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## THE ASIATIC SPECIES OF LINDENBERGIA Lehm. (Scrophulariaceae)

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## SUMMARY

*Lindenbergia* is represented in Asia by 7 species. Based on the hairiness of their ovaries *L. muraria* (Roxb.) Briihl (= *L. urticifolia* Lehm.) and *L. indica* (L.) Vatke (= *L. polyantha* Benth.) are reinstated as distinct species. I follow Bentham in including<sup>1</sup> *Lindenbergia* in the tribe *Gratioleae*.

Objection to the use of the aestivation of corolla as the only positive character for distinguishing subfamilies of the *Scrophulariaceae* is put forward; it is shown that several genera (*Lindenbergia*, *Isoplexis*, *Lagotis*, *Erinus*, *Freylinia*, *Phygelius* and *Mimulus*) considered to belong to one subfamily actually have the aestivation character of the other subfamily.

The occurrence of resupination of the flower in *Dopatrium junceum* (Roxb.) Buch.-Ham. ex Benth. is recorded for the first time.

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\* Forest Research Institute, Bogor.

## INTRODUCTION

The 7 Old World species of *Lindenbergia* occur in W. Pakistan, India, Burma, Siam, S.W. China and the Philippines. The delimitation of the species has been somewhat inconstant and there has been no agreement whether or not *L. muraria* (Roxb.) Briihl and *L. indica* (L.) Vatke should be united; *Lindenbergia* is one of a few genera whose position within the *Scrophulariaceae* has often been disputed. It is generally accepted that the distinction between the two subfamilies *Scrophularioideae* and *Rhinanthoideae* lies solely in the aestivation of the corolla lips. From time to time, however, the aestivation character has become the source of controversy. Because of its affinity with the other genera of subfamily *Scrophularioideae* the genus *Lindenbergia* is placed in this subfamily, despite the fact that the aestivation of its corolla is similar to that of the *Rhinanthoideae*. The genus and a few more genera discussed in the present paper give evidence to the inadequacy of the currently accepted classification of the *Scrophulariaceae*.

## LINDENBERGIA Lehm.

*Lindenbergia* Lehmann in Link & Otto, Ic. Pl. rar. 95. 1831; Bentham, Scroph. Ind. 21. 1835; in DC, Prodr. 10: 376. 1846; in Bentham & Hooker f., Gen. Pl. 2: 948. 1876; Lindley, Nat. Syst. Bot., ed. 2, 292. 1836; Endlicher, Gen. 679. 1839; Enchir. 339. 1841 (nomen); Walpers, Rep. 3: 365. 1845; Miquel, Fl. Ind. bat. 2: 677. 1857; Drury, Hatidb. Ind. Fl. 2: 358. 1866; Loudon, Encycl. 1416. 1872; Boissier, Fl. Or. 4: 424. 1879; Hooker f., Fl. Brit. India 4: 261. 1884; Wettstein in Engler & Prantl, Nat. Pfl. fam. 4(3b): 73. 1891; Collett, Fl. Simlensis 351. 1902; Prain, Bengal Pl. 2: 760. 1903; Cooke, Fl. Bombay 2: 306. 1905; Hemsley & Skan in Thiselton-Dyer, Fl. trop. Afr. 4(2): 311. 1906; Thonner, Bl. pfl. Afr. 524, 1908; Duthie, Fl. Upper Gangetic Plain 2: 519. 1911; Merrill, Fl. Manila 422. 1912; Muschler, Man. Fl. Egypt. 2: 872. 1912; Blatter in Rec. Bot. Surv. India 7: 177. 1913 et 8 (1): 347. 1919; Brühl in J. Dep. Sci. Univ. Calcutta (Bot.) 2: 11-16 et 17-30. 1920; Haines, Bot. Bihar Orissa 4: 623. 1922; Gamble, Fl. Madras 947. 1923; Fyson, Fl. S. India Hill Stations 1: 426. 1932; Lemée, Diet. Genres 4: 105. 1932; Post, Fl. Syria (ed. Dinsmore) 2: 297. 1933; Pennell, Scroph. W. Himalaya 27. 1943; Hartl in Osterr. bot. -Zeitschr. 102: 80 - 83. 1955; in Beitr. biol. Pfl. 33: 265-277. 1957.

*Brachycorys* Sehrader, Ind. Sem. Hort. Götting. 1830 (n.v.); in Linnaea 6, Litt. 72. 1831.

*Bovea* Decaisne in Ann. Sci. Nat. II, 2: 253. 1834.

*Hemiorchis* Ehrenberg ex Schweinfurth, Beitr. Fl. Aethiop. 241. 1867.

*Omania* Moore in J. Bot. 39: 258. 1901.

Annual or perennial herbs, sometimes woody below; stem terete, erect or ascending, simple or branched, glabrous or pubescent; branches erect, straggling or ascending, pubescent or more rarely glabrous. Leaves simple, opposite or the uppermost alternate, long or shortly petiolate, rarely sessile,

pinnately nerved, margin toothed. Flowers yellow or violet, usually with brown or orange marks on the corolla tube, sessile or subsessile, solitary in the axils of the leaves, or terminally racemose; bracts foliaceous, similar or smaller than the main leaves. Bracteoles absent. Calyx campanulate or crateriform, 5-lobed. Corolla elongate, bilabiate; tube cylindrical; posterior lip internal in aestivation, erect, pubescent in the middle; anterior lip longer than the posterior one, galeate, base with two plaits, apex 3-lobed, spreading, lobes rounded or subrotundate. Stamens 4, didynamous, included; filaments filiform, attached to the corolla tube above the base; anther thecae distinct, separate, stipitate, all with pollen, longitudinally dehiscent. Pollen grains small, 3-colporate, rarely 2-colporate, oblate spheroidal to prolate spheroidal (polar axis 12—19  $\mu$ . long, equatorial diameter 13—18  $\mu$ ; apocolpium diameter 3—5 $\mu$ ; exine about 0.8—1.5 $\mu$ . thick, sexine as thick as nexine, reticulate. Ovary globose, ovoid, ellipsoidal or elongate ovoid, glabrous or pubescent; style filiform, stigma capitate. Capsule oblong, ovoid or ellipsoidal, loculicidally dehiscent, valves entire, separating from the placentiferous axis. Seeds numerous, minute, elongate ovoid or ellipsoidal, oblique, testa reticulate.

TYPE SPECIES: *L. uruicifolia* Lehm.

ETYMOLOGY: Named in honour of J.B. Lindenberg, a 19th Century German botanist.

SCOPE AND DISTRIBUTION: Some 15 species, distributed in tropical Africa and Asia.

ECOLOGY: Common on walls, rocks and river banks in the lowland region, ascending to more than 3000 m in the Himalayas.

The *Scrophulariaceae* are traditionally divided into two subfamilies, *Scrophularioideae* (including *Antirrhinoideae*, *Pseudosolanoideae* and *Selaginoidae*) and *Rhinanthoideae*, based on the aestivation of the corolla; in the *Scrophularioideae* the posterior corolla lobes are external in aestivation, whereas in the *Rhinanthoideae* they are internal (cf. Bentham in DC., Prodr. 10: 186 - 586. 1846; in Benth. & Hook, f., Gen. Pl. 2: 913 - 980. 1876; Wettstein in Engl. & Prantl, Nat. Pfl. fam. 4(3b) : 39- 107. 1891; Pennell, Scroph. E. temp. N. Am. 1935; Scroph. W. Himalaya 1943; Melchior in Engler's Syll. 2: 448-452. 1964).

