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Genera of the Vernonieae (Asteraceae) of China with a Study of Their Pollen

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ABSTRACT: The genera and species of Vernonieae in China are reviewed using revised generic concepts. The recognized genera are *Acilepis, Baccharoides, Camchaya, Cyanthillium, Decaneuropsis, Distephanus, Elephantopus, Ethulia, Gymnanthemum, Khasianthus, Monosis, Pseudelephantopus, Strobocalyx,* and *Tarlmounia.* The pollen of each genus is described and illustrated. Keys are provided to genera and species.

KEY WORDS: Vernonieae, Asteraceae, pollen, SEM, generic descriptions, keys, China.

INTRODUCTION

Generic revisions in the tribe Vernonieae during the last 30 years have been generally completed for the Western Hemisphere members (Robinson, 1999b), but were only partially and inadequately dealt with in the Eastern Hemisphere members (Robinson, 1999a). These treatments were summarized in the Kubitzki volume (Robinson, 2007). Although the work was incomplete, one fact was unmistakable, the genus *Vernonia* Schreb., sensu stricto, was an exclusively Western Hemisphere, mostly North American entity. There is no *Vernonia* native to the Eastern Hemisphere.

While the reassignment of species from *Vernonia* to other genera in the Western Hemisphere is largely complete, the Eastern Hemisphere species are still mostly retained under the name *Vernonia* due to the lack of proper published alternatives. The partial revision of Eastern Hemisphere Vernonieae (Robinson, 1999a) placed a number of common species in segregate genera, but most species were unplaced, and some others need corrections. It is only in the last few years that important further progress has been made in Asian members of the tribe with the recognition of *Monosis* DC. in Wight (Robinson and Skvarla, 2006), *Decaneuropsis* H. Rob. and Skvarla (2007), *Strobocalyx* (Bl. ex DC.) Spach. and *Tarlmounia* H. Rob., S.C. Keeley, Skvarla and Chan (2008), and expansion of the concept of *Acilepis* D. Don (Robinson and Skvarla, 2009a).

In spite of recent progress, revisions of the Vernonieae for the entire Paleotropical region are far from complete, but all of the species reported from China have now been resolved. It seems best to present the completed results on a country by country basis, and not to wait for resolution of species in other areas such as India (Uniyal, 1995) which has a more complex Vernonian flora. Of additional interest in the case of China, most of the genera seem to have distinctive forms of pollen. For that reason, pollen is reviewed and illustrated with SEM micrographs for each genus.

MATERIALS AND METHODS

Specimens examined are from the U.S. National Herbarium in Washington, D.C. (Appendex). Examination of characters with a light microscope involved use of Hoyer's Solution (Anderson, 1954). Pollen grains in illustrations were in one case (Fig. 1F) unacetolysed, but were mostly treated with acetolysis (Erdtman, 1960), followed by staining with osmium thiocarbohydrazide solutions and sputter coating with gold/palladium (Robinson and Skvarla 2006, 2007, Robinson et al., 2008). Unacetolyzed grains were rehydrated in water or alcohol directly from herbarium sheets and similarly sputter coated. Observations were made with a JEOL 880 (Samuel Roberts Microscopy Laboratory at the University of Oklahoma), or a LEICA 440 and AMRAY 1810 (United States National Museum of Natural History in Washington) scanning electron microscopes (SEM), all equipped with lanthanum hexaboride (LaB_6) electron sources.

RESULTS

The tribe Vernonieae of the plant family Asteraceae is pantropical in distribution with some elements,

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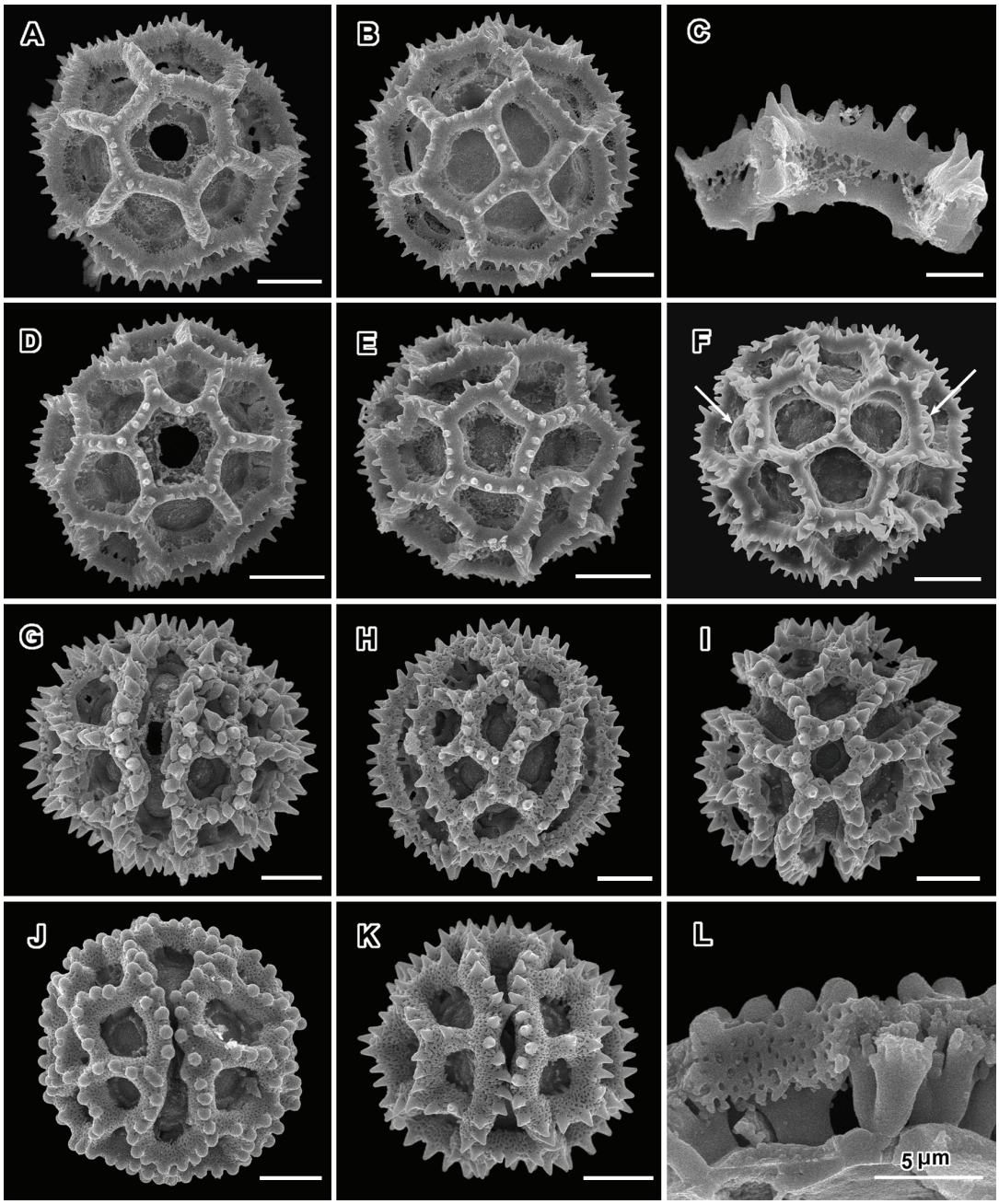


Fig. 1. Scanning electron micrographs of *Acilepis* and *Baccharoides* pollen. A: *Acilepis attenuata*, equatorial (poral) view (Henry 11692). B: *Acilepis attenuata*, oblique lateral view (Henry 11692). C: *Acilepis attenuata*, exine fragment (Henry 11692). D: *Acilepis divergens*, equatorial (poral) view (Saldanha 12223). E: *Acilepis divergens*, polar view (Saldanha 12223). F: *Acilepis saligna*, polar view of unacetolyzed grain showing aperture caps at arrows (Henry 12714). G-L. Sculptural variations in three collections of *Baccharoides anthelmintica* pollen. G: Equatorial (poral) view (USDA P. J. 283729). H: Lateral view (USDA P. J. 283729). I: Polar view (USDA P. J. 283729). J: Equatorial (poral) view (Koelz 7469). K: Equatorial (poral) view (Cooray 70031701R). L: Fractured grain (Koelz 7469). All pollen acetolyzed except F. Unless indicated, all scale bars = 10 µm. Collector data in parenthesis.

including the genus *Vernonia* Schreb., extending northward into eastern North America. In China, members extend northward into the southern and coastal parts of the country and in the interior in Yunnan Province. None of the Chinese species belongs to the genus *Vernonia*, but the genera in China are all more widespread in southern Asia or introduced from Africa.

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The Vernonieae are members of the subfamily Cichorioideae whose oldest members seem to be from the area of Africa or the Indian Ocean. The tribe is distinct in the undivided stigmatic surface inside of its style branches, the sweeping hairs on the outer surface of the style branches sometimes extending onto the upper shaft of the style, the homogamous heads without ray florets and usually without liguliform florets, the usually reddish to bluish color of the corollas (except in *Distephanus* Cass.), the usual lack of latex in the stems, the usual lack of phytomelanins in the achene walls, the usually alternate leaves and usually pinnate venation of the leaves (trinervate in *Distephanus*).

The pollen of the Vernonieae, with few exceptions is sublophate or lophate in exine pattern, and has an extreme diversity of lophate forms including tricolporate, triporate or even 6-porate (Bunwong and Chantaranothai, 2008), in some cases showing the most complete loss of a perforated exine in the subfamilies Cichorioideae and Asteroideae. Variation in spinulosity is notable, and muri in lophate forms vary in the presence or absence of rhizomiform bases. As a result, each of the genera of Vernonieae in China can be distinguished by its pollen. Some of the pollen differences are included in the following key.

The following treatment is partially based on the treatment in the Flora Republicae Popularis Sinicae by Chen (1985).

Key to the genera of Vernonieae in China

1. Woody trees, large shrubs or vines; leaves often coriaceous …… 2
1. Herbs, sometimes subshrubs or weak shrubs; leaves usually membraneous or chartaceous …… 7
2. Leaves trinervate or triplinervate; corollas yellowish …… *Distephanus*
2. Leaf venation pinnate; corollas purple to bluish or white …… 3
3. Plants scandent or scrambling shrubs; inflorescences elongate-thyrsoid; sweeping hairs of the style branches blunt …… 4
3. Erect shrubs or trees; sweeping hairs of style branches acute or blunt …… 5
4. Hairs of the stems and leaves simple, not T-shaped; corollas slender -stalked, with bases elongate and filiform; bases of styles without nodes; achenes strongly 10-ribbed; pollen sublophate, with perforated tectum continuous over incipient lacunae …… *Decaneuropsis*
4. Hairs of the stems and leaves T-shaped with long arms, short -stalked and pressed against stems or leaf surface, sericeous; corollas without long slender bases; style with distinct basal node; pollen nonlophate, densely spinulose, without incipient lacunae but with perforated tectum continuous over noncolpar surfaces …… *Tarlmounia*
5. Leaves strongly obovate, with basal secondary veins spreading nearly straight toward leaf margins; inflorescence pyramidally thyrsoid; sweeping hairs stout and pointed; pollen tricolporate, echinolophate with 3 or 4 equatorial lacunae in each intercolpus, tectum lacking obvious perforations, tectum absent in centers of lacunae; chromosome number n = 27, 30 …… *Monosis*
5. Leaves ovate to elliptic, with basal secondary veins curved and often becoming subparallel with basal leaf margins; inflorescence corymbiform to somewhat cymiform; sweeping hairs pointed or blunt …… 6
6. Corollas with slender bases; achenes strongly 10-ribbed; style base without large node; sweeping hairs of style branches pointed; pollen sublophate with continuous perforated tectum over incipient lacunae, columellae centered under spines …… *Gymnanthemum*
6. Corollas widening from near base; achenes 5-ribbed to weakly 10-ribbed; style base with large distinct node; sweeping hairs of style branches blunt; pollen nonlophate, with crowded spinules and without distinct incipient lacunae, with more than one columella or projection from perforated tectum under spines; chromosome number n = ca. 30. …… *Strobocalyx*
7. Pappus absent; pollen sublophate with perforated tectum continuous over intercolpi …… *Ethulia*
7. Pappus present, coroniform, awned, or of capillary bristles; pollen lophate, tectum discontinuous in lacunae …… 8
8. Inflorescences with heads consistently containing four florets; corollas zygomorphic; anther bases without spurs or shortly spurred; pappus usually of 5 awns …… 9
8. Heads with florets not consistently 4; corollas not zygomorphic; anthers with long spurs at base; pappus usually of many capillary bristles …… 10
9. Heads condensed into pedunculate, broad, compound heads enclosed in foliose bracts; pappus awns straight; chromosome number n = 11 …… *Elephantopus*
9. Heads sessile in axils of leaves or bracts; pappus of contorted awns; chromosome number n = 13 …… *Pseudelephantopus*
10. Achenes with ribs reaching base, carpopodium absent; pappus coroniform or with short, easily deciduous capillary bristles shorter than the achene body; annuals; chromosome number n = 10; pollen 6-porate with pores in three pairs straddling a murus. …. *Camchaya*
10. Achenes with distinct basal carpopodium; pappus of many capillary or flattened bristles longer than the body of achene; annuals or perennials; pollen with 3 pores. …… 11
11. Pollen tricolporate, echinlophate, with single lacunae at poles; corollas with slender bases one of two times as long as limb; base of style without node …… 12
11. Pollen triporate, without regular arrangement of lacunae at poles; slender corolla bases usually shorter than limb; base of style with distinct node. …… 13
12. Heads subtended by foliose bracts as long as the involucral bracts; slender base of corollas more than twice as long as limb; pappus bristles flattened on outer surface; lower part of leaf blades with ascending or upward curving secondary veins; chromosome number n = 10 …… *Baccharoides*
12. Heads without foliose or membraneous appendaged bracts at base of involucre; slender bases of corollas about as long as limb; pappus segments scabrid on outer surface; lower part of leaf blades cuneate with mostly spreading secondary veins. …… *Khasianthus*
13. Perennial herbs; stems, leaves and involucres with simple hairs; achenes 10-ribbed, setulae of achenes deeply divided into unequal halves; pappus of many capillary bristles reaching nearly as long as corolla; pollen lophate, triporate, tectum without obvious microperforations, muri weakly attached to foot layer and sometimes peeling away as a unit; chromosome number n = 18. …… *Acilepis*
13 Annual or short-lived perennial herbs; hairs of stems, leaves and involucres T-shaped; achenes 5-ribbed, without deeply divided unequally branched setulae; pappus often short; pollen lophate, triporate, tectum with distinct perforations, muri firmly attached to foot layer only at interstices; chromosome number n = 9, 11, 18 …… *Cyanthillium*

