent, but there are long-pubescent pods in New Guinea material (*Brass 24244*) while pods are usually short-pubescent, just the opposite of the stems and leaves. The specimens from Indonesia are similar to those from the Philippines.

13. Pueraria rigens Craib. ***(Map 13, p.95; Plate 20, p.94)**

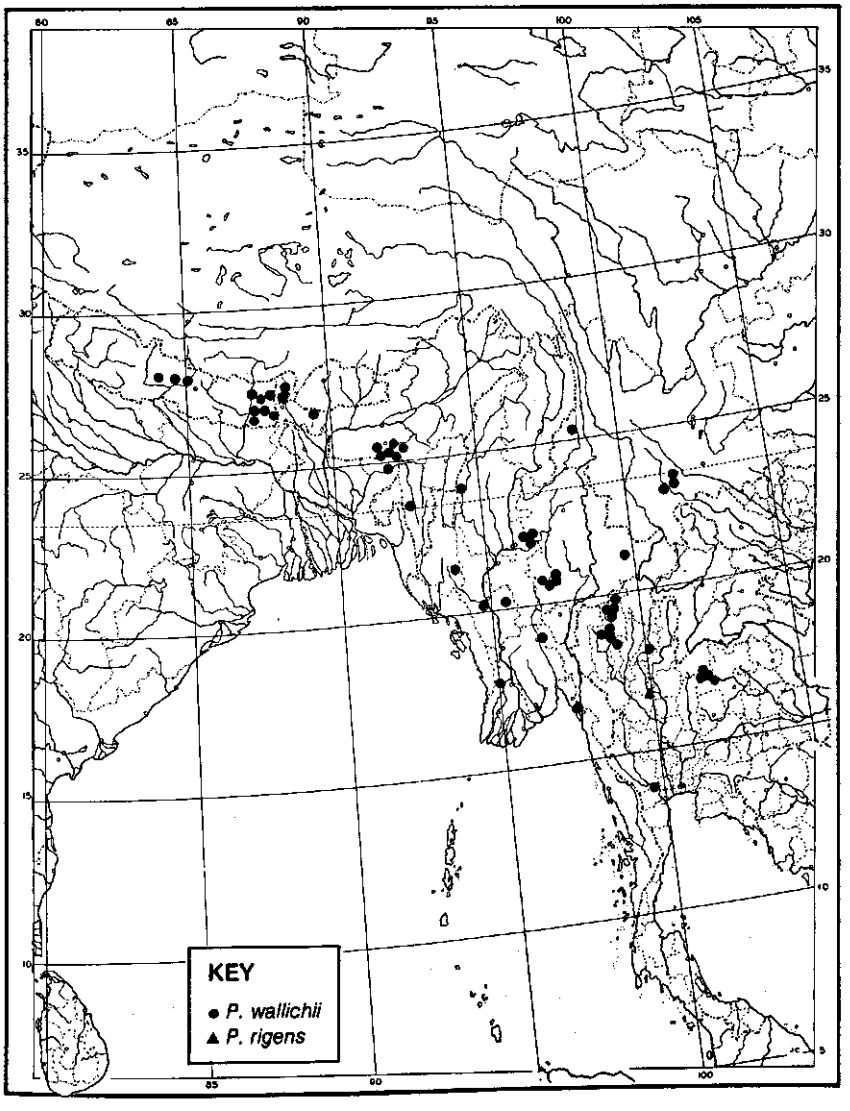
Pueraria rigens Craib, Kew Bull. 1927: 380; Craib, Fl. Siam. Enum. 1-3: 451(1928); Lackey, Synops. Phaseol. 77(1977).

Type: Thailand, Sukotai, Kao Luang, ca 1100 m, on rocks, *Kerr 5924*(K, holo; iso: BM).

Description: Stiff *woody* climber, perennial. *Stems* up to 3(-?) mm diameter, ribbed, later terete, adpressed greyish pubesent. *Stipules* deltoid-acute, up to ca 3 mm long, base thickened, 2 mm wide, hairy as the stem. *Leaves* pinnately trifoliolate, petiole ribbed, pubescent, 2-7 cm long, rachis 0.5-1.5 cm long. Top leaflets ovate-rhomboid, 6-10 cm long, 3.5-6.5 cm wide, apex acute to acuminate, base cuneate-attenuate to rounded, margin entire, side leaflets somewhat obliquely ovate, 5-10 cm long, 3-5 cm wide, (dark?) green and thinly puberulous above, veins conspicuous, hairy, densely greyish adpressed pubescent below, ribs prominent, in ca 7 (sub)opposite pairs. *Stipellae* setaceous, 0.5-1.5 mm long, hairy, petiolules thickened, 4-7 mm long, pubescent. *Inflorescences* axillary or terminal, unbranched but with short 7 mm nodose laterals, to ca 15 cm long, ribbed, rusty brown pubescent, flowering close to the base, flowers on short nodose laterals, ca 5-10 together, bracts very caducous, ovate-lanceolate, ca 2-3 mm long, pubescent, *pedicels* short, ca 2 mm, *bracteoles* 2 per flower, lanceolate, ca 1 mm long, caducous. *Calyx* adpressed pubescent, tube ca 4 mm long, upper teeth connate, obtuse-emarginate, ca 2.5 mm side teeth acute, ca 2 mm long, lower tooth lanceolate, ca 3 mm. *Vexillum* orbicular, purple, ca 8.5 mm long, 7 mm wide, apex emarginate, base, not clawed, margin near the base inflexed, no auricles or callosities; alae elliptic-clawed, purple, ca 8.5 mm long, 3 mm

PLATE 20. *Pueraria rigens* Craib, holotype (*Kerr 5924*)

wide, one auricle near the base, short, 0.3 mm, claw 2 mm, keel petals boat-shaped, ca 9 mm long, 3.5 mm wide, ventrally adnate, purple. *Ovary* elongate, densely silvery pubescent, ca 7 mm long, 6 ovules, base stipitate, style ca 2 mm, not expanded, straight, glabrous above; stigma terminal, globular-papillate, short-penicillate at the base. *Stamens* diadelphous, vexillary stamen entirely free,



MAP 13. *Pueraria wallichii* and *P. rigens* in south Asia.

ca 8.5 mm, free part 1-2 mm, not yet upcurved, anthers uniform, basidorsifix, alternately on long and short filaments. *Pods* not known.

Distribution: Thailand.

Ecology: On rocks.

Altitude: ca 1100 m.

Flowering: May.

Specimens examined: Only the type material extant.

Note: LACKEY(1977a) reduced *Pueraria rigens* Craib to the synonymy of *P. wallichii* DC. Although only a single gathering exists, the differences are too great to abandon *P. rigens*. The leaflets are narrower, darker green above and more dense grey-pubescent below, the side leaflets are very much less oblique, venation is more conspicuous, and more symmetrical in the side leaflets. The inflorescence has reduced laterals, which is an aproach to *P. wallichii*. Although *P. rigens* flowers are not fully expanded, they are very much smaller. The calyx is much more hairy, has acute side teeth, and a lanceolate lower tooth, not a short-obtuse one as in *P. wallichii*. Corollar parts are of different shape, the 6-ovular ovary is stipitate and the vexillary stamen is completely free while it is attached in *P. wallichii*. Despite the scarcity of material *P. rigens* appears a good species.

14. Pueraria sikkimensis Prain ***(Map 14, p. 99; Plate 21, p. 97)**

Pueraria sikkimensis Prain, J. Asiatic Soc. Bengal 66: 419(1897); Lackey, Synops. Phaseol. 72, 75(1977).

Lectotype: India, Sikkim, Rangeet, 1000 feet, 11 March 1876, *Clarke 27263*(K, holo, iso: BM, CAL, K) chosen from PRAIN'S syntypes.

Paratypes: India, W. Bengal, Sistra, Darjeeling Terai, *Gamble 2227A*(K); Sikkim Terai, Anderson (CAL), ibid., *Gamble s.n.* and *Gammie s.n.* (CAL), Teesta Valley, *King s.n.* (CAL).

Description: *Woody* climber, perennial. *Branches* sparsely clad with adpressed glabrescent hairs, young branches rusty-puberulous (*teste* Prain). *Stipules* peltate, ovate-obtuse, striate, at least up to 5 mm long and wide. *Leaves* trifoliolate. *Leaflets* broadly rhomboid, up to 15 cm long, 17.5 cm wide (*teste* Prain), glabrous above, adpressed-pubescent below. *Inflorescences* branched at the base, 15-30 cm long, branches foxtail-like, few, ridged, nodose, densely covered with rusty brown hairs, supported by ovate stipules, barely peltate, ca 3-4 mm long, 3-4 mm wide, tip obtuse; pedicels short, up to 3 mm; flowers 3 per node, nodes crowded; bracts lanceolate, 4-8 mm long, 1-2 mm wide, dorsally long-pubescent, ventrally glabrous, striate, very caducous; *bracteoles* 2 per flower, lanceolate, inconspicuous in pubescence of calyx, 1-1.5 mm long and wide. *Calyx* rusty brown, densely long-pubescent, inside also pubescent, tube ca 4-5 mm long, teeth short, triangular, subobtuse, upper teeth connate, ca 3-4 mm long, side teeth ca 2 mm long, lowest tooth ca 3 mm. *Vexillum* orbicular-ovate, purplish blue, apex emarginate, base long-clawed, callosities not conspicuous, auricles inflexed, reinforced, ca 13-18 mm long, 10-12 mm wide, margins

PLATE 21. *Pueraria sikkimensis* Prain, lectotype (*Clarke 27263 A*)

inflexed. *Alae* lanceolate, purplish, ca 10-14 mm long, ca 5 mm wide, base auriculate, claw 3-4 mm, auricle 1 mm long. *Keel* petals rounded along base, ventrally adnate, 12-14 mm long. *Ovary* elongate, rusty brown-adpressed pubescent, 6-7 mm long, ca 10 ovules; style almost glabrous, ca 2 mm as flattened extension

of ovary, ca 4 mm perpendicularly upcurved; stigma terminal, globular, penicillate at base or not. *Stamens* monadelphous, vexillary stamen attached in the middle with a knee, 11-13 mm long, free part 2-3 mm, upcurved; anthers uniform, dorsifix below the middle, alternatively on long and short filaments. *Pods* not known, but likely to be similar to those of *P. tuberosa*.

Distribution: Bhutan, India (Sikkim, adjacent W. Bengal, NW Himalayas).

Ecology: Climber in deciduous forest or shrubs, on plains, river valleys.

Altitude: 330-1600 m.

Flowering: March. Fruiting: April-May.

Vernacular names: not recorded.

Specimens examined:

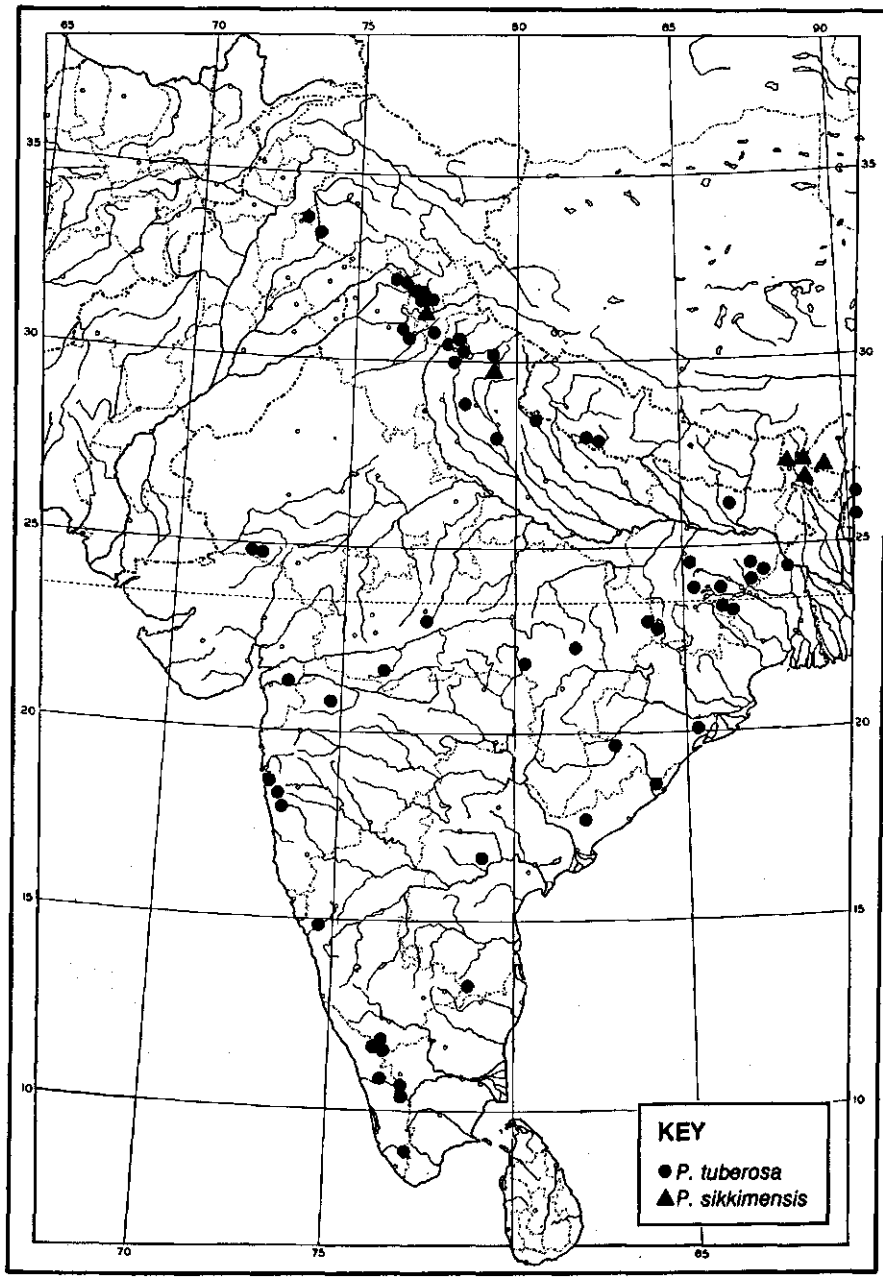
BHUTAN: Tista, Beleri Cava P? *Cave s.n.* (E).
INDIA: Himachal Pradesh: Sutlej Valley, 5000 ft., *Anon. s.n.* (BM); W. Himalaya: *Patrick Gerard s.n.* (BM). Sikkim: Rangeet, *Clarke 27263* (K, hololecto; isolecto: BM, K); Mongpu, *Ribu & Rhomoo 4058* (CAL); Baninpokri, *Gamble 667C* (CAL); Terai, *Hooker s.n.* (CAL, K). W. Bengal: Darjeeling Terai, Tista, *Gamble 2227A* (K); Kurseong, *Modde 128* (CAL); Jaldaka, Sikkim Terai, *Ribu 3654* (CAL). Uttar Pradesh: Ambori? Dehra Dun distr., *Gamble 22980*(K); Siwaliks, *Stewart 154*/BS(K).