Bentham, Hooker f., Wettstein, Pennell and others placed *Lindenbergia* in the tribe *Gratioleae* (subfam. *Antirrhinoideae*) near *Limnophila*, *Stemodia* and *Adenosma*, because of the supposed external posterior, corolla lobes. Cooke and Duthie assumed that *Lindenbergia* had the posterior corolla lobes internal, and hence incorporated it in *Gerardieae* (subfam. *Rhinanthoideae*), near *Centranthera* and *Sopubia*. Although Muschler and Haines agreed to this, they placed the genus in *Gratioleae*, near *Adenosma* and *Dopatrium*. Briihl found that in all species of *Lindenbergia* the posterior lip of the corolla is internal in aestivation. Briihl stated that the rela-

tionship of *Lindenbergia* with *Sopubia* and other *Gerardieae* was not at all close. He was sure about the close relationship of *Lindenbergia* with *Gratioleae*, but at the same time admitted that if the aestivation is taken into account the inclusion of *Lindenbergia* in *Rhinantheae* is not unwarranted. By taking other characters (anthers, pistil, seed, endosperm development and indumentum) into consideration, Hartl (*in Beitr. biol. I.e.*) concluded that *Lindenbergia* should be retained in *Gratioleae*, despite its rhinanthoid aestivation of the corolla.

Moore described *Omania* with the posterior corolla lobes internal, and accordingly placed it in the *Rhinanthoideae*. The genus was later reduced by Hartl (*in Osterr. bot. Zeitschr. I.e.*) to *Lindenbergia*.

I have found in living- and cured material that in *Lindenbergia* the posterior corolla lobes are internal in aestivation and hence should be in *Rhinanthoideae* - *Rhinantheae*, but if we take other morphological characters into consideration, the relationship between *Lindenbergia* and the other genera of *Rhinantheae* is very remote. The outstanding character of *Lindenbergia* are its separate, stipitate anther thecae (only in *Gratioleae*). Moreover, the opposite leaves, solitary, axillary, or racemose flowers, campanulate calyx, bilabiate corolla, 2-lobed posterior lip, 3-lobed anterior lip, 4 didynamous stamens, filiform style, many-seeded capsule and reticulate seeds conform with *Gratioleae*, hence inclusion in *Gratioleae* seems justified.

In several other genera we find the same phenomenon; the aestivation does not fit.

*Isoplexis* and *Digitalis* are two closely related genera of *Digitalae*; they are readily distinguished by the position of the posterior corolla lobes, external in *Isoplexis* and internal in *Digitalis*. Using the conventional system, we should place them in different subfamilies.

*Lagotis* has been placed in *Rhinanthoideae* - *Veroniceae*, although it has external posterior corolla lobes. Likewise in most characters *Erinus* shows a relationship with the *Manuleae*, but it has the posterior corolla lobes internal.

In *Scrophularieae* I have observed that the posterior corolla lobes of *Freylinia* and *Phygelius* are internal, while other genera of the same tribe have the posterior lobes external.

*Mimulus* has as a rule the upper lip of corolla external, but Haines (*Bot. Bihar Orissa* 4: 623. 1922) described *M. gracilis* Br. with the lower lip external in bud.

Bentham described the flower of *Dopatrium* as having the posterior lip of corolla small, external in bud, the anterior one large, and the

fertile stamens posterior. Almost all botanists after Bentham accepted this. Contrary to Bentham, Yamazaki (*in J. Jap. Bot.* 28(5) : 129 - 133. 1953) stated that the larger corolla lip is posterior, and the fertile stamens anterior.

In Indian material of *Dopatrium junceum* (Roxb.) Buch.-Ham. ex Benth. fixed in FAA, I found that resupination occurs. In the young flower bud, the posterior lip of the corolla is external, it is shortly 2-lobed or emarginate, smaller than the deeply 3-lobed anterior lip; the posterior stamens are fertile, the anterior ones are absent or staminodial. In more mature flower the pedicel is twisted for 180 degrees, the posterior part of the flower becoming lower than the anterior one, and in the mature flower, the lower lip of the corolla is external in aestivation. In some specimens of *D. junceum*' {*Horsfield s.n.* (K), from Java and *Milne-Redhead & Taylor 10036* (K), from Tanganyika) the pedicels are very short and there is no possibility of the pedicels to become twisted. This explains the contradiction between Bentham and Yamazaki. Bentham apparently made his description from non-resupinate flowers.

Consequently the use of the aestivation as a subfamily diagnostic character is debatable and the distinction between *Scrophularioideae* and *Rhinanthoideae* based solely on the aestivation character is unsatisfactory and misleading.

## KEY TO SPECIES

- 1a. Stem densely covered with long, soft, silky, hairs; style hairy throughout . . . . . 1. *L. griffithii*  
 b. Stem pilose or glabrate; style hairy only at base or completely glabrous . . . . . 2  
 2a. Ovary hairy; base of filaments hairy . . . . . 3  
 b. Ovary glabrous; base of filaments glabrous . . . . . 4  
 3a. Calyx-lobes acute; corolla-tube 4.5 — 8 mm long; leaves 0.7 — 3.8 x 0.4 — 2.5 cm; annual herbs . . . . . 2. *L. muraria*  
 b. Calyx-lobes obtuse or rounded; corolla-tube 1.2 — 2 cm long; leaves 4.5 — 9 x 3.5 — 7 cm; perennial herbs . . . . . 7. *L. grandiflora*  
 4a. Flowers oppositely secund in raceme; calyx crateriform . . . . . 6. *L. hookeri*  
 b. Flowers alternate or if opposite, not secund in raceme; calyx campanulate . . . . . 5  
 5a. Style hairy at base; calyx-lobes ovate-lanceolate with sharp tips 4. *L. philippensis*  
 b. Style glabrous; calyx-lobes ovate or triangular, obtuse or acutish . . . . . 6  
 6a. Leaves ovate, crenate, apex obtuse, pilose on both surfaces; annual herbs . . . . . 3. *L. indica*  
 b. Leaves elliptic, dentate, apex acute, lower surface pilose, upper surface glabrous or scarcely pilose, glabrescent; perennial herbs . . . . . 5. *L. macrostachya*

## 1. LINDENBERGIA GRIFFITHII Hook. f. — Fig. 1.

*Lindenbergia griffithii* Hooker f., Fl. Brit. India 4: 262. 1884; Das in Kanjilal & Das, FL Assam 3: 378. 1939. — Typus: *Griffith, K.D. 3882* (K).

