

Contributions to the Flora of Southeast Asia

II. *Impatiens* of Thailand and Malaya

by

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As a member of the Kyoto University Biological Expedition to Thailand and Malaysia, 1967, I had an opportunity to participate in botanical trips. My purpose was mainly to survey the limestone flora of Thailand. Since the *Impatiens* flora was most attractive to me in every limestone area which I visited on these trips, I have concentrated on the taxonomy and phytogeography of that genus. As a result, I have recognized 47 species including 7 new species in Thailand and Malaya 17 of which are limestone-loving plants.

The present article consists of a key to these species, changes in nomenclature of some taxa, and an annotated enumeration of all species with revisional notes. It is supported mainly by the material obtained on the Kyoto University Biological Expeditions during 1965-1966 and in 1967. In addition, the herbaria of the Royal Forest Department, Bangkok (BKF), of Muséum national d'Histoire naturelle, Paris (P), of the Botanic Gardens, Singapore (SING), and of the University of Tokyo, Tokyo (TI) have provided me with many important specimens for this work. Herewith I wish to express my hearty thanks to the directors and the curators of these herbaria. Thanks are extended also to Professr Jôji ASHIDA, Head of our Expeditions, and to all the other members for their encouragement.

Key to the species

- A. Flowers axillary, solitary or fascicled.
- B. Leaves opposite or whorled; flowers violet, with 2 lateral sepals.
- C. Leaves opposite; lip funnel-shaped; distal lobes of the wing-petals much larger than the basal ones; seeds glabrous.
- D. Pedicels unilaterally hirsute; lateral sepals linear1. **I. chinensis**
- DD. Pedicels glabrous; lateral sepals ovate.
- E. Leaves rounded or cordate at base2. **I. pseudochinensis**
- EE. Leaves acuminate toward base3. **I. craddockii**

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- CC. Leaves whorled ; lip boat-shaped ; wing-petals subequally bilobed ; seeds pilose.
- D. Leaves nearly sessile, more or less hirsute.
- E. Standard narrowly winged through the posterior costa.....4. **I. griffithii**
- F. Leaves linear-lanceolate, less than 1 cm widevar. **griffithii**
- FF. Leaves lanceolate to ovate-lanceolate, more than 1 cm wide var. **sarcantha**
- EE. Standard gibbose in the middle of the posterior costa.....5. **I. wrayi**
- DD. Leaves long-petiolate.
- E. Leaves always whorled, not congested, nearly glabrous.6. **I. exilipes**
- EE. Leaves sometimes opposite or alternate, congested on upper part of stem, hirsute on both sides.7. **I. curtisii**
- BB. Leaves alternate, rarely opposite on lower part of stem.
- C. Lateral sepals 2; spur of the lip elongate, longer than the lip, or absent (in 19 and 20); wing-petals free.
- D. Flowers violet or whitish; capsules hairy.
- E. Flowers pendulous; spur of the lip not exceeding twice the length of the lip; capsules tomentose.....8. **I. balsamina**
- EE. Flowers not pendulous; spur of lip much elongate, or absent; capsules hirsute.
- F. Leaves congested on upper part of stem ; fruiting pedicels pendulous, recurved9. **I. curvipes**
- FF. Leaves not congested; fruiting pedicels erect, nearly straight.
- G. Stems more or less repent.
- H. Stems ascendent above; lateral sepals 2-3 mm long.....10. **I. inops**
- HH. Stems wholly repent; lateral sepals 7-8 mm long.....11. **I. purpurata**
- GG. Stems erect.
- H. Leaves glabrous above; seeds smooth, glabrous12. **I. aureliana**
- HH. Leaves more or less hirsute above; seeds more or less pubescent (unknown in 18 and 20).
- I. Lip spurred.
- J. Leaves ovate.
- K. Flowers small, the standard 5-6 mm tall.
- L. Wing-petals subequally bilobed13. **I. subaqualis**
- LL. Distal lobes of the wing-petals apparently larger than the basal ones.....14. **I. noei**
- KK. Flowers larger, the standard more than 10 mm tall; seeds granulate-pubescent.
- L. Standards 10 mm or so tall, distal lobes of the wing-petals somewhat larger than the basal ones.
- M. Floral segments glabrous to minutely pubescent; lateral sepals ovate to lanceolate, 1-3 mm long.....15. **I. violaeiflora**
- MM. Floral segments long-hirsute; lateral sepals linear, 3-5 mm long16. **I. chiangdaoensis**

- LL. Standards about 20 mm tall; distal lobes of the wing-petals much larger than the basal ones17. **I. phuluangensis**
- JJ. Leaves lanceolate18. **I. patula**
- II. Lip not spurred.
- J. Lateral sepals 1 mm long; standard equaling the wing-petals.....19. **I. muscicola**
- JJ. Lateral sepals 2 mm long; wing-petals twice as long as the standards20. **I. saxicola**
- DD. Flowers yellow; capsules glabrous.....21. **I. smitinandii**
- CC. Spur of the lip shorter than lip; wing-petals connate; capsules glabrous.
- D. Pedicels articulate and bracteate in the middle; seeds prominently reticulate22. **I. puttii**
- DD. Pedicels not articulate, bracteate at base or ebracteate (in 35); seeds not reticulate.
- E. Spur of the lip deeply bilobed.
- F. Spur of the lip about 5 mm long, recurved, nipple-like.
- G. Lateral sepals 2.
- H. Frutescent perennial herb with yellowish flowers.....23. **I. kerriae**
- HH. Succulent annual herb with blue-purple flowers.....24. **I. vaughanii**
- GG. Lateral sepals 4.
- H. Outer sepals free25. **I. calcicola**
- HH. Outer sepals connate.
- I. Flowers blue-purple; costa of the standard winged on the lower half26. **I. harmandii**
- II. Flowers white; costa of the standard winged throughout.....27. **I. macrosepala**
- FF. Spur of the lip about 10 mm long, straight, tubular ...28. **I. scortechinii**
- EE. Spur of the lip not bilobed.
- F. Spur of the lip basally adnate.
- G. Flowers mottled with white, purple and blue; lateral sepals 229. **I. psittacina**
- GG. Flowers white or orange-yellow; lateral sepals 4.
- H. Flowers white; inner sepals less than 1 mm long.
- I. Leaves orbicular-ovate30. **I. ridleyi**
- II. Leaves lanceolate.....31. **I. cryptoneura**
- HH. Flowers orange-yellow; inner sepals linear, about 4 mm long32. **I. tipusensis**
- FF. Spur of the lip subbasally adnate.
- G. Petioles basal.
- H. Flowers blue-purple; lateral sepals 233. **I. nalampoonii**
- HH. Flowers white with red streaks; lateral sepals 4.....34. **I. parishii**
- GG. Petioles peltately attached35. **I. peltata**

