

Taxonomic Studies in the Compositae of Thailand 17. *Vernonia* Sect. *Lepidaploa* Subsect. *Paniculatae*

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Abstract The taxonomy of *Vernonia* sect. *Lepidaploa* subsect. *Paniculatae* in Thailand was examined. Nine species are enumerated in this paper. Seven species can be recognized, but two species are thought to have affinities to species previously described. Three species are described as a new to science from Thailand.

Key words: Taxonomy, *Vernonia* sect. *Lepidaploa* subsect. *Paniculatae*, Thailand, new species, *Vernonia chiangdaoensis*, *V. kradungensis*, *V. pseudosutepensis*.

Introduction

New specimens collected by the botanical expedition team of Kyoto University and obtained through the exchange program between Kyoto University and other botanical institutes, such as the Denmark Botanical Garden, Aarhus University, Leiden Botanic Garden and other Botanical Institutes, have allowed a reexamination of the taxonomy of *Vernonia* in Thailand. Seven sections with 27 species have already been reported.

In his enumeration of Thai species of *Vernonia*, Kerr (1936) cited 28 species including 4 varieties. Koyama (1993) considered 3 of the species recognized by Kerr, *V. andersonii* sensu Kerr, *V. cummingii* sensu Kerr and *V. sangka* Kerr, to be the same after examining specimens cited by Kerr. The circumscription of two species, *V. kerrii* Craib and *V. rupicola* Ridl., is still unclear, because of the poor state of the available material.

Nine species treated in this paper are characterized by having the pappus in 2 series, with the inner long and the outer short, the achenes oblong and clearly 10-ribbed, and the stems sometimes branched at the base. They may be considered to be members of sect. *Lepidaploa*, which is largely tropical in the New World, except for

some species in the Old World (Bentham & Hooker, 1873). The Asian sect. *Lepidaploa* was subdivided by Clarke (1876) into two subsections, *Oligocephalae* and *Paniculatae*. Subsect. *Oligocephalae* which is characterized by having a short, palaeaceous outer pappus and acute phyllaries, comprises 3 species from Sri Lanka and one from Khasia. Subsect. *Paniculatae*, which is characterized by the short, setaceous outer pappus and obtuse or acute phyllaries, comprises 3 species from Southeast Asia. Our nine species can be considered to be the members of Subsect. *Paniculatae*, a primarily New World section.

According to Jones (1974), the New World members of Sect. *Paniculatae* subsect. *Paniculatae* have a chromosome number of $n=17$. I observed chromosome numbers of $2n=54$ for one species in Thailand, which may indicated that the Asian species of subsect. *Paniculatae* are different from the New World subsect. *Paniculatae* in some taxonomic characters that have not been recognized. It is therefore necessary to clarify the relationship between the New World species and the Old World species.

Subsect. *Paniculatae* is closely related to Sect. *Xipholepis*, which is characterized by having 10-ribbed achenes and somewhat woody, erect stems. The pappus in both taxa is in two series of

capillary bristles, but the outer pappus of sect. *Xipholepis* is scanty, caducous or none.

Observations and Results

The surface of the receptacle, which was observed to have interesting variation in *Blumea* (Randeria, 1960), has been examined in subsect. *Paniculatae*. According to Randeria, there are four types of receptacles in *Blumea*, but in the subsect. *Paniculatae* there are two types of receptacle. One is fimbriate and pilose or with long hairs, another is areolate and pilose. In young heads the alveoli of the receptacle are discontinuous. In *Vernonia pseudosutepensis*, the receptacle was not completely developed in specimens just after flowering. The central area of the receptacle was nearly smooth, but the marginal areas had finely fimbriate alveoli. The fimbriate alveoli of the marginal area may disappear during growth of the heads.

Vernonia principes is unique in its flowering habit. In our collection, the stem branches at the base. One stem is erect, while the other bends downward. The erect stem has a large, terminal inflorescence which has just flowered. The downwardly bent stem also has a large, terminal inflorescence that had already flowered. On the bent stem, the upper part of the inflorescence lies on the ground and has given rise to a plant from the axis of the inflorescence and which also has a small inflorescence that has just flowered. The flowering of the inflorescence on the erect stem and on the smaller adventitious plant appears to be simultaneous. The inflorescence of the downwardly bent stem may have flowered slightly before anthesis of the inflorescence on the erect stem.