The genera and species of Vernonieae in China

Acilepis D. Don, Prodr. Fl. Nepal. 169. 1825. Type: *Vernonia squarrosa* D. Don. Figs. 1A-F

臺灣大學學術期刊資料庫

Lysistemma Steetz in Peters, Reise Mossamb. Bot. 340. 1864. Type: *Lysistemma. dendigulense* (DC.) Steetz.
Xipholepis Steetz in Peters, Reise Mossamb. Bot. 344. 1864. Type: *Xipholepis silhetensis* Steetz
Vernonia sect. ***Xipholepis*** (Steetz) Benth. & Hook. f., Gen. Pl. 2: 229. 1873.

Treatment by Robinson and Skvarla (2009a). Studies on the paleotropical Vernonieae (Asteraceae). Additions to the genus *Acilepis* from southern Asia. Proc. Biol. Soc. Wash. 122(2): 131-145.

Erect perennial herbs; stems terete to pentangular; hairs multiseptate at base and often with long subfusiform apical cell. Leaves alternate; petioles short; blades obovate to oblong-ovate, margins remotely serrate, apex acute to short-acuminate, with secondary veins pinnate, ascending at 45° angles or more. Inflorescence of single terminal heads, racemiform to spiciform cymes, or corymbiform cymes with few to many heads; peduncles elongate to short or lacking; involucres funnelform to broadly campanulate; bracts 30-200 in 5-12 series, gradate, persistent, mostly subcoriaceous, apiculate to long-attenuate at apex; receptacle epaleaceous, with or without hairs. Florets 25-80 in a head; corollas lavender, tubes slender below, funnelform into throat above, throat half or less as long as anther thecae, lobes long and narrow, with glandular dots outside; anther thecae blunt at base, not tailed; apical anther appendages glabrous, with thin-walled cells; style base with distinct node; style branches with acicular sweeping hairs. Achenes 8-10 ribbed, setulae when present with paired cells unequal, deeply divided with one of the cells short; raphids oblong with rhomboid tips; pappus whitish to somewhat reddish, with short capillary or scarcely broadened outer series, inner series long, of many barbellate, capillary bristles nearly as long as corolla, both series rather easily deciduous. Chromosome number x = 18.

Pollen: 27-45µm diameter, triporate, echinolophate, ca. 27 lacunae somewhat irregularly disposed at poles and in intercolpi; tectum restricted to muri, without evident microperforations, bits of tectum often continuing downward as curtain over part of columellae; spinules of muri numerous, short, shorter than width of mural ridge, blunt; columellae close-set under mural ridge, ca. as close-set as spinules; columellae linked below by rhizomiform structure that is weakly attached to foot layer, muri thus easily peeling off of body of grain.

A genus with 33 presently recognized species in India and southeast Asia, the following eight species known from China.

Key to the Chinese species of *Acilepis*

1. Involucres of mature heads 5-6 mm high, with 5-6 series of bracts ……..… 2
1. Involucres of mature heads 9-11 mm high, with 7-10 or more series of bracts ……... 4
2. Inflorescences with many heads in dense clusters; leaf blades ovate and acuminate below to a petioliform base. ……. *A. divergens*
2. Inflorescences with heads in lax panicles; leaf blades sessile or subsessile without acuminate base. ……. 3
3. Achenes with setulae; peduncles mostly 1 cm long or longer. ……. ……. *A. attenuata*
3. Achenes without setulae; peduncles mostly shorter than 1 cm. ..…. ……... *A. saligna*
4. Inflorescences with numerous heads in dense clusters ……..…. 5
4. Inflorescences with few large heads solitary or in small clusters of 2-4. …….. 6
5. Achenes with numerous setulae; involucral bracts with short apical acuminations or apicula ……..…. *A. aspera*
5. Achenes with few or no setulae; lower and middle involucral bracts with slender dark apical acuminations ……..…. *A. clivorum*
6. Involucral bracts with strongly reflexed or hooked tips ….. *A. spirei*
6. Involucre bracts with tips not strongly reflexed or hooked. ……. 7
7. Heads on elongate peduncles, without immediately subtending foliose bracts; pappus bristles not obviously broadened at tips. ..…. ……. *A. nantcianensis*
7. Heads terminal or axillary with 1 or more immediately subtending leaves or foliose bracts; involucre with numerous crowded, lanceolate bracts; pappus bristles with somewhat broadened tips. ……..…. *A. squarrosa*

Acilepis aspera (Buch.-Ham.) H. Rob., Proc. Biol. Soc. Wash. 112(1): 226. 1999.

Vernonia aspera Buch.-Ham. pro parte, Trans. Linn. Soc. London 14: 219. 1824.
Eupatorium pyramidale D. Don., Prodr. Fl. Nepal 170. 1825.
Vernonia roxburgii Less., Linnaea 6: 674. 1831.
Xipholepis aspera (Buch.-Ham.) Steetz in Peters, Reise Mossamb. Bot. 345. 1864.
Vernonia thorelii Gagnep., Bull. Museum Paris 492. 1919,
Vernonia pyramidalis (D. Don) Mitra, Ind. J. For. 99: 100. 1973.

China (Hainan), Myanmar, Thailand.

Acilepis attenuata (DC.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 122(2): 137. 2009a. Figs. 1A-C

Conyza attenuata Wall., Numer. List [Wallich] n. 3030, comp. 130, nom. nud.
Vernonia attenuata Wall. ex DC., Prodr. 5: 33. 1836.

China (Yunnan), India, Thailand.

Acilepis clivorum (Hance) H. Rob., Proc. Biol. Soc. Wash. 112(1): 226. 1999.

Vernonia clivorum Hance, J. Bot. 7: 164. 1869.
Aster coriaceiformis H. Lév & Vaniot, Repert. Spec. Nov. Regni. Veg. 8: 358. 1910.

China (Hainan, Yunnan), Vietnam, Thailand, India (Assam).

Acilepis divergens (Roxb.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 122(2): 140. 2009a. Figs. 1D & E

臺灣大學學術期刊資料庫

Conyza divergens Wall., Numer. List [Wallich] n. 3027A comp. 137, nom. nud.
Conyza multiflora Wall., Numer. List [Wallich] n. 3032q, comp. 142, nom. nud.
Conyza lanceolata Wall., Numer. List [Wallich] n. 3059, comp. 169, nom. nud.
Eupatorium versicolor Wall., Numer. List [Wallich] n. 3167, comp. 277, nom. nud.
Eupatorium polyanthemum Wall., Numer. List [Wallich] n. 3171, comp. 281, nom. nud.
Eupatorium divergens Roxb., Fl. Ind. (Roxburgh) 3: 414. 1832.
Decaneurum divergens (Roxb.) DC. in Wight, Contr. Bot. India. 8. 1834.
Vernonia nilgheryensis DC., Prodr. 5: 32. 1836.
Vernonia divergens (Roxb.) Edgew., J. Asiat. Soc. Bengal 2: 172. 1853.
Lysistemma divergens (Roxb.) Steetz in Peters. Reise Mossamb. Bot. 341. 1864.
Lysistemma multiflorum Steetz in Peters, Reise Mossamb. Bot. 341. 1864.
Gymnanthemum metzianum Sch. Bip. ex Hook.f., Fl. Brit. India 3: 234. 1881, nom. nud.
Vernonia metziana Sch. Bip. ex Hook.f., Fl. Brit. India 3: 234. 1881, nom. nud.

China (Yunnan), Vietnam, Thailand, India (Mysore, Assam, Bengal).

Acilepis nantcianensis (Pamp.) H. Rob., Proc. Biol. Soc. Wash. 112(1): 226. 1999.

Vernonia bracteate var. *nantcianensis* Pamp., Nouv. Giorn. Bot. Ital, n.s. 18: 98. 1911.
Vernonia silhatensis var. *nantcianensis* (Pamp.) Hand.-Mazz,. Symb. Sin. 7: 1084. 1930.
Vernonia nantcianensis (Pamp.) Hand.-Mazz, Notisbl., Bot. Gart. Mus. Berl.-Dahl. 13: 608. 1937.

China (Hupeh, Szechuan).

Acilepis saligna (DC.) H. Rob., Proc. Biol. Soc. Wash. 112(1): 226. 1999. Fig. 1F

Conyza saligna Wall., Numer; List [Wallich] n. 3061, comp. 171, nom. nud.
Eupatorium longicaule Wall., Numer. List [Wallich] n. 2169, comp. 279, nom. nud.
Vernonia saligna DC., Prodr. 5: 33. 1836.
Vernonia longicaulis DC., Prodr. 5: 33. 1836.
Vernonia martinii Vaniot, Bull, Acad. Intern. Geogr. Bot. 12: 124. 1903.
Vernonia sequinii Vaniot, Bull. Acad. Intern. Geogr. Bot. 12: 124. 1903.

China (Yunnan), India, Assam, Sikkim.

Acilepis spirei (Gandog.) H. Rob., Proc. Biol. Soc. Wash. 112(1): 227. 1999.

Vernonia spirei Gandog., Bull. Soc. Bot. France 54: 194. 1907.

China (Yunnan), Laos.
The species seems very close to *A. silhetensis*.

Acilepis squarrosa D. Don., Prodr. Fl. Nepal. 169. 1825.

Vernonia squarrosa (D. Don) Less., Linnaea 6: 627. 1831.
Vernonia rigida Wall., Numer. List [Wallich] n. 2925, comp. 35, nom. nud.
Vernonia teres Wall., Numer. List [Wallich] n. 2926. comp. 35, nom. nud.
Vernonia rigiophylla DC., Prodr. 5: 15. 1936.
Vernonia teres Wall. ex DC., Prodr. 5: 15. 1836.

China (Yunnan), India, Nepal.

Baccharoides Moench, Methodus 328. 1794. Type: *Conyza anthelmintica* L. Figs. 1G-L

Ascaricida Cass., Dict. Sci. Nat. 3, suppl. 38. 1817, nom. supfl. Type: *Conyza anthelmintica* L.
Candidea Tenore, Atti Reale Accad. Sci. Sez. Soc. Reale Borbon 4 (CI. Botan.): 104, t. 1, 2. 1839. Type: *Candidea senegalensis* Tenore.
Vernonia subsect. *Stengelia* Sch.Bip. ex Walp., Repert. Bot. Syst. 2: 946. 1843. Type: *Vernonia adoensis* Sch.Bip. ex Walp.
Stengelia Steetz in Peters, Naturw, Reise Mossambique, Bot. 360. 1864. Type: *Vernonia schimperi* DC.
Vernonia* sect. *Stengelia (Sch.Bip. ex Walp.) Benth. in Benth. & Hook.f., Gen. Pl. 2: 127. 1873.

Treatment by Isawumi, M. M., G. El-Ghazzly and B. Nordenstam. 1996. Pollen morphology, floral microcharacters and taxonomy of the genus *Baccharoides* Moench (Vernonieae: Asteraceae). Grana 35: 205-230.

Perennial herbs, suffruticose; stems erect or reclining; hairs short-stalked with an erect, elongate apical cell. Leaves alternate, narrowly petiolate; blades chartaceous, ovate to elliptic, serrate, secondary veins pinnate, ascending at 45° angles or more. Inflorescence with single lateral or terminal head or heads in corymbiform groups; peduncles usually solid, sometimes fistulose. Heads with involucres broadly campanulate or hemispherical; bracts 25-100 in 4-8 series, mostly gradate but with outer bracts sometimes elongate and foliiform, tips of bracts appendaged, white or colored; receptacles epaleate. Florets 25-100 in a head; corollas reddish or lavender to white, with long slender basal tube, limb abruptly expanded at base, cylindrical, with lobes about as long as throat, erect, with various hairs and glands outside, inside with cells elongate, transversely striate; anther thecae spurred with small tails; endothecial cells with nodular thickenings on transverse walls; apical appendages oblong-ovate, rounded or acute at tips, glabrous; nectary elongate, cylindrical; style base without node; sweeping hairs acicular. Achenes cylindrical or turbinate, 8-20-costate, glabrous or with setulae or glands or idioblasts, carpopodium annuliform, large to obsolete, with

臺灣大學學術期刊資料庫

thickened porose walls, raphids in ovules elongate, with rhomboid tips; pappus pluriseriate, persistent or caducous, inner capillary, flattened, barbellate on margins, sometimes shortly connate at base, sometimes with outer row of small scales. Chromosome number x = 10

Pollen: 43.5-72.0 µm diameter (Isawumi et al., 1996); tricolporate, echinolophate; lacunae regularly disposed, one at each pole, 2 across intercolpus; tectum restricted to muri, with distinct microperforations; stout columellae firmly attached to foot layer.

A single species is known from China.

Baccharoides anthelmintica (L.) Moench, Method. 578. 1794. Figs. 1G-L

Conyza anthelmintica L., Sp. Pl. ed 2, 1207. 1763.
Vernonia anthelmintica (L.) Willd., Sp. Pl. 3: 1634. 1803.
Centratherum anthelminticum (L.) Gamble, Fl. Pres. Madras 2: 667. 1921.
Vernonia stenolepis Oliv., Trans Linn. Soc. ser 2, 2: 337. 1887.
Dolosanthus sylvaticus Klatt, Bull., t. 5. 1896.

Subshrubs. Chromosome number n = 10. Sri Lanka, India, China, widely cultivated, introduced in parts of America.

Camchaya Gagnep. in Lecomte, Not. Syst. 4: 14. 1920. Figs. 2A-C

Thorelia Gagnep. in Lecomte, Not. Syst. 4: 18. 1920.
Thoreliella C.Y. Wu, Acr. Phytotax. Sin. 6: 297. 1957.

See treatment by Koyama, H. 1984. Taxonomic studies in the Compositae of Thailand 3. Act. Phytotax, Geobot. 35: 49-58.

Annual herbs; stems erect or ascending; hairs T-formed and simple. Leaves alternate; petioles narrow, short to elongate; blades membraneceous, ovate, margins slightly to distinctly serrate, secondary veins pinnate, often spreading at more than 45° angles, arching distally. Inflorescence sparsely branched, with elongate peduncles Heads with involucres campanulate; bracts 20-130 in 3-5 series, only partly herbaceous, gradate, spinose and sometimes barbellate at tips; receptacles epaleaceous. Florets 12-130 in a head; corollas pale, delicate, with narrow, glanduliferous, basal tubes and narrowly funnelform limbs, throat about as long as lobes, lobes linear, nearly glabrous, not reflexed; anther thecae rounded at base; endothecial cells subquadrate, with nodular thickenings on transverse walls; apical appendage triangular, acute at tip; style base without node; style branches with acicular sweeping hairs, with short acuminate apical appendage. Achenes obovate, with 5 or 10 prominent ribs, with or without setulae, raphids short rhomboid to elongate, ribs reaching base and curving inward, without evident carpopodium; pappus lacking and with coroniform rim or with 5-10 short very deciduous bristles. Chromosome number 2n = 20

Pollen: ca. 40-60 µm in diameter (in Hoyer's solution), 6-porate with pores in three pairs each pair straddling a murus, echinolophate, lacunae ca. 27, somewhat irregularly disposed at poles and in intercolpi, tectum restricted to muri, without evident microperforations, spinules numerous, short, shorter than width of mural ridge, blunt; columellae stout, firmly attached to foot layer below. See Bunwong and Chantanothai (2008) for notes and illustrations.

A genus of ca. eight species with one occurring in China.

Camchaya loloana Kerr., Kew Bull. Misc. Inf. 1935: 327. 1935. Figs. 2A-C

Vernonia loloana Dunn ex Kerr in Craib., Fl. Siam. 2: 236. 1936.
Thorelia montana Gagnep. in Lecomte, Nat. Syst. 4: 18. 1920. *Thorelia montana* (Gagnep.) C.Y. Wu, Act. Phytotax. Sin. 6: 297. 1957.

China (Yunnan).

Cyanthillium Blume, Bidjr. 889. 1826. Type: *C. villosum* Blume. Figs. 2D-F

Isonema Cass., Bull. Soc. Philom. Paris 1817: 152. 1817, hom. illeg., non R. Br. (1810). Type: *Isonema ovata* Cass.
Vernonia sect. *tephrodes* DC., Prodr. 5: 24. 1836. Lectotype: *Conyza cinerea* Blume
Cyanopsis Blume ex DC., Prodr, nom. illeg. et superfl., non Cassini (1817)
Seneciodes L. ex Post & O. Kuntze, Lex. Gen. Phan. 2: 515. 1903. Type: *Conyza cinerea* L.
Triplotaxis Hutch., Bull. Misc. Inform. 1914: 355. 1914. Lectotype: *Herderia stellifera* Benth. in Hook.f.
Vernonia subsect. *tephrodes* (DC.) S.B. Jones, Rhodora 83: 70. 1981.

Annual or short-lived perennial herbs to 1 m tall; stems erect or spreading; hairs symmetrically or asymmetrically T-shaped with short stalk. Leaves alternate; petioles narrow; blades membraneceous, ovate to narrowly lanceolate. Inflorescences terminal, moderately densely to laxly branching, distinctly cymiform or with rather corymbiform branches, with minute bracteoles; peduncles rather short to elongate. Heads narrowly campanulate, involucral bracts ca. 30 in 3(-5) series, gradate, thinly chartaceous, green with pale or purplish margins, persistent, often with sericeous pubescence; receptacles epaleaceous. Florets 15-94 in a head; corollas bluish to lavender, funnelform with slender lower tubes, throat a third as long to nearly as long as lobes, lobes with simple hairs especially near tips; anthers without tails; apical appendages

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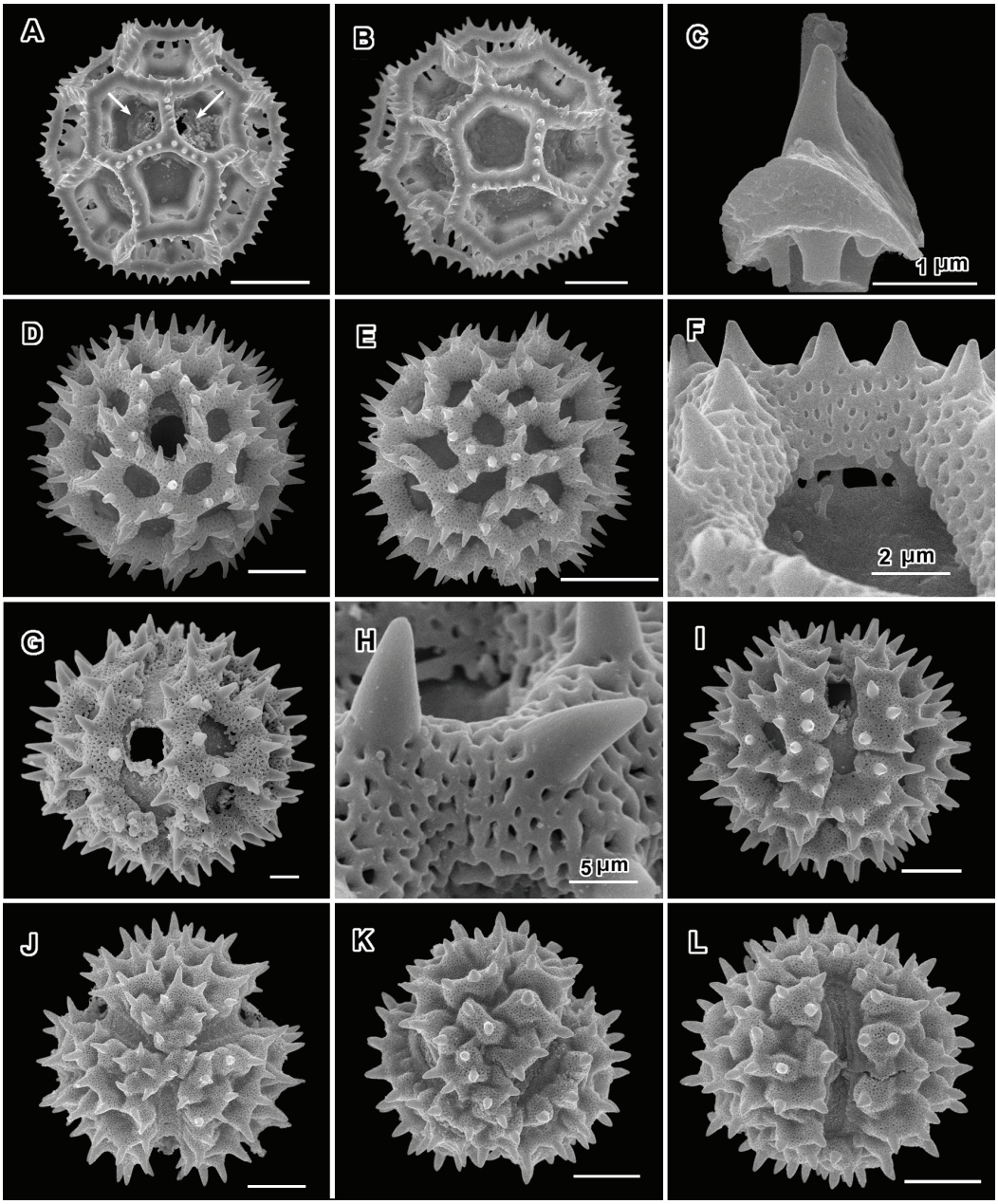


Fig. 2. Scanning electron micrographs of *Camchaya, Cyanthillium, Decaneuropsis*, and *Distephanus* pollen. A: *Camchaya loloana*, equatorial view showing partially covered pores (arrows) in lacunae separated by a ridge (Henry 12375A). B: *Camchaya loloana*, lateral view (Henry 12375A). C: *Camchaya loloana*, fragment of spine, ridge and columellae (Henry 12375A). D: *Cyanthillium cinereum*, equatorial (poral) view (Evans 344). E: *Cyanthillium cinereum,* near polar view (Shi-Hsien Lin 685). F: *Cyanthillium patulum*, view showing areas of partial separation and connection of lophal and lacunar areas (Taam 1722). G: *Decaneuropsis blanda*, equatorial (poral) view (Lei 311). H: *Decaneuropsis blanda*, enlargement of microperforate, spiny lophate surface (Lei 311). I: *Decaneuropsis cumiangiana*, slightly oblique equatorial (poral) view (Taam 1917). J: *Distephanus forestii*, polar view (Rock 5146). K: *Distephanus henryi*, polar view (Forest 21069). L: *Distephanus henryi*, equatorial (poral) view (Forest 21069). Unless indicated, all scale bars = 10 μm. Collector data in parenthesis.

oblong-ovate, glabrous, with thin cell walls; style base with broad node; style branches with acicular sweeping hairs. Achenes 5-ribbed, or terete, with idioblasts, sometimes with glands, raphids elongate; inner pappus of many long, sometimes rather fragile, slender-tipped capillary bristles, outer series of persistent squamellae, one species with callose ring. Chromosome number n = 9, 11, 18.