- AA. Flowers in racemes with conspicuous peduncles; capsules glabrous.
- B. Wing-petals free.
- C. Flowers small, numerous, yellow36. **I. racemosa**
- CC. Flowers large, few, violet or yellow.
- D. Lateral sepals 2; spur of the lip longer than the lip.
- E. Flowers violet.
- F. Wing-petals subequally bilobed; standard cordate, 15 mm long.....
-37. **I. walleriana**
- FF. Distal lobes of the wing-petals larger than the basal ones; standard ovate, 6 mm long38. **I. garrettii**
- EE. Flowers yellow.
- F. Flowers pale-yellow; lip saccate with incurved spur; distal lobes of the wing-petals nearly equal to the basal ones39. **I. mengtzeana**
- FF. Flowers bright yellow; lip boat-shaped with straight spur; distal lobes of the wing-petals fan-shaped, much larger than the basal ones
-40. **I. oncioides**
- DD. Lateral sepals 4.
- E. Lip attenuate toward the slender spur; distal lobes of the wing-petals loriform, elongate41. **I. longiloba**
- EE. Spur of the lip distinct, shorter than the lip, hooked; distal lobes of the wing-petals obovate.
- F. Inner sepals minute, less than 1 mm long.
- G. Outer sepals 3-5 mm long42. **I. jurpia**
- GG. Outer sepals 10-12 mm long43. **I. jurpioides**
- FF. Inner sepals linear, longer than the outer ones.
- G. Leaves obovate; outer sepals entire.....44. **I. claviger**
- GG. Leaves oblong; outer sepals crenulate.....45. **I. damrongii**
- BB. Wing-petals connate; lateral sepals 4; spur shorter than the lip.
- C. Leaves alternate, congested on upper part of stem46. **I. opinata**
- CC. Leaves crowded at the top of stems.....47. **I. mirabilis**

Enumeration of the species

1. **I. chinensis** L., Sp. Pl. 2: 937. 1753; Hook. f. & Thoms. in Jour. Linn. Soc. 4: 119. 1860; Hook. f., Fl. Brit. Ind. 1: 444. 1874, excl. specim. from Malacca, in Rec. Bot. Surv. Ind. 4: 28. 1905 & 4: 40. 1906, in Kew Bull. 1909: 6, in Lecomte, Fl. Gén. Indo-Chine 1: 614. 1911; Craib, Fl. Siam. Enum. 1: 209. 1926.—*Balsamina chinensis* (L.) DC., Prodr. 1: 686. 1824.

Annual. Stems slender, glabrous, decumbent below. Leaves opposite, hard, linear-oblong, nearly sessile, 3-6 cm long, 5 mm or so wide, remotely spinulose-serrate, acute toward apex, cordate or truncate at base, minutely hirsute above, glaucous beneath;

stipular glands present. Flowers violet, axillary, solitary; pedicels 2-4 cm long, unilaterally hirsute, bracteate at base; lateral sepals 2, linear, apiculate, 10 mm long, 1 mm wide; lip with long recurved spur; standard orbicular, apiculate at apex, 10 mm or so long and wide; wing-petals free, 15 mm long, the basal lobes small, the distal obovate, auricled near base. Capsules turgid in the middle, glabrous. Seeds black, shiny, spherical, about 2 mm across.—Open marshy grasslands; 100-1200 m alt.

THAILAND. Loei: Phu Kradung, on the plain at the summit, T510 (BKF, KYO, SHIN). Kanchanaburi: Hindato, about 16 km NW of Kanburi, A. Kostermans 1348 (SING). Phetchabun: Lom Kao, T. Smitinand 510 (BKF, SHIN).

Distr. India, Bhutan, Burma, Indo-China and South China.

2. *I. pseudochinensis* T. Shimizu in Acta Phytotax. Geobot. 24: 37. 1969.

Annual, 30-50 cm tall. Stems creeping below, branching, glabrous. Leaves opposite hard, linear-lanceolate, sessile or nearly so, 3-8 cm long, 0.5-2 cm wide, remotely spinulose-serrate, acute toward apex, widely cuneate to cordate at base, usually glabrous but sometimes hirsute above, glaucous beneath; stipular glands present. Flowers violet, axillary, solitary or binary; pedicels 3-5 cm long, glabrous, bracteate at base; lateral sepals 2, ovate, anequal at base, 7-8 mm long, 4-4.5 mm wide; lip funnel-shaped, 1 cm deep, 15 mm across the mouth, long-spurred; the spur 2.5-3.5 cm long, loosely incurved; standard cordate, 15-18 mm wide, mucronulate at apex, with costa narrowly winged behind; wing-petals separate, bilobed, 25-35 mm long, the distal lobes obovate, 20-25 mm long, scarcely auricled at base, the basal orbicular, 12-15 mm across, emarginate at apex. Capsules turgid in the middle, glabrous. Seeds globose, 2-2.5 mm across, glabrous.—Open marshy grassland; 1200-1300 m alt.