In this paper, the taxonomy of nine species are examined. They are distinguished from one another as follows:

Key to species

- A. Receptacle fimbriate B
- A. Receptacle partly fimbriate or smooth and pilose E
- B. Stems branched at base 5. *V. principes*

- B. Stems unbranched at base C
- C. Leaves sessile, coriaceous, elliptic to oblanceolate (10–17 cm long, 2–5 cm wide, base narrowed into short petiole, apex acuminate) 3. *V. kingii*
- C. Leaves petiolate, membranaceous, obovate to elliptic (15–33 cm long, 5–13 cm wide, base attenuate to cuneate, apex acute) D
- D. Heads ca. 2 cm across, involucre campanulate, 8–9 mm tall, phyllaries in 5 series; flowers ca. 21 per head, corolla ca. 8 mm long, inner pappus ca. 8 mm long 2. *V. chiangdaoensis*
- D. Heads ca. 1.5 cm across, involucre broadly campanulate, ca. 5 mm tall, phyllaries in 4 series; flowers ca. 13 per head, corolla ca. 6.5 mm long, inner pappus 6–7 mm long 4. *V. kradungensis*
- E. Receptacle (of young heads) partly fimbriate F
- E. Receptacle smooth, pilose G
- F. Heads ca. 1.5 cm across, with 13–19 flowers; involucre broadly campanulate, ca. 9 mm tall; inner pappus ca. 7–8.5 mm long 7. *V. sutepensis*
- F. Heads ca. 1 cm across, with ca. 10 flowers; involucre campanulate, ca. 6 mm tall; inner pappus ca. 6 mm long 6. *V. pseudosutepensis*
- G. Cauline leaves apparently of 2 types; lower leaves ovate or obovate, upper ones lanceolate to linear 1. *V. attenuata*
- G. Cauline leaves nearly same in shape, rhomboid elliptic or elliptic, upper leaves gradually smaller H
- H. Leaves petiolate, rhomboid elliptic, 8–10 cm long, 2.8–3.5 cm wide, apex shortly acuminate; petiole 2–4 mm long 9. *V. aff. virgata*
- H. Leaves sessile, elliptic, 5–9 cm long, 1.5–4 cm wide, apex acute; petiole 0.5 mm long 8. *V. aff. tonkinensis*

Enumeration

1. *Vernonia attenuata* DC., Prodr. 5: 33 (1836); Kerr, Fl. Siam. Enum. 2 (3): 236 (1936).

Type not seen, from Moalmyne in India orient.

Vernonia subacaulis Gagnep. in Bull. Museum, Paris: 491 (1919), in Lecomte, Fl. Gen. de l'Indo-Chine, 3: 486 (1924). Type not seen, from Cochinchine.

Vernonia pierrei Gagnep. in Bull. Museum, Paris: 490 (1919), in Lecomte, Fl. Gen. de l'Indo-Chine, 3: 486 (1924). Type not seen, from Cochinchine.

Perennial, diffuse herbs from woody rhizomes; **stem** erect, to ca. 2 m tall, slender, stiff, pubescent throughout, branched above; branches ending in inflorescences. **Petioles** to 12 mm long. **Leaves** petiolate, coriaceous, lower leaves 3–6, subverticillate, obovate to oblong, 8–25 cm long, 4–11 cm wide, apex acute, base cuneate, margin shallowly serrate, upper surface subglabrous, lower surface puberulous, silky hairy, reticulate, veins prominent; upper leaves lanceolate or linear lanceolate, 7–13 cm long, 0.5–3 cm wide, becoming to leaves of inflorescence. **Inflorescences** sparse, terminal, more or less panicle with much narrower elliptic or linear-oblong leaves. **Heads** discoid, ca. 2 cm across; peduncles subsessile to 6.5 cm long, stout, slightly curved; receptacle pilose; **involucre** broadly campanulate, ca. 10 mm tall; **phyllaries** in 5 series, imbricate, pubescent, outer phyllaries linear-lanceolate, apex acuminate, rigid point, innermost phyllaries narrow oblong-lanceolate, 1.5–10 mm long, 0.7–1.5 mm wide, apex acute, rigid point. **Flowers** December to January, 26–41 per head; **corolla** pale-violet to purple, ca. 8 mm long, tube ca. 4 mm long, glandular-punctate and colleters. **Achenes** more or less oblong, 3–4 mm long, 10-ribbed, glandular-punctate and pilose; **pappus** whitish, in 2 series, inner series ca. 6–8 mm long, outer pappus setose, caducous, few, 0.5–1 mm long.

Habitat: sandy soils in open deciduous and pine-dipterocarp forests and on weathered granite in evergreen forests, 50–500 m alt.