臺灣大學學術期刊資料庫

Pollen: ca. 30 µm in diameter (dry); triporate, echinlophate, ca. 21 lacunae rather irregularly disposed at poles and in intercolpi; tectum restricted to ridges of muri, with distinct microperforations; spinules of muri short, shorter than width of mural ridge, pointed, without columellae under each murus, each intersection of muri with stout columella that is firmly attached to foot layer.

A genus of numerous sometimes weedy species. Three species occur in China.

Key to the Chinese species of *Cyanthillium*

1. Pappus biseriate, inner pappus about as long as corolla; body of achene not conspicuously angular, with many setulae. .... *C. cinerea*
1. Pappus unseriate, 1-3 mm long, much shorter than corolla; body of achene 4-6-angled, without setulae, with glands. …….... 2
2. Plants to 10 cm tall, with crowded leaves, leaf blades oblanceolate; heads 6-7 mm high. ……..…... *C. maritima*
2. Plants 30-90 cm tall, with uncongested leaves, leaf blades ovate; heads 8-10 mm high. ……..…….. *C. patula*

Cyanthillium cinereum (L.) H. Rob., Proc. Biol. Soc. Wash. 103: 252. 1990. Figs. 2D & E

Conyza cinerea L., Sp. Pl. 862. 1753.
Vernonia cinerea (L.) Less, Linnaea 4: 291. 1829.
Seneciodes cinerea (L.) Post & L. Kuntze, Lex. Gen. Phan. 2: 515. 1903.

Southern Asia to China, Africa, Pacific Islands, introduced in America.

Cyanthillium maritimum (Merr.) H. Rob. & Skvarla, comb. nov.

Vernonia maritima Merr., Philipp. J. Bot. 3: 404. 1908.
Vernonia kawakamii Hayata, J. Coll. Sci. Univ. Tokyo 30(1): 149. 1911

China, Philippines.

Cyanthillium patulum (Ait.), Hortus Kew 3: 184. 1789. Fig. 2F

Conyza patula Ait., Hortus Kew 3: 184. 1789.
Isonema ovata Cass., Bull. Soc. Philom. Paris 1817: 152. 1817.
Cyanthillium villosum Blume, Bijdr. Fl. Ned. Ind. 889. 1826.
Cyanthillium pubescens Blume, Bijdr. Fl. Ned. Ind. 890. 1826.
Cyanopis madgascariensis DC., Prodr. 5: 69. 1836.
Vernonia pratensis Klatt, Ann. K. K. Naturhist. Hofmus. 7: 99. 1892.
Cacalia patula (Less.) O. Kuntze, Rev. Gen. Pl. 324. 1894.

Southern Asia to China, Africa, introduced in America.

Decaneuropsis H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 360 (2007). Type: *Vernonia cumingiana* Benth. Figs. 2G-I

See treatment by Robinson, H. and J. Skvarla. (2007), Studies on the Gymnantheminae (Asteraceae: Vernonieae). II: a new genus, *Decaneuropsis*, from China, India, southeast Asia and Malaysia. Proc. Biol. Soc. Wash. 120(3): 359-366.

Plants woody, scandent or subscandent, with mostly slender stems, with simple, symmetrical to somewhat asymmetrical hairs. Leaves alternate, short-petiolate, blades oblong to obovate, usually with glands abaxially, base cuneate to obtuse, margins entire or remotely denticulate, apex short-acuminate, surfaces concolorous, sometimes with veins and veinlets moderately exsculpate, glabrous or with erect or appressed hairs abaxially (Pl. 1B); secondary veins pinnate, regularly arching toward tips. Inflorescences on distal or lateral branches, elongate thyrsiform, narrowly pyramidal with corymbiform to thyrsiform lateral branches; heads clustered or solitary on usually relatively short peduncles; involucral bracts imbricated in 4-6 series, graduated, broadly obtuse to acute at tip, inner bracts tardily deciduous; receptacle sometimes hirsute. Florets 3-40+ in a head; corolla white to purple, 8-12 mm long, with long slender basal tube, becoming narrowly campanulate in limb, with glands on limb, especially on base of throat; anther thecae with broad tails at base; apical appendages narrowly ovate-oblong; glabrous; nectary cylindrical; style base without differentiated node, upper shaft and branches of style with blunt sweeping hairs. Achenes strongly 8-10-ribbed when mature, often puberulous with simple hairs or setulae, with small elongate raphids in wall, idioblasts not seen; carpopodium broad, obconical to cylindrical; pappus of numerous slender bristles, broadened distally, with relatively few or no shorter bristles interspersed.

Pollen: ca. 45 µm in diameter (in Hoyer's solution); tricolporate, echinate, sublophate; tectum continuous over intercolpi and poles, with distinct microperforations; columellae single and stout under each spine, solid, firmly attached to foot layer; interveing perforated tectum scarcely mamillose on inner surface.

Key to the Chinese species of *Decaneuropsis*

1. Heads up to 2 cm wide, with more than 20 florets ..…. *D. chingiana*
1. Heads mostly 1.0-1.2 cm wide, with 9-20 florets. ……... 2
2. Leaf blades with veinlets not exsculpate; receptacle not pubescent. …….. *D. blanda*
2. Leaf blades with veinlets exsculpate; receptacle pubescent. …..…. 3
3. Heads with ca. 18 florets. ……..…….. *D. cumingiana*
3. Heads with ca. 9 florets. ……..…… 4
4. Involucral bracts oblong, with short-acute tips, glabrous; involucres ca. 9 mm high. ……..... *D. andersonii*
4. Involucral bracts narrowly ovate to lanceolate, acute, with dense short pubescence on margins and tips; involucres ca. 12 high. ……..
…….. *D. gratiosa*

臺灣大學學術期刊資料庫

Decaneuropsis andersonii (C.B. Clarke) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 364. 2007.

Vernonia andersonii C.B. Clarke, Compos. Ind. 27. 1876.
Vernonia chevalieri Gagnap., Bull. Mus. Hist. Nat. (Paris). 488. 1919.
Vernonia sangka Kerr., Kew. Bull. 1935: 329. 1935.

India (Sikkim, Assam), Burma, Thailand, Vietnam, China (Yunnan).

Decaneuropsis blanda (DC.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 64. 2007. Figs. 2G & H

Vernonia blanda DC., Prodr. 5: 32. 1836.
Conyza blanda Wall., Cat. (Bull.) 3033 (1830), nom. nud.
Vernonia tavoyana C.E.C. Fisch., Kew Bull. 1927: 92. 1927.

India, Burma, Thailand, Vietnam, China (Hainan).

Decaneuropsis chingiana (Hand.-Mazz.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 364. 2007.

Vernonia chingiana Hand.-Mazz., Sinensia 7: 622. 1936.

China.

Decaneuropsis cumingiana (Benth. in Hook.f) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 364. 2007. Fig. 2I

Vernonia cumingiana Benth., Hooker's J. Bot. Kew Gard. Misc. 4: 232. 1852.

Hong Kong, adjacent China and Indochina.

Decaneuropsis gratiosa (Hance) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 120(3): 365. 2007.

Vernonia gratiosa Hance, J. Bot. 20: 290. 1882.
Vernonia andersonii C. B. Clarke var. *albipappa* Hayata, Icon. Pl. Formosan. 8: 42. 1919.

Taiwan.

Distephanus Cass., Bull. Soc. Philom. Paris 1817: 151. 1817. Type: *Conyza populifolia* Lam. Figs. 2J-L

Gongrothamnus Steetz in Peters, Reise Mossamb. Bot. 6(2): 336. 1864. Type: *Gongrothamnus divaricatus* Steetz in Peters
Newtonia O. Hoffm. In Engler & Prantl, Nat. Pflanzenfam. 4(5): 285. 1892, non Baill. (1888). Type: *Newtonia angolensis* Hoffm.
Antunesia O. Hoffm., Bot. Soc. Brot. 10: 178. 1893, nom. nov. for *Newtonia*.

See treatment by Robinson and Kahn, 1986. Trinervate leaves, yellow flowers, tailed anthers and pollen variation in *Distephanus* Cassini. Proc. Biol. Soc. Wash. 99(3): 493-501.

Shrubs or vines; hairs arachnoid, contorted or asymmetrically T-shaped. Leaves alternate; petioles short; blades ovate to rounded, often with truncate to subcordate bases, less often narrow with cuneate bases, margins usually entire or subentire, venation usually with stronger more ascending basal pair or strongly triplinervate, less often irregularly pinnate. Inflorescences terminal on stems or branches, with single heads or usually branching, corymbiform with minute bracts or thyrsoid with foliose bracts; peduncles usually short. Heads with campanulate involucres; bracts 21-24(-75) in 4-6(-7) gradate series, without appendaged tips; receptacles epaleaceous. Florets 10-16(-75) in a head; corollas usually yellow, purplish in a few continental African species; anther thecae with distinct broad often sclerified basal appendages; endothecial cells with simple, broad, non-contiguous, sclerified shields; apical appendages without glands; style base with large abruptly distinct node; style branches with obtuse sweeping hairs. Achenes cylindrical to prismatic, sometimes subtriquetrous or quadrangular, with 5-12 ribs, usually 10, setulae or glands present or absent, raphids elongate; carpopodium turbinate; pappus of many capillary bristles, outer series of squamellae.

Pollen: 30-36 μm in diam. (dry); tricolporate, sublophate to lophate; lophate forms with muri projecting as spurs into colpus, with echinate or with nearly psilate ridges; tectum continuous in intercolpi and at poles, or in pockets surrounded by ridges, with distinct perforations; with columellae under spines or with muri granular inside and without distinct columellae.

A genus of over 40 species, mostly in Africa, Madagascar and Indian Ocean Islands. Two species in Asia, both occurring in China.

Key to the Chinese species of *Distephanus*

1. Heads few or solitary, lateral on short peduncles or terminal on longer branches; involucral bracts with tips long-acuminate, recurved; involucre to 15 mm high. …….. *D. forrestii*
1. Heads crowded in terminal pyramidal panicles; involucral bracts with tips acute, mostly erect or appressed; involucre to 7 mm high. ……..…… *D. henryi*

Distephanus forrestii (Anthony) H. Rob. & B. Kahn, Proc. Biol. Soc. Wash. 99(3): 499. 1986. Fig. 2J

Vernonia forrestii Anthony, Nat. Bot. Gard. Edinb. 18: 35. 1933.

China (Yunnan).

Distephanus henryi (Dunn) H. Rob., Proc. Biol. Soc. Wash. 112(1): 238. 1999. Figs. 2K & L

Vernonia henryi Dunn, J. Linn. Soc. Bot. 35: 5000. 1903.

China (Yunnan).

