

## REVISION OF ASIATIC PORANEAE (CONVOLVULACEAE) – CORDISEPALUM, DINETUS, DUPERREYA, PORANA, PORANOPSIS, AND TRIDYNAMIA

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### SUMMARY

The genera *Porana* Burm.f. and *Cordisepalum* Verdc. are taxonomically revised. Five distinct groups of species segregated from *Porana* are here recognized at generic rank and the names *Dinetus* Sweet, *Duperreya* Gaudich., *Poranopsis* Roberty, and *Tridynamia* Gagnep., are taken up for four of them. *Porana* Burm.f., s.str., is herein restricted to two species. *Cordisepalum* is maintained as a genus distinct from, and closely related to, *Poranopsis*. All names are typified, selected taxa and characters are illustrated, and distribution maps are provided for all taxa. In total 20 species, one comprising two subspecies, are recognized. Two new species, *Cordisepalum phalanthopetalum* and *Dinetus rhombicarpus*, are described and illustrated. Names for *Porana* described from Africa, Madagascar, and the Americas are dealt with in the Species Exclusae. An index of numbered collections examined is provided.

**Key words:** Convolvulaceae, *Cordisepalum*, *Duperreya*, *Dinetus*, *Porana*, *Poranopsis*, *Tridynamia*, new species.

### INTRODUCTION

Fifty epithets have been published or combined in *Porana* Burm.f. at species rank and an additional eight infraspecific taxa have been named. The majority of these taxa were described from tropical continental Asia, a few from Malesia and Australia, with widely disjunct species reported from Africa, Socotra, Madagascar, and Mexico. As historically conceived, *Porana* species share in common the characteristics of an enlarged, persistent, wing-like calyx that invests an indehiscent, usually one-seeded fruit with a papery pericarp. Often the fruiting sepals are two to many times longer than wide, but there are several exceptions to this generalization. Beyond these shared features, *Porana* species encompass a smorgasbord of morphology and ecological preferences.

The widely disjunct taxa of *Porana* (e.g., outside the greater Asian region) have been transferred to other genera (see Species Exclusae for list). The remaining taxa of *Porana* are mostly found in tropical Asia and Malesia, with two in Australia.

The present revision recognizes only 20 species, one of which includes two subspecies. A preliminary systematic analysis of these 21 taxa (Staples, 1987a) based on morphological characters indicated that they fall into five groups of species. One of these groups corresponds to a much-narrowed concept of *Porana* s.s. The other four species-groups are herein recognized at generic rank under the previously published generic names *Dinetus* Sweet, *Duperreya* Gaudich., *Poranopsis* Roberty, and

*Tridynamia* Gagnep. Many of the new combinations were published already (Staples, 1993). Furthermore, the genus *Cordisepalum* Verdc., described as a distinct genus closely related to *Porana*, is maintained at generic rank and included in this revisionary study.

The preliminary systematic analysis (Staples, 1987a) indicated that these six Asian genera do not comprise a monophyletic group. Recent molecular studies support this conclusion (Stefanovic et al., 2002). The morphological analysis (Staples, 1987a) revealed that *Porana* s.s. has several characters that set it apart from the other species that had been included in the genus. The molecular analysis corroborates this finding and places *Porana* s.s. in a different tribe from the other five genera (Stefanovic et al., 2003). In the most recent infrafamilial classification of the Convolvulaceae (Stefanovic et al., 2003) the tribe Poraneae has been dissolved: *Porana* s.s. is included in the tribe Dichondreae, while the other five genera as recognized here are classified in the newly erected tribe Cardiochlamyae. For present purposes, the higher level classification issues are set aside and all species formerly included in *Porana* s.l. are revised so that a comprehensive morphological foundation is available.

The present paper is a straightforward taxonomic revision that clarifies  $\alpha$ -taxonomic concepts, rectifies the nomenclature, describes and illustrates the 21 taxa recognized, and documents the geographic distribution, ecological preferences, and ethnobotanical uses for each taxon. The revision is based primarily on morphological study of herbarium specimens, over 3,700 sheets of which were examined in the course of the revision. Living material of six species was studied in the field or in cultivation. These methods were augmented by comprehensive studies of pollen characters and trichome morphology – two areas of inquiry that have proven taxonomically informative for other Convolvulaceae – using scanning electron microscopy (SEM).

#### TAXONOMIC HISTORY

The generic concept for *Porana* has undergone a gradual expansion through accretion since its inception in 1768 by N.L. Burman. Based on a single species, the original generic protologue described vegetative and floral morphology but omitted fruits. Later authors described additional species of *Porana* with increasing emphasis on the fruiting calyx. Over time the generic concept became increasingly heterogeneous, especially in regard to floral morphology. Ultimately, the generic concept for *Porana* became quite amorphous except for the shared common features of accrescent calyces with fruiting sepals longer than broad and a papery-walled fruit.

The taxonomic history that follows is presented in chronological order except where two or more treatments by the same author appeared in a brief span of time; these have been grouped together for convenience. Only selected treatments – those which added information pertinent to the development of the generic concept – have been included.

Burman (1768) named the genus *Porana*, based on *P. volubilis*, from flowering material collected by Kleinhoff [or Kleynhof] on Java. The ‘Flora indica’ plate, numbered 21\*<sup>1</sup>, examined in conjunction with the protologue, is sufficient to identify

1) Some copies of ‘Flora indica’ lack plate 21\*, as noted by Robert Wight (*vide infra*).

*P. volubilis* as a member of the Convolvulaceae, but little more. Omitted is any mention of the fruits, the fruiting calyx, the number of locules in the ovary, and the number of ovules, all points that later proved important in characterizing *Porana*.

Linnaeus (1771) paraphrased Burman's description and first commented on the fruiting sepals of *P. volubilis*, "Cal[yx] ... in fructu grandioribus." He also described the fruit, "Per[icarp] ... bivalve." Linnaeus marked the genus with the dagger (†), which can mean uncertainty about the affinity of the plant, and he placed it in the appendix to the *Mantissa altera*, and not with the other genera of the Convolvulaceae, which mostly occur in the Pentandria – Monogynia of the Linnaean Sexual System.

Two phrases in the Linnaean description (Linnaeus 1771: 560) for *P. volubilis* are curious, "Folia serrata" and "Flores ... an nonnulli masculi apetalii?" neither of which correspond to *P. volubilis* as currently understood. Linnaeus evidently examined a specimen since he was able to expand on Burman's description in this way, but none are cited. No material of *Porana* is extant in the Linnaean herbarium (Savage, 1945). However, there is one sheet, numbered 305.1, in the J.E. Smith Herbarium (LINN-Smith), which is annotated in the handwriting of Linnaeus f. with the name *Porana volubilis* and "Thunb." According to Savage (1963) such sheets annotated by Linnaeus f. were formerly in the Linnaean Herbarium and came into Smith's possession either as a gift from the younger Linnaeus when he visited London, 1781–1782, or when Smith bought the Linnean Collections after the death of Linnaeus f. in 1783. It is quite possible that this specimen of *P. volubilis* was examined by the senior Linnaeus and was the basis for his peculiar comments (1771: 560): the leaves of sheet 305.1 dried with slightly undulate margins that appear vaguely serrate, and the flowers consist of calyces with pistils but the corollas have all dropped off, taking the stamens with them.

Jussieu (1789) paraphrased Burman's description and Linnaeus' comments, omitting the reference to serrate leaves but including the cryptic remark about the apetalous flowers. Although Jussieu was the first to recognize the family 'Convolvuli', he did not place *Porana* there, instead putting it in the 'incertis sedis' group. He suggested comparing *Porana* to *Ehretia* P. Browne (Boraginaceae).

Lamarck (1804) paraphrased the preceding three treatments and echoed Jussieu's suggestion of a relationship between *Porana* and *Ehretia*. The generic concept to that time was based solely on *P. volubilis* and it is of a plant with a branched style, capitate-reniform stigmas, a 2-valved capsule, and an accrescent and persistent fruiting calyx.

Palisot de Beauvois (1804) named *Porana acuminata* from "Oware" [Nigeria]. Although the species was later transferred to *Neuropeltis* Wall. (Bentham, 1849), Palisot de Beauvois' work is noteworthy because he was the first to recognize *Porana* as a member of the family Convolvulaceae.

Brown (1810) did not treat *Porana* but he compared it to his new genus *Breweria* with the words, "a *Porana*, cui caractere proxima, distinguitur calyce fructifero non mutato, et habitu." And he diagnosed it from *Bonamia*, which later proved congeneric with *Breweria*, by saying, "quae a *Porana* differt solummodo calyce fructifero non mutato, ..." This is the first time that *Porana*, then with two species, was compared with *Bonamia*; more on this relationship below.

Roxburgh (1814) published *P. paniculata* and *P. racemosa* as *nomina nuda*, later (1819) validating the former name by publishing a description and illustrating the species with a coloured plate. Wallich (in Roxburgh, 1824) validated *P. racemosa* by publishing

Roxburgh's description in the 'Flora indica'. Wallich also described *P. grandiflora*, a plant unknown to Roxburgh. Inclusion of these three taxa in *Porana* broadened the generic concept in terms of the habit, leaf venation, floral morphology and allometry, pistil characters, and fruit type.

Sweet (1825), recognizing that these three Indian species did not accord well with Burman's generic concept, took up Buchanan-Hamilton's manuscript name, *Dinetus*, and transferred *P. racemosa* into it, while suggesting that the other two Indian species, "will prove to be congeners of our plant [*Dinetus racemosus*]." Later, Sweet (1827) transferred *P. paniculata* into *Dinetus*. This was the first attempt to limit the generic concept of *Porana* to plants having a campanulate corolla, 2-branched style, and 2-valved fruit, all characters shared by *P. volubilis* and *P. acuminata*.

Gaudichaud (1829) described the monospecific genus *Duperreya* from the western coast of Australia. The protologue does not compare *Duperreya* with *Porana* and this connection was only made by Mueller (1868), after examining fruits of the Australian plant.

Choisy (1834) in the first part of his 'Convolvulaceae Orientales' reduced *Dinetus* to synonymy with *Porana*. Choisy's dissertation includes several anomalous statements regarding *Porana*. The generic description states that the ovary is unilocular, though in fact *P. volubilis* often has a bilocular ovary. Later Choisy recognized *Duperreya* Gaudich. as a genus distinct from *Porana* (Choisy, 1837, 1845).

Endlicher (1839) treated *Dinetus* and *Euporana* as infrageneric categories in *Porana*, though he did not designate a rank for them, nor did he name the species assigned to each. His diagnosis for *Dinetus* states, "Calycis pentaphylli foliola duo exteriora immutata, tria interiora post anthesim aucta." This is erroneous: no species of *Porana* has the outer two sepals unchanged while the inner three are accrescent. Furthermore, the type species of *Dinetus*, *D. racemosus*, has all five sepals accrescent and equal in size. Endlicher maintained *Duperreya* as a genus.

Wight (1843) first noted that *P. volubilis* differs from all other species of *Porana* in terms of its ovary: "The character of the genus *Porana* (of which I believe this is the type) is to have a 1-celled ovary, but in this species I have ascertained beyond all doubt, that it is 2-celled, with 2 erect ovules in each. If the other species have 1-celled ovaries then this must be removed from the genus." Wight (1850) examined this point again, and observed: "... I was led to scrutinize the characters of the genus more closely than when publishing my figure of *Porana volubilis* and very unexpectedly found that that plant, so far as the characters derived from the style, stigmas, and ovary show, is a genuine species of the more modern genus *Breweria* [now *Bonamia*], as a comparison of ... that figure (No. 347) ... with those of the accompanying figure, No. 1370, of *Breweria Roxburghii*, will at once show." Wight went on to say that a major nomenclatural upheaval would ensue if *Breweria* were synonymised with *Porana* and all the species of the former were transferred to the latter. Likewise *Dinetus* would have to be restored to accommodate the species of *Porana* other than *P. volubilis*. However, Wight was uncertain that the plant he illustrated as figure 347 was indeed *P. volubilis*: Wight's copy of Burman's 'Flora indica' lacked plate 21\* so he was unable to verify his living material against the original illustration of *P. volubilis* and Burman's description, as noted above, was lacking in critical details. Wight (1850) was aware that his own figure 347 (Wight, 1843) had been cited by Choisy (1845) as illustrative for *P. volubilis*, but

he declined to initiate any taxonomic changes on those grounds. The recognition that *P. volubilis* shares several characters with *Bonamia* spp. was forgotten.

Mueller (1868) reduced the genus *Duperreya* to synonymy with *Porana* after he examined fruiting material collected by Drummond in Western Australia. This was the first time the Australian *Duperreya* was considered congeneric with *Porana*.

Bentham (in Bentham & Hooker, 1876) placed *Dinetus* and *Duperreya* in synonymy with *Porana*, having earlier (Bentham, 1849) transferred the African *P. acuminata* to *Neuropeltis*. Bentham's account of *Porana* was copied almost verbatim by Baillon (1891) into his 'Histoire des Plantes'.

Clarke (1883) discussed the relationships of three Indian taxa, *P. racemosa*, *P. malabarica*, and *P. truncata*. He recognized them at species rank based on their distinctive fruiting calyces and utricle shapes. This constitutes the first recognition of the 'Dinetus' species group.

Peter (1891) divided *Porana* into three sections: *Euporana* (1 sp.), *Duperreya* (1 sp.), and *Dinetus* (8 spp.).

Hallier (1893) prepared a detailed generic description for *Porana* including the first anatomical and pollen characters. His generic concept of *Porana* was the broadest to date (including *Dinetus* and *Duperreya* as synonyms), with nine Asian, two African, one Australian, and one Mexican species.

The early twentieth century saw the publication of several new species of *Porana*, including the first from China (Gagnepain & Courchet, 1915a). Gagnepain & Courchet (1915b) included some Chinese taxa in a key to the Indo-Chinese species, which gave a perspective on all the east Asian taxa of *Porana* and broadened the generic concept yet further.

Schneider (1916) attempted a comprehensive revision of *Porana* though World War I precluded access to botanical literature and specimens of four species. Nonetheless, he named three new Asian taxa. Schneider retained *Duperreya* as a monotypic genus and treated 11 species and one variety in *Porana*. Three subgenera were recognized based on the number of ovules and the shape of the stigmas. The subgenus *Euporana* (lianas with 4-ovulate ovaries and globular stigmas) contained five species, the subgenus *Dinetus* (herbaceous twiners with 2-ovulate ovaries and ellipsoidal stigmas) contained five species plus one variety. For the first time *P. paniculata* was not included in *Dinetus* but was placed with *P. volubilis* in the subgenus *Euporana* [*Porana*]. The subgenus *Pseudodinetus* (herbaceous twiners with 2-ovulate ovary and globular stigmas) contained only *P. dinetoides*. The latter species is intermediate between the two subgenera and Schneider chose to recognize a new subgenus for it. Schneider relied heavily on ovule number as a taxonomic character and the species known to him do sort out well using this feature.

Gagnepain (1950) described the genus *Tridynamia* from a single collection made in Annam and remarked that the much accrescent sepals placed it in the Poraneae, although the simple style and entire stigma were exceptional for that tribe, evidently a comparison with *P. volubilis*, which has a bifid style and two capitate-reniform stigmas.

Roberty (1952) published 'Genera convolvulacearum', which established many new names at the rank of genus and above. In the tribe Poraneae, for example, he recognized seven genera including *Porana*. Two of these genera had earlier been synonymised with *Porana*, and two, *Poranopsis* and *Dinetopsis*, were therein segregated from it

for the first time. In recognizing so many genera, Roberty brought *Porana* near to its original circumscription, including only *P. volubilis* and *P. densiflora* (= *Metaporana densiflora*). Yet this generic concept is unsatisfactory because *P. densiflora* lacks the generic characters that define *Porana* and the tribal characters of accrescent calyx and utricular fruit. To make matters worse, Roberty included *Turbina* Raf. in the tribe. While it is true that *Turbina* has an indehiscent, usually 1-seeded fruit, with a tough pericarp and an accrescent calyx, features all similar to those found in the Poraneae, its pantoporate and spinose pollen, dichasial inflorescences, and the ligneous rather than papery pericarp indicate a placement in the tribe Argyreieae Hallier f. Roberty (1964) published an emendation to his classification and typified the generic names he had published in 1952.

Melchior (1964) claimed 20 species of *Porana* in Asia and Australia and also three in Africa. This reference to African taxa must hark back to older concepts for the genus, because by 1964 the African taxa described in *Porana* had been transferred to *Neuropeltis*, *Turbina*, and *Metaporana*.

Verdcourt (1971) erected the genus *Cordisepalum* for one of two Asian taxa formerly considered congeneric with the Madagascan genus *Cardiochlamys*, and transferred the second into *Porana*. Verdcourt acknowledged the great similarity between *Cordisepalum* and the *Porana* species centred on *Porana paniculata*, yet felt the distinctive features of the gynoeceum warranted generic rank.

Two floristic accounts of Chinese Convolvulaceae (Fang & Huang, 1979a, b) increased the number of *Porana* taxa known from China and provided keys and commentary (in Chinese) on relationships within the genus. Huang Suhua prepared the treatments for *Porana* in both accounts (pers. comm., 1985).

#### MORPHOLOGY

In the discussion that follows *Porana* refers to the greatly narrowed generic concept adopted in this revision (2 spp.); *Dinetus*, *Duperreya*, *Poranopsis*, and *Tridynamia* are the four genera segregated from *Porana* s.l., and *Cordisepalum* is maintained as a distinct genus closely related to *Poranopsis*. Two informal subgroups within *Dinetus* are herein referred to as the 'Dinetus' species group and the 'Dinetopsis' species group.

#### *Habit*

All plants are stem twiners or, if no support is available on which to twine, prostrate in growth form. *Cordisepalum*, *Duperreya*, *Porana*, *Poranopsis*, and *Tridynamia* are perennial, suffrutescent climbers with woody lower stems and herbaceous shoot tips. *Dinetus* is exclusively herbaceous: the species in the 'Dinetopsis' species group are perennial while those in the 'Dinetus' species group appear to be annuals or perennials. Duration in *Dinetus* taxa seems to depend upon the climatic regime under which the plants grow. In temperate climate areas or at high elevations the plants die off during cold weather, and herbarium labels do not record whether they persist for a second year. In areas without a killing cold season the plants are recorded as perennials.

#### *Roots*

The root system is fibrous without an evident taproot in *Porana* and *Poranopsis*. The genus *Dinetus* has at least two types of root systems. *Dinetus racemosus* and

*D. truncatus* have fibrous root systems. *Dinetus duclouxii* differs from its congeners by having enlarged, conical (fascicled?) roots with three to twelve segments that are “rich in starch” (ex label *Veget. Team Chengdu Biol. Inst.* 5262 at HBC). This same species may at times have a prominent taproot (ex *Handel-Mazzetti* 7041 at WU). The root system is unknown for *Cordisepalum* and *Tridynamia*.

### Stems

The stem is cylindrical, dextrorsely twining, or prostrate or pendent if no support is available on which to climb. The pendent growth form occurs when the plants grow on steep rock faces or cliffs (e.g., *Poranopsis sinensis*, *Tridynamia sinensis*). The genera *Cordisepalum*, *Poranopsis*, and *Tridynamia* have striate or fissured bark, tan to brown or grey-brown in colour, with a corky outer surface. *Porana* has faint striations on the bark, which is dotted with whitish, elliptical lenticels. *Dinetus* stems are herbaceous, terete, and do not develop bark. *Duperreya* may have a few scattered lenticels on otherwise smooth stems; only the extreme base is woody and may be verrucate or have a thin, peeling bark.

### Indumentum

A variety of trichome types is found. The most frequently encountered type is the malpighiaceus, or 2-armed hair (Fig. 1). This type is 2-celled, with a small stalk cell and a large terminal cell. The cells have smooth outer surfaces, thin walls and large

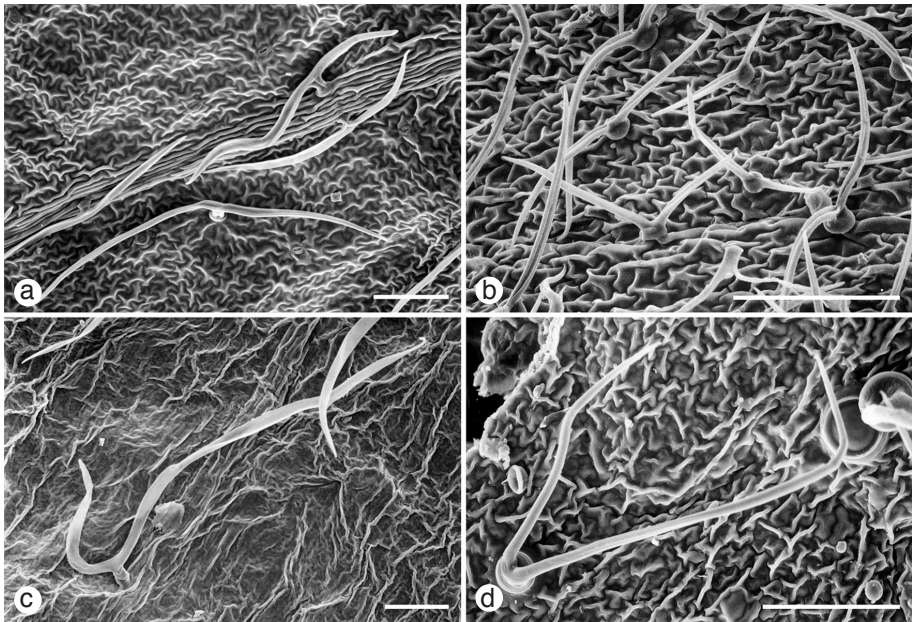


Fig. 1. Trichome morphology: 2-armed trichomes. — a. *Duperreya commixta*, appressed, equal-armed trichomes from abaxial sepal surface; b. *Poranopsis paniculata*, patent, equal-armed trichomes from adaxial leaf surface; c. *Duperreya sericea*, appressed, unequal-armed trichome from corolla interplexia; d. *Cordisepalum thorelii*, erect, equal-armed trichome from adaxial leaf surface (a: *Mitchell* N657a; b. living material; c: *George* 11533; d: *Chevalier* 30976). Scale bar = 100  $\mu$ m.

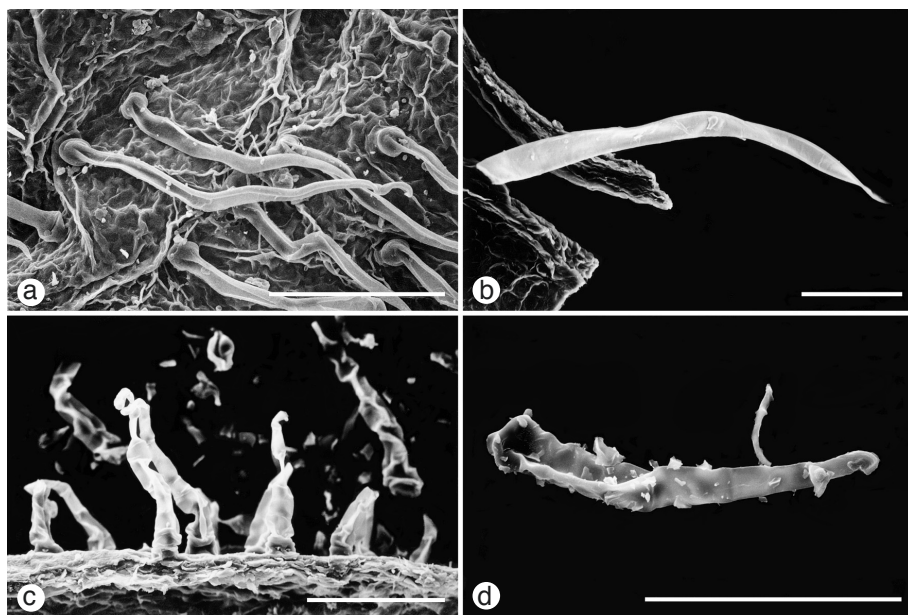


Fig. 2. Trichome morphology: simple and glandular trichomes. — a. *Porana volubilis*, simple trichomes from corolla interplacae; b. *Dinetus dinetoides*, simple trichome from stamen filament base; c. *Poranopsis discifera*, glandular trichomes from outer wall of utricle; — d. glandular trichome of *P. discifera* (a: O.E. White 123; b: A. Henry 9340; c, d: Poilane 26910). Scale bar = 100  $\mu$ m.

lumina. The terminal cell bears two elongate arms, which may be straight or crimped and curly, appressed, ascending or erect in orientation, and equal or unequal in size. *Cordisepalum*, *Dinetus*, *Duperreya*, *Poranopsis*, and *Tridynamia* have predominantly 2-armed hairs.

Simple hairs occur in most genera (Fig. 2), though typically they are restricted to specific organs of some species. These simple hairs are 2-celled, with a very small stalk cell and a large terminal cell. The cells are usually thick walled and the lumina small. The terminal cell varies from subterete, as in *Dinetus duclouxii*, to deeply sulcate, as in *Porana volubilis*. *Porana volubilis* has exclusively simple hairs (Fig. 2a). Simple hairs have been observed on the pistil of *Tridynamia sinensis*, the axial parts of *Cordisepalum phalanthopetalum*, and on the leaves and bracts of most species of *Dinetus*. Pilose simple hairs also appear on the staminal filaments of *Dinetus dinetoides* (Fig. 2b) and various vegetative organs of *Dinetus* spp. (Fig. 3).

Stellate hairs are found only on the leaves and bracts of some species of the genus *Dinetus* (Fig. 3). The stalk cell is small with 3 arms radiating from it. The arms are typically erect and unequal in length.

Glandular hairs are of several types and are sporadic in their occurrence (Fig. 2, 3). Multicellular stalked glandular hairs occur on the leaves and bracts of *Dinetus grandiflorus* (Fig. 3d). Multicellular simple glandular hairs are found on virtually all vegetative parts of *Dinetus duclouxii* (Fig. 3c). The latter hair type also occurs on the outer fruit wall of *Poranopsis discifera* (Fig. 2c, d), the only instance of simple hairs in that genus.

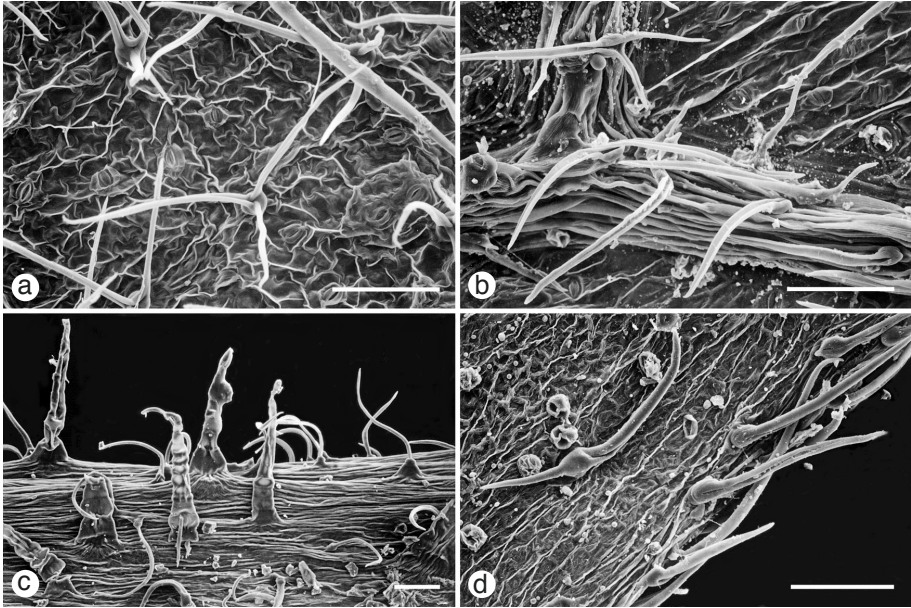


Fig. 3. Trichome morphology in *Dinetus* species. — a. *D. truncatus*, 3-armed trichomes from abaxial leaf blade; b. *D. truncatus*, distribution of simple and 3-armed hairs on abaxial veins and lamina; c. *D. duclouxii*, simple and glandular trichomes from inflorescence axis; d. *D. grandiflorus*, simple, glandular, and 3-armed trichomes from inflorescence bract edge (a, b: Staples et al. 425; c: Handel-Mazzetti 7041; d: *T. Thomson s.n.*). Scale bar = 100  $\mu$ m.

### Leaves

The leaves of all taxa form a homoblastic series, with the upper leaves and bracts like the cauline leaves in shape, only smaller and often more attenuate apically. All are bifacial, entire (lobed in *Dinetus duclouxii*), herbaceous to stiffly chartaceous in texture, and provided with a dense to sparse indumentum.

The leaves are petiolate, with a long to short petiole. The uppermost bracts and bracteoles become sessile since the petioles gradually diminish in length toward the stem apex. A basal pulvinus is present, though often weakly developed, in the petioles of *Cordisepalum*, *Poranopsis*, *Tridynamia*, *Porana volubilis* and some species of *Dinetus*. No conspicuous pulvinus is present in the petiole of *Duperreya commixta*, *Duperreya sericea*, and some species of *Dinetus*. Terete petioles occur in *D. commixta*, *D. sericea* and *Cordisepalum* species; they are terete to flattish in *Poranopsis*. Petioles are terete to compressed and sulcate adaxially in *Tridynamia*. The petiole in *Dinetus* is terete or compressed and sulcate adaxially.

Blade shape varies. *Porana volubilis* has ovate leaves with a truncate, emarginate, or subcordate base (Fig. 4e). The Australian *Duperreya* species (Fig. 4c) have linear to oblong blades with rounded or cuneate bases. Species of *Cordisepalum*, *Dinetus*, *Poranopsis*, and *Tridynamia* have cordiform blades with cordate bases (subcordate to truncate in *Tridynamia sinensis* var. *delavayi*) (Fig. 4d). The basal sinus may be deep, in which case the auricles often approach or overlap, or shallow, with the auricles

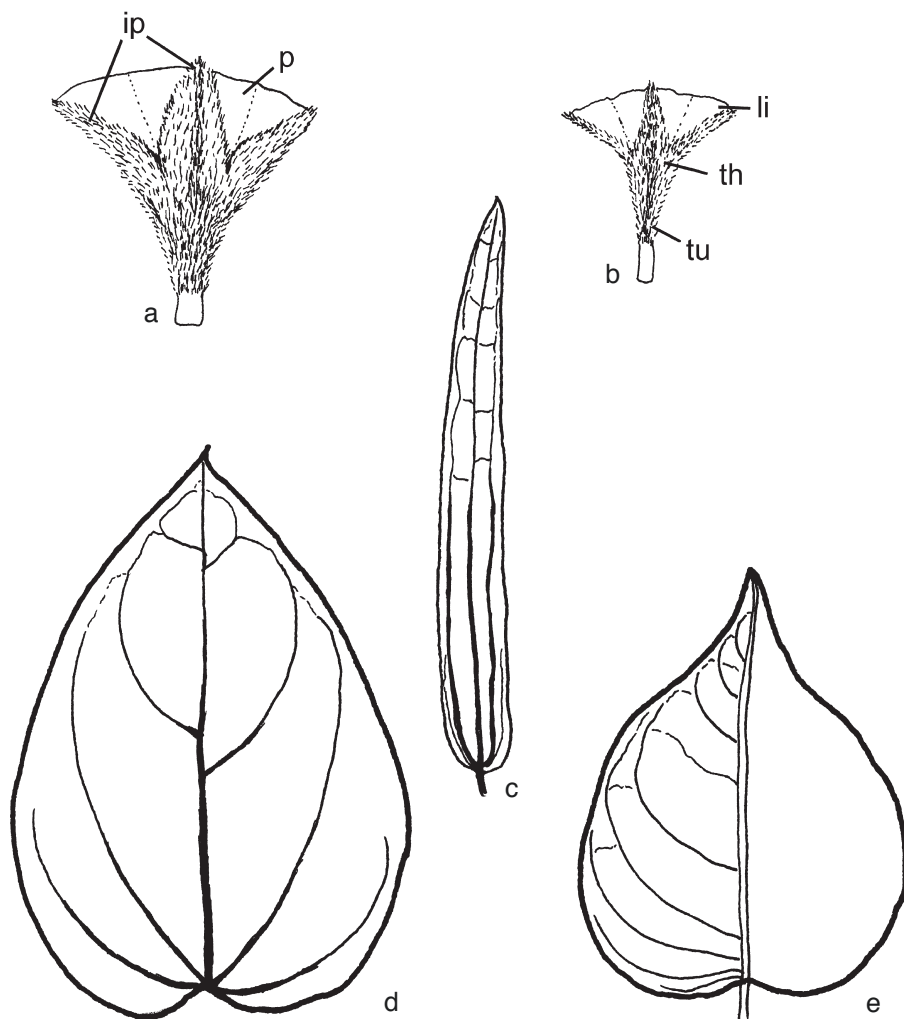


Fig. 4. Corolla and leaf blade morphology. — a. Corolla of *Tridynamia megalantha*, ip = interplica, p = plica; b. corolla of *Tridynamia spectabilis*, tu = tube, th = throat region, li = limb; c. leaf of *Duperreya sericea* with one strong pair of basal secondary veins; d. leaf of *Tridynamia spectabilis* with pedate venation; e. leaf of *Porana volubilis* with pinnate venation (a: King's collector s.n. in 1884; b, d: A.F.G. Kerr 10223; c, e: living material).

distant. The blades are entire, except for *Dinetus duclouxii*, which often has incised or lobed leaves (Fig. 9n). Blade shape may vary markedly on a single individual and these differences are not taxonomically meaningful.

#### Leaf venation

Three venation patterns are found in these genera and leaf venation is a taxonomically useful character at the generic level. Pinnate leaf venation is found only in *Porana* (Fig. 4e). This venation type is distinctive and sets *P. volubilis* apart from all other

species formerly assigned to *Porana* s.l. The midvein gives rise to 5–8, usually 6 or 7, pairs of secondary veins evenly distributed along its length. The secondary veins are arranged in a brochidodromous pattern. Pedate leaf venation is found in *Cordisepalum*, *Dinetus*, *Poranopsis*, and *Tridynamia*. Because rather few taxa of Convolvulaceae are presently known to have pedate leaf venation this is a useful taxonomic character for recognizing the genera segregated from *Porana* s.l. In the pedate arrangement the midvein usually has two well-developed pairs of basal secondary veins (Fig. 4d, 7–9, 12). The lowermost pair often branches immediately, thus giving the appearance of three basal pairs of secondaries. From 1–3 weaker pairs of secondaries depart from the midvein between its midpoint and the apex of the blade. These distal secondary veins are arranged in a brochidodromous pattern. *Duperreya* species have a third venation type. A single pair of secondary veins departs from the midvein near the blade base (Fig. 4c). A few weak secondaries also depart near the apex of the blade. This venation pattern, correlated with the linear blade shape found in these xeromorphic desert species, could be developed by reduction from either a pinnate or a pedate pattern.