THAILAND. Loei: Phu Kradung, T8932—type (KYO; isotype in BKF & SHIN), D. Bunpheng 38 (BKF, SHIN), D. Bunpheng 571 (BKF), T930 & T9016 (KYO, SHIN).

Distr. Endemic.

This resembles *I. chinensis* L., from which it is easily distinguished by its larger flowers with broader lateral sepals. Both *I. chinensis* and *I. pseudochinensis* are found in Phu Kradung.

3. *I. craddockii* Hook. f. in Rec. Bot. Surv. Ind. 4: 29 & 34. 1905; Craib, Fl. Siam. Enum. 1: 210. 1926.

Annual, simple or branching, glabrous. Leaves opposite, linear-lanceolate, 5-13 cm long, 0.3-2 cm wide, remotely spinulose-serrate, acuminate toward both ends, glaucous beneath; stipular glands present. Flowers violet, axillary, solitary or binary; pedicels straight, about 3 cm long, bracteate at base, the bracts linear; lateral sepals 2, ovate, about 10 mm long, 5 mm wide; lip funnel-shaped, 1 cm deep, 1-1.5 cm across the mouth, the spur 2.5-3.5 cm long, somewhat incurved; standard cordate 12-13 mm tall, the costa slightly winged; wing-petals separate, 25 mm long, the distal lobes obovate, much larger than the basal ones. Capsules and seeds glabrous.—Grassy ground in the light forest;

500–1100 m alt.

THAILAND. Lamphun: Me Kaw, Winit 1235—cited in Craib l.c. (BKF). Chiang Mai: Mae Sariang to Chom Thong, T10415 (KYO, SHIN).

Distr. Upper Burma.

This species is closely related to the previous one, from which it is distinguished by the narrowed leaf bases and the smaller basal lobes of the wing-petals. Winit 1235 is a large plant with leaves 8–13 cm long and 1–2 cm wide, with the lateral sepals sometimes spurred at the base, as pointed out by Craib (1926). Specimen T10415 is from a rather small plant with leaves 5–9 cm long and 0.3–1 cm wide, sometimes rounded or cordate at the base.

4. *I. griffithii* Hook. f. & Thoms. in Jour. Linn. Soc. 4: 120. 1860; Hook. f., Fl. Brit. Ind. 1: 445. 1874, in Rec. Bot. Surv. Ind. 4: 54 & 55. 1906, in Kew Bull. 1909: 6; Ridley, Fl. Malay Penin. 1: 336. 1922; Henders., Malay. Wild Flowers pt. 1, 52. 1949.

Annual. Stems slender, more or less hirsute especially on upper part and on the nodes, creeping below. Leaves opposite or 3–5-whorled, remotely spinulose-serrate, acuminate toward both ends, more or less hirsute on both sides, glaucous beneath, nearly sessile or often petiolate; stipular glands present. Flowers violet, axillary, solitary; pedicels 3–7 cm long, puberulous, bracteate at base, the bracts linear; lateral sepals 2, ovate, about 8 mm long, 3 mm wide, glabrous but sometimes puberulous outside; lip boat-shaped, 1–2 mm deep, 7–9 mm across the mouth, the spur 3–3.5 cm long, straight; standard obovate or orbicular, 1.2–1.6 cm tall, the costa narrowly winged; wing-petals separate, 1.5–2 cm long, subequally bilobed. Capsules turgid in the middle, 1.5 cm long, glabrous. Seeds obovoid, compressed, 2.5 mm long, pilose.

var. ***griffithii*** Hook. f. & Thoms., l.c., p.p.; Hook. f., ll. cc., p.p.; Ridley, l.c., p.p.; Henders., l.c., p.p.

Leaves linear-lanceolate, less than 1 cm wide. —Marshy places; 1000–1200 m alt.

MALAYSIA. Johore: Mt. Ophir, R.W. Hullett 299 & 825 (SING), R. Derry 620 (SING), G. H. Addison 36992 (SING). Malacca: Gunong Ledang, H. N. Ridley s.n. (SING).

Distr. Endemic.

var. ***sarcantha*** (Hook. f.) T. Shimizu in Acta Phytotax. Geobot. 24: 45. 1969. —*I. sarcantha* Hook. f. ex Ridley, in Jour. Fed. Malay. States Mus. 4: 8. 1909. & l. c. 1922; Henders., l.c. 51. 1949. *I. griffithii* Hook. f. & Thoms., l.c., p.p.; Hook. f., ll. cc., p.p.; Ridl., l.c., p.p.; Henders., l.c., p.p.

I. polycycla Hook. f. ex Ridley in Jour. As. Soc. Straits Br. 75: 9. 1917.

Leaves lanceolate to ovate-lanceolate, more than 1 cm wide. —Marshy or damp shady places; 100–1200 m alt.

THAILAND. Nakhon Si Thammarat: Tab Chang, P. Suvarnakoses 231 (BKF); interior of Wat Kiri Wang, at the foot of Khao Luang, T5395 (KYO); without particular locality name, P. Suvarnakoses 776 (BKF, SHIN), T. Smitinand 685 (BKF). MALAYSIA.

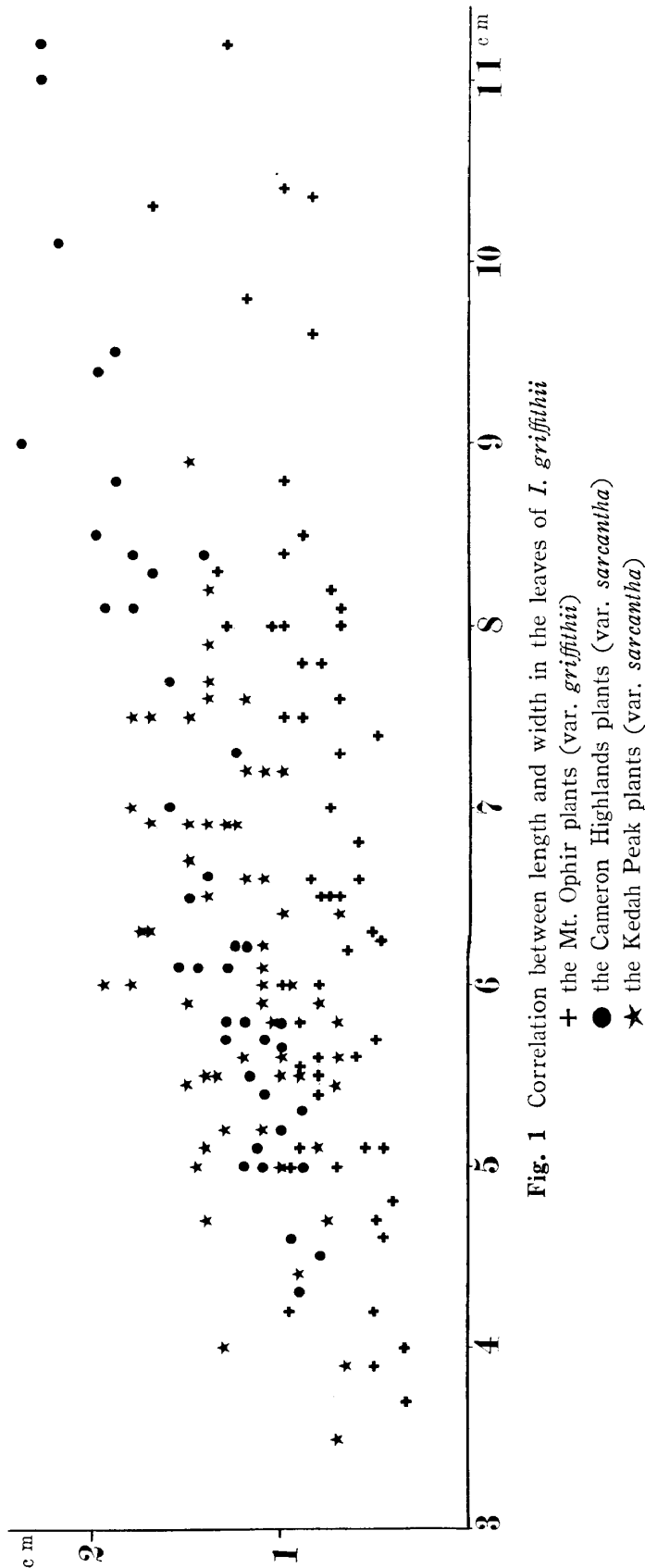


Fig. 1 Correlation between length and width in the leaves of *I. griffithii*

Kedah : Kedah Peak (Gunong Jerai) Evans & Gordow 1077 (SING); Haniff 4198 (SING), H. M. Burkill 3360 (SING), Haniff & Ridley 575 (SING), H. N. Ridley 5351 (SING). Pahang : Cameron Highlands, M. R. Henderson 11678, 11785 & 10919 (SING), C. P. Synington 21032 (SING), T13705 (KYO, SHIN). Perak : Sg. Grok, hills east of Gopeng, Ng 1582—nearly glabrous (SING). Distr. Endemic.

The present species was originally described from Mt. Ophir and Gunong Jerai, which are remotely distant from each other in the Malay Peninsula. Ridley as later as 1922 mentions only these two localities for this species. *I. sarcantha*, on the other hand, was reported from Telom (Pahang) which is situated just midway between the former two localities. According to Ridley (1922) and also to Henderson (1949), the key character for separation of these two species is in the hairiness of the stems and in the leaf-shape, viz. *I. griffithii* has puberulous stems and linear-lanceolate leaves, 0.6–0.8 cm in width, while *I. sarcantha* has hairy stems and broad-lanceolate leaves, 0.6–1.9 cm in width.

Figure 1 shows the correlation between length and width of leaves of these three geographical groups, viz. the Kedah Peak plants, Mt. Ophir plants, and the Cameron Highlands plants. The Mt. Ophir

plants show linear leaves in which most leaves fall in the range of 0.5–1 cm in width, while the Kedah Peak plants have apparently broader leaves. It is worth noticing that the Cameron Highlands plants are not separable from the Kedah Peak plants by a difference in the leaf-shape. Therefore, the latter should be included in *I. sarcantha*. Specimen T13705 from the Cameron Highlands is a well-grown plant with large leaves up to 13 cm long and 3.5 cm wide, the petioles of which are up to 2 cm long.

In regard to hairiness of stems, on the other hand, all the specimens cited above are more or less pubescent with brownish hairs. Those from the Cameron Highlands are mostly conspicuously hairy on the stems. Specimen Addison 36992 from Mt. Ophir has densely hirsute stems, the leaves up to 8 cm long and 1.7 cm wide and with the petioles 1.5 cm long. Thus I believe that density of hairiness is highly variable, and it is not a useful specific character.

Contrary to Ridley's statement (1922), I found the seeds of the specimens of the Cameron Highlands and Kedah Peak to be pilose not glabrous. The Ophir plants had no seeds available.

I. polycycla may be a form of the present species with smaller leaves, 2.5–3.8 cm long and 1 cm wide. The ratio of length and width of the leaves is the same as in the small leaves of *I. sarcantha*. *I. polycycla* is here considered the same as *I. griffithii* var. *sarcantha*.

5. *I. wrayi* Hook. f. in Rec. Bot. Surv. Ind. 4: 55 as *Wrayii*, & 56. 1906, in Kew Bull. 1909: 6; Ridley, Fl. Malay Penin. 1: 336. 1922; Craib, Fl. Siam. Enum. 1: 214. 1926. Distr. Lower Thailand? and the Malay Peninsula.

I have seen no specimens referable to this species. Craib (1926) mentions that the Thai specimens in his citation are doubtfully referred to it.

6. *I. exilipes* Hook. f. ex Ridley in Jour. As. Soc. Straits 75: 10. 1917, Fl. Malay Penin. 1: 337. 1922.

I. betongensis Craib in Kew Bull. 1926: 337, Fl. Siam. Enum. 1: 209. 1926.

Glabrous, but sometimes slightly hirsute on leaves and lateral sepals. Leaves opposite or 3–4-whorled, broad-lanceolate, up to 12 cm long, 3.5 cm wide, spinulose-serrate but spinulose-glandulose on lower margin, glaucous beneath; lateral nerves 5–6-paired; petioles distinct, 1–4 cm long; stipular glands present. Flowers violet, solitary, axillary; pedicels 3–7 cm long, bracteate at base; lateral sepals 2, ovate, cuspidate at apex, 8–9 mm long, lip boat-shaped, with long spur about 3.5 cm long; standard broadly obovate, 15 mm long, emarginate at apex, the costa pilose, winged; wing-petals 22 mm long, separate, bilobed. Capsules turgid in the middle, 2 cm long, glabrous. Seeds obovoid, compressed, 3 mm long, pilose with brownish hairs. —Damp places in forests: 200–500 m alt.

THAILAND. Trang: lower elevation of Khao Chong, T6990 (KYO). Pattani: Betong, Kerr 7685—isotype of *I. betongensis* (BK), photo. MALAYSIA. Perak: Road to Tapah, H. N. Ridley 13552 (SING); Tapah to Jor, H. N. Ridley s.n. (SING); circular path

round Gunong Hijau, Sinclair & Kiah 38753 (SING). Penang : Insl. Penang, M. Togashi 6855 (KYO) ; Penang Hill to Water-fall Botanic Garden M 12993 (KYO, SHIN), T. Shimizu 19394—cult. from seeds in Matsumoto (SHIN).

Distr. Endemic.

This species, closely related to *I. griffithii*, is characterized by long-petiolate, opposite or whorled leaves. Contrary to the original explanation, I found the seeds to be pilose as far as the specimens, Sinclair & Kiah 38753 and M12993, are concerned. The other specimens lack seeds.

Craib (1926) described *I. betongensis*, when he maintained that it was different from *I. exilipes* by having the lateral sepals pilose outside. However, I found that the lateral sepals of *I. exilipes* were rather commonly pilose outside. Thus *I. betongensis* is considered as a synonym of the present species.

7. ***I. curtisii*** Hook. f. in Rec. Bot. Surv. Ind. 4 : 55. 1906, in Kew Bull. 1909 : 6 ; Ridley, Fl. Malay Penin. 1 : 337. 1922 ; Henders., Malay. Wild Fl. pt. 1, 52. 1949.

Stems erect, branching, glabrous, 10–40 cm tall. Leaves congested on the upper part of the stem, alternate to whorled, but sometimes opposite on the lower part, ovate, membranaceous, acuminate toward apex, cuneate or somewhat truncate at base, sparsely hirsute with scurfy hairs above, hirsute on nerves beneath, spinulose-crenate but spinulose glandulose near base ; lateral nerves arcuate, 10–12-paired ; petioles up to 8 cm long ; stipular glands present. Flowers pale-violet, axillary, solitary ; pedicels 2–5 cm long, ebracteate ; lateral sepals 2, ovate, 2 mm long ; lip boat-shaped, 3 mm deep, 5 mm across the mouth, ciliate on the margin, the spur 2.5–3.5 cm long ; standard cordate, 10 mm long, 12 mm wide, the costa mucronate at apex ; wing-petals separate, 10 mm long, deeply bilobed, the lobes shortly aristate at the apex. Capsules turgid in the middle, about 2 cm long, glabrous. Immature seeds obovoid, compressed. —1000–1200 m alt.

MALAYSIA. Perak : Maxwell Hill (Taiping Hill), L. Wray Jr.—isosyntype (SING), C. Curtis 1348—isosyntype (SING), J. Sinclair 38757 (SING) ; Gunding Hija, H. N. Ridley s.n.—isosyntype (SING).

Distr. Endemic.

The leaves of this species are so strictly crowded that they appear alternate to whorled. The lower leaves are few, subopposite or opposite.

8. ***I. balsamina*** L., Sp. Pl. 2 : 938. 1753 ; Hook. f. & Thoms. in Jour. Linn. Soc. 4 : 130. 1860 ; Hook. f., Fl. Brit. Ind. 1 : 453. 1874, in Rec. Bot. Surv. Ind. 4 : 4 & 7. 1904, 13 & 19. 1905, 25 & 32. 1905, 42 & 47. 1906, 49 & 52. 1906, in Kew Bull. 1909 : 7.—*Balsamina hortensis* DC., Prodr. 1 : 685. 1824.

Annual. Stems erect, puberulous. Leaves alternate, herbaceous, lanceolate, 5–12 cm long, 1–2.5 cm wide, serrate, acute toward apex, acuminate toward the short glandulose petiole. Flowers rose, violet or white, axillary, solitary or 2–3-fascicled, pendulous ; pedicels about 2 cm long, pubescent ; lateral sepals 2, oval to ovate, 1–2.5 mm long, api-

culate at apex; lip pubescent, usually long-spurred; standard cordate, horned at apex; wing-petals separate, bilobed. Capsules tomentose. Seeds globose, 3-4 mm long, granulate.

THAILAND. Chanthaburi: Makklam, C. Nuphakdi 202 (BKF).

Distr. India, Burma and South China.

9. *I. curvipes* Hook. f. in Rec. Bot. Surv. Ind. 4: 25 & 32. 1905.

Stems erect, simple, glabrous. Leaves alternate, crowded on upper part of stem, ovate-oblong, attenuate toward apex, round to cuneate at base, 4-9 cm long, 1-3 cm wide, pubescent above, glabrous beneath, crenate on the margin, with stipitate glands near base; lateral nerves 5-6-paired; petioles shorter than 1 cm, having distinctly stipitate glands; stipular glands absent. Flower violet, axillary or binary; pedicels about 2.5 cm long, pubescent, bracteate at base, deflexed after flowering; lateral sepals 2, oblong, 3.5 mm long, 1.5 mm wide, pubescent outside; lip funnel-shaped, 3 mm deep, 8 mm across the mouth, pubescent, the spur 3-3.5 cm long; standard cordate, 8 mm tall, 20 mm wide, the costa slightly pubescent, winged, mucronulate at apex; wing-petals 15 mm long, subequally bilobed, the distal lobes obovate, 15 mm long, 10 mm wide, auricled at base, the basal lobe nearly equal to the distal one in shape, cordate at apex. Capsules densely hirsute. Seeds unknown.

THAILAND. Mae Hong Son: Doi Pae Poe, about 90 km NW of Tak, 1300 m, common in wet localities, B. Hansen & T. Smitinand 12921 (KYO).

Distr. Upper Burma.

Only one specimen was available to me. This is a new record for the Thai flora.

10. *I. inops* Hook. f. in Lecomte, Not. Syst. 1: 12. 1909; in Hook. Ic. Pl. 30: t. 2922. 1910, in Lecomte, Fl. Gén. Indo-Chine 1: 617. 1911.

Stems creeping below, pubescent on the upper part. Leaves alternate, ovate, up to 5 cm long, 2.5 cm wide, hirsute above, hispidulous on the nerves beneath, crenulate on the margin, spinulose near the base, shortly petiolate; lateral nerves 6-8-paired; stipular glands present. Flowers violet, axillary, solitary; pedicels erect, protruding above the leaf cluster, 2.5-3.5 cm long, pubescent, bracteate at base; lateral sepals 2, lanceolate, 2-2.5 mm long, pubescent outside; lip funnel-shaped, 3-4 mm deep, 6 mm across the mouth, densely hirsute outside, the spur straight, 2-2.5 cm long; standard cordate, 8-9 mm tall, the costa thickened, hirsute, mucronulate at apex; wing-petals separate, deeply bilobed, the basal lobes cordate, larger than the distal ones, slightly apiculate at apex, the distal one oblong, round at apex. Capsules turgid in the middle, 1 cm long, pubescent.

THAILAND. Bannkikh and Taktoong, B. Hayata s.n. Dec. 24, 1921 (TI).

Distr. Laos.

This is a new record for the Thai flora.

11. *I. purpurata* Tardieu in Not. Syst. 11: 175. 1944.

Stems slender, creeping, branching, hirsute with ferruginous hairs. Leaves alternate,

orbicular to ovate, 0.8–3 cm long, 0.7–1.5 cm wide, hirsute on both sides, with marginal stipitate glands at base; lateral nerves 8-paired, prominent above; petioles up to 1 cm long, hirsute. Flowers violet or rose, terminal or axillary, solitary; pedicels 1–3 cm long, hirsute; lateral sepals 2, ovate, apiculate at apex, 7 mm long, 4 mm wide; lip funnel-shaped, 8 mm deep, 10 mm across the mouth, hirsute, the spur 20–25 mm long, incurved; standard orbicular, 8 mm tall, the costa hirsute; wing-petals 13 mm long, 7 mm wide, bilobed in the middle. Ovary slightly hirsute.

THAILAND. Bannkikh and Taktoong, B. Hayata s.n. Dec. 24, 1921 (TI).

Distr. Annam and Laos.

This is also new for the Thai flora. The specimen cited above is somewhat different from the description by Tardieu in having brownish stems and smaller flowers. Reexamination of our specimen will be made when authentic reference material becomes available.

12. *I. aureliana* Hook. Ic. Pl. 29: t. 2851. 1908, in Lecomte, Fl. Gén. Indo-Chine 1: 616. 1911; Craib, Fl. Siam. Enum. 1: 208. 1926.

Distr. Thailand?

INDO-CHINA, without precise locality, P. Henry de Orléan—type (P).

Since it was described in 1908, no other information has been available. As mentioned in the original description, it is distinguished from the other Thai allies by its smooth glabrous seeds.

13. *I. subaequalis* Craib in Kew Bull. 1926: 165, Fl. Siam. Enum. 1: 213. 1926.

THAILAND. Chanthaburi: Kao Soi Dao, ca. 1200 m, on rocks in evergreen forest, A. F. G. Kerr 9624—isotype (BK), photo.

I have seen only a poor photograph of the isotype. According to Craib (1926), this species is near to *I. violaeiflora*, but the former has smaller flowers, the standard 5.5 mm long and the subequally bilobed wing-petal 9 mm long. In this respect, the present species comes so much nearer to the following one, *I. noei*, that it is very difficult to separate them.

14. *I. noei* Craib in Kew Bull. 1926: 162, Fl. Siam. Enum. 1: 212. 1926.

Stems slender, erect, 10–40 cm tall, branching, glabrous or pilosulous on the upper part. Leaves alternate, lanceolate to ovate-lanceolate, acuminate toward apex, attenuate toward base, up to 8 cm long, 2.5 cm wide, puberulous with scurfy hairs above, glabrous or pilose on nerves beneath, crenate on margin but 2–3-spinulose-glandulose near base; lateral nerves 7–8-paired; petioles up to 3 cm long, glabrous or pilosulous. Flowers violet, axillary, solitary or binary; pedicels glabrous or pilose, 2–4 cm long, minutely bracteate at base; lateral sepals 2, lanceolate, 2 mm long; lip funnel-shaped, 2–3 mm deep, 5 mm across the mouth, apiculate at apex, the spur slender, straight, 15–25 mm long, glabrous or slightly pilose; standard orbicular-obovate, 5–6 mm tall, retuse at apex, the costa narrowly carinate, glabrous or puberulous; wing-petals separate, 8–9 mm long,

nearly equally bilobed. Capsules turgid in the middle, 10–13 mm long, hirsute to glabrescent. Seeds obovoid, compressed, 2.5 mm long, pubescent with spirally sculptured hairs.—Shady damp spots; 30–500 m alt.

THAILAND. Phitsanulok: Tung Salaeng Luang National Park, T11224 (BKF, KYO, SHIN). Saraburi: Kao Mak Kok, Muak Lek, N. Noe 128—isotype (BK), photo. Prachuap Khiri Khan: Nam Tok Huay Yang, near Thap Sakae, T7725 (BKF, KYO, SHIN).

Distr. Endemic.

This species has the smallest flowers of any Thai allies, i. e. in the *I. violaeiflora* group, and the seeds have spirally sculptured hairs. The size of the vegetative parts and the pubescence are very variable. The Saraburi plants (according to Craib) and the Prachuap ones have pilose stems, leaves, and pedicels, and hirsute floral segments, while the samples from Phitsanulok are completely glabrous except on the leaves above.

15. *I. violaeiflora* Hook. f., Fl. Brit. Ind. 1: 457. 1874, in Rec. Bot. Surv. Ind. 4: 26 & 32. 1905; Toppin in Kew Bull. 1920: 352, with fig. Craib, Fl. Siam. Enum. 1: 214. 1926, as *violiflora*.

Stems up to 50 cm tall, erect, branching, glabrous, except pubescent on the upper portion. Leaves alternate, ovate-lanceolate, petiolate, acute to acuminate toward apex, cuneate at base, up to 8 cm long, 3 cm wide, hirsute with scurfy hairs above, nearly glabrous to densely pubescent beneath, crenate-serrulate on margin but conspicuously spinulose-glandulose at base; petioles up to 3 cm long, sometimes spinulose; lateral nerves 6–13-paired; stipular glands absent. Flowers violet, axillary, solitary or binary; pedicels 1–3.5 cm long, pubescent with striped hairs, bracteate at base; lateral sepals 2, ovate. 1–3 mm long, glabrous or puberulous outside; lip funnel-shaped, 5 mm deep, 6 mm across the mouth, puberulous, the spur 2.5–4 cm long, nearly straight or curved; standard broadly cordate, 10–12 mm tall, the costa narrowly winged, slightly pubescent, horned at apex; wing-petals separate, 15–18 mm long, deeply bilobed, the distal lobes somewhat larger than the basal ones. Capsules turgid in the middle, densely hirsute, about 15 mm long. Seeds obovoid, compressed, 2.5 mm long, hairy with spirally sculptured hairs.—In open or shady, clayey or rocky places; 900–2000 m alt.

THAILAND. Mae Hong Son: Mae Sarieng to Mae Hue, T10363 (BKF, KYO, SHIN). Chiang Mai: Doi Suthep, H. B. G. Garrett 99—cited in Craib, l.c. (BKF), B. Hayata s.n. Oct. 2, 1921 (TI), B. Hayata s.n. Oct. 7, 1921 (TI), T. Tuyama 57193 (TI), S. Singhasathat 29 (BKF, SHIN), P. Suvarnakoses 3 (BKF), T3222 (BKF, KYO, SHIN), T9523 (BKF, KYO, SHIN), T10507 (BKF, KYO, SHIN); Doi Chiang Dao, K. Bunchuai 69 (BKF), T. Tuyama 57358 (TI), P. Suvarnakoses 1003 (BKF). Chiang Rai: Doi Pa Hom Pok, NW of Phan, T9683 (BKF, KYO, SHIN); Doi Pacho, T3669 (BKF, KYO, SHIN). Lamphun: Doi Khun Tan, T9251 (KYO); Ban Khun Tan to Doi Khun Tan, T9156 (BKF, KYO, SHIN). Lampang: Doi Pang La, Huay Tak, T10826 (KYO); Pang La to Huay Tak, T10756 (KYO). Phetchabun: Phu Miang, T11420 (BKF, KYO, SHIN). Loei: Phu Kradung,

T8823 & T8839 (BKF, KYO, SHIN).

Distr. Upper Burma.

The present species is variable not only in size and appearance, as pointed out by Toppin (1920), but also in pubescence. Even in the same locality, for examples in Doi Suthep, some plants, as Hayata s.n. and Suvarnakoses 3, are densely pubescent on the leaves beneath, while the others are nearly glabrous. The lateral sepals are usually puberulous outside, but sometimes glabrous as in Garrett 99, the size of which is also variable from 1 to 3 mm long.

Toppin (1920) mentions that the seeds of this plant are without hairs when ripe, but covered with tomentum when green. However, I have found in specimens with seeds in microscope examination that the seeds have distinct projections with spiral pattern (cf. Fig. 2). This is characteristic of the *I. violae flora* group.

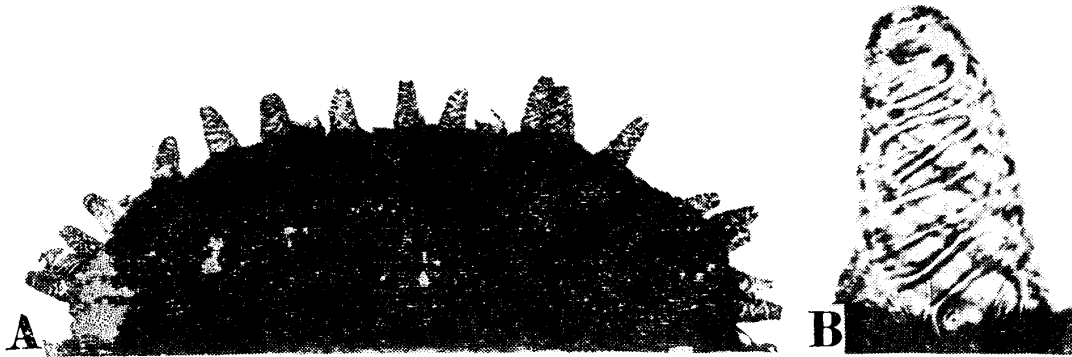


Fig. 2 Epidermal structure of the seed of *I. chiangdaoensis*, showing a cross section of the seed (A) and a projection (B) A. $\times 90$, B. $\times 500$

In the highlands in northern Thailand, this species occurs usually in somewhat shady places, without regard to the ground conditions. It is worth noticing that it grows on limestone outcrops at Huay Tak.

16. *I. chiangdaoensis* T. Shimizu in Acta Phytotax. Geobot. 24: 35. 1969.

Stems erect, 10-50 cm tall, branching, glabrous. Leaves alternate, rarely opposite on the lower part, ovate, acuminate toward apex, cuneate or attenuate toward base 1.5-11 cm long, 0.8-3.5 cm wide, hirsute with long hairs above, glabrous beneath, ciliate, obscurely crenate, marginally 2-3-spinulose-glandulose near base; lateral nerves 5-7-paired; petioles mostly indistinct but rarely up to 1 cm long on the lower leaves; stipular glands absent. Flowers violet, axillary or binary; pedicels 3-5 cm long, unilaterally hirsute, bracteate at base, the bracts linear, 3 mm long, long-hirsute; lateral sepals 2, linear-lanceolate, 3-5 mm long, long hirsute; lip funnel-shaped, 5-7 mm deep, 6-8 mm across the mouth, aristate at apex, dorsally long hirsute, the spur 2-3 cm long, loosely curved; standard cordate, 10-12 mm tall, 12-14 mm wide, the costa slightly winged, long hirsute,

apiculate to aristate at apex; wing-petals separate, the basal lobes oblong, 10 mm long, the distal ones 12 mm long, broader than the basal ones. Capsules turgid in the middle, hirsute, 1.5 cm long. Seeds obovoid, 2 mm long, granulate-pubescent. —Shady rocky places on limestone; 1000–2000 m alt.

THAILAND. Chiang Mai: Doi Chiang Dao, T10134—type (KYO; isotype in BKF & SHIN), T9885 (BKF, KYO, SHIN), T9887 (BKF, KYO, SHIN), T10229 (BKF, KYO, SHIN), K. Bunchuai 941 (BKF), T. Smitinand 4698 (BKF), T. Shimizu 18985, grown from seeds in Matsumoto (SHIN).

Distr. Endemic.

This species is very near to the previous one, from which it is distinguished by the nearly sessile leaves, unilaterally hirsute pedicels, linear-elongate lateral sepals and long hirsute floral segments except the wing-petals. The specimens cited above are all from limestone ridges above 1000 m in altitude on Doi Chiang Dao.

17. *I. phuluangensis* T. Shimizu in Acta Phytotax. Geobot. 24: 37. 1969.

Stems erect, simple, 50–60 cm tall, stramineous, glabrous. Leaves alternate, ovate or obovate, acute to acuminate toward apex, attenuate toward base, 6–15 cm long, 2.5–6 cm wide, sparsely pubescent above, hispidulous on nerves beneath, crenate on margin but spinulose near base; lateral nerves 7–8-paired; petioles up to 3.5 cm long; stipular glands absent. Flowers violet, axillary, solitary or 2–3-fascicled; pedicels 5–6 cm long, glabrous, bracteate at base, the bracts linear, 8 mm long, long ciliate; lateral sepals 2, linear-lanceolate, 6–8 mm long, 2 mm wide, long hirsute; lip boat-shaped, 10 mm across the mouth, aristate-apiculate at apex, hirsute, the spur filiform, straight 4–5 cm long; standard cordate, 2 cm tall, 2.4 cm wide, the costa 1 cm long, not winged, hirsute, narrowly horned at apex, the horn 4 mm long; wing-petals separate, deeply bilobed, the distal lobes dimidiate-subcordate, 16 mm long, 14 mm wide, the basal ones oblong, 14 mm long. Capsules turgid in the middle, hirsute. Seeds obovoid, compressed, 3.5 mm long, granulate-pubescent.

THAILAND. Loei: Phu Luang, northