

Revision of *Neanotis* W.H.Lewis (Rubiaceae) in Thailand

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Received: 6 June 2014; Accepted: 23 September 2014

Abstract.— *Neanotis* W.H.Lewis (Rubiaceae) in Thailand is mainly distributed in high elevation areas, usually at least 800 m a.s.l., except *Neanotis trimera*. Five species are enumerated in Thailand viz. *N. calycina*, *N. hirsuta*, *N. trimera*, *N. tubulosa* and *N. wightiana*. *Hedyotis nalampoonii*, *H. pahompokae* and *N. pahompokae*, which are endemic and known in Thailand, are presently reduced to the synonym of *N. calycina*. A key to the Thai species is provided. Lectotypifications of *Anotis calycina*, *A. trimera*, *Hedyotis stipulata*, *H. wightiana* and *Oldenlandia tubulosa* are designated.

KEY WORDS: *Neanotis*, Rubiaceae, *Hedyotis*, Lectotypification, Thailand

INTRODUCTION

Lewis (1966) named the Asian members of the invalid genus, *Anotis* DC. (De Candolle 1830) as *Neanotis* with one section, 28 species and six varieties. Presently, it comprises approximately 31 species (Govaerts *et al.*, 2014). *Neanotis* is a monophyletic group that includes three combinations and one synonym from *Hedyotis* (Wikström *et al.*, 2013). The genus *Neanotis* is distributed in South Asia, East Asia and Southeast Asia. These plants are an herb, with pectinate stipules between the opposite leaves, capsules that dehisce at the apex or indehiscent, few to numerous ovules that can be reduced to one ovules per locule and in which seeds are pitted (Mill 1999, Ridsdale 1998). Pollens are (5–) 6 to 12-aperture (Lewis 1966).

Neanotis was first reported in Thailand by Craib in 1932, and he referred to the genus as *Anotis* before the name *Neanotis* was established. There were four taxa in Thailand, *Anotis calycina*, *A. quadrilocularis*,

A. trimerra and *A. wightiana* var. *compressa*. He also mentioned *Hedyotis linleyana* which is a synonym of *Neaotis hirsuta*. Fukuoka (1969) named two endemic *Hedyotis* from Thailand, *H. pahompokae* and *H. nalampoonii*, however they resemble *N. calycina*. Recently, Wikström *et al.* (2013) transferred *H. pahompokae* to *N. pahompokae* (Fukuoka) Wikström & Neupane. However, after this the status of the Thai plants has not been reevaluated and their identities remain disputable.

MATERIALS AND METHODS

This study was based on Thai material of *Neanotis* in herbaria: BK, BKF, BM, BO, CMU, G, K, KEP, KGU, L, P, QBG, SING and TCD (acronyms follow Thiers, 2013). Fruits and flowers were studied using a dissecting microscope. The distribution and ecological data were collected from the field and herbarium specimens.

TAXONOMIC TREATMENT

NEANOTIS

W.H.Lewis, Ann. Missouri Bot. Gard. 53: 34. 1966; Ridsdale in Dassanayake, Revis. Handb. Fl. Ceylon 12: 268. 1998. Type species: *N. indica* (DC.) W.H.Lewis.

Hedyotis sect. II Wight & Arn., Prod. Pl. Ind. Or.: 409. 1834.

Annual or perennial herbs. Stem erect, prostrate or procumbent, angled, with 4 ribs. *Leaves* opposite, ovate, oblong, elliptic or lanceolate, chartaceous, with or without petiole. *Stipules* truncate, lobes fimbriate, adnate with petioles. *Inflorescence* terminal or axillary; dichasium, monochasium, corymbose, cymose or capitate cymes. *Flowers* 4-merous, heterostylous, white, pale pink or lilac, with or without pedicel. *Calyx* connate at base; lobes triangular. *Corolla* salverform, tubular or campanulate; lobes valvate in bud. *Ovary* inferior, 2-, 3- or 4-locular; ovules 2 to numerous. *Capsule* loculicidally dehiscent at the apex or indehiscent with thin exocarp, crowned by persistent calyx; lateral strongly flattened, cup-shaped. *Seeds* tiny, concavo-triangular ellipsoid, cymbiform, concavo-convex with a longitudinal hilar ridge or lenticular, reticulate or papillate testa, dark brown to black.

Key to the species

1. Ovary 3–4-locular 2
1. Ovary 2-locular 3
2. Seeds cymbiform or concavo-convex with a longitudinal hilar ridge 4. *N. tubulosa*
2. Seeds lentiform or flattened without a longitudinal hilar ridge 5. *N. wightiana*
3. Capsules cup-shaped, ovoid or obovoid 4
3. Capsules lateral strongly compressed 5. *N. wightiana*
4. Herb procumbent or prostrate. Inflorescence capitate 2. *N. hirsuta*
4. Herb erect. Inflorescence dichasial or monochasial cyme 5
5. Leaves hairy. Inflorescence dichasial cyme 1. *N. calycina*
5. Leaves glabrous. Inflorescence monochasial cyme in ultimate branch 3. *N. trimera*

1. *Neanotis calycina* (Wall. ex Hook.f.)

W.H.Lewis, Ann. Missouri Bot. Gard. 53: 37. 1966. Fig. 1A.

Anotis calycina Wall. ex Hook.f., Fl. Brit. India 3: 73. 1880. Type: Nepal, 1821, Wallich 878 (lectotype K-W!; isolectotypes G!, K!, here designated).

Hedyotis nalampoonii Fukuoka, Acta Phytotax. Geobot. 24: 28. 1969, **syn. nov.** Type: Thailand, Chiang Mai, Doi Pui, Doi Suthep-Pui National Park, 1,200–1,685 m, 8 Sept. 1967, K. Iwatsuki, H. Koyama, N. Fukuoka & A. Nalampoon T-9422 (holotype KYO; isotypes BKF!, BO!, L!, TI).

Hedyotis pahompokae Fukuoka, Acta Phytotax. Geobot. 24: 29. 1969, **syn. nov.** Type: Thailand, Chiang Rai, Doi Pha Hom Pok, 1,300–2,000 m, 12 Sept. 1967, K. Iwatsuki, N. Fukuoka & A. Chintayungkun T-9562 (holotype KYO; isotypes A, AAU, BKF!, BO!, K!, L!, TI).

Neanotis pahompokae (Fukuoka)

N.Wikström & Neupane, Taxon 62(2): 372. 2013, **syn. nov.**

Erect herb. *Stem*: quadrangular, (5–)13–30 cm tall, with 1-several branches, mostly sparsely branched, glabrous or pubescent.

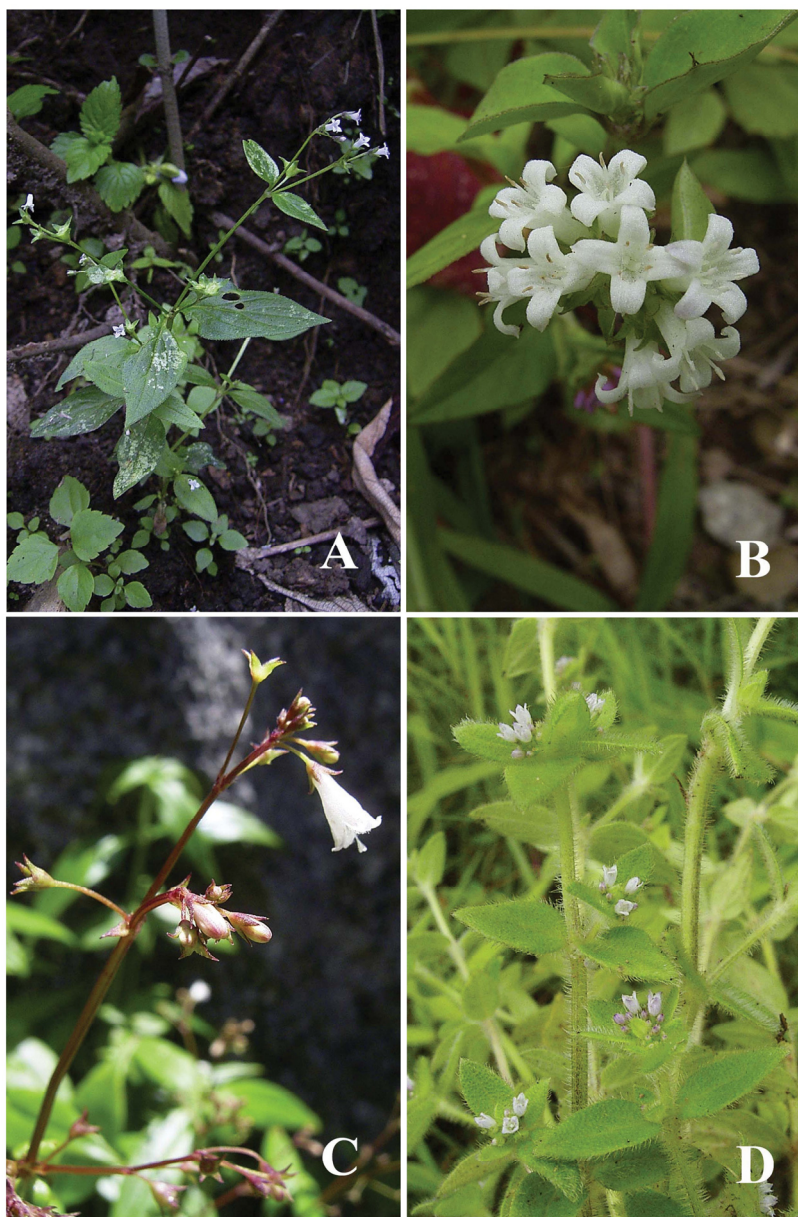


FIGURE 1. A. *Neanotis calycina*: habit; B. *N. hirsuta*: inflorescence; C. *N. trimera*: inflorescence; D. *N. wightiana*: twig and inflorescence.

Leaves: ovate, oblong, elliptic or lanceolate, (1–) 1.5–4.5 cm long, 0.5–1.5 cm wide, chartaceous, apex acute to acuminate, base obtuse, acute or attenuate, upper leaves gradually reduced in size and become bract-

like on uppermost node; lateral veins 3–5 pairs, upper surface sparsely hirsute, lower surface glabrous or slightly hirsute on veins; petiole sessile or 1–5 mm long. *Stipules*: membranous, sheath truncate; lobe

pectinate, 0 or 3–7 fimbriate lobes, hairy. *Inflorescence*: terminal dichasial cyme; pedicel of middle flowers sessile or 1–6 mm long. *Flower*: 4-merous. *Calyx*: lobes triangular, 0.6–1 mm long, 0.8–1 mm wide, pubescent. *Corolla*: tubular, white, pale pink or lilac; tubes 1.5–2 mm long; lobes deltoid, 0.8–1 mm long, glabrous. *Stamens*: filament 0.1–0.2 mm long; anther oblong, 0.4–0.5 mm long. *Style*: 1.2–1.5 mm long; stigma bifid, 0.4–0.5 mm long. *Ovary*: 2-locular. *Capsule*: loculicidally dehiscent, cup-shaped, 1.8–2 mm long, 3–3.5 mm wide, pubescent, upper part beaked, slightly protruded over the calyx tube up to 1/3 of capsule. *Seeds*: 10–16 per locule, concavo-convex or cymbiform, *ca.* 0.6 x 0.5 mm, dorsal sides convex, ovate or broadly elliptic, margins recurved to ventral side, ventral sides concave with a protruding longitudinal ridge of hilum, *ca.* 0.3 mm long, smooth outside, reticulate, black.