Perennial herbs or small weak shrubs, almost all parts of the plant, except the inflorescence, densely covered with long, soft, silky hairs. Stems simple, erect or subscentent. Leaves opposite, shortly petiolate, 7—11 x 2.5—5 cm, elliptic, margin serrate, base cuneate, apex sharply acute or tapering with a sharp tip. Racemes simple or fascicled at the leaf-axils, often branched. Peduncle 1—3 cm long, ca 1 mm in diam., cylindrical. Rachis 5—10 cm long, slender, pilose. Bracts 2.5—4 x 1—2 mm, sessile, ovate, acute. Flowers opposite, sometimes subalternate near apex, pedicels up to 3 mm long. Calyx 3—5 mm long, 2.5—3.5 mm in diam.; lobes shortly triangular, acute. Corolla tube 3—4 mm long, 1.5—2 mm in diam., both sides sparsely pilose, glabrescent; upper lip 2—2.5 mm long, deltoid, base 2.5—3 mm wide, abruptly tapering towards the apex, apex ca 0.5 mm wide, emarginate, inside along the middle densely pilose; lower lip 2—2.8 mm long, 3-lobed, lobes rounded, the middle lobe somewhat larger than the other two. Stamens inserted at ca 1.5 mm above the base of the corolla tube, the posterior filaments 3.5—4 mm long, the anterior filaments 4—4.5 mm long, connectives ca 0.2 mm long, anther thecae subglobose, ca 0.3 mm in diam. Ovary subglobose-oblong, 1.5—2 mm long, 0.9—1.3 mm in diam., glabrous, style 5—5.5 mm long, hairy throughout. Capsule broadly ellipsoidal or subglobose, 2.6—2.9 mm long, glabrous throughout except the loculicidal ridge sparsely pilose, glabrescent; seeds ca 0.4 mm long and ca 0.2 mm in diam., elongate ovoid or obovoid.

DISTRIBUTION: Eastern Himalayas.

A readily distinguished species because of the simple stem, often fascicled and branched racemes, and the long, soft, silky hairs except on the inflorescence. In the other species the hairs are usually short and erect.

BHUTAN, *Griffith, K.D. 3882* (K, S); E. Bhutan, lat. 26°30' E, 1200 m, 19 Febr. 1925, *Kingdon-Ward 6435* (E); ASSAM, Dewangang Hills, *Simons s.n.* (BO, L).

## 2. LINDENBERGIA MURARIA (Roxb.) Briihl — Fig. 2a — c.

*Lindenbergia muraria* (Roxb.) Briihl in J. Dep. Sci. Univ. Calcutta 2: 27. 1920. — *Stemodia muraria* Roxburgh in Don, Prodr. Fl. Nepal. 89. 1825.—Typus: *Hamilton s.n.*, Nepal.

*Stemodia ruderalis* (nee Blanco, nee Retzius) Benth in Wallich, Cat. 3923. 1831 (p.p.); Bot. Reg. 17: sub tab. 1470. 1832. — Typus: *Wallich s.n.* (K).

*Lindenbergia urtieifolia* Lehmann, Ind. Sem. Hort. Hamb. 5. 1830 (*urticaefolia*, nomen); in Link & Otto, Ic. PL rar. 95, t. 48. 1831; Benth, Scroph. Ind. 22. 1835; in DC, Prodr. 10: 377. 1846; Miquel, Fl. Ind. bat. 2: 677. 1857; Dalzell & Gibson, Bombay FL 176. 1861; Brassier, FL Or. 4: 425. 1879; Hooker f., FL Brit. India 4: 262. 1884;

Forbes & Hemsley in J. Linn. Soc. Bot. 26: 184. 1890; Collett & Hemsley in J. Linn. Soc. Bot. 28: 100. 1890; Nairne, Fl. PL W. India 215. 1894; Collett, Fl. Simlensis 352. 1902, Wood in Rec. Bot. Surv. India 2(1) : 50. 1902; Prain, Bengal PL 2: 760. 1903; Cooke, FL Bombay 2: 307. 1905; Strachey, Cat. Pl. Kumaon 126, 1906; Duthie, Fl. Upper Gangatic Plain 2: 519. 1911; Craib, Contrib. Fl. Siam 144. 1912; Dunn & Tutchter in Kew Bull., Add. ser. 10: 185. 1912; Bambsr, PL Punjab 198. 1916; Blatter & Hallberg in J. Bomb. Nat. Hist. Soc. 25: 424. 1918 (p. p.); Saxton & Sedgwick in Rec. Bot. Surv. India 6(7): 286. 1918; Haines, Bot. Bihar Orissa 624. 1922; Gamble, Fl. Madras 948. 1923; Bonati, Fl. Gén. Indo-Chine 4: 361. 1927; Sayeedud-Din in J. As. Soc. Bengal Sci. 1: 68. 1935; Pennell, Scroph. W. Himalaya 127. 1943; Santspau in J. Bomb. Nat. Hist. Soc. 49(1): 45. 1950 (p.p.) — Typus: *Sine coll.* (?B), Nepal.

*Brachycorys parviflora* Schrader in Linnaea 6, Litt. 72. 1831.

Annual herbs, 10 — 40 cm tall, most part of the plant densely or sparsely covered with long, simple or glandular hairs, stems usually branched from the base, rarely simple. Branches 6 — 25 cm long, stout or slender, erect or ascending. Leaves uniform throughout the stems and branches, or gradually becoming smaller upwards and forming leafy bracts, 0.7 — 3.8 x 0.4 — 2.5 cm, petiolate, membranous to chartaceous, rarely coriaceous, ovate, margin crenately serrate from the apex and becoming entire near the base, base cuneate, apex obtuse or more often acutish, both surfaces sparsely covered with long simple hairs. Petiole 0.5 — 2.5 cm long, linear. Flowers solitary, axillary. Pedicels up to 3 mm long, cylindrical. Calyx slightly zygomorphic, 4 — 5 mm long, 2 — 3 mm in diam., lobes ovate, acute, the mid posterior lobe 0.8 — 2.6 x 0.6 — 1.5 mm, the other four 1.2 — 3.6 x 1 — 2.2 mm, usually covered with short, glandular or simple hairs on both sides. Corolla tube 4.5 — 8 mm long, 1.5 — 2.5 mm in diam.; posterior lip 2 — 4 mm long, inside along the middle covered with short simple hairs, apex obcordate or bilobed, lobes rounded, 0.8 — 2.2 mm in diam.; anterior lip 2.5 — 7.5 mm long, inside along the middle densely covered with long glandular hairs, spreading, apex three-lobed, lobes rotundate, 0.9 — 2.6 mm diam. Posterior filaments 3 — 6 mm long, inserted at 1.5 — 3 mm above the corolla base, anterior filaments 4 — 7.5 mm long, inserted at 1 — 2.2 mm above the corolla base, the base of the filaments hairy; connectives 0.4 — 0.6 mm long, anther theca oblong, 0.4 — 0.7 mm long, 0.2 mm in diam. Ovary densely covered with long, simple hairs, ovoid to elongated ovoid, 1.1 — 1.6 mm long, 0.7 — 1.2 mm in diam., style hairy at base, 3.3 — 6.4 mm long. Capsule ovoid, densely pilose, 2.6 — 4.1 mm long, 2.5 — 3.5 mm in diam.; seeds ellipsoid to elongate ovoid, ca 0.3 mm long, ca 0.1 mm in diam.

DISTRIBUTION: From Afghanistan through India and Burma to S.W. China; ascending to 3000 m in the E. Himalayas.