Elephantopus L., Sp. Pl. 814. 1753. Lectotype: *Elephantopus scaber* L. Figs. 3A-G

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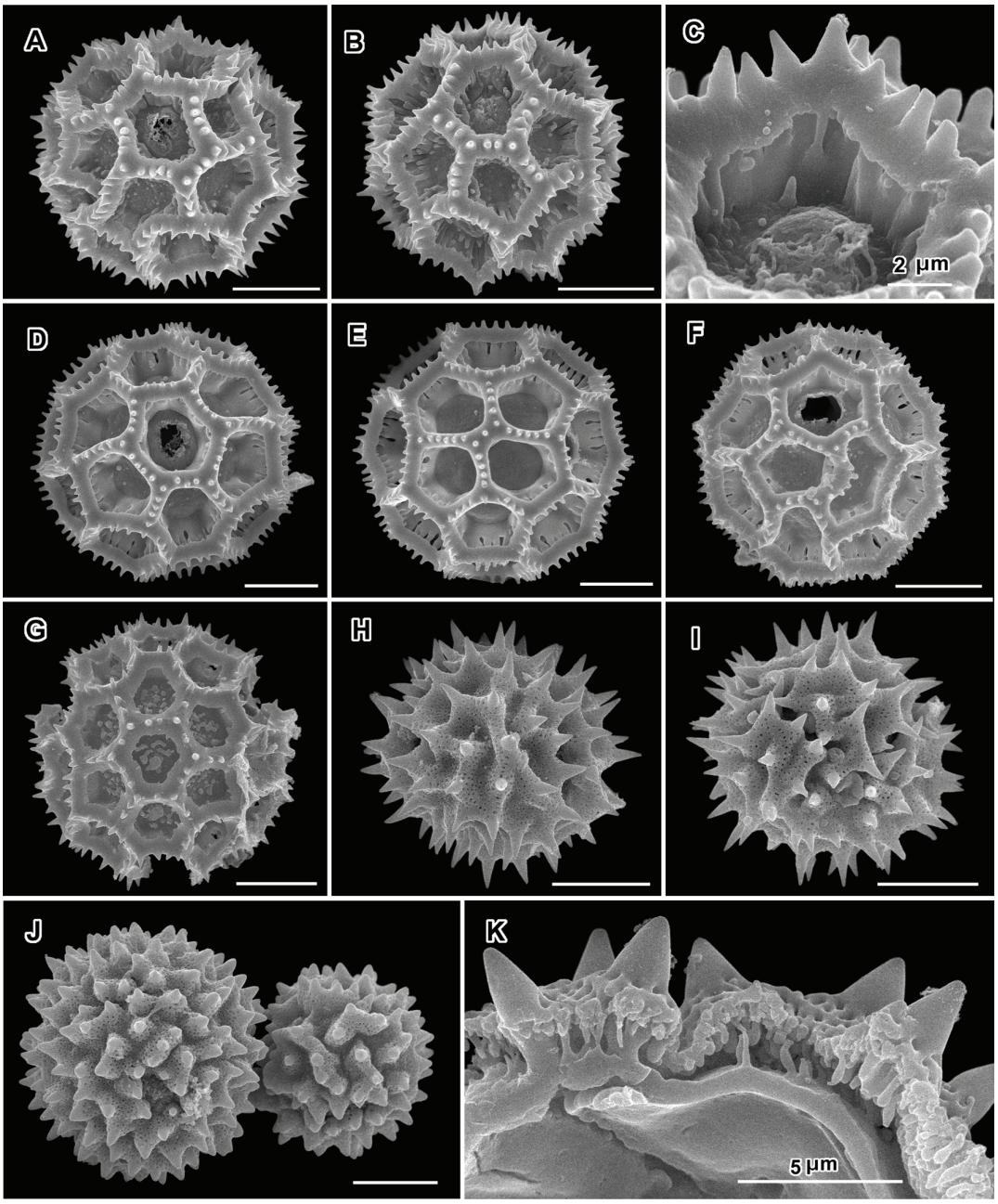


Fig. 3. Scanning electron micrographs of *Elephantopus* (three collections) and *Ethulia* (two collections) pollen. A: *Elephantopus scaber*, poral view (Levine 3355). B: *Elephantopus scaber*, polar view (Levine 3355). C: *Elephantopus scaber*, enlargement of lacuna and surrounding lophae (Levine 3355). D: *Elephantopus scaber*, poral view (Fosberg 50660). E: Elephantopus scaber, polar view (Fosberg 50660). F: *Elephantopus scaber* (Shiu Ying Hu 5682). G: *Elephantopus tomentosus* (Chow 78065). H: *Ethulia conyzoides*, lateral view (Lewis 6025). I: *Ethulia conyzoides*, polar view, (Lewis 6025). J: *Ethulia conyzoides*, two distinct pollen grain sizes (Petelot 4.047). K: *Ethulia conyzoides*, exine fracture (Petelot 4.047). Unless indicated, all scale bars = 10 µm. Collector data in parenthesis.

Elephantopsis Less., Linnaea 4: 322 (1829). Lectotype: *Elephantopsis biflora* Less.

Perennial herbs, with erect stems, sometimes multiple stems from base; pilose with simple stiff hairs. Leaves alternate, in basal rosette or cauline; sessile or short-petiolate; blades obovate to oblong, margins serrulate to serrate; venation pinnate with secondary veins usually spreading at ca. 60° angles. Inflorescnces cymiform to spiciform, with terminal or lateral glomerules of heads; glomerules enclosed in distinct

臺灣大學學術期刊資料庫

secondary involucre of foliiform bracteoles;individual heads cylindrical; involucral bracts decussate, 8 in 3 series, gradate. Florets (2-)4 in a head; corollas lavender, zygomorphic, with inner sinus deeper; anther thecae not calcarate, not tailed; apical appendage without glands; style base without node; branches with acicular sweeping hairs. Achenes 10-costate, setuliferous, raphids elongate; pappus bristles 5-15(-40-81), straight, basally winged, without outer series. Chromosome number x = 11.

Pollen: 27-30 μm in diameter (dry); triporate to subtricolporate, echinolophate; with 30-36 lacunae somewhat irregularly disposed at poles; tectum restricted to muri, with distinct microperforations, spines short-pointed, columellae under mural ridges moderately stout, firmly attached to foot layer.

A genus with ca. 15 species. Two species credited to China.

Key to the Chinese species of *Elephantopus*

1. Leaves basal or cauline; undersurfaces of blades pilose; pappus bristles 3.0-5.5 mm long. ……..… *E. scaber*
1. Leaves in basal rosette; undersurfaces of blades pilose to tomentose; pappus bristles 6-8 mm long. ……..……... *E. tomentosa*

Elephantopus scaber L., Sp. Pl. 814. 1753. Figs. 3A-F

Scabiosa cochinchinensis Lour., Fl. Cochinch. 68. 1790.
Asterocephalus cochinchinensis Spreng., Syst. 1: 380. 1825.

Southeast Asia, Sri Lanka, India, Nepal, southern China, Taiwan. It is not certain how the widespread *E. mollis* H.B.K. of Tropical America and the Pacific differs.

Elephantopus tomentosus L., Sp. Pl. 814. 1753. Fig. 3G

Elephantopus bodinieri Gagnep., Bull. Soc. Bot. France 68: 117. 1921.

Eastern North America, Mexico, Asia.

Ethulia L.f., Dec. Prima Pl. Rar. Horti Upsal. 1. 1762; L.f. ex L., Sp. Pl. ed. II: 1171. 1763. type: *Ethulia conyzoides* L. f. Figs. 3H-K

Hoehnelia Schweinf. in Höhn., Zum Rudolf-See und Stephanie-See 86. 1892. Type: *Hoehnelia vernonioides* Schweinf. in Höhn.

See treatment by Gilbert, M. G. and C. Jeffrey. 1988. A revision of *Ethulia* (Compositae: Vernonieae). Kew Bull 43(2): 165-193.

Annual or short-lived perennial herbs, rarely rhizomatous; stems terete and usually striate, with broad solid pith; hairs uniseriate with erect apical cells, with glandular dots. Leaves alternate, sessile or short petiolate; blades thinly herbaceous, ovate to linear lanceolate, base cuneate or continuous onto stem, margins subentire to serrate or dentate, apex acute to obtuse, surfaces glabrous to densely pubescent; venation pinnate with ascending secondary veins. Inflorescence terminal, corymbiform to rather cymiform, lower bracteoles a reduced foliiform, peduncular bracteoles filiform. Heads rather small, with broadly campanulate involucres; involucral bracts 15-40 in 2-3 usually subequal series; receptacle flat or slightly convex, epaleaceous. Florets 3-100 in a head, strongly exserted; corollas white or pink to purple, with glandular dots on surface, with a narrow cylindrical base, limb narrowly funnelform to narrowly campanulate. lobes lanceolate, without apical hairs; bases of anther thecae rounded, not tailed; apical appendages glabrous; style base without node; branches with sweeping hairs shortly acute. Achenes cylindrical to obconic, with 2-6 usually paler ribs, sides with glandular dots, rarely with short white setulae; raphids short-oblong; pappus lacking or a coroniform rim. Chromosome number n = 10, 20.

Pollen: ca. 35 μm in diam. in fluid; tricolporate, sublophate, echinate, spines long; tectum continuous in intercolpi and at poles, distinctly microperforate; columellae below spines firmly attached to foot layer.

A genus of ca. 12 species, mostly in Africa. One species widely adventive pantropically and in China.

Ethulia conyzoides L. f. Decas Prima Pl. Rar. Horti Upsal. 1, pl. 1. 1762. . Figs. 3H-K

Ethulia ramosa Roxb., Hort. Beng. 61. 1814.
Ethulia gracilis Delile in Cailliaud., Voy. Meroe 4: 398. 1827.
Ethulia angustifolia Bojer ex DC., Prodr. 5: 12. 1836.

Africa, introduced in Brazil & China.

Gymnanthemum Cass., Bull. Soc. Philom. Paris 1817: 10. 1817. Type: *G. cupulare* Cass. = *Baccharis senegalensis* = *Gymnanthemum coloratum* (Willd.) H. Rob. & B. Kahn. Figs. 4A-D

Bracheilema R. Br. ex Salt., Abyss. Append. 65. 1814, nom. nud.
Decaneurum DC., Arch. Bot. (Paris) 2: 516. 1833, nom. superfl., type same as *Gymnanthemum.*
Plectreca Rafin., Fl. Tellur. 4: 119. 1838, Type: *Staehelina corymbosa* Thunb.
Keringa Rafin., Sylva Tellur. 144. 1838. Type: *Vernonia amygdalina* Del.
Cheliusia Sch.Bip., Flora 24, 1. Intell. 26. 1841. Type: *C. abyssinica* Sch.Bip. = *Gymnanthemum amygdalinum* (Del.) Sch.Bip. ex Walp.
Vernonia subsect. *Urceolata* S.B. Jones, Rhodora 83: 67. 1981. Type: *Vernonia sphaerocalyx* O. Hoffm.

Shrubs or small trees, moderately to densely branching; stems mostly terete, with solid pith; hairs of

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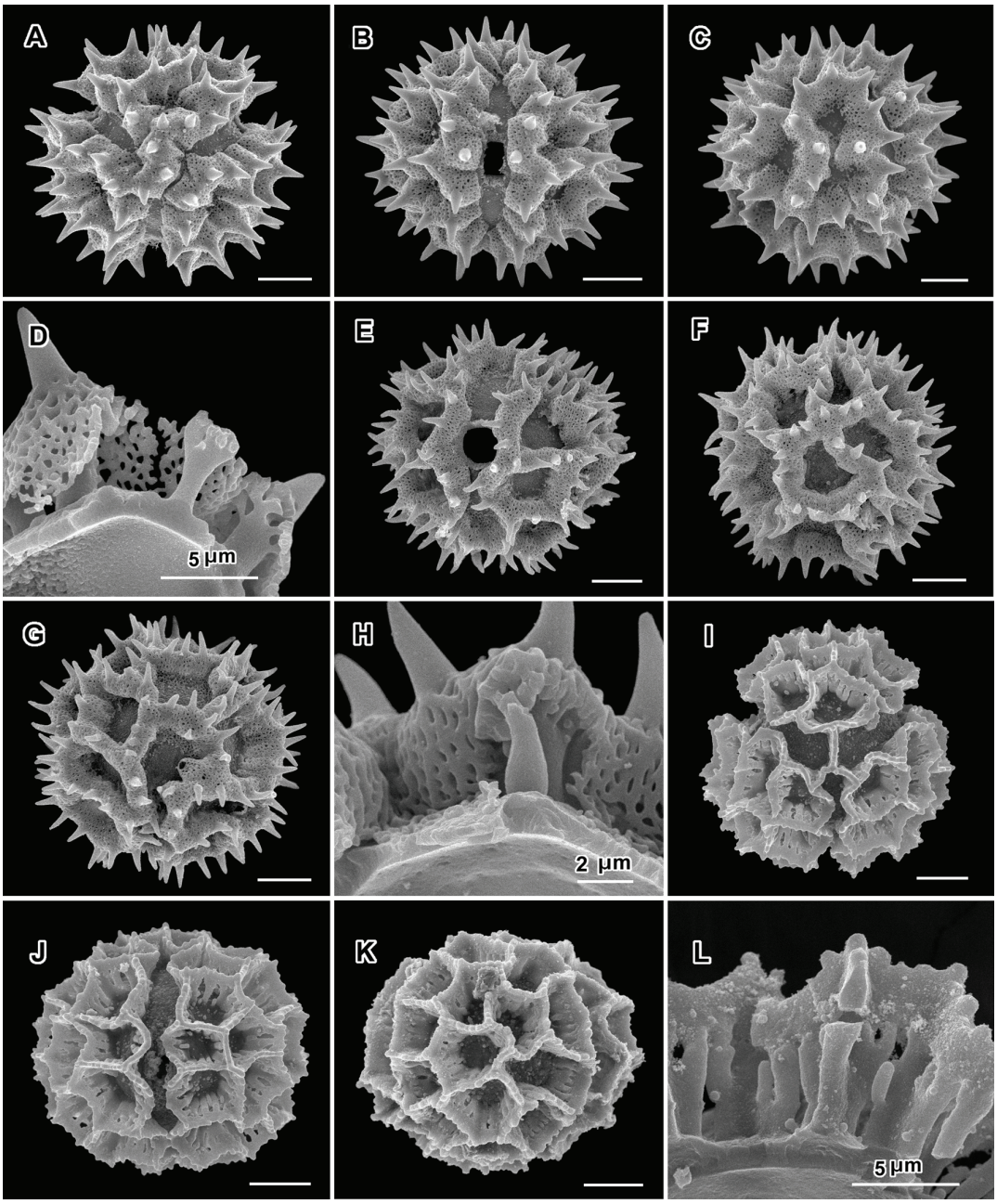


Fig. 4. Scanning electron micrographs of *Gymnanthemum*, *Khasianthus* and *Monosis*. A: *Gymnanthemum extensa*, polar view (J. F. Rock 7909). B: *Gymnanthemum extensa*, equatorial (poral) view (J. F. Rock 7909). C: *Gymnanthemum extensa*, lateral view (J. F. Rock 7909). D: *Gymnanthemum extensa*, grain fracture (J. F. Rock 7909). E: *Khasianthus subsessilis*, equatorial (poral) view (US sheet 2492470). F: *Khasianthus subsessilis*, approximate polar view (J.D. Hooker 7.7., US sheet 2492470). G: *Khasianthus subsessilis*, lateral view (J. D. Hooker 7.7., US Sheet 2492470). H: *Khasianthus subsessilis*, fractured grain (J. D. Hooker 7.7., US sheet 2492470). I: *Monosis volkameriifolia*, polar view. J: *Monosis volkameriifolia*, equatorial (poral) view (Rock 2406). K: *Monosis volkameriifolia*, lateral view (Rock 2406). L: *Monosis volkameriifolia*, fractured grain (Rock 2406). Unless indicated, all scale bars = 10 µm. Collector data in parenthesis.

stem often forming a felt, with large often contorted cap cell basally or nearly basally attached. Leaves alternate; petioles short, winged or elongate; blades usually rather coriaceous, margins entire or toothed, upper surfaces usually essentially glabrous and somewhat glossy; secondary veins pinnate, spreading at 50-60E angles, arching nearer margins. Inflorescences terminal, densely corymbiform, with small bracteoles; peduncles

臺灣大學學術期刊資料庫

short. Heads with campanulate to cylindrical or ovoid involucres; involucral bracts coriaceous to subcoriaceous, appressed, 25-35 in 4-5 gradate series, inner bracts persistent to easily deciduous, outer surface with median shield, without narrow median costa; receptacles epaleaceous. Florets 5-50 in a head; corollas white to violet, basal tube cylindrical, throat longer than the anther thecae or very deeply cut, lobes with glands or spicules on outer surface; anther thecae with base broadly tailed, tails often long; apical appendages glabrous, with rather thick-walled cells; style base without or with scarcely distinct node; style branches with stout, pointed sweeping hairs. Achenes 5-10-costate, with or without setulae, raphids short to elongate, sometimes not evident; pappus of many rather persistent capillary bristles, often with broadened tips, with outer series of short squamellae. Chromosome numbers n = 10, 20.

Pollen: 30-35 μm in diameter (dry); tricolporate, echinate, sublophate; tectum continuous in intercolpi and at poles, with distinct microperforations; spines long, each with single stout columella below firmly attached to foot layer, intervening perforated tectum scarcely mamillose on inner surface.

Generic limits more restricted than given in Robinson (1999a), see Robinson and Skvarla (2006, 2007) and Robinson, Keeley, Skvarla and Chan (2008).

There is one species in China.

Gymnanthemum extensum.(Wall. ex DC.) Steetz in Peters, Reise Mossamb. Bot. 337. 1864. Figs. 4A-D

Vernonia extensa Wall. ex DC., Prodr. 5: 33. 1836.

China (Yunnan), Thailand.

The species may or may not be conspecific with *Gymnanthemum cylindriceps* (C.B. Clarke) H. Rob. which was described with 4 or 5 rather than 8-10 florets in a head?

Khasianthus H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 122(2): 148. 2009b. Type: *Vernonia subsessilis* DC. Figs. 4E-H

See treatment by Robinson, H. & J. Skvarla. 2009b. A new genus, *Khasianthus* from India, Myanmar, and China (Vernonieae: Asteraceae). Proc. Biol. Soc. Wash. 122 (2): 146-149.

Subshrubs up to 1 m tall; stems erect from basal cluster of roots, sparingly branched, densely pubescent with strongly antrorse, whitish hairs, hairs mostly of a long, I-shaped, rather straight terminal cell. Leaves alternate, subsessile, chartaceous, oblanceolate to obovate, with cuneate bases, margins remotely serrulate or crenulate to subentire, apices acuminate to rounded, with many spreading lower secondary veins, surfaces with prominulous veins and veinlets, with sparse, small glandular dots, with appressed hairs on midvein and sometimes sparse over abaxial surface. Inflorescence corymbiform or nearly racemiform, with linear bracts at lower nodes; peduncles elongate, with dense whitish hairs. Heads with involucre broadly campanulate; involucral bracts gradate, persistent, sericeous on outer surface, ca. 80 in 5-6 series, 3-7 mm long, lanceolate or acicular to linear-lanceolate, apices slender and herbaceous in all but inner series, recurved in anthesis in lower series, inner bracts erect, with raised midvein, with short-acute tips,; receptacle alveolate, with fine hairs. Florets 40-50; corollas purple, becoming whitish, basal tube slender with small stipitate glands, lobes as long as throat, lobes erect, with glandular dots mostly near tip; anther base spurred, with distinct broad tail; endothecial cells with vertical annulations; apical appendages oblong-ovate, with narrowly rounded tips, glabrous, cells thin-walled; style shaft thick, rounded at base to narrow insertion, without basal node; style branches with sharply acute sweeping hairs. Achenes to 3.5 mm long, 10-ribbed, with many slender setulae that have pairs of cells fused to the tip, glands dense between ribs, raphids elongate, mostly in ribs; pappus reddish, of many capillary bristles, not or scarcely broadened at tips, not flattened on outer surface, outer series of short bristles.

Pollen: ca. 55 μm in diameter (in Hoyer's solution), ca. 40 μm in diameter (dry); tricolporate, echinolophate, with lacunae regularly disposed, one at each pole, two across intercolpi; tectum restricted to muri, with distinct microperforations; spines pointed, short, longer than width of mural ridge; columellae under muri regularly disposed, firmly attached to foot layer.

Khasianthus subsessilis (DC.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 122(2): 149. 2009. Figs. 4E-H

Conyza *divergens* Wall., Numer. List [Wallich], n. 3000 comp. 110, nom. nud.
Vernonia subsessilis DC., Prodr. 5: 62. 1836.
Conyza bracteolata Wall., Numer. List [Wallich] n. 3036 comp. 146, nom. nud..
Vernonia bracteolata DC., Prodr. 5: 62. 1836.
Vernonia subsessilis var. *bracteolatus* Hook.f., Fl. Brit. India 3: 230. 1881

India, Myanmar, China.

Khasianthus subsessilis var. *macrophylla* (Hook.f.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 122(2): 149. 2009.

Vernonia subsessilis var. *macrophylla* Fl. Brit. India 3: 230. 1881.

India, Myanmar, China.

Monosis DC. in Wight, Contrib. Bot. Ind. 5. 1834. Type - *Monosis wightiana* DC. in Wight. Figs. 4I-L

臺灣大學學術期刊資料庫

Review: Robinson and J.J. Skvarla, 2006, Studies on the Gymnantheminae (Vernonieae: Asteraceae): restoration of the genus *Monosis*. Proc. Biol. Soc. Wash. 119(4): 600-607

Mostly trees, moderately branched; stems and branches rounded, rather smooth; pith solid; hairs uniseriate, with few short basal cells and large, straight or vermiform apical cell often swollen at base and apiculate at tips, forming dense whitish or brownish tomentum. Leaves alternate; petioles 3-8 (-20) mm long. stout; leaf blades obovate to oblanceolate, with cuneate bases, with many spreading secondary veins below the broadest part directed toward the margins, upper margins entire to coarsely toothed. Inflorescences terminal on stems and branches; pyramidally thyrsiform, with rather straight, widely spreading, tomentose branches; heads in small clusters or sessile at bases of branches; involucres campanulate to ovoid, bracts appressed, chartaceous, without median thickened shield, gradate in 4-5 series, inner bracts rather persistent, tips rounded to obtuse or subacute; receptacles epaleaceous, glabrous, alveolate. Florets 1-20 in a head; corollas mostly purple or mauve, sometimes whitish with age, without obvious hairs outside, lobes lanceolate, smooth on both surfaces; anther thecae with short, broad, pointed tails at base; apical appendages ovate to oblong, with rather lax cells and undulate margins; style base with distinct basal node; style appendages with pointed sweeping hairs. Achenes cylindrical, somewhat obcompressed, with 10 ribs, with some glandular dots between ribs, with short biseriate setulae or with few to many uniseriate hairs, ideoblasts numerous, raphids not seen in wall, only in enclosed ovule; pappus of many capillary bristles about as long as the corolla; broadened in distal part, with short outer pappus series. n = 27, 30.

Pollen: ca. 55 µm in diam. (in Hoyer's solution), ca. 40 µm in diam. (dry); tricolporate; echinolophate, colpi abutting at poles, ca. 30 lacunae in each intercolpus, four lacunae across intercolpus; tectum mostly restricted to muri, with many stray deposits, without distinct microperforations; spinules vestigial, blunt, crowded along mural ridge; columellae numerous and crowded in muri, ca. as many as vestigial spinules, firmly attached to foot layer.

A genus of seven known species, with two in China.

Key to the Chinese species of *Monosis*

1. Shrubs 2-3 m tall; leaf blades oblong or oblanceolate, 15-30 cm long, 5-8 cm wide, subglabrous above, densely pubescent below, with 7-12 pairs of secondary veins; body of mature achenes ca. 2.5 mm long. ……. *M. parishii*

1. Trees 3-8 m tall; leaf blades obovate or oblanceolate, 25-50 cm long, 10-20 cm wide, nearly glabrous above, glabrous or sparsely pubescent below, with 12-17 pairs of secondary veins; body of mature achenes 3-4 mm long. …….. *M. volkameriifolia*

Monosis parishii (Hook.f.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 119(4): 605. 2006.

Vernonia laosensis Gandog., Bull. Soc. Bot. Fr. 54: 194. 1907.
Vernonia volkameriifolia var. *lanata* S.Y. Hu, Quart. J. Taiwan Mus. 22(1-2): 21. 1969.

China, Myanmar, Thailand.

Monosis volkameriifolia (DC.) H. Rob. & Skvarla, Proc. Biol. Soc. Wash. 119(4): 606. 2006. Figs. 4I-L

Conyza volkameriifolia Wall., Numer. List [Wallich], 3033, nom. nud.
Conyza acuminata Wall., Numer. List [Wallich], 3033, nom. nud.
Conyza punduana Wall., Numer. List [Wallich], 3035, nom. nud.
Vernonia volkameriifolia DC., Prodr. 5: 32. 1836.
Vernonia acuminata DC., Prodr. 5: 32. 1836.
Vernonia punduana DC., Prodr. 5: 32. 1836.
Vernonia esquirolii Léveillé, Feddes Repert. Spec. Nov. Regn. Veg. 11: 304, 1912, non Vaniot (1907).
Vernonia leviellei Feddes ex Léveillé, Fl. Kouy-Tchéou 109. 1914.
Gymnanthemum volkaneriifolium (DC.) H. Rob., Proc. Biol. Soc. Wash. 112: 243. 1999.

Eastern India, Nepal, Thailand, and China (Yunnan).