Notes: PRAIN (1897) mentioned the rusty pubescence, larger bracts, (6 mm), much longer flowers as features distinguishing *P. sikkimensis* from its nearest ally, *P. tuberosa* DC. In the protologue the length of the dense clustered racemes and panicles (foxtail-like pseudoracemes cf. LACKEY, 1977) is given as usually only 10-15 cm. Even in the type material longer branches exist. The specimens from the NW Himalayan foothills appear to be *P. sikkimensis* despite the larger number of branches, and the slightly longer inflorescences. *P. tuberosa* specimens from this area have less densely clustered flowers, of smaller size but larger than the Central Indian ones; their pubescence is light brown.

In Kala Middi? (*Ritchie s.n.*, E) a specimen with long bracts was found but otherwise it entirely agrees with *P. tuberosa*.

According to LACKEY (1977), in the first case the free stamen is often slightly adherent to the other and has to be peeled off. It has no knee, as far as could be ascertained, as in *P. sikkimensis*. In *P. sikkimensis* I saw penicillate stigmas, LACKEY's drawing shows a stigma without hairs around the base.

Although many flowers are available in herbarium specimens, dissection has to be kept to a minimum. Regarding these subtle differences preferably a comparison of live material should indicate whether the above mentioned differences warrant specific status or not. A decision whether to reduce *P. sikkimensis* to varietal status has to be deferred until the time that live material can be studied.



MAP 14. *Pueraria tuberosa* and *P. sikkimensis* in south Asia.

At the moment I am inclined to say that the available *P. sikkimensis* specimens represent a limit of variability in one extreme of the diversity of *P. tuberosa*. The dearth of material also makes conclusions for geographical reasons uncertain.

15. Pueraria stricta Kurz ***(Map 15, p. 103; Plate 22, p. 101)**

Pueraria stricta Kurz, J. Asiatic Soc. Bengal 42-2: 254(1873); id., ibid. 45-4: 253(1876); Baker in Hooker, Fl. Brit. India 2: 198(1876); Prain, J. Asiatic Soc. Bengal 66-2: 420(1897); Lackey, Synops. Phaseol. 73, 76(1977).

Lectotype: Burma, Pegu (Yomah), *Kurz 2557* (CAL, holo, not seen; iso: K) *lectotypus novus.*

Paratype: Burma, Martaban hills 300-1000 m, *Kurz* (CAL).

Synonyms: *Pueraria brachycarpa* Kurz, J. Asiatic Soc. Bengal 42-2: 232, 254(1873); id. ibid., 45-4: 185, 254(1874); Baker, in Hooker, Fl. Brit. India 2: 199(1876); Prain, J. Asiatic Soc. Bengal 66-2: 420(1897); Craib, Fl. Siam. Enum. 1-3: 449(1928); Lackey, Synops. Phaseol. 73, 76(1977).

Type: (*teste* Prain) Burma, Pegu, *Kurz 2553* (CAL, holo; iso: CAL).

Pueraria hirsuta Kurz, J. Asiatic Soc. Bengal 42-2: 254(1873); Baker in Hooker, Fl. Brit. India 2: 199(1976); Prain, J. Asiatic Soc. Bengal 66-2: 42 (1897); Craib, Fl. Siam. Enum. 1-3: 450(1928).

Lectotype: Burma, Pegu Yomah, *Kurz 1720* (CAL, holo).

Paratype: Burma, Pegu, *Kurz 2554*(CAL).

Pueraria collettii Prain, J. Asiatic Soc. Bengal 66-2: 420(1897); Craib, Contrib. Fl. Siam, Aberdeen Univ. Stud. 57: 64(1912); Gagnepain, Gén. Indo-Chine 2: 254(1916); Brandis, Indian Trees 228(1921); Craib, Fl. Siam. Enum. 1-3: 449(1928); Lackey, Synops. Phaseol. 73-76(1977); id., Bot. J. Linn. Soc. 74: 170(1977); id., Phytologia 37: 109(1977).

Lectotype: Burma, Shan hills at Ywanggyen, 1300 m, *Collett 654* (CAL, holo;iso: K).

Paratypes: Burma, Fort Stedman (Mong Hsawk), *Abdul Huk s.n.*(CAL, K); Taunggyi, *Abdul Khalil s.n.*(CAL, L); Maymyo, *Badal Khan 104*(CAL, G, K); Indine, Saga, *King's collectors*; unspecified specimens from *King's collectors.*

Pueraria siamica Craib, Kew Bull. 1911: 40; id., Contrib. Fl. Siam, Aberdeen Univ. Stud. 57: 65(1912); Gagnepain, Fl. Gén. Indo-Chine 2: 256(1916); Craib, Fl. Siam. Enum. 1-3: 449(1928).

Type: Thailand, Chiengmai, Doi Sutep at 420 m, *Kerr 831*(K, holo; iso: BM, CAL, E, K).

Pueraria colletti Prain var. *siamica* (Craib) Gagnep., Fl. Gén. Indo-Chine 2: 254(1916); Craib, Fl. Siam. Enum. 1-3: 449(1928), based on *P. siamica* Craib.

Pueraria longicarpa Nguyen van Thuan, Adansonia Ser. 2, 16-4: 509(1977); id., Fl. Cambodge, Laos, Viet-nam 17: 82, 91(1979), *syn. nov.*

Type: Laos, Pak Leun 1500 m, nr Xieng Khouang, *Poilane 16897*(P, holo).

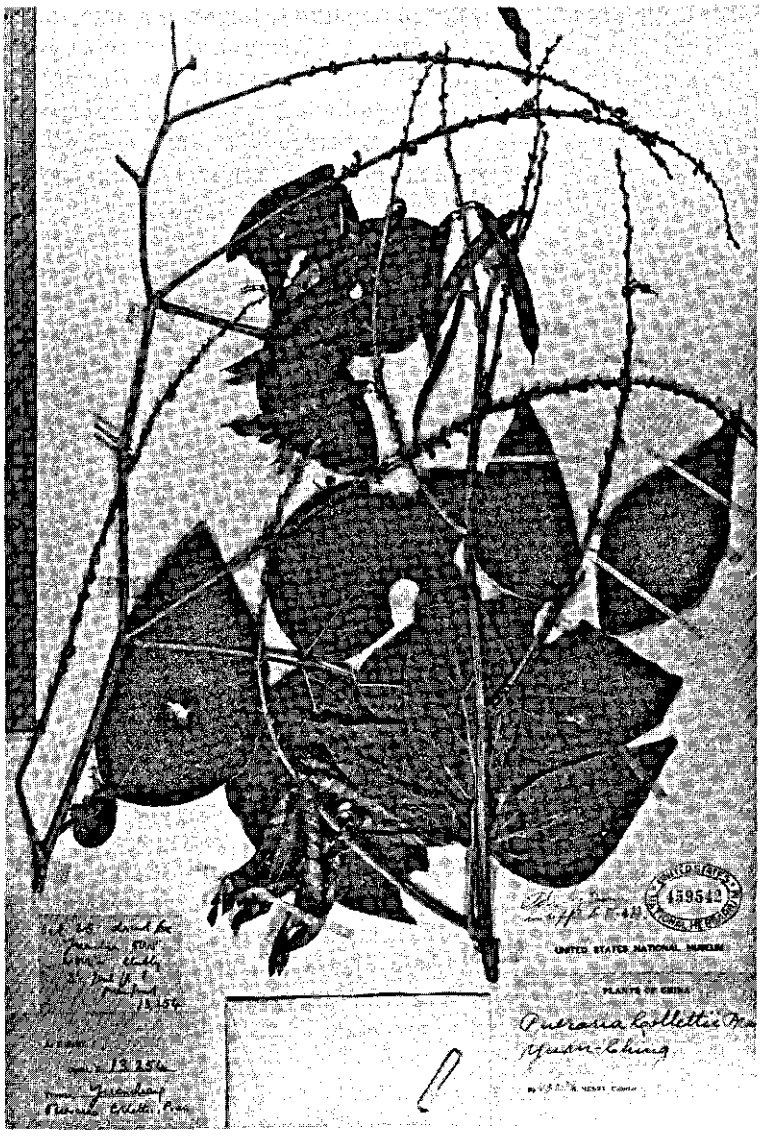


PLATE 22. *Pueraria stricta* Kurz (*Henry 13254*)

Description: *Shrub*, occasionally straggling, perennial. *Stems* up to 6 mm diameter, 1-2.5 m tall, striate and short grey-pubescent, terete and glabrous with age. *Stipules* triangular-ovate, up to 7 mm long, 3 mm wide, apex acuminate, quite persistent, leaving a narrow scar when lost, densely grey-pubescent. *Leaves* pinnately trifoliolate, petiole canaliculate above, short grey-pubescent, 3-9 cm long, rachis 1.2-3.5 cm long. Top leaflets rhomboid to ovate, 11-24 cm long,

4-12 cm wide, side leaflets obliquely ovate, apices short to long-acuminate, rarely obtuse (*Henry 13431*), bases rounded to cuneate, green and thinly short grey-pubescent above, greyish and densely velvety grey-pubescent below, ribs prominent, not in pairs, ca 5 laterals each side; petiolules 2-6 mm long, pubescent; stipellae lanceolate-setaceous, 2-6 mm long, pubescent. *Inflorescence* axillary, usually single, many-flowered, with one main branch, if terminal sometimes further branched; nodes being thickened condensed racemuli up to 2 mm in fruit, bearing 4-6(-8) flowers, supported by soft lanceolate bracts, 2-3 mm long, spreading and hooked, pubescent, ventrally glabrous, usually falling, sometimes hard and quite persistent when in fruit; pedicels slender, up to 3 mm long, sturdier and up to 5 mm in fruit, supported by lanceolate adpressed-pubescent bracts, ca 1 mm long, ventrally glabrous; *bracteoles* 2 per flower, ca 1 mm long, pubescent, ventrally glabrous. *Calyx* pubescent, with adpressed grey hairs, tube glabrous inside, 1.5-2.5 mm long, teeth pubescent both sides, upper ones connate, obtuse, more or less dilated at the tip, 0.5-1.5 m long, side and lower teeth acute, 0.5-1.5 mm long. *Vexillum* obovate, 5-8 mm long, 4.5-7 mm wide, white, pinkish to purple or blue, once reported yellow, apex emarginate, base clawed, auricles inflexed, no callosities. *Alae* obovate, 5-8 mm long, 2.3-2.6 mm wide, white to pinkish or purple, base curved-clawed, auriculate, claw ca 1.5-2.5 mm long, auricle ca 0.5 mm, base margin lobed. *Keel* petals oblique, white to pinkish or purple, clawed, ventrally adnate, 5-7 mm long, 1.5-2.5 mm wide. *Ovary* elongate, grey silky pubescent along the sutures only, ca 3-5 mm long, ca 10 ovules; style glabrous, ca 2.5 mm, upcurved; stigma terminal, globular, penicillate at base. *Stamens* monadelphous, vexillary stamen connate in the middle, ca 6 mm long, free part 1-2 mm long, upcurved; anthers uniform, basi- dorsifix, alternately on long and short filaments. *Pods* flattened-oblong, apex long-acuminate, base cuneate, 3.5-6 cm long, ca 0.5-0.7 cm wide, rarely constricted where ovules failed, light brown, glabrous to slightly pubescent, diagonally striate, sutures thickened, delineate between seeds, (5-)7-10 seeded; valves curling when ripe, interior lined with thin papery layer. *Seeds* flattened-ovoid, ca 4 mm long, 3 mm wide, 1.5 mm thick, dark brown to black, seed coat finely tuberculate, strophiole thin, circular, ca 0.5 mm diameter. Seedling epigeal, first 2 leaves simple and opposite, ovate, 10-15 mm long, 8-15 mm wide, apex obtuse, base cordate.

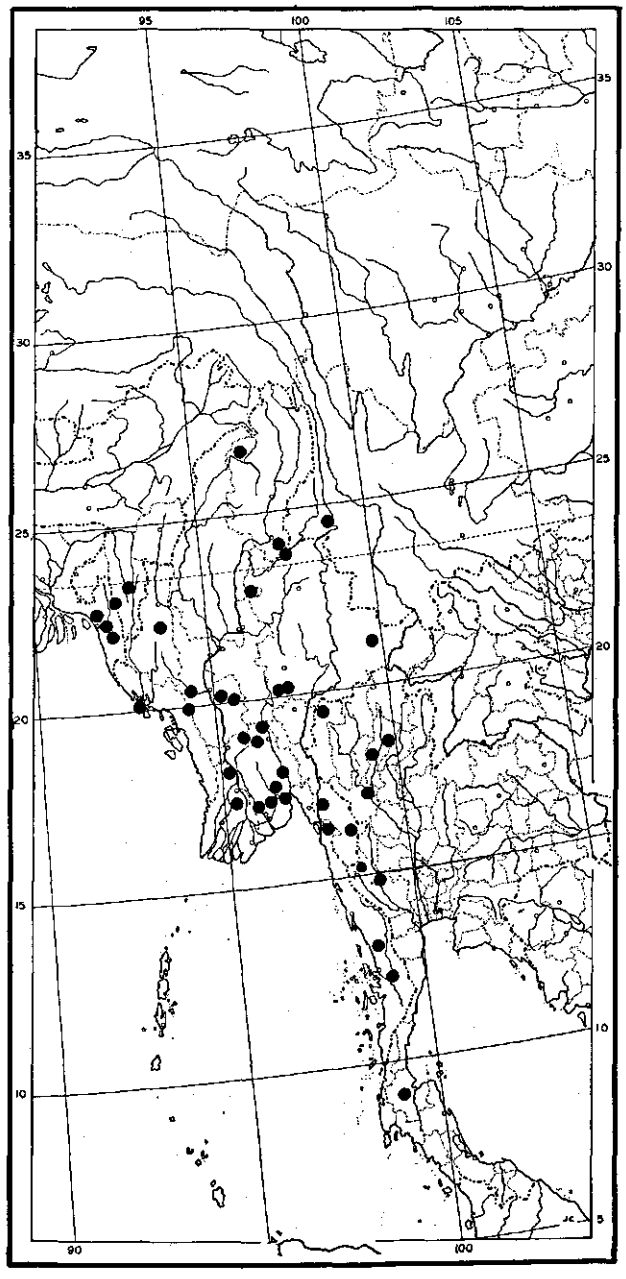
Distribution: Burma, China (Yunnan), Thailand.

Ecology: Open grassy *Pinus-Helicia* jungle, deciduous or dry evergreen forest with bamboo or oak, on sandstone or calcareous soil, on hillsides, dry ridges.

Altitude: 400-1700 m.

Flowering: May, July, October-November(-January). Fruiting: (September) November-January.

Vernacular names: Burma: Maik chi ya (Shan).



MAP 15. *Pueraria stricta* (= *P. colletti*) in south Asia.

Specimens examined:

BURMA: Maymyo, *Badal Khan 104*(G, K, para); Ywanguen, Shan hills, *Collett 654*(CAL, holo; iso: K); nr. Malow, S Shan, *Gilbert Rogers 696* (CAL); Fort Stedman (Mong Hsawk), Abdul Huk(K, para); Shan state, *Abdul Khalil s.n.*(CAL, G); *Taunggyi id. s.n.*(CAL, L, para); Shan state, *King's collector 595*(BM, CAL); Mindat, W Central Burma, *Kingdon Ward 22514* (BM); Pegu Yomah, *Kurz 2557*(K, isolecto); Magyigon to Tindaw, Thayetmyo distr., *Lace 2719*(E, K); Popa hill, Myingyan distr., *id. 4903*(E, K); One-Tree hill, Maymyo plateau, *id. 5938*(CAL, E, K); Keng Tung, S Shan state, *MacGregor 947*(CAL, E); Taunggyi hillside, *McKee 5891*(K, P); Sillotia roadside, Minbu distr., *Shaik Mokim 294*(CAL, G); sine. loc., *Parkinson 3642*(K); Loilem, S. Shan state, *Robertson 8*(K); nr Yegyano, Maymyo, *Rodger 615*(E); Singu Ravy, Lower Madaya reserve, Mandalay distr., *Saw Maung Mya 3642*(K); Taunggyi crags, *Vogt BU-445*(US).

CHINA: Yunnan: Yuanchiang, *Henry 11579*(CAL, NY, US); ibid., *id. 13254*(CAL, E, K, US); Szemao, *id. 13431*(BM, K, NY); betw. Keng Hung (Cheli) & Muang Hing, Pang Khun forest, *Rock 2604*(E, US).

LAOS: Phak Lou nr Xieng Khuang, Tranninh, *Poilane 16897*(P, holotype of *P. longicarpa* N.V. Thuan).

THAILAND: Phu Krading, Loie, *Native collectors DE 10*(W); Chiengmai, Doi Sutep, *Floto 931*(C); ibid., *id. 4924*(C); Payap, Doi Chiengdao mt, *Hennipman 3224*(K, L); Chiengmai, Doi Sutep 720 m, *Kerr 831*(K, holo; iso: BM, E, K); ibid., *id. 1386*(BM, CAL, K); ibid., *id 1606*(BM); Doi Chiangdao mt, *Murata et al. T14980*(C); ibid., *Put 4534*(BM); ibid., *Sørensen et al. 1227*(C); Chiengmai, Doi Sutep, *Smitinand 3985*(L); ibid., *Sørensen et al. 4061*(E, P); ibid., *id. 5105*(C); ibid., *id. et al. 5106*(C, E, L); ibid., *id. 5472*(C).

Notes: PRAIN (1897) noted that KURZ had described *Pueraria stricta*, *P. hirsuta*, and *P. brachycarpa* from rather inadequate fruiting material without flowers, and that the Calcutta collectors never found the species again. Since material from CAL, where PRAIN worked, was not available, BAKER (1876) had not seen it. *Pueraria collettii*, which was found much more often, is extremely close both to *P. stricta* and *P. brachycarpa*. PRAIN concluded, that it might appear necessary to reduce the latter two and unite *P. collettii* with them.

Although no flowering specimens are known of for *P. stricta* or *P. brachycarpa*, it appears warranted to unite the species. The types of *P. stricta* and *P. brachycarpa* are less pubescent specimens with more persistent bracts, and shorter pods respectively, of the typical *P. collettii*. It is my opinion that the soft bracts in the more hairy specimens turn harder with age, and appear as the conspicuous hooked, more or less persistent bracts in fruiting specimens which is the case in several '*P. stricta*' accessions. The short length of a few inflorescences and indeed less pubescence of the typical *P. stricta* are not sufficient to keep the species apart, unless comparison of live materials proves the opposite. Another reason why *P. stricta* was never found again, whereas KURZ (1876) described it as rather frequent in the 'hill-eng' (dry deciduous forests on hills) and upper dry forests of the Pegu Yomah and Martaban hills (rare in the drier upper mixed forests), is that it apparently constitutes an extreme in the range of the species.

P. hirsuta Kurz is a hairy form of *P. stricta*, and contrary to PRAIN (1897) I notice but little difference with ordinary '*P. collettii*'. It is not an *Ophrestia*, as LACKEY (1977) suggested. The specimens *Kerr 3246, 3276* and *5475* (from Thailand, BM), determined earlier as *P. hirsuta* (CRAIB, 1928) fit Thuan's description of *Ophrestia laotica* (Gagnep.) Verdc. (THUAN, 1979), but are not *P.*

stricta. I have not compared the Thai specimens with material of *O. laotica* (type: *Harmand, P*).

CRAIB (1928) reduced his *Pueraria siamica* of 1912 and *P. collettii* Prain var. *siamica* Gagn. (really (CRAIB) Gagn.) of 1916 to the synomymy of *P. collettii*.

LACKEY (1977a, b) reported the presence of canavanine, a free amino acid, in *P. collettii*, a compound generally absent in most Glycininae. LACKEY (1977c, 1980) suggested that *P. collettii* could be a *Neonotonia*, which seems chemically correct but 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) LACKEY.

LARSEN (1971) reported a chromosome number of 2n = 20, but NEWELL (1982, pers. commun.) found a tetraploid with 2n = 44 in root tips of *Floto 931*, which I was also able to inspect.

16. Pueraria tuberosa (Roxb. ex Willd.) DC. ***(Map 14, p. 99)**

Pueraria tuberosa (Roxburgh ex Willdenow) de Candolle, Ann. Sc. Nat. Ser. 1-4: 97(1825); id., Mém. Lég. 254(1825); id. Prodr. 2: 240(1825); Wight & Arnott, Prodr. Fl. Penins. Ind. Or. 205, 449(1834); Wight, Icon. Pl. Ind. or 2-1: t.412(1843); Bentham in Miq., Pl. Jungh. 2: 235(1852); id., J. Linn. Soc. Bot. London 9: 123(1867); Kurz, J. Asiat. Soc. Bengal 45-4: 253(1876); Baker in Hooker, Fl. Brit. India 2: 197(1876); Taubert, in Engler & Prantl, Natürl. Pflzfam. 3-3: 370(1894); Collett, Fl. Siml. 139(1902); Wood, Rec. Bot. Survey India 2: 64, 97(1902); Cooke, Fl. Bombay 1-2: 374(1902) and 1: 399(repr. 1958); Duthie, Fl. Upper Gang. Plain 1-1: 233(1903) and 215(repr. 1960); Prain, Bengal Pl. 1: 282(1903, repr. 1963); Gagnepain, Fl. Gen. Indo-Chine 2: 250(1916); Gamble, Fl. Madras 1-2: 360(1918); 1: 245(repr. 1967); Brandis, Indian Trees 228(1921); Fischer, Rec. Bot. Survey India 9-1: 68(1921); Gamble, Manual Indian Timbers 245(1922); Haines, Bot. Bihar Orissa 3: 294-295(1922) and 2: 294(repr. 1961); Kanjilal et al., Fl. Assam 2: 79(1938); Barrau, Ethnology 4: 285(1965); Ahuja, Medicinal Pl. Saharanpur 62(1965); Vartak, Enum. Pl. Gomantak 43(1966); Patel, Forest Fl. Melghat 116(1968); Wealth of India 8: 313-317(1969); Lackey, Synops. Phaseol. 72, 74(1977); Ali, Fl. W. Pakistan 100, Papil. 233-235(1977); Nair, Fl. Punjab Plains, Rec. Bot. Survey India 21-2: 99(1978); Shah, Fl. Gujarat 1: 237(1978); Hara & Williams, Enum. Pl. Nepal 2: 128(1979).

Basionym: *Hedysarum tuberosum* Roxb. ex Willd., Sp. Pl. 3-2: 1197(1803); Wight & Arnott, Prodr. Fl. Penins. Ind. Or. 205, 449(1834); Roxburgh, Fl. Indica 3: 363(1832).

Type: India, Bengal, *Roxburgh s.n.*(B, Herb. Willdenow, holo; iso: G, K, received via Puerari from the Calcutta Botanical Garden and via Lambert from Roxburgh).

Description: *Woody* climber, perennial, with large tubers up to 0.75 m circumference or up to 35 kg, often in strings connected to the main roots by thin

roots. *Branches* strong, up to 12 mm diameter, many m long, ribbed, sparsely clad with caducous adpressed greyish hairs, glabrous with age. *Stipules* peltate, bifid or 3-split to bearded below the point of insertion, ovate-obtuse above, striate, 5-10 mm long, 4-7 mm wide, caducous, leaving an oval scar. *Leaves* pinnately trifoliolate, petiole canaliculately striate, grey-tomentose, 10-23 cm long, rachis 1-6 cm long. *Leaflets* orbicular-ovate, side leaflets obliquely so, 8-32 cm long, 6-25 cm wide, apex long-acuminate, base narrow to wide-acuminate or rounded, occasionally cordate, green and adpressed grey-puberulous above, glabrous with age, light or grey-green and densely adpressed grey pubescent below, ribs prominent, in 6-9 unequal pairs, petiolules barely thickened, densely pubescent, to 8 mm long, stipellae lanceolate, more or less striate, 2-8 mm long, 1-2 mm wide. *Inflorescences* wide-branched, at the base, up to 20-50 cm long, branches many, ridged, slightly nodose, upright, densely covered with short grey hairs, bracts at the base ovate, not produced below insertion or barely fringed, ca 2 mm long and wide, obtuse, flowers (2-)3 per node, pedicels short, up to 5 mm at maturity, bracts lanceolate, ca 3, rarely 7 mm long, 1, rarely 2 mm wide, dorsally pubescent, ventrally glabrous, striate, very caducous, *bracteoles* 2 per flower, ovate to deltoid, tip obtuse, long-pubescent, ventrally glabrous, 1-2 mm long, fairly persistent. *Calyx* grey to light brown pubescent, hairs longer along margin of teeth and center of upper connate teeth, puberulous inside, tube ca 4 mm long, teeth short, triangular, almost obtuse, upper teeth connate, 3-4 mm long, side teeth 3-4 mm, lowest tooth 4-5 mm long. *Vexillum* orbicular-ovate, apex emarginate, base clawed, auricles inflexed, reinforced, callosities not conspicuous, purplish, (9-)10-16 mm long, 9-13 mm wide, margins inflexed. *Alae* lanceolate-ovate, 10-14 mm long, ca 4 mm wide, base auriculate, claw 3-4 mm, auricle 1.5-2 mm long. *Keel* petals rounded along base, ventrally adnate, 9-13 mm long. *Ovary* elongate, grey silky adpressed pubescent, 6-12 mm long, ca 10 ovules, style almost glabrous, 2-4 mm as flattened extension of ovary, ca 3 mm perpendicularly upcurved, stigma terminal, globular, penicillate at base. *Stamens* diadelphous, vexillary stamen free, or slightly adherent, 10-14 mm long, free part 3-4 mm, upcurved, anthers uniform, dorsifix below the middle, alternatively on long and short filaments. *Pods* flattened oblong, up to 7 cm long, 1.1 cm wide, (1-2-)3-8-seeded, acuminate at base and apex, tipped with rest of style, constricted where ovules fail, sutures indented slightly between seeds, locule outline visible, hairs golden brown, bulbous-based, rather dense, somewhat caducous, rarely absent. *Seeds* flattened reniform, reddish brown, ca 5 mm long, 4 mm wide, 2 mm thick, hilum small, white, 1 mm long.

Distribution: India, Nepal, Pakistan.

Ecology: Hill forests, deciduous vegetation, slopes, sides of rocky streams, growing in exposed and eroded areas, covering the ground, bushes and even trees.

Altitude: 0-1300 m

Flowering: February-April after the leaves have shed from December to February, new leaves arrive around May. Fruiting: April-June.

Vernacular names:

India: Bengali: Shimiabatraji. English: Indian kudzu. Gond: Patal. Gujarati: Fagdonovelo, Fagianigand, Fagio, Fagvelo (Porbandar) Karwinai, Khakarvel, Vidari, Vidarikand. Gharwali: Sirala. Hindi: Badar, Ban kumra, Batraj Yam, Bedarikand, Bel (Mt. Abu), Bendo, Bilaikand, Billi, Bodar, Bolaikand, Dedarikand, Patalkand, Patalkohnda, Pona, Sarwala (Bijnor), Saral, Sarur (Saharanpur), Siali, Sural, Surur, Tirra. Kannada: Gumadigida. Kumauni: Bilaikand, Bildikand, Bili, Birali, Biralipanwa, Bisalu, Biralipuna. Marathi: Badra, Bharda, Dari, Darni, Ghorbel (Berar), Ghorabel (Merwara), Pithana. Mundari: Birkakaru, Otekakaru. Oriya: Bui(n)ka Karkaru, Kataka, Handiphuta. Paharia: Debrelara. Punjabi: Badar, Bilaikand, Bidarikand, Saloha, Salor, Sara'e ka tel, Siali, Sural. Sadani: Pataktora. Sanskrit: Bhukushmandi, Bhumikushmand, Gajavajipriya, Gajeshta, Gandhapala, Ikshugandha, Kandapalash, Shrigalika, Shukla, Shurava, Sita, Svadukanda, Svadulata, Triparna, Vajivallabha, Vidali, Vidarika, Vidarikanda, Vrikshavalla, Vrishyakanda, Vrishyavallika, Vrishyavardhini. Santali: Jan chirra, Jan tshira, Jang tira, Jangtirra, Patalkohnda, Tirra. Telugu: Darigummadi, Kubayatige.

Nepal: (Nepali) Biralikund.

Pakistan: Badar, Sarar, Sarwala, Siali, Surar (Urdu).

Uses: The tubers sometimes attain an enormous size (up to 30 seers, Ahuja 1965; or even 35 kg, Wealth of India 1969; or 60 cm long and 75 cm in circumference, CAMPBELL cf. HAINES 1922), and are sometimes eaten boiled (HAINES, 1922) or raw (KANJILAL, 1938) but this use seems far from general. The tubers taste like liquorice. As is the case with kudzu, *P. tuberosa* is mainly a scarcity food. Starch can be extracted. The tubers are also fed to horses and tonga-ponies (COLLETT, 1902; Wealth of India, 1969).

In Punjab, western Uttar Pradesh and Central India *P. tuberosa* was found suitable for soil erosion control, where kudzu and tropical kudzu failed. Its leaves afford good cattle fodder. In most districts (HAINES, 1922), the tubers are used medicinally e.g. for renal complaints, for certain bowel conditions. Tubers of certain genotypes are reported to be employed as fish poison in Manbhum, Bihar (*Watt 9251*) as compared with those used for food (*Watt 8444*). CAMPBELL cf. HAINES (1922) also refers to the use as fish poison in Manbhum.

Other medicinal uses of the tubers include application as a demulcent and refrigerant in fevers, as a cataplasm to cure swellings of joints, and as a lactagogue (WATT, 1892; Wealth of India, 1969; AHUJA, 1965; KIRTIKAR & BASU, 1933). The ayurvedic preparation is called chyavanprash. An estimated amount of 1500 maunds (ca 60,000 kg) is collected annually in the Saharanpur area. The dried decorticated flat thin white or dirty-white slices with a peculiar sweet taste and characteristic odor are sold in markets.

Chemical contents (Wealth of India, 1969) of the tubers are 85.1% dry matter,

64.6% carbohydrates, 28.4% crude fiber, 10.9% crude protein, 0.5% aether extracts. P. S. RAO (1958) obtained similar results for the tubers, which compare well with the composition of *P. lobata*. He also analyzed the leaves: with 23.8% crude protein these constitute a good fodder for cattle. Sucrose, glucose, fructose, and beta-sitosterol have been identified. WATT (1892) reports an inulin-related compound, a resin and a resin acid as analyzed for the Pharmacographia India. The tuber exudes a bitter acrid gum of opalescent color when wounded (DYMOCK cf. WATT 1892).

HAINES (1922) claims that the stems reach 60 cm (2 feet) girth. The bark is brown and fibrous, peeling off in strips, sometimes twisted. No mention is made of any use of bark or stem fibers. PERRY (1980) did not cover *P. tuberosa* in her work on Medicinal Plants of East and Southern Asia.

Specimens examined:

INDIA: Andhra Pradesh: Horsleykonda, Chittoor distr., *Fischer 4332* (CAL); Palkonda hills, Vishakhapatnam hills, Srikakulam distr., *Gamble 13912* (K); Bainuti, Kurnool distr., *id. 18709* (K); Rampa hill, E. Godavari distr., *Ramaswami 1578* (CAL). Assam: Dhemsin (Lankhailingam), Nowgong dist., *Kanjilal 3861* (CAL). Bihar: Parasnath, Chota Nagpur, *Clarke 14010* (CAL, K); SE of Gibraltar hill, Hazaribagh, Chota Nagpur, *Kerr 2580* (BM); Parasnath Hill, *van der Maesen* (ICRISAT, WAG); Moondhu, Chota Nagpur, *W. J. Nurtu? s.n.*(K); Biswadi, Manbhum, *Watt 8444* (E); Souen Pani, Manbhum, *id. 9251* (E). Gujarat: Malangdev, Songudh, Surat distr., *A.S.B. 316*(US). Himachal Pradesh: Simla hills, *Drummond 20723* (E); Ram Baluk, ibid., *id. 23824* (K); sine loc., *id. 25349* (K); Naini Tihar, *id. 25350* (E, K); Khuzerabad, *Edgeworth 160* (OXF); Kalisar Dhun, *id. s.n.*(OXF); Subsiwaliks and Himala(ya), *id. s.n.*(K); Bhadwar, Kangra, *Koelz 4214* (F, NY, US); ibid., *id. 4373* (NY) and 4380 (US); Oot, Mandi distr., *id. 8330* (NY); Simla, Himal. Bor. Occ. Regio trop., *Thomson s.n.*(K, L, W); Bisantpur, Suni, Simla, *Watt s.n.*(OXF); ibid. *id. 10051* (NY). Karnataka: N. Canara distr., *Talbot 885* (CAL). Kerala: Achinkirril, Travancore, *Calder 1660* (CAL); E slopes, Anamuli, Palghat distr., *Nair 5678* (CAL). Madhya Pradesh: Bilaspur, Tenduchua-Kotari, *Haines 3220* (K), Balaghat, Simawani, *id. 322* (K); Gulhu, former Jashpur state, Rititungri Khol, *Mooney 1940* (K); E Satpura Hills, *Thompson 353* (CAL); Jashpur, Chota Nagpur, *Wood 222* (K). Maharashtra: Concan, *Law s.n.*(K) id., *Law & Stocks s.n.*(FI, K); Kala Middi, *Ritchie s.n.*(E); Toorheira, *id. 1040* (G); Oorun/Uran, *Stocks s.n.*(K); Concan, *Stocks & Law s.n.*(K); Malabar, Concan Regio trop., *id. s.n.* (BM, B, K, L). Meghalaya: Kauces Trace, Shillong, *Deka 18361* (CAL). Orissa: Sonahalla, Khurda, *Gamble 9327* (CAL); Kalahandi distr., R.M. Zamindry, Oothu hill, *Haines 4647* (K). Punjab: Kalesar, Plains, *Lace 33* (E, OXF); Kalka, *Rawal Chand s.n.* (CAL). Rajasthan: Mt. Abu, *Anon. s.n.*(L); ibid., *King s.n.*(CAL). Tamil Nadu: Annamalai forests, *Beddome 2201* (BM); Wynad, *id. 2202* (BM); Gudalur, *Clarke 11331* (K); Coonoor, *id. 11541* (BM, K); Attakatti, Annamalai Hills, *Fischer 3297* (CAL). Uttar Pradesh: Garhwal, *Falconer s.n.*(K); Kalsi, *Gamble 26532* (K); Dehra Dun and Kalsi, *Golong 38* (NY); Rajpur nr Dehra Dun, *Haines 2617* (K, NY); Dudhwa range, Kheri distr., Oudh, *Inayat/Duthie 21528a* (CAL, K); Gharwal Bhabus, *King s.n.*(K?); Kumar Sot, Dumundu bridge, *Pant 43693* (G); Lachiwala, Dehra Dun, *Raizada s.n.*(NY); Sirmor-(ia), Kumaon, *Strachey & Winterbottom s.n.*(K, P); Dehra Dun & vicinity, *Umrao Singh 367* (NY); Hardwar, *Wallich 5352C* (G,K). West Bengal: Cult. in Hort. Bot. Calc., *Anon. s.n.* (L); Bandarchua, Kelma, Purulia distr., *Biswas 79* (CAL); *Wallich 5352D* (BM, K) *id. s.n.*(C).

NEPAL: Rapti valley, Polunin, *Sykes & Williams 3621* (BM); Lothar, ibid., *Stainton 5597* (BM).

PAKISTAN: betw. Mirpur & Nekki, *Jacquemont 156* (BM, K, P); 'NW India' *J.L. Stewart s.n.*(E); Saidpur nr Rawalpindi, *R.R. Stewart 13751* (NY); 'NW India', *Royle s.n.*(K).

Notes: The specimens from NW India approach the typical *P. sikkimensis* in size of flowers, more crowded inforescences, and brown colouration of the

pubescence (see note under *P. sikkimensis*).

In January and February the large senescent yellowing leaves are conspicuous in the Indian forests.

17. Pueraria wallichii DC. ***(Map 13, p. 95)**

Pueraria wallichii DC., Ann. Sci. Nat. Ser. 1-4: 97(1825); DC., Mém. Lég. 254, t.43(1825); DC., Prodr. 2: 240(1825); Benth. in Miq. Pl. Jungh. 2: 235(1852); Benth., J. Linn. Soc. Bot. London 9: 124(1867); Baker in Hooker, Fl. Brit. India 2: 198(1876); Kurz, J. Asiat. Soc. Beng. 45-4: 253(1876); Collett & Hemsley, J. Linn. Soc. Bot. London 28: 47(1890); Prain, J. Asiatic Soc. Bengal 66-2: 419(1897); Duthie, Fl. Upper Gang. Plain 234(1903); 216 (repr. 1960); Craib, Kew Bull. 1911: 41, Craib, Contrib. Fl. Siam, Aberdeen Univ. Stud. 57: 65(1912); Gagnepain, Fl. Gen. Indo-Chine 2: 252, 257(1916); Brandis, Indian Trees 228(1921); Craib, Fl. Siam. Enum. 3: 452(1928); Kanjilal et al., Fl. Assam 2: 80(1938); Hara, Fl. E. Himalaya 162(1966); Lackey, Synops. Phaseol. 77(1977); Hara & Williams, Enum. Fl. Nepal 2: 128(1979).

Type: Nepal, *Wallich* (1821) (G, holo, microfiche seen; iso: BM, C, K: *Wallich 5353* a/c).

Synonyms: *Pueraria composita* Graham ex Wallich *nom. nud.*, Cat. Herb. Ind.no. 5570, based on Burma, Taong Dong, *Wallich 5570* (BM, G, K).

Neustanthus wallichii (DC.) Benth., in Miq. Pl. Jungh. 2: 234(1852), based on *Pueraria wallichii* DC.

Pueraria wallichii DC. var. *composita* (Grah. ex Wall.) Benth., J. Linn. Soc. Bot. London 9: 124(1867); Kurz, J. Asiatic Soc. Bengal 45-4: 253(1876), based on *Pueraria composita* Grah. ex Wall. *nom. nud.*

Type: Burma, Taong Dong, *Wallich 5570* (K, holo; iso: BM, G, K).

Dolichos frutescens Hamilton, in Don, Prodr. 240 (1825), *teste* Prain, J. Asiatic Soc. Bengal 66-2: 419(1897).

Type: Nepal, Hamilton (CAL, holo).

Description: *Shrub* with woody stems and branches, sometimes straggling, perennial. *Stems* up to 7 mm diameter, 1.5-4(-7) m tall, striate, sparsely pubescent, hairs adpressed, vertical, disappearing with age. *Bark* brown. *Stipules* very caducous, linear-acuminate, not produced below the base, to ca 8 mm long, 2 mm wide, striate, finely pubescent, leaving a narrow-oval scar, sometimes folded downwards; buds protected by similar, smaller stipules. *Leaves* pinnately trifoliolate; petiole striate, glabrescent, 7-18 cm long; rachis 2-5.5 cm long. Top leaflets rhomboid-elliptic, ovate or sometimes obovate, 8-28 cm long, 5-19 cm wide, side leaflets obliquely so, 8-23 cm long, 5-15 cm wide, apex long-acuminate, sometimes obtuse, base cuneate, margins rarely shallowly lobed, green and gla-

brous above, grey-green and very short- adpressed-pubescent below, very thinly if leaflet is large sized, ribs prominent, in ca 7 (sub-) opposite pairs. *Stipellae* linear-setaceous, 2-3 mm long, ca 0.5 mm wide, finely pubescent, caducous with time, petiolules thickened, 4-11 mm long, pubescent. *Inflorescences* axillary or terminal, sometimes branched, 8-30(-52) cm long, 1 or 2, sometimes more per axil (Nepal), axes finely ribbed, finely pubescent, flowering close to the base, flower buds crowded on short laterals, which expand with age, up to 3.5 cm long, ca 5-8 flowers per node or lateral, leaving top flowers close together, rarely remaining short-nodose; bracts very caducous, linear, ca 5 mm long, pubescent; pedicels slender, 2-5 mm, sturdy in fruit; *bracteoles* 2 per flower, ovate, ca 0.5 mm, caducous. *Calyx* short-pubescent, interior glabrous, tube 3.5-5 mm, teeth short, obtuse, 0.5-1 mm long, upper ones connate or slightly dilated. *Vexillum* obovate, ca 16-19 mm long, 6-8 mm wide, white or pale yellow to (rarely) violet red, apex rounded, base narrowed, not clawed, no auricles or callosities; alae narrow-elongate, ca 15-17 mm long, ca 2 mm wide, white or pink, darker than vexillum and keel, claw ca 4 mm long, auricle short, 0.5 mm; keel petals boat-shaped, ventrally and basally adnate, white to pinkish or violet red, ca 14-17 mm long, 3 mm wide, auricle near claw ca 1 mm, claw 5 mm. *Ovary* elongate, finely pubescent, ca 10 mm long, ca 8 ovules; style ca 4.5 mm, 2.5 mm upcurved, glabrous, stigma terminal, globular, penicillate at the base. *Stamens* monadelphous, vexillary stamen attched in the middle, ca 15 mm long, free part 1-2 mm, upcurved; anthers uniform, dorsifix, alternately on long and short filaments. *Pods* flattened-oblong, somewhat S-shaped, ca 6-7 seeded, 6-10 cm long, 0.7-1.1 cm wide, acuminate at both ends, tipped with rest of style, pale to medium brown, glabrous, valves faintly reticulate, curling when ripe. *Seeds* reniform, ca 5.5 mm long, 3.5 mm wide, 2.5 mm thick, brown with black mosaic, seed coat minutely reticulate, strophiole oval, ca 1.2 mm longest diameter, yellowish.

Distribution: Bangladesh, Burma, China (Yunnan), India (E Himalayas, Meghalaya), Nepal, Thailand.

Ecology: In or near dry evergreen forests, associated with sal (*Shorea robusta* Gaertn.), pines, dipterocarps, *Quercus*; in open grassy vegetation, on slopes, along rivers, erect or scandent in shrubs and trees.

Altitude: 180-1900(-2300) m.

Flowering: (August-September) October-January (February). Fruiting: (August) October-February.

Vernacular names: India: Mei-soh-ktaw (Khasi).

Uses: *Hooper 34722* (CAL) refers to the use of *Pueraria wallichii* as a hedge near the villages of Therria ghat in the Khasi hills of Meghalaya, India.

Specimens examined:

BANGLADESH: Sylhet, *Wallich 5353B* (BM, G, K);

BURMA: Pandaung, Toungoo distr., *Chin 4446* (CAL); Taunggyi, *Collett 90* (K); Khyrbani, Dangmai, *Gamble 313B/C* (CAL, K); Chenga distr., *id. 2423* (CAL, K); Fort Stedman (Mong Hsawk), Inle Lake, *Abdul Huk s.n.* (CAL); Heho, S Shan, *Abdul Khalil s.n.*(CAL); Esakan, Victoria, *Kingdon Ward 22871*(BM); Martaban, *Kurz 1724*(FI, US); Palwe reserve, Gamethin distr., *Lace 4534*(K); Wetwun, N. Shan State, *id. 4975* (CEL, E); Ani Sakan nr Maymyo Plateau, *id. 5510*(CEL, E, K); Keng Tung, S. Shan State, *MacGregor 950* (CEL, E); Byinban, Upper Chindwin, *Meebold 7737* (CAL, K); betw. Numpandet and Wetpyuye?, *Melville 10* (BM); Shinday, Chihia hill, Minbu, *Shaik Mokim 1173* (G); Upper Burma, *Prazer 32*(CAL, G, US); ibid., *id. 45*(G); Polamy Mohye, S. Shan State, *Robertson A*(K); Thangthagon, Indaing forest, *id. 44*(K); Taunggyi backyard, *Vogt 417*(US); Tuang Dong or Taong Dong, *Wallich 5570*(BM, G, K).

CHINA: Yunnan: sine loc., *Bons d'Arty s.n.*(P); hills NE of Tengyueh, *Forrest 8276* (K); Talang, *Henry 11568* (CAL, K); Talang, Tatien river, Sheo Dai, *id. 13233* (CAL, E, K, NY,US); on the Babien-ho betw Talang and Puorl, von *Wissmann 543* (W).

INDIA: Assam: Pynursla, *Biswas 4055* (CAL); Jowai, *King's collector s.n.*(BM); Khasi & Jaintia hills, Dawki market, *Panigrahi 4678* (CAL, L). Meghalaya: Khasi hills: Mausmai, *Clarke 5538* (BM, CAL); Pooriang (Puriang?) *id. 5793* (BM, K); Mingot or Mungot nr river, *id. 14829* (BM, CAL, K); Shoula, *id. 14884* (BM, CAL, K); Sohra, *id. 15599* (BM); Walong, *id. 17819* (BM, K); ibid., *id. 17825* (CAL, K); sine loc., *Griffith 350* (G, K); Chabadi, *id. 1733* (K, W); Regio trop. Mahadev, *Hooker & Thomson s.n.*(BM, C, CAL, FI, G, K, L, NY, OXF, P, U, US, W); below Pomrang, *id. 2488* (K); Syndai, *Kanjilal 2777* (CAL); Cherrapunji to Therria, *id. 4579* (CAL); Mahadeo; *id. 4621* (CAL); Mawlynkneng, *Koelz 28421* (L); ibid., *Thakur Rup Chand 5085* (L); Dawki Market & surroundings, *Panigrahi 4678* (CAL). Mizoram: Sherkoi, Lushai hills, Mrs. *Parry 446* (CAL). Sikkim: Himalaya, *Gammie 47* (U); betw. Chumthang and Lamteng, *Prain s.n.*(BM, CAL, L); West Bengal: Cult. Hort. Bot. Calc., *Anon. s.n.*(G, L).

NEPAL: Num, *Beer 12356* (BM); Lumle Agric. Centre, *Dawson 473* (BM); Garhi Daura-Linkim-Tuwa, *Hara et al., 6301726* (BM); Illam-Jog Mai-Ranga Pani, *id. 6301727* (BM, NY); E. Dhankuta, *id. 6301728* (BM, E); Taplethok-Helok, *id. 6301729* (BM); Khebang-below Siling Tzokupa, *id. 6301730* (BM, E, NY); E. Nepal & Sikkim, *Hooker s.n.*(K); Lungtung, Tambur river, *id. s.n.*(K); Khabili river, *id. s.n.*(K, P); Darondi Khola S of Himal Chuli, *Stainton 6030* (BM); Mardi Khola S of Annapurna, *id. 6091* (BM); Sattewati, Stainton, *Sykes & Williams 8896* (BM, E); Nepal sine loc., *Wallich 5353 A+C* (BM, C, K); Arun valley, mouth of Choyang Khola into Arun, *Wraber 471* (BM);

THAILAND: Phu Kradung, Loei distr., *van Beusekom et al. 4620* (L); ibid., *Charoenphoi et al. 14850* (K); Doi Sutep, Chiengmai, *Mrs Collins 1222* (K, US); Dai-Angka, Me Ka Pak drainage, *Garrett 313*(E, K, L); Payap, Doi Buak Ha, W of Chiengmai, *Hennipman 3175* (C); Doi Sutep, nr Chiengmai, *Hosseus 207* (BM, CAL, W); Doi Chieng Dao, *Kanthachai 95* (L); Doi Sutep, Chiengmai, *Kerr 878* (BM, L); 1556 (BM, E, K, US); Tapoh, *Larsen 9144* (L); Chieng Dao, *Seno Pengnaren 31* (L); Kanchanaburi, Tham Pa, *Phenkhlai 344* (L); Doi Chiang Dao, *Put 368* (BM, C, L); *4436* (BM, E, K); Camp Hoi Chan Kiang, Doi Sutep, *Rock 116* (US); Chiengmai to Chieng Rai betw. Pang Kai & Meh Kha Chan, basin of Meh Lao, *id. 1620* (US); Phu Krading, Loei, below Sam Khae, *Smitinand 2113* (CAL, L); *id. 3091* (L); Chiengmai, *id. 3936, 3956* (L.); Kuhm Tan mts, *H.M. Smith 454* (US); Pah Hom Pok, in opium field, *Sørensen et al., 1659* (C); Doi Sutep, Chiengmai, *id. 5857* (C); *5914* (C, L); & *5972* (C, E); Chiang Dao, *Suvarnakoses 976* (K, L); Phrae, *Vanpruk 478* (CAL, K); Lampun, Mi Li Pi forest, *Winit 1521* (K).

Notes: The holotype, sent by WALLICH to DE CANDOLLE between 1821 and 1825 is conserved in the Herbier de Candolle at G. As isotypes I consider the specimens sent later with the Herbarium of the East India Company, *Wallich 5353A*, and *Wallich 5353C*, grown in the Calcutta Botanic Garden from seeds brought from Nepal, likely to be from the same source. *Wallich 5353B* is from

Sylhet, now Bangladesh, and is not a type.

Pueraria wallichii contains canavanine, unlike most *Pueraria* spp. and is morphologically so distinct from the other *Pueraria* sp., that LACKEY (1977a, b) considered it anomalous in the genus and felt it should be removed, even though it fits nowhere else well.

Pueraria rigens Craib was listed as a synonym of *P. wallichii* by LACKEY (1977a). I think *P. rigens* is at any rate specifically sufficiently distinct, although as to flower and inflorescence structure it is somewhat like *P. peduncularis*.

11. MATERIAL OF UNCERTAIN DISPOSITION

Some specimens could not be placed in other genera and fit the general habit of *Pueraria*.

Cunningham 105 and *173*(BM) both from Tatsienlu (now Kangting) in Szechwan, China, are erect shrubs with terminal pseudoracemes, flowers (14 mm) similar to those of *P. peduncularis*, also without auricles on the vexillum, but with a somewhat bulgy style base, larger hooked wing auricle, similar calyx, stipellae, ovary, stamens, and bracteoles. The leaflets are ovate-rounded with emarginate-mucronate apex, not long-acuminate, truncate-cordate base and margin sinuate. Its pubescence is thin-woolly, the hairy forms of *P. peduncularis* are semi-adpressed pubescent. The Cunningham specimens are either a variety of *P. peduncularis* or a closely related, erect species of *Pueraria*.

Simeon Ten 266(E) from Nanfantchoang, Yungse (Yangtze?) in Yunnan, China, has rounded to obovate leaves, emarginate, nonmucronate apex, rounded base, slightly sinuate thickened-pubescent margin, with thin adpressed pubescence above and woolly pubescence below. Its inflorescence is branched, paniculate with ca 2 flowers at the base of most laterals, thin hairy pedicels and flowers much the same as *P. peduncularis*. With *Cunningham 105* and *173* it has flower shape, size (10 mm) and approximate leaf shape and pubescence in common. If this specimen belongs in *Pueraria*, its alliance is with *P. peduncularis*.

Henry 13626 (BM, NY, US) and *10931* (CAL, K, NY) from Mengtze mts, Yunnan, China, has the facies of a hybrid between *Pueraria lobata* and *P. edulis*. Its leaves are 3-lobed, coarser than the thinner (when dried) leaves of *P. lobata* var. *lobata* and *P. edulis*, with acute rather than acuminate leaflet tips, relatively broad stipellae as in *P. edulis* but in a single pair near the side leaflets. Stipules are peltate. The flowers are ca 12 mm long, smaller than those of the mentioned species, with a quite hairy calyx and vexillary stamens attached at first at least. The ribs on the greyish and grey-pubescent lower leaflet side are quite prominent, more so than in *P. lobata* var. *lobata* and *P. edulis*, the pubescence of the latter disappearing soon. At present I cannot decide upon specific or varietal status. The sheets were identified as *P. phaseoloides*, but that is definitely an error. Per-

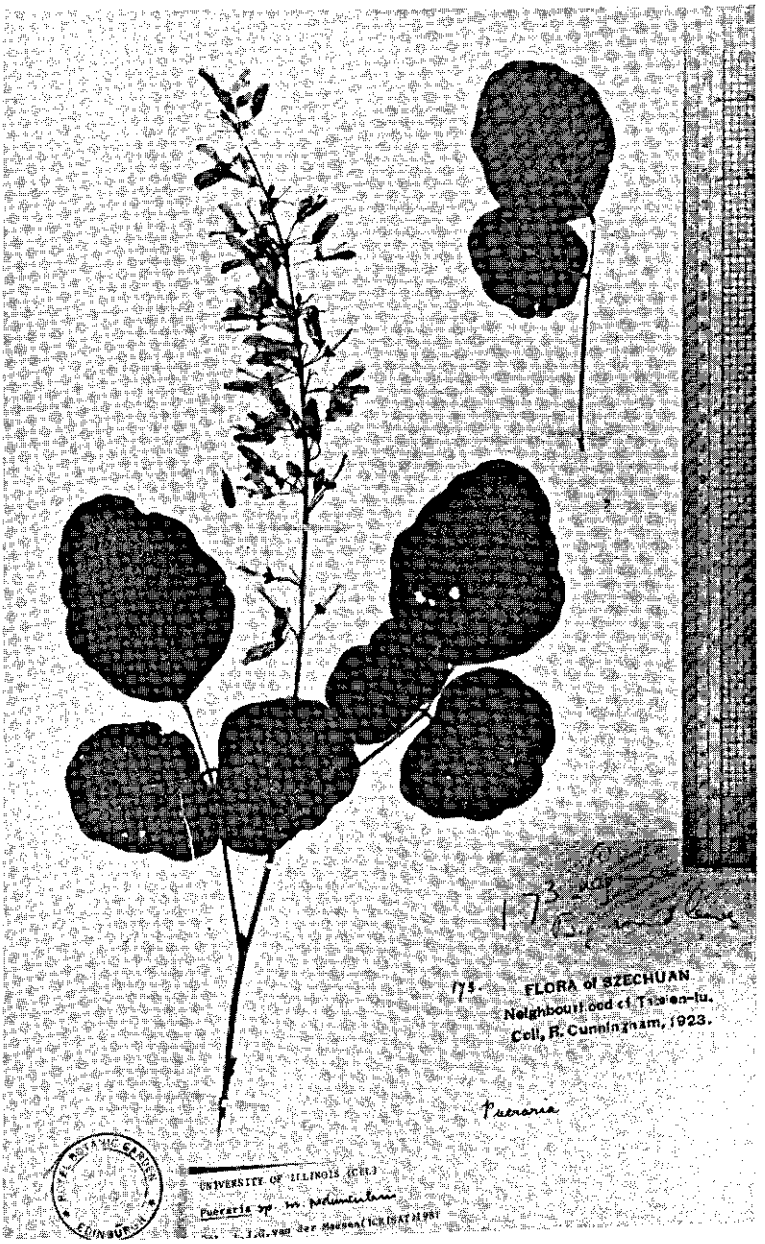


PLATE 23. *Cunningham 173*, near *Pueraria peduncularis*

haps this material is simply a form of *P. lobata* var. *lobata*, or, indeed, a hybrid of *P. edulis*, or *P. lobata* var. montana, of which it has the leaf structure.

Ducloux 5805(P) from Liao Fa Ka, Kiao Kia region in Yunnan, China, deter-

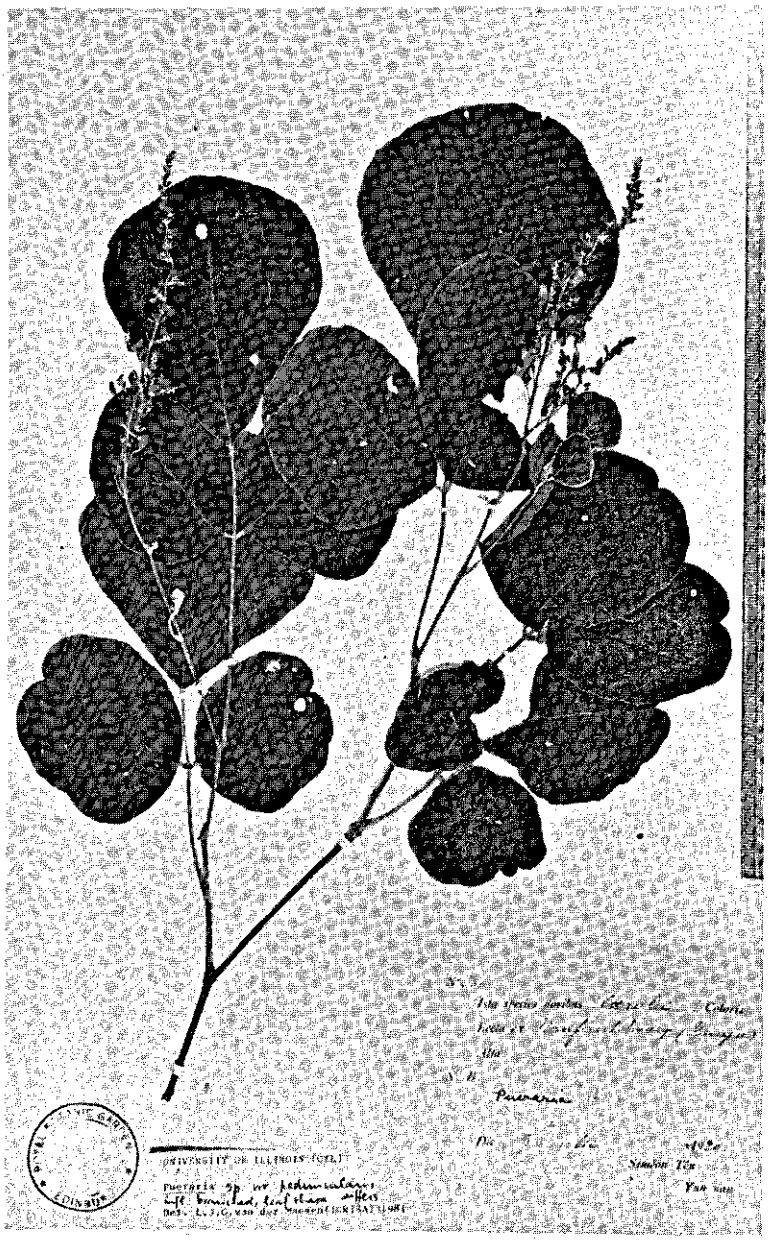


PLATE 24. *Simeon Ten 266*, near *Pueraria peduncularis*

mined as *Pueraria bicalcarata* Gagn., seems to be a *P. lobata* var. *lobata* but with short, rather broad calyx lobes, short-grey hairy calyx and thin longer-pubescent lower leaflet sides and more prominent veins.

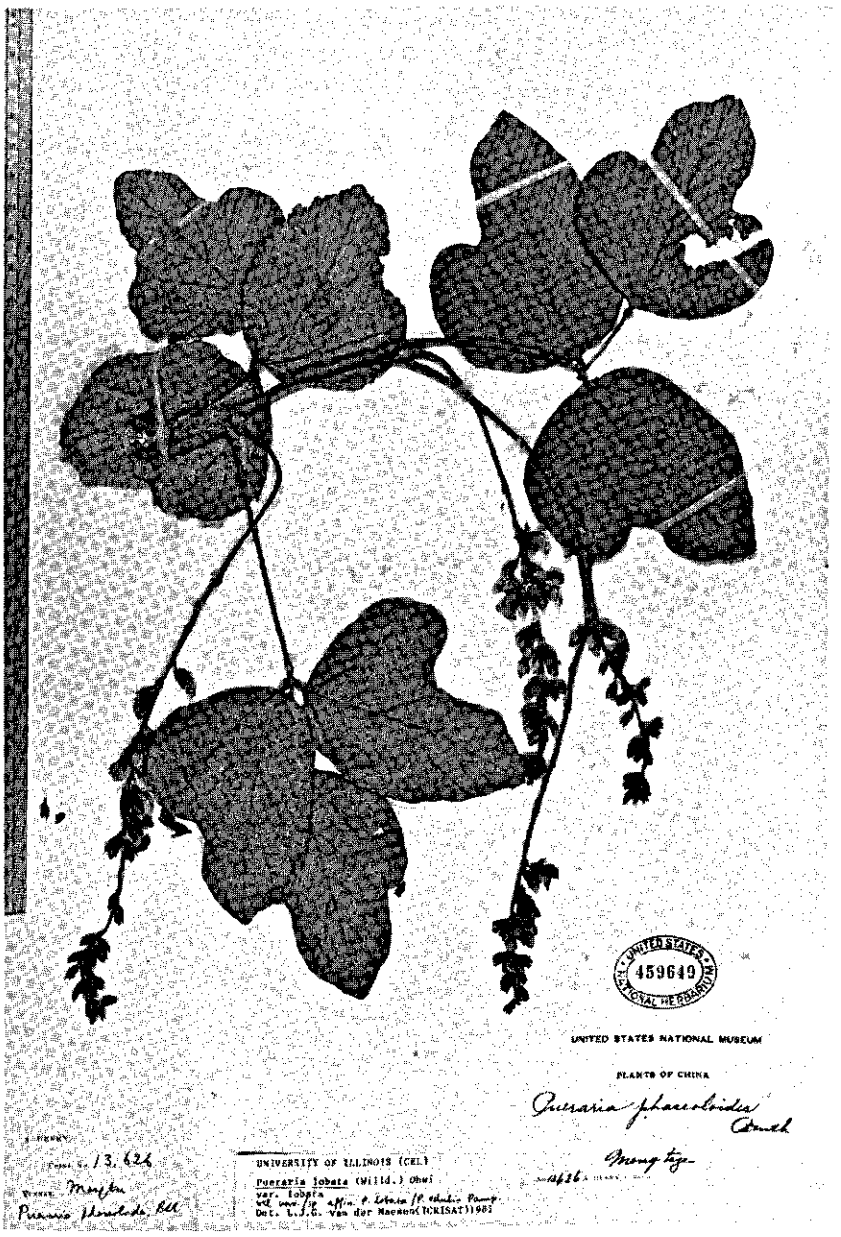


PLATE 25. *Henry 13626*, near *Pueraria lobata* and *P. edulis*

Palmer & Bryant 266(US) from Chiburum, slopes of Gunung Gedeh on Java looks somewhat like *Pueraria pulcherrima*. Leaflets are smaller, not so woolly greyish pubescent below, stipellae are not so caducous, black, short linear, ca

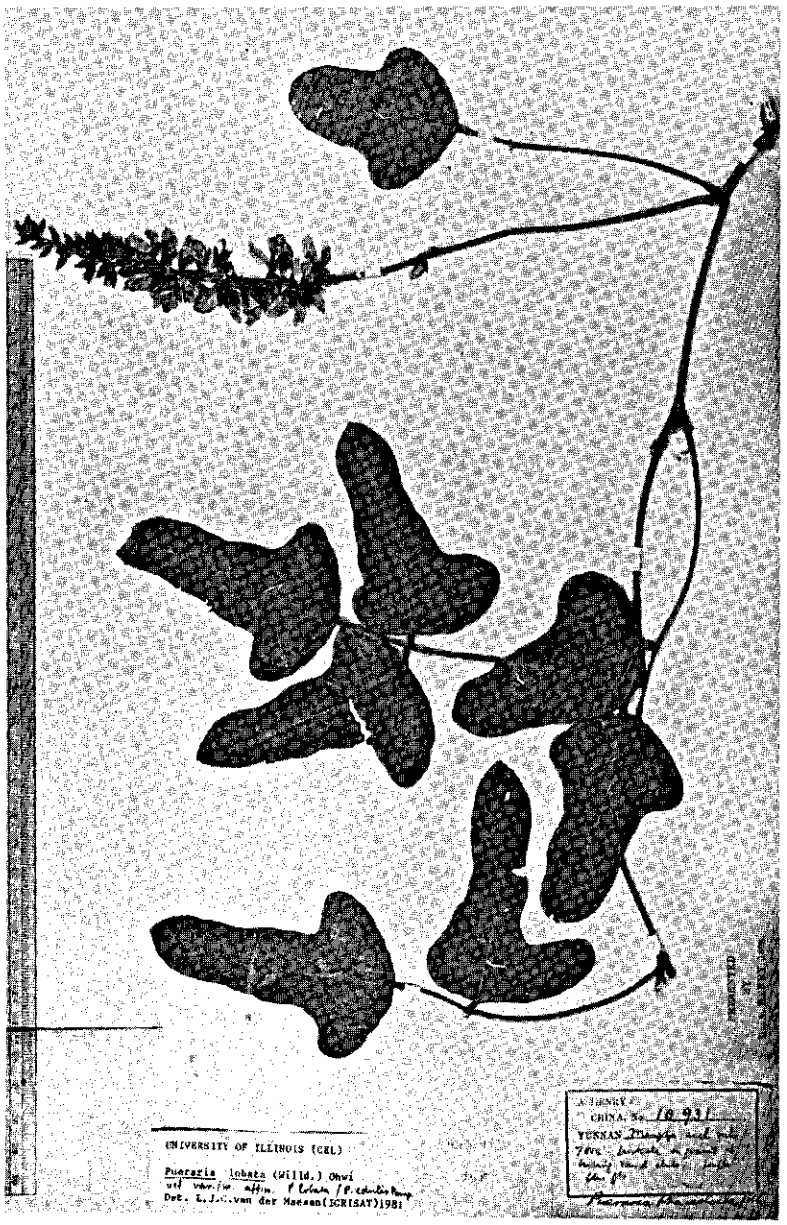


PLATE 26. *Henry 10931*, near *Pueraria lobata* and *P. edulis*

5 mm long. Stipules are narrower and also more persistent than in *P. pulcherrima*, rather papery. The pubescent inflorescence is not well developed yet, but flowers are tended by large bracts and arranged ca 3 per node. The flowers are

as large as those of *P. pulcherrima* (8 mm at least) but the calyx is not greyish canescent while the upper lobe is incised. The stamens are monoecious. If this is a *Pueraria*, it is an undescribed species.

Pueraria tanaii Ozaki (fossil species)

Pueraria tanaii Ozaki, Sci. Rep. Yokohama Nat. Univ. Sect. 2. Biol. Geol. Sci. 21: 15(1974).

Type: Japan, Izumi distr., Inkyoyama hill, N of Toki, *GYNU-CMP-1029*, Geological Inst. Yokohama Nat. Univ. (photograph seen).

Paratypes: Same location, *GYNU-CMP-1028 & 1030* (ibid., photograph seen).

Ecology: Considered to have been warm-temperate to transitional forests during Miocene.

Notes: Fossils of single leaflets, resembling present-day *Pueraria* (of which *P. lobata* is commonly found in Japan), were found in Miocene sediments (OZAKI, 1974). The leaflets, judging from the photograph, do indeed resemble *P. lobata* leaflets, the holotype may be an unlobed asymmetric side leaflet, paratype *1030* looks like a slightly lobed ± symmetric top leaflet. Venation and shape were described in detail (OZAKI, 1974). The leaflet size varied from 5-7 cm long and 4-7 cm wide.

12. EXCLUDED SPECIES AND REJECTED NAMES, WITH NOTES ON TEYLERIA

Some new combinations were necessary; some of LACKEY's (1977) new names are validated in this chapter.

Pueraria anabaptista Kurz, J. Asiatic Soc. Bengal 45-2: 253(1876): *Shuteria hirsuta* Bak. in Hooker, Fl. Brit. India 2: 182(1876); Prain, J. Asiatic Soc. Bengal 46-2: 402(1897); Gagnepain, Fl. Gén. Indo-Chine 2: 405(1916); Thuan, Adansonia ser. 2,12-2: 303 (1972) (*as anabaptis*). Further synomyms: *Glycine ferruginea* Grah. ex Wall. nom. nud., Cat 5514 (1831); *Shuteria anabaptis(ta)* (Kurz) Wu, J.W. China Border Res. Soc. ser B. 16: 173(1946).

Pueraria barbata Craib, Kew Bull. 1927: 379: *Teyleria barbata* (Craib) Lackey ex van der Maesen comb. nov., Lackey, Synops. Phaseol 77 (1977).

Type: Thailand, Doi Sutep 3000 ft, *Kerr 2653* (K, holo; iso: BM). Other material seen: Ibid., *id. 2224*(BM, K). See note under *P. tetragona.*

Pueraria chaneti Lévl. Bull. Acad. Geogr. Bot. 17 suppl. iii (1907): *Phaseolus*

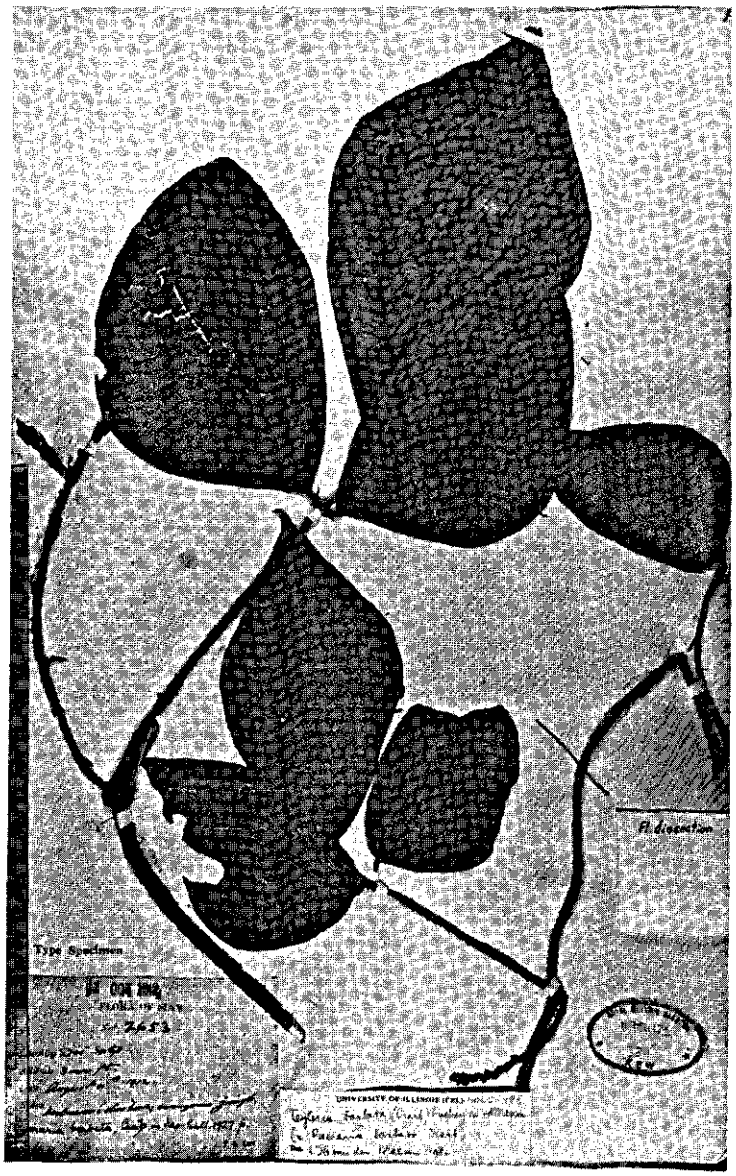


PLATE 27. *Teyleria barbata* (Craib) Lackey ex van der Maesen, holotype (*Kerr 2653*)

chaneti (Lévl.) Lévl., Bull. Soc. Bot. France 55: 427(1908): *Vigna radiata* (L.) Wilczek, Lackey, Synops. Phaseol. 77(1977).

Pueraria ferruginea Kurz, J. Asiatic Soc. Bengal 42-2: 232 (1873): *Shuteria ferruginea* (Kurz) Bak. in Hooker, Fl. Brit. India 2: 187(1876): *Shuteria hirsuta* Bak. ibid.: Lackey, Synops. Phaseol. 77(1977).

Pueraria ficifolia (Benth.) L. Bolus, Ann. Bolus Herb. 1: 189(1915): *Neorautanenia ficifolius* (Benth.) C.A. Smith in Burtt Davy, Fl. Pl. Ferns Transvaal 2: XXVIII & 417(1932). See Verdcourt, Kew Bull. 24: 306(1970).

Pueraria hochstetteri Chiov., Ann. Inst. Bot. Roma 8: 434(1908); Cufodontis, Enum. Pl. Aeth. Sperm. 319(1955): *Neorautanenia mitis* (A. Rich.) Verdc., Kew Bull. 24: 306(1970); Lackey, Synops. Phaseol. 7 (1977).

Lectotype: Ethiopia, betw. Adeita & Cualo Dijot mt, Assaorta, *Pappi 5795* (FI, holo? not seen; iso: G, *lectotypus nov.*).

Paratypes: ibid., *Pappi 2998* (FI? not seen); Ethiopia, *Pappi 3721, 3728, 3064* bis (FI? not seen).

Pueraria maclurei (Metcalf) F. J. Hermann, Techn. Bull. USDA 1268: 46(1962), basionym *Glycine maclurei* Metcalf, Lingnan Sci. J. 19: 557(1940): *Sinodolichos lagopus* (Dunn) Verdc., Kew Bull. 24: 398(1970), basionym *Dolichos lagopus* Dunn, J. Linn. Soc. Bot. 35: 490(1903), *teste* Lackey, Synops. Phaseol. 77(1977).

Pueraria rogersii L. Bolus, Ann. Bolus Herb. 1: 189(1915): *Neorautanenia amboensis* Schinz, Bull. Herb. Boiss. 7: 35(1899), for other synonyms see Verdcourt, Kew Bull. 24: 306(1970); Lackey, Synops. Phaseol. 77(1977).

Type: Transvaal, Selati railway betw. Komati Poort & Letaba riv., *Rogers 11806* (BOL, holo, not seen).

Pueraria seguini Lévl. & Vaniot, Bull. Soc. Bot. France 55: 426(1908): *Cajanus grandiflorus* (Benth. ex Bak.) van der Maesen comb. nov. (Agric. Univ. Wageningen Papers); Other synonym: *Dunbaria pulchra* Benth. ex Bak. in Hooker, Fl. Brit. India 2: 218(1876), established by Gagnepain, Not. Syst. 3: 205(1916).

Pueraria stracheyi Bak. in Hooker, Fl. Brit. India 2: 198(1876): *Shuteria* sp.? teste Lackey, Synops. Phaseol. 77(1977).

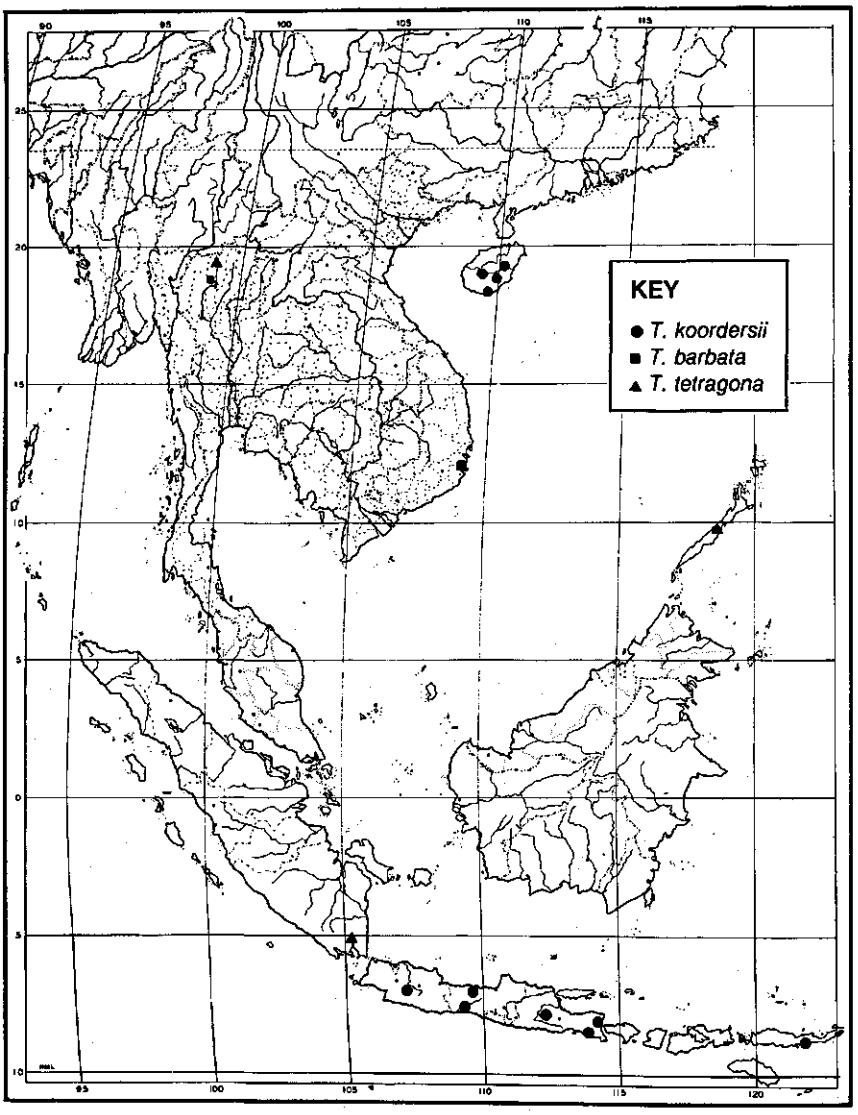
Type: India, U.P., Kumaon, Kalimundi 7300 ft, *Strachey & Winterbottom s.n.* (K, holo).

Pueraria strobilifera Kurz ex Prain, J. Asiatic Soc. Bengal 66: 2-403 (1897): *Shuteria hirsuta* Bak., Fl. Brit. India 2: 182(1876), Lackey, Synops. Phaseol. 77(1977).

Type: syntypes are *Clarke 13493* from Sikkim and Mann; Collett; and *Clarke 40383* from Khasia. A lectotype has to be selected from material in CAL or K.

Pueraria tetragona Merr., Philipp. J. Sci. 5: 122(1910): *Teyleria tetragona* (Merr.) Lackey ex van der Maesen comb. nov. Lackey, Synops. Phaseol. 77(1977).

Type: Philippines, Palawan, nr Puerto Princesa, Bermejos, Bur. Sci. 295



MAP 16. *Teyleria koordersii, T. barbata,* and *T. tetragona* in east and southeast Asia.

(PNH, holo? not seen; iso: CAL, NY). Other specimens seen: Indonesia: Sumatra, Lampongs, Kota Jawa, *Forbes 1396* (CAL). Thailand: Me Pa Tang, left side nr foot of Doi Chiengdao, 1140 m, *Garrett 1226* (K), pubescence of pods different, pod larger and more sturdier hooked than the type.

Note: for the convenience of the users a key to the species of *Teyleria* is given here. The locations of the three species are mapped, the specimens seen

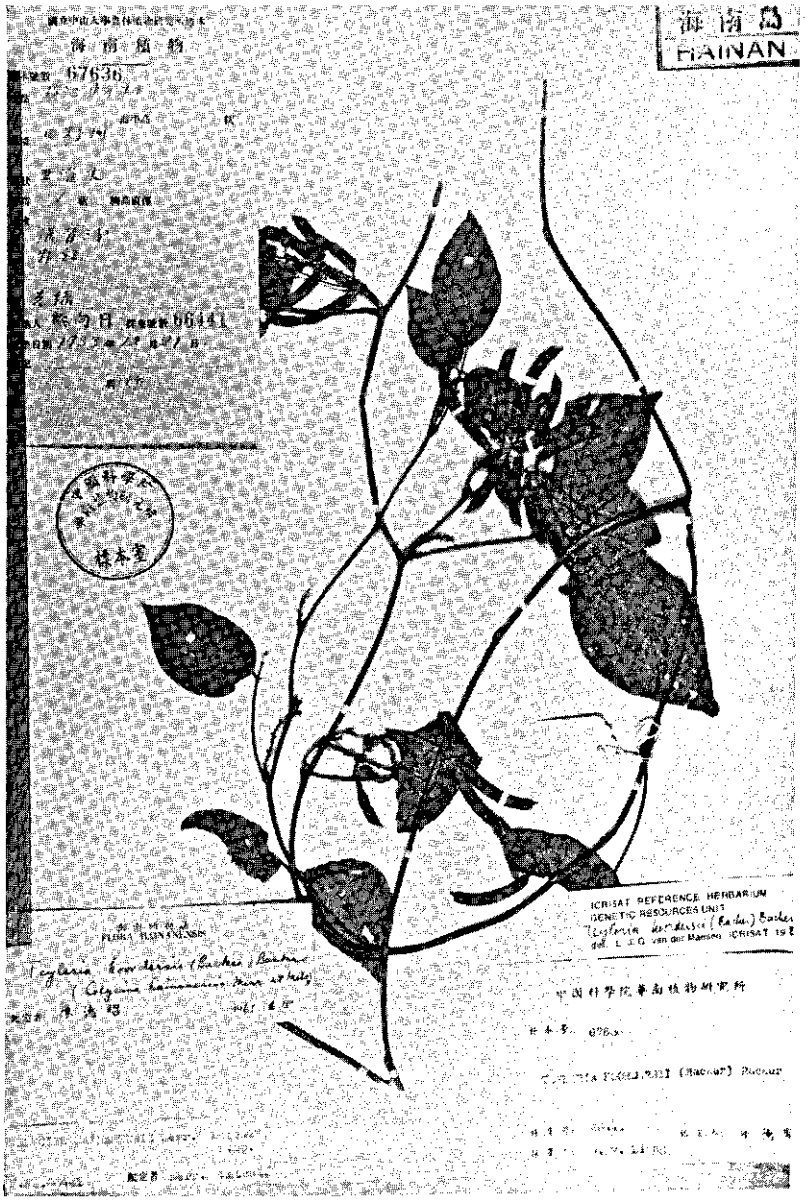


PLATE 28. *Teyleria koordersii* (Backer) Backer (*H. Y. Ling 67636*)

are listed in the previous sections and after the key respectively. *Teyleria* has more the facies of *Glycine*, with which the type species was formerly associated. *Teyleria* differs from *Glycine* and *Pueraria* by its four-angled stems, bearing retrorse hairs on the angles. The inflorescence is short, the flowers measure 5 mm or less.

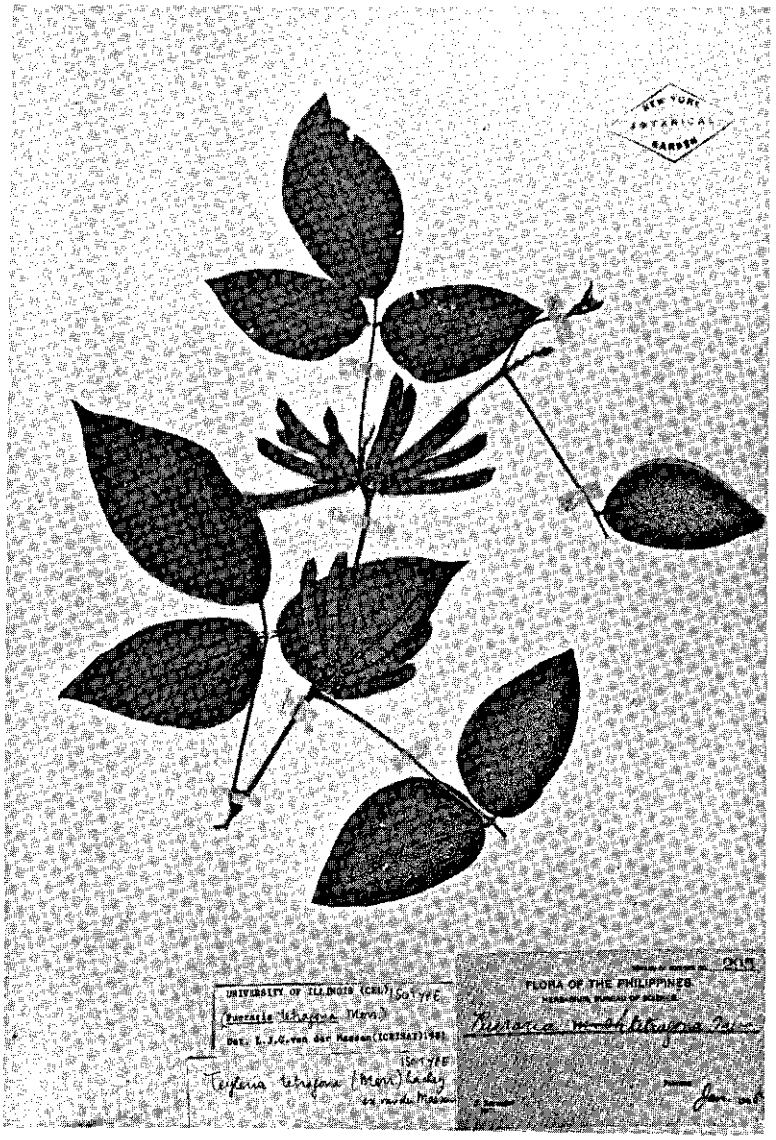


PLATE 29. *Teyleria tetragona* (Merr.) Lackey ex van der Maesen, isotype (*Bermejos 295*)

Key to the species of Teyleria

1a. Leaflets large, ca 9-15 cm long, densily pubescent below, stem angles long-pubescent, strong climber . . . . . **T. barbata**

1b. Leaflets smaller, up to 10 cm long, thinly pubescent or glabrous below, stem angles short-pubescent, weak climber 2

2a. Fruits ca 4-7 cm long, 0.5 cm wide . . . . . **T. tetragona**

2b. Fruits ca 3 cm long, 0.3 cm wide . . . . . **T. koordersii**

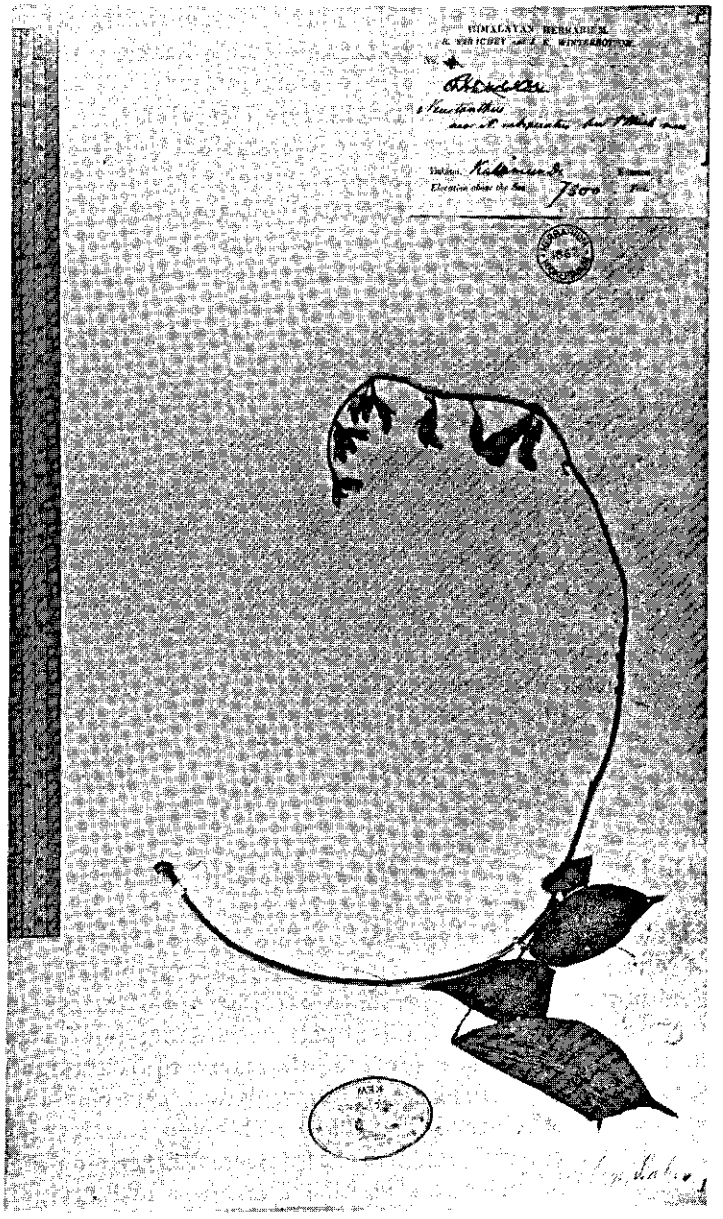


PLATE 30. *Pueraria stracheyi* Baker = *Shuteria sp.*?, holotype (*Strachey & Winterbottom s.n.*)

Teyleria koordersii (Backer) Backer, Bull. Jard. Bot. Buitenzorg ser. 3 16:108(1939), Hermann, USDA Techn. Bull. 1268: 79(1962); Backer, Fl. Java 1: 625(1963).

Basionym: *Glycine koordersii* Backer, Schoolfl. *Java 358*(1911).

Lectotype: Java: Kediri Res., Gudangan Pare, *Koorders 22997*(BOG, holo-lecto, not seen; isolecto: L; *lectot. nov. typus floriferus.*

Paratype: Java: Besuki, Puger, *Koorders 21260* (BOG, not seen; L, 2 sheets seen; *typus fructiferus*).

Synonyms: *Glycine hainanensis* Merrill & Metcalf, Lingnan Sci. J. 16: 194(1937). Hermann, USDA Techn. Bull. 1268: 79(1962).

Type: China, Hainan, Lok Mooi Shan; Changkiang distr., *S. K. Lau 1198* (holo: ?; iso: BM).

Specimens examined:

INDONESIA, Java: Banyumas, Meluwung Plantation, *Anon. s.n.*(L); N of Kiara Payung, N of Chianjur, *Backer 23717* (K, L); Pekalongan, Margasari forestry, *Beumee 1799*(L); Besuki, Puger, *Koorders 21260* (*iso. fruct.*, L); ibid, *id. 21283* (L); Kediri, Gudangan-Pare *id. 22997* (*iso. floriferus*, L); Besuki, Rogojimpi, *id. 28959* (L). Flores: Endeh, *Rensch 1040*(L). Backer (1939) quotes more specimens from Indonesia.

CHINA: Kwangtung/Guangdong prov., Hainan: Janfenling, *K. S. Chow 78227* (BM, NY); Lok Mooi Shan, Changkiang distr., *S. K. Lau 1198* (iso, BM); Ka Chik Shan, ibid., *H. Y. Liang 66441* (KWA, US).

VIETNAM: Annam, region of Nha Trang, *d'Alleizette s.n.*(L).

13. ACKNOWLEDGEMENTS

I wish to thank Dr. L. D. SWINDALE, Director General, ICRISAT for according permission to go on study leave to the Crop Evolution Laboratory, the University of Illinois, Urbana, where Dr. J. R. HARLAN, Dr. J. M. J. de WET, and Dr. T. HYMOWITZ offered me hospitality and guidance. Their staff members and students assisted in creating a good working atmosphere, for which I am grateful. I am also grateful to Mr. TUNG MING SUNG for translation of Chinese herbarium labels and EMILY FORTENBERRY for typing the manuscript. I am grateful to Prof. Dr. H. C. D. de Wit, Agriculture University Wageningen, for critically reviewing the manuscript. This research would have been impossible without the support of the Directors and Curators of the following Herbarium Institutes who sent *Pueraria* material on loan and assisted in various ways:

BM – British Museum (Natural History), London, U.K.
C – Botanical Museum and Herbarium, Copenhagen, Denmark.
CAL – Central National Herbarium, Botanical Survey of India, Calcutta, Howrah,India.
CEL – Crop Evolution Laboratory, University of Illinois, Urbana, Ill, U.S.A.

E – Royal Botanic Garden, Edinburgh, U.K.
F – Field Museum Herbarium, Chicago, Ill., U.S.A.
FI – Herbarium Universitatis Florentinae, Florence, Italy.
G – Conservatoire et Jardin Botanique, Geneva, Switzerland.
K – The Herbarium, Royal Botanic Garden, Kew, Richmond, U.K.
KWA – South China Institute of Botany, Academia Sinica, Kwangchow (Canton), Guangdong, People's Republic of China.
IL – Department of Botany, University of Illinois, Urbana, Ill., U.S.A.
L – Rijksherbarium, Leiden, The Netherlands.
NAN – Hortus Botanicus Nanjingensis, Nanjing, Jiangsu, People's Republic of China.
NY – New York Botanical Garden, New York, U.S.A.
OXF – Fielding-Druce Herbarium, Department of Botany, Oxford, U.K.
P – Laboratoire de Phanerogamie, Museum National d'Histoire Naturelle, Paris, France.
PE – Herbarium, Institute of Botany, Academia Sinica, Beijing (Peking), People's Republic of China.
U – Institute for Systematic Botany, Utrecht, The Netherlands.
US – National Herbarium, Smithsonian Institution, Washington, D.C., U.S.A.
W – Naturhistorisches Museum, Vienna, Austria.
WAG – Herbarium Vadense, Department of Plant Taxonomy, Wageningen Agricultural University, the Netherlands.

SUMMARY

The taxonomy of the Asian genus *Pueraria* DC. (Leguminosae) has been revised. The study was based on herbarium material. In total 17 species are now recognized, including *P. imbricata* van der Maesen sp.nov. from Laos and Thailand. Some species anomalous in the genus have been retained: *Pueraria peduncularis* (Grah. ex Benth.)Benth. and *P. wallichii* DC.

Pueraria subspicata (Benth.)Benth. was lowered from species to variety level under *P. phaseoloides* (Roxb.)Benth., as was done for *P. thomsoni* Benth. and *P. montana* (Lour.)Merr., which are better placed as varieties of *P. lobata* (Willd.)Ohwi.

Two *Pueraria* species were placed in a related, earlier monotypic genus, *Teyleria* Backer: *T. barbata* (Craib.)Lackey ex van der Maesen comb. nov. and *T. tetragona* (Merr.)Lackey ex van der Maesen comb.nov.

Lectotypes were designated for *Pueraria alopecuroides* Craib., *P. mirifica* Shaw & Suvatabandhu, *P. sikkimensis* Prain, *P. stricta* Kurz and the synonyms *P. collettii* Prain, *P. peduncularis* (Grah. ex Benth.) *var. violacea* Franch., *Derris bonatiana* Pamp., *Neustanthus subspicatus* Benth., *Pueraria textilis* Lautb. &

Schum., *P. tonkinensis* Gagnep. and *P. sericans* R. Schum.

Geography, flowering, uses and vernacular names are compiled, occurrence of specimens examined was plotted on maps. Most of the genetic diversity is found in Burma, S. China, Thailand, Indochina, NE India. *P. pulcherrima* (Kds.)Merr. is confined to SE Asia and parts of Oceania.

Biosystematic references, of which there are few, are added. Chromosome counts in the genus are 2n = 22 and 44, rarely 2n = 20 and 24, the latter almost certainly incorrect.

For further studies it is imperative that live material and, for many species, better herbarium material be collected, to elucidate the taxonomy of the genus. Related to *Glycine*, the soybean and its relatives, *Pueraria* and *Teyleria* may have useful genes to contribute to soybean improvement.

RESUMÉ

La taxonomie du genre asiatique *Pueraria* DC. (Leguminosae) a été révisée; ce genre comprend 17 espèces. L'étude était basée sur les collections d'une vingtaine d'herbiers importants. *Pueraria imbricata* van der Maesen est décrite comme une nouvelle espèce du Laos et de la Thailande. Quelques espèces appartenant au genre, mais de morphologie atypique, restant dans *Pueraria: P. peduncularis.* (Grah. ex Benth.) Benth. et *P. wallichii* DC. *Pueraria subspiata* (Benth.) Benth. a été reclassée d'espèce à variété sous *P. phaseoloides* (Roxb.) Benth. ainsi que *P. thomsoni* Benth. et *P. montana* (Lour.) Merr. qui sont mieux placées comme variétés de *P. lobata* (Willd.) Ohwi, le kudzu.

Deux espèces de *Pueraria* ont été reclassées dans un genre voisin: *Teyleria* Backer: *T. barbata* (Craib) Lackey ex van der Maesen et *T. tetragona* (Merr.) Lackey ex van der Maesen.

Des lectotypes ont été désignés pour *Pueraria alopecuroides* Craib, *P. mirifica* Shaw et Suvat., *P. sikkimensis* Prain, *P. stricta* Kurz et les synonymes *P. collettii* Prain, *P. peduncularis* (Grah. ex Benth.) Benth. var. *violacea* Franch., *Derris bonatiana* Pamp., *Neustanthus subspicatus* Bent., *Pueraria textilis* Lautb. & Schum., *P. tonkinensis* Gagnep. et *P. sericans* K. Schum.

La géographie, les dates de floraison, les utilisations et les noms vernaculaires sont compilés. Des cartes montrent la répartition des espèces. La plus grande diversité se trouve en Birmanie, au sud de la Chine, en Thailande, en Indochine et au nord-est de l'Inde. *Pueraria pulcherrima* (Kds.) Merr. se retrouve uniquement au sud-est asiatique et dans certaines parties de l'Océanie.

Les références biosystématiques, peu nombreuses, sont discutées. Les nombres chromosomiques sont 2n = 22 et 44, rarement 2n = 20 ou 24, le dernier étant probablement incorrect.

On a besoin de semences de plantes vivantes, ainsi que de meilleurs échantillons d'herbier pour poursuivre l'étude biosystématique.

Apparenté à *Glycine*, la soja et ses espèces, *Pueraria* et *Teyleria*, pourront avoir des charactères utiles contribuant à l'amélioration du soja.

SAMENVATTING

Deze taxonomische revisie van het Aziatische genus *Pueraria* DC. (Leguminosae), welke gebaseerd is op de analyse van herbariummateriaal, leidt tot het onderscheiden van 17 soorten binnen het genus. Een van de soorten, *P. imbricata* van der Maesen, is nieuw beschreven. *P. peduncularis* (Grah. ex Benth.) Benth. en *P. wallichii* DC. zijn twee taxonomisch problematische taxa die voorshands in het genus worden gehandhaafd. *P. subspicata* (Benth.) Benth. wordt gereduceerd tot een variëteit van *P. phaseoloides* (Roxb.) Benth., terwijl *P. thomsoni* Benth. en *P. montana* (Lour.) Merr. worden gereduceerd tot twee afzonderlijke variëteiten van *P. lobata* (Willd.) Ohwi. Twee *Pueraria* soorten worden geplaatst in het tot nog toe monotypische genus *Teyleria* Backer. Dit leidt tot het onderscheiden van *T. barbata* (Craib.) Lackey ex van der Maesen comb.nov. en *T. tetragona* (Merr.) Lackey ex van der Maesen comb.nov.

Lectotypes zijn aangewezen voor *Pueraria alopecuroides* Craib., *P. mirifica* Shaw & Suvatabandhu, *P. sikkimensis* Prain, *P. stricta* Kurz en de synoniemen *P. collettii* Prain, *P. peduncularis* (Grah. ex Benth.) var. *violacea* Franch., *Derris bonatiana* Pamp., *Neustanthus subspicatus* Benth., *Pueraria textilis* Lautb. & Schum., *P. tonkinensis* Gagnep. en *P. sericans* R. Schum.

Een overzicht van geografie, bloeitijden, gebruik en volksnamen volgt de beschrijving van iedere soort. De verspreiding van de bestudeerde exemplaren is aangeduid op kaarten. De grootste verscheidenheid vindt men in Burma, Zuid China, Thailand, Indochina en Noordoost India. *Pueraria pulcherrima* (Kds.) Merr. is beperkt tot Zuidoost Azië en delen van Oceanië.

De weinige biosystematische gegevens zijn gecompileerd. Het aantal chromosomen van het genus is 2n = 22 en 44, zelden is 2n 20 of 24 gevonden; het laatste aantal is vrijwel zeker onjuist.

Van diverse taxa is weinig geconserveerd materiaal, dat bovendien dikwijls van matige kwaliteit is, beschikbaar.

Het is te verwachten dat de analyse van levend materiaal tot een juister begrip van de taxonomie zal leiden.

Onderzocht dient te worden of *Pueraria* en *Teyleria* die verwant zijn aan *Glycine*, de sojaboon en zijn verwanten, misschien kunnen bijdragen aan de (genetische) veredeling van de sojaboon.

14. REFERENCES

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16. INDEX TO PLANT NAMES

The accepted names pertaining to this study and the page numbers of their main entries are printed in bold face. Plates are indicated with italicized page numbers. Synonyms, nomina nuda and excluded names are in italics, new names or synonyms listed as such.