*L. urticifolia* was described by Lehmann, with a good illustration. The type specimen was probably lost in Berlin, but the original description and illustration fully agree with the material at hand. The species was considered to be conspecific with *Stemodia muraria* Roxb. by Bruhl.



*L. muraria* is so closely related to *L. indica* (L.) Vatke that some have united them. *Stemodia ruderalis* Wall, ex Benth. based on Wallich 3923 (K), is a mixture of *L. muraria* and *L. indica*.

3923 A.	H. Ham. e Raymahl	<i>L. indica</i>
3923 B.	Napalia 1821	not seen
3923 C.	Hurdwar 1825	not seen
3923 D.	Ripa Irawaddi ad Prome, Pingee, Pagharn, Segam, 1826	<i>L. muraria</i>
3923 E.	Ripa Akan propi Agromi 1827	<i>L. muraria</i>
3923 F.	Tavoy W. G.	<i>L. muraria</i>

In 1835 Benthham incorporated *Stemodia ruderalis* "Vahl" (= *S. ruderalis* Retz.) in *L. muraria*. I have had the opportunity to examine the type specimen of *S. ruderalis* Retz. from Lund Herbarium and found that the characters of this specimen agree in most respects with *L. indica*.

Thwaites' record of *L. muraria* of Ceylon (Enum. pi. Zeylan. 218. 1864, sub *L. urticifolia*) represents an *Adenosma*.

INDIA. Punjab, Dalhousie, 1500 m, Aug. 1879, *Drummond 13A3* (E); Uttar Pradesh, Mussorie, below Gracemount, 1900 m, July 1915, *Anderson s. n.* (E); W. Bengal, Calcutta, Mungpoo, 12 Febr. 1900, *Cave 64* (E); S. India, Madras, Shevaroy Hills, Soleur, *Wight 2444* (E); NEPAL. Hatair, N. of Num, Arum valley, 2100 m, in forest, 21 Aug. 1956, *Stainton 1418* (E); BURMA. N. Shan States, Goktsik Gorge, 400 - 1000 m, 8 Oct. 1911, *Laos 5484* (E); SIAM. Meping, 400 m, 13 Febr. 1905, *Hosseus 888* (E, K); Doi Sootep, Chiengmai, 300 - 800 m, 2 Jan. 1910, *Kerr 923* (K, L); W. CHINA. Mo-tsou, 800 m, May 1913, *Maire 836* (E); Yunnan, Kani pass Mekong-Yangtze divide, 27°40' N, 3000 m, open sandy pasture by streams, Aug. 1914, *Forrest 13077* (E); C. China, Hupeh, *Henry 323* (E); S. China, Kwangtung, near Fung Wah, North river region, July 1924, *Herb. C.C.C. 12843* (E).

### 3. LINDENBERGIA INDICA (L.) Vatke — Fig. 2d — f.

*Lindenbergia indica* (L.) Vatke in *Osterr. bot. Zeitschr.* 25: 10. 1875; Kuntze, *Rev. Gen. Pl.* 462. 1891; Briihl in 3'. *Dep. Sci. Univ. Calcutta* 2: 27. 1920; Santapau, *Fl. Purandhar* 93. 1953 (p.p.). — *Dndartia indica* Linnaeus, *Sp. Pl.* 633. 1753. — Typus: *Sine coll.* (LINN), India.

*Lindenbergia ruderalis* (Retz.) Voigt, *Hort. suburb. Calcutt.* 501. 1845; Kuntze, *I.e.*; Das in Kanjilal & Das, *Fl. Assam* 3: 378. 1939 (p.p.). — *Stemodia ruderalis* Retz.'us, *Obs. Bot.* 5: 25. 1789; Vahl, *Symb. Bot.* 2: 69. 1791. — Typus: *König s. n.* (LD), India.

*Lindenbergia polyantha* Royle ex Benthham, *Scroph. Ind.* 22. 1835; in DC, *Prodr.* 10: 377. 1846; Hooker f., *Fl. Brit. India* 4: 262. 1884; Prain, *Bengal PL* 2: 760. 1906; Cooke, *Fl. Bombay* 2: 307. 1905; Misra & Rao in *J. Ind. Bot. Soc.* 27: 186 - 199. 1948. — Typus: *Royle s. n.* (K), India.

Annual herbs, most parts of the plant usually densely covered with pilose hairs. Stem erect, ascending or sometimes decumbent, often branched from the base, very rarely simple. Branches 6—23 cm long, stout or slender, lateral or ascending. Leaves 0.7—2 (—3.5) x 0.5—1.4 (—2.5) cm, opposite, chartaceous to coriaceous, ovate, crenate, base cuneate, apex obtuse, pilose on both surfaces. Petiole 0.5—1 cm long. Flowers sessile or subsessile in the axils of the leaves from the base to the apex of the branches, forming an uninterrupted leafy spike. Calyx zygomorphic, 4—5 mm long, 2.5—3.5 mm in diam., pilose on both sides, lobes triangular, obtuse or acutish, the posterior lobes 0.8—1.4 mm long, 0.6—1.1 mm wide, the anterior lobes 1.7—2.2 mm long, 1.5—1.8 mm wide. Corolla tube 4.5—7.5 mm long, 0.9—2.2 mm in diam., posterior lip deltoid, 3.0—6.5 mm long, base 4—4.5 mm wide, abruptly tapering towards apex, apex 1—1.5 mm wide, retuse or more often 2-toothed, teeth ca 0.6 X 0.3 mm; anterior lip spreading, 3.5—8.5 mm long, apex 3-lobed, lobes rotundate, 1—3 mm in diam., inside along the middle densely covered with long, simple, pilose hairs. Posterior filaments 4.5—6.5 mm long, inserted at 1.5—2.5 mm above the corolla base, anterior filaments 5.5—7.6 mm long, inserted at 2—3 mm above the corolla base; connectives ca 0.2 mm long, anther thecae oblong, 0.4—0.6 mm long, ca 0.2 mm in diam. Ovary glabrous, subovoid, 1.3—2 mm long, 0.9—1.4 mm in diam., style 6—7 mm long. Capsule ovoid, 4—5 mm long, 2.5—3.0 mm in diam., sparsely pilose at apex, tip exserted; seeds ca 0.3 mm long, 0.2 mm in diam.

DISTRIBUTION: West Pakistan and Northern India, extending eastwards to Bengal.

Examination of the type specimens of *L. polyantha* Royle ex Benth. (*Royle s.n.* Hab. ad Delhi secus ripos Jumma, Royle) and *Dodartia indica* L. confirmed Bentham's statement (*in DC, l.e.*) that they are conspecific.