Specimens examined. Thailand [N] Prov. Chiang Mai: Doi Inthanon, Maecham Distr. (1-1983, H. Koyama *et al.* T-32159 KYO, TNS). Prov. Mae Hong Son: Pang Mapha (2-1968, B. Hansen & T. Smitinand 12722 C, L, P), Pai

Wildlife Sanctuary Station, Pai Distr. (1-1983, H. Koyama *et al.* T-32594 KYO, T-32602 KYO, TNS). [NE] Prov. Loei: Sitthan, Phu Kradung foot hill (3-1958, Th. Sorensen *et al.* 2439 C; 12-1982, H. Koyama *et al.* T-31440 KYO, TNS). Prov. Mukdahan: 38 km from Mukdahan to Khamcha-e on route 2030 (12-1982, H. Koyama *et al.* T-30951 KYO, TNS). Prov. Nongkhai: route 2186, 20 km E of Sangkhom, Sangkhom Distr. (12-1982, H. Koyama *et al.* T-31135 KYO, TNS). Prov. Sakonnakhon: Phu Phan National Park (11-1984, G. Murata *et al.* T-49803, T-50603 KYO, TNS). Prov. Udon Thani: Nongbualumphoo (11-1963, Pradit 641 US). [SW] Prov. Kanchanaburi: Sisawat (1-1926, Kerr 10147 BK), Kroengkawia Nonhunting Area, Thong Phaphum Distr. (11-1982, H. Koyama *et al.* T-30414 KYO), Khao Kamphaeng, Tham Than Lod National Park, Srisawat Distr. (11-1982, H. Koyama *et al.* T-30519, T-30520 KYO, TNS). Prov. Uthaitani: Huay Kha Kaeng Wildlife Sanctuary, Larn Suk Distr. (11-1979, T. Shimizu *et al.* T-22269, T-22381, T-22382 KYO). [without province] Adang (10-1979, Congdon 62 A; 2-1980, Congdon 379 A).

Distribution: Sikkim (Hooker s.n. A, P), Yunnan (A. Henry 11692B NY, 1935/36 C. W. Wang 81138 A), Burma and Thailand, Laos (1-1925, M. Poilane 11478 P; 11-1930, Coloni 3874 P), Cambodia (1-1928, M. Poilane 14516 P) and S. Vietnam (Pierre 6917 A; J. Dournes s.n. P).

2. *Vernonia chiangdaoensis* H. Koyama, sp. nov. (Fig. 1)

Haec species *Vernonia kradungensis* affinis est, sed ab *V. kradungensis* capitula mediocaria ca. 21-flora facile distinguuntur.

Perennial herbs from somewhat woody rhizomes; **stem** erect, 1–2 m tall, finely striate, with minute hairs throughout, branched above; branches ending in inflorescences. **Petioles** 0.5–1.5 cm long, sometimes with narrow wing. **Leaves** petiolate, membranaceous, obovate to elliptic or lanceolate, 15–33 cm long, 5–13 cm wide, base attenuate to cuneate, margin denticu-



Fig. 1. Holotype specimen of *Vernonia chiangdaoensis* H. Koyama sp. nov.
 Thailand [N] Prov. Chiang Mai: Doi Chiangdao, Chiang Dao Distr. (1-1966, M. Tagawa, K. Iwatsuki & N. Fukuoka T-4038 KYO).

late, apex acute, upper surface somewhat scaberulous, lower surface with minute silky hairs and glandular punctate. **Inflorescences** broad panicles. **Heads** discoid, ca. 2 cm across; peduncles to 18 mm long, stout, straight, densely pilose; receptacle fimbriate; **involucre** campanulate, 8–9 mm tall, **phyllaries** in 5 series, imbricate, apex rigidly pointed, innermost series subglabrous, outer four series hairy and glandular punctate. **Flowers** November to January, ca. 21 per head; **corolla** pale purple, purple, glandular punctate, ca. 8 mm long, tube 4–5 mm long. **Achenes** oblong, 3–4 mm long, 10-ribbed, ribs prominent, glandular punctate only; **pappus** snow white or straw colored, in 2 series, inner series ca. 8 mm long, outer pappus setose, bristles few, 1–1.5 mm long. Chromosome number $2n=54$.

Habitat: along trail in bamboo thickets and dry dipterocarp forests, 500–1200 m alt.

Type collection. Thailand [N] Prov. Chiang Mai: Doi Chiang Dao, Chiang Dao Distr. (1-1966, M. Tagawa, K. Iwatsuki & N. Fukuoka T-4038 KYO-holotype, A, TNS-isotype).

Other specimens examined. Thailand [N] Prov. Chiang Mai: Doi Chiang Dao (10-1979, T. Shimizu *et al.* T-20996 KYO, T-21027-bis KYO, TNS; 2-1983, H. Koyama *et al.* T-33291, T-33160 KYO; 12-1984, H. Koyama & C. Phengk-lai T-39831, T-39832 KYO; 11-1989, J. F. Maxwell 89-1442 A), Mae Rim (12-1989, J. F. Maxwell 89-1585 A); Maesai Botanical Garden (1-1988, H. Koyama T-s.n. KYO, TNS), Wang Tao (2-1958, Th. Sorensen *et al.* 1073 BKF, C).