Thailand.— NORTHERN: Mae Hong Son [Doi Pui, Baan Huai Hee, 1,650 m, 24 Aug. 1999, *S. Watthana, P. Suksathan & G. Argent* 635 (QBG)]; Chiang Mai [Doi Suthep-Pui National Park, 8 Sept. 1967, *K. Iwatsuki, H. Koyama, N. Fukuoka & A. Nalampoon* T-9422 (BKF, BO, L); same locality, 24 Sept. 1988, *J.F. Maxwell* 88-1120 (BKF, CMU, L); same locality, 31 Oct. 1989, *J.F. Maxwell* 89-1335 (CMU, L); same locality, 14 Oct. 1997, *W. Nanakorn et al.* 9730 (QBG); Jawm Thong District, Mae Soi Ridge, 28 Sept. 1992, *J.F. Maxwell* 92-592 (BKF, CMU, L); Doi Angka, Doi Pa Mawn spur, 9 Sept. 1927, *H.B.G. Garrett* 440 (K, L-2 sheets); Doi Inthanon, enroute from Pha Mawn (Ban Yang), 900–1,800 m, 2 Oct. 1971, *G. Murata, K. Iwatsuki, C. Phengklai & C. Charoenphol* T-15667 (BKF); same locality, 900–1,800 m, 2 Oct. 1971, *G. Murata, K. Iwatsuki, C. Phengklai & C. Charoenphol* T-15739 (BKF-2 sheets);

same locality, 900–1,800 m, 4 Oct. 1971, *G. Murata, K. Iwatsuki, C. Phengklai & C. Charoenphol* T-15783 (BKF); San Kamphaeng, Doi Lohn, Haay Gayo Subdistrict, 23 Oct. 1996, *J.F. Maxwell* 96-1390 (BKF, CMU, L); Doi Lohn, Mae Awn, 1,550 m, 21 Sept. 2004, *J.F. Maxwell* 04-503 (BKF, CMU); Doi Ang Khang, 19.54°N, 99.02°E, 8–9 Sept. 1999, *C. Puff* 990908-1/1 (QBG); Bang Hin Fon Village, Mae Jam, 1,475 m, 1 Nov. 2002, *J.F. Maxwell* 02-372 (CMU)]; Chiang Rai [Doi Pha Hom Pok, 1,300–2,000 m, 12 Sept. 1967, *K. Iwatsuki, N. Fukuoka & A. Chintayungkun* T-9562 (BKF, BO, K, L)]; Nan [Doi Phu Kha National Park, Pua District, 19°10'N, 101°07'E, 1,800 m, 31 Aug. 2000, *P. Srisanga* 1536 (QBG); 6 Oct. 2010, *K. Wangwasit* 101006-3 (KKU)]; Uttaradit [Klong Tron National Park, 1,650 m, 16 Oct. 2005, *J.F. Maxwell* 05-583 (CMU)]; Phitsanulok [Phu Hin Rong Kla, 1,700 m, 13 Oct. 1998, *P. Suksathan* 1208 (QBG)].

Distribution.— India [Shilling, *C.B. Clarke* 40530 (BM); Kasumpti Shimla, *H.H. Rich* 682 (K); Dewa Diha, *J.S. Gamble* 23229 (K)]; Nepal [Williams & Stainton 8518 (BM)]; S. China [Yunnan, 5,500 ft., *A. Henry* 11293 (K); *G. Forrest* 18591 (BM, K); Szemao, *A. Henry* 13512 (K); 10134 (K); 10134A (K)]; Myanmar [Kanpetlet Township, Chin State, *ca.* 1,750 m, 23 Oct. 2011 *L.S. Man* 087626 (QBG)]; Vietnam [Annam, Chapa, 1,500 m, *A. Petelot* 3.133 (K)].

Ecology.— Open areas, in evergreen forest, 1,100–1,700 m a.s.l. Flowering September–October.

Note.— Fukuoka (1969) described two endemic species, *H. pahompokae* and *H. nalampoonii* from Thailand, which were alike. The former was transferred to *N. pahompokae* by Wikström *et al.* (2013) as it

has dense branching, the diameter of the bush is more than 10 cm and the leaves have prominent veins, while the latter is an erect herb or slightly branching, the diameter of the bush is less than 10 cm and it has slightly prominent veins on the leaves. Both of them are similar to *N. calycina* in being hairy throughout and having prominent calyx. The *N. calycina* material, *Henry 10134* (K) has many branches, *Henry 11293* (K) has an erect stem and slight branches while *Gamble 23229* (K) shows both characters. Therefore, *N. pahompokae* and *H. nalampoonii* are treated as synonyms of *N. calycina*.