When Bentham (*l.e.* 1835) described *L. polyantha*, he realized that his new species had a very close affinity with *L. muraria* (Roxb.) Briihl (*L. urticifolia* Lehm. *in* Bentham's nomenclature). According to Bentham the corolla of *L. indica* (as we must now call *L. polyantha*) was twice as long as the calyx, whereas in *L. muraria* it was three times as long. Hooker (1884) found that both had corollas twice as long as the calyces. Nevertheless, Hooker maintained the two species as they differed by their general habit; *L. indica* had stems 30—50 cm with erect or ascending, stout or slender branches, whereas *L. muraria* had brittle stems, 10—25 cm high. Prain (1903) considered the length of petioles and pedicels to be the distinguishing character; he said that *L. indica* has leaves very shortly petiolate, leaf-blades only about 1.2 cm long, and flowers sessile, whereas; *L. muraria* should have leaves long petiolate, leaf-blades 2.5 cm or longer and flowers pedicellate. Cooke (1905) agreed that *L. indica* had smaller

leaves and shorter petioles than those of *L. muraria*. He furthermore found that in *L. indica* the leaves were ovate or elliptic, acute, serrate-dentate, softly villous on both sides, whereas in *L. muraria* they were ovate, sub-acute, crenate-serrate, usually glandular-villous on both sides. Blatter & Hallberg (*in J. Bomb. Nat. Hist. Soc.* 25: 424. 1918) included *L. indica* in *L. muraria* because of intermediate forms; ten forms were listed, in which each form consisted of a group of plants having similar habit. Blatter & Hallberg's view was not accepted by Briehl (1920). *L. indica* was described by him as having the mid anterior corolla-lobe overlapping the lateral lobes, whereas *L. muraria* should have the mid anterior lobe overlapped by the lateral ones. Das (1939) and Santapau (cf. *L. muraria*) followed Blatter & Hallberg's view. Das used *L. ruderalis* as the uniting name; Santapau at first used *L. urticifolia*, but later changed it to *L. indica*.

Despite the resemblance in general appearance, as to shape and size of leaves, *L. indica* and *L. muraria* differ in the following and merit to be kept as distinct species. (Since I have only dried specimens at my disposal, it has not been possible to confirm Brühl's statement about the aestivation of the corolla).

*L. indica* . *L. muraria*

- |  |   |
|--|---|
| 1. Calyx-lobes unequal, triangular, obtuse or acutish.   | 1. Calyx-lobes somewhat equal, ovate, acuta.                                      |
| 2. Ovary ovoid or subglobose, glabrous; style glabrous throughout.   | 2. Ovary elongated ovoid, always hairy; style hairy at base.                      |
| 3. Posterior lip of the corolla sharply tapering from the wide base to the emarginate apex.                    | 3. Posterior lip of the corolla obcordate, or obovate, broadly bilobed.           |
| 4. Hairs inside the anterior lip eglandular.   | 4. Hairs inside the anterior lip glandular.                                       |
| 5. Base of the filaments glabrous.   | 5. Base of the filaments hairy.   |
| 6. Capsule ovoid or subglobose, apex acuminate; sparingly hairy in the middle, the base and the apex glabrous. | 6. Capsule ovoid, apex acute; densely hairy throughout from the base to the apex. |

W. PAKISTAN. Hazara Distr., between Darband and Shergarh, E. bank of Indus, rocky roadside, 23 Aug. 1958, *Burt B. 1183* (E); INDIA. Punjab, Dadam, 22 March 1904, *Drummond 15271* (E); Suray Kund, 8 miles S. of Delhi, arable plain with rock outcrop, 300 m, 25 Febr. — 9 Mar. 1962, *Bowen 402* (K); Agra, Tajmahal, 4 Jan. 1810, *Hamilton 1421* (E); Bengal, Calcutta, Barrackpore, on old walls, 17 Aug. 1945, *Sinclair 4396* (E).

4. LINDENBERGU PHILIPPENSIS (Cham.) Benth. — Fig. 3a — c.

*Lindenbergia philippensis* (Cham.) Bentham *in DC*, *Prodr.* 10: 377. 1846; F.-Villar, *Nov. App.* 147. 1880; Hooker f, *Fl. Brit. India* 4: 261. 1884; Vidal, Phan.

Cuming. Philip. 130. 1885; Rev. PL vase. Filip. 198. 1886; Forbes & Hemsley in J. Linn. Soc. Bot. 26: 184. 1890; Collett & Hemsley in J. Linn. Soc. Bot. 28: 99. 1890; Prain in J. As. Soc. Bengal 72(2) : 15. 1903 (*philippinensis*); Williams in Bull. Herb. Boiss. 5: 437. 1905 (*philippinensis*); Merrill in Philip. J. Sci. Bot. 5: 384. 1910; Fl. Manila 422. 1912; Sp. Blanco. 344. 1918; Enum. Philip, fl. Pl. 3: 432. 1923; Craib, Fl. Siam 144. 1912; Dunn & Tutchet in Kew Bull., Add. Ser. 10: 185. 1912 (*philippinensis*); Handel-Maazetti, Symb. Sin. 7(2) : 836. 1936; Das in Kainjilal & Das, Fl. Assam 3: 378. 1939; Craib & Kerr, Fl. Siam. Enum. 3(2) : 53. 1954. — *Stemodia philippensis* Chamisso in Linnaea 3: 5. 1828. — Typus: *Sine coll.* (IB), Luzon.

*Stemodia ruderalis* (nee Bentham, nee Retzins) Blanco, Fl. Filip. 498. 1837; ed. 2, 348. 1845; ed. 3, 2: 281, t. 378. 1878.

*Lindenbergia macrostachya* (non Bentham) Hance in J. Bot. 16:111. 1878; Collett & Hemsley, I.e.; Williams, I.e.; Craib, I.e.

*Lindenbergia giamensis* Teijsmann & Binn. in Nat. Tijd. Ned. Ind. 25: 411. 1863; Miquel ex Hooker f., l. c. 4: 262. 1884; Williams, l. c. — Typus: *Teijsmann s.n.* (L), Siam.

*Lindenbergia melvillei* Moore in J. of Bot. 43: 144. 1905. — Typus: *Melville s.n.* (BM), Manders U7 (K).

Perennial herbs, woody below. Stems 50 — 100 cm high, terete, stout, erect, much branched from base to the apex; stems and branches densely covered with short or long, eglandular or glandular hairs, glabrescent. Leaves 2.5 — 6 x 1 — 3.5 cm, elliptic or elliptical-ovate, dentate, the teeth usually acuminate, base attenuate, apex sharply acute or rarely acuminate. Petiole 0.5 — 1 cm long. Racemes 4 — 10 cm long, terminal. Flowers numerous, alternate or rarely opposite, sessile or shortly pedicellate, aggregate into a compact raceme with hardly any internodes. Bracts 5 — 8 x 1 — 2.5 mm, lanceolate, sharply acute, denticulate or subentire. Calyx slightly zygomorphic, 4 — 6 mm long, 3 — 4 mm in diam., lobes 2.5 — 4 x 1 — 1.5 mm, ovate-lanceolate with sharp tips, pilose on both sides. Corolla tube 6 — 8 mm long, 2 — 3 mm in diam., glabrous or sparsely pubescent on both sides; posterior lip more or less glabrous, 4 — 6 mm long, base 5 — 8 mm wide, abruptly curved and tapering towards the apex, apex 1.1 — 2.6 mm wide, minutely bilobed, lobes wavy or subentire; anterior lip 5 — 8 mm long, obovate, base 3.7 — 5.6 mm wide, slightly widened upwards, apex 4 — 6.1 mm wide, 3-lobed, lobes rounded, 1.4 — 1.9 mm in diam., subentire, the middle part of the lip densely covered with short pilose hairs. Stamens inserted at ca 2 mm above the base of the corolla, the posterior filaments 6 — 7 mm long, the anterior filaments 8 — 10 mm long, connectives ca 0.3 mm long, thecae ellipsoid or subglobose, ca 0.5 mm long and ca 0.3 mm in diam. Ovary ca 1.5 mm in diam., subglobose or ovoid, glabrous; style 8 — 10 mm long, pilose at base. Capsule ovoid, 4 — 5 mm long, 2.5 — 4 mm in diam., pilose, glabrescent, tip exserted; seeds ellipsoid, ca 0.2 mm long, 0.1 mm in diam.

DISTRIBUTION: From the Eastern Himalayas eastwards to the Philippines, and from Central China throughout the whole of Indochina.

INDIA. Darjeeling, *Cowan, s.n.* (E); UPPER BURMA. Tuping valley, 24°20' N, open rocky, *Forrest 9658* (E); S. Shan States, Keng Tung, *MacGregor 182* (E); CHINA. W. Yunnan, 1200 m, shady habitat on the margin of (the thickets in the Shweli valley near Lung Ling, 24°35' N, March 1906, *Forrest 4986* (E); Kwangtung, Tseh An Wai, Yun Fou Distr., 120 m, foot hill, 20 Jan. 1928, *Wang 453* (E); SIAM. Mekok, Chiangmai, summit of Dai Tam Yup, 510 m, 9 March 1924, *Garret 156* (K, L); LAOS. G. Nape-, Nunku, Jan. 1930, *Shaik Mokim 1095* (E); PHILIPPINES. Luzon, Pampanga Prov., Camp Stotsenburg (Mt. Pinatubo), May 1927, *Elmer 21996* (BM, L); Paluan, Mindoro, April 1921, *Ramos 89757* (BM).

5. LINDENBERGIA MACROSTACHYA Benth. — Fig. 3d — f.

*Lindenbergia macrostachya* Benth. Scroph. Ind. 22. 1835; in DC, Prodr. 10: 376. 1846; Hooker f., Fl. Brit. India 4: 262. 1884; Collett, Fl. Simlensis 351. 1902; Prain in J. As. Soc. Bengal 72(2): 14. 1903; Strachey, Cat. PL Kumaon 126. 1906; Duthie, Fl. Upper Gangetic Plain 2: 519. 1911; Bamber, Pl. Punjab 198. 1916. — *Stemodia macrostachya* Benth. in Wallich, Cat. 3925. 1831 (nomen).— Typus: *Wallich s.n.* (K), India.

*Adenosma cuspidatum* Benth. in Wallich, Cat. 3852. 1831 (nomen).

Perennial herbs; stems erect, stout or slender, many branched. Branches ascending, slender, glabrous or pubescent, more often glabrous at base and becoming pubescent at the apex. Leaves 2.5 — 5 x 1 — 2.5 cm, elliptic, dentate, base cuneate, apex acute, upper surface glabrous or scarcely pilose, glabrescent. Petiole 0.5 — 1.5 cm long, linear. Flowers alternate or sub-opposite, sessile or very shortly pedicellate in an elongated raceme. Racemes 7 — 19 cm long, terminal. Leafy bracts 5 — 9 x 2 — 3.5 mm, elliptic, denticulate, the uppermost leaves often gradually passing upwards into bracts. Calyx pilose on both sides, 4 — 5 mm long, 3 — 5 mm in diam.; lobes 1 — 2 mm, triangular, tip acutish, the three posterior lobes usually uniform, slightly shorter but higher in position than the other two. Corolla tube glabrous, 3 — 4 mm long, ca 1.5 mm in diam.; the posterior lip 2 — 4.5 mm long, more or less triangular or elongated triangular, base 3.5 — 4.5 mm wide, apex 0.6 — 1.4 mm wide, obcordate, glabrous throughout; the anterior lip spreading, 4 — 5.5 mm long, obovate or elongated obovate, base 1.8 — 3.2 mm wide, apex 2.5 — 3.9 mm wide, 3-lobed, sunken along the middle of the lip, densely covered with long, simple or subclavate hairs. Posterior stamens inserted at 1.4 — 2.6 mm above the corolla-base, filaments 3 — 4 mm long, anterior stamens inserted at 1.6 — 3 mm above the base, filaments 3.5 — 5 mm long, glabrous; connectives ca 0.2 mm long, thecae globose or subglobose, ca 0.3 mm in diam. Ovary ovoid, ca 1.5 X 1 mm, glabrous, style 3 — 3.5 mm long, glabrous. Capsule ovoid, 4.5 — 6 x 3 — 4 mm, sparsely pilose, glabrescent, subexserted; seeds elongate ovoid, ca 0.3 mm long, 0.1 mm in diam.

DISTRIBUTION: West Pakistan, Northern India and Nepal, ascending to 1800 m.

*L. macrostachya* is confined to the northern part of W. Pakistan, India and Nepal. All collections from Burma, Siam and China, which look very much like this, are *L. philippensis*.

W. PAKISTAN. Peshawar, near Akora, ca 4 miles west of Attock bridge, Nullah leading to Kabul R., earth bank, 15 April 1958, *Burt B. 554* (E); INDIA. Punjab, Kernal to Daha Bajuda, 29 March 1886, *Drummond 25911* (E); Kumaon, Kalapathar, 900 m, *Strachey & Winterbottom, S* (BM); NEPAL. Mayangdi Kholā, 1800 m, steep dry south facing stony slope, 27 May 1954, *Stainton, Sykes & Williams 1890* (E, BM).

6. LINDENBERGIA HOOKERI Clarke ex Hook. f. — Fig. 4a — c.

*Lindenbergia hookeri* Clarke ex Hooker f., Fl. Brit. India 4: 261. 1884; Fischer in Kew Bull. 93. 1934; Das in Kanjilal & Das, Fl. Assam 3: 378, 1939. — Typus: *Hooker s.n.* (K), Sikkim, Himalaya.

Perennial herbs; stems erect, stout, glabrous, many branched. Leaves 1.4 — 3 x 0.7 — 1.2 cm, shortly petiolate or sub-sessile, elliptic, serrate or serrulate, base cuneate, apex acute or acuminate, glabrous on both surfaces. Racemes 6 — 9 cm long, terminal, mostly covered with minute, subclavate hairs. Flowers oppositely secund, pedicellate. Bracts 4 — 6 x 2.5 — 3.5 mm, sessile, ovate, acute, subentire, sparsely pubescent. Calyx slightly zygomorphic, crateriform, 7 — 9 mm long, 5 — 8 mm in diam., sparsely pubescent on both sides, lobes triangular, acuminate, 2 — 2.3 mm long, 1.3 — 2.4 mm wide. Corolla tube 7 — 14 mm long, 3.5 — 4.5 mm in diam., broadened upwards, outside glabrous, inside pilose glabrescent; upper lip ca 4 mm long, triangular, more or less glabrous, base ca 7 mm wide, abruptly tapering towards the apex, apex ca 1 mm wide, emarginate; lower lip ca 6 mm long, spreading, broadly obovate, deeply galeate at the middle, densely pubescent inside the galea, apex broadly 3-lobed, lobes subrotundate, ca 2 mm in diam., glabrous. Stamens inserted at ca 2 mm above the base of the corolla, the posterior filaments 6 — 10 mm long, the anterior 12 — 15 mm, connectives ca 2 mm long, thecae sausage-shaped, 1.1 — 1.6 mm long, 0.4 — 0.6 mm in diam. Ovary globose or subovoid, 1.9 — 2.2 mm long, 1.2 — 1.3 mm in diam., glabrous, style 1.4 — 1.6 cm long, hairy at base. Capsule ovoid, 6 — 8 mm long, 3.5 — 4.5 mm in diam., included, sparsely pilose, glabrescent; seeds elongate ovoid, ca 0.4 mm long, ca 0.2 mm in diam.

DISTRIBUTION: Eastern Himalayas, from 600 to 1200 m.

S. E. BHUTAN. Pintsogong, 1200m, 6 March 1936, *Ludlow & Sherrif 1151* (BM), INDIA. Sikkim, foot hills, 900 - 1200 m, *Hooker s.n.* (K); Assam. Denning, Lohit valley road 28°0' N, 96°15' E, 660 m, March 1928, *Kingdon-Ward 7901* (K).

7. LINDENBERGIA GRANDIFLORA (Ham.) Benth. — Fig. 4d — f.

*Lindenbergia grandiflora* (Ham.) Bentham, Scroph. Ind. 22. 1835; in DC, Prodr. 10: 376, 1846; Hooker f., Fl. Brit. India 4: 261. 1884; in Bot. Mag. 126: t. 7738. 1900; Collett, Fl. Simlensis 351. 1902; Prain in J. As. Soc. Bengal 72(2): 14. 1903; Strachey,

Cat. PL Kumaon 126. 1906; Gamble, PL Madras 948. 1923. — *Stemodia grandiflora* Hamilton in Don, Prodr. Fl. Nepal. 89. 1825. — Typus: *Wallich s.n.* (K), Nepal.

Perennial herbs, erect or subscandent, with somewhat flexuous stems and branches. Leaves 4.5 — 9 x 3.5 — 7 cm, elliptic-ovate, oblique, serrate, often with acuminate teeth, base obtuse, abruptly tapering into a linear, 0.8 — 2.5 cm long petiole, apex acuminate; both surfaces densely covered with simple and glandular hairs. Flowers axillary, solitary or racemose. Leafy bracts usually smaller than the main leaves, 1 — 2.5 X 0.7 — 1.5 cm, subsessile, oblong-ovate or ovate, serrate, base cuneate, apex slightly acuminate. Calyx 6 — 8 mm long, 3.5 — 5 mm in diam., densely hairy on both sides; lobes 2 — 3 mm long, 3.5 — 5 mm wide, broadly ovate, obtuse or rounded. Corolla tube 1.2 — 2 cm long, gradually broadened upwards, outside glabrous at base but becoming hairy near the throat, inside sparsely hairy; posterior lip broadly obcordate, 3 — 6 mm long, 2.5 — 7 mm wide, both sides hairy; anterior lip spreading, broadly 3-lobed, lobes rotundate, 3 — 7 mm in diam. Stamens inserted at 6 — 8 mm above the corolla base, posterior filaments 4 — 10 mm long, anterior 9 — 14 mm, filaments hairy at base; connectives ca 0.6 mm long, thecae ca 0.7 mm long. Ovary 2 — 3 X 1 — 1.5 mm, globose, densely covered with long, simple hairs, style 19 — 20 mm long, pilose at base. Capsule 8 — 10 X 3 — 5 mm, ovoid, pilose, tip exserted; seeds elongate ovoid, ca 0.4 mm long, 0.2 mm in diam.

DISTRIBUTION: Subtropical Himalayas, 500 — 2000 m.

*L. grandiflora* can be easily separated from the other perennial species by its hairy ovary. Its other distinguishing characters are the shape and the hairiness of the leaves, and the size and form of the flowers.

NEPAL. Kumak Ridge, N. of Sallyana, banks around cornfields, 1800 m, 30 March 1952, *Polunin, Sykes & Williams 1803* (BM); Arun valley, Num, 1500 m, on river bank, 22 Sept. 1956, *Stainton 1733* (E, BM); INDIA. Rieng, 600 m, 7 Nov. 1913, *Cave s.n.* (E); Sikkim, 1500 m, Nov. 1875, *Kuntze 6701* (E); S. E. BHUTAN. Chungkar, clearings in evergreen jungle, 1950 m, 23 Febr. 1936, *Ludlow & Sherriff 1129* (BM).

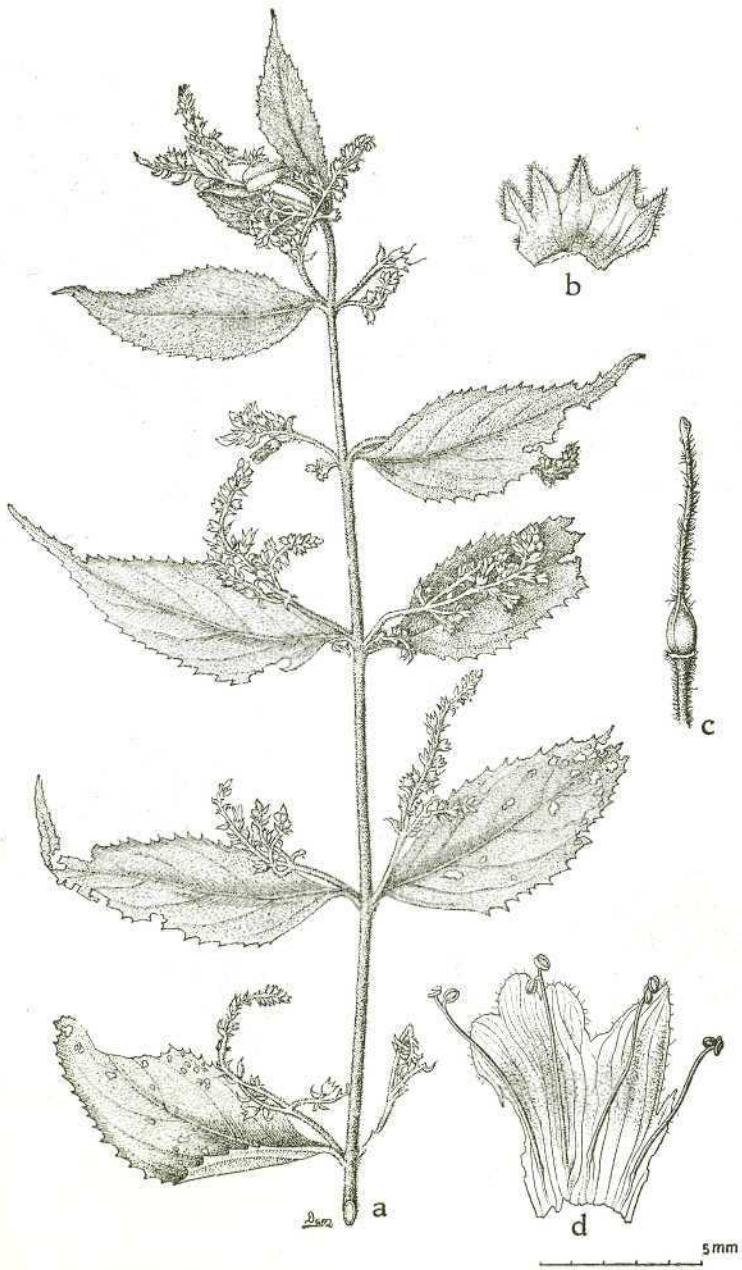


Fig. 1a — d. *Lindenbergia griffithii* Hook. f.



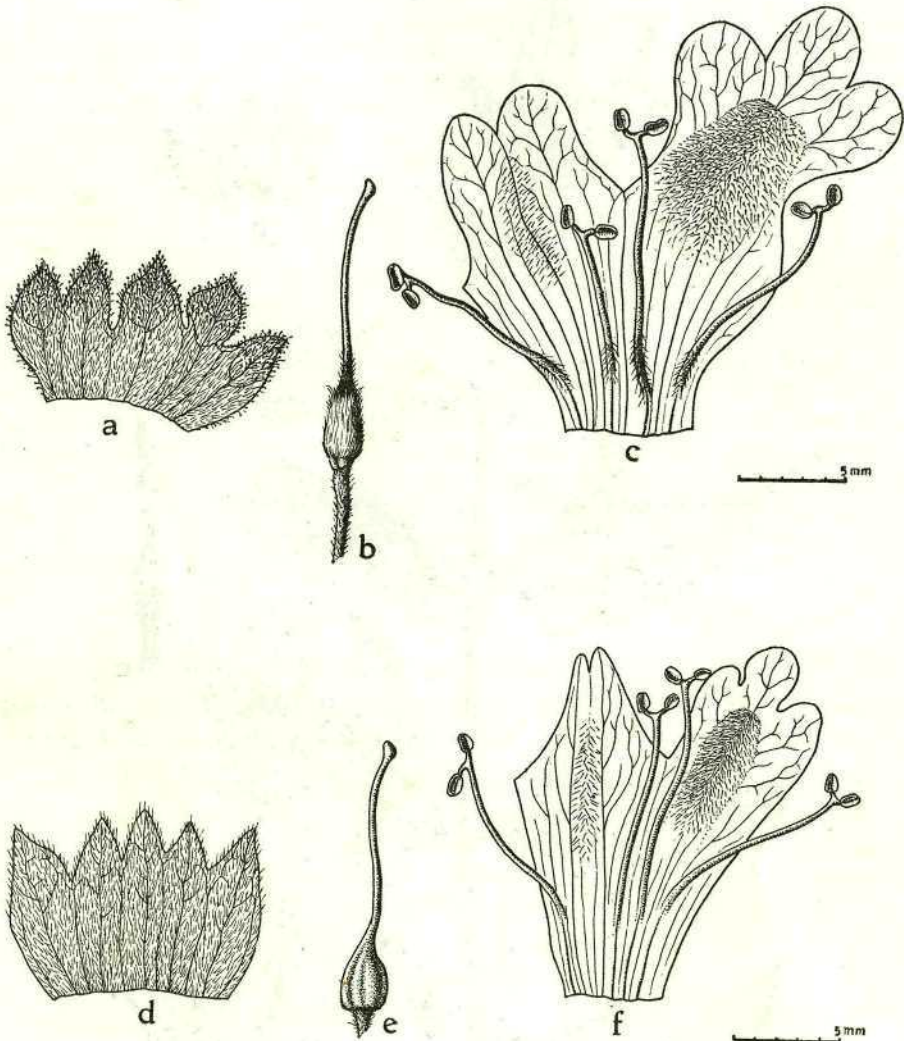
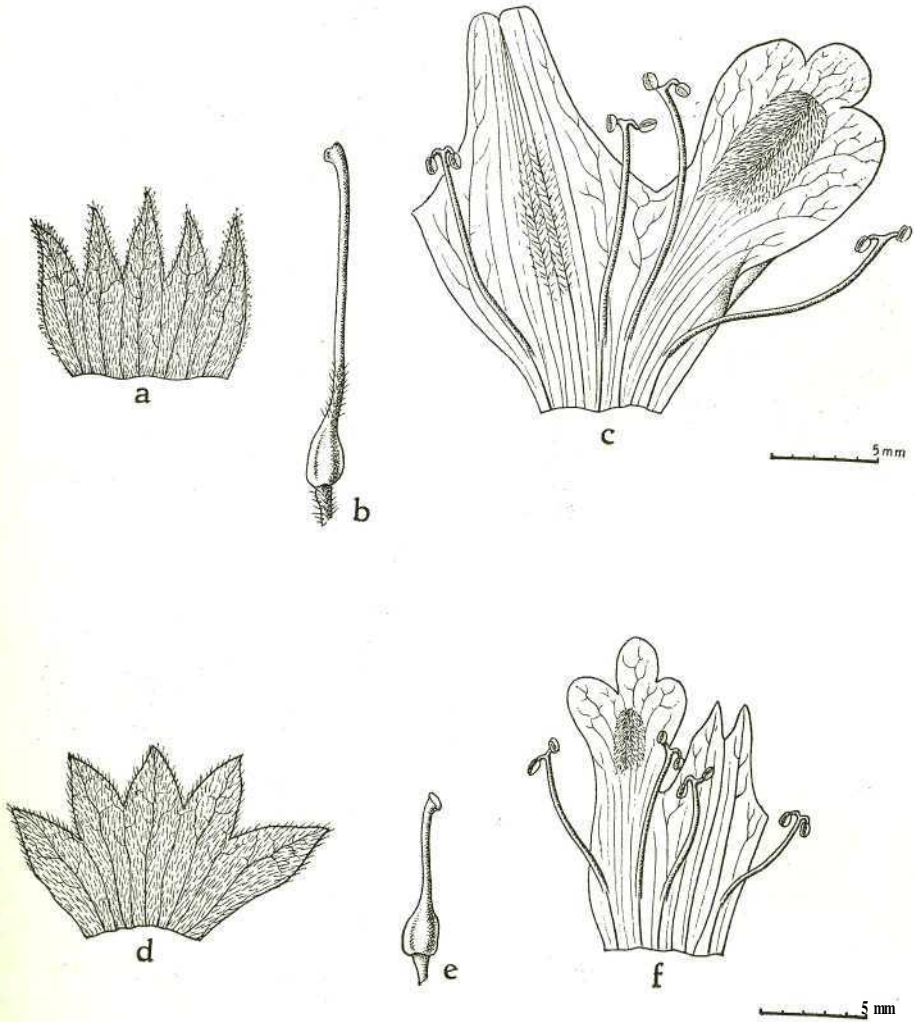


Fig. 2a — c. *Lindenbergia muraria* (Roxb.) Bruhli.  
 — Fig. 2d — f. *Lindenbergia indica* (L.) Vatke.



Fig<sup>1</sup>. 3a — c. *Lindenbergia philippensis* (Cham.) Benth.  
 — Fig. 3d — f. *Lindenbergia macrostachya* Benth.

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