Notes: The membranaceous, easily caducous leaves are similar to those in *Blumea*. This species is similar to *Vernonia kradungensis*, but is distinguished by having somewhat large heads with ca. 21 florets, long involucre 8–9 mm long, and a long inner pappus ca. 8 mm long.

3. *Vernonia kingii* C. B. Clarke, Comp. Ind. 12 (1876); Kerr, Fl. Siam. Enum. 2 (3): 241 (1936). Type not seen, from Burma.

Perennial large herbs from woody rhizomes; **stem** erect, 1–2 m tall, finely striate, subglabrous pilose, branched above; branches densely pilose,

ending in inflorescences. **Petioles** nearly absent to 6 mm long. **Leaves** coriaceous, elliptic to oblanceolate, 10–17 cm long, 2–5 cm wide, base narrower into short petiole, margin mucronate, apex acuminate, upper surface glabrous, more or less scaberulous, lower surface reticulate, pilose along veins and veinlets, glandular punctate. **Inflorescences** terminal, broad panicles, pubescent. **Heads** discoid, ca. 20 mm across; peduncles sessile to 15 mm long, stout, straight; receptacle fimbriate pilose; **involucre** campanulate, ca. 7 mm tall; **phyllaries** coriaceous, in 5 series, imbricate, glabrous on dorsal surface, woolly at margin, outer phyllaries oblong, apex obtuse with short rigid point, inner phyllaries linear oblong, concave, obtuse. **Flowers** December to February, 20–25 per head, 18 in Laos specimen; **corolla** purple, violet blue, ca. 7 mm long, tube ca. 3 mm long, glabrous, glandular punctate. **Achenes** immature, more than 3 mm long, 10-ribbed, ribs obtusely angled, pilose, glandular punctate; **pappus** whitish or reddish, in 2 series, inner series ca. 7 mm long, outer pappus setose, 0.5 to 2 mm long.

Habitat: grassy fields on mountain ridges in *Pinus* forests, or ridges in dry evergreen forests, bamboo thickets and mixed oak forests, 600–1600 m alt.

Specimens examined. Thailand [N] Prov. Chiang Mai: Doi Hua Mot (12-1933, Garrett 855 BKF, L, P), Doi Inthanon (2-1905, Hosseus 328 L), Khun On (1-1921, Kerr 4729 BK, P), Khun Kong San (1-1964, B. Hansen *et al.* 10862 BKF, C, L, P). Prov. Chiang Rai: Doi Lang Ka (11-1930, Put 3449 BK; 12-1965, K. Iwatsuki & N. Fukuoka T-3556 KYO; 3646 A, AAU, KYO, TNS), Doi Thung (1-1975, R. Geesink *et al.* 8277 BKF, C, L). [SW] Prov. Kanchanaburi: Khao Kampaeng, Tham Than Lot National Park (11-1979, T. Shimizu *et al.* T-22098, T-22116, T-22156 KYO; 11-1982, H. Koyama *et al.* T-30521 KYO).

Distribution: Burma, Yunnan, Laos (2-1932, M. Poilane 20104 P) and Thailand.

4. *Vernonia kradungensis* H. Koyama, sp. nov.
(Fig. 2)

Haec specio *Vernonia chiangdaoensis* affinis est, sed ab *V. chiangdaoensis* capitula parva ca. 13 flora facile distinguitur.

Perennial herbs from somewhat woody rhizomes; **stem** erect, 1–2 m tall, finely striate, with minute hairs throughout, branched above; branches ending in inflorescences. **Petioles** 0.5–3 cm long. **Leaves** petiolate, membranaceous, obovate to elliptic, 15–30 cm long, 5–12 cm wide, base attenuate to cuneate, margin serrulate, apex acute, upper surface somewhat scaberulous, lower surface minute with silky hairs and glandular punctate. **Inflorescences** broad panicles. **Heads** discoid, ca. 1.5 cm across; peduncles short to ca. 2 cm long, slender, straight; receptacle fimbriate; **involucre** broadly campanulate, ca. 5 mm tall, **phyllaries** in 4 series, imbricate, apex rigidly pointed, innermost series lanceolate, subglabrous, outer phyllaries linear, densely hairy and glandular punctate. **Flowers** November to January, ca. 13 per head; **corolla** pale purple or purple, glandular-punctate, ca. 6.5 mm long, tube 3–4 mm long. **Achenes** oblong, ca. 3 mm long, 10-ribbed, ribs prominent, glandular-punctate; **pappus** white or straw colored, in 2 series, inner series 6–7 mm long, outer pappus setose, 1–1.5 mm long.