2. *Neanotis hirsuta* (L.f.) W.H.Lewis, Ann. Missouri Bot. Gard. 53: 38. 1966. Fig. 1B. *Oldenlandia hirsuta* L.f., Suppl. Pl.: 127. 1782. Type: Indonesia, Java, *Thunberg s.n.* (UPS).

Anotis hirsuta (L.f.) Miq. ex Backer & Slooten, Geill. Handb. Jav. Theenkr.: 203. 1924.

Hedyotis lindleyana Hook. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 409. 1834, *nom. inval.*

Oldenlandia hirsuta var. *glabrior* Miq., Fl. Ned. Ind. 2: 194. 1857. Type: Indonesia, Java, *Korthals s.n.* (L barcode L0000864!), Java, Waru waterfall, *Blume s.n.* (L barcode L0000863!), *Blume s.n.* (L barcode L0000862!).

Neanotis hirsuta var. *glabrior* (Miq.) W.H.Lewis, Ann. Missouri Bot. Gard. 53: 38. 1966.

Hedyotis stipulata R.Br. ex Hook.f., Fl. Brit. India 3: 63. 1880. Type: Nepal, 1821, *Wallich 6195* (lectotype K-W!; isolectotype G!, here designated).

Oldenlandia stipulata (R.Br. ex Hook.f.) Pit. in Lecomte, Fl. Indo-Chine 3: 111. 1922.

Anotis papuana Lauterb. Nachtr. Fl. Schutzgeb. Südsee: 391. 1905. Type: New Guinea, Bismarckgebirge, 1,200 m, Jan. 1902, *R. Schlechter 13982* (K!).

Procumbent or prostrate herb. *Stem*: quadrangular, usually glabrous to pubescent rarely tomentose at shoot or young branches. *Leaves*: ovate, elliptic, ovate-lanceolate or lanceolate, 1.3–5.1 cm long, 0.6–3.1 cm wide, membranous, upper surface usually scabrid near margin or rarely entirely pubescent at young part, lower surface glabrous or rarely pubescent on young part, margin ciliate, apex acute, base rounded or acute, usually attenuate; lateral veins 3–5 pairs; petiole 1–10 mm long. *Stipules*: adnate with petiole, sheath membranous, 7–9 fimbriate lobes, glabrous. *Inflorescence*: single terminal or umbellate-capitate, rarely dichasium-capitate, 1–3 head, or axillary capitates; peduncle 3–23 mm long, glabrous to pubescent. *Flowers*: 4-merous; heterostylous, sessile. *Calyx*: lobes narrowly deltoid to oblong, 1.5–2.5 mm long, 0.5–1.0 mm wide, apex acute, glabrous or pubescent on both surfaces, margin glabrous or slightly ciliate. *Corolla*: funnelform or campanulate, white; tube 2.2–3 mm long; lobes triangular to oblong, 1.8–3 mm long, 1–1.5 mm wide, outside glabrous, inside pubescent. *Stamens*: 4. *Longistylous flowers*: filament 0.3–0.5 mm long; anther inserted, oblong, 0.6–0.8 mm long, 0.1–0.2 mm wide. *Style*: ca. 3 mm; stigma 1–1.5 mm long. *Brevistylous flower*: filament 1–1.2 mm long; anther exserted, oblong, 0.8–1 mm long, c. 2 mm wide. *Style* ca. 2 mm long; stigma 1–1.2 mm long. *Ovary*: 2-locular. *Capsule*: indehiscent with thin exocarp, ovoid 2–2.5 mm long, 3–3.5 mm wide, beak not distinct or slightly protruding not reached the calyx apex. *Seed*: (3–)20–25 per locule, concavo-triangular

ellipsoid, 0.5–0.6 mm long, 0.4–0.5 mm wide, dorsal flattened or slightly concave, ventral side with longitudinal ridge of hilum, 2 ventral sides concave, margin not recurved, reticulate, black.

Thailand.— NORTHERN: Mae Hong Son [Pang Kham, Pang Ma Pha, 14 Dec. 2007, *N. Tanaka, H. Nagamasu, A. Naiki, S. Nishida, P. Srisanga & S. Watthana HN8352* (QBG)]; Chiang Mai [Doi Suthep-Pui National Park, 22 Oct. 1910, *A.F.G. Kerr 1491* (BM, K); same locality, 13 May 1912, *A.F.G. Kerr 2590* (BM, K); same locality, 1 Oct. 1922, *A.F.G. Kerr 6371* (BM, K); same locality, 16 Aug. 1988, *J.F. Maxwell 88-999* (BKF, CMU); same locality, 23 Jan. 1991, *J.F. Maxwell 91-98* (CMU, L); same locality, 1,525 m, 12 Nov. 1996, *J.F. Maxwell 96-1534* (BKF); same locality, 1,475 m, 14 Jun. 2002, *J.F. Maxwell 02-157* (BKF); Chang Khian, Doi Suthep, ca. 1,400 m, 26 Dec. 1997, *BGO. Staff 10291* (QBG); Me Tawn, E of Hui Pa Han, ca. 1,150 m, 26, Sept. 1938, *H.B.G. Garrett 1098* (K); Near Bo Luang, ca. 1,050 m, 12 Jun. 1973, *R. Geesink, D. Phanichapol & T. Santisuk 5868* (BKF, K); 30 km S of Bo Luang along the Om Koi trail, 18°02'N, 98°24'E, 3 Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke 2048* (BKF, K, L); Ob Luang tableland, along road from Bo Luang to Om Koi, 11 Jun. 1968, *C.F. van Beusekom & C. Phengklai 1144* (L); Doi Saket, Daht Mawk Village, Tep Sadet Subdistrict; bordering Jae Sawn National Park, 23 Sept. 1996, *J.F. Maxwell 96-1270* (BKF, L); Doi Inthanon, Siriphum Waterfall, 1,300 m, 23 Jul. 1988, *S. Tsugaru T-61748* (BKF); same locality, 1,020 m, 22 Jul. 1988, *N. Fukuoka T-62175* (BKF); Doi Chiang Dao, SE foothills near Ban Yang Pong Luang, 525 m, 25 Jun. 1989, *J.F. Maxwell 89-818* (CMU); Samoeng, 1,300