### *Inflorescence*

The raceme is the fundamental type of inflorescence in all genera. Simple racemes have been reduced to solitary flowers, and by aggregation have given rise to more complex types of inflorescences. Anthesis proceeds acropetally in all cases. Each node of the inflorescence is subtended by a bract. Bract refers to laminar structures that subtend a branch of an inflorescence or two or more flowers; bracteole refers to the laminar structure(s) immediately below a single flower. The lowermost bracts can be quite large and foliaceous whereas the uppermost bracts are frequently reduced to scales. Inflorescences are axillary in position, or they may terminate a lateral branch. Due to the large size of the lianoid species it is sometimes difficult to recognize the axillary position of the inflorescences from herbarium specimens. A single inflorescence is produced in each axil of *Cordisepalum*, *Porana*, *Poranopsis*, and *Tridynamia*. Paired inflorescences, with one larger than the other, are common in *Dinetus*.

Simple racemose inflorescences are found in *Cordisepalum*, *Dinetus*, and *Tridynamia*. More complex paniculate inflorescences are found in *Cordisepalum*, *Dinetus*, *Poranopsis*, and *Tridynamia*. Thyrsiform panicles are found in *Porana* (*P. volubilis*) and *Cordisepalum phalanthopetalum*. Solitary flowers are usual in *Duperreya*. In general there is a correlation between diminishing flower size and increasing complexity of the inflorescence: *C. phalanthopetalum* has the smallest flowers and the most congested thyrses, whereas *Dinetus* (*D. grandiflorus*) and *Tridynamia* (*T. megalantha*) have the largest flowers, which are borne, typically, in simple racemes.

A brief explanation about terminology is needed regarding the terms pedicel and bracteole. In developmental terms, the penultimate axial structure in an inflorescence is the peduncle, supporting one or more ultimate axes – pedicels – bearing a single flower each. The node between the peduncle and pedicel(s) bears one or more bracteoles. Among plants treated here the true pedicel is mostly absent, as indicated by the position of the bracteoles immediately below the calyx. Only *Porana volubilis* has both a true peduncle and a pedicel, with two scalelike bracteoles at the node between them. All species now assigned to *Cordisepalum*, *Dinetus*, *Duperreya*, *Poranopsis*, and *Tridynamia* have only a peduncle, morphologically speaking. However, in general

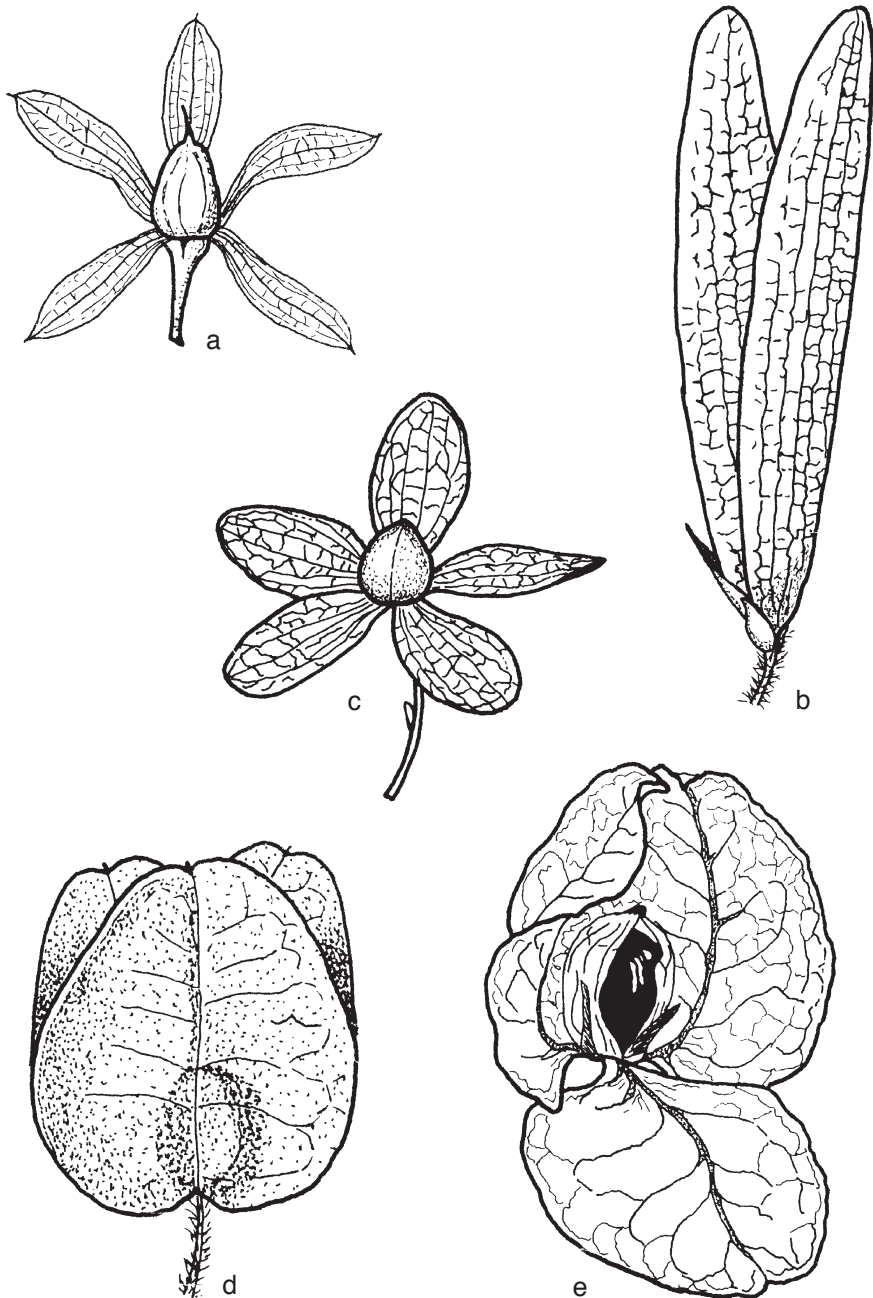


Fig. 5. Utricle and fruiting calyx morphology (not to scale). — a. *Dinetus racemosus*; b. *Tridynamia sinensis*; c. *Porana volubilis*; d. *Cordisepalum thorelii*; e. *Poranopsis sinensis* (a: redrawn from Wight, 1850: t. 1376; b: redrawn from Zhongguo ke xue yuan, 1974: 538, t. 5030; c: photos and Poilane 5332; d: redrawn from Gagnepain & Courchet, 1915b: 296, f. 33; e: redrawn from Verdcourt 1971: 139, f. 1).

botanical usage 'pedicel' has come to refer to the stalk of a single flower and that is how it has been used in the descriptions following.

### *Bracteoles/Calyxle*

The absence of a true pedicel means that the bracteoles are borne immediately below the calyx, forming a calyxle when the bracteoles are developed in a sepaloid manner. Two sepaloid bracteoles occur in *Duperreya* species and three in *Tridynamia*. The bracteoles are reduced to scales in other genera: two in *Poranopsis*, three in *Cordisepalum*, and two or three in *Dinetus*. In some species the scale-like bracteoles undergo enlargement during fructification, becoming more prominent in fruit, e.g. *Dinetus grandiflorus*. *Dinetus duclouxii* differs from other *Dinetus* in having three sepaloid bracteoles in flower that persist and enlarge in fruit.

### *Calyx*

The calyx consists of five sepals that are accrescent and chartaceous in fruit (Fig. 5). The developmental variations on this basic theme provide the morphological characters that have historically been of the most taxonomic value in classifying this group of plants. In the descriptions that follow emphasis is given to the readily observable outer sepals; where the inner sepals are concealed by the outer ones, they are generally similar to them but the texture is more delicate and the indumentum sparser.

*Porana* and *Duperreya* have free, subequal, quincuncial sepals. The calyx is large relative to the corolla: at anthesis the corolla varies from just longer than the calyx to twice as long as the calyx. In fruit (Fig. 5c), all five sepals enlarge equally (unequally in the Mexican *Porana nutans*) and at maturity loosely clasp (*Duperreya*), or become reflexed from (*P. volubilis*) the fruit. The fruiting sepals have several weakly developed, parallel, longitudinal veins that form a reticulum near the apex; no single vein reaches the apex. No midvein is evident (Fig. 6a).

*Tridynamia* has free, unequal, quincuncial sepals that are small in proportion to the corolla. In fruit (Fig. 5b), all five sepals enlarge, but the outer two or three are proportionately much larger than the inner ones. The fruiting sepals are thickly chartaceous to subcoriaceous in texture, and the sepal bases tightly enclose the fruit, flaring out and becoming flat and wing-like apically. The sepals have multiple, parallel, longitudinal veins arising at the base. Three of these veins usually reach the apex, the remainder fade out along the margins (Fig. 6e).

*Cordisepalum* and *Poranopsis* have free, subequal, quincuncial sepals that are small to tiny in proportion to the corolla. In fruit all five sepals enlarge and the outer three become much larger than the inner two. The texture is thinly chartaceous, often reticulate, and the outer sepals loosely clasp the fruit (*P. paniculata*, *P. discifera*) or form a bladderly 'pod' around it. In *P. sinensis* (Fig. 5e) the lower halves of the outer three sepals cohere along their margins where curly hairs on the inner (adaxial) faces tangle together. In *C. thorelii* (Fig. 5d) the sepal margins are free. The venation pattern is distinctive for these genera (Fig. 6c, d). A single prominent midvein extends to the apex. Numerous pinnately arranged secondaries depart from the midvein, looping back within the margin and anastomosing in a semi-brochidodromous pattern. The secondaries give rise to a reticulum of tertiary veins.

*Dinetus* has equal or unequal sepals that are tiny in proportion to the corolla. Aestivation varies in this genus, and due to the minute size of the flowering sepals it is

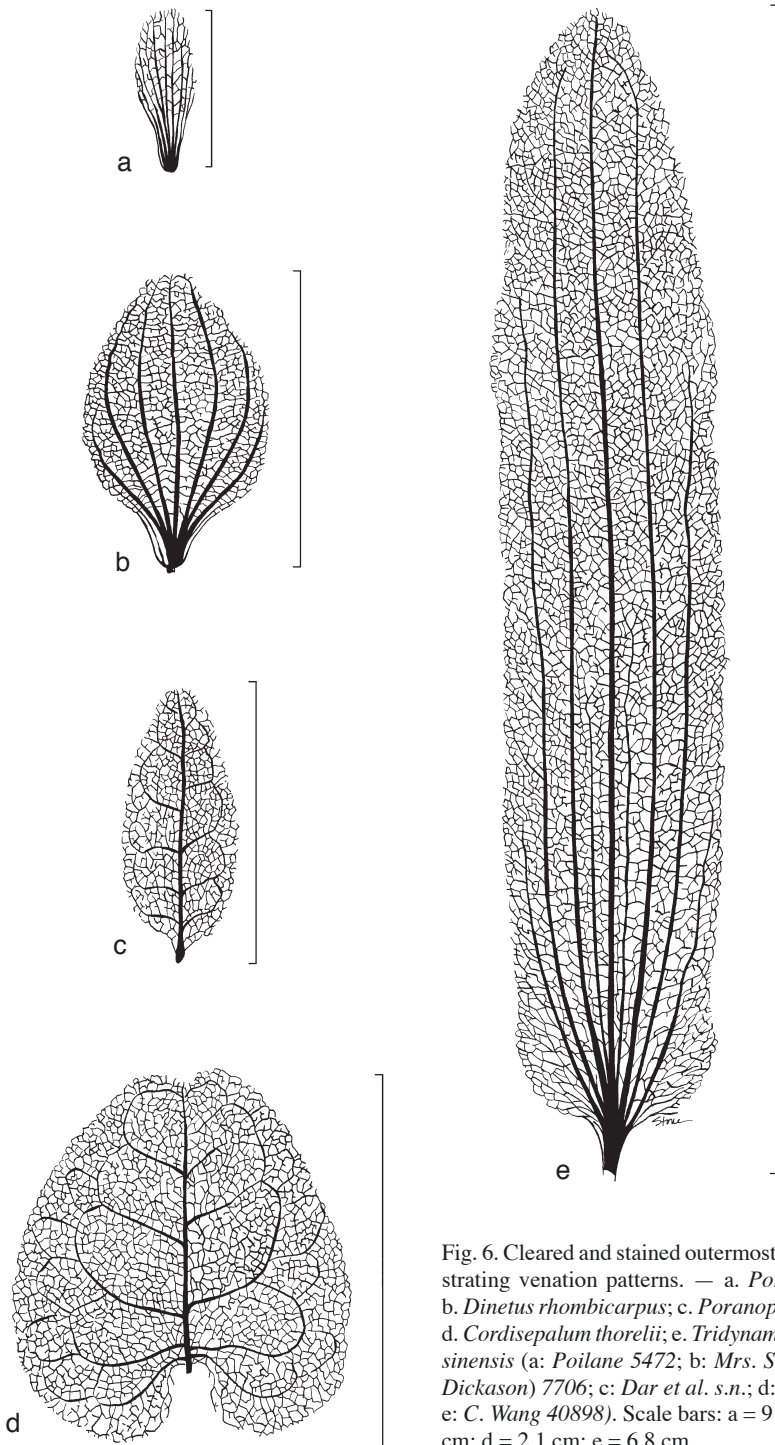


Fig. 6. Cleared and stained outermost sepals demonstrating venation patterns. — a. *Porana volubilis*; b. *Dinetus rhombicarpus*; c. *Poranopsis paniculata*; d. *Cordisepalum thorelii*; e. *Tridynamia sinensis* var. *sinensis* (a: Poilane 5472; b: Mrs. Strait (sub F.G. Dickason) 7706; c: Dar et al. s.n.; d: Poilane 8768; e: C. Wang 40898). Scale bars: a = 9 mm; b, c = 1.7 cm; d = 2.1 cm; e = 6.8 cm.

difficult to discern. The fruiting calyx displays the aestivation clearly. The 'Dinetus' species group has sepals that are slightly fused at the base and the aestivation is valvate. The 'Dinetopsis' species group has free sepals that are quincuncial in aestivation (*D. duclouxii*, *D. grandiflorus*) or slightly gamosepalous and valvate (*D. decorus*). The fruiting calyx of the 'Dinetus' species group (Fig. 5a) has all five sepals equally enlarged, reflexed from the fruit or loosely clasping it at maturity, thinly chartaceous in texture, with nine parallel, longitudinal veins arising at the sepal base and three veins reaching the apex. No midvein is evident; all veins are developed more or less equally (Fig. 6b). Two species of the 'Dinetopsis' species group, *D. grandiflorus* and *D. duclouxii*, have the three outer sepals enlarged more than the inner two, the fruiting calyx loosely clasps the fruit at maturity, the texture is more stiffly chartaceous, and the venation has the median vein slightly more prominent than the others. *Dinetus decorus*, the third species belonging to the 'Dinetopsis' species group, has fruiting sepals like those in the 'Dinetus' group.

### *Corolla*

The corolla is sympetalous and consists of five petals fused basally into a tube, and either free or fused apically. The aestivation of the apical portion varies, and can be taxonomically informative.

Terminology for the regions of the convolvulaceous corolla varies from author to author. The terms employed here follow. The tube (Fig. 4b) is the lowermost part of the corolla, which may be short or quite long, and is usually narrow. The throat (Fig. 4b) is the area where the tube begins to widen out into the limb. Widening may be either abrupt or gradual, and the throat can thus be almost nonexistent or quite extensive, respectively. The limb is often presented at an oblique angle to the tube, or it may be reflexed or perpendicular to the tube. The limb varies from entire to toothed, lobed, or parted (Fig. 4b).

Two distinct regions are formed on the corolla limb due to the aestivation in the bud stage. Five thinner hyaline areas that are folded inside the bud are the *plicae* (Fig. 4a). At anthesis the plicae form the thin, translucent areas of the corolla limb. Alternating with them are five slightly thicker areas, the *interplicae* (Fig. 4a) sensu Myint & Ward (1968), containing the vasculature and forming the exposed outer surface of the bud. The interplicae are equivalent to the 'midpetaline bands' or 'midpetaline lines' of Van Oostroom (1934), O'Donnell (1941), Van Oostroom & Hoogland (1953), and Robertson (1971).

Indumentum distribution varies on these regions of the corolla. In general, the inner (adaxial) surface of the entire corolla is glabrous, except for specialized hairs present on the filament bases in some species (Fig. 2b). The plicae are glabrous on the outer (abaxial) surface as well. But the external corolla surfaces of the tube, throat, and limb have varying distributions and densities of hairs, and these are often taxonomically informative characters. *Dinetus*, for example, has an apical tuft of hairs at the tips of the interplicae, the corolla is otherwise glabrous, which immediately sets this genus apart from all other plants considered here.

Aestivation of the limb varies and can be taxonomically informative. *Porana* has a campanulate corolla with plicate and valvate aestivation. *Poranopsis* has a funnellform corolla with valvate aestivation. *Cordisepalum* has a rotate corolla with valvate to

contortuplicate aestivation; the degree of twisting of the limb in bud seems to increase with corolla size. *Dinetus* has a funnellform to subsalverform corolla with contortuplicate aestivation of the corolla lobes in bud. *Duperreya* has a campanulate or broadly funnellform corolla with contortuplicate aestivation of the lobes in bud. *Tridynamia* has a campanulate to broadly funnellform corolla with contortuplicate aestivation. Thus two groups of genera can be recognized: those with unambiguously valvate corolla aestivation (no twisting evident in buds) and those with contortuplicate aestivation (buds show evident twisting); *Cordisepalum* has one species with each type of aestivation.

#### *Androecium*

There are five equal or unequal stamens arranged alternately with the petals. The lower part of each filament is flattened and adnate to the corolla tube. This basal area may be glabrous or provided with glandular or pilose hairs. Distally the filaments are free from the corolla and become terete and glabrous. The anthers are bilocular and dehisce laterally. *Cordisepalum*, *Dinetus*, *Duperreya*, *Porana*, and *Poranopsis* have ellipsoidal anthers that are introrse or extrorse. *Tridynamia* has sagittate anthers with diverging bases and versatile attachment to the filament. This feature is taxonomically diagnostic for *Tridynamia*.

#### *Pollen*

A separate paper with detailed pollen descriptions of all genera in the tribe Poraneae is under preparation, so only a summary is provided here. Descriptive terminology follows that proposed by Moore & Webb (1978). The six genera recognized in this account have non-spinose pollen grains with smooth, psilate or finely granulate surface. Grains are small: no more than 35  $\mu\text{m}$  in their longest axis. The grains vary in shape from nearly spheroidal to oblate or prolate spheroidal, more rarely obtusely rectangular in some species of *Dinetus*. Apertures are typically 3 longitudinal colpi in most specimens of all taxa surveyed. Exceptional specimens of *T. megalantha* have 3- and 4-colpate grains in the same anther. Likewise some specimens of *Duperreya commixta* have 3-colpate and 3-zonocolpate grains (3 polar  $\times$  3 equatorial  $\times$  3 polar colpi) in the same anther. Well-developed pilate, multi-angulate outgrowths are present inside the margins of the colpi in *Cordisepalum*, *Poranopsis*, and *Tridynamia*. The outgrowths are only weakly developed in *Duperreya* and *Porana* and absent in all species of *Dinetus*.

#### *Gynoecium*

The pistil is comprised of two carpels, fully fused except for the distal part of the style (*Porana*) and the stigmas in a few species. A disc may be present or not; this feature varies within individuals of a species and cannot be consistently used as a taxonomic character. The ovary is unilocular in *Cordisepalum*, *Dinetus*, *Duperreya*, *Poranopsis*, and *Tridynamia*. Some individuals of any of these genera, however, may have a vestigial basal septum in the ovary. *Porana* (*P. volubilis*) usually has a bilocular ovary. Ovule number varies in most genera: *Tridynamia* has four ovules except *T. bialata*, which has two; *Cordisepalum thorelii* has a 4-ovulate ovary, though the only known collection of *C. phalanthopetalum* has five ovules in the ovary.

The style is simple in all genera, except for *P. volubilis*, which has a 2-branched style similar to those found in *Calycobolus* and *Dipteropeltis*. Fundamentally there are two stigmas, and their shape and degree of fusion are taxonomically informative.

*Porana* has two globose, free stigmas. In *Duperreya* there are 2 reniform or cordiform stigmas that are partially fused at the base. *Tridynamia* has two subglobose stigmas, fused for part of their length, compressed either laterally or longitudinally, and coarsely wrinkled. *Cordisepalum* and *Poranopsis* have two globose stigmas that are partially fused and almost smooth. In *Dinetus* the two stigmas are almost fully fused, ellipsoidal to clavate in shape, with an emarginate or rounded apex, and a smooth surface. Dried stigmas of *Dinetus* are frequently coloured differently from the style; for example, the stigma may be grey and the style tan or yellowish.

### Fruit

A 1-seeded fruit with a thin papery fruit wall that breaks open irregularly to release the seed is distinctive for this group of genera. This fruit type fits the technical description of an utricle (Lawrence, 1951; Radford et al., 1974). The style or the style base often persists in fruit, so that the utricle is apiculate. The accrescent calyx may tightly invest the utricle, loosely surround it, or be reflexed from it at maturity (Fig. 5). The utricle remains attached to the accrescent calyx in any case, and seems to comprise a dispersal unit.

*Cordisepalum*, *Poranopsis*, and most species of *Dinetus* have utricles with thin walls that closely conform to the shape of the seed. The utricle in *C. thorelii* is unusual in gradually tapering to a slender stalk at the base. *Dinetus truncatus* and *D. rhombicarpus* have an inflated utricle that is filled with a spongy matrix between the seed and the fruit wall. The calyx loosely surrounds or is reflexed from the utricles in these genera (Fig. 5, 8, 9, 12).

Utricles of *Tridynamia* species have a thicker, more stiffly chartaceous wall that is harder to break open. The lower calyx tightly encloses the utricle but distally the sepals flare out and become flat and wing-like (Fig. 5, 13). Fruits of *Tridynamia* are parasitized by insect larvae and the fruits thus affected have a particularly tough fruit wall that is often crustose and somewhat shiny on the inner surface.

Utricles of *Duperreya* are chartaceous to thinly coriaceous and conform closely to the shape and size of the single seed. The fruiting sepals loosely enclose the utricle and are only moderately enlarged, relative to their size at flowering (Fig. 11).

The fruit of *Porana* is somewhat larger than the seed and has a stiffly papery fruit wall that breaks open easily. *Porana volubilis* has a suture clearly visible in the fruit wall, which sometimes begins to split open from the base upward yet the utricle typically shatters irregularly. This species also occasionally has 2-seeded fruits. The calyx is reflexed from the utricle (Fig. 5).

### Seed

The single seed is usually ellipsoidal or subglobose, sometimes slightly asymmetrical at the base, with a basal circular hilum; the seed coat is hard, smooth, and glabrous. The embryo is erect, with a straight radicle and two foliaceous, multiplicate and corrugate cotyledons. Endosperm is scant and cartilaginous, turning mucilaginous upon hydration.

### Seedling

Viable seeds were available for only three species. Voucher specimens of the seedlings or cotyledons were prepared and placed in the Arnold Arboretum herbarium (A).

*Duperreya sericea* seedlings have two orbicular cotyledons with a deeply emarginate apex and are borne on a short hypocotyl.

*Dinetus racemosus* and *D. truncatus* have two ovate cotyledons that are apically acute or incised, margins entire, with palmate venation visible, borne on a short hypocotyl. These observations agree with a published illustration of the seedling of *D. racemosus* (Sweet, 1825: t. 127), but they disagree with recent studies of seedling morphology (Shenoy & Inamdar, 1985). Since Shenoy & Inamdar cited no voucher specimens for the plants that were their seed source it is impossible to verify their identifications. Their seedlings are not *Dinetus*, but appear to be some other member of the Convolvulaceae.

#### DISTRIBUTION, HABITATS, AND PHENOLOGY

When considered in the historical context, the distribution of *Porana* s.l. is centred on continental Asia. However, when the six genera (*Porana* s.s. and the five segregates) are considered separately the geographic distributions are more restricted. *Duperreya* is confined to xeric habitats in Australia. *Tridynamia* is centred in Southeast Asia, extending westward to northeast India and the Andaman Islands and north into subtropical China. *Poranopsis* has a very similar distribution pattern to *Tridynamia*, although one of its species extends westward much further along the southern flank of the Himalayas as far as Pakistan and northwest India. *Porana* extends from Southeast Asia through Malasia. *Cordisepalum* has the most limited distribution, being confined to Southeast Asia. It is the least well collected of the genera, however, and its distribution may be more extensive than presently understood.

*Dinetus* is unique among the segregates of *Porana* because it is found in much more temperate latitudes than the others. In tropical latitudes, *Dinetus* generally grows at higher elevations than the other genera. Because *D. racemosus* is a weedy camp follow, often associated with human activity that has surely enhanced its range, *Dinetus* has the greatest geographic distribution of any segregate of *Porana*: from India across Myanmar and Southeast Asia, north into China as far as southern Gansu and Shaanxi and northern Henan provinces, with widely disjunct populations in Indonesia on Java, Sulawesi (Celebes) and some of the Lesser Sunda Islands. One species, *D. grandiflorus*, just penetrates into Tibet, but no species of *Dinetus* (nor *Poranopsis* nor *Tridynamia*) crosses the Himalayan massif; instead the distribution follows the southern and eastern flanks of that mountain range.

Habitat information is summarized from herbarium specimen label data and personal observation of living plants in Asia. All taxa are climbing heliophytes that grow in sunny habitats or sunny situations in forested habitats. Three genera (*Cordisepalum*, *Poranopsis*, and *Tridynamia*) show a marked calciphilic tendency and are often collected from limestone or calcareous soils.

*Dinetus* species are herbaceous climbers from distinctly temperate climates and also from higher elevations in the tropics where conditions are more temperate, such as *D. malabaricus* in southwestern India's ghats at 1000–1500 m, or *D. racemosus* on mountain peaks at 1300–2075 m in Java. The elevational range overall is from 900–3500 m. *Dinetus* has been collected from limestone soils but does not demonstrate

the marked preference for them that the other genera do. In fact, *Dinetus* occurs on a wide range of soils, having been recorded from fertile loams, humus, and on rich red soils as well as sandy, granitic, schistaceous, silty, and clay soils.

*Dinetus* grow in diverse mesic habitats ranging from grasslands to forest margins and clearings, including scrub, thickets, understory, conifer-hardwood forest, cloud forest, deciduous forest, old cultivated land, roadsides, rocky hillsides and ravines, along watercourses and in waste places. Plants are summer to fall flowering, with fruits borne later in the same year.

*Duperreya* species are found in dry habitats and deserts of Western Australia with a widely disjunct population of *D. commixta* in east-central Australia. Although infrequently collected from crevices in limestone-conglomerate cliffs, neither species can be said to have a pronounced calciphilic tendency, and the majority of specimen labels record soil types such as red sands, sandy clay soils, or lateritic or granitic rocks. Both species are suffrutescent perennial climbers that are found mostly along watercourses as well as in various vegetation associations, forest margins, and on rocky slopes at elevations that range from sea level to 200 m. They flower most heavily between August and October, with fruits developing in the weeks after.

The other four genera are woody lianas from more tropical latitudes, although individual species do extend the distribution for *Poranopsis* and *Tridynamia* into subtropical and warm temperate areas. Little is known about *Cordisepalum*, but the few specimens extant indicate the two species are low elevation (25–1200 m) woody climbers that grow at the margins of, or in clearings in, a variety of mesic or seasonally dry forest types, including hardwood, evergreen, and mixed/deciduous forests. The plants flower during the cool dry season (November and December) and bear fruit shortly thereafter.

Members of the genus *Poranopsis* are woody lianas that seem to have a marked preference for limestone soils, although one species, *P. paniculata*, has been collected on many other soil types as well. It is probably significant that *P. paniculata* is the only cultivated species of this genus, and it has not been easy to distinguish herbarium specimens made from cultivated plants grown on diverse soil types from those of wild origin, thus the calciphile tendency of wild plants may be more marked than it seems based on herbarium specimen label data alone. The habitats in which *Poranopsis* grows are diverse and include many types of seasonally dry forest, thickets, scrub, open plains, rocky hillsides, margins of cultivated land, and around human habitation (the latter two derive from collections of *P. paniculata*). Elevational data recorded by collectors suggest that most plants were found between 350 and 2000 m, although cultivated plants seem to extend this downward to sea level. All species seem to flower after the end of the rainy season, throughout the cool dry season, with fruits ripening from the latter part of the cool dry season into the hot dry season.

*Tridynamia* taxa are also woody lianas that have a marked preference for calcareous soils between sea level and 1800 m elevation, rarely up to 2500 m. A number of other soil types have been noted, including clay, schistaceous, lava beds, and rock ledges. Habitats include various forest types, prairies, grassy savannahs, stream banks, rock cliffs and steep slopes, and along roadsides, the margins of cultivated land, and near villages. There seems to be flowering almost year-round in the tropical species, with a peak from May to August; the subtropical to temperate *T. sinensis* shows a more pronounced summer flowering season with fruits maturing in the fall.

The genus *Porana* has an amphi-Pacific distribution, with one species in Southeast Asia and one in Mexico. The Asian *P. volubilis* is a mesic forest species, primarily, and it has been collected from monsoon forest, coastal forest, as well as thickets, savannahs, along river banks, and on rocks at elevations ranging from sea level up to 500 m. There is no evidence to support a limestone preference and label data indicate it has been found on diverse soil types including sandy, rocky, and 'rich red' soils. Because *P. volubilis* has long been associated with human activity, its distribution and apparent habitat preferences have surely been altered by human intervention. *Porana volubilis* seems to flower year round with a definite peak between April and August in Indonesia. As one moves further north away from the equator the flowering peak shifts to later in the year, and in Southeast Asia and the Philippines the flowering peak falls between October and January.

## TAXONOMY

The following key will enable the identification of flowering and fruiting specimens of the six genera recognized here. The taxa are arranged alphabetically in the Taxonomic section. In the Phenology section the number of flowering/fruiting specimens studied is recorded by month.

- 1a. Leaves linear-oblong, with a single basal pair of secondary veins (Fig. 11); flowers solitary, axillary. — Xeric Australia . . . . . **Duperreya**
- b. Leaves broader, with 3 or more pairs of secondary veins; flowers in racemose, paniculate, or thyriform inflorescences. — Asia and Malesia . . . . . 2
- 2a. Leaf venation pinnate (Fig. 4e); calyx covering half or more of the corolla; style branched distally; stigmas 2, free . . . . . **Porana**
- b. Leaf venation pedate (Fig. 4d); calyx covering 1/4 or less of corolla tube; style entire or absent; stigmas 2, partly or wholly fused . . . . . 3
- 3a. Plants herbaceous; flower buds glabrous except for minute apical tuft of hairs; fruiting sepals all equally enlarged (unequally in *D. grandiflorus*). . . . . **Dinetus**
- b. Plants woody (often with herbaceous stem tips); flower buds hairy externally; outer 2 or 3 fruiting sepals greatly enlarged, the others less so . . . . . 4
- 4a. Sepals unequal in flower; fruiting sepals with 3 to 9 parallel longitudinal veins (Fig. 4e) . . . . . **Tridynamia**
- b. Sepals (sub)equal in flower; fruiting sepals with 1 midvein and a reticulum of fine secondary veins (Fig. 4c, d) . . . . . 5
- 5a. Corolla funnellform, white, limb subtire to 5-toothed; utricle sessile on torus . . . . . **Poranopsis**
- b. Corolla rotate, yellowish, limb deeply 5-lobed or -parted; utricle raised on a slender stalk . . . . . **Cordisepalum**

## I. CORDISEPALUM

*Cordisepalum* Verdc. (1971) 138. — Type species: *Cordisepalum thorelii* (Gagnep.) Verdc.

Lianas, lower stem woody, glabrescent, upper branches herbaceous, tawny or ferruginous, velutinous. *Leaf* petiole slender, terete, slightly pulvinate; blade ovate-cordate,

entire, chartaceous; venation pedate, veins prominent abaxially. *Inflorescence* axillary, racemose, paniculate, or thyrsiform, anthesis proceeding acropetally; bracts foliaceous, texture, indumentum and venation like the leaves; bracteoles scale-like, attached just below calyx. *Flowers* small, numerous; sepals 5, free, quincuncial, clasping corolla tube base, unequally accrescent in fruit. *Corolla* rotate, tube short, limb 5-lobed or -parted to below middle, lobes reflexed at anthesis, valvate in bud. *Stamens* 5, equal, slightly exerted, filaments in lower half adnate to corolla tube, free and filiform above; anthers oblong, longitudinally dehiscent; pollen 3-colpate, nonspinose. *Pistil* included; disc not obvious; ovary unilocular, glabrous; ovules 4 (or 5), basal, erect; style simple or absent; stigma terminal, biglobose, lobes slightly longer than broad, coarsely wrinkled. *Fruiting calyx* enclosing utricle, outer 3 sepals greatly enlarged, subcircular or broadly ovate, base cordate, margins free, inner 2 sepals only slightly enlarged; sepals all thinly chartaceous, midvein 1, finer veins reticulate, prominulous, dark. *Utricle* ellipsoid or fusiform, apiculate by persistent style, borne on a stalk developed from ovary base, velutinous. *Seed* 1, ellipsoid, smooth, glabrous; hilum basal, circular.

A genus of two species, endemic in Southeast Asia.

The genus *Cordisepalum* is similar in several characters to the genus *Poranopsis* and Verdcourt's comment (1971: 140) at the time he named the genus, "... my only doubt has been the wisdom or otherwise in separating it" is apt. The features that distinguish *Cordisepalum* from *Poranopsis* are the rotate, deeply parted corolla and the stalked utricle.

Gagnepain (in Gagnepain & Courchet, 1915a), in naming *Cardiochlamys thorelii*, recognized the similarities between the Asian plant and the Madagascan genus *Cardiochlamys* and concluded that the former was a widely disjunct species of *Cardiochlamys*. He went on to differentiate his plant from the two Madagascan species, and it is in these differences that the characteristics allowing one to separate *Cordisepalum* from *Cardiochlamys* emerge. Species of *Cardiochlamys* are herbaceous twiners (including the stem base?) with slenderly funnellform corollas, well-exserted stamens, pantoporate pollen grains, biovulate ovaries, a thick stalk (gynophore) bearing the utricle, a prominent floral disc, and ovate-cordate fruiting sepals with acuminate-acute apices and adherent margins. While there are superficial similarities between these two genera, *Cordisepalum* can readily be distinguished on the basis of its rotate corolla, 3-colpate pollen grains, 4- (or 5-)ovulate ovaries, seeming lack of a floral disc, and fruit sepals that are free at the margins. Deroin (2004) has compared the floral anatomy of these two genera and shown that while a disc is not obvious in *Cordisepalum*, its presence can be demonstrated on histological grounds.

#### KEY TO THE SPECIES

- 1a. Inflorescence congested; flowers 3(–4) mm diam.; corolla lobes glabrous on the inner surface . . . . . **1. *C. phalanthopetalum***
- 1b. Inflorescence lax; flowers (5–)7–11 mm diam.; corolla lobes velutinous on both surfaces . . . . . **2. *C. thorelii***



Fig. 7. *Cordisepalum phalanthopetalum* Staples. a. Habit; b. branch from the inflorescence; c. calyx and calycle; d. corolla opened, with stamens; e. pistil (all: Van Beusekom et al. 3791). Scale bars: a = 5 cm, b = 5 mm, c–e = 1 mm.

**1. *Cordisepalum phalanthopetalum* Staples, *spec. nov.* — Fig. 7; Map 1**

Suffrutex volubilis, affinis *C. thorelii*, sed a inflorescentiis densioribus, floribus parvioribus (ad 3 mm diametro), corollis rotatis 5-partitis lobis intra glabris extra dense velutinis, et stigmatibus biglobosis sessilibus, differt. — Typus: *C.F. van Beusekom*, *C. Phengkklai*, *R. Geesink & B. Wongwan 3791* (holo BKF; iso BISH, C, K, KYO, L, MO, P), Thailand (SW), Kanchanaburi: along track from Huay Bankan to Si Sawat, 14°50' N, 98°50' E, 15 Nov. 1971.

Liana; vegetative parts tawny to brownish hairy; lower stem woody, glabrate; branches 4–5 mm diam., smooth to striate, fistulose when dry, pubescent; younger stems to 3 mm diam., herbaceous, velutinous. Indumentum composed of hispid, simple, swollen-based hairs, c. 1.5 mm long, and shorter, 2-armed, erect hairs. *Leaf* petiole 2–2.5 cm long; blade broadly ovate-cordate, 9.5–14.2 by 5.4–9 cm, base cordate, apex apiculate to shortly caudate, adaxially castaneous, velutinous, abaxially ± densely tawny-fulvous velutinous; venation with 3 basal pairs and 2 distal pairs of secondary veins. *Inflorescence* thyriform: a congested compound raceme, 40–51 cm long; lower bracts foliaceous, petiolate, petiole terete, (9–)15–25 mm long, blade ovate-cordate, 5.4–8.2 by 3.4–4.4 cm; upper bracts diminishing in size, petiole 1–4 mm long, blade ovate to elliptic-fusiform, 4–7 by 2–5 mm; uppermost bracts sessile, subulate-lanceolate, 1–2 mm long; pedicels filiform, ≤ 1 mm long; bracteoles 3. Flower buds broadly ellipsoid, apex rounded. *Sepals* c. 1 mm long, outer 3 lanceolate to narrowly ovate, inner 2 linear to narrowly oblong, bases truncate, margins entire, apex obtuse to acute and slightly cucullate, outside densely velutinous, inside apex pilose-velutinous, otherwise glabrous. *Corolla* yellow, tube c. 1 mm long, limb 3(–4) mm diam., lobes broadly ovate to obovate, c. 1 by 1 mm, apex obtuse to acute, outside velutinous, inside glabrous. *Stamens* c. 1 mm long, just protruding from corolla tube; filaments pilose basally, glabrous above; anthers broadly ellipsoid, extrorse, white; pollen 3-colpate, oblate spheroidal, c. 9 by 10–12 μm, surface finely granulate, pilate multiangulate within the colpi. *Pistil* c. 1.5 mm long, equal in length to calyx, just reaching mouth of corolla tube; ovary broadly ovoid, pale tan, glabrous; ovules 5; style absent; stigma sessile, biglobose, green drying to black. *Fruiting calyx*, utricle and seeds not seen.

*Etymology* — The specific epithet (from the Greek *phalanthos* ‘bald in front’ + *petala*) refers to the glabrous inner surface of the lobes of the deeply divided corolla.

*Distribution* — Known from the type locality in the Tenasserim Hills of Kanchanaburi province, southwestern Thailand, and in adjacent south-eastern Myanmar.

*Habitat* — Disturbed forest on limestone between 150–450 m elevation.

*Note* — Five-ovulate ovaries are extraordinary in the Convolvulaceae, where 2- or 4-ovulate ovaries are typical. Other ovule numbers are known to occur in isolated individuals, species, or groups of species (e.g. *Ipomoea* sect. *Pharbitis*) in genera otherwise having 2- or 4-ovulate ovaries. All flowers that I dissected from the type collection were found to have 5-ovulate ovaries. While it may be characteristic for this species, it is also possible that the plant from which the type was collected is aberrant in this character. Additional collections are needed to confirm that 5-ovulate ovaries are found in all individuals of *C. phalanthopetalum*.

*Specimens examined*:

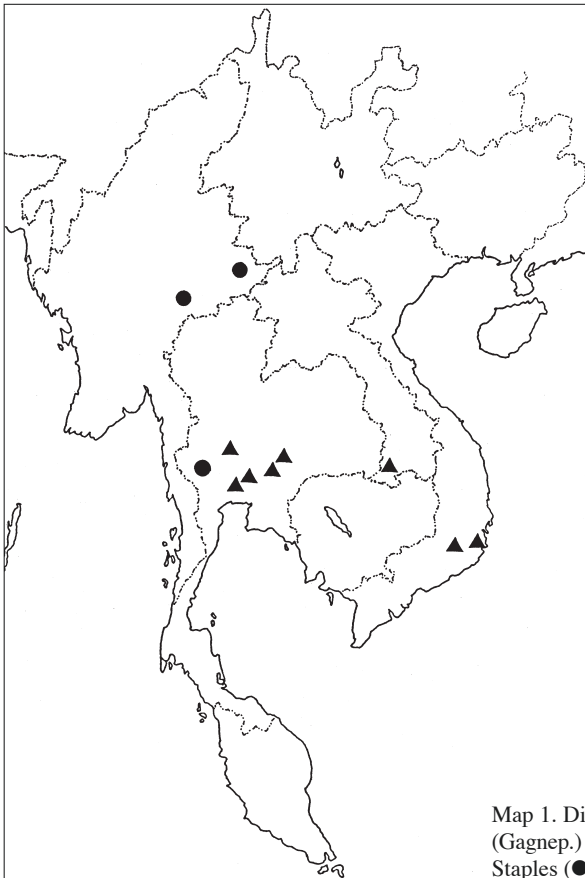
*Abdul Khalil s.n.* (CAL), Myanmar, Southern Shan States, Indi, anno 1898; *R.W. MacGregor 1800* (E), *ibid.*, Keng Teng, elev. 1000 ft., Oct. 1884.

## 2. *Cordisepalum thorelii* (Gagnep.) Verdc. — Fig. 12 l–n; Map 1

*Cordisepalum thorelii* (Gagnep.) Verdc. (1971) 138. — *Cardiochlamys thorelii* Gagnep. (1915a) 136.

— Type: *Thorel* 2625 (holo P, photo K; iso P, photo K), Laos.

Liana to 4–6(–8) m long; vegetative parts fulvous to ferruginous; older stems 5–8 mm diam., smooth to slightly striate, dark brownish black, ± puberulous to subglabrous, pith solid; younger stems 1–2 mm diam., herbaceous, terete, tan to brownish, velutinous. Indumentum hairs 2-armed; arms wavy, ± appressed on axial parts, arms erect or ascending on laminar parts. *Leaf* petiole 17–43 by < 1–2 mm, ± velutinous; blade broadly ovate to attenuate-ovate, 8–11.5 by 4.3–7.6 cm, base subcordate, sinus broad and shallow, apex attenuate-acuminate to subcaudate, adaxially darker, ± velutinous, abaxially greyish, tawny, or rufous, densely woolly; venation with 2 basal pairs and 1 or 2 distal pairs of secondary veins. *Inflorescence* lax, a simple or compound raceme 25–50 cm long; lower bracts petiolate, petioles (2–)5–13(–21) mm long, blades broadly ovate, 21–31 by 13–24 mm; upper bracts sessile, ovate, 12–19 by 6–9 mm, diminishing to small scales; pedicels filiform, 3–5 mm, increasing to 8–10(–13) mm in fruit; bracteoles 3, < 1 mm long. *Flowers* fragrant; buds obovoid or ellipsoid, widest



Map 1. Distribution of *Cordisepalum thorelii* (Gagnep.) Verdc. (▲) and *C. phalanthopetalum* Staples (●) in south-eastern Asia.

above calyx, apex rounded. *Sepals* naviculate, c. 2 by < 1 mm; outer 3 obpandurate to narrowly ovate, inner 2 narrowly elliptic-oblong, bases truncate, margins entire, apex acute, outside densely velutinous, inside pilose apically, otherwise glabrous. *Corolla* cream to pale yellowish; tube 1–2 mm long, glabrous inside and out; limb (5–)7–11 mm diam.; lobes ovate, 3.5–5 by 1.5–3 mm, apex acute to acuminate, both sides densely velutinous-woolly. *Stamens* < 2 mm long, just protruding from corolla tube; filaments glabrous; anthers broadly ellipsoid, introrse, whitish; pollen 3-colpate, oblate spheroidal, c. 10 by 11–14  $\mu\text{m}$ , surface psilate or finely granulate, with pilate multiangulate outgrowths within colpi. *Pistil* c. 2 mm long, just exceeding calyx, stigma protruding from corolla tube; ovary ovoid, glabrous; ovules 4; style short, terete; stigma biglobose. *Fruiting calyx* clasping utricle; sepals markedly unequal; outer 3 sepals broad ovate-cordate to suborbicular, 21–28(–33) by 19–26(–28) mm, base cordate, lobes approaching or overlapping, margins entire, free, apex emarginate, mucronulate, third sepal folded back on itself along midvein (in dried material); inner 2 sepals linear-spathulate, falcate, 5–7 by < 1–2 mm; all sepals chartaceous, stramineous to tan, opaque, reticulate, both sides sparsely pilose. *Utricle* ellipsoid-fusiform, apiculate, 6–7 by 3–4.5 mm, borne on a columnar stalk c. 2 mm long, chartaceous, brownish, smooth or shallowly furrowed, tawny to rufous velutinous. *Seed* broadly ellipsoid, 4 by 3.5 mm, dark reddish brown; hilum basal, c. 1 mm diameter.

Phenology — Flowering: February (1), April (1), October (1), November (4), December (5). Fruiting: December (1).

Distribution — Thailand, Laos, and Vietnam; probably also in Cambodia.

Habitat — Evergreen forests, mixed/disturbed and open hardwood forests, often in clearings or along the margins; seemingly always on limestone. From 25–1200 m elevation.

Vernacular names — Rahet khati dong (Thailand, Nakhon Ratchasima), re cai, ma coi (Vietnam, Moï dialect).

Notes — The vegetative morphology and fruiting sepals of *C. thorelii* approach those of *Poranopsis sinensis*. The two taxa are almost identical in the aspect of the infructescence and in the shape of the fruiting sepals. However, the sepal margins are free in *C. thorelii* and the utricle is borne on a slender stalk to 2 mm long. In flower, these plants are readily separable, with *C. thorelii* having a rotate, deeply 5-lobed corolla, whereas *P. sinensis* has a funnellform corolla.

Gagnepain (in Gagnepain & Courchet, 1915a) described the corolla lobe aestivation in *Cardiochlamys thorelii* as quincuncial, which he assumed was the case in the two Madagascan taxa of *Cardiochlamys* as well, remarking that this character had been overlooked by Oliver (1883) and Hallier (1894) in their respective descriptions. My own examination of the flowers of *C. thorelii* shows that the aestivation is valvate: each corolla lobe has the margins first folded inward, and the infolded lobes are then apposed edge-to-edge in a valvate arrangement. There is also no twisting of the corolla lobes in bud. When the corolla is fully expanded the lobes overlap slightly at the margins and the arrangement at that stage appears to be quincuncial, which may be the source of Gagnepain's statement. Further investigation has shown that the corolla lobe aestivation in bud is also valvate in the Madagascan *Cardiochlamys* (Deroin, 2001).

Another inaccuracy to be corrected is that Gagnepain (in Gagnepain & Courchet, 1915a) described and figured the ovary of *C. thorelii* as “breviter piloso-papillosum”,

which is not the case at the time of flowering. The ovary in every flower I dissected was exclusively glabrous, including flowers from the type collection. The utricles, however, are velutinous, and the indumentum first appears on the outer fruit wall during the development of the fruit. Possibly Gagnepain based his figure and description on recently fertilized gynoecea in the early stages of fruit development when the indumentum first appears.

## II. DINETUS — Fig. 8, 9

*Dinetus* Sweet (1825) t. 127. — Type: *Dinetus racemosus* (Roxb.) Sweet.

*Dinetopsis* Roberty (1952) 27. — Type: *Dinetopsis grandiflora* (Wall.) Roberty.

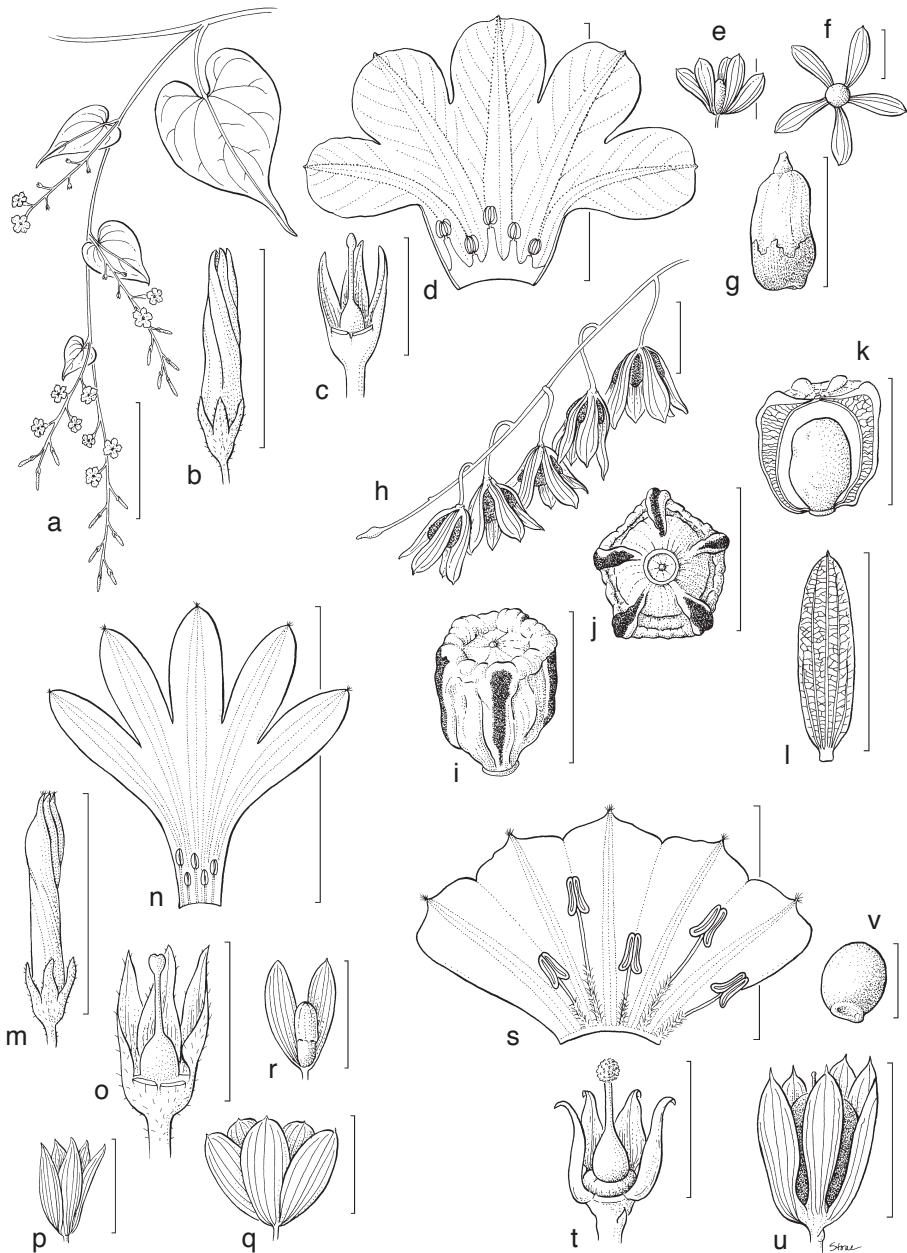
*Schillingia* Verdc. ex Airy Shaw in Willis (1973) 1038, nomen. — Type: not designated.

Herbaceous, annual or perennial twiners, glabrous or sericeous. Roots fibrous (enlarged storage organs in *D. duclouxii*). Stems striate, nodes often pilose, otherwise subglabrous. *Leaf* petiole terete, sulcate adaxially, or compressed, pulvinus sometimes present; blade cordiform, entire or lobed, thinly chartaceous, venation pedate, secondary veins 2 or 3 basal pairs and 1, 2 (or 3) distal pairs, veins prominent, often alate abaxially. *Inflorescences* solitary or paired, axillary, bracteose, racemose or paniculate, anthesis proceeding acropetally; bracts foliaceous, petiolulate or sessile, amplexicaule, persisting; bracteoles 2 (or 3), minute scales (sepaloid in *D. duclouxii*), immediately below calyx. *Flowers* small to large, often fragrant; sepals 5, free and quincuncial, or bases slightly connate, valvate, equal or unequal. *Corolla* funnellform or subsalverform, lobes contortuplicate in bud, glabrous except for tuft of hairs on apex of each interplica. *Stamens* 5, equal or unequal, included; lower filaments fused to corolla tube, base glabrous or pilose, free above; anthers hastate-sagittate or linear, introrse, longitudinally dehiscent prior to anthesis; pollen 3-colpate, nonspinose. *Pistil* included; disc annular, 5-lobulate, or absent; ovary unilocular; ovules 2, erect, basal; style, simple, often jointed above base; stigma ellipsoid, entire and emarginate or slightly apically bilobed. *Fruiting calyx* greatly accrescent, scarious, reflexed or loosely clasping utricule, with (5) 7, 9 (11) parallel, longitudinal veins at base, 3 reaching apex. *Utricle* chartaceous. *Seed* 1, ellipsoid to subglobose, often keeled, smooth, glabrous; hilum basal, recessed, semicircular.  $n = 14$  (*D. racemosus*, Manitz, 1983 as *Porana racemosa*).

*Dinetus* is a genus of 8 species widely distributed in Asia. The genus name is derived from the Greek *dinetos* 'whirled round' in reference to the fruits that spin around as they fall. The diagnostic characters for recognizing it are: herbaceous habit; flower buds glabrous except for an apical tuft of hairs; an ellipsoidal, entire to emarginate stigma;

→

Fig. 8. *Dinetus*, 4 small-flowered species. — a–g: *D. racemosus* (Roxb.) Buch.-Ham. ex Sweet. a. Flowering stem habit; b. flower bud; c. flowering calyx (2 sepals removed) and gynoeceum; d. corolla opened to show stamen attachment; e. utricule with ± clasping calyx; f. utricule with spreading calyx; g. utricule eroded at base to expose seed. — h–l: *D. truncatus* (Kurz) Staples. h. Fruiting stem habit; i. utricule in side view; j. utricule base; k. utricule opened to show spongy layer; l. fruiting sepal. — m–r: *D. malabaricus* (C.B. Clarke) Staples. m. Flower bud; n. opened corolla to show stamen attachment; o. calyx (2 sepals removed) and gynoeceum; p. fruiting calyx; q. fruiting calyx; r. fruiting calyx (sepals removed) and utricule. — s–v: *D. dinetoides* (C.K. Schneid.) Staples. s. Corolla



opened; t. flowering calyx (1 sepal removed) and gynoecium; u. fruiting calyx and utricle; v. seed (a: adapted from *W.P. Fang 5592* and *Henry 2595*; b–d: *Staples 131*; e, f, m, n: *Tsai 56660*; f, g: *Staples et al. 427*; h–l: *Staples et al. 425*; h: redrawn from photo; m–o: *H.S. (= Santapau) 2958*; p, r: *Santapau 9545*; q: *Stocks & Law s.n.*; s, t: *Henry 9340*; u, v: *Henry 9340a*). Scale bars: a = 5 cm; b, u = 8 mm; c, o, v = 3 mm; d = 9 mm; e, f, m, n = 1 cm; g = 5 mm; h, l = 1.5 cm; i–k = 6 mm; p, r = 2 cm; q = 1.9 cm; s = 7 mm; t = 2 mm.

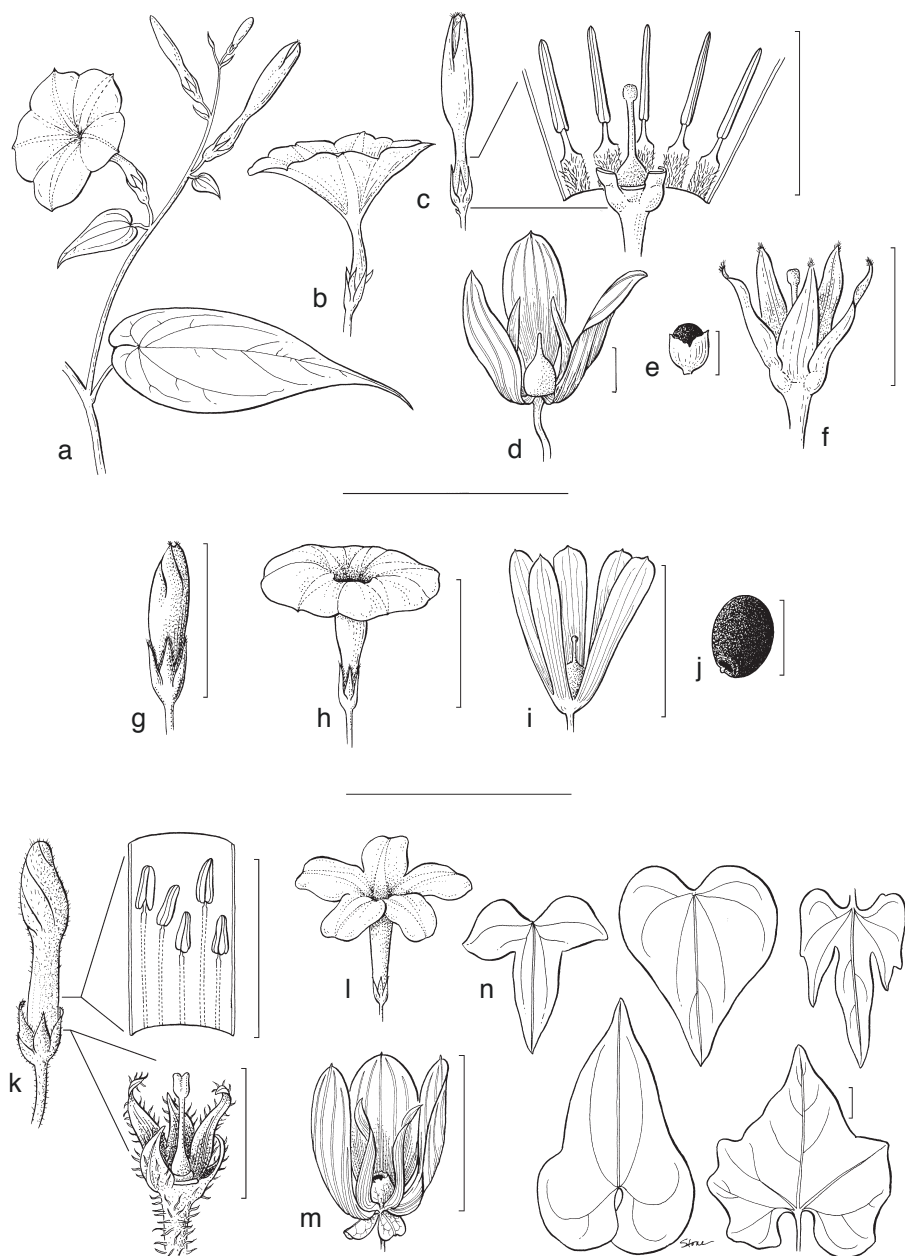


Fig. 9. *Dinetus*, 3 large-flowered species. — a–f: *D. grandiflorus*. a. Flowering stem habit; b. flower in side view; c. mature bud showing swollen tube base, and opened to show equal stamens, gynoecium; d. fruiting sepals and utricle; e. utricle broken to expose seed; f. flowering sepals. — g–j: *D. decorus*. g. Flower bud; h. flower; i. fruiting calyx and utricle; j. seed. — k–n: *D. duclouxii*. k. Flower bud showing cylindrical tube with insets showing stamens and calyx (2 sepals removed), gynoecium, and 2 bracteoles; l. flower; m. fruiting calyx, enlarged bracteoles, and utricle; n. leaf

fruiting sepals with multiple, parallel longitudinal veins; the calyx reflexed from the utricule at maturity, or fruit sepals strongly concave and enclosing the utricule.

Two informal species groups are clearly recognizable with a single species having intermediate characteristics. The 'Dinetus' group (Fig. 8) is recognizable by its small flowers (< 1 cm long) with white corollas and by the fruiting calyces with 5 flat, equally accrescent sepals that are reflexed at maturity. Additional characters distinguishing the 'Dinetus' group include the presence of stellate hairs (in some species), flowering sepals equal, slightly connate at the base and valvate in aestivation, sagittate-hastate anthers with diverging bases, and usually 5 or 7 veins at the base of the fruiting sepals.

The 5 species comprising the 'Dinetus' species group are separable *inter se* primarily by characters of the fruiting calyx and utricule. Variation in the sepal shape, size, coloration, utricule shape, degree of separation between the pericarp and the single seed, and the coloration and pubescence of the utricule are taxonomically informative. Floral characters are useful only to distinguish *D. dinetoides* from the other members of the group. The flowers of *D. rhombicarpus* are unknown and those of *D. truncatus* insufficiently known. It is likely that some of the flowering material herein assigned to *Dinetus racemosus* is misidentified, and actually represents the other three species, *D. malabaricus*, *D. rhombicarpus*, and *D. truncatus*. Further study is needed, using plants raised in cultivation from seed of known identity, to establish what, if any, floral morphological differences exist between these four species.

The second species group, consisting of *D. duclouxii* and *D. grandiflorus*, has larger flowers (2.2–4 cm long) with corollas of various colours, but only rarely white. The fruiting sepals are unequally enlarged, concave, and loosely enclose the utricule. The flowering sepals are equal or unequal, free and quincuncial in aestivation, the anthers linear, and the fruiting sepals with 7, 9 or 11 veins at the base. I refer to this pair informally as the 'Dinetopsis' group (Fig. 9).

The intermediate species, *Dinetus decorus*, has a suite of characters that bridges the gap between the two groups, including: a rose pink corolla 1.7–2.3 cm long; flowering sepals equal, basally connate, and valvate in aestivation; anthers hastate with diverging bases; and fruit sepals that are flat, equally enlarged, with 5 veins at the base, but which loosely enclose the utricule. Purely for convenience I have decided to include this species in the 'Dinetopsis' group, because the easily visible morphological characters (large, coloured corolla, and enclosing fruiting sepals) are like those of the 'Dinetopsis' group. Pollen morphology also supports this placement, because the grains of all 3 species assigned to the 'Dinetopsis' group are oblate spheroidal and more coarsely granular on the surface than those of the 'Dinetus' group, which are finely psilate but not granular. Further study of the infrageneric relationships is needed.

The name *Schillingia* was published by Airy Shaw (in Willis, 1973) after discussions with Bernard Verdcourt regarding the identity of *Schilling 612* (Verdcourt, pers.

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blade diversity (a, b: drawn from colour slide; c, f: *De Haas 2053*; d, e: *J.D. Hooker s.n.*; g: *Ten 173*; h: redrawn from Fang & Huang 1979b; t. 8; i, j: *Kingdon-Ward 7741*; k, l: *Handel-Mazzetti 7041*; m: *Henry 9229d*; n: top row-left, from *Hsieh 41660*; middle, *anonymous 8714*; right, *anonymous 5230*; bottom row-left, *Tsiang 1242*; right, *Handel-Mazzetti 7041*). Scale bars: a–c = 7 mm; d, e, n = 1 cm; f = 5 mm; g = 8 mm; h = 1.7 cm; i = 1.8 cm; j, k (calyx, gynoecium, bracteoles) = 4 mm; k = 9 mm (stamens); l, m = 2 cm.

comm. 1984). At the time of the discussions, Verdcourt was puzzled by the identity of this collection, and thought it might represent an undescribed genus of the Convolvulaceae. Verdcourt later realized that the plant collected by Schilling was conspecific with *Ipomoea cuspidata* D. Don, and correctly identified that name as a synonym of *Porana grandiflora* (Verdcourt, 1970). Airy Shaw (in Willis, 1973), unaware that the plant had been identified as *Porana grandiflora*, went on to use the name *Schillingia*, credited to Verdcourt. No specific epithet was published or combined in it.

#### KEY TO THE SPECIES

- 1a. Corolla 1.5–4 cm long, rose pink, lavender, blue, or violet (rarely white in *D. duclouxii*); fruiting sepals  $\pm$  unequal, loosely clasping the utricle . . . . . 2
- b. Corolla < 1 cm long, white; fruiting sepals (sub)equal, reflexed at maturity . . . 4
- 2a. Plants  $\pm$  viscid glandular; bracteoles 3, sepaloid . . . . . **5. *D. duclouxii***
- b. Plants pubescent or glabrous, never viscid; bracteoles 2, minute, scale-like . . . 3
- 3a. Corolla funnellform, 1.7–2.3 cm long, tube tapering from the base upwards; fruiting sepals flat . . . . . **3. *D. decorus***
- b. Corolla subsalverform, 3–4.5 cm long, tube narrow with a basal swelling; fruiting sepals concave . . . . . **6. *D. grandiflorus***
- 4a. Leaves bifacially hairy; corolla campanulate . . . . . **4. *D. dinetoides***
- b. Leaves subglabrous adaxially; corolla funnellform . . . . . 5
- 5a. Fruiting sepals linear-oblong to narrowly obovoid-spatulate . . . . . 6
- b. Fruiting sepals elliptic to ovate . . . . . 7
- 6a. Utricle ellipsoidal and apiculate . . . . . **8. *D. racemosus***
- b. Utricle broadly obovoid, truncate or depressed at the apex . . . . . **10. *D. truncatus***
- 7a. Utricle ellipsoidal . . . . . **7. *D. malabaricus***
- b. Utricle broadly rhomboidal . . . . . **9. *D. rhombicarpus***

### **3. *Dinetus decorus*** (W.W. Sm.) Staples — Fig. 9g–j; Map 2

*Dinetus decorus* (W.W. Sm.) Staples (1993) 199. — *Porana decora* W.W. Sm. (1914) 197. — Type: *Maire 64* (holo E; iso BM), China.

*Porana mairei* Gagnep. in Gagnep. & Curchet (1915a) 154, excl. note about fruit. — Type: *Maire s.n.* (lectotype (here designated) P; isoelectotypes A, E, G, L, P), China.

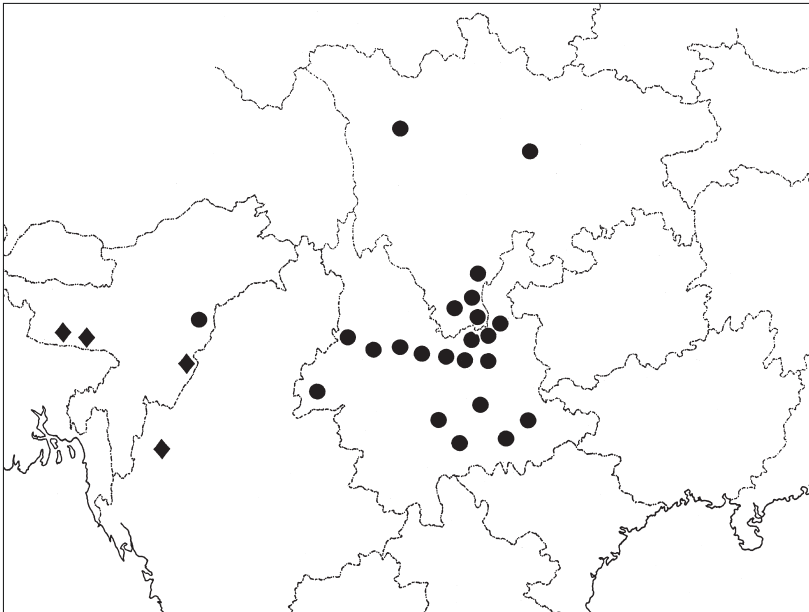
*Porana microsepala* Hand.-Mazz. (1921) 229. — Type: *Pater S. Ten 1980* (lectotype (here designated) C; isoelectotype WU), China.

*Porana macrocephala* Hand.-Mazz. ex Erdtman (1952) 128, nomen, sphalm. '*Porana microsepala*' Hand.-Mazz. based on *Handel-Mazzetti 4929*.

*Porana mairei* Gagnep. var. *holosericea* C. Y. Wu in Fang & Huang (1979b) 163. — Type: *Sichuan-Liangjiang Team 5830* (holo KUN; iso PE), China.

Perennial twiners or prostrate, to 2 m long, branches pendulous, vegetative parts silvery-white. Stem terete, 3–5 mm diam., stramineous to deep brown or purplish,  $\pm$  puberulent, older stems glabrate. Indumentum greyish white, axial parts  $\pm$  velutinous, laminar parts sericeous, hairs 2-armed. *Leaf* petiole 2.5–8.4 cm long; blade broadly ovate-cordate, 8–14 by 4.8–10 cm, base shallowly to deeply cordate, sinus broad, apex attenuate or acute, cuspidate, texture chartaceous, adaxially olivaceous, glabrous to sparsely and minutely strigose, abaxially tawny and subglabrous to greyish white and  $\pm$  shining

sericeous. *Inflorescence* pendulous, 21–33 cm long; lower bracts petiolate, petioles 7–12 mm long, blades cordate-ovate, 4.1–6 by 1.7–3 cm, base with deep, narrow sinus, apically attenuate; upper bracts sessile, lanceolate-filiform, 1–4 by 0.8–1.6 cm, base amplexicaule; bracts mostly deciduous in fruit; pedicels filiform, 8–12 mm long; bracteoles 2, immediately below calyx, filiform, to 3 mm long, deciduous or persisting but not enlarging in fruit. *Flowers* showy; buds clavate to slenderly obovoid, 17–24 mm long. *Sepals* equal, often divergent, lanceolate to narrowly ovate or subulate, 2–3 by < 1 mm, truncate basally, margins entire, often slightly revolute, apex acute to attenuate, abaxially shining golden sericeous, along margins (or entire surface). *Corolla* slenderly funnelliform to subsalverform, 1.7–2.3 by 1.5–1.8 cm, diaphanous, outside rose-pink or purplish to white, inside white, tube gradually widening, limb flaring abruptly, subentire, glabrous except for small golden hair tufts at apices of interplacae and a few scattered hairs on tube. *Stamens* unequal, biseriate; filaments 4–7 mm long, glabrous; anthers hastate, c. 1 mm long, yellowish white; pollen 3-colpate, oblate spheroidal, c. 10 by 12–14  $\mu\text{m}$ , surface granulate. *Pistil* c. twice as long as calyx; disc absent; ovary ovoid-conical, c. 1 mm long; style 2–3 mm long, golden-tan; stigma broadly ellipsoid-oblong, emarginate to slightly bilobed apically, greyish tan. *Fruiting calyx* loosely clasping to slightly spreading from the utricle; sepals (sub)equal, oblong to elliptic-oblong to subspatulate, flat, 3 outer 23–31 by 6–8 mm, 2 inner 15–30 by 4–7 mm, texture stiffly chartaceous, tan to brown to purplish brown, glabrous. *Utricle* obovoid, apiculate, 6–7 by 4–5 mm, chartaceous, tan to deep reddish or purple-brown, finely wrinkled, glabrous. *Seed* globose to broadly ellipsoid, 4–5 by 4 mm, reddish tan, smooth, glabrous.



Map 2. Distribution of *Dinetus decorus* (W.W. Sm.) Staples (●) and *D. rhombicarpus* Staples (◆) in the eastern Indian subcontinent and western China.

Distribution — China (Yunnan, Sichuan) and north-eastern India (Nagaland) surely also in intervening northern Myanmar.

Habitat — Forest, often in river valleys and on steep, often rocky slopes, at 1300–3500 m elevation.

Phenology — Flowering: June (5), July (12), August (10), September (2). Fruiting: October (4), November (3), December (1).

Vernacular name — Bai teng (China).

Typification — Gagnepain & Curchet (1915a) based *P. mairei* on a series of syntypes, including *Wilson 4186a*, which is actually a fruiting collection of *D. duclouxii*. Their species concept is here amended to exclude the fruiting characters based on *Wilson 4186a*.

Note — The diagnostic characters for *D. decorus* are: a medium-sized slenderly funnelliform to subsalverform corolla which is pink or rose; unequal stamens with hastate-sagittate, 1–2 mm long anthers; filiform bracteoles, which are not accrescent in fruit; (sub)equal, flat, stiffly chartaceous fruiting sepals. In addition, the white under surface of the leaves is reported by collectors to be a good field character for distinguishing the species. This last character is the source of its common name in Chinese, *bai teng* – white cane or white vine.

#### 4. *Dinetus dinetoides* (C.K. Schneid.) Staples — Fig. 8s–v; Map 3

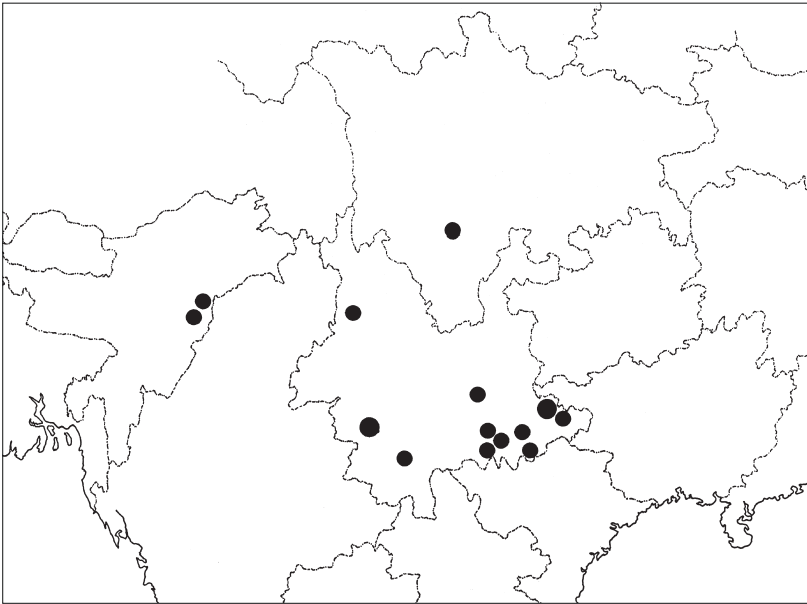
*Dinetus dinetoides* (C.K. Schneid.) Staples (1993) 199. — *Porana dinetoides* C.K. Schneid. (1916) 360. — Type: *A. Henry 9340* (holo A; iso E, K, MO, NY, US), China.

*Porana megathyrsa* C.Y. Wu in Wu & Li (1965) 101, t. 18. — Type: *G.S. Sin 1044* (holo KUN; iso IBSC, KUN, PE), China.

*Porana brevisepala* C.Y. Wu & S.H. Huang in Fang & Huang (1979a) 630, t. 179, f. 4, 5. — Type: *C.A. Wu 9775* (holo KUN; iso KUN), China.

*Porana dinetoides* C.K. Schneid. var. *mianningensis* S.H. Huang in Fang & Huang (1979b) 163. — Type: *T.S. Ying 4342* (holo KUN, not found; iso KUN), China.

Perennial herbaceous climber to 3 m long. Stem twining, terete, faintly striate, minutely verruculose, 2–3 mm diam., stramineous to reddish brown, tomentose-pilose, glabrate with age, pith solid. Indumentum yellowish, tomentose; axial parts with mixture of longer, erect simple hairs and shorter, ± appressed, 2-armed hairs; laminar parts hairs mostly 2-armed. *Leaf* petiole 23–70 by 1–3 mm, pulvinate; blade cordate to broadly ovate-cordate, 5.8–11 by 4.3–8.7 cm, base deeply cordate, apex caudate or acuminate and mucronate, adaxially darker, yellowish green, smooth and ± sericeous, abaxially tomentose, more so along veins. *Inflorescence* 18–35 cm long; lower bracts petiolate, petiole 1.2–3.5 cm long, blades cordate, 4.5–8 by 3.2–4.6 cm, persisting; upper bracts becoming sessile, diminishing to 1–3 mm long, caducous; pedicels filiform, 4–5 mm; bracteoles 2, minute scales, immediately subtending calyx. Flower buds ellipsoid-fusiform, obtuse. Calyx urceolate in bud, becoming campanulate as corolla enlarges; sepals 5, equal, triangular to narrowly ovate, becoming cymbiform at anthesis, 1–2 by < 1 mm, herbaceous, basally connate, margins glabrous or reddish sericeous, apex attenuate-apiculate, recurved. *Corolla* campanulate, flaring from base, entire, 4–7 by 4–6 mm, membranous, white, outside glabrous except for apical hair tuft on each interplica, inside glabrous. *Stamens* unequal, 2 (or 3) just reaching corolla throat, 2 (or 3)



Map 3. Distribution of *Dinetus dinetoides* (C.K. Schneid.) Staples in the eastern Indian subcontinent and western China.

included; filaments pilose basally, glabrous above; anthers c. 1 mm long, white; pollen 3-colpate, oblate or prolate spheroidal, 12–15 by 11–16  $\mu\text{m}$ , surface psilate. *Pistil* just exceeding calyx; disc annular; ovary conical, < 1 mm tall; style 1–1.5 mm long; stigma ellipsoid-globose, c. 1 mm diam., emarginate. *Fruiting calyx* clasping utricle (reflexed at maturity?); sepals subequal, spatulate to linear-oblong, mucronate, 6–10 by 1.5–3 mm, chartaceous, glabrous or ciliate; 3 nerves extending to apex. *Utricle* ellipsoid-ovoid, rarely obovoid, apiculate, 6–8 by 4–5 mm, chartaceous, tan to brownish, glabrous. *Seed* ellipsoid, 3 by 2 mm, smooth, brownish, glabrous.

Distribution — China (Sichuan, Yunnan), India (Nagaland), and surely in N Myanmar.

Habitat — Forests and grassy slopes in mountainous areas ranging from 1200–2200 m elevation.

Phenology — Flowering: July (2), August (4), September (4), October (3). Fruiting: September (2), November (1).

Typification — A comment on the type collections of *Porana dinetoides* is warranted. Based on the fragmentary label information gleaned from duplicates of Henry's 9340, 9340a, 9340b, and 9340c, it seems certain that he mixed under one collection number plants gathered from several localities spanning a period of at least three months; subsequently he tried to separate the material into discrete units. The type gathering, 9340, is in flower, and bears the locality "Laochen mts, 14 Sept." (US) and "E mts." (E). Number 9340a is in fruit and is dated "8 Nov." (US). Sheets numbered 9340b are in flower, have no date, and the elevations range from 1000–2000 ft (NY) to 5000 ft (A) to 5500 ft (K). All of these collections are labelled "Mengtze." Number 9340b

(CAL) indicates “Szemao” as place of collection, and 9340c (K) does likewise, adding “W mts., 5000 ft”; both these specimens are in flower.

Note — *Dinetus dinetoides* is distinct from the other members of the genus by virtue of its shortly gamosepalous calyx, densely pilose filaments, and nearly exerted anthers. It may be separated from the similar *D. racemosus* by its hairy leaves, obtuse flower buds, densely pilose filament bases, subexserted stamens, and floral disc.

### 5. *Dinetus duclouxii* (Gagnep. & Courchet) Staples — Fig. 9k–n; Map 4

*Dinetus duclouxii* (Gagnep. & Courchet) Staples (1993) 199. — *Porana duclouxii* Gagnep. & Courchet (1915a) 153. — Type: *Ducloux 5459* (lecto P), China.

*Ipomoea* #26 F.B. Forbes & Hemsl. (1890) 163, nomen, based on *Faber 1199*.

*Porana triserialis* C.K. Schneid. (1916) 356. — Type: *A. Henry 3220* (holo A; iso A, BM, E, F, K, MO, US), China.

*Porana triserialis* C.K. Schneid. var. *lasia* C.K. Schneid. (1916) 362. — *Porana duclouxii* Gagnep. & Courchet var. *lasia* (C.K. Schneid.) Hand.-Mazz. (1936) 809. — Type: *A. Henry 9229c*, p.p. (holo A), China.

*Porana lutingensis* Lingelsh. in Pax (1922) 471. — Type: *A. Limpricht 1628* (holo not found; photo and fragment A, ex WRS�), China.

*Porana lobata* C.Y. Wu in Wu & Li (1965) 105, t. 34, f. 3. — Type: *F.T. Wang 22608* (holo KUN; iso NAS, PE), China.

Perennial twiner, branches often pendant, 1–7 m long, often viscid glandulose; roots enlarged, conical, 3–6.8 by 4.2–5.1 cm, yellowish when fresh; finer roots fibrous. Stem twining, terete, faintly striate or smooth, sometimes minutely verruculose, stramineous to reddish purple, glabrous or ± viscid. Indumentum yellowish to reddish, a mixture of simple trichomes and multicellular, glandular trichomes, with or without a swollen apical cell. *Leaf* petiole 2.2–7 cm long; blade variable in shape, broadly ovate to cordate, hastate, or sagittate in outline, 6.4–11.5 by 4.3–9.6 cm, base deeply cordate, sagittate, or hastate with broadly rounded lobes, margins entire, undulate, or palmately 3-lobed or cleft, or ± irregularly incised, apex attenuate, mucronulate, texture chartaceous, adaxially brownish, glabrous to ± viscid puberulent, abaxially greyish, glabrous to densely viscid tomentose; lower order veins covered with minute pustules or vesicles. *Inflorescence* 8–17(–40) cm long, sometimes with a small raceme arising from lower axil; lower bracts petiolate, petiole 3–18 mm long, blade ovate, 1.9–4.4 by 1–2.7 cm, base shallowly cordate, apex attenuate, deciduous; upper bracts diminishing in size, becoming sessile, linear-subulate, 4–8 by ≤ 1 mm, deciduous; pedicels filiform, 6–11 mm; bracteoles 3, unequal, immediately subtending calyx, ovate, c. 1 mm long, to lanceolate, 3–5 by ≤ 1 mm, flat or undulate, in fruit enlarging and becoming reflexed along pedicel, circular, ovate or obovate, unequal, 3–11(–14) by 1–5(–8) mm, apex often inequilateral. *Flowers* showy, fragrant; buds slenderly clavate to spatulate, apex acute to obtuse. *Sepals* unequal, triangular-ovate to lanceolate to linear-subulate, outer 3 larger, 3–8 by 1–2 mm, inner 2 smaller, 1.5–4 by 0.5–1 mm, base truncate, margins entire, flat, undulate, or crinkled distally, apex acute to acuminate, texture herbaceous, smooth to faintly striate, glabrous or viscid pubescent; venation not visible. *Corolla* salverform to narrowly funnellform, 2.2–3.5 by 1.7–3.4 cm, diaphanous, tube narrow, yellowish inside, limb flaring, white to pale yellow, lavender, blue, reddish, or violet, deeply 5-parted, lobes obtuse to rounded, mucronate. *Stamens* unequal, 5–10 mm long,

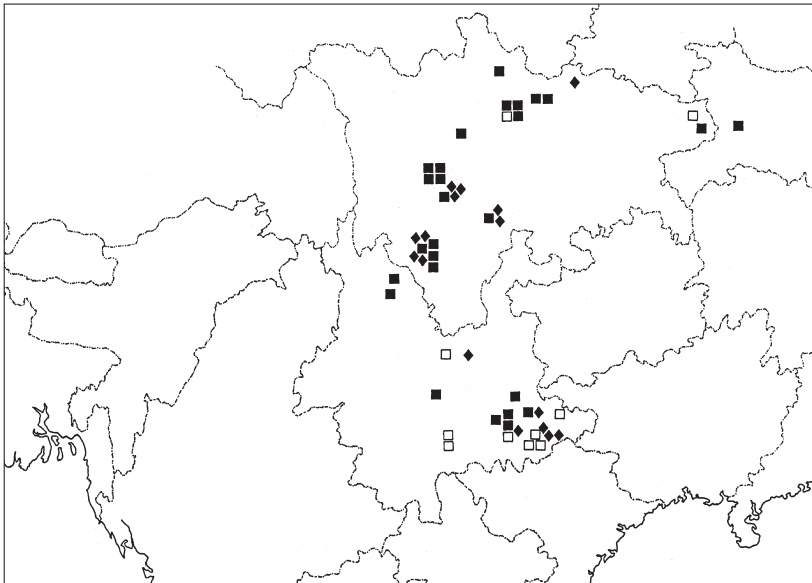
usually triseriate, yellowish white; filaments (3–)5–8 mm long, basal 2 mm villous, otherwise glabrous; anthers linear, 1.5–2 mm, yellowish white; pollen 3-colpate, oblate spheroidal to obtusely triangular, c. 10 by 12–14  $\mu\text{m}$ , surface psilate. *Pistil* shorter than calyx, 4(–5) mm long; disc annular, slightly 5-lobed, or absent; ovary ovoid, c. 1 mm tall; style c. 2 mm long, white; stigma oblong to narrowly obovoid, c. 0.5 mm long, emarginate to bilobed, sometimes inequilateral, green when fresh, pale grey when dry. *Fruiting calyx* clasping utricle, sepals unequal, bases encircling utricle, distally flattened and flaring; outer 3 sepals narrowly ovate to elliptic, 1.9–3.7 by 0.7–1.3 cm, inner 2 linear-lanceolate to narrowly elliptic, 1.5–2 by 0.3–0.9 cm, margins entire, sometimes undulate or ciliolate, apex acuminate, acute, obtuse or rounded, apiculate, texture stiffly chartaceous, tan to purple-brown when dried, glabrous or  $\pm$  viscid. *Utricle* globose to broadly ellipsoid, 5–8 by 5–7 mm, apiculate by persistent 1–2 mm long style, thinly chartaceous to membranous, sometimes hyaline, smooth to faintly striate, pale yellowish tan to dark chestnut brown, glabrous. *Seed* (sub)globose, 5–6 by 4–5 mm, reddish brown to black-brown, scurfy yellowish at first, later smooth, glabrous.

Distribution — China (Hubei, Sichuan, Yunnan).

Habitat — Roadsides, margins of fields, grassy areas, thickets, stream banks, in scrub, often in rocky or stony situations and several times collected on calcareous or limestone substrates at (120–)900–2000(–4000) m elevation.

Phenology — Flowering: February (3), May (6), June (3), July (5), August (14), September (16), October (8), November (1), December (1). Fruiting: September (5), October (8), November (3).

Notes — The following unique characters distinguish *D. duclouxii*: markedly unequal, glabrous or glandular flowering sepals; a salverform corolla with a slender tube;



Map 4. Distribution of *Dinetus duclouxii* (Gagnep. & Courchet) Staples in western China: dark flowered plants (■); light flowered plants (□); fruiting plants (◆).

unequal stamens inserted in (2 or) 3 series below the middle of the tube; 3 prominent bracteoles, which become accrescent and reflexed in fruit, and are borne immediately below the calyx. The presence of viscid, multicellular glandular trichomes on the vegetative parts is also unique to this species, though some individuals have so few as to seem glabrous.

*Ducloux 5459* is the only collection cited by Gagnepain & Courchet that agrees with the protologue in being glabrous and having white corollas; it is here chosen as lectotype. The other cited syntypes are wholly or partly glandular viscid hairy, or have corollas that are not white, which seems to have been overlooked in drafting the protologue.

*Dinetus duclouxii* is variable in leaf shape (Fig. 9n), corolla colour, relative stamen length, and density of glandular indumentum. This variation has provided the foundation for taxonomic overdescription, with several distinctive phenotypes having received taxonomic recognition. As with numerous other species in the Convolvulaceae, these character states are not taxonomically reliable. The protologue of *Porana duclouxii*, for example, defines the taxon as glabrous and white-flowered. However, individuals having this combination of character states are a minority within the species as a whole. Most specimens in my sample have glandular trichomes as well as simple trichomes, and dark-coloured corollas outnumber white or pale yellow corollas. The taxonomic concept adopted here recognizes considerable variation as a single polymorphic species.

My examination of all available material demonstrates that the density of glandular hairs varies continuously across populations and it is the extreme ends of the continuum that have been granted taxonomic recognition. I have been unable to demonstrate any correlation between the presence/absence of glandular indumentum and geographic distribution. Likewise, habitat preference, altitudinal range, and season of collection have no apparent correlation with the indumentum character. While recent workers have maintained varietal status for the glandulose plants, I do not find any basis for doing so.

Similarly, the relative lengths of the 5 stamens vary, and three patterns of stamen length have been observed: stamens of 3 lengths (triseriate) and two biseriate patterns (3 long, 2 short) and (2 long, 3 short). These relative lengths are taxonomically uninformative, *inter se*, but the unequal stamens immediately separate *D. duclouxii* from *D. grandiflora*, which has equal stamens, 5–6 mm long.

Leaf shape varies greatly in this species and *Porana lobata* C. Y. Wu was proposed based on its sinuate trilobate leaves. Even more unusual leaf blade shapes are observable in 2 collections (*Chuan Jing A 1737* and *5230*) at KUN. Both have leaf blades that are lobed and dissected to an extreme degree for *P. duclouxii*, but in all other characters they conform with that species. Generally speaking leaf shape is an untrustworthy taxonomic character in many species of Convolvulaceae, and recognition of taxa based on it is unwarranted in *D. duclouxii*.

Corolla colour in *D. duclouxii* varies from white through pale yellow, lavender, pink, reddish, and blue to violet. Of 50 collections citing corolla colour, 13 report white or pale yellow and 37 report darker colours. This is very near a 3 : 1 ratio, which suggests a simple case of incomplete dominance in corolla colour. No correlation is apparent between corolla colour and geographic distribution or ecological factors. I believe the white flowered plants do not warrant taxonomic recognition.

**6. *Dinetus grandiflorus* (Wall.) Staples** — Fig. 9a–f; Map 5

*Dinetus grandiflorus* (Wall.) Staples (1993) 199. — *Dinetopsis grandiflora* (Wall.) Roberty (1952)

27. — *Porana grandiflora* Wall. in Roxb. (1824) 41. — Type: *Wallich s.n.* (lecto K-Wal 1324.1, A, excluding packet contents; isolecto CAL-Wal 1324.bis, sheet 314331), Nepal.

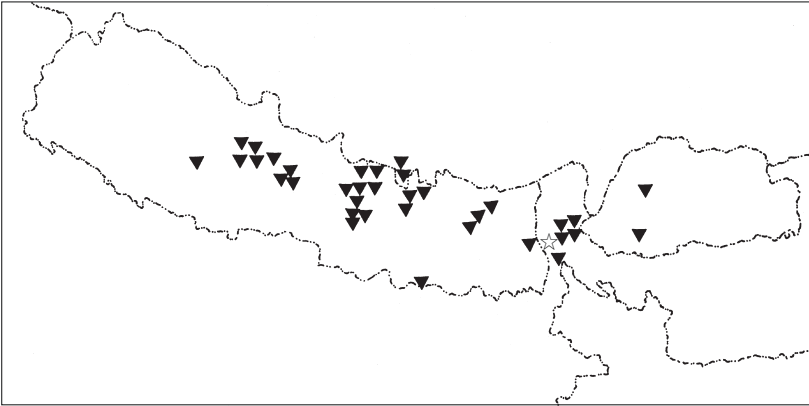
*Porana stenoloba* Kurz (1873) 136. — Type: *S. Kurz s.n.* (holo CAL; iso K), India, Sikkim.

*Ipomoea cuspidata* D. Don (1825) 98. — Type: *Hamilton s.n.* (not found), Nepal.

Perennial twiner to 7 m long, branches often pendulous. Stem terete, spirally striate, stramineous to brownish, ± puberulent. Indumentum tawny yellowish to golden; hairs of axial parts simple, erect; laminar parts puberulous to velutinous, hairs simple, multicelled glandular, and 2-armed. *Leaf* petiole 2.8–8.5(–14) cm long, puberulent to villous or glabrous; blade narrowly to broadly cordate, rarely subhastate, (8.7–)10.3–12.5(–17.7) by (5.3–)7.2–9(–13) cm, base usually deeply cordate, apex long attenuate to apiculate, mucronulate, adaxially darker brown, subglabrous, strigose or villous, abaxially paler tan, glabrous to velutinous. *Inflorescence* solitary (or paired), pendulous, 8–16(–23) cm long; bracts sessile, subulate to linear, 2–4 mm, attenuate, yellowish pilose, early deciduous, lowermost bract sometimes foliaceous, petiole 4–9(–19) mm long, blade cordate to attenuate-ovate, 2.2–5.6 by 1.4–3.7 cm, more rarely bracts all lanceolate-linear, 15–35 by 2–5 mm; pedicels filiform, 6–16 mm; bracteoles 2, scale-like, golden pilose, usually deciduous, rarely accrescent and ovate to subcircular, 1–3 mm long, chartaceous, stramineous. *Flowers* showy, sweetly to spicily fragrant; buds elongate, ± clavate, base swollen, apex acute. *Sepals* equal, subulate to triangular, occasionally elliptic-ovate, flat or medially keeled, 3.5–6 by 0.5–1.25 mm, base truncate, margins entire, apex acute, chartaceous, margins usually golden sericeous, rarely entirely sericeous or glabrous. *Corolla* (sub)salverform, 3–4.5 by 2.8–4.4 cm, membranous, mauve to rose or purple with a white eye and throat, rarely white or blue, tube narrow, base swollen, limb flaring abruptly, obscurely 5-lobed, lobes rounded-obtuse, apex tufted with golden hairs, otherwise corolla glabrous. *Stamens* equal, borne near corolla tube base; filaments 2–3 mm long, base puberulous to velutinous, glabrous above; anthers linear, 2–2.5 mm, yellow to cream-white; pollen 3-colpate, oblate spheroidal, 12–15 by 15–21 μm, surface granulate. *Pistil* shorter than calyx; disc absent or narrowly annular; ovary ovoid to subglobose, c. 1 mm tall; style 3–4 mm long; stigma ellipsoid, entire or scarcely 2-lobed, green in life. *Fruiting calyx* loosely clasping utricle; sepals narrowly ellipsoid to linear-oblong, rarely narrowly obovate, unequal, concave, chartaceous, stramineous to pale brown, glabrous (rarely glandular pubescent), 3 outer 3.2–4.2 by 0.9–1.6 cm, 2 inner 2.3–3.3 by 0.5–0.7 cm, base ± naviculate, enclosing utricle, flaring distally, margins entire, flat or occasionally revolute, apex obtuse-rounded to retuse or emarginate, mucronulate. *Utricle* broadly obovoid to globose, (10–)14–16 by 9–13 mm, apiculate by persistent 2–3 mm long style, chartaceous, olivaceous to stramineous with darker striations, glabrous. *Seed* ellipsoid, c. 11 by 9.5 mm, smooth, dark brown, glabrous.

Distribution — Nepal, Sikkim, N West Bengal, Bhutan, and extreme SW China (Tibet).

Habitat — Rare to common in moist situations in cloud forests, deciduous forests, thickets, ravines and along watercourses; in association with *Quercus* L., *Rhododendron* L., *Juglans* L., and *Codonopsis* Wall. Mostly on north or west facing slopes at 1750–2600 m elevation.



Map 5. Distribution of *Dinetus grandiflorus* (Wall.) Staples in sub-Himalayan Asia (▼); type locality for *Porana stenoloba* Kurz (☆).

Phenology — Flowering: June (6), July (4), August (30), September (26), October (7), December (1). Fruiting: July (1), August (1), September (5), October (4), November (1).

Vernacular names — Chamera lahara, chamero laharo (Nepal); zang fei e teng (China).

Typification — The typification of *Porana grandiflora*, like that of other Wallich names, is complicated by the uncertain provenance and date of collection for much of the material distributed under the Wallich Catalogue numbers. The protologue for *P. grandiflora* states: “A native of the environs of Katumanda, especially the mountains of Shiva-poor (commonly called Sheopore), blossoming during the rainy season, and ripening its fruit in January and February.” (Wallich, in Roxburgh 1824: 42). Only one sheet in the Wallich herbarium, numbered *1324.1,A*, agrees with the protologue. This sheet is a flowering collection of *D. grandiflorus*, gathered in “Sheopore, July 1821,” probably by Wallich himself, since he collected in Nepal from late 1820 until early 1822. This sheet bears a packet containing corollas of *Ipomoea alba* L.; in choosing sheet *1324.1,A* as lectotype the packet contents are excluded. The Wallich herbarium at Calcutta has a duplicate sheet of this collection (*Wallich 1324.bis*, CAL 314331); it is here identified as an isolectotype. All other specimens of *Wallich dist. 1324 I* have examined differ from the protologue in terms of the place or date of collection, or have no label data beyond the Wallich catalogue number, and are thus ineligible as lectotypes.

*Porana stenoloba* Kurz was described as a distinct species based on its steel blue corolla, caudate foliaceous bracts, shallowly cordate leaves, and very narrow fruiting sepals. In comparison, the leaf blades of *D. grandiflorus* range from shallowly to deeply cordate, with sinuous or distant lobes, the bracts are usually deciduous but occasionally persistent and notably foliaceous (e.g., *Saulière 767*, *G.H. Cave s.n.*), and the corolla colour ranges from white through pink, mauve, and blue to violet. Thus, these character states for *P. stenoloba* all fall within the range of variation I accept for *D. grandiflorus*. There remain only the linear-oblong fruiting sepals as a diagnostic character for *P. stenoloba*.

Kurz (1873) described his new species from a single collection he made in Sikkim; only one further collection (*C.B. Clarke 36065*) resembling it has become available since then. The type specimens conserved at CAL and K have what appear to be fruits enclosed by 5 enlarged sepals, 20–30 by 3–5 mm; a few corollas are still present on the CAL specimen. However, upon dissection no fruits were found inside the accrescent calyces on the type. I interpret these collections as individuals of *D. grandiflorus* with abnormally developed sepals. *Dinetus grandiflorus* has accrescent sepals as narrow as 5–9 mm and the other morphological characters ascribed to *P. stenoloba* fall within the range of variation I accept for *D. grandiflorus*. Furthermore, the known range of *P. stenoloba* is confined to Sikkim, entirely encompassed by that of *D. grandiflorus*, thus there is no geographic basis for recognizing two taxa. I find no consistent grounds for maintaining this species and follow Bentham & Hooker (1876: 876) in reducing *P. stenoloba* to synonymy.

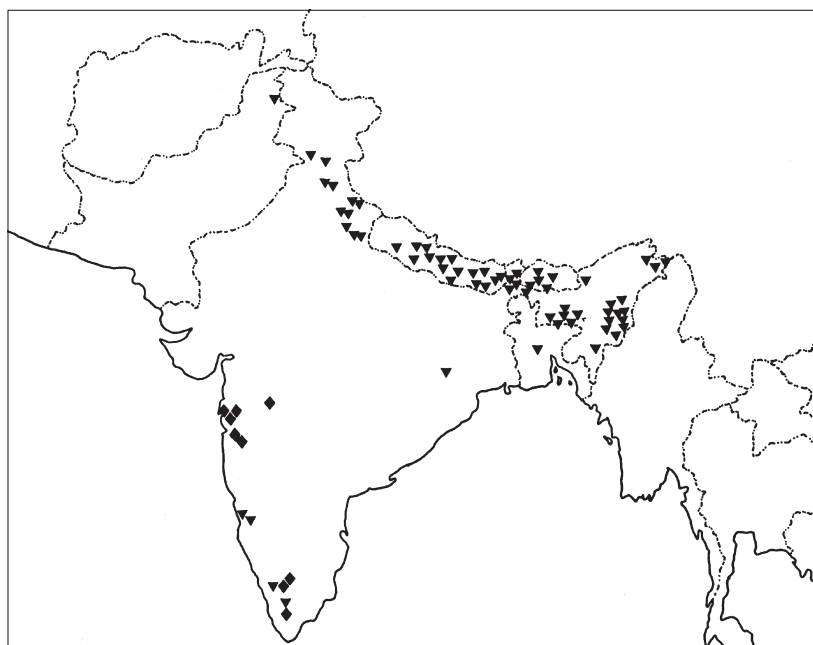
Note — *Dinetus grandiflorus* is distinctive for its equal sepals with golden sericeous margins (entirely sericeous in Tibetan material), showy salverform corolla with a swelling near the base of the tube, equal stamens borne at the level of the swelling, and fruits without enlarged, reflexed bracteoles. The plants are softly puberulous or subglabrous, rarely velutinous, but never viscid glandular as is *D. duclouxii*.

### 7. *Dinetus malabaricus* (C.B. Clarke) Staples, *comb. nov.* — Fig. 8m–q; Map 6

*Porana malabarica* C.B. Clarke (1883) 223. — Type: *Stocks & Law s.n.* distributed as ‘# 3 Porana’ (lectotype (here designated) K; isolecotypes BM, C, CAL, E, FI, G, GH, GOET [mixed with *Evolvulus alsinoides*], L, LE, M, MEL, MO, NY, P, S, W), India, Karnataka.

*Porana racemosa* auct. non Roxb. (1824): Dalzell & Gibson (1861) 162.

Subglabrous twiner several meters long. Stems terete, stout, striate or verruculose, stramineous to purplish brown. Indumentum on axial parts velutinous or tomentose, hairs simple; laminar structures strigose, hairs simple, rarely some 2- or 3-armed, erect hairs. *Leaf* petiole terete, 2.4–7 cm long, subglabrous; blade broadly cordate, 6.8–12 by 4.2–7.4 cm, base cordate, sinus deep, broad, apex abruptly acuminate to apiculate, adaxially darker brown, glabrous or sparsely strigose, abaxially paler tan, hairs especially dense along margins and on veins. *Inflorescence* lax, 12–20 cm long, slightly longer in fruit, axis stout, subglabrous; lower bracts sessile and amplexicaule, or petiolate, petiole 2–18 mm long, blade ovate to cordate, 3–5.5 by 1.7–3.7 cm, base cordate, apex apiculate to acuminate, persisting in fruit; upper bracts sessile, attenuate-ovate to lanceolate, 5–10 by 2–5 mm, deciduous; uppermost bracts linear, 2–4 mm long, deciduous; bracteoles 2, minute, immediately subtending calyx, sparsely sericeous or glabrous, deciduous or persisting, enlarged to 1–3 mm long; pedicels filiform, 2–3 mm, elongating to 6–12 mm in fruit, velutinous to sericeous. *Flowers* small; buds slenderly fusiform, attenuate at both ends, 5–6.5 mm long, apex acute. *Sepals* equal, lanceolate, 2–3 by 1 mm, base truncate, margins entire, apex attenuate, chartaceous, sparsely golden sericeous. *Corolla* slenderly funnelform, diaphanous, white, 7–9(–10) by 5–9(–11) mm, tube widening gradually, limb spreading abruptly, deeply 5-lobed, lobes broadly elliptic to ovate, apically obtuse to acute, tufted with tawny hairs, corolla otherwise glabrous. *Stamens* unequal, 1–2.5 mm long, included; filaments glabrous or bases sparsely pilose; anthers ovoid-sagittate, < 0.5 mm long; pollen 3-colpate,



Map 6. Distribution of *Dinetus racemosus* (Roxb.) Buch.-Ham. ex Sweet (▼) and *D. malabaricus* (C.B. Clarke) Staples (◆) in the Indian subcontinent.

spheroidal, c. 15  $\mu\text{m}$  diam., surface psilate. *Pistil* c. 2 mm long, included; disc annular, tan; ovary attenuate-ovoid, < 1 mm tall, tapering into style; style c. 1 mm long; stigma clavate, apically emarginate to slightly bilobed, greyish. *Fruiting calyx* loosely clasping utricle (reflexed at maturity?), sepals all enlarged  $\pm$  equally, inner 2 narrower than outer 3, elliptic to narrowly obovate-spatulate, occasionally ovate to lanceolate, 17–23.5 by 7–12.5 mm, base truncate, margins entire, flat, apex obtuse, rounded, or retuse and mucronulate, chartaceous, stramineous to brownish or purplish, glabrous (rarely sparsely sericeous). *Utricle* ellipsoid, widest near middle, (8–)10–13(–14) by 4–5.5 mm, apex acute or obtuse, apiculate with persistent style base, chartaceous, stramineous to brownish tan, glabrous. *Seed* ellipsoid to obovoid, 6–8 by 3–4 mm, brown to reddish brown, smooth, glabrous.

Distribution — India (Maharashtra, Karnataka, Tamil Nadu).

Habitat — Rare to abundant in dry fields, *Carissa* scrub, forest margins and along roadsides, at 1000–1500 m elevation.

Phenology — Flowering: October (6), November (2), December (1). Fruiting: January (1), March (1), October (4), November (3).

Vernacular names — Bowri, gariya (Marathi, ex Talbot 1894: 149).

Notes — *Dinetus malabaricus* is distinctive for its elliptic to narrowly obovate-spatulate fruiting sepals and ellipsoidal utricle. Overall, the plants have a more robust aspect than *D. racemosus*, with stouter stems, thicker leaf blades, noticeably larger fruiting sepals and utricles. Admittedly, this *gestalt* is not easily quantifiable, but the plants are recognizable after one has become familiar with the morphological variability

of both taxa. The shape of the fruiting sepals and utricle also serves to differentiate *D. malabaricus* from *D. rhombicarpus* and *D. truncatus*, the nearest relatives of this species within the 'Dinetus' species group.

The distribution of *D. malabaricus* in southern peninsular India is entirely disjunct from that of *D. rhombicarpus* (north-eastern India and upper Myanmar) and of *D. truncatus* (north-eastern India across to eastern China). The range of *D. racemosus* marginally overlaps that of *D. malabaricus* but they are mostly allopatric. Clarke (1883) considered that these taxa might be varieties of *P. racemosa*, but rejected this in favour of species rank for each. Based on the distinctive fruiting characters and the almost completely allopatric distribution of these 4 taxa I also recognize them at species rank. Further study is needed to verify this placement. In particular, cytological study of *D. malabaricus* might prove instructive.

### 8. *Dinetus racemosus* (Roxb.) Buch.-Ham. ex Sweet — Fig. 8a–g; Map 6–8

*Dinetus racemosus* (Roxb.) Buch.-Ham. ex Sweet (1825) t. 127. — *Porana racemosa* Roxb. (1824) 41. — Type: *Roxburgh s.n. sub Wallich Catalogue 1326E.1* (lecto K-W), India, Calcutta Botanic Garden.

*Porana cordifolia* Ledeb. (1824) 6. — Type: *Herb. Ledebour s.n.* (lecto LE; isolecto LE, W), Estonia, cultivated in hort. bot. Dorpat.

*Porana racemosa* J. Jacq. in Sprengel (1825) 614; J. Jacq. (1844) 11, t. 165, non Roxb. (1824). — Type: *Wallich Cat. 1326* (lecto here chosen: W; isolecto LE, S, W), Nepal.

*Porana dichotoma* Buch.-Ham. ex D. Don (1825) 99, nomen pro syn., invalid under Art. 34.

*Porana elegans* Zoll. (1846) 571. — Type: *Zollinger distr. 2560* (lecto here chosen: A; isolecto BM, G, LE, P), Java.

*Porana gagnepainiana* H. Lév. (1916) 58. — Type: *E. Maire s.n.* (holo E; iso A, G, W), China.

*Porana racemosa* Roxb. var. *tomentella* C. Y. Wu in Wu & Li (1965) 103, t. 33, f. 4. — Type: *C. W. Wang 80276* (holo KUN; iso A), China.

*Porana racemosa* Roxb. var. *violacea* C. Y. Wu in Wu & Li (1965) 103, t. 34, f. 1. — Type: *T. T. Yü 14179* (holo KUN; iso A, KUN), China.

Perennial (or annual) twiner to 3–5(–20) m long, sericeous or glabrous. Stem terete, smooth or striate, often minutely verruculose, stramineous to purplish, pubescent, later glabrate. Indumentum yellowish to silvery, axial parts: hairs simple and 2-armed; laminar parts: hairs simple on veins and along blade margins, 2- and 3-armed on blade surface. *Leaf* petiole 2.9–7.7 cm long, glabrous or puberulent; blade deeply cordate, 6–16.7 by 3.3–9.4 cm, basal sinus narrow, apex attenuate-acuminate, adaxially darker, strigose, abaxially paler, puberulous to tomentulose or rarely tomentose-sericeous. *Inflorescence* solitary (or paired), spreading, paniculate, 13–45 cm long; lower bracts petiolate, petiole 3–20 mm long, or sessile, amplexicaule, blade cordate, 2.6–4.6 by 1.4–2.8 cm, persistent; upper bracts 1.8–2.8 by 0.9–2.2 cm, diminishing to scales, deciduous; pedicel filiform, 4–7 mm; bracteoles 2, minute scales. *Flowers* fragrant; buds slenderly fusiform, (4–)5–7(–8) mm long, apex acute, tufted with yellowish gold hairs. *Sepals* lanceolate-linear, equal, 1–2 by < 1 mm, acute to attenuate, glabrous and dark coloured to densely silvery or golden sericeous. *Corolla* funnellform, white (rarely violet, see Notes), tube base yellow, membranous, (7–)8–11 by (6–)8–12(–13) mm, tube narrow, limb flaring, deeply 5-lobed or 5-parted, lobes obtuse, apiculate, glabrous inside and out except for abaxial tufts of hairs on lobe apices. *Stamens* unequal, 1.5–2.5 mm long; filaments adnate to corolla tube, base pilose, glabrous above; anthers c. 0.5

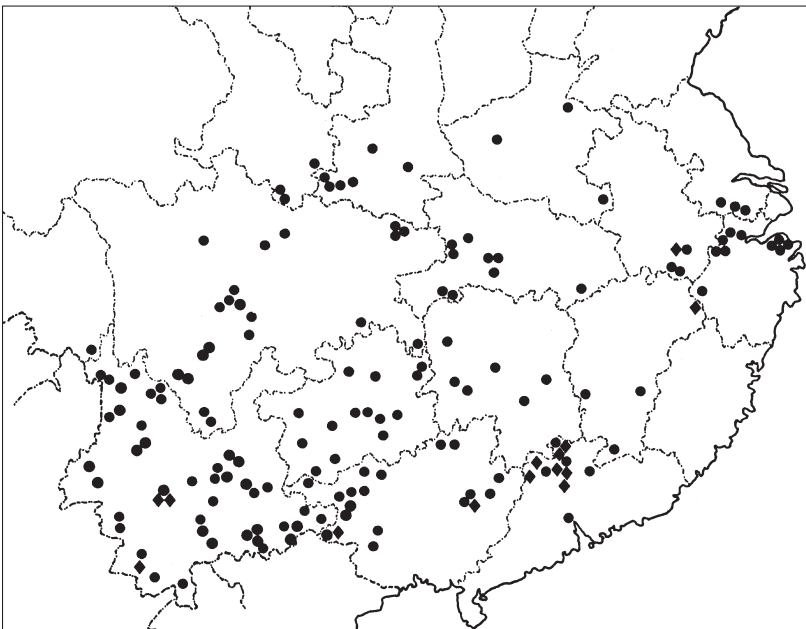
mm long, white; pollen 3-colpate, prolate to obtuse rectangular, 18–20 by 12–13(–15)  $\mu\text{m}$ , surface psilate. *Pistil* equal to or just longer than calyx; disc absent; ovary ovoid, < 0.5 mm tall, smooth; style 1.5–2.5 mm long; stigma ellipsoid to claviform, apically emarginate or slightly bilobed. *Fruiting calyx* venose, reflexed; sepals spatulate to slenderly obovate, flat or slightly concave, 9–14(–18) by 2.5–4(–5) mm, margins entire, apex rounded or obtuse, apiculate, chartaceous, tan, brownish or purplish, inner surface opaque or slightly shiny, glabrous, outer surface opaque, puberulent or glabrous. *Utricle* pendant, slenderly ellipsoid to obovoid, 5–7(–9) by 3–4(–5) mm, apex apiculate or acute, thinly chartaceous, fragile, tan to stramineous, basally sometimes with 5 darker brown-purple streaks, glabrous. *Seed* ellipsoid to subglobose, 3–5 by 2.5–4 mm, reddish brown to dark brown, smooth, glabrous. Seedlings with visible hypocotyl; cotyledons ovate, apex acute or tridentate; chromosome number  $n = 14$  (Manitz, 1983, as *P. racemosa*).

Distribution — Pakistan throughout N India, Nepal, Bhutan (Map 6), China (Map 7), Myanmar and Southeast Asia to Malesia (Map 8).

Habitat — Open sites in forests, thickets, scrub, on hillsides and along watercourses on diverse soil types (e.g., sand, limestone, humus, granitic, loam, schistaceous, rocky, ‘terre rouge riche’) at (50–)1000–2000(–3200) m elevation. Evidently weedy and now often associated with human habitations and disturbance.

Phenology — By geographic region:

*Indian subcontinent, East to Bangladesh* — Flowering: January (2), February (2), April (1), May (3), June (2), August (2), September (23), October (47), November (9).



Map 7. Distribution of *Dinetus racemosus* (Roxb.) Buch.-Ham. ex Sweet (●) and *D. truncatus* (Kurz) Staples (◆) in China.

Fruiting: January (3), February (4), March (1), April (2), October (5), November (23), December (14).

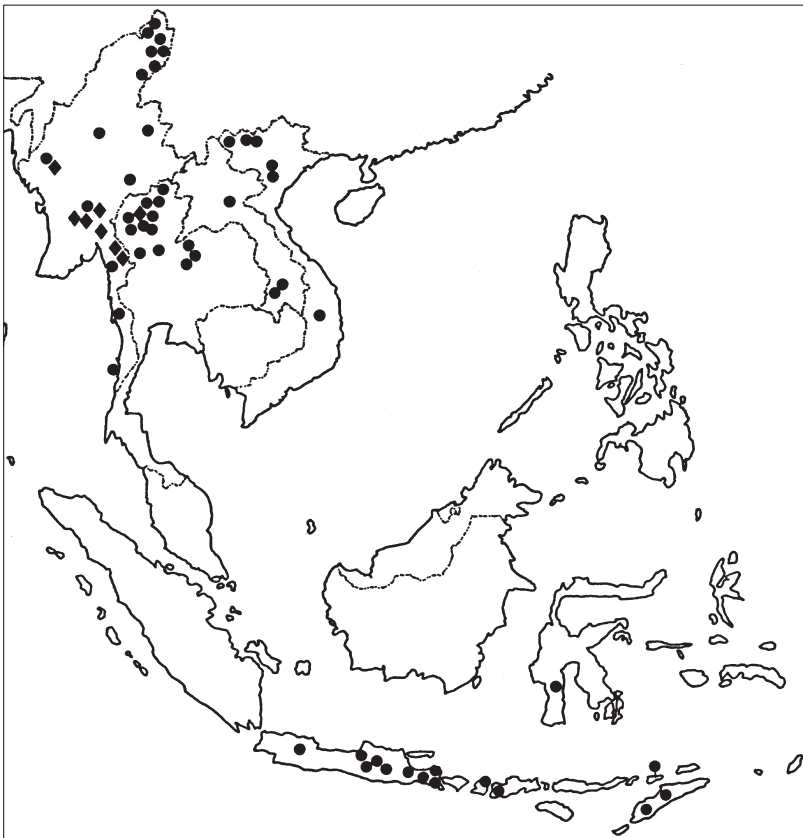
*Myanmar, Southeast Asia, Peninsular Malaysia* — Flowering: April (2), July (1), September (5), October (16), November (14), December (8). Fruiting: January (4), April (2), October (1), November (6), December (15).

*China* — Flowering: February (4), May (2), June (2), July (3), August (8), September (83), October (56), November (10), December (2). Fruiting: April (1), July (2), August (1), September (10), October (58), November (38), December (16).

*Insular Malaysia, Indonesia* — Flowering: April (5), May (5), June (5), July (5), August (1), October (1). Fruiting: June (2), July (3), August (1), October (1).

Vernacular names — Snow creeper (Nepal, Bhutan); ma-ywe (Myanmar, Kachin); bai hua teng, xiao yuan bao (China); phung khrua daeng (Thailand, Chiang Mai); khua tak tenk (Laos); rendeng, srintil, tjloenga, tjoenlor (Java); bofa-bofa (Alor, Lesser Sunda Islands).

Typification & Nomenclature — Three names were published in 1824 for this species: *Porana racemosa* Roxb. (1824) appeared between March and June 1824; *P. racemosa*



Map 8. Distribution of *Dinetus racemosus* (Roxb.) Buch.-Ham. ex Sweet (●) and *D. truncatus* (Kurz) Staples (◆) in south-eastern Asia and Malesia.

J. Jacq. (in Sprengel, 1825) was actually published late in 1824; and *P. cordifolia* Ledeb. (1824) appeared on 6 December 1824.

*Porana racemosa* was first published as a *nomen nudum* by Roxburgh in 'Hortus bengalensis' (Roxburgh, 1814). Wallich (in Roxburgh, 1824) later took up the name and validated it by publishing Roxburgh's draft description in 'Flora indica'. Wallich did not typify the name. One element in the Wallich Herbarium at Kew conserved under Catalogue number 1326 has been authenticated as a Roxburgh specimen by L. Forman (pers. comm., 1993): the small label at the top left corner "*Porana racemosa*" is in Roxburgh's handwriting. This element (excluding the fruiting specimen mounted on the same sheet) has been chosen as the lectotype (Staples, 1993).

Notes — The characters diagnostic for *D. racemosus* are: a small, funnellform, deeply 5-lobed corolla; unequal stamens with almost the entire filament adnate to the corolla tube; an ellipsoid, scarcely bilobed stigma; narrowly obovoid to spatulate fruit sepals; and the ellipsoid utricle with an apiculate apex (Fig. 8g). Other members of the 'Dinetus' species group have characters that intergrade with *D. racemosus*; only the shape of the fruiting sepals and the utricle are reliable for distinguishing this species from others in the 'Dinetus' species group.

*Dinetus racemosus* is the core species in a group of 5 herbaceous perennial species that are widespread in tropical and subtropical Asia. Of the members of this group, only *D. dinetoides* is distinct from *D. racemosus* in terms of vegetative, floral, and fruit characters. Three other species (*D. malabaricus*, *D. rhombicarpus*, and *D. truncatus*) cannot be separated from *D. racemosus* at the present state of knowledge, based on the available collections, by vegetative and floral characters. Only fruiting sepal and utricle characters serve to conclusively differentiate these three species from *D. racemosus*.

*Dinetus racemosus* exhibits considerable variation in stem colour, leaf indumentum, bract morphology and duration, flower size, degree of filament fusion to the corolla, corolla colour, fruiting sepal shape and size, and utricle shape and size. Several variants have been recognized as distinct taxa, yet when these characters are examined across a wide sample (a large number of specimens from throughout the geographic range of the species) they do not vary in a correlated pattern that I can discern. I have reduced all segregates to synonymy and recognize a single variable species. Only one variant warrants specific comment.

Violet flowers (or corollas) have been reported in *D. racemosus* from collections made in Nepal, China, and Vietnam. Some of these records (e.g., *Q.X. Liu 51376* (IBSC), *Sino-Russian Exped. A0174* (YUKU)) are dubious because they are fruiting specimens with purplish calyces and a label that states "flower violet". I regard these as cases of poor field notation or inaccurate translation from Chinese into English. But in other cases the corolla is reported to be some shade of purple and there is nothing to contradict the label information. Such specimens are few and they are scattered throughout the continental Asian range of *D. racemosus* (e.g., Nepal, *D.H. Nicolson 2369* (US); China, August, *E. Maire s.n.* (A, P), Sept., *E. Maire s.n.* (A, P), *Y. Tsiang 12048* (IBSC); Vietnam, *E. Poilane 26636* (A, P)). Wu in Wu & Li (1965) described *Porana racemosa* var. *violacea* based on one such specimen (*T.T. Yü 14179* (KUN)) from Muli Xian in Sichuan province. Because these purplish flowered collections are so few in number and they are scattered throughout the range of *D. racemosus* I regard them as individual variations in flower colour, and reduce Wu's variety to synonymy.

*Dinetus racemosus* has several ethnobotanical uses across its geographic range. In China it is used for treating 'wind damage' and dyspepsia (Fang et al., 1986); the plant parts used and the method of preparation are not stated. In Laos, "... les jeunes feuilles sont comestibles les Laotiens les mangent avec du piment." (ex label *Poilane* 2080) and "... sont comestibles à l'état vert et à l'état sec." (ex label *Poilane in herb.* A. *Chevalier* 2375).

### 9. *Dinetus rhombicarpus* Staples, *spec. nov.* — Fig. 10; Map 2

Herba annua volubilis, similis *D. truncato* (Kurz) Staples et ad multos annos ea confusa, sed a sepalis fructificantibus ovatis ad basin plus minusve abrupte attenuatis, et utriculis late obrulloidis apice obtusis vel rotundatis, differt. Flores ignoti. — Typus: *C.B. Clarke* 16602 (holo K; iso BM, CAL, FI, K, LE, SING, US), India, Assam.

*Porana truncata* auct. non Kurz (1873): *C.B. Clarke* (1883).

Herbaceous, subglabrous twiner to 2 m long. Stem terete, often minutely verruculose, stramineous to purplish brown, glabrous or sparsely pubescent in axillae near tips. Indumentum on axial parts: hairs 2-armed, simple, appressed, rarely some setose; laminar parts: hairs simple, straight, appressed. *Leaf* petioles 3.5–13 cm long, flattish; blade broadly cordate, 7.5–11 by 4.6–8.2 cm, basal sinus deep, broad, apex attenuate-acuminate, adaxially darker brown, glabrous or sparsely strigose, abaxially paler greyish, glabrous. *Inflorescence* and flowers not seen. Infructescence a raceme or panicle, 12–27 cm long; fruits pendulous; bracts foliaceous, sessile, cordate-auriculate, lower ones 4.1–6.2 by 2.1–3.6 cm, both sides ± shiny, glabrous, tardily deciduous, upper bracts similar, 1.8–3 by 1.2–1.8 cm, early deciduous; pedicels filiform, deflexed, (8–)11–13(–15) mm. *Fruiting calyx* reflexed, sepals enlarged ± equally, inner 2 slightly narrower, ovate to ovate-elliptic, (11.5–)14–16(–18) by (4.5–)8–10(–11) mm, base ± abruptly attenuate, margins entire, apex obtuse to rounded (rarely acute), usually mucronulate, stiffly chartaceous, outside brownish purple, inside paler, becoming translucent with age, glabrous or outside sparsely pubescent basally. *Utricle* broadly rhombic to broadly obrulloid, 5–7 by 6–8(–9) mm, stramineous, thickly chartaceous, smooth to coarsely wrinkled, with a spongy white mass inside between seed and fruit wall, glabrous. *Seed* globose, faintly keeled, 3–4 mm diam., surface slightly resinous-mealy, dark brown to reddish brown.

Distribution — NE India and W Myanmar, perhaps also in Bangladesh.

Habitat — Rare to common at elevations ranging from 1300–2075 m, on slopes and along streams, in open forests.

Phenology — Flowering: none. Fruiting: May (1), October (1), November (3).

Vernacular name — He rut te (Myanmar, Chin State).

Typification — Clarke customarily designated duplicates of his collections with letters. I have seen 8 duplicates of *Clarke* 16602, two of them in K. The duplicate 16602A is designated as holotype, while 16602F is an isotype.

Notes — *Dinetus rhombicarpus* is most similar morphologically to *D. truncatus* and *D. malabaricus* in the 'Dinetus' species group. For many years it was confused with *D. truncatus* (q.v.) and had been considered conspecific with that species. While the two are similar, *D. rhombicarpus* is unique in terms of its ovate to ovate-elliptic fruiting sepals with ± abruptly attenuate bases, and in its broadly rhomboid to broadly obrulloid utricles. The specific epithet denotes the latter character.

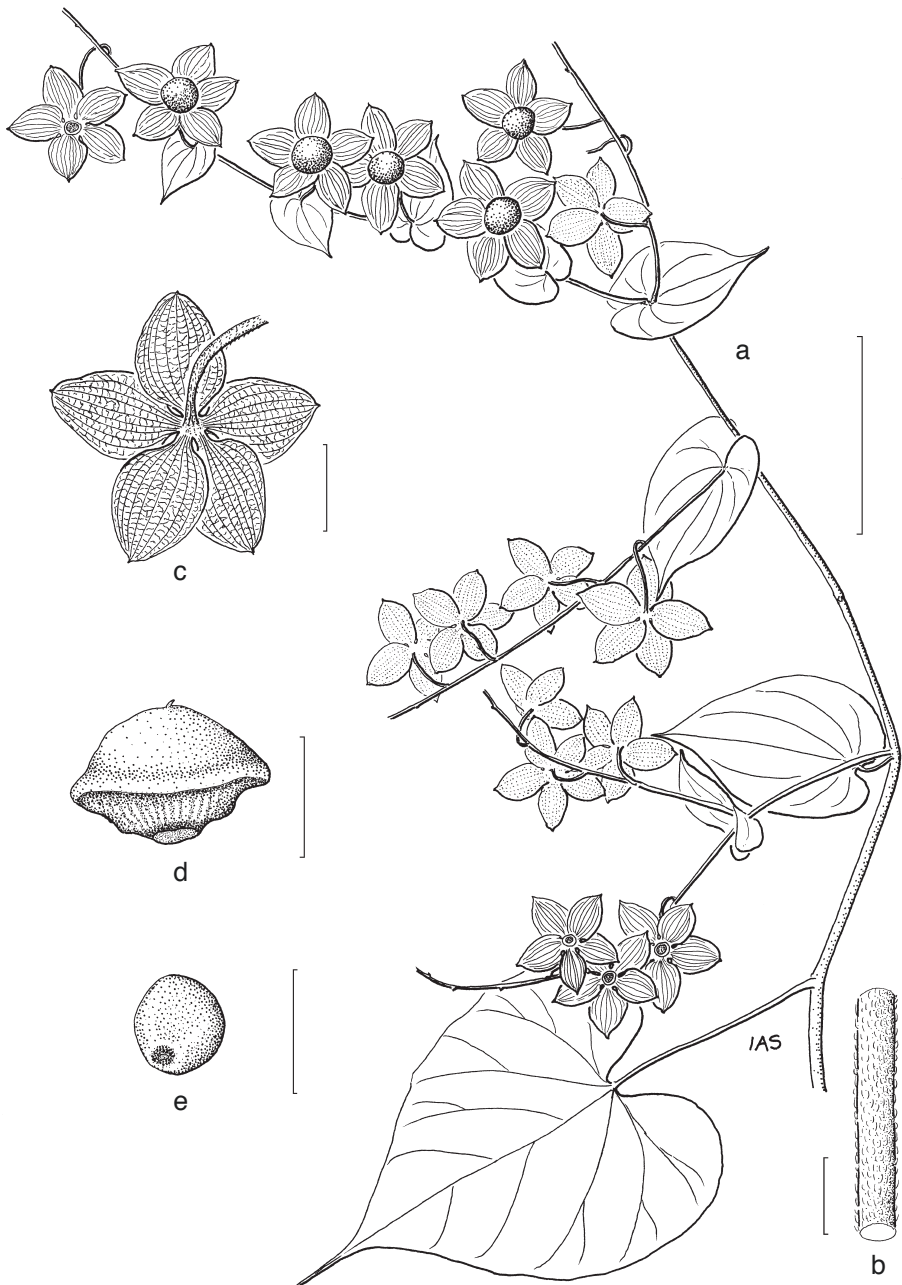


Fig. 10. *Dinetus rhombicarpus* Staples. a. Habit; b. stem; c. fructing calyx from the outside; d. utricle; e. seed (all: Dickason 7706). Scale bars: a = 5 cm; b = 2 mm; c = 1 cm; d, e = 5 mm

*Dinetus rhombicarpus* remains under-collected and consequently it is little better known today than it was in 1873 when Kurz first considered it a distinct species, one which he hesitated to describe until better material was available. The flowering stages remain unknown and only fruiting material, some including vegetative organs, has been collected since then. The fruit morphology and the distinctive shape of the fruiting sepals, however, indicate that this is a distinct species; flowering material may provide additional taxonomic characters.

#### 10. *Dinetus truncatus* (Kurz) Staples — Fig. 8h–l; Map 7, 8

*Dinetus truncatus* (Kurz) Staples (1993) 200. — *Porana truncata* Kurz (1873) 136. — Type: *F. Mason 17* (lecto K; isolecto HBG), Myanmar; non *P. truncata* (Göpp.) Schimp. in Schimper & Schenk (1890), a fossil taxon.

*Porana racemosa* Roxb. var. *sericocarpa* C.Y. Wu in Wu & Li (1965) 103, t. 33, f. 3. — Type: *P. Y. Chiu (Qiu Bing-yun) 53220* (holo KUN; iso KUN, PE), China.

Herbaceous twiner to 2 m long. Stems terete, slightly verruculose with blackish dots, stramineous to reddish brown, sparsely sericeous, glabrate. Indumentum on axial parts sericeous: hairs simple or 2-armed; laminar parts: hairs simple or 3-armed. *Leaf* petiole terete, 3.8–6.4 cm long, base pulvinate; blade broadly ovate-cordate, 8.3–9.5 by 5.6–6.9 cm, base cordate, sinus deep, broad, apex ± caudate, adaxially darker brown, glabrous or sparsely strigose, abaxially sparsely sericeous along veins with simple hairs, sparsely stellate on lamina. *Inflorescence* racemose or paniculate, bracteose; bracts foliose, sessile and amplexicaule, ovate-cordate, 3.6–3.9 by 2–2.4 cm, persisting and enlarging. Flower buds acute; apex minutely tufted with shining hairs. *Sepals* clasping corolla base, lanceolate, equal, 2–2.5 mm long, sparsely sericeous, apex tapering-acute, often slightly recurved. *Corolla* slenderly funnelform, 7–10 by 9–11 mm, glabrous outside, tube flaring gradually, limb 5-parted, lobes broadly ovate, about as long as tube, faintly 3-veined, apex mucronate. *Pistil* shorter than calyx (not visible after corolla drops off). *Infructescence* lax, 15–23 cm long; bracts 3.6–5 by 2.3–2.8 cm, purplish, chartaceous, adaxially ± shiny, abaxially opaque, glabrous or sparsely sericeous; pedicels filiform, (7–)10–11(–15) mm, deflexed. *Fruiting calyx* spreading, sepals all enlarged ± equally, slenderly elliptic to oblong, (10–)17–21 by (3–)4–5 mm, margins entire, apex obtuse to rounded, mucronulate (rarely apiculate), stiffly chartaceous, purplish tan to brownish, glabrous or sparsely pubescent toward base, along margins, and on veins. *Utricle* pendulous, inflated, broadly obovoid to rhomboid, often 5-angled, 4–6(–8) by 4–6.5(–8) mm, base with an annular lip, tapering smoothly upward, apex truncate or depressed concave, chartaceous, wrinkled or smooth, stramineous to rusty-brown, often darker on 3(–5) angles, glabrous or puberulent with yellowish hairs, filled with a spongy, whitish mass between seed and pericarp. *Seed* ellipsoid to subglobose, 3–5 by (2–)3–4 mm, yellowish brown to dark red-brown, smooth to coarsely wrinkled, glabrous. Seedling hypocotyl visible above ground; cotyledons ovate, apex acute to tridentate.

*Distribution* — This species ranges from eastern Myanmar across northern Thailand and in a wide arc across southern China as far as Anhui Province in central China; it very likely occurs in Laos but no material has been seen from there.

*Habitat* — Rare to locally abundant in damp clearings in conifer/hardwood forests, along roadsides, in thickets and old *taungyas* (cultivated land) at elevations ranging from 700–2500 m. Soils are variously noted as sandy, silty, clay, and fertile.

Phenology — Flowering: January (1), October (2). Fruiting: October (6), November (10), December (5).

Vernacular name — Khya nám myg (northern dialect, Thailand).

Typification — The taxonomic concept for *Porana truncata* has been somewhat obscure since Kurz (1873) named the species, based on fruiting material only. I have identified syntypes in the herbaria at CAL, HBG, and K. No illustration accompanied the description and the type collections at HBG and K were inserted in the general herbaria, labelled *P. racemosa*. In his observations for this species Kurz mentioned that, “another species nearly allied to the above” was represented by fruiting material collected in East Bengal (*Griffith 5876*). This number lacks both leaves and flowers and Kurz declined to name it.

Clarke (1883: 223) treated *Griffith 5876* as a specimen of *Porana truncata*, indeed it is the only specimen he cited for this species. His description of the utricle of *P. truncata* agrees with *Griffith 5876*, but is quite different from that of the type specimens of *P. truncata*. In the Kew herbarium a sheet of *Griffith 5876* was filed in the type folder for *P. truncata* whereas the actual type material of *P. truncata* at Kew was not recognized as such. Because the Griffith collection was more widely available to botanists *Griffith 5876* was misinterpreted as representative of *P. truncata*. In fact it is a distinct species treated in this revision as *D. rhombicarpus*.

Notes — *Dinetus truncatus* is recognized by its distinctive larger, truncate, often 5-angled and purplish streaked utricle, and elliptic-oblong, purplish fruiting sepals. The purplish streaks on the utricle correspond to gaps between the sepals where the fruit wall is exposed to light. The utricle is bladdery and inflated and the space between the fruit wall and the seed is filled with a whitish, spongy material.

*Dinetus truncatus* is morphologically similar to both *D. racemosus* and *D. malabarius*; indeed Clarke (1883) suggested the three might be varieties of a single species. Within the genus *Dinetus*, the members of the ‘*Dinetus*’ group are separable based on characters of the fruiting calyx and utricle such as sepal shape, size, coloration, utricle shape, degree of separation between the pericarp and the single seed, and the coloration and pubescence of the utricle. The species in the ‘*Dinetus*’ group share the common features of 5 equally enlarged sepals that are reflexed at maturity, and a valvate aestivation pattern for the calyx. This is evident in the fruit, but less easily seen in the flower due to the small size (1–2 mm) of the sepals.

I am unable to associate the distinctive fruiting stage of *D. truncatus* with the flowering stage, which seems to intergrade completely with that of *D. racemosus*. Only two flowering specimens are here referred to *D. truncatus*, albeit with some hesitation. *Sin 1210* was cited by Wu in Wu & Li (1965) as a paratype of *P. racemosa* var. *sericocarpa*. The holotype specimen for Wu’s variety is in fruit; it agrees fully with the concept of *D. truncatus* and on this basis Wu’s variety is reduced to synonymy. But there is nothing to distinguish the flowers of *Sin 1210* from those of *D. racemosus*. I provisionally refer this collection to *D. truncatus*. The second collection, *Parish 178*, legit 1859 (K), has five short pieces mounted on the sheet: two with flowers and three with fruit; all parts are glued tightly on the sheet and so details of the internal parts are unavailable. The fruits are certainly *D. truncatus* and the flowers, if taken from the same plant and not a mixed gathering, can be assumed to be conspecific. They are the basis for the foregoing description but do not differ significantly from those of *D. racemosus*, which

is quite variable. Further study, preferably a common garden experiment, is needed to ascertain how the flowers of *D. truncatus* differ from those of *D. racemosus*.

### III. DUPERREYA

*Duperreya* Gaudich. (1829) 452. — Type: *Duperreya sericea* Gaudich.

Slender, suffrutescent, sericeous twiners. Roots fibrous. *Leaf* petiole terete, blade linear-oblong, entire, chartaceous, venation with a single pair of secondary veins departing above blade base. *Flowers* solitary, axillary; bracteoles 2, sepaloid, borne just below calyx, persisting. *Sepals* 5, free, quincuncial, (sub)equal, about 3/4 as long as corolla. *Corolla* campanulate (or broadly funnelform), subentire to 5-toothed, contortuplicate, lobe apices with abaxial hair tuft (rarely sparsely sericeous along interplicae), otherwise glabrous. *Stamens* 5, included, filaments fused below to corolla tube, free above, glabrous; anthers ellipsoid, longitudinally dehiscent prior to anthesis; pollen 3-colpate, nonspinose. *Pistil* included or exerted; disc annular; ovary 1- or 2-celled; ovules 2, basal, erect; style terminal, simple; stigma 1, biglobose. *Fruiting calyx* with all sepals equally enlarged, scarious, veins 3 or 5, parallel, longitudinal. *Utricle* chartaceous, ± enclosed in accrescent calyx. *Seed* 1, smooth, glabrous; hilum basal, circular.

There are 2 species of *Duperreya*, both endemic in Australia. Gaudichaud named the genus in honour of Louis-Isidore Duperrey, an officer of the marines attached to Commander Freycinet's hydrographic expedition, in recognition of his diligence as a collector of plants.

#### KEY TO THE SPECIES

- 1a. Sepals elliptic to lanceolate, only partly covering corolla tube; in fruit becoming elliptic-oblong to narrowly ovate . . . . . **11. *D. commixta***
- b. Sepals ovate to broadly elliptic, completely covering corolla tube; in fruit becoming broadly elliptic-ovate to suborbicular . . . . . **12. *D. sericea***

#### **11. *Duperreya commixta*** (Staples) Staples, *comb. nov.* — Map 9

*Porana commixta* Staples (1987b) 52. — Type: *P.G. Wilson 8965* (holo PERTH; iso A, CANB, K), Australia.

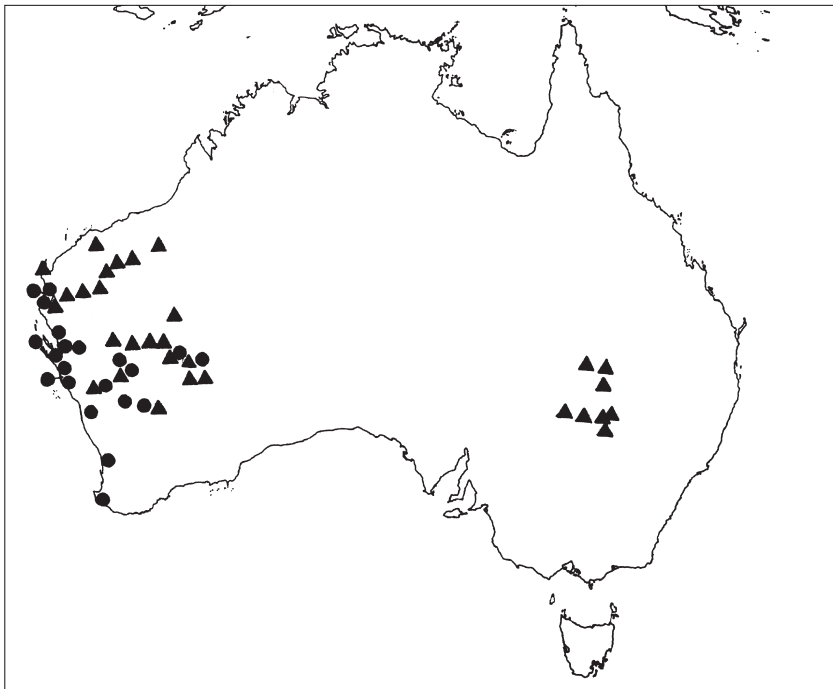
Perennial twiner to 4 m, silvery grey-sericeous. Stems woody, cylindrical, 3–5 mm diam., brownish red with sparse paler lenticels, glabrate, bark peeling with age. Indumentum of 2-armed hairs up to 1 mm long, arms mostly equal, appressed, occasionally unequal and erect. *Leaf* petiole < 1 mm long; blade linear to narrowly lanceolate or narrowly oblong, 16–57 by 1.5–5 mm, base cuneate to obtuse, apex acuminate to acute, rarely obtuse or rounded, usually mucronulate, adaxially darker, sparsely sericeous, abaxially sericeous. *Flower* pedicel filiform, 6–8 mm long; bracteoles subopposite, narrowly elliptic-lanceolate, subequal, 2–5 by < 1 mm, slightly enlarging in fruit; buds ellipsoidal, apex obtuse, ± sparsely sericeous. *Calyx* incompletely covering corolla tube; sepals equal in length, outer 2 broader, narrowly elliptic to tapering lanceolate, 5–7 by 1–2.5 mm, base rounded to truncate, margins entire, apex acute, chartaceous, outside

sparsely pubescent, shining, inside glabrous; veins 3. *Corolla* campanulate, 7–13 by 8–15 mm, membranous, blue, purple-blue, purple or white, limb entire to lobed, lobes obtuse, apiculate, glabrous (rarely subsericeous along interplacae). *Stamens* (sub)equal; filaments 2–3 mm long; anthers 1.5–2 mm long, introrse, dehiscent in bud; pollen 3-colpate (rarely 3-zonocolpate), prolate spheroidal, 32–33 by 27–31  $\mu\text{m}$ , surface psilate. *Pistil* just exceeding corolla tube, glabrous; disc dark brown; ovary ovoid-ellipsoid, c. 1 mm, unilocular; style filiform, 3.5–5 mm long, sometimes jointed above ovary; stigma < 1 mm diam., wrinkled. *Fruiting calyx* spreading; narrowly elliptic-oblong to narrowly ovate, 11–15(–20) by 3–6(–10) mm, stramineous to tan, glabrate; veins 5. *Utricle* ellipsoid, apiculate, 5–5.5 by 3.5–4.5 mm, brownish tan with darker striations, smooth, glabrous or apex with a few hairs. *Seed* ellipsoid to subspherical or obovoid, c. 4 mm diam., reddish brown; hilum c. 1 mm diameter.

**Distribution** — Australia (Western Australia, SE Queensland, and NW New South Wales).

**Habitat** — Inland situations in dry habitats near pools and watercourses: on rocky slopes in dead scrub, mulga, bloodwood, among lancewood escarpments, in *Dodonaea* thickets, over rocks, and along forest margins. Soil types recorded as red sands, loamy or sandy-clay soils, and crevices in limestone-conglomerate cliffs. At 0–200 m elevation.

**Phenology** — Flowering: July (7), August (11), September (6), October (6). Fruiting: February (2), April (1), September (1), October (3), November (2).



Map 9. Distribution of *Duperreya commixta* (Staples) Staples (▲) and *D. sericea* Gaudich. (●) in Australia.

Notes — The diagnostic characters for *D. commixta* are: the narrowly elliptic to lanceolate sepals, widest below the middle and gradually tapering distally; the calyx incompletely covering the lower corolla (the corolla tube is visible between the sepals); the biglobose stigma, each lobe directed more or less horizontally from the style apex; the fruiting sepals narrowly elliptic-oblong or narrowly ovate. Dried material of *D. commixta* has a silvery-grey aspect due to the colour of the indumentum.

Plants from around Cobar in New South Wales have wider fruiting sepals, on average, than plants from Western Australia or Queensland. These plants are intermediate in this character between *D. commixta* and *D. sericea*, but in other respects they are typical of the former species.

The range of *D. commixta* overlaps in Western Australia with that of *D. sericea*. The former is found primarily on inland sites, while *D. sericea* has a more coastal distribution.

## 12. *Duperreya sericea* Gaudich. — Fig. 11; Map 9

*Duperreya sericea* Gaudich. (1829) 452. — *Porana sericea* (Gaudich.) F. Muell. (1868) 100. — Type: *Gaudichaud s.n.* (holo P; iso G), Australia.

*Ipomoea modesta* F. Muell. (1860) 22. — Type: *Oldfield s.n.* (holo MEL; iso K), Australia.

Perennial twiner to 1.6 m long, golden-grey sericeous. Stem terete, smooth or sparsely lenticellate or verrucate, glabrate. Indumentum of 2-armed hairs, arms equal, opposite, appressed, stalk short. *Leaves* solitary or axillary shoots developed and leaves appearing fascicled; petiole < 1 mm; blade attenuate-lanceolate, linear-oblong, to narrowly elliptic, 21–65 by 1.5–6 mm, base rounded to cuneate, margins entire or slightly involute, apex acute to acuminate (to rounded or obtuse), sometimes mucronulate, adaxially darker, sparsely sericeous, margins subglabrous, abaxially golden-grey sericeous; venation with 1 strong basal pair and 4–6(–8) weak distal pairs of secondary veins. *Flower* pedicel filiform, 9–11 mm, to 15–18 mm in fruit; bracteoles subequal, tapering elliptic to lanceolate, 3–4 by 1–1.5 mm, chartaceous, sericeous outside, glabrous inside, to 5 mm long in fruit; buds ovoid (to ellipsoid), apex acute (to obtuse). *Calyx* covering corolla tube; sepals (sub)equal in length, outer 2 slightly wider, broadly ovate to elliptic to broadly elliptic, 5–8 by 3–5.5 mm, base obtuse to rounded, margins entire, apex acute to acuminate, chartaceous, smooth, outside golden sericeous, inside glabrous; veins 3 or 5. *Corolla* campanulate (or broadly funnelform), (6–)8–10(–11) by (10–)13–15(–16) mm, membranous, pale to dark blue or blue-violet with a white centre, limb entire to 5-toothed, interplacal areas sparsely sericeous, plicae and corolla interior glabrous. *Stamens* equal; filaments c. 5 mm long; anthers 1–2 mm long, extrorse, whitish, bases free and slightly divergent; pollen oblate spheroidal, 22–25 by 24–31  $\mu\text{m}$ , surface psilate. *Pistil* included, glabrous; disc annular; ovary ellipsoid, c. 1 by 1 mm, unilocular, dark brown, rough; style c. 4 mm long; stigma bilobed, < 1 mm diam., lobes cordiform. *Fruiting calyx* loosely clasping utricle; all sepals accrescent, broadly elliptic-ovate to suborbicular, 3 outer 14–19 by 10–19 mm, 2 inner 14–16 by 8–16 mm, tan to pale brown, outside sparsely appressed pubescent (or glabrate), inside glabrous; veins 5. *Utricle* obovoid, apiculate, 4–5 by 3–4 mm, stiffly chartaceous to thinly coriaceous, brownish with darker striations, smooth, glabrous. *Seed* ellipsoid to subglobose, 3–4 by 2 mm, brownish to black-brown; hilum c. 1 mm diameter.

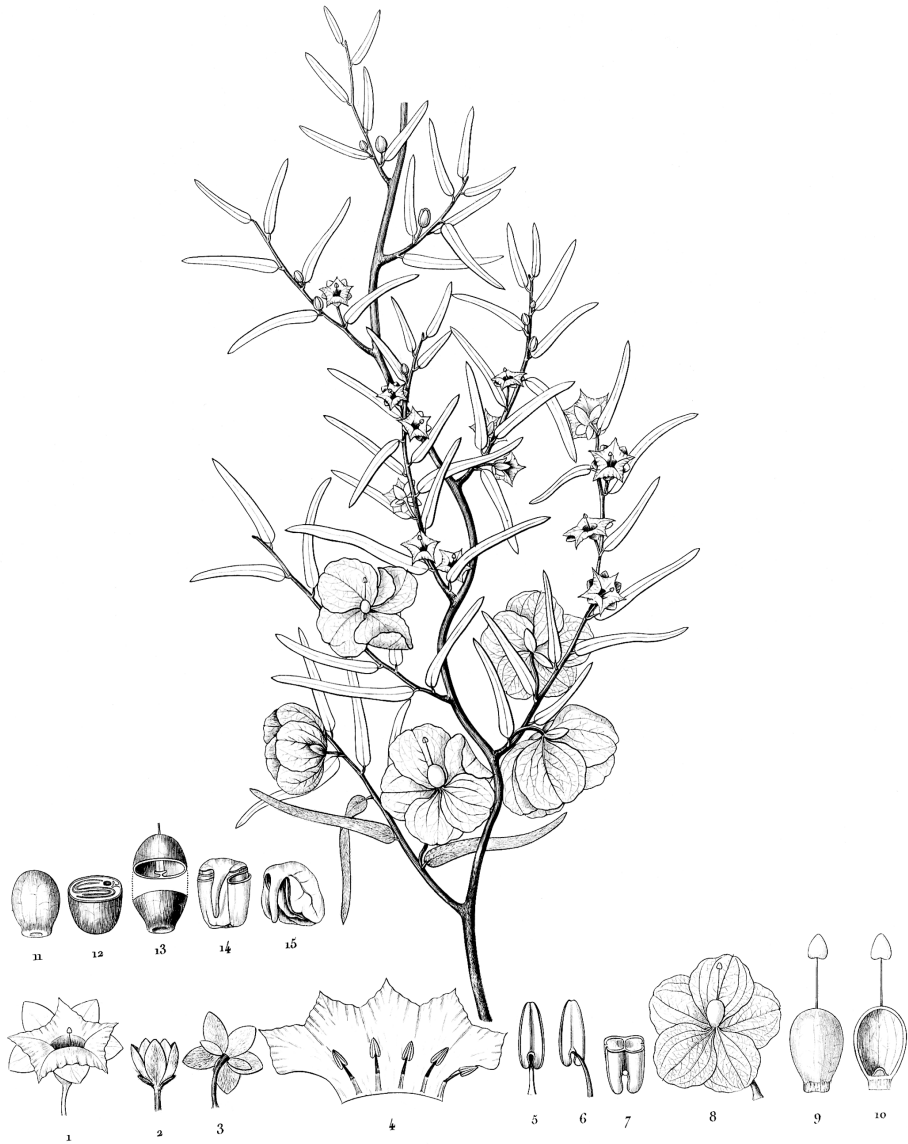


Fig. 11. *Duperreya sericea*, reproduced from Gaudichaud 1829: t. 63 (original life size). 1. Flower, natural size; 2, 3. calyx and bracteoles; 4. corolla opened; 5, 6. stamens; 7. anther in transverse section; 8. developed ovary, fruit surmounted by the style and stigma; 9. pistil; 10. ovary in vertical section, inner surface of wall, the base protuberant; 11. ovule, concavity at the base; 12. ovule in transverse section; 13. the same figure, type of lateral placentation near which the radicle was found to be placed; 14, 15. embryo with deflexed radicle, and folded and crumpled cotyledons. [Legends translated from original French.]

Distribution — Australia (Western Australia).

Habitat — Deserts including *Hakea-Acacia* bush, open heath, *Triodia-Acacia* steppe, on rocky slopes climbing *Casuarina dielsiana*, and in *Acacia* (Wanya) scrub. Recorded from red sands and granitic soil (once); in creek beds and on hilltops among lateritic boulders. No elevation data reported on specimen labels.

Phenology — Flowering: July (2), August (4), September (6), October (2). Fruiting: March (1), September (2), October (2).

Typification — The holotype sheet of *Ipomoea modesta* is at MEL. A sheet at Kew so-labelled has three collections mounted together. The collection on the left side of the sheet is labelled “Murchison River” and is inscribed *Ipomoea modesta* F. Muell., which agrees with the holotype sheet at Melbourne. Therefore only this fragment on the Kew sheet is recognized as isotype material for *I. modesta*.

The Gaudichaud specimen in P is taken to be the holotype for *D. sericea*. The notation on that sheet at lower right “tab. 60” is an error; that at lower left “t. 63” correctly corresponds to the plate cited in the protologue.

Notes — *Duperreya sericea* may be recognized by the following combination of characters: the broadly ovate, elliptic to broadly elliptic sepals, widest near the middle; the calyx completely covering the lower corolla; the biglobose stigma with the two lobes more or less cordiform in shape and deflexed downward along the style; the fruiting sepals subcircular or broadly elliptic-ovate. Dried material of this species has a golden aspect due to the yellowish colour of the indumentum.

Study of living plants grown in cultivation shows that the style elongates during anthesis. Initially, when the flowers open in the morning, the pistil is shorter than the androecium, but during the course of the day the pistil elongates so that by day’s end it equals the stamens in length. This developmental pattern, plus the fact that the anthers dehisce in bud, suggests that *D. sericea*, like many Convolvulaceae, is protandrous.

#### IV. PORANA

*Porana* Burm.f. (1768) 51. — Type: *Porana volubilis* Burm.f.

Subglabrous lianas. Roots fibrous. *Leaf* petiole sulcate, blade simple, entire, chartaceous; venation pinnate, veins prominent abaxially. *Inflorescence* thyriform: an axillary (or terminal), bracteose, compound panicle; bracts foliaceous and petiolate, diminishing distally and becoming sessile; bracteoles 2, scale-like, borne at peduncle/pedicle junction; anthesis proceeding acropetally. *Flowers* erect, small, fragrant. *Sepals* 5, free, quincuncial, outer ones half as long as corolla, equally or unequally accrescent in fruit. *Corolla* campanulate or broadly funnelform-campanulate, 5-lobed, lobes plicate and valvate (not twisted), interplicae hairy outside, plicae diaphanous, glabrous. *Stamens* 5, unequal, longest 2 or 3 exserted, filaments fused below to corolla tube, free above, glabrous; anthers ellipsoid, longitudinally dehiscent prior to anthesis; pollen 3-colpate, nonspinose. *Pistil* exserted; disc annular; ovary unilocular or incompletely bilocular; ovules 4, basal, erect; style terminal, unequally 2-branched; stigmas 2, reniform. *Fruiting calyx* chartaceous, all 5 sepals equally enlarged or outer 3 larger than inner 2, venation parallel, with 7 or 9 longitudinal veins, forming a subapical reticulum, veins

± prominulous. *Utricle* chartaceous, 1 suture visible, breaking irregularly or tardily splitting along suture in acropetal direction. *Seed* 1 (rarely 2), scurfy at first, smooth later, glabrous; hilum basal, C-shaped.

As defined here, *Porana* consists of just two species, one from Southeast Asia and Malasia, and the other from Mexico<sup>1</sup>. The morphological characters diagnostic for *Porana* are: lenticellate stems; pinnate leaf venation; a large calyx that covers much of the corolla; a campanulate or broadly funnelform-campanulate corolla; a 2-branched style; fruiting calyx with outer 3 or all 5 sepals ± equally enlarged; and the looping, weakly developed longitudinal veins of the fruiting sepals. Recent molecular studies support this generic concept (Stefanovic et al., 2002).

The generic concept adopted for *Porana* in this revision is the narrowest since the late eighteenth century. Wight (1843) recognized that the generic concept of *Porana*, based on *P. volubilis*, was very close to that for *Bonamia* Thouars, due principally to similarities in vegetative and floral characters. However, Myint & Ward (1968) made no mention of the similarities between *P. volubilis* and *Bonamia* in their revision of the latter genus. The fruits, long thought to be diagnostic (septicidal capsules in *Bonamia* and indehiscent or irregularly fragmenting utricles in *Porana*) are not so distinctive as once thought. Field observation of some Mexican *Bonamia* spp. revealed that their fruits break open irregularly (A. McDonald, pers. comm. 1987). And the suture in the fruit of *P. volubilis* sometimes first splits apart near the base and the fruit later shatters irregularly. The accrescent calyx of *Porana* immediately sets this genus apart from *Bonamia*, which has persistent but nonaccrescent calyces. Clearly the relationship between *Porana* s.s., and *Bonamia* bears further investigation.

### 13. *Porana volubilis* Burm.f. — Map 10

*Porana volubilis* Burm.f. (1768) 51, t. 21\*, f. 1. — Type: sine collector, “*Herb. Burman 2087*” (neotype G), locality unknown.

*Porana volubilis* Burm.f. var. *burmanniana* Blume (1826) 723. — Type: *Zippelius 91* (lectotype (here designated): L sheet 901.184-360), Timor.

*Porana volubilis* Burm.f. var. *microcarpa* Engl. (1886) 472. — Type: *Naumann s.n.* (holotype not found at B, presumed destroyed), Timor.

Liane 6–10(–20) m long, innovations sparsely golden velutinous. Mature stem woody, to 4 cm diam., bark brown, coarsely wrinkled, ridged to verrucose, glabrate; younger stems flexuous, 2–5 mm diam., greyish brown, dotted with whitish, elliptic to fusiform lenticels, tips weakly twining. Indumentum on axial parts, along veins on laminar parts, calyx, and corolla of simple, curved, appressed, hairs. *Leaf* petiole 1.3–2.7(–3.8) cm long, base slightly pulvinate, ± velutinous within groove; blade ovate, ovate-elliptic, or rarely suborbicular, 5.8–10.7 by 3.7–6.3 cm, base truncate, emarginate or shallowly cordate, margins sometimes undulate when dry, apex acuminate or caudate, mucronulate, adaxially olivaceous to reddish brown, glossy, glabrous, abaxially paler, more opaque, glabrous or sparsely velutinous along veins; midvein sunken and sparsely velutinous

1) *Porana nutans* (Choisy) O’Donell (1960) 62. — *Ipomoea nutans* Sessé & Moç. ex Choisy (1845) 368. — *Calycobolus nutans* (Sessé & Moç. ex Choisy) D.F. Austin (1971) 244. — Type: unpublished Sessé & Moçino plate of *Trivolvulus nutans* (lectotype chosen here, G).

adaxially, secondary veins (5 or) 6 or 7 (or 8) pairs, veins darker than blade. *Inflorescence* ascending, 12.5–26 cm long; lower bracts  $\pm$  persisting, blade ovate, 2.4–4.7 by 1.5–3.2 cm; upper bracts smaller, becoming (sub)sessile, deciduous, blade 9–15(–21) by 4–9(–11) mm; bracteoles triangular or subulate, 2–4 mm long, deciduous; pedicels filiform, 3–5 mm long, to 5–9 mm in fruit; buds obovoid, basally  $\pm$  angular, apically obtuse or rounded, sparsely sericeous. Calyx loosely clasping corolla tube; sepals equal, outer 2 elliptic-ovate, 4–5 by 1–2 mm, inner 3 elliptic, 4–5 by < 1–1.5 mm, base truncate, margins entire, apex rounded to obtuse, herbaceous and pale green in life, chartaceous and brownish when dry, sparsely puberulent outside, glabrous inside, longitudinal veins several, indistinct, darker. *Corolla* 7–8 by 7–8 mm, membranous, white, limb lobes acute, margins hyaline, outside sparsely golden puberulent, inside glabrous. Stamen filaments 4–5 mm long; anthers c. 1 mm long, introrse, white; pollen oblate (or prolate) spheroidal, 19–28 by 18–27  $\mu$ m, surface psilate. *Pistil* 7–8 mm long; disc glossy orange; ovary broadly ovoid, slightly 4-lobed,  $\leq$  1 mm tall, glossy green dotted brown, apically sericeous; style 3–5 mm long, whitish, sericeous basally, glabrous above; stigmas < 1 mm diam., white. *Fruiting calyx* reflexed at maturity, all sepals equally enlarged, elliptic to narrowly obovate or spatulate, 7–9(–11) by 3–4.5 mm, slightly concave, base shortly keeled, distally thin, scarious, stramineous to tan, glabrous; veins  $\pm$  parallel, 9 at base, 3 reaching apex. *Utricle* globose, depressed globose or ovoid, sometimes faintly lobed, 2–4 mm diam., apiculate, stiffly chartaceous, stramineous to dark brown, glossy or opaque, glabrous or sparsely sericeous apically. *Seed* globose or faintly 2- or 3-lobed, 1.5–3 mm diam., dark brown to black; hilum < 1 mm diameter.

*Distribution* — Probably native in Thailand, Laos, Cambodia, Vietnam, Malaysia, and Indonesia; seemingly introduced and naturalized in southern India, Myanmar, and the Philippines.

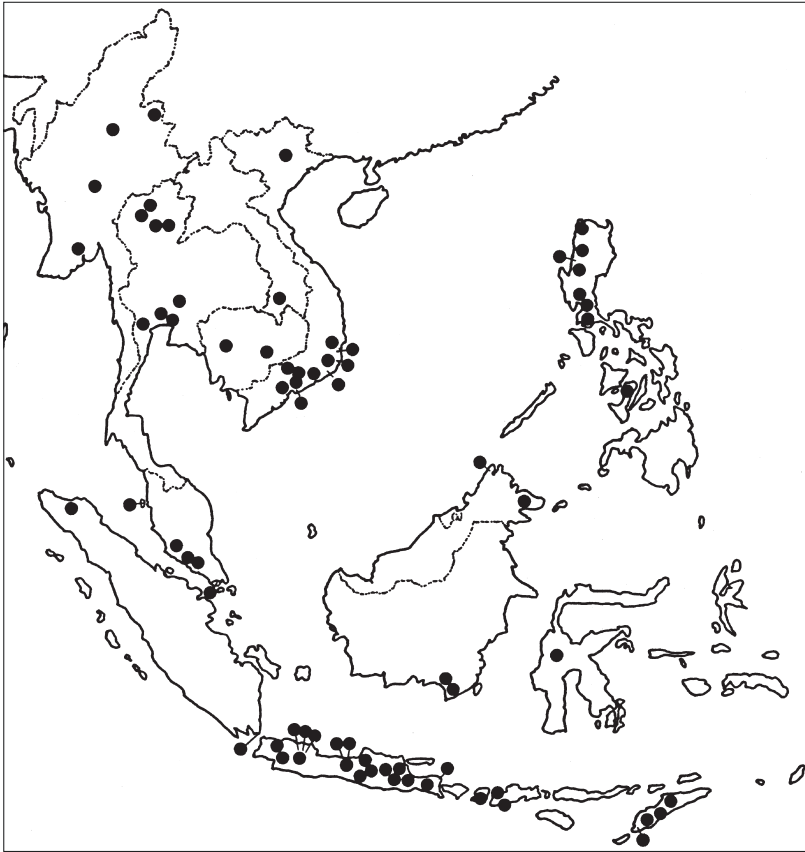
*Habitat* — Coastal forests, monsoon forests, thickets, savannahs, along riverbanks and on rocks, and in many situations near human habitations. Soil types reported to be sand, rocky, and ‘terre rouge riche’; from sea level to 500 m (exceptionally to 750 or 1000 m) elevation.

*Phenology* — By geographic region:

*Continental Asia, including Peninsular Malaysia and Singapore* — Flowering: January (7), February (1), March (3), June (1), September (1), October (8), November (19), December (7). Fruiting: January (2), February (1), March (2), June (2), October (1), November (3), December (2).

*Insular Malaysia, Indonesia, Philippines* — Flowering: January (1), February (5), March (2), April (5), May (8), June (3), July (5), August (4), September (1), October (1), November (3), December (2). Fruiting: January (1), April (1), May (2), June (1), July (2), August (5), October (1), November (4), December (5).

*Vernacular names* — Bridal creeper (India, Malaysia, English); saung daw pu (Myanmar); ladaa, ladaawan, maliwan (C Thailand); kalaa phueak (N Thailand); mok-han-sen (N Thailand, Shan dialect); nada (N Thailand, Lao dialect); dâu bìm bìm núi (Vietnam, Annamite dialect); mac lôi, uu muôa (Vietnam, Mõi dialect); widosarie, widosari, wedosari (Indonesia, Java); plilitan (Indonesia, Soebah); lapat (Indonesia, akar, Idahan); domag-ac, bevoio al Paro (Philippines); German vine (Philippines, English). Additional vernacular names are cited by Van Ooststroom (1938: 90).



Map 10. Distribution of *Porana volubilis* Burm.f. in south-eastern Asia and Malesia.

**Typification** — The types of Burman's 'Flora indica' are mostly in the Delessert herbarium at Geneva, with some duplicates at Munich (Merrill, 1921). Curiously, of the Flora indica Convolvulaceae described by Burman f., all the original material identifiable as potential type specimens were located in G except for that of *P. volubilis* (Staples & Jacquemoud, 2005). One sheet of *P. volubilis* at Geneva is labelled "Herb. Burman 2087." It has no locality [Java] or collector [*Kleinhof* or *Kleynhoff*] corresponding to the protologue, and thus it cannot be considered original material for the name. Yet the sheet has a brief Latin diagnosis and the words *novum genus* written on it in Burman's minute handwriting (confirmed by D.O. Wijndans, pers. comm. 1987). This sheet was clearly a specimen Burman studied and it has been chosen as the neotype of *P. volubilis*.

**Notes** — The following characters are diagnostic for *P. volubilis*: prominently lenticellate stems; pinnate leaf venation; calyx about half as long as the corolla; fully or partly 2-locular ovary; 2-branched style; reniform stigmas; and the fruiting sepals only slightly accrescent relative to their size at flowering. Additional, more subjective

characters are the weakly twining or scrambling habit, and the (often) grooved or lobed seeds.

This species enjoys localized use in folk medicine. In Vietnam “racines à faire des médicaments” (ex label *Phung v. Dien 300*). Van Ooststroom (1938: 90) and Perry (1980: 108) cite the use in Indonesia of the fresh leaves as one ingredient in the tonic *djamboe bagolan*, chewed to freshen the mouth, and in the preparation of a decoction given to women following childbirth.

*Porana volubilis* is grown widely in Asia as an ornamental. In Myanmar, women wear the flowers in the hair and the inflorescences are sold for that purpose in the market (ex label *O.E. White 123*). The flowers are esteemed for their delicate fragrance.

## V. PORANOPSIS — Fig. 12

*Poranopsis* Roberty (1952) 27. — Type: *Poranopsis paniculata* (Roxb.) Roberty.

Lianas, lower stem woody, glabrescent, the branches and stem tips herbaceous, tawny or greyish villous or sericeous with 2-armed hairs. Roots fibrous. *Leaf* petiole terete or flattish, slightly pulvinate; blade cordate-ovate, chartaceous, often rugulose and moderately pubescent adaxially, densely pubescent abaxially; venation pedate. *Inflorescence* axillary (or terminal), bracteose, paniculate, flowers fascicled at nodes; bracts foliaceous, texture, indumentum and venation like the leaves, bracteoles 2, scale-like, attached just below calyx. *Flowers* small, numerous, often fragrant; sepals 5, free, quincuncial, clasping corolla tube base, unequally accrescent in fruit. *Corolla* funnellform or campanulate-funnelform, limb 5-lobed, lobes plicate (but not twisted) in bud. *Stamens* 5, filaments basally adnate to corolla tube, free and filiform above; anthers ellipsoidal, < 1 mm long, longitudinally dehiscent; pollen 3-colpate, nonspine. *Pistil* included; disc annular or absent; ovary unilocular; ovules 4, basal, erect; style simple or absent; stigma terminal, biglobose. *Fruiting calyx* enclosing or partially reflexed from utricle, outer 3 sepals greatly enlarged, ovate or subcircular, margins free or partially adherent basally, inner 2 sepals only slightly enlarged, often falcate; sepals all thinly chartaceous, midvein 1, finer veins reticulate, prominulous, darker. *Utricle* globose to ellipsoid, often apiculate by persistent style, chartaceous, smooth or slightly wrinkled, glabrous or puberulent. *Seed* 1, reddish brown to black, smooth, glabrous; hilum (semi-)circular.

A genus of three species, ranging across the Indian subcontinent to southwestern China and throughout Southeast Asia.

Typification — Roberty (1952) diagnosed his new genus *Poranopsis* as follows “Poranineae, corolla subintegra, profunde infundibuliforme, minima vel maxima”. He included two taxa in it, *P. paniculata* (Roxb.) Roberty and *P. spectabilis* (Kurz) Roberty, placing *Porana megalantha* Merr. in synonymy with the latter species. Later, Roberty (1964) typified the genus, selecting *P. paniculata* as the type species. In the generic concept adopted here, I include only the small-flowered plants, excluding the large-flowered species to the genus *Tridynamia*.

Notes — The characters diagnostic for *Poranopsis* are: the lianoid habit; densely velvety pubescent leaves; small funnellform corolla; unequally accrescent fruiting calyx with the outer 3 sepals much enlarged, ovate or suborbicular, and the inner 2 only slightly enlarged; the fruit sepals with a single midvein and a reticulum of secondary veins.

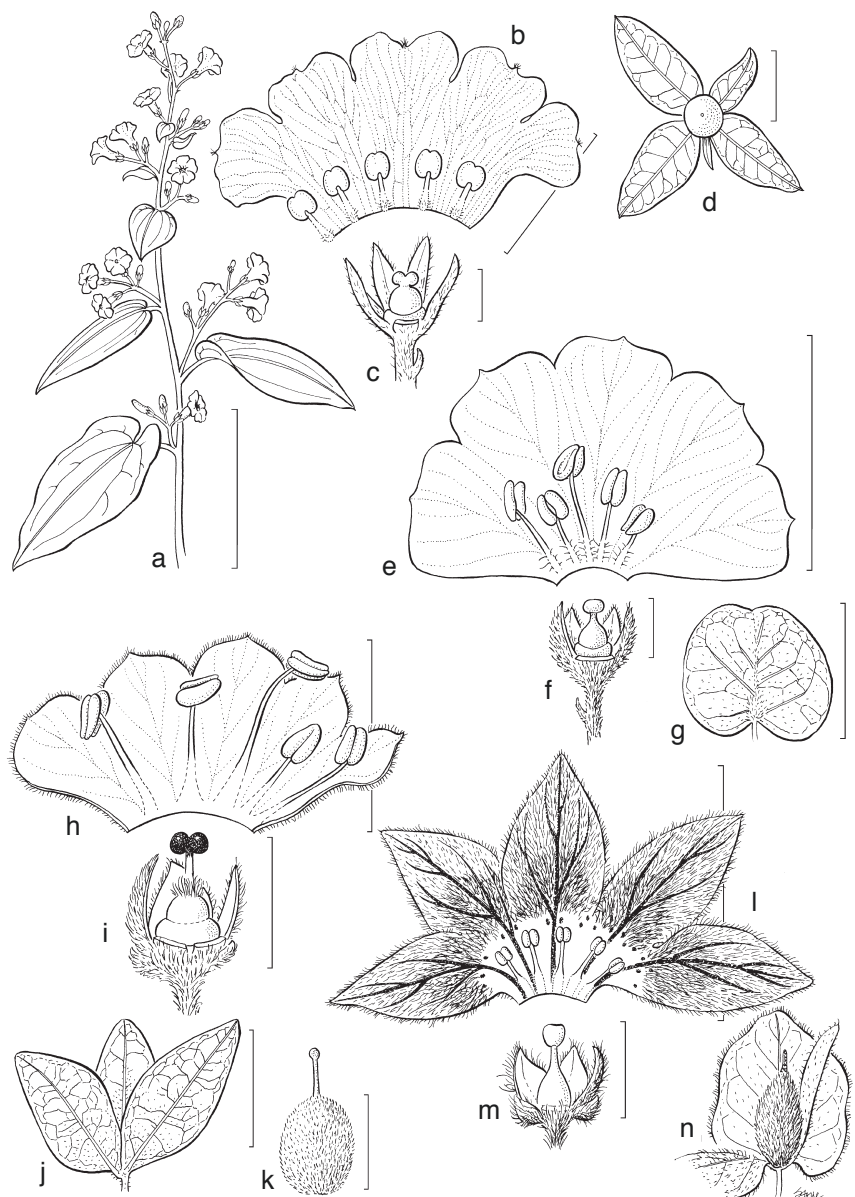


Fig. 12. *Poranopsis* and *Cordisepalum* species. a–d: *Poranopsis paniculata*. a. Flowering stem habit; b. corolla opened; c. calyx (1 sepal removed), gynoecium, and bracteole; d. fruiting calyx and utricle. — e–g: *P. sinensis*. e. Corolla opened; f. calyx (1 sepal removed), gynoecium, and bracteole; g. fruiting calyx. — h–k: *P. discifera*. h. Corolla opened; i. calyx (2 sepals removed), gynoecium, and bracteoles; j. fruiting calyx; k. gynoecium. — l–n: *Cordisepalum thorelii*. l. Corolla opened; m. calyx (2 sepals removed), gynoecium, and bracteoles; n. fruiting calyx and utricle (a–c: drawn from living plant; d: Koeltz 4273; e–g: Henry 9489; h–k: Poilane 26707; l–n: Chevalier 30976). Scale bars: a = 5 cm; b, e, l = 5 mm; c, f = 1 mm; d, j = 1 cm; g = 1.6 cm; h = 3 mm; i, m = 2 mm; k = 4 mm; n = 8 mm.

The three species are very similar and it is essential to have fertile material to differentiate between them; vegetatively they are indistinguishable. Geographic provenance is helpful, at least narrowing the choice to two of the three possibilities.

## KEY TO THE SPECIES

- 1a. Plants flowering . . . . . 2
- b. Plants fruiting . . . . . 4
- 2a. Style very short, stigma subsessile; stamens  $\pm$  equal . . . . . **15. *P. paniculata***
- b. Style length  $\geq$  ovary; stamens unequal in length . . . . . 3
- 3a. Longest stamens exserted from the corolla throat . . . . . **14. *P. discifera***
- b. Longest stamens included within corolla throat . . . . . **16. *P. sinensis***
- 4a. Sepals cordate to suborbicular; utricle glabrous . . . . . **16. *P. sinensis***
- b. Sepals ovate to elliptic-oblong; utricle puberulent . . . . . 5
- 5a. Sepals  $\pm$  shiny and glabrous on the inner face; utricle trichomes simple and septate . . . . . **14. *P. discifera***
- b. Sepals opaque and puberulent on the inner face; utricle trichomes 2-armed . . . . . **15. *P. paniculata***

**14. *Poranopsis discifera*** (C.K. Schneid.) Staples — Fig. 12h–k; Map 11

*Poranopsis discifera* (C.K. Schneid.) Staples (1993) 200. — *Porana discifera* C.K. Schneid. (1916) 358. — *Cardiochlamys discifera* (C.K. Schneid.) C.Y. Wu in Wu & Li (1965) 106. — Type: *A. Henry 12694* (holo A, K, MO, NY, fragment W), China.  
*Porana henryi* auct. non *Cardiochlamys sinensis* Hand.-Mazz. (1920): Verdc., p.p. (1971) 137, quoad *Forrest 13591*, *Anderson & Smitinand 7219*.

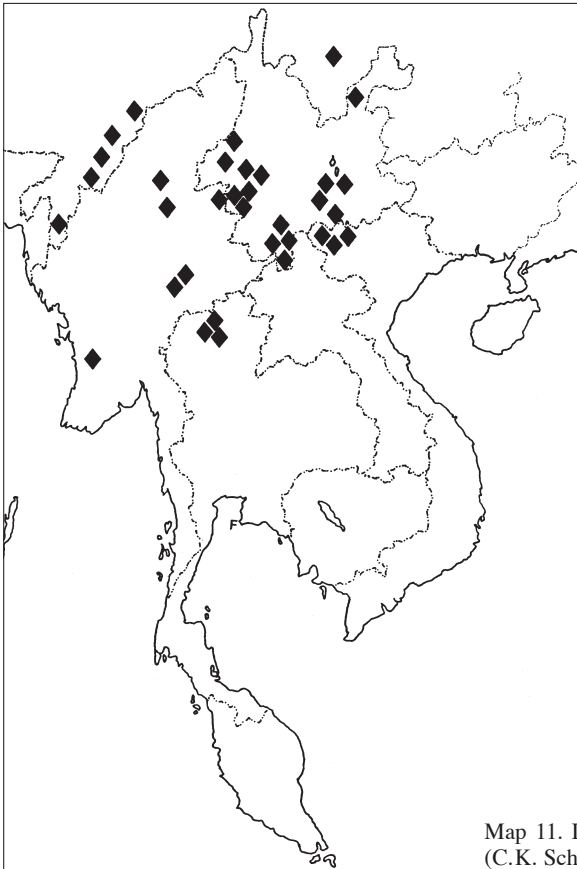
Lianas to 10 m long, vegetative parts tawny to ferruginous. Mature stem brownish, striate or wrinkled, solid; younger stems terete, smooth, 3–5 mm diam., appressed pubescent, fistulose when dry. Indumentum arms usually appressed. *Leaf* petiole 2.1–5 cm long; blade broadly ovate-cordate to nearly orbicular, 5.8–13 by 4–10.5 cm, base cordate, apex acuminate, adaxially darker sericeous to glabrate, abaxially densely villous; venation with 3 or 4 basal pairs and 2 (or 3) distal pairs of secondary veins. *Inflorescence* congested, to 36 cm long; bracts foliose; lower bracts petiolate, petiole (5–)13–16(–23) mm long, blade ovate, 3.7–6.3 by 2.5–4.3 cm, base cordate, apex acute to acuminate; upper bracts subsessile, lanceolate to linear, (0.5–)1–3.3 by 0.4–1.8 cm; pedicels filiform, 3–5 mm long, increasing to 9 mm in fruit. *Flowers* slightly fragrant; buds ellipsoid, obtuse to rounded, to 5 mm long, villous. *Sepals*  $\pm$  equal, 1–1.5 by  $< 1$  mm, outer 3 lanceolate to narrowly ovate, inner 2 lanceolate to falcate, all 5 flat medially keeled or  $\pm$  naviculate, base truncate, margins entire, apex acute to acuminate, chartaceous, villous outside, glabrous inside. *Corolla* 3–5 by 3–5 mm, membranous, white or cream-coloured, outside tube base glabrous, upper tube and interplacal areas tawny villous, plicae glabrous, inside entirely glabrous. *Stamens* unequal, 3 exserted, 2 included; filaments 3–5 mm long, sparsely pubescent below with crinkled hairs, glabrous above; anthers introrse, whitish; pollen oblate to prolate spheroidal, 11–13 by 12–15  $\mu\text{m}$ , surface psilate to finely granulate, pilate-multiangulate inside colpi. *Pistil* 1.5–2 mm long, just exceeding to twice as long as calyx; disc

annular, c. twice diameter of ovary, black when dry, glabrous; ovary ovoid, apically or entirely rusty velutinous; style present; stigma biglobose, black when dry. *Fruiting calyx* spreading; outer 3 sepals ovate-oblong to elliptic-oblong, 15–22 by 7–13 mm, base truncate to shallowly cordate, margins entire, free, apex obtuse, acute, or acuminate, often mucronulate, inner 2 linear to oblanceolate,  $\pm$  falcate, 3–11 by 1–4 mm; sepals all pale tan to brownish, translucent with age, abaxial surface  $\pm$  puberulent, opaque, adaxial surface subglabrous, shiny. *Utricle* globose to broadly obovoid, flaring above disc, apiculate, 4–6(–8) by 3–5 mm, dark brown, smooth, tawny pilose with erect, multicellular, simple hairs. *Seed* spherical, c. 3 mm diam., glabrous or tawny puberulent at first, glabrate; hilum c. 1 mm diameter.

Distribution — NE India, N Myanmar, SW China, N Thailand, and Vietnam; probably also in Laos, but no collections seen from there.

Habitat — Open situations in evergreen forests, scrub jungles, thickets, along riverbanks and roadsides and at the margin of cultivated areas. Often on rich, calcareous soils; at 380–1800 m elevation.

Phenology — Flowering: January (1), March (1), September (1), October (6), November (14), December (15). Fruiting: January (5), February (2), April (1), December (4).



Map 11. Distribution of *Poranopsis discifera* (C.K. Schneid.) Staples in south-eastern Asia.

Vernacular names — M' ma (Vietnam, Meo dialect); da peng teng (China).

Notes — *Poranopsis discifera* may be recognized by the following characters: ovate sepals covering the base of the corolla tube; the pistil longer than the calyx; a prominent cushion-like disc; an ovary that is apically or entirely rusty velutinous; 3 stamens exerted from the corolla; fruiting sepals that are slightly shiny and (sub)glabrous on the inner surface; and utricles puberulent with simple, glandular multicellular hairs (Fig. 2c, d). The indumentum of this species is often rusty or reddish brown, and the leaves are distinctly darker coloured adaxially, due to a lower density of trichomes on that side.

*Poranopsis discifera* is closely related to, and readily confused with, *P. paniculata*. The characters that separate them are constant, though the floral characters are difficult to observe due to the small size of the flowers. In addition, their ranges overlap only slightly and the geographic origin of a specimen is often a clue to its identity. They would seem to be a pair of closely related, allopatric species.

*Poranopsis discifera* is also similar to *P. sinensis*; it is distinguishable from that species by its spreading ovate-oblong fruiting sepals with acute apices, free margins, and truncate, rounded or shallowly cordate bases, and puberulent utricles. *Flowers* of these two taxa are much alike, but the 2 longest stamens of *P. sinensis* just reach the corolla throat without being exerted as in *P. discifera*. In addition, the leaves of *P. discifera* are usually darker adaxially, due to their lower indumentum density, and the panicles are comparatively more congested with shorter internode length and more flowers per node.

### 15. *Poranopsis paniculata* (Roxb.) Roberty — Fig. 12a–d; Map 12

*Poranopsis paniculata* (Roxb.) Roberty (1952) 26. — *Porana paniculata* Roxb. (1819) 31, t. 235. — *Dinetus paniculatus* (Roxb.) Sweet (1827) 289. — Type: *Roxburgh s.n. sub Wallich Catalogue 1325E* (lectotype (chosen here) K-W; probable isolectotypes BR, OXF), India, Calcutta Botanic Garden.

*Porana tomentosa* Lesch. ex Choisy (1834) 489, nomen pro syn., invalid under Article 34.

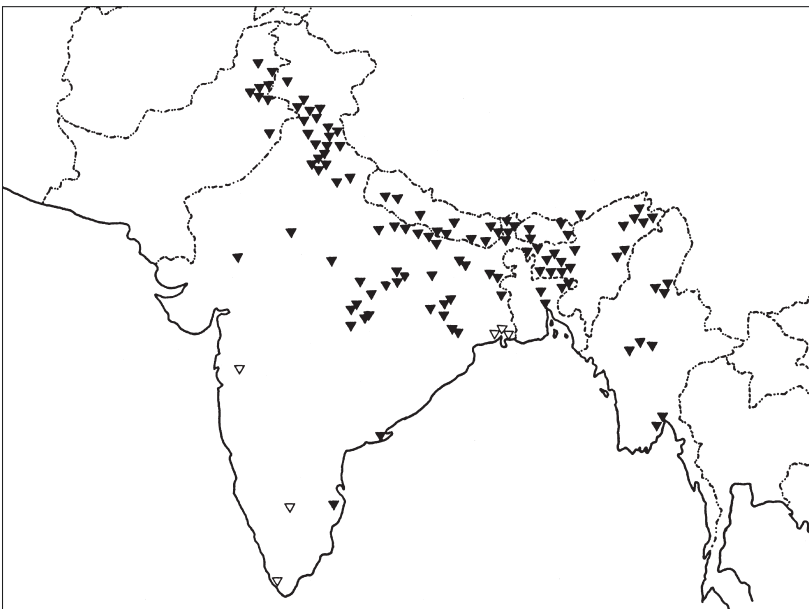
Liana to 15 m long, vegetative parts greyish to tawny. Mature stems cylindrical, spirally striate, 2.5(–5) cm diam., tan to greyish brown; branches often pendulous, younger stems terete, 3–6 mm diam., smooth or striate, shoot tips puberulent, pith solid. Indumentum arms appressed or erect. *Leaf* petiole 2.6–10.8 cm long, 2–3 mm diam.; blade cordate or broadly ovate-orbicular, 7.5–16.5 by 5.3–15 cm, base cordate, apex acute to acuminate, sometimes apiculate, adaxially subglabrous or scabridulous with appressed hairs, abaxially greyish to silvery villous, denser along veins, venation with 2 or 3 (or 4) basal pairs and 1 (or 2) distal pairs of secondary veins. *Inflorescence* horizontal or ascending, 33–62 cm long, lower bracts foliose, petiolate, petiole 7–30 mm long, blade cordate, 3.1–7.7 by 1.8–5.5 cm, sometimes apiculate; upper bracts becoming (sub)sessile, cordate-ovate (to linear-subulate), (5–10–)15–28 by (1–2–)6–14 mm; pedicels filiform, 2–4 mm long, elongating slightly in fruit. *Flowers* sweetly fragrant; buds ellipsoid to obovoid, apically obtuse, villous. *Sepals* equal, lanceolate to linear, flat or slightly naviculate, 1–2 mm long, base truncate, margins entire, apex tapering acuminate, chartaceous, tomentose-villous outside, glabrous inside. *Corolla* narrowly funnellform, (4–)5–6(–7) by (3–4–)5–7 mm, membranous, white to cream coloured, tube slender, throat flaring abruptly, limb shallowly 5-lobed, lobes obovate, retuse,

± mucronulate, outside of tube and plicae glabrous, throat and interplical areas villous, inside completely glabrous. *Stamens* subequal, ≤ 2 mm long, included; filaments glabrous; anthers extrorse, whitish; pollen 3-colpate, prolate to obtuse-rectangular, 13–14 by 9–10 μm, surface psilate. *Pistil* ≤ 0.5 mm, included in corolla tube; disc absent, or small, annular, and brown; ovary subglobose to broadly ovoid, brownish, glabrous; style very short; stigma sessile, biglobose, lobes spherical, erect. *Fruiting calyx* loosely clasping to diverging from utricle, outer 3 sepals elliptic-oblong to narrowly ovate, 16–22(–24) by 7–9 mm, base obtuse to truncate, margins entire, free, apex rounded, obtuse (or retuse), often mucronulate; inner 2 sepals linear to falcate, (4–5–)6–7(–9) by (< 1–)2–3 mm; all sepals chartaceous, tan, reddish or pale brown, bifacially puberulent, opaque. *Utricle* globose to broadly ellipsoid, apiculate, 5–6(–7) by 4–5 mm, chartaceous, tan to brownish, darker striate, pubescent with erect, 2-armed hairs. *Seed* globose to broadly ellipsoid, 4–6 by 3–5 mm, dark brown, faintly striate, glabrous; hilum basal, c. 1 mm diameter. Chromosome number  $2n = 26$  (Manitz, 1983).

Distribution — South of the Himalayas in Pakistan, India, Nepal, Bhutan, Tibet, Bangladesh, and Myanmar.

Phenology — Flowering: January (9), February (5), March (2), April (1), September (2), October (20), November (40), December (15). Fruiting: January (2), February (3), March (8), April (5), November (1).

Habitat — Forests, scrub thickets, subtropical jungles, open plains, and around human habitations. Soil types have been recorded as rocky, stony, conglomerate and limestone (in a subtropical jungle habitat); from sea level to 2000 m elevation. Widely introduced as an ornamental throughout the tropical regions of the world.



Map 12. Distribution of *Poranopsis paniculata* (Roxb.) Roberty (▼) in the Indian subcontinent; (▽) cultivated plants.

Vernacular names — Faindal, jhol (India, Himachal Pradesh); bel-kámú, bridal wreath, lethai, safed-bel (Uttar Pradesh); jharo, silver creeper (Madhya Pradesh); poranana (Maharashtra); buria-lar, khar (Orissa); silvar creeper (West Bengal); rutaza (Meghalaya, Garo dialect); mahadeo lahara (E Nepal); December pan (Myanmar, Rangoon); thazin pan (Myanmar, Pinyinmana); yuan zhui fei e teng (China); bridal creeper (Malaysia, English), schildersverdriet (Dutch), kembang garen (Malay); bridal bouquet (Philippines); bridal veil, Christmas vine, white corallita (USA, Florida); Ipomoea (Mexico, Yucatan); Christmas vine, white coralita (Jamaica); vela de nova (Dominican Republic); coralite, coralline (U.S. Virgin Islands); mague (St. Barts); Chinese lace (Dutch Antilles); muget, muguet (Guadeloupe); corallila (Grenada); corallite creeper (Sierra Leone); liane de mai (Seychelles Islands).

Typification — The typification of Roxburgh's plant names has long been problematic (Forman, 1997). The late Leonard Forman verified that the specimen of *P. paniculata* in the East India Company Herbarium at Kew, under Wallich Catalogue number 1325E is one of Roxburgh's own specimen; the small handwritten label in the upper left corner '*Porana paniculata*' is Roxburgh's handwriting. This specimen is here chosen as the lectotype.

Notes — The characters diagnostic for *P. paniculata* are: the narrowly lanceolate sepals that do not fully cover the base of the corolla tube; the pistil shorter than the calyx, with the stigma virtually sessile atop the ovary; the glabrous ovary; the subequal stamens borne low in the corolla tube; the fruiting sepals which are dully opaque and ± puberulent on the inner surfaces.

It is necessary to clarify one misconception about the floral morphology of *P. paniculata* and its close relative *P. discifera*. Schneider (1916) named *P. discifera* because of its prominent disc, contrasting it with *P. paniculata*, which he thought always lacked a disc. In fact, some individuals of *P. paniculata* have an annular, tan to brown disc, which is less prominent than that of *P. discifera*, but is still discernible. It is clearly depicted in the plate appearing in 'Curtis's Botanical Magazine' (118: t. 7240. 1892) and in Van Ooststroom's Flora Malesiana treatment (Van Ooststroom & Hoogland, 1953: 404, f. 10) illustrating *Porana paniculata*. In contrast, Govil (1972), in studying the vascular anatomy of this species, found the disc absent in the plants he examined.

Two collections from the area of range overlap with *P. discifera* [*W.H. Koelz 27343*, *S.M. Toppin 4023*] exhibit character states intermediate between these two species. The rufous indumentum, sepal shape and apically velutinous ovary are like those of *P. discifera*, while the small disc, pistil shorter than the calyx, and stamens borne within the corolla tube are like those of *P. paniculata*.

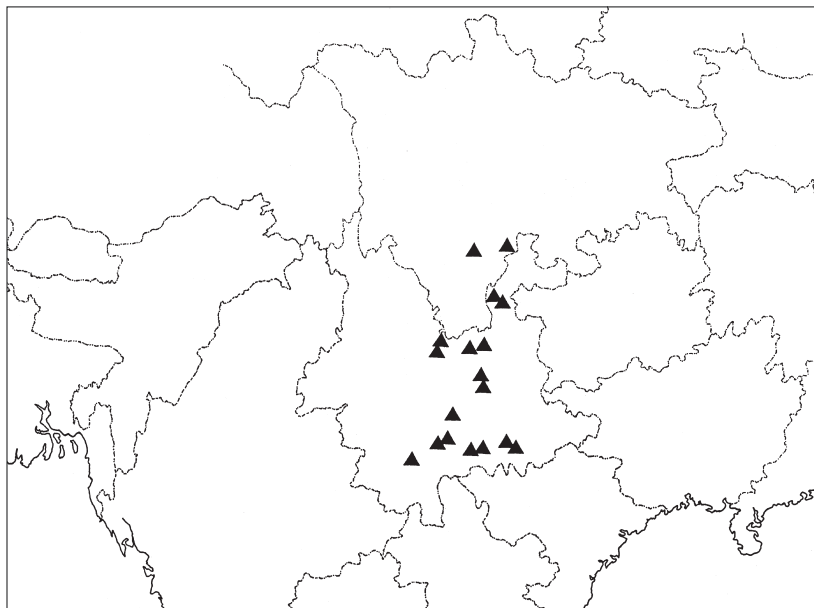
*Poranopsis paniculata* is widely cultivated as an ornamental. The first report of its cultivation dates from 1799, in the botanical garden of the British East India Company at Calcutta. It is now found throughout the tropical regions of the world. However, the large size and expansive habit of the plant limit its popularity with horticulturalists.

## 16. *Poranopsis sinensis* (Hand.-Mazz.) Staples — Fig. 12e–g; Map 13

*Poranopsis sinensis* (Hand.-Mazz.) Staples (1993) 200. — *Cardiochlamys sinensis* Hand.-Mazz. (1920) 241; (1923) 98; (1936) 809; (1938) 125. — *Porana henryi* Verdc. (1971) 137, nom. nov., non *P. sinensis* Hemsl. in Forbes & Hemsley (1890). — Type: *Handel-Mazzetti 751* (holo W; iso WU), China.

*Porana paniculata* auct. non Roxb. (1819): C.K. Schneid. (1916) 359, quoad *Henry 9489*.

Liana to several meters long, vegetative parts tawny to rufous brownish. Stem base brownish, glabrate; younger stems terete to subangular, fistulose, densely sericeous. Indumentum of 2-armed hairs, arms equal, appressed, erect, or ascending. *Leaf* petiole 1.6–4.9 cm long; blade ovate-cordate, 6.3–9.5 by 3.6–7.8 cm, base shallowly cordate, apex acuminate or rarely acute, adaxial surface slightly darker coloured; venation with 3 (or 4) basal pairs and 1 (or 2) distal pairs of secondary nerves. *Inflorescence* lax, 21–36 cm long, internodes long. Lower bracts petiolate, petiole 7–12 mm long, blade cordate-ovate to oblong, 2.5–5.8 by 1.7–3.8 cm, apically attenuate or acute, apiculate; upper bracts sessile, ovate or elliptic (or scale-like), (2–)8–35 by (< 1–)4–23 mm; pedicels 3–6 mm long, increasing to 8 mm in fruit. *Flowers* fragrant; buds obovoid-clavate, apex rounded, c. 5 mm long, sericeous. *Sepals* equal, 1–2 by < 1 mm, outer 3 broadly ovate, midvein raised, visible, inner 2 linear-filiform to narrowly lanceolate, all bases truncate, margins entire, apices acute or acuminate, densely golden tomentose outside, glabrous inside. *Corolla* campanulate-funnelform, 4.5–6(–7) by 4–6(–7) mm, membranous, white to creamy, tube broad, outside glabrous below, upper tube and interplacal areas tawny sericeous, limb entire to shallowly 5-lobed, lobes mucronate, terminating in abaxial apical tuft of hairs, plicae glabrous, inside of corolla glabrous. *Stamens* unequal,  $\leq 2$  mm long, 2 reaching corolla throat, 3 included in tube; filaments villous below, glabrous above; anthers extrorse, spirally twisted with age, light yellow; pollen 3-colpate, prolate spheroidal, 14–15 by 10–12  $\mu\text{m}$ , surface psilate to finely granulate, pilate-multiangulate within colpi. *Pistil* c. 2 mm long, included; disc annular or absent; ovary narrowly ovoid-conical, < 1 mm tall, black when dry, glabrous or sparsely villous apically; style < 1 mm long; stigma biglobose, lobes horizontal or slightly deflexed. *Fruiting calyx* bladderly, clasping utricle, third sepal folded back



Map 13. Distribution of *Poranopsis sinensis* (Hand.-Mazz.) Staples in western China.

on itself lengthwise in dried material; outer 3 sepals ovate-cordate to suborbicular, (1.2–)1.4–1.9 by (1.2–)1.5–1.7 cm, base shallowly cordate, margins adherent for lower 1/3–1/2, free distally, apex obtuse, rounded to emarginate, mucronulate, stiffly chartaceous, tan to pale brown, outside sparsely puberulent, opaque, inside glabrous, shiny; veins purplish brown, prominulous, inner 2 sepals slightly enlarged, filiform, 2–4 mm long, membranous, puberulent. *Utricle* ellipsoid or narrowly obovoid, apiculate, 3.5–6 by 2.5–4 mm, chartaceous, pale tan to dark brownish, darker striate, smooth to slightly wrinkled, glabrous or sparsely apically hairy. *Seed* ellipsoid, ovoid, or subglobose, 3–4 by 3 mm, black, red-brown, or dark brown, smooth, glabrous; hilum basal, circular, c. 1 mm diameter.

Distribution — China (Sichuan, Yunnan).

Habitat — Scrub, covering rock cliffs, on dry slopes, and along riverbanks on calcareous and schistaceous soils. At 350–2000 m elevation.

Phenology — Flowering: October (5), November (5), December (1). Fruiting: February (1), November (4).

Vernacular names — Bai hua ye (China).

Notes — *Poranopsis sinensis* is recognizable by its possession of the following characters: 2 or 3 stamens reaching the corolla throat, but not exerted from it; the small (or absent) disc; the glabrous or only apically velutinous ovary; the fruiting sepals (Fig. 12g) suborbicular or broadly ovate, with shallowly cordate base and emarginate apex, the margins of the outer 3 sepals adherent for the lower 1/3 to 1/2 of their length; and the glabrous utricles. Additional characters are the comparatively lax inflorescences and more or less uniformly coloured leaves, due to the indumentum density on the upper leaf surface, which masks the dark colour of the lamina proper.

Flowering material of *P. sinensis* is very similar to *P. discifera*. Indeed, Verdcourt (1971) cited specimens of *P. discifera* (Forrest 13591, Anderson & Smitinand 7219) among those he assigned to *Porana henryi* (= *Poranopsis sinensis*). The principal means for distinguishing flowering specimens is the length of the stamens, although the aspect of the leaves and the degree of congestion in the inflorescences is also helpful. The fruiting characters are quite distinctive however, and readily differentiate these species.

The orbicular or broadly ovate fruiting sepals of *P. sinensis* with their cordate base and partially adherent margins, are unique in *Poranopsis*. Similarly shaped fruiting sepals (with free margins) are typical of the genus *Cordisepalum*, which is separable from *Poranopsis* based on its rotate, deeply divided corolla and the elongated stalk that supports the utricle.

## VI. TRIDYNAMIA — Fig. 13

*Tridynamia* Gagnep. (1950) 26. — Type: *Tridynamia eberhardtii* Gagnep. (= *T. megalantha*).

Lianas, lower stem woody, glabrescent, upper branches herbaceous, ± tomentose-villose. *Leaf* petiole terete or compressed, sulcate adaxially, pulvinate; blade cordiform, stiffly chartaceous or subcoriaceous, densely pubescent abaxially; venation pedate, secondary veins 2 or 3 basal pairs and 1, 2, or 3 distal pairs, veins prominulous abaxially. *Inflorescence* axillary (or terminal), bracteose, racemose or paniculate, flowers fascicled (rarely solitary) at nodes, anthesis proceeding acropetally; bracts foliaceous,

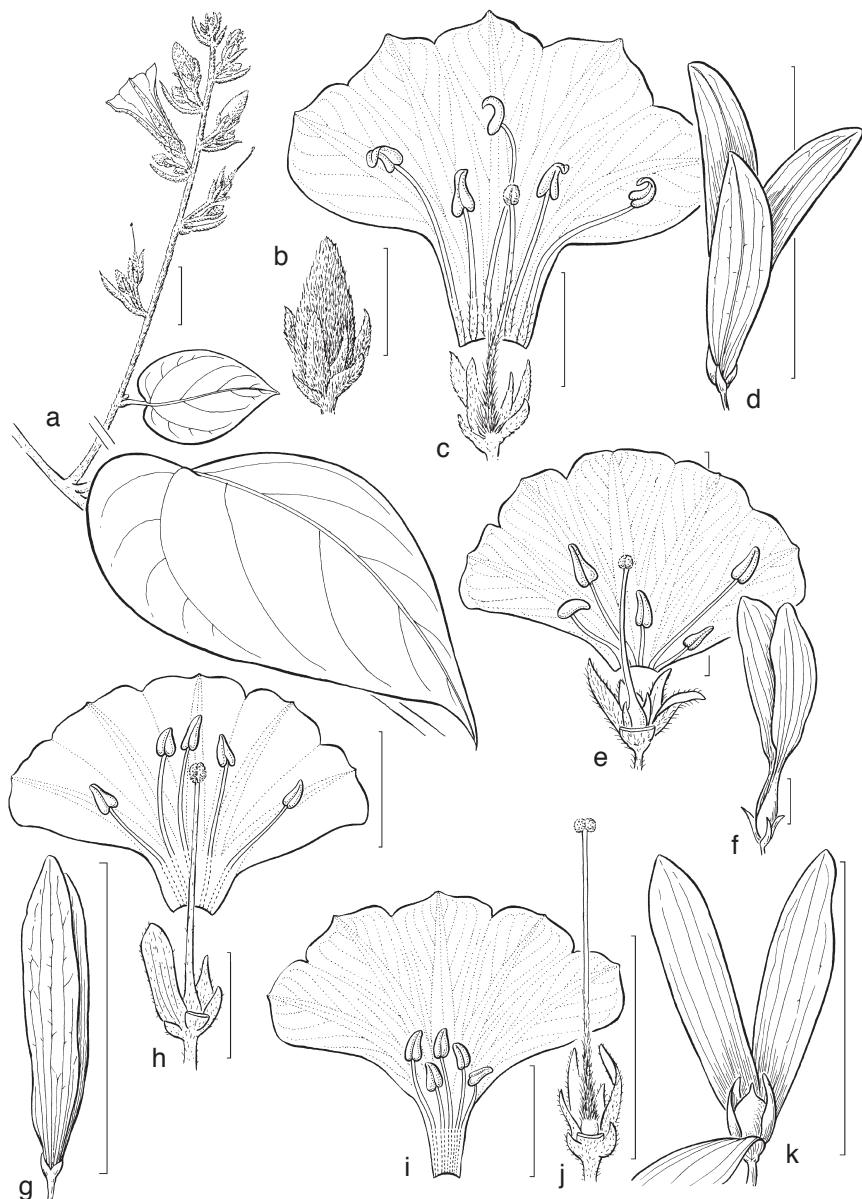


Fig. 13. *Tridynamia* species. a–d: *T. megalantha*. a. Flowering stem habit; b. flower bud with calyx; c. flower, corolla opened, showing hairy style base and sagittate anthers; d. fruiting calyx. — e, f: *T. bialata*. e. Flower, corolla opened; f. fruiting calyx with prominent calyx. — g, h: *T. sinensis* var. *sinensis*. g. Fruiting calyx; h. flower, corolla opened, 1 sepal removed. — i–k: *T. spectabilis*. i. Corolla opened; j. flowering calyx (1 sepal removed), calyx, and gynoecium; k. fruiting calyx, 1 sepal deflexed to expose utricle (a, d: from photo of Staples & Wongprasert 140; b, c: Poilane 28095; e: Poilane 3053; f: Put 2326; g: Huang 40898; h: Handel-Mazzetti 10877; i, j: Koyama et al. T-49020; k: from photo of Kurz 1083). Scale bars: a–c, e, f, i, j = 1 cm; d = 6.5 cm; g = 8.7 cm; h = 6 mm; k = 5 cm.

shape, texture, indumentum, and venation like the leaves; bracteoles 3, unequal, attached just below calyx, scale-like or bracteose, persisting in fruit. *Flowers* small to large, showy, odourless or fragrant. *Sepals* 5, free, quincuncial, unequal, clasping corolla tube base, unequally accrescent in fruit. *Corolla* campanulate to broadly funnelform, limb subentire to 5-lobed, lobes contortuplicate in bud. *Stamens* 5, filaments in lower half adnate to corolla tube, free and filiform above; anthers sagittate, versatile, dehiscing longitudinally; pollen 3-colpate, nonspinose. *Pistil* included or exerted; disc 5-lobulate or absent; ovary unilocular; ovules (2 or) 4, basal, erect; style simple, glabrous or pubescent below middle; stigma entire or bilobed, wrinkled. *Fruiting calyx* basally enclosing utricle, flat and slightly flaring above, outer 2 or 3 sepals greatly enlarged, oblong-linear, inner sepals only slightly enlarged, ovate; sepals all chartaceous, veins (7 or) 9 from base, parallel, longitudinal, 3 reaching apex, veins prominulous abaxially. *Utricle* ovoid, ellipsoid, or obovoid, often apiculate by indurate style base, chartaceous, wrinkled, glabrous or pilose-tomentose. *Seed* 1, shaped like utricle, reddish brown to black, smooth, glabrous; hilum basal, circular.

A genus of four species, one encompassing two varieties, distributed from north-eastern India and the Andaman Islands across south-eastern Asia to southern China and Hainan Island.

The characters diagnostic for *Tridynamia* are: the suffrutescent habit; 3 sepaloid bracteoles; unequal sepals; showy, campanulate or broadly funnelform corolla; sagittate, versatile anthers; unequally accrescent fruiting calyx with the outer 2 or 3 sepals greatly enlarged, oblong-linear, and the inner sepals only slightly enlarged; fruiting sepals with 7 or 9 parallel longitudinal veins at the base, with 3 reaching the apex. There is remarkable convergence in morphology between *Tridynamia*, especially *T. bialata*, and the monospecific Malagasy endemic, *Rapona tiliifolia* (Stefanovic et al., 2002). Historically considered to be closely related and consequently placed together in the tribe Poraneae, the molecular data suggest that *Rapona* is distantly related at best. In the latest attempt at a family classification, *Rapona* is tentatively assigned to tribe Dichondreae, sensu Stefanovic et al. (2003), whereas the same authors place *Tridynamia* in the new tribe Cardiochlamyaeae.

The genus *Tridynamia* comprises two species pairs. *Tridynamia bialata* and *T. sinensis* share the features of blue corolla and outer 2 sepals greatly enlarged in fruit; *T. megalantha* and *T. spectabilis* share the characters of white corolla and the outer 3 sepals greatly enlarged in fruit.

Typification — Gagnepain (1950) named the monotypic genus *Tridynamia* without a description, basing it on *T. eberhardtii*. He did not conclusively assign the genus to a tribe, noting the similarities and differences with the Convolvuleae, "... bandes longitudinales de la corolle et les autres caractères, mais le stigmate entier ce qui l'en exclut." and also with the Poraneae, "... qu'il a des sépales très accrescents, mais il ne possède qu'un seul style et qu'un stigmate entier." He went on to comment that the 3 sepaloid bracteoles gave the flower the appearance of having eight sepals rather than the five typical for Convolvulaceae, and that, "... ce qui serait sans exemple dans aucune autre Convolvulacée." by which Gagnepain may have been suggesting that a new tribe be recognized for *Tridynamia*.

Van Ooststroom (1963) examined the type collection of *T. eberhardtii*, but was unable to decide whether or not to reduce it to synonymy with *Porana*. He commented that

*T. eberhardtii* was very close to *P. spectabilis* Kurz, "... and may even be conspecific with it". In this revision *T. eberhardtii* is reduced to synonymy with *T. megalantha*.

#### KEY TO THE SPECIES

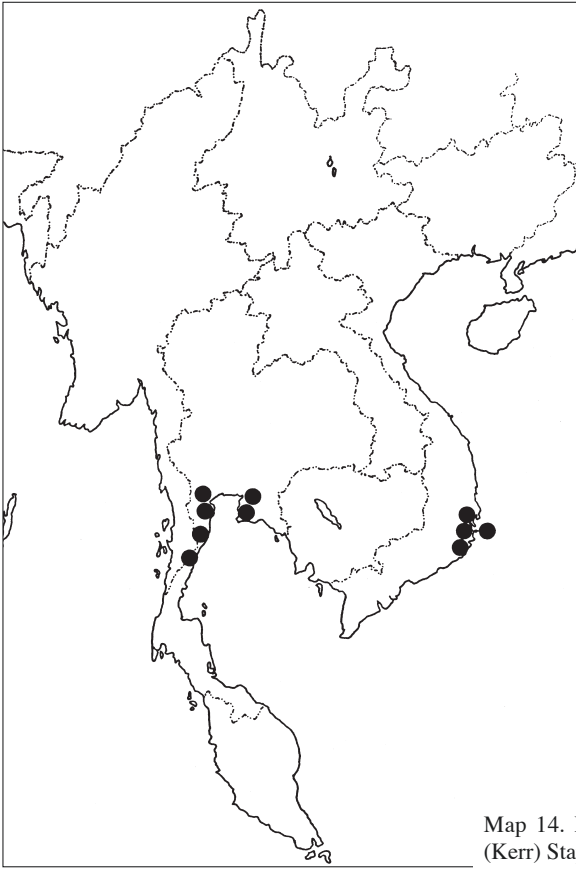
- 1a. Corolla blue or violet (rarely white); outer 2 sepals greatly elongate in fruit . . . 2
- b. Corolla white; outer 3 sepals greatly elongate in fruit . . . . . 3
- 2a. Corolla up to 1.1 cm across; all stamens included . . . . . **17. *T. bialata***
- b. Corolla (1–)1.6–3 cm across; some or all stamens exerted . . . . . **19. *T. sinensis***
- 3a. Corolla narrowly funnellform, tube widening gradually from base upward; fruiting sepals narrowly obovate to spatulate . . . . . **20. *T. spectabilis***
- b. Corolla campanulate to broadly funnellform, tube flaring abruptly above a narrow base; fruiting sepals oblong . . . . . **18. *T. megalantha***

#### **17. *Tridynamia bialata* (Kerr) Staples** — Fig. 13e, f; Map 14

*Tridynamia bialata* (Kerr) Staples (2004) 149. — *Porana bialata* Kerr (1941) 19. — Type: *Put 3166* (lectotype (chosen here) BM; iso A, ABD, BK, E, K, L), Thailand.

Liana 2–20 m long; vegetative parts ferruginous; stem slender, basally woody; upper stems terete to angular, 2–3 mm diam., ± puberulent, glabrate, pith solid. Indumentum yellowish to rusty; hairs 2-armed, arms mostly erect or ascending. *Leaf* petiole 1.4–4.5 cm long; blade broadly ovate to cordate, 5.5–10.2 by 4.5–7.8 cm, base cordate, apex acute to acuminate, rarely obtuse, apiculate, adaxially darker, pilose or subglabrous, abaxially paler, velutinous. *Inflorescence* a raceme or panicle, 10–25 cm long; lower bracts foliaceous; petiole 4–10 mm; blade ovate to ovate-lanceolate, 2–2.5 by 0.9–1.5 cm, puberulent; upper bracts sessile, lanceolate to subulate, 1–3 mm long; pedicels filiform, 4–8 mm long, thickening but not lengthening in fruit; bracteoles linear-filiform, 3–4 mm long, persistent, to 5–7 mm in fruit. *Flowers* odourless; buds narrowly fusiform, 7–9 mm long, apically acute or obtuse, puberulent. *Sepals* unequal, outer 2 narrowly elliptic-oblong, 3–4 mm long, basally tightly enveloping ovary, flaring and flat above, puberulent; inner 3 sepals shorter, ovate to lanceolate, ≤ 1 mm long, glabrous or apically tufted with hairs. *Corolla* 8–15 by 7–11 mm, pale bluish, centre yellowish, limb (sub)entire, outside puberulent on midpetaline bands, inside glabrous. *Stamens* unequal, included; filaments 2–5 mm long, sparsely pilose basally; anthers < 1 mm long; pollen 3-colpate, oblate spheroidal, c. 10 by 15–20 μm, surface psilate or minutely granulate. *Pistil* twice as long as calyx; ovary ovoid-globose, < 1 mm tall, attenuate into style, glabrous or apically hairy; ovules (1 or) 2; style filiform, 5–7 mm, glabrous; stigma globose, < 1 mm, entire to slightly emarginate. *Fruiting calyx*: outer 2 sepals linear-oblong, 3.5–5.4 by 0.7–1.1 cm, bases tightly surrounding utricle, constricted medially, flaring above, stiffly chartaceous, tan to brownish, subglabrous; inner 3 sepals unequal, ovate to lanceolate, 5–7 by 3–4 mm, membranous, outside puberulent apically, otherwise glabrous. *Utricle* ovoid-conical, 6–10 by 3–4 mm, apiculate by indurate style base, thinly chartaceous, tan to reddish brown, glabrous. *Seed* ellipsoid-oblong, 4–5 by 2–3 mm, reddish brown to black, smooth, glabrous; hilum basal, circular, < 1 mm diameter.

Distribution — Thailand, Vietnam; probably also Laos and Cambodia.



Map 14. Distribution of *Tridynamia bialata* (Kerr) Staples in south-eastern Asia.

Habitat — Forests, disturbed forests, scrub thickets, prairies, and near villages, on clay soils and among rocks and crags. At 20–300 m elevation.

Phenology — Flowering: April (1), August (2), September (1), October (1). Fruiting: January (4), February (2), September (1), November (1).

Vernacular names — Tap tao (Thailand, Prachuap Khiri Khan); bónga yang Hröi (Vietnam, Jörai dialect).

Notes — *Tridynamia bialata* is recognizable by the flowers c. 1 cm diam.; the pale bluish white corolla with yellow at the tube base; the unequal stamens included within the corolla throat; the biovulate ovary; the two outer sepals greatly enlarged in fruit, with the base tightly clasping the utricle, the middle portion inrolled/constricted, and the apical region flaring and flattened. The habit of this species is more delicate in comparison to its closest relative, *T. sinensis*.

*Tridynamia bialata* is the only species of the genus to have a biovulate ovary; all other taxa have 4-ovulate ovaries. The mosaic distribution of ovule number in the taxa formerly assigned to *Porana* s.l. demonstrates once again that this character is taxonomically uninformative for the Convolvulaceae at levels above the rank of species, a fact that was pointed out by Hallier (1893) and Van Ooststroom (1943).

**18. *Tridynamia megalantha* (Merr.) Staples — Fig. 4a, 13a–d; Map 15**

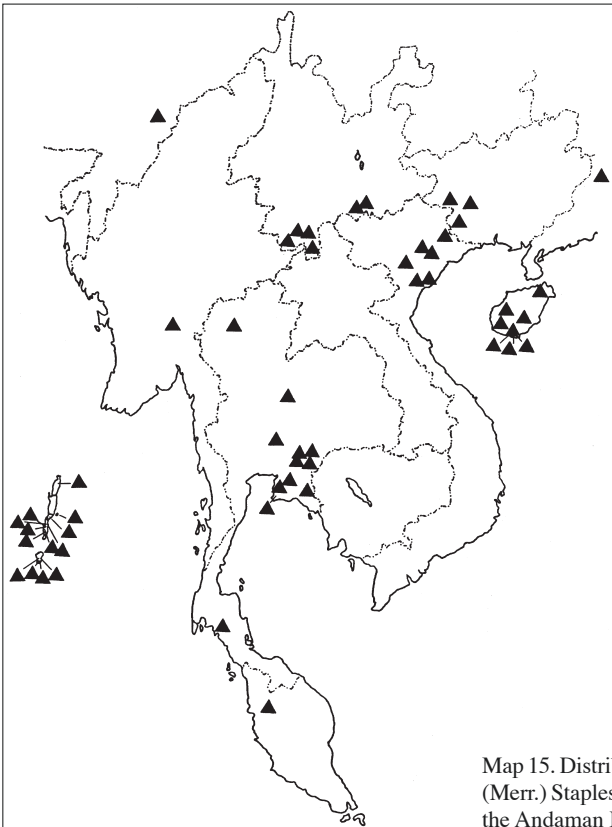
*Tridynamia megalantha* (Merr.) Staples (1993) 201. — *Porana megalantha* Merr. (1935) 53. — *Porana spectabilis* Kurz var. *megalantha* (Merr.) F.C. How ex H.S. Kiu (1974) 475, f. 867. — Type: *S.K. Lau* 373 (holo NY; iso A, B, BM, E, G, K, MICH, MO, P, PE, UC, US, W), China.

*Porana sutepensis* Kerr (1941) 20. — Type: *A.F.G. Kerr* 2605 (lecto (chosen here) BM; iso A, K, L), Thailand, *syn. nov.*

*Tridynamia eberhardtii* Gagnep. (1950) 26. — Type: *Eberhardt* 3132 (holo P; iso P), Vietnam.

*Porana spectabilis* auct. non Kurz (1873): Gagnep. & Courchet (1915b: 293, f. 32), Kiu (1974), Fang & Huang (1979a, b), Fang (1986).

Liana to 10 m long; lower stem 1–2.3(–4) cm diam., tan to brownish, bark corky, coarsely wrinkled; branches terete, 5–8 mm diam., wrinkled, dark brown, (sub)glabrous; stem tips terete, 2–3 mm diameter. Indumentum whitish to yellowish, tomentose to villose; hairs 2-armed, arms equal or not, erect or appressed. *Leaf* petiole 1.2–4(–7) cm, coarsely wrinkled; blade ovate, elliptic or suborbicular, 7.8–15(–19.7) by 5–9.3(–12.5) cm, base cordate, rarely rounded or truncate, apex acute, acuminate or apiculate, texture stiffly chartaceous to subcoriaceous, adaxially darker, subglabrous to tomentose, abaxially tomentose-villose (rarely subglabrous). *Inflorescence* a simple or compound raceme, 19–48 cm long; lower bracts foliaceous, petiolate; petiole 4–17 mm long; blade ovate, 3.2–6.3 by 1.5–4.2 cm, base rounded or cordate, apex acute or apiculate;



Map 15. Distribution of *Tridynamia megalantha* (Merr.) Staples in south-eastern Asia, China and the Andaman Islands.

bracts diminishing upward, becoming sessile, uppermost scale-like, 1–3 mm long; pedicels flattish, 7–10 mm long, to 15 mm in fruit; bracteoles acute-ovate, unequal, 1–2 mm long, in fruit 5–6 by 2 mm. *Flowers* showy, erect, odourless; buds ellipsoid, apex acute to obtuse, tomentulose. *Sepals* unequal, outer 3 narrowly oblong to linear, flat or revolute, 7–8 by 1–2 mm, base slightly broader, margins entire, apex rounded, outside glabrous basally, otherwise tomentose, midvein prominent abaxially; inner 2 sepals attenuate-lanceolate, curved around ovary, c. 4 by 1 mm, outside tomentose, inside glabrous. *Corolla* flaring from base, subentire to 5-lobed, 3–4.5(–5) by 2.7–4.6 cm, white, membranous, plicae and tube base glabrous outside, otherwise golden-brown tomentulose, glabrous inside. *Stamens* unequal, 11–17 mm long, included; filaments with a collar around attachment point on corolla tube; anthers c. 2 mm long, whitish; pollen 3- (or 4-)colpate, oblate spheroidal, 18–21 by 23–30  $\mu\text{m}$ , surface psilate, with pilate-multangulate structures inside colpi. *Pistil* to 19 mm long; disc absent; ovary broadly ovoid, 1–2 mm diam., attenuate into style, brownish basally, yellowish above, glabrous (sometimes obscured by style hairs); ovules 4; style filiform, 17–18 mm, lower half densely pilose, glabrous above; stigma biglobose, c. 1 mm diam., greyish tan. *Fruiting calyx* unequal, basally clasping utricle, flaring above; outer 3 sepals oblong, 5.5–7.5 by 1–1.8 cm, base medially thickened, forming a triangular keel, margins entire, apex rounded or obtuse (rarely acute), stiffly chartaceous, stramineous to tan, both sides  $\pm$  tomentulose, abaxially coarsely reticulate; inner 2 attenuate-lanceolate, wrapped around utricle, 15–26 by 4–6 mm, thinly chartaceous, yellowish tan, outside tomentulose, inside glabrous. *Utricle* borne erect, slenderly obovoid to ellipsoid, 10 by 6 mm, apiculate, chartaceous, yellowish pilose. *Seed* narrowly obovoid to ellipsoid, 8–10 by 5–6 mm, dark brown, wrinkled, glabrous; hilum semicircular, c. 1 mm diameter.

*Distribution* — NE India (and the Andaman Islands), Myanmar, Laos, N and E Thailand, Vietnam, S China (including Hainan Island).

*Habitat* — Grassy savannahs, roadsides, scrub, clearings and the edges of forests and thickets, stream banks and open sunny slopes on hills and steep mountains. Recorded from diverse soil types, often limestone; from sea level to 900 m elevation.

*Phenology* — Flowering: January (2), February (2), March (5), April (2), May (5), June (8), July (14), August (7), September (5), October (6), November (11), December (8). Fruiting: January (5), February (2), March (4), April (1), May (2), June (3), July (3), August (3), September (2), October (2), November (1), December (1).

*Vernacular names* — Dà hua fei é téng (China), dà hua yì é téng, máo máo (China, Guangxi); ladaa dong (central Thai dialect, ex Smitinand (1980) as *Porana spectabilis* Kurz).

*Taxonomy* — *Tridynamia megalantha* has been considered conspecific with *T. spectabilis* (Kurz) Parmar or reduced to varietal rank under it. Roberty (1952), without comment, reduced *Porana megalantha* to synonymy under his *Poranopsis spectabilis*. How in Kiu (1974), followed by Fang & Huang (1979b), treated *P. megalantha* as a variety of *P. spectabilis*, distinguishing the two on the basis of flower size. This is a case of mistaken identity: no authentic material of *T. spectabilis* has been seen from China and the plants described by Chinese authors are all referable to *T. megalantha*. Although the holotype collection of *P. megalantha* bears quite large flowers relative to the species as a whole, flower size among the Chinese plants intergrades completely, thus rendering the recognition of varieties in *T. megalantha* quite artificial. However, flower size is

useful in separating genuine *T. spectabilis* from *T. megalantha*: the largest flowers of *T. spectabilis* just reach the size of the smallest flowers of *T. megalantha*. The separation between the size distributions is almost complete. Based on these characters I maintain the two taxa at specific rank.

Notes — Characters diagnostic for *T. megalantha* are a campanulate to broadly funnelliform corolla (Fig. 4a) that flares from just above the base, the corolla 3–4.5(–5) by 2.7–4.6 cm, by the unusual ‘collar’ formed around each filament where it departs from the corolla tube (vide Gagnepain & Curchet, 1915b: 293, f. 32, as *P. spectabilis*), and by the oblong outer three fruiting sepals. Additional, more subjective, characters include the usually whitish indumentum, the simple or only once or twice branched racemose inflorescences, and the reticulate abaxial surface of the outer fruiting sepals.

Within the wide geographic range of *T. megalantha* there is a clinal variation in the colour of the indumentum. Plants growing in the northern part of the range, from north-eastern India across China to Hainan Island have a creamy or whitish indumentum, whereas plants growing further south, in Thailand, Laos and Vietnam, have a distinctly yellowish colour to the indumentum, giving the plants a yellow or brownish cast. The darkest individuals of *T. megalantha* approach the golden-brown to ferruginous colour of *T. spectabilis*.

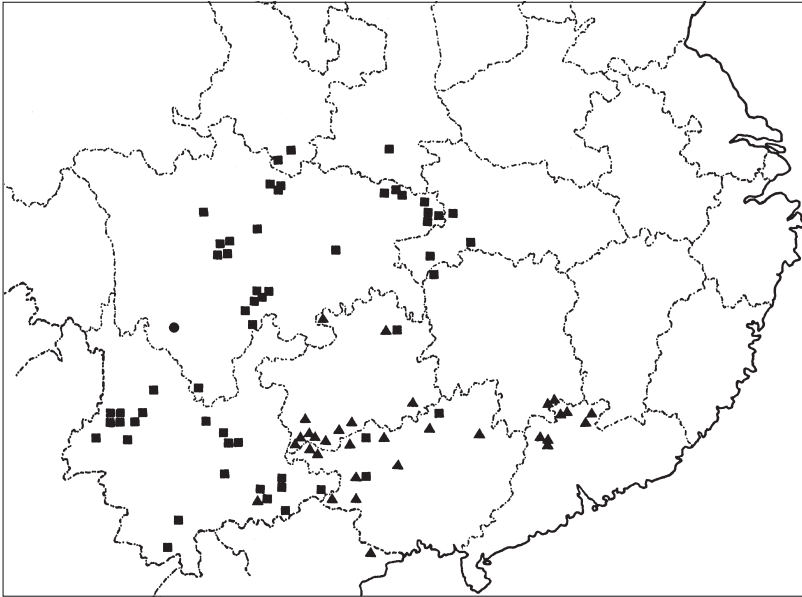
Fang et al. (1986) report that this species (as *Porana spectabilis* and *P. spectabilis* var. *megalantha*) has several uses in folk medicine in Guangxi province, China. The uses include treatment for metropotosis, sprain, and chest distress. The plant parts used and the method of preparation are not explained.

### 19. *Tridynamia sinensis* (Hemsl.) Staples — Map 16

*Tridynamia sinensis* (Hemsl.) Staples (1993) 201. — *Porana sinensis* Hemsl. in Forbes & Hemsley (1890) 167. — Type: *C. Ford* 290 (holo K; iso IBSC, P), China.

*Porana esquirolii* H. Lévl. (1911) 444. — Type: *J. Esquirol* 976 (holo E, photo A; iso A, K), China.  
*Vatica cordata* Hu [Dipterocarpaceae] (1930) 225. — Type: *R.C. Ching* 7426 (holo PE; iso fragment A, IBSC, W), China.

Liana to 15 m long, climbing or prostrate; stem basally woody, terete to faintly striate, dark brown, glabrescent, sometimes fistulose when dry; young stems herbaceous, 4–5 mm diam., rusty or tawny pubescent. Indumentum rufous or tawny, velutinous to tomentose; hairs 2-armed, arms equal, appressed or erect. *Leaf* petiole (1–)2.7–6.2 cm long; blade ovate, elliptic-ovate to suborbicular, (4.4–)8.5–13.2 by (1.9–)6.1–10 cm, base shallowly cordate, emarginate, to rounded, margins entire or slightly revolute, apex acuminate to cuspidate, texture stiffly chartaceous to coriaceous, adaxially darker, subglabrous, abaxially paler, rufous to tawny velutinous or glabrous. *Inflorescence* a simple or compound raceme, 21–30 cm long; lower bracts foliaceous or absent, petiolate, petiole 6–15 mm long, blade ovate, 2.5–5.6 by 1.4–4 cm; upper bracts scale-like or absent; pedicels filiform, 10–16 mm; bracteoles unequal, largest ovate-lanceolate, 3–4 by 1–2 mm, attenuate-acuminate, folded medially, 2 smaller ovate to ovate-elliptic, 1–3 by 1–2 mm, obtuse, flat, persistent. *Flowers* erect; buds ellipsoidal, obtuse or acute, velutinous. *Sepals* unequal, outer 2 oblong, flat or slightly incurved, 4–5 by 1–2 mm, base subsagittate, margins entire, apex obtuse or rounded, outside glabrous basally, otherwise velutinous; inner 3 ovate to lanceolate, curved around ovary, 2–3(–4) by 1–2 mm, base abruptly attenuate, third sepal asymmetrical



Map 16. Distribution of *Tridynamia sinensis* (Hemsl.) Staples var. *sinensis* (▲) and *T. sinensis* (Hemsl.) Staples var. *delavayi* (Gagnep. & Courchet) Staples (■) in China.

basally, margins entire, hyaline, apex attenuate to aristate, outside velutinous, inside glabrous or sparsely hairy; all sepals chartaceous; 3 longitudinal veins faintly visible. *Corolla* broadly funnellform, diaphanous, violet, blue-violet, pale blue, rose to white; tube (6–)8–10 mm long, glabrous inside and basally outside, velutinous above; limb flaring abruptly, reflexed, (1–)1.6–2.3(–3) cm diam., subtire or 5-parted, lobes broadly rounded, obtuse or apiculate, margins entire or sinuous, interplacae velutinous outside, corolla otherwise glabrous. *Stamens* ± exerted from corolla, (7–)11–12 mm; filaments 5.5–10 mm; anthers 1.5–2 mm; pollen 3-colpate, oblate spheroidal, c. 15 by 18–20  $\mu\text{m}$ , surface psilate. *Pistil* 11–13 mm long, exerted; disc absent or 5-lobulate; ovary ovoid-conical, 1–2 mm long, black, glabrous below, velutinous distally with simple, appressed hairs; ovules (3 or) 4; style filiform, jointed above base, (5–)9–11 mm, appressed pubescent below, glabrous distally; stigma globose, entire or ± emarginate, < 1 mm diam., coarsely wrinkled, brownish. *Fruiting calyx* tightly clasping utricle; outer 2 sepals oblong to spatulate, 6.5–7.8 by 0.9–1.4(–1.8) cm, base cuneate, medially thickened, keeled, margins entire, apex rounded-obtuse; third sepal variably enlarged, straight or falcate, 1–6.4 by (0.4–)0.6–0.9 cm; 2 inner sepals oblong-obovate, 8–11(–13) by 3.5–5(–7) mm, margins curved around utricle, sometimes ciliate, apex aristate; all sepals chartaceous, tan to pale brown, shiny or opaque, sparsely velutinous; veins darker, tertiary venation reticulate, prominulous abaxially. *Utricle* ellipsoid-ovoid or narrowly obovoid, 10–11 by 6–8 mm, apiculate, style remnant 3–5 mm tall, stiffly chartaceous, coarsely wrinkled, glabrous, dark brown below, rufous, sparsely pilose above middle. *Seed* ovoid to obovoid, 9–10 by 6–8 mm, dark brown to black, smooth or faintly striate, glabrous; hilum basal, circular,  $\leq$  1 mm diameter.

Distribution — China, N Vietnam.

Notes — The diagnostic characters of *T. sinensis* are: the broadly funnellform corolla, to 2.5 cm diam. with reflexed limb; the (usually) long exserted pistil and stamens; the fruiting calyx with the outer two sepals greatly enlarged (Fig. 13g); the outer two fruiting sepals with a triangular median keel at the base, flat and slightly venose otherwise.

The degree of enlargement for the middle (third) fruiting sepal is variable in this species. In most fruiting collections the third sepal enlarges as much as the inner two sepals, e.g. much less dramatically than the outer two. In some cases, however, the third sepal enlarges to one quarter (*C. Wang 40898, S.K. Lau 28682*) or one half (*A. Henry 10715B, MO specimen*) the size of the outer two, and in at least one collection (*R.C. Ching 7426*), the middle sepal is fully as large as the outer two sepals. This condition appears in individual fruits rather than in every fruit on a given collection, and it appears in plants assigned to both varieties.

There is a clinal increase in flower size from west to east across this species' range. The smallest flowers, collected in western China (*S.Y. Hu 1130*), have a corolla tube only 6 mm long and a limb just 12 mm diameter. The largest flowers were collected in south-eastern China (*Handel-Mazzetti 10877*). A corresponding variation in stamen length is noticeable, with eastern populations having all stamens equal and exserted from the corolla throat, whereas some western populations have the stamens unequal, with the shorter ones reaching the corolla throat, but not exserted from it. Two partially allopatric varieties of *T. sinensis* are distinguishable.

#### KEY TO THE VARIETIES

- 1a. Plants rusty velutinous; leaf blade broadly ovate to suborbicular, base cordate . . .  
 . . . . . **a. var. *sinensis***  
 b. Plants subglabrous; leaf blades (narrowly) ovate, base truncate, rounded or emarginate . . . . . **b. var. *delavayi***

**a. var. *sinensis*** — Fig. 13g, h; Map 16

For synonymy see under the species.

Pubescent liana to 15 m long. *Leaf* blade broadly ovate, elliptic ovate to suborbicular, 8.5–13.2 by 6.1–10 cm, base cordate or emarginate, apex ± acuminate or cuspidate, adaxially subglabrous, abaxially rufous (to tawny) velutinous or tomentose. *Corolla* blue-violet, pale blue to white, tube 8–10 mm long, limb 19–23(–30) mm diam.; stamens equal, exserted, 11–12 mm; disc absent.

Distribution — China (Guangxi, Guizhou, Guangdong, S Hunan) and NE Vietnam. Its range overlaps that of var. *delavayi* along a broad zone through Guangxi and Guizhou provinces.

Habitat — Thickets, forests, stream banks, slopes and rock cliffs on soils recorded as rich and moist, or rocky and conglomerate in nature. It is not reported from limestone soils as frequently as is var. *delavayi*, and the specimen labels indicate that var. *sinensis* prefers more mesic habitats. At (100–)300–1300(–2500) m elevation.

Phenology — Flowering: April (1), May (8), June (4), July (4), August (3), September (3). Fruiting: May (3), June (3), July (3), August (1), September (5), December (1).

Vernacular names — Da guo fei e teng (Chinese), mu lu hua (China, Guangxi).

Typification — The protologue for *Vatica cordata*, based on a single collection from Guangxi province, states that the fruit has “two linear, divergent wings.” This agrees with the holotype and one isotype (IBSC), but the other isotype (W) has three ± equally enlarged fruiting sepals. As noted above, there is variability in the degree to which the third sepal enlarges in fruit, and that is evident in the duplicates of *Ching* 7426.

Note — *Tridynamia sinensis* var. *sinensis* is recognized by its broadly ovate to sub-orbicular leaf blades with cordate base, and the rusty pubescence on the lower surface of the leaves, the bracts, and on the stem tips. Furthermore, the flowers are larger than in var. *delavayi*, the corolla tends to be lighter in colour, and the stamens are equal in length and clearly exserted from the corolla throat.

**b. var. delavayi** (Gagnep. & Courchet) Staples — Map 16

*Tridynamia sinensis* (Hemsl.) Staples var. *delavayi* (Gagnep. & Courchet) Staples (1993) 201. — *Porana delavayi* Gagnep. & Courchet (1915a) 153. — *Porana sinensis* Hemsl. var. *delavayi* (Gagnep. & Courchet) Rehder (1934) 319. — Type: *Delavay* 3539 (lecto P; isolecto A), China. *Porana confertifolia* C. Y. Wu in Wu & Li (1965) 104, t. 34, f. 2. — Type: *F.T. Wang* 22308 (holo KUN), China.

Liana 1.5–6.5 m long, glabrous or sparsely pubescent, indumentum tawny. *Leaf* blade narrowly ovate to elliptic ovate, (4.4–)8–14.2 by (1.9–)4.1–9.2 cm<sup>1</sup>, base rounded (rarely truncate), emarginate, or shallowly cordate, apex attenuate-acuminate to apiculate, adaxially glabrous, abaxially glabrous or sparsely velutinous, especially along veins. *Corolla* violet, dark blue, purple with a white throat, or rarely rose-pink, tube 6–9(–10) mm long, limb subtire to 5-lobed, 10–20(–27) mm diam.; stamens 7–12 mm long, ± exserted from throat; disc 5-lobulate or absent.

Distribution — China (C, W, and SW).

Habitat — Thickets, scrub and open situations along streams, roadsides, on cliffs and rock ledges and in lava beds; the soil is often recorded as rocky, frequently limestone, and dry. At 400–1800(–2200) m elevation.

Phenology — Flowering: April (1), May (13), June (10), July (17), August (8), October (1), December (1). Fruiting: June (1), July (1), August (5), September (1), October (5), November (3).

Vernacular name — Jin wú máo fei é téng (Chinese).

Typification — *Porana delavayi* was effectively lectotypified by Huang in Fang & Huang (1979a: 626). In her words [my translation], “The selected type specimen gathered from [Yunnan] Heqing (Jiangyun).” This statement can refer only to *Delavay* 3539, which was made in Jiangyun [romanized as Kiang-yu on the original label], now Heqing Xian.

Note — *Tridynamia sinensis* var. *delavayi* is separable from var. *sinensis* by its narrower leaves with the base not distinctly cordate (ranging from rounded or rarely truncate to emarginate, occasionally shallowly cordate) which are glabrous or, at most, sparsely velutinous on the lower side, and the generally smaller flowers. Its range overlaps that of variety *sinensis* along a wide band in Guizhou and Guangxi provinces.

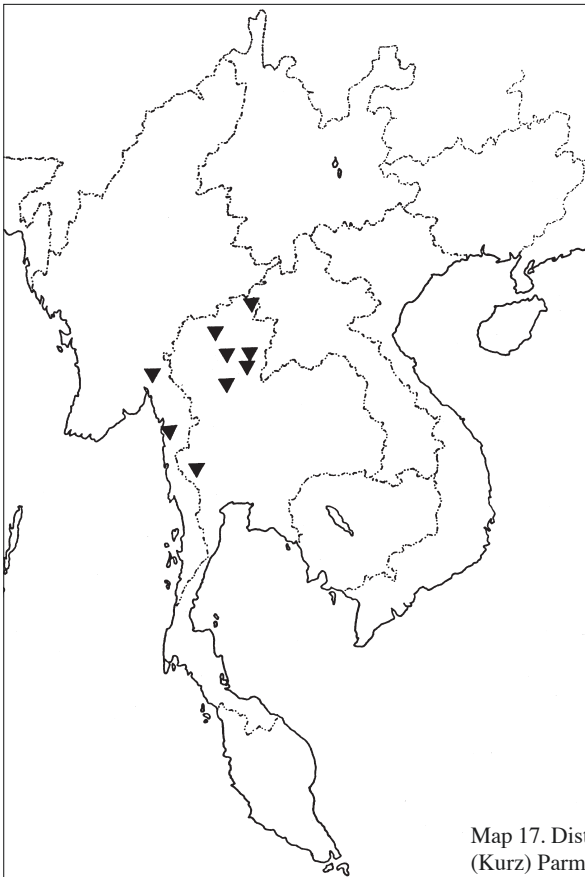
1) It is likely that the leaf size of var. *delavayi* is here under-reported, since herbarium specimens rarely have full-sized cauline leaves present.

## 20. *Tridynamia spectabilis* (Kurz) Parmar — Fig. 13i–k; Map 17

*Tridynamia spectabilis* (Kurz) Parmar (1994) 251. — *Porana spectabilis* Kurz (1873) 136. — *Poranopsis spectabilis* (Kurz) Roberty (1952) 26. — Type: *S. Kurz 1083* (lectotype (chosen here) CAL sheet 314372; isolectotypes CAL sheet 314371, K), Myanmar.

*Porana speciosa* Benth. in Bentham & Hooker f. (1876) 876, sphalm., '*spectabilis*' ex B.D. Jacks. (1894) 606, based on the same type as Kurz's epithet.

Liana 6(–10) m long, vegetative parts tawny. Lower stem woody; branches terete, 5–6 mm diam., striate, brownish, sparsely tomentulose to glabrous; stem tips terete, 2–3 mm diam., herbaceous, tomentose. Indumentum yellowish ochraceous, tomentose; hairs 2-armed, arms erect or appressed. *Leaf* petiole 1.6–7 cm long, coarsely wrinkled; blade narrowly to broadly ovate or suborbicular, 7.1–19.5 by 4–18 cm, base emarginate to cordate, apex acute or obtuse, apiculate or mucronulate, stiffly chartaceous or subcoriaceous, adaxially olivaceous and subglabrous, abaxially yellowish olive, tomentulose. *Inflorescence* a panicle of racemes, 12.5–59 cm long, nodes with raised scars after flowers fall off; lower bracts foliaceous, petiolate, petiole 0.9–2.4 cm long, blade ovate, 5.2–7.2 by 2.7–4.8 cm, base rounded or cordate, apex acute, rounded, or emarginate; bracts diminishing in size apically, becoming sessile, uppermost subulate



Map 17. Distribution of *Tridynamia spectabilis* (Kurz) Parmar in south-eastern Asia.

to ovate, 4–7 mm long; pedicels flattened-filiform, 8–10 mm; bracteoles ovate to ovate-lanceolate, unequal, 1–1.5 mm long, increasing to 3–4 mm in fruit. *Flowers* showy, sweetly fragrant; buds slenderly ellipsoid, 1.6–2.2 cm long, apex acute to obtuse, tomentose. *Sepals* unequal, outer 3 ovate-oblong, flat or incurved, 3–4 by 1 mm, base broader, margins entire, apex rounded, texture herbaceous, with 1 (or 3) longitudinal ridges, glabrous basally outside, otherwise golden-brown tomentose; inner 2 ovate-lanceolate, clasping corolla tube base, 2–3 by 1 mm, lower margins hyaline, apex attenuate, tomentose outside except on hyaline margins, glabrous inside. *Corolla* narrowly funnellform, 1.9–2.7(–3.3) by 1.7–2.3(–2.7) cm, white, membranous, glabrous inside; tube gradually flaring, base glabrous, otherwise yellowish tomentose; limb 5-lobed, lobes obtuse to rounded, tomentose outside. *Stamens* unequal, included; filaments 6–10 mm; anthers c. 2 mm long; pollen 3-colpate, oblate spheroidal, 18–20 by 22–24  $\mu\text{m}$ , surface psilate. *Pistil* included in corolla throat, 12–13 mm long; disc absent; ovary ovoid, attenuate into style, c. 1 by 1 mm, dark brown below, yellowish distally, glabrous; ovules 4; style 10–12 mm, appressed pilose on lower half, glabrous above; stigma biglobose, taller than broad, c. 1 mm diam., greyish tan. *Fruiting calyx* (immature) clasping utricle basally, flaring above; outer 3 sepals greatly enlarged, narrowly obovate-spathulate, flat, 4.9–5.5 by 1.1–1.5 cm, base medially thickened, keeled, margins entire, apex rounded to obtuse, stiffly chartaceous, greenish to tan, outside slightly reticulate, sparsely tomentulose to subglabrous; inner 2 linear-lanceolate, incurved around the utricle, 15–16 by 3–4 mm, apex long attenuate, thinly chartaceous, pale tan, glabrous inside, sparsely tomentulose outside. *Utricle* (immature) obovoid, c. 6 by 5 mm, apically rounded, densely yellowish tomentose. *Seed* (immature) obovoid, c. 5 by 3 mm, dark brown to blackish, glabrous.

Distribution — SE Myanmar (Karen and Mon States), W Thailand.

Habitat — Evergreen forests, mixed deciduous/evergreen forests, hardwood forests, and moist upper deciduous forests, along streams and on the edges of clearings. The soil type, when recorded, is exclusively limestone. At 100–550 m elevation.

Phenology — Flowering: January (5), February (9), March (1), July (1). Fruiting: July (1), December (1).

Vernacular names — Ladaa dong (Central Thai dialect, ex Smitinand, 1980).

Notes — *Tridynamia spectabilis* is recognizable by the narrowly funnellform corolla (Fig. 4b), 1.9–2.7(–3.3) by 1.7–2.3(–2.7) cm, the tube widening gradually from the base upwards, the limb flaring out from it more or less abruptly; the staminal filaments flattened and fused to the corolla tube below, lacking a ‘collar’ at the point where the free portion of the filament departs from the corolla tube; the narrowly obovate to spatulate outer three fruiting sepals. Furthermore, plants of *T. spectabilis* have a golden-brown or yellowish indumentum, the inflorescence is a panicle composed of racemes, and the three outer fruiting sepals are smooth or only slightly reticulate on the abaxial surface.

*Tridynamia spectabilis* shares the common features of a white corolla and three outer sepals greatly enlarged in fruit with *T. megalantha*. For a discussion of the confusion between the two see under *T. megalantha*. As defined here, *T. spectabilis* has a restricted distribution in Myanmar and western Thailand.

## EXCLUDED SPECIES

The following list accounts for several names published in the genus *Porana* that are extralimital to the present treatment. Types and pertinent literature are cited for all taxa.

*Porana acuminata* P. Beauv. (1806) 66, t. 39. — Type: *Palisot de Beauvois s.n.* (holo G; iso P), Nigeria = **Neuropeltis acuminata** (P. Beauv.) Benth. (1849) 469.

*Porana densiflora* Hallier f. (1894) 93. — Type: *Fischer 284* (holo B, destroyed, fragment GOET), East Africa, sine loco = **Metaporana densiflora** (Hallier f.) N.E. Br. (1914) 169; Staples (1990) 253–254.

*Porana obtusa* Balf.f. (1883) 83. — Type: *Balfour, Cockburn & Scott 355* (holo K; iso BM, E, fragment GOET, LE), Socotra = **Metaporana obtusa** (Balf.f.) Staples (1990) 253.

*Porana parvifolia* K. Afzel. (1929) 182. — Type: *K. Afzelius s.n.* (holo S; iso S, photo K), Madagascar = **Metaporana parvifolia** (K. Afzel.) Verdc. (1969) 291.

*Porana subtrotundifolia* De Wild. (1902) 111. — Type: *Verdick 525* (lectotype (here designated) BR), Democratic Republic of Congo = **Paralepistemon shirensis** (Oliv.) Lejoly & Lisowski (1986) 197.

*Porana velutina* (M. Martens & Galeotti) Hallier f. (1893) 538, *Dufourea? velutina* M. Martens & Galeotti (1845) 259. — Type: (lectotype (chosen here): 2nd sheet BR; isolectotypes: 1st sheet BR, G, P, W), Mexico = **Porana nutans** (Sessé & Mocq. ex Choisy) O'Donell (1960) 62.

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## IDENTIFICATION LIST

The numbers after the collector numbers refer to the following taxa:

- |  |   |
|--|---|
| 1 = <i>Cordisepalum phalanthopetalum</i> | 12 = <i>Duperreya sericea</i>                         |
| 2 = <i>Cordisepalum thorelii</i>         | 13 = <i>Porana volubilis</i>                          |
| 3 = <i>Dinetus decorus</i>               | 14 = <i>Poranopsis discifera</i>                      |
| 4 = <i>Dinetus dinetoides</i>            | 15 = <i>Poranopsis paniculata</i>                     |
| 5 = <i>Dinetus duclouxii</i>             | 16 = <i>Poranopsis sinensis</i>                       |
| 6 = <i>Dinetus grandiflorus</i>          | 17 = <i>Tridynamia bialata</i>                        |
| 7 = <i>Dinetus malabaricus</i>           | 18 = <i>Tridynamia megalantha</i>                     |
| 8 = <i>Dinetus racemosus</i>             | 19 = <i>Tridynamia sinensis</i>                       |
| 9 = <i>Dinetus rhombicarpus</i>          | 19a = <i>Tridynamia sinensis</i> var. <i>sinensis</i> |
| 10 = <i>Dinetus truncatus</i>            | 19b = <i>Tridynamia sinensis</i> var. <i>delavayi</i> |
| 11 = <i>Duperreya commixta</i>           | 20 = <i>Tridynamia spectabilis</i>                    |

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