Pseudelephantopus Rohr, Skr. Naturh.-Selsk. Kjøb. 2: 213. 1793. Type: *Elephantopus spicatus* Juss. ex Aubl. Figs. 5A-C

Distreptus Cass., Bull. Soc. Philom. Paris 1817: 66. 1817, type: *E. spicatus*.
Matamoria La Llave & Lex., Nov. Veg. Descr. 1: 8. 1824, type: *E. spicatus*
Spirochaeta Turcz., Bull. Soc. Nat. Mosc. 24: 166. 1851, type: *S. funckii* Turcz.

Perennial rosulate herbs; hairs simple, stiff. Leaves alternate, mostly basal, narrowed toward base, margins serrate; venation pinnate, with secondary veins spreading at 45-55° angles. Inflorescence spiciform, with axillary, sessile clusters of heads; heads with involucral bracts decussate, 4, 6, or 8. Florets 4 in a head; corollas lavender, zygomorphic with deep inner sinus; anther thecae only shortly calcarate, without tails; apical appendage glabrous; style base without node; branches with acicular sweeping hairs. Achenes 10-costate, setuliferous, without glands, with idioblasts along costae, raphids short-oblong; pappus of 5 contorted bristles, with bases broadened. Chromosome number x = 13.

Pollen: ca. 30 µm in diameter (dry); triporate,

臺灣大學學術期刊資料庫

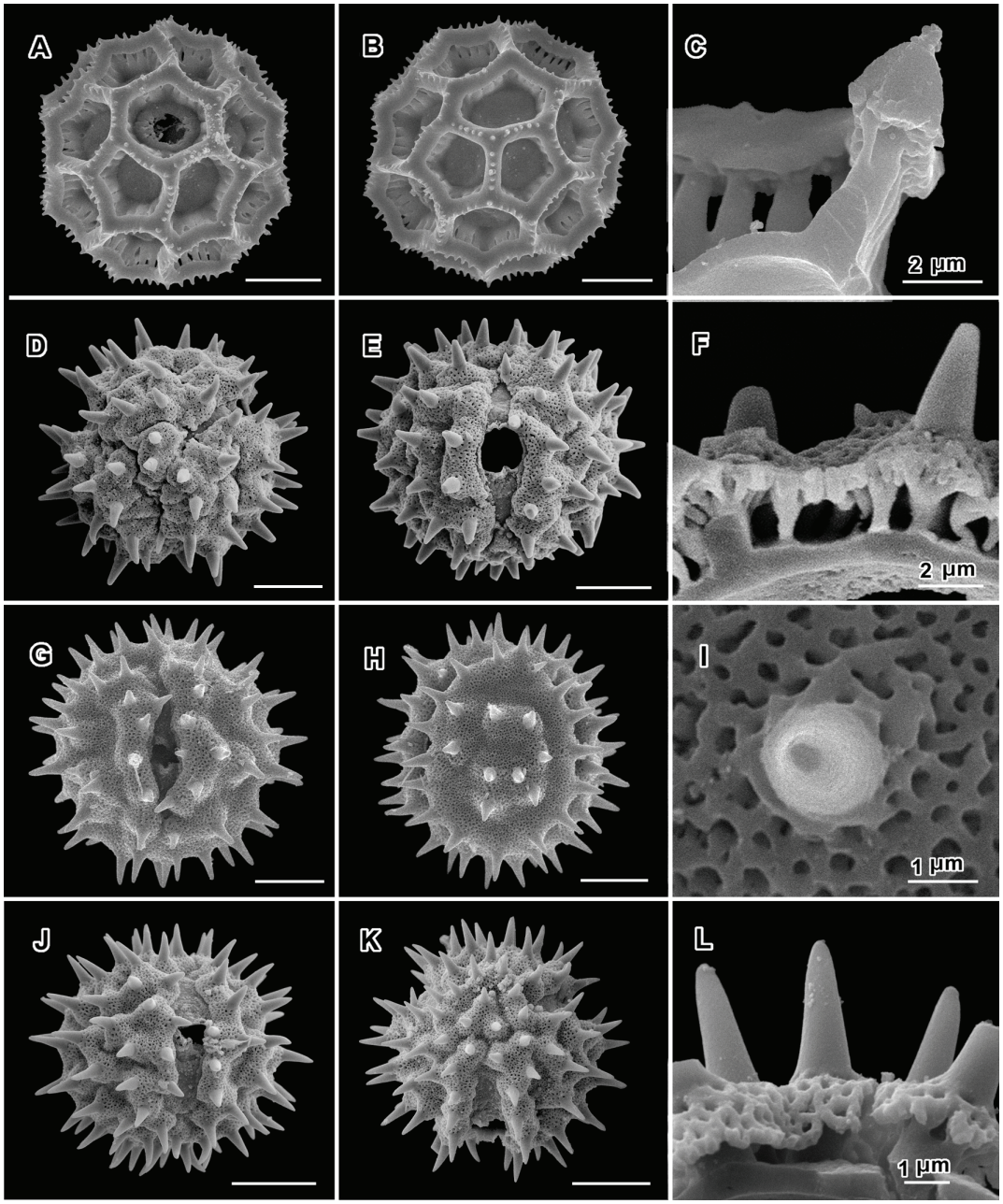


Fig. 5. Scanning electron micrographs of *Pseudoelephantopus*, *Strobocalyx* and *Tarlmounia* pollen. A: *Pseudoelephantopus spicatus*, equatorial (poral) view (Ekman 7604). B: *Pseudoelephantopus spicatus*, lateral view (Ekman 7604). C: *Pseudoelephantopus spicatus*, fractured grain with side view of ridge (Ekman 7604). D: *Strobocalyx arborea*, polar view (Rahmat Si Toroes 3264). E: *Strobocalyx arborea*, equatorial view(Rahmat Si Toroes 3264). F: *Strobocalyx arborea*, fractured grain (Rahmat Si Toroes 3264). G: *Strobocalyx esculenta*, equatorial (poral) view (Rock 10608). H: *Strobocalyx esculenta*, lateral view (Rock 10608). I: *Strobocalyx esculenta*, surface view directly above spine (Rock 10608). J: *Tarlmounia elliptica*, approximate equatorial (poral) view (Grierson 1013). K: *Tarlmounia elliptica,* approximate polar view (Grierson 1013). L: *Tarlmounia elliptica*, fractured grain (Grierson 1013). Unless indicated, scale bars = 10 µm. Collector data in parenthesis.

echinate; with ca. 35 lacunae rather irregularly disposed in intercolpi and at poles; tectum restricted to mural ridges and with small deposits in lacunae, with distinct microperforations; spinules short, pointed, shorter than width of mural ridge; columellae under muri stout, firmly attached to foot layer.

臺灣大學學術期刊資料庫

Pseudelephantopus spicatus (Juss. ex Aubl.) Gleason, N. Amer. Fl. 33: 109. 1922. Figs. 5A-C

Elephantopus spicatus Juss. ex Aubl., Fl. Guiana 2: 808. 1775.
Distreptus spicatus (Juss. ex Aubl.) Cass., Dict. Sci. Nat. 13: 367. 1819.

Tropical America and introduced into Asia.

Strobocalyx (Blume ex DC.) Spach, Hist. Mat. Veg. Phan. 10: 39. 1843. Figs. 5D-I

Vernonia sect. *Strobocalyx* Blume ex DC., Prodr. 5:21. 1836. Type: *Vernonia arborea* Buch.-Ham.

See treatment by Robinson, Keeley, J. J. Skvarla and R. Chan. 2008. Studies on the Gymnantheminae: Asteraceae) III: Restoration of the genus *Strobocalyx* and the new genus *Tarlmounia*. Proc. Biol. Soc. Wash. 121(1): 19-33.

Trees or small shrubs; stems and branches rather rounded, pith solid; Leaves alternate, petiolate, hairs uniseriate, with a long apical cell symmetrical or slightly asymmetrical at base; blades ovate or oblong to obovate, with cuneate to obtuse bases, with lower secondary veins ascending toward margins. Inflorescence somewhat sympodial, corymbiform with slightly cymiform tip. Involucres campanulate to ovoid; bracts appressed, rather chartaceous, without median thickened shield, graduate in 4-5 series, inner bracts rather deciduous, tips rounded to short-acute; receptacles epaleaceous, glabrous to puberulous, alveolate. Florets 5-30 in a head; corollas whitish, narrowly funnelform from near base; apical anther appendage triangular with blunt tip; style base with prominent sclerified node; upper shaft and branches with blunt sweeping hairs. Achenes 5-10-angled, often only 5 clearly evident, surface with few or no setulae, with many idioblasts in surface layer, few or no small rectangular raphids in wall. Pappus of many long capillary bristles, slightly to distinctly enlarged distally, with few shorter bristles at base not forming distinct outer series. Chromosome number n = ca. 30 (Jones, 1982).

The genus name is from the Greek στροβο for twisted and καλγχ for cup, in reference to the imbrication pattern of the bracts of the involucre.

Pollen: 37-45 µm in diameter (in Hoyer's solution), 28-35 µm in diameter (dry); tricolporate, nonlophate or sublophate, echinate, spines densely disposed, with small depressions or grooves between, without large lacuna-like depressions in intercolpi, sometimes syncolpous; tectum continuous over noncolpar surfaces, with distinct microperforations; columellae under spines in groups, primary columellae and additional columellae mostly firmly attached to foot layer, rarely perforations evident on surface of foot layer; intervening perforated tectum with projections and some incipient columellae from inner surface.

A genus of ca. seven species with six in China.

Key to the species *Strobocalyx*

1. Upper surfaces of leaves and outer surfaces of involucral bracts densely pubescent with silky or tomentose hairs…….. *S. solanifolia*
1. Upper surfaces of leaves and outer surfaces of involucral bracts with hairs short, sparse or lacking ……. 2
2. Upper surfaces of leaves dull with numerous sessile glandular dots; branches ascending ……. 3
2. Upper surfaces of leaves rather shiny and usually glabrous between veins, with immersed glandular dots; at least lower branches spreading at ca. 90º angles …….. 4
3. Heads with 5-6 florets ……..…. *S. esculenta*
3. Heads with 8-12 florets ……..…. *S. bockiana*
4. Heads with ca. 10 florets; receptacles pubescent ..…… *S. sylvatica*
4. Heads with 2-6 florets; receptacles without hairs ……... 5
5. Trees to 30 m tall; heads clustered on short peduncles … *S. arborea*
5. Scrambling shrubs; heads mostly on peduncles 2-5 mm long ……... ……. *S. chunii*

Strobocalyx arborea (Buch.-Ham.) Sch.Bip., Jahres. Pollichia 18-19: 171. 1861. Figs. 5D-F

Vernonia arborea Buch.-Ham., Trans. Linn. Soc. London 14: 218. 1824.
Vernonia celebica DC., Prodr. 5: 21. 1836.
Vernonia javanica DC., Prodr. 5: 22. 1836.
Vernonia blumeana DC., Prodr. 5: 22. 1836.
Strobocalyx celebica (DC.) Sch. Bip., Jahres. Pollichia 18-19: 171. 1861.
Strobocalyx javanica (DC.) Sch. Bip., Jahres. Pollichia 18-19: 171. 1861.
Strobocalyx blumeana (DC.) Sch. Bip., Jahres. Pollichia 18-19: 171. 1861.
Vernonia vaniotii Lévl., Repert. Spec. Nov. Regni Veg. 12: 531. 1913.
Vernonia urdanetensis Elmer, Leafl. Philipp. Bot. 7: 2591. 1915.

Sri Lanka, India, China, Southeast Asia, Malaysia, Indonesia, Papua New Guinea, Philippines.

Strobocalyx bockiana (Diels) H. Rob., S. C. Keeley, Skvarla & R. Chan, Proc. Biol. Soc. Wash. 121(1): 31. 2008.

Vernonia bockiana Diels, Bot. Jahrb. Syst. 29: 608. 1900.
Pluchea rubicunda Schneid. In Sarg., pl. Wils. 3: 418. 1916.
Gymnanthemum bockianum (Diels) H. Rob., Proc. Biol. Soc. Wash. 112: 240. 1999.

China (Szechuan).

Strobocalyx chunii (Chang) H. Rob., S. C. Keeley, Skvarla & R. Chan, Proc. Biol. Soc. Wash. 121(1): 31. 2008.

Vernonia chunii Chang, Sunyats. 3: 272, pl. 35. 1937.

China (Hainan).

臺灣大學學術期刊資料庫

Strobocalyx esculenta (Hemsl.) H. Rob., S. C. Keeley, Skvarla and R. Chan, Proc. Biol. Soc. Wash. 121(1): 31. 2008. Figs. 5H & I

Vernonia esculenta Hemsl. ex F.B. Forbes & Hemsl., J. Linn. Soc. Bot. 23: 401. 1888,
Vernonia papillosa Franch. J. Bot. 10: 368. 1896.
Vernonia arbor Lévl., Repert. Spec. Nov. Regni Veg. 11: 304. 1912.

China (Kweishou, Szechuan, Yunnan).

Strobocalyx solanifolia (Benth.) Sch. Bip., Jahres. Pollichia 18-19: 171. 1861.

Vernonia solanifolia Benth., Hooker's J. Bot. Kew Gard. Misc. 1: 486. 1842.
Gymnanthemum solanifolium (Benth.) H. Rob., Proc. Biol. Soc. Wash. 112: 243. 1999.

China (north to Kwangsi, Swatow), Thailand, Vietnam.

Strobocalyx sylvatica (Dunn.) H. Rob., S. C. Keeley, Skvarla and R. Chan, Proc. Biol. Soc. Wash. 121(1): 31. 2008.

Vernonia sylvatica Dunn., J. Linn. Soc. Bot. 35: 501. 1903.

China (Yunnan, Hainan), Vietnam, Myanmar

Tarlmounia H. Rob., S.C. Keeley, Skvarla & R. Chan, Proc. Biol. Soc. Wash. 121(1): 31. 2008; type *Vernonia elliptica* DC. in Wight. Figs. 5J-L

See treatment by Robinson, Keeley, Skvarla and R. Chan. 2008. Studies on the Gymnantheminae: Asteraceae) III: Restoration of the genus *Strobocalyx* and the new genus *Tarlmounia*. Proceedings of the Biological Society of Washington 121: 19-33.

Plants scandent, with slender stems, pith solid; stems, undersides of leaves, and peduncles densely silvery sericeous with long-armed T-shaped hairs. Leaves alternate, short-petiolate; blade oblong to obovate, base obtuse, margins entire to remotely denticulate, apex rounded to apiculate, upper surface green, nearly glabrous, with few scattered hairs, undersurfaces densely sericeous with slender, appressed T-shaped hairs, secondary veins pinnate, 4-6, irregularly arching toward tip. Inflorescences terminal on branches, narrowly pyramidal with usually short, lateral corymbiform branches and branchlets, mature branches usually deflected at nodes; heads in small rather dense clusters; involucral bracts imbricated in ca. 5 series, broadly obtuse to rounded at tip, inner bracts tardily deciduous; receptacle glabrous. Florets ca. 5; corollas white or pale purple in bud and becoming white, ca. 6 mm long, texture of corolla wall thin, funnelform from ca. 1.5 mm above base, without hairs, with scattered glands; anther thecae tailed with minimal basal fringe, apical appendage narrowly oblong; style base broadened with annulus of sclerified cells; upper shaft and branches of style with blunt sweeping hairs. Achenes 5-sided, rarely with extra angle, without hairs, with glandular dots, with numerous idioblasts on surface, with scattered small rhombic or short oblong raphids in wall; carpopodium narrowly stopper-shaped, nearly cylindrical, longer than wide; pappus of numerous slender bristles, narrow near base, broadened distally, somewhat fragile, with few short bristles interspersed.

Pollen: 37-40 μm in diameter (in Hoyer's solution), ca. 28 μm in diameter (dry); tricolporate, nonlophate or sublophate, echinate with spines densely disposed, with only small depressions and grooves between; tectum continuous in intercolpi and at poles, with distinct microperforations; with single columellae below spines, firmly attached to foot layer; intervening perforated tectum without projections or incipient additional columellae from inner surface.

There is one species in the genus.

Tarlmounia elliptica (DC in Wight) H. Rob. S. C. Keeley, Skvarla & R. Chan, Proc. Biol. Soc. Wash. 121(1): 32. 2008. Figs. 5J-L

Vernonia elliptica DC. in Wight, Contrib. Bot. Ind. 5. 1834.
Vernonia elaeagnifolia DC., Prodr. 5: 22. 1836.
Strobocalyx elaeagnifolia (DC.) Sch. Bip., Jahresb. Pollichia 18-19: 171. 1861.
Strobocalyx elliptica (DC. in Wight) Sch. Bip., Jahresb. Pollichia 18-19: 171. 1861.

Sri Lanka, Thailand, Vietnam, widely introduced (China, Hawaii).

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LITERATURE CITED

Anderson, L. E. 1954. Hoyer's solution as a rapid permanent mounting medium for Bryophytes. The Bryologist **57**: 242-244.

Bunwong, S. and P. Chantaranothai. 2008. Pollen morphology of the Tribe Vernonieae (Compositae) in Thailand. Natural History Journal of Chulalongkorn University **8**: 45-55.

Chen, Y. 1985. Vernonieae, pp. 2-47. In: Ling, Y. and Y. Chen. Angiospermae, Dicotyledoneae, Compositae (1), Carduoideae Kitam., Vernonieae – Astereae. Flora Republicae Popularis Sinicae **74**: i-xiv, 1-388.

臺灣大學學術期刊資料庫

Erdtman, G. 1960. The acetolysis method. A revised description. Svensk Botanisk Tidskrift **54**: 561-564.

Gilbert, M. G. and C. Jeffrey. 1988. Revision of *Ethulia* (Compositae: Vernonieae). Kew Bulletin **43**: 165-193.

Isawumi, M. M., G. El-Ghazaly and B. Nordenstam. 1996. Pollen morphology, floral microcharacters and taxonomy of the genus *Baccharoides* Moench (Vernonieae: Asteraceae). Grana **35**: 205-230.

Jones, S. B. 1982. IOPB Chromosome Numbers Reports LXXIV. Taxon **31**: 126-127.

Koyama, H. 1984. Taxonomic studies in the Compositae of Thailand 3. Act. Phytotax, Geobot. **35**: 49-58.

Robinson, H. 1999a. Revisions in paleotropical Vernonieae (Asteraceae). Proceedings of the Biological Society of Washington **112**: 220-247.

Robinson, H. 1999b. Generic and subtribal classification of American Vernonieae. Smithsonian Contributions to Botany **89**: i-iv, 1-116.

Robinson, H. 2007 [2006]. Tribe Vernonieae Cass. (1819), In: Kadereit, J. W. and C. Jeffrey (eds.). Families and Genera of Vascular Plants, Vol. VIII: 165-192. Flowering Plants - Eudicots - Asterales, 740pp., 131 illus. Part of series by Kubitzki, K., ed. Kubitzki's Authoritative Encyclopedia of Vascular Plants. Springer-Verlag.

Robinson, H. and B. Kahn. 1986. Trinervate leaves, yellow flowers, tailed anthers and pollen variation in *Distephanus* Cassini. Proc. Biol. Soc. Wash. **99**: 493-501.

Robinson, H. and J. J. Skvarla. 2006. Studies on the Gymnantheminae (Vernonieae: Asteraceae): restoration of the genus *Monosis*. Proc. Biol. Soc. Wash. **119**: 600-607.

Robinson, H. and J. J. Skvarla. 2007. Studies on the Gymnantheminae (Vernonieae: Asteraceae) II: A new genus, *Decaneuropsis*, from China, India, and southeast Asia. Proc. Biol. Soc. Wash. **120**: 359-366.

Robinson, H. and J. J. Skvarla. 2009a. Studies on the Paleotropical Vernonieae (Asteraceae): additions to the genus *Acilepis* from southern Asia. Proc. Biol. Soc. Wash. **122**: 131-145.

Robinson, H. and J. J. Skvarla. 2009b. A new genus, *Khasianthus*, from India, Myanmar, and China (Vernonieae: Asteraceae). Proc. Biol. Soc. Wash. **122**: 146-149.

Robinson, H., S. C. Keeley, J. J. Skvarla and R. Chan. 2008. Studies on the Gymnantheminae (Vernonieae: Asteraceae) III: restoration of the genus *Strobocalyx* and the new genus *Tarlmounia*. Proceedings of the Biological Society of Washington **121**: 19-30.

Uniyal, B. P. 1995. Tribe 12. Vernonieae. In: Haira, P. K., R. R. Rao, F. K. Singh and B. P. Uniyal (eds.), Flora of India **13**: 330-394. Asteraceae (Inuleae - Vernonieae), Botanical Survey of India, Calcutta, viii + 411pp., 10 pl.

Apendex. Specimens from U.S. National Herbarium used in preparation of the SEM illustrations.

Acilepis attenuata (DC.) H. Rob. & Skvarla, China: Yunnan, Szema, *Henry 11692*.
Acilepis divergens (Roxb.) H. Rob. & Skvarla, India: Mysore, Hassan Distr,, 15 Jan 1969, *Saldanha 12223*.
Acilepis saligna (DC.) H. Rob., China, Szemoa, *Henry 12714*.
Baccharoides anthelmintica (L.) Moench, Sri Lanka: Ruhuna Nat. Park, 17 March 1970, *Cooray 70031701R*.
Baccharoides anthelmintica (L.) Moench, NW India: Punjab, 15 Nov 1953, *Koelz 7469*.
Baccharoides anthelmintica (L.) Moench., USDA P.I. 283729, Jones
Baccharoides anthelmintica (L.) Moench. Assam, *Koelz 7469.*
Camchaya loloana Kerr., China, Yunnan, Szemoa, *Henry 12375A*
Cyanthillium cinereum (L.) H. Rob., Pacific, Caroline Isl., Fais Isl., 30 July 1965, *Evans 344*.
Cyanthillium cinereum (L.) H. Rob., Taiwan: 24 June 1991, *Shi-Hsiem Lin 685*.
Cyanthillium patulum (Aitch.) H. Rob., China (Hong Kong), *Y. W. Taam 1722.*
Decaneuropsis blanda (DC.) H. Rob. & Skvarla, China (Hainan),27 Dec 1932, *C.I. Lei 311.*
Decaneuropsis cumingiana (Benth.) H. Rob. & J.J. Skvarla, Hong Kong, 2 Feb 1942,*Taam 1917.*
Distephanus forrestii (Anthony) H. Rob. & B. Kahn, China, Yunnan, *Rock 3146.*
Distephanus henryi (Dunn) H., Rob., China, Yunnan, *Forrest 21o69.*
Elephantopus scaber L., China, Sept 23, 1913, *Levine 3355*
Elephantopus scaber L., Ceylon, Kandy district, *Fosberg 50660*
Elephantopus scaber L., China (Hong Kong), Ma On Shan, *Shui Ying Hu 5682.*
Elephantopus tomentosus L., China (Kwangtung), 1978, K.S. *Chow 78065.*
Ethulia conyzoides L., Uganda, *W. H. Lewis 6025.*
Ethulia conyzoides DC., Vietnam, (Tonkin), 19 June 1927, *Petelot 4047.*
Gymnanthemum extensum DC., China, Yunnan, *J.F. Rock 7909*
Khasianthus subsessilis (DC.) H. Rob. & Skvarla, India Orietalis: subtropical zone, *J.D. Hooker 7.7.*
Monosis volkameriifolia DC., China (Yunnan), 13-15 Feb 1922, *Rock 2406*.
Pseudelephantopus spicatus (Juss.) Cass., Haiti, 15 Feb 1927, *Ekman H 7604.*
Strobocalyx arborea Buch.-Ham., Sumatra, east coast, June-July 1932, Rahmat Si Toroes 3264.
Strobocalyx esculenta (Hemsl.) H. Rob., S.C. Keeley, Skvarla & R. Chan, China, Yunnan, *Rock 10608.*
Tarlmounia elliptica DC., Ceylon, 8 Feb 1969, Grierson 1013,

臺灣大學學術期刊資料庫

中國斑鳩菊族的分類處理與花粉研究

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摘要：本文以菊科新修訂屬的概念對中國菊科斑鳩菊族（Vernonieae）下的屬及種進行分類訂正，除了包括屬及屬下種間的檢索表，並附上每屬花粉學的描述及繪圖。本文共認定：*Acilepis*, *Baccharoides*, 凋纓菊屬(*Camchaya*), *Cyanthillium*, *Decaneuropsis*, *Distephanus*, 地膽草屬(*Elephantopus*), 都麗菊屬(*Ethulia*), *Gymnanthemum*, *Khasianthus*, *Monosis*, 假地膽草屬(*Pseudelephantopus*), *Strobocalyx* 及 *Tarlmounia*。

關鍵詞：斑鳩菊族、菊科、花粉、SEM、屬的描述、檢索表、中國。

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