Habitat: along trail in open grassland, 1200 m alt.

Type collection. Thailand [NE] Prov. Loei: Phu Kradung, Phu Kradung Distr. (12-1982, H. Koyama, H. Terao & T. Wongprasert T-31211 KYO-holotype, TNS-isotype).

Other specimens examined. Thailand [NE] Prov. Loei: Phu Kradueng National Park (7-1947, native DE 22 BKF with *Vernonia cinerea*; 11-1979, T. Shimizu *et al.* T-22557 KYO, TNS; 11-1984, G. Murata *et al.* T-43024, T-43083 KYO, L), Wang Saphung (7-1949, D. Bunpheng 264 BKF).

Notes: The texture of the leaves is similar to that of *Blumea*. In general appearance, this species is very similar to *Vernonia chiangdaoensis*. Considering only the characters of the ach-

enes, this species may be conspecific with *V. chiangdaoensis*, although it can be clearly distinguished from the latter by having small heads with ca. 13 florets, short involucre ca. 5 mm long and short inner pappus ca. 6–7 mm long.

5. *Vernonia principis* Gagnep. in Bull. Mus. Hist. Nat., Paris, **25**: 490 (1919), in Lecomte, Fl. de l'Indo-Chine, **3**: 478, fig. 43 (1924); Kerr, Fl. Siam. Enum. **2** (3): 242 (1936). Type from Molu [without Province] (2-1892, H. d'Orleans s.n. P), Thailand.

Perennial herbs from woody rhizomes, with two types of **stem** branched at base; one type of stem erect, ca. 2 m tall, finely striate, subglabrous throughout, upper part branched, branches ending in inflorescences; other type of **stem** bending down, with secondary inflorescence developing from primary inflorescence axes and flowering after anthesis of primary inflorescence. **Petioles** nearly absent to ca. 1 cm long. **Leaves** of erect stem sessile, coriaceous, lanceolate to oblanceolate, 13–22 cm long, 3–4 cm wide, apex long acuminate, sometimes curved, base rounded, margin subentire or remotely serrulate, upper surface more or less scaberulous, lower surface reticulate, shortly pubescent along veins, scarcely glandular punctate; **leaves** of downwardly bent stem petiolate, coriaceous, lanceolate to elliptic, 13–17 cm long, 4–7 cm wide, lower surface reticulate, pilose, glandular punctate, upper surface scaberulous. **Inflorescences** broad panicles on both types of stems. **Heads** discoid, ca. 13 mm across; sessile or peduncle to 25 mm long, slender, straight; receptacle fimbriate; **involucre** campanulate, ca. 9 mm tall; **phyllaries** in 5 series, imbricate, woolly hairy at margin, innermost phyllaries lanceolate, apex obtuse, outer phyllaries ovate, appressed, apex with short rigid point. **Flowers** December, ca. 20 per head; **corolla** pale violet at lobes, ca. 9 mm long, tube ca. 3 mm long, sparsely glandular punctate with some col-leters. **Achenes** immature, ca. 3.5 mm long, 10-ribbed, pilose without glands; **pappus** white or whitish, in 2 series, inner series ca. 7 mm long, bristles individually caducous, outer pappus se-



Fig. 2. Holotype specimen of *Vernonia kradungensis* H. Koyama, sp. nov. Thailand [NE] Prov. Loei: Phu Kradung, Phu Kradung Distr. (12-1982, H. Koyama, H. Terao & T. Wongprasert T-31211 KYO).

tose, ca. 1 mm long. (Fig. 3)

Habitat: mountain slopes evergreen forests on hills, 1200–1370 m alt.

Specimens examined. Thailand [N] Prov. Lam-pang: Doi Khun Tan, Mae Tha Distr. (12-1984, H. Koyama & C. Phengklai T-39099 A, AAU, KYO, TNS; 1-1985, H. Koyama & C. Phengklai T-39209 A, AAU, KYO, TNS). Siam [without Province]: Molu (2-1892, H. d'Orleans s.n. P).

Distribution: Endemic to Thailand.

Notes: This is similar to *Vernonia kingii*, but differs in having a small involucre and lanceolate phyllaries with an acuminate apex.

6. *Vernonia pseudosutepensis* H. Koyama, sp. nov. (Fig. 4)

Haec species *Vernonia sutepensis* affinis est, sed ab *V. sutepensis* capitula parva ca. 10-flora, phyllaria extima linearia facile distinguitur.

Perennial herbs from woody rhizomes; **stem** erect, ca. 150 cm tall, finely striate, pubescent throughout, branched above; branches ending in inflorescences. **Petioles** 3–5 mm long. Leaves of lower part of stem obovate, those of middle part of stem oblong, 9–15 cm long, 3–6 cm wide, those of upper part of stem lanceolate, 4–11 cm long, 1–2 cm wide, upper surface somewhat scaberulous, lower surface reticulate, silky hairy and glandular punctate, base attenuate, margin minutely dentate, apex acuminate. **Inflorescences** compound corymbose, with many heads. **Heads** discoid, ca. 1 cm across; peduncles sessile to 15 mm long, slender, straight, densely pilose; receptacle partly fimbriate in young heads; **involucre** campanulate, ca. 6 mm tall; **phyllaries** in 5 series, imbricate, densely pilose, apex rigidly pointed, innermost series lanceolate, ca. 6 mm long, ca. 1 mm wide, outer phyllaries linear. **Flowers** December to February, ca. 10 per head; **corolla** purple, ca. 8 mm long, tube ca. 5 mm long, glandular punctate. **Achenes** immature, 10-ribbed (?), densely pilose and glandular punctate; **pappus** whitish, in 2 series, inner series ca. 6 mm long, outer pappus setose, 0.2–1 mm long.

Habitat: dry evergreen forest on hills, bamboo/deciduous forests, ca. 200 m alt.

Type Collection. Thailand [SW] Prov. Uthaitani: Kow Hin Dang, Huay Ka Kang Reserve, Ban Rai Distr. (2-1976, Maxwell 76-94 AAU, L).

Other specimens examined. [SW] Prov. Kanchanaburi: Sai Yok (12-1961, C. Phengklai 346 BKF, L), Sang Khla Buri Distr. (? BKF 26038 BKF).

Notes: This is similar to *Vernonia sutepensis*, but differs from latter in having small heads with ca. 10 flowers, a short involucre ca. 6 mm long, and the lower surface of the leaves reticulate with curved silky hairs.

7. *Vernonia sutepensis* Kerr in Kew Bull. 1935: 329 (1935), Fl. Siam. Enum. 2 (3): 244 (1936). Type not seen, from Doi Suthep (Kerr 3561), Northern Thailand.

Vernonia aspera sensu Kitam. in Acta Phytotax. Geobot. 24: 14 (1969), p. p.

Woody herbs, somewhat climbing, straggling; **stem** erect, 120–150(–200) cm tall, striate, densely pilose throughout, usually branched above, branches ending in inflorescences, but sometimes branched at base into two shoots; a sterile and a fertile shoot. **Petioles** to 1.5 cm long. **Leaves** of lower part of fertile shoot petiolate, broadly oblanceolate, oblong, apex acute, base narrowed into a short petiole, 9–15 cm long, 3.5–6 cm wide, margin serrate or mucronate, both surfaces pubescent and glandular punctate; leaves of upper part of fertile shoot petiolate, lanceolate, apex acuminate, 8–13 cm long, 1.5–3.5 cm wide; leaves of sterile shoots petiolate, elliptic, 5–11 cm long, 2.5–5.5 cm wide. **Inflorescences** broadly paniculate, corymbose, pubescent. **Heads** discoid, ca. 1.5 cm across; peduncles sessile to 23 mm long, slender or stout, densely pilose, sometimes curved; receptacle smooth and glabrous; **involucre** broadly campanulate, ca. 9 mm tall; **phyllaries** in 5 series, coriaceous, imbricate, woolly at margin, glandular punctate on dorsal surface at apex, inner series linear-oblong, concave, obtuse, outer phyllaries oblong, apex acuminate, rigidly mucronate. **Flowers** February to March, 13–19 per head, **corolla** blue, purplish,



Fig. 3. Two types of stem branched at base in *Vernonia principis*; one type of stem (A) erect, ca. 2 m tall, upper part branched, branches ending in inflorescences.; other type of stem (B) bending down, with secondary inflorescence developing from primary inflorescence axes and flowering after anthesis of primary inflorescence.

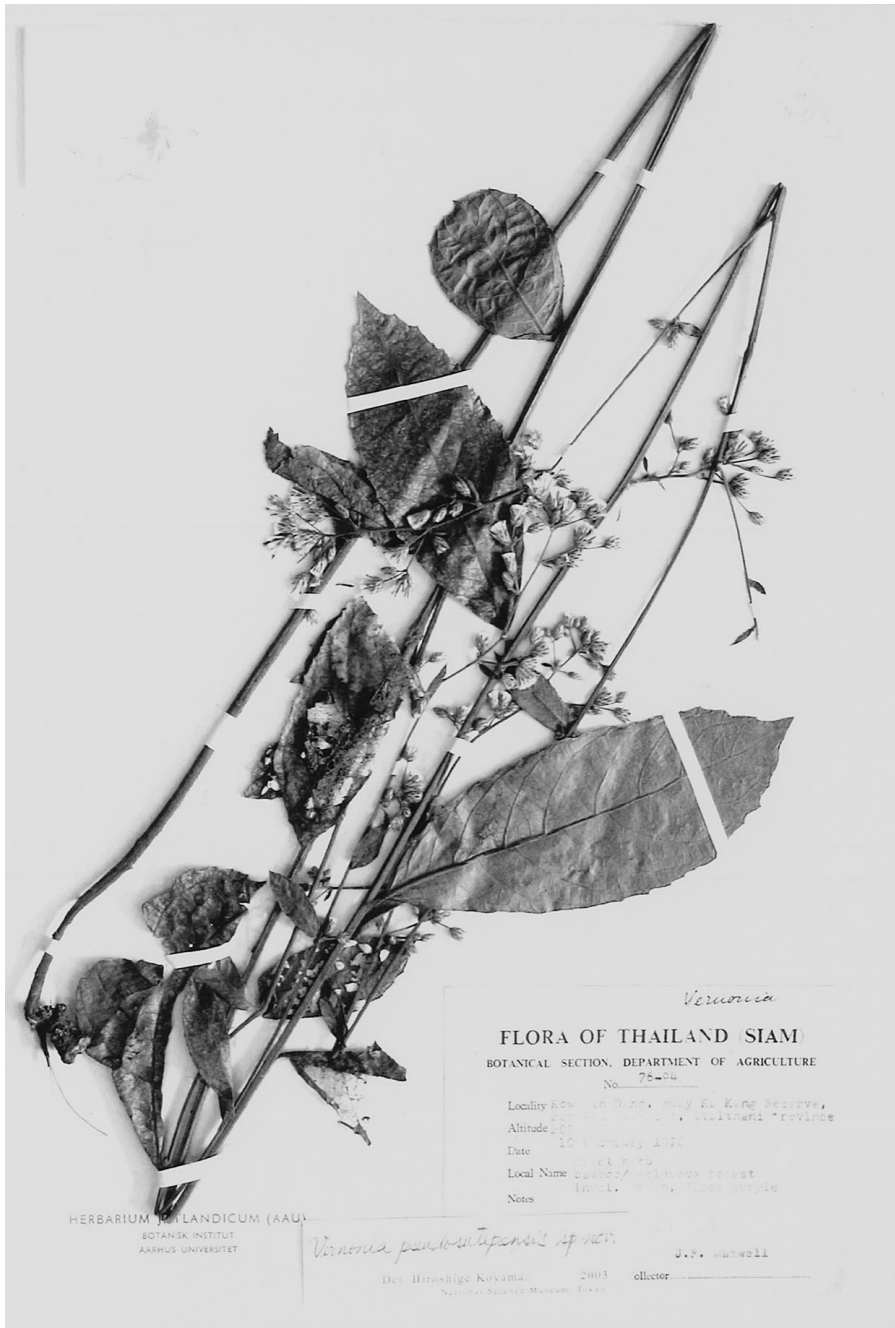


Fig. 4. Holotype specimen of *Vernonia pseudosutepensis* H. Koyama, sp. nov. Thailand [SW] Prov. Uthairat: Kow Hin Dang, Huay Ka Kang Reserve, Ban Rai Distr. (2-1976, J. F. Maxwell 76-94 AAU)

light purple or bright purple, glandular punctate outside. **Achenes** immature, ca. 2.5 mm long, 10-ribbed, pubescent and glandular punctate; **pappus** white, in 2 series, inner series 7–8.5 mm long, outer pappus setose, 0.5–1 mm long.

Habitat: among shrubs in oak forests or in evergreen forests on hills, 800–1500 m alt.

Specimens examined. [N] Prov. Chiang Mai: Doi Chang (1-1983, H. Koyama *et al.* T-32692, T-32787 KYO), Doi Chiang Dao (3-1979, T. H. Koyama *et al.* 15599 AAU, BKF, KYO; 2-1983, H. Koyama *et al.* T-33282 KYO), Doi Put (3-1965, C.H. & B.S. 287 BKF, TNS), Doi Suthep (3-1951, T. Smitinand 152 BKF, P, TNS; 2-1958, Ogawa & Yoda OCUBE 112-4 KYO; 2-1958, Th. Sorensen *et al.* 915 BKF, C; 2-1959, Th. Sorensen *et al.* 6903 BKF, C; 2-1987, C. Niyomdham & R. Kubat 1347 BKF, C, L; 10-1979, T. Shimizu *et al.* T-18711 KYO; 2-1983, H. Koyama *et al.* T-33612 KYO; 12-1984, H. Koyama & T. Nagamasu T-40126, T-40158 KYO; T-40125 A, BKF, KYO, L), Nam Dang, Maetaeng Distr. (1-1983, H. Koyama *et al.* T-32692 KYO).

Distribution: Endemic to northern Thailand.

Notes: This species is similar to *Vernonia kingii* in general appearance, but is quite different from the latter in having coriaceous leaves and a smooth, glabrous receptacle.

The specimen, 3-1966, B. Sukkri 68 (BKF?), was collected from Doi Suthep, but is different from this species in having crisp hairs on the lower surface of the leaves and obtuse involucre phyllaries.

8. *Vernonia aff. tonkinensis* Gagnep. [in Bull. Mus. Hist. Nat. Paris, **25**: 492 (1919). Type not seen, from Tonkin.]

Perennial herbs from woody rhizomes; **stems** erect, ca. 150 cm tall, obscurely striate, pubescent throughout, upper part branched, branches ending in inflorescences. **Petioles** 0.5 cm long. **Leaves** elliptic, 5–9 cm long, 1.5–4 cm wide, base truncate, apex acute, upper surface scabrous, lower surface reticulate, pilose, densely pilose on nerves, densely glandular punctate. **In-**

florescences broad panicles. **Heads** discoid, ca. 2 cm across; peduncles subsessile to 30 mm long, stout, straight; receptacle pilose; **involucre** broadly campanulate, ca. 9 mm long; **phyllaries** in 5 series, imbricate, with few glands and sparse hairs on back, apex with short rigid point. **Flowers** February, ca. 20 per head; **corolla** purple, ca. 9 mm long, tube ca. 5 mm long, glandular punctate. **Achenes** oblong, ca. 3 mm long, 10-ribbed, pilose and glandular punctate; **pappus** white, in 2 series, inner series ca. 8 mm long, outer pappus setose ca. 1.3 mm long.

Habitat: in dipterocarp forests, ca. 930 m alt.

Specimens examined. Thailand [N] Prov. Chiang Mai: along route 1019, from Chiang Rai to Chiang Mai, Doi Saket Distr. (2-1983, H. Koyama *et al.* T-33577 KYO).

Notes: Because of the ovate involucre phyllaries, the specimen cited is determined as this species, but the peduncles of the specimen cited above are more slender than those reported for *Vernonia tonkinensis*.

9. *Vernonia aff. virgata* Gagnep. [in Bull. Mus. Hist. Nat. Paris, **25**: 493 (1919). Type not seen, from Laos.]

Perennial herbs from woody rhizomes; **stem** erect, ca. 80 cm tall, finely striate, densely pilose throughout, upper part branched, branches ending in inflorescences. **Petioles** 2–4 mm long. **Leaves** petiolate, rhomboid elliptic, 8–10 cm long, 2.8–3.5 cm long, apex shortly acuminate, base truncate, margin punctate, lower surface reticulate, pilose, glandular punctate, upper surface pilose along main and lateral veins. **Inflorescences** corymbose. **Heads** discoid, ca. 1.5 cm across; peduncles subsessile to 15 mm long, slender, straight; receptacle pilose; **involucre** broadly campanulate, ca. 6 mm long; **phyllaries** subulate, in 5 series, imbricate, with few glands and sparse hairs on back, apex of outer phyllaries with rigid point. **Flowers** March, ca. 21 per head; **corolla** purple, ca. 7 mm long, tube ca. 2.5 mm long, glandular punctate. **Achenes** immature, more than ca. 2 mm long, 10-ribbed (?), densely pilose

and glandular punctate; *pappus* in 2 series, white, inner series ca. 6 mm long, outer pappus setose ca. 0.6 mm long.

Habitat: stream banks in evergreen forest, ca. 180 m alt.

Specimens examined. Thailand [PEN] Prov. Surathani: Khao Sok National Park, Phanom Distr. (3-1983, H. Koyama *et al.* T-33960 KYO).

Notes: Because of the subulate involucreal phyllaries, the specimen cited is questionably determined to be *Vernonia virgata*, but I was unable to observe the characteristic achenes because of the immature nature of the collection.

Acknowledgements

Specimens examined are kept in the Harvard University Herbaria (A), Smithsonian Institution (US), U.S.A., Aarhus University (AAU), Denmark, Kyoto University (KYO), National Science Museum, Tokyo (TNS), Japan, in the Museum of Natural History at Copenhagen (C), Denmark, at Leiden (L), the Netherlands, at Bangkok (BK,

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