m, 1 Aug. 2002, *J.F. Maxwell 02-222* (BKF)]; Nan [Doi Phuka National Park, 19.13°N, 101.05°E, 1,700 m, 16–18 Sept. 1999, *C. Puff 990917-1/2* (QBG); same locality, 19°22'55.61"N, 100°30'53.98"E, 1,170 m, 30 Nov. 2011, *W. La-onsri, M. Norsaengsri, P. Panyachan, P. Tatiya & S. Satatha 1975* (QBG)]; Phitsanulok [Phu Miang, 1,400 m, 4 Oct. 1967, *T. Shimizu, K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom T-11674* (BKF)].

Distribution.— India [Sikkim, *C.B. Clarke 25219A* (BM)]; Nepal [*Wallich 863a* (K-W)]; S. China [Yunnan, 19 Sept. 1888, *M.I. Delavay 4744* (K); same locality, 8,000–9,000 ft., *G. Forrest 4678* (K); same locality, 5,600 ft., *G. Forrest 8105* (K); Hill of Manme, Wuxiang, Menghan, Jinghong, Yunnan, 1,200 m, 18 Dec. 2005, *Zhou-Shishun 3530* (QBG); Menglian county, Lafu reservoir, Yunnan, 1,514 m, 2 Nov. 2011, *L. Jianwu Cx00030* (QBG)]; Vietnam [Annam, Chapa, 1,500 m, July 1927, *A. Petelot 3.130* (K)]; Malay Peninsula [Pahang, 30 Mar. 1909, *H.N. Ridley 13646* (K); Camemis Highlands, Robinsmis Fall, *M.R. Henderson 23460* (K)]; Java [Dieng, 4,000 ft., 1875, *O. Kuntze 5639* (K)]; Papua New Guinea [Anga valley, 6,500 ft., *R. Schodde 1642* (K)].

Ecology.— Open areas, 900–1,600 m a.s.l. Flowering May–September.

Note.— *Neanotis hirsuta* is distinguished by having 3–5 pairs of lateral veins and the capsule has a thin exocarp.

3. *Neanotis trimera* (Craib) W.H.Lewis, *Ann. Missouri Bot. Gard.* 53: 40. 1966. Fig. 1C.

Anotis trimera Craib, *Fl. Siam.* 2: 59. 1932.

Type: Thailand, Saraburi: Hin Lap, 3 Sept. 1924, *A.F.G. Kerr 9133* (lectotype K!; isolectotypes BK!, BM!, here designated).

Annual and erect herb. *Stem*: 30–80 cm tall, base roundish, branchlets quadrangular, 4-ribbed, subsucculent, glabrous. *Leaves*: opposite, lanceolate, ovate or elliptic, 2–10 cm long, 0.6–3.5 cm wide, apex acute or acuminate, base attenuate or rounded, glabrous, dry leaves membranous; lateral veins 4–5 pairs, sunken above; petiole sessile or 5 mm long. *Stipules*: adnate to petioles, sheath broadly deltoid, or mucronulate, with 3–6 fimbriate lobes, pubescent. *Inflorescence*: terminal monochasial cyme; peduncle glabrous. *Flowers*: white, campanulate; heterostylous; pedicel 3–22 mm long, glabrous. *Calyx*: 4, base minutely connate; lobes narrowly deltoid, 0.8–1 mm long, 0.5–0.6 mm wide, apex acute, erect, glabrous. *Corolla*: 4; tube 2–3.5 mm long; lobes ovate, 1.2–1.5 mm long, apex acute, outside glabrous, or sparsely papillae, inside tomentose. *Stamens*: 4, white. *Longistylous flowers*: filament 0.3–0.5 mm long, glabrous; anther oblong, 0.8–1 mm long. *Style* 3.5–4.5 mm long, glabrous; stigma 2; lobes 0.3–0.5 mm long. *Brevistylous flowers*: filament *ca.* 0.8 mm long, glabrous; anther oblong 1–1.2 mm long. *Style*: 2–2.5 mm long, glabrous, 0.3 mm long. *Ovary*: 2-locular, glabrous. *Capsule*: loculicidally dehiscent, obovoid, 2–3 mm long, 2–3 mm wide, widest at the top of capsule, beak slightly protruding not reached the persistent calyx. *Seed*: (1–)2 per locule, oblong, concavo-convex or cymbiform, 1.8–2.3 mm long, 0.7–0.8 mm wide, dorsal side convex, ventral side with a longitudinal hilar ridge, surface verruculose, dark brown.

Thailand.— NORTHERN: Phrae [Doi Pha Klang National Park, 18°08'N, 100°5'E, 300–400 m, 19 Sept. 1999, *C. Puff* 990919-1/1 (QBG)]; NORTH-EASTERN: Loei [Tham Khuhasawan, 19 Aug. 2010, *K. Wangwasit* 100819-1 (KKU)]; Khon Kaen

[Pha Nok Khao, 9 Sept. 1963, *T. Smitinand & H. Sleumer et al.* 1124 (K); 16°52'N, 101°55'E, 6 Nov. 1970, *Ch. Charoenphol, K. Larsen & E. Warncke* 4556 (K-2 sheets, P); 682 m, 15 Aug. 2012, *M. Norsaengsri, C. Lakoet & N. Tathana* 9928 (QBG); Phuphaman National Park, 25 Oct. 2007, *K. Wangwasit* 071025-1 (KKU); 25 Oct. 2007, *K. Wangwasit* 071025-2 (KKU); Pha Daeng Cave, Phuphaman National Park, 300 m, 24 Aug. 2011, *M. Norsaengsri, N. Tathana & C. Lakoet* 8082 (QBG); Sum Phak Nam, Phuphaman National Park, 377.3 m, 24 Oct. 2007, *M. Norsaengsri & C. Lakoet* 2785 (QBG); Tham Phapuang, Phuphaman National Park, 1 Aug. 2011, *M. Norsaengsri, N. Tathana & C. Lakoet* 7964 (QBG)]; CENTRAL: Saraburi [Hin Lap, 3 Sept. 1924, *A.F.G. Kerr* 9133 (BK, BM, K); Muak Lek, 4 Sept. 1928, *Put* 1873 (BK, BM, K)].

Distribution.— Endemic.

Vernacular.— Nom ratchasi (Saraburi).

Ecology.— Open area, limestone bedrock, 200–600 m a.s.l. Flowering July–November.

Note.— *Neanotis trimera* differs from most Thai *Neanotis* by virtue of its glabrous stem and verruculose seed surface.

4. *Neanotis tubulosa* (G.Don) Mabb., K.S.Manilal, Bot. Hist. Hort. Malabar.: 92. 1980. Fig. 2.

Oldenlandia tubulosa G.Don, Gen. Hist. 3: 531. 1834. Type: India, *Wallich* 876 (lectotype K-W 876.C!; isolectotypes BM!, K!, here designated).

Hedyotis tubularis R.Br. ex Arn., Pug. Pl. Ind. Or.: 23. 1836.

Hedyotis quadrilocularis Thwaites, Enum. Pl. Zeyl.: 144. 1859. Type: Sri Lanka, Badulla District, *Thwaites* C.P. 3132 (holotype K!, isotypes BM!, MPU, GH, NY image!, FR, TCD!).

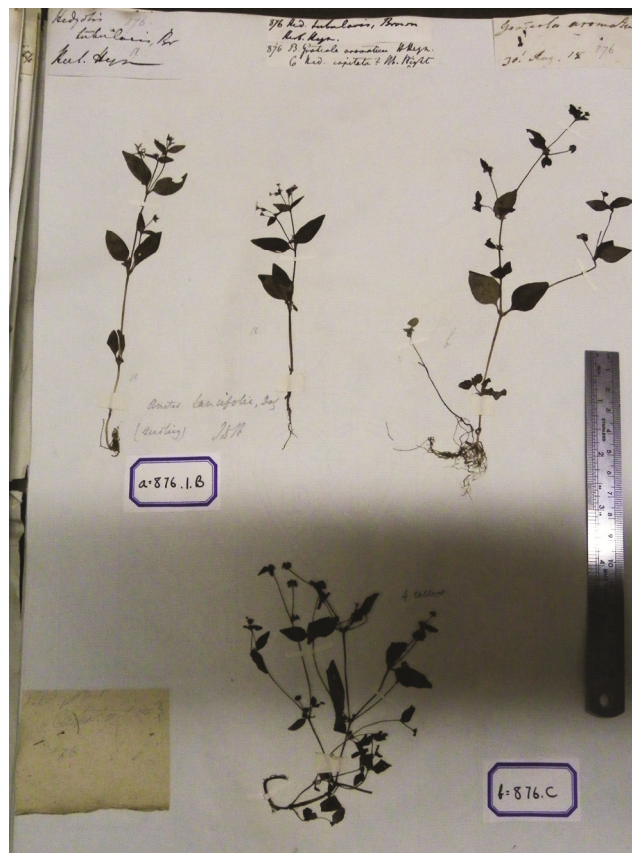


FIGURE 2. *Neanotis tubulosa* [lectotype: Wallich 876 (K)].

Anotis quadrilocularis (Thwaites) Benth. & Hook.f. ex B.D.Jacks., Index Kew. 1: 142. 1893.

Neanotis quadrilocularis (Thwaites) W.H.Lewis, Ann. Missouri Bot. Gard. 53: 40. 1966.

Erect herb, 8–40 cm tall. *Stems*: quadrangular, glabrous. *Leaves*: ovate, lanceolate or elliptic 1.2–4 cm long, 0.7–2 cm wide, membranous, upper surface sparsely pubescent, lower surface glabrous, apex acute, base rounded, acute, attenuate; lateral veins 3–5 pairs; petiole 1–10 mm long. *Stipules*: membranous, sheath truncate, 0.5–1 mm long, with or without a ridge near margin; lobes truncate to denticulate.

Inflorescence: terminal dichasial cyme. *Flowers*: salverform; blue-violet (ex Garrett 389 & 701) or purple (ex Kerr 1421); pedicel sessile. *Calyx*: 4; lobes triangular, ovate or oblong, 0.8–1.5 mm long, 0.5–0.7 mm wide, glabrous or margins fimbriate. *Corolla*: 4; tube 3–4.5 mm long; lobes deltoid or ovate, 1–2 mm long, 0.8–1 mm wide, outside hairy near apex. *Stamens*: exserted; filaments 0.5–0.8 mm long; anther oblong, 0.5–0.6 mm long. *ca.* 0.1 mm wide. *Style*: 2.5–3 mm long; stigma 3–4-fid, 1.5–2.2 mm long. *Capsule*: (3–) 4-locular, loculicidally dehiscent, obovoid, 1.5–2 mm long, 2–2.5 mm wide, membranous, top view quadrangular rarely triangular. *Seeds*: 3–5 per locule, concavo-convex or

cymbiform, 0.7–0.9 mm long, 0.6–0.7 mm wide, dorsal side convex, ovate or broadly elliptic, margins recurved to ventral side, ventral sides concave with protruding longitudinal hilum ridge, 0.4–0.5 mm, reticulate on both sides, dark brown to black.

Thailand.— NORTHERN: Chiang Mai [Doi Angka, Doi Pa Mawn Spur, 25 Jun. 1927, *H.B.G. Garrett* 389 (K, L-2 sheets, P); Doi Inthanon National Park, Doi Pa Kao, 24 Aug. 1931, *H.B.G. Garrett* 701 (BKF, K, L); Doi Suthep-Pui National Park, 25 Sept. 1910, *A.F.G. Kerr* 1421 (BM, K); 1,450 m, 23 Aug. 2002, *J.F. Maxwell* 02-281 (CMU); Mae Phan Waterfall, 1,000–1,060 m, 29 Jul. 1988, *N. Fukuoka* T-62328 (BKF, L); Jawm Thong, 1,450 m, 13 Aug. 1994, *J.F. Maxwell* 94-580 (BKF); Mae Soi Ridge, Mae Soi, Jawm Thong, 1,450 m, 13 Aug. 1994, *J.F. Maxwell* 94-880 (CMU)].

Distribution.— S. India, Sri Lanka, S. China.

Ecology.— In bog, on rock, open areas, by streams, 1,000–1,650 m a.s.l. Flowering August–December.

Note.— This species is quite rare in Thailand. It was collected only in a single province. It resembles *N. calycina* but differs by having a 4-locular and obovoid capsule.

5. *Neanotis wightiana* (Wall. ex Wight & Arn.) W.H.Lewis, Ann. Missouri Bot. Gard. 53: 40. 1966. Fig. 1D.

Hedyotis wightiana Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 410. 1834. Type: India, Peninsular India Orientalis, *Wight* 1299 (lectotype E barcode E00174761 image!; isolectotypes K!, E barcode E00174762 image!, here designated).

Spermacoce compressa Wall. ex G.Don, Gen. Hist. 3: 621. 1834. Type:

Bangladesh, *Wallich* 6187 (holotype K-W!; isotypes E image!, G!, P image!).

Anotis wightiana (Wall. ex Wight & Arn.) Benth. & Hook.f., Gen. Pl. 2: 60. 1873

Anotis wightiana (Wall. ex Wight & Arn.) Benth. & Hook.f. var. *compressa* (Wall. ex G.Don) Craib, Fl. Siam. 2: 59. 1932.

Neanotis wightiana (Wall. ex Wight & Arn.) W.H.Lewis var. *compressa* (Wall. ex G.Don) W.H.Lewis, Ann. Missouri Bot. Gard. 53: 40. 1966.

Oldenlandia teysmaniana Miq., Fl. Ned. Ind. 2: 354. 1857. Type: Indonesia, Sumatra, *Miquel* s.n. (K!).

Stoloniferous, creeping, prostrate or procumbent herb, erect shoots. *Stems*: quadrangular with slight wings, pubescent to tomentose, rarely glabrous. *Leaves*: ovate or elliptic, 0.9–2.5 cm long, 0.4–1.2 cm wide, chartaceous, glabrous to tomentose on both surfaces, apex acute, base obtuse to acute, usually attenuate; lateral veins 2–3 pairs; petiole 0–2.5 mm long. *Stipules*: membranous, sheath acuminate, 0.5–4 mm long; lobe denticulate, 3–5-lobed, glabrous to tomentose. *Inflorescence*: terminal, solitary or capitate-cymes, capitates subtending with 2 leaves. *Flowers*: tubular, white; pedicel 0.5–1 mm long. *Calyx*: short; lobes triangular, 0.2–0.4 mm long 0.2–0.4 mm wide, glabrous or margin fimbriate. *Corolla*: tube 1–1.2 mm long; lobes ovate 0.5–0.8 mm long, 0.5–0.6 mm wide, glabrous on both sides. *Stamens*: exserted; filament 0.2–0.3 mm long; anther broadly elliptic, 0.2–0.3 mm long. *Style*: 1–1.5 mm long, glabrous; stigma bifid; lobes 0.2–0.3 mm long. *Capsule*: 2(–3)-locular; lateral strongly compressed, 1.5–2 mm long, 1.5–1.8 mm wide, glabrous. *Seeds*: (1–)2 per locule, strongly flattened, lenticular, dorsal

side flattened or slightly convex, ovate or rounded, 0.4–0.7 mm long, 0.4–0.5 mm wide, smooth or reticulate, ventral side flattened, peltate or rarely with a longitudinal ridge, reticulate, black.

Thailand.—NORTHERN: Mae Hong Son [Sam Muen, Doi Hua Chang, 1 Mar. 1991, *T. Smitinand s.n.* (BKF)]; Chiang Mai [Me Tun, 5 Jul. 1922, *A.F.G. Kerr* 6246 (BM, K); Doi Chieng Dao, 8 Nov. 1922, *A.F.G. Kerr* 6647 (BK, BM, K); Doi Nang Ka, 4 Nov. 1930, *Put* 3348 (BK, BM, K)]; Chiang Rai [Doi Pha Hom Pok, 2,100 m, 13 Sept. 1967, *K. Iwatsuki, N. Fukuoka & A. Chintayungkun* T-9651 (BKF, K); T-9652 (BKF, K)]; Nan [Doi Phu Kha National Park, 19°13'N, 101°6'E, 1,320 m, 4 Nov. 1999, *P. Srisanga* 1117 (QBG); same locality, 19°10'N, 101°7'E, 1,650 m, 12 Jan. 2000, *P. Srisanga* 1258 (QBG); same locality, 19°10'N, 101°7'E, 1,800 m, 31 Aug. 2000, *P. Srisanga* 1491 (QBG); same locality, 19°13'N, 101°5'E, 1,330 m, 23 Sept. 2000, *P. Srisanga* 1608 (QBG)]; Uttaradit [Phu Soi Dao National Park, 17°42'N, 100°56'E, 28 Oct. 1998, *V. Chamchumroon* 294 (BKF)]; Phitsanulok [Phu Mieng, 28 Jul. 1966, *K. Larsen, T. Smitinand & E. Warncke* 966 (BKF, L); Phu Soi Dao, 1,600 m, 14 Aug. 2000, *P. Suksathan* 2695 (QBG); 9 Feb. 2000, *P. Suksathan* 2309 (QBG); 18 Nov. 2010, *K. Wangwasit* 101118-1 (KKU)]; NORTH-EASTERN: Loei [Phu Kradung, 13 Mar. 1924, *A.F.G. Kerr* 8717 (BK, BM, K); 11 May 1948, *Din* 38 (BKF); 16 Oct. 1954, *T. Smitinand* 2047 (L); 29 Nov. 1958, *Th. Sørensen, K. Larsen & B. Hansen* 6319 (L); 8 Jul. 1959, *F. Floto* 7344 (BKF, K, L); 14 Jul. 1959, *T. Smitinand & F. Floto* 5938 (BKF); 16 Dec. 1963, *Umpai* 137 (BK); 7 Jul. 1964, *Adisai* 843 (BK), 28 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-

497 (BKF); ca. 1,200 m, 29 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-805 (QBG, L); 6 Dec. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1802 (BKF); 21 Oct. 1967, *Prayad* 1077 (BK); 11 Sept. 1969, *P. Sangkhachand* 2107 (BK); 16°53'N, 101°53'E, 7–9 Nov. 1970, *Ch. Charoenphol, K. Larsen & E. Warncke* 4789 (K); 16°53–54'N, 101°47–49'E, 31 Oct. 1984, *S. Mitsuta, H. Nagamasu, T. Yahara & N. Nantasan* T-42273 (BKF); 16°53–54'N, 101°47–49'E, 1,300 m, 31 Oct. 1984, *G. Murata & C. Phengklai* T-42314 (BKF); 1 Sept. 1988, *N. Fukuoka* T-63804 (BKF); 7 Nov. 2010, *K. Wangwasit* 101107-5 (KKU); Phu Luang Wildlife Sanctuary, 1,250–1,500 m, 17 Nov. 1968, *C. Chemsirivathana* 1137 (BK); 16 Jun. 2004, *S. Bunwong* 137 (KKU, QBG)]; EASTERN: Chaiyaphum [Thunkamang, 16°20'N, 101°45'E, 800 m, 14 Dec. 1971, *C.F. van Beusekom, C. Phengklai, R. Geesink & B. Wongwan* 4238 (BKF, K, L); 15°40'N, 102°-E, 850 m, 29 May 1974, *R. Geesink, T. Hattink & C. Phengklai* 7042 (BKF, K, L)]; PENINSULAR: Ranong [Kao Pawta Luang Keo, 2 Feb. 1929, *A.F.G. Kerr* 16967 (BK, BM, K, L)].

Distribution.—India [M. Nilgiris district, Sept. 1883, *J.S. Gamble* 12776 (K)]; Nepal, S. China [Yunnan, *A. Henry* 12415 (K)]; Vietnam [Annam, Dalat, 1,400 m, 11 Feb. 1914, *Chevalier* 30681 (P); Chapa, 700–1,400 m, 9 Dec. 1913, *Chevalier* 29366 (P); Sha-ba village, 1,700–1,900 m, 5 Aug. 1997, *C. Phengklai et al.* 10433 (BKF)]; Sumatra [*Miquel s.n.* (K)].

Ecology.—Open places, grassy ground, stream bank, 900–1,600 m a.s.l. Flowering throughout the year.

Note.—Most material of *N. wightiana* was pubescent throughout, except *R. Geesink, T. Hattink & C. Phengklai* 7042 (BKF, K, L)

from Tungkamang, Chaiyaphum, which was glabrous and *C.F. van Beusekom, C. Phengkklai, R. Geesink & B. Wongwan 4238* (K) from the same area that in fact had an intermediate form (between glabrous and pubescent).

ACKNOWLEDGEMENTS

This work was supported by a grant from the Graduate School, Khon Kaen University for visiting BM, K, L and TCD, and also support from the Applied Taxonomic Research Center, grant ATRC_R5401. We would like to thank the curators and staff of BK, BKF, BM, BO, CMU, K, KEP, KKU, L, QBG, SING and TCD for permission to study the specimens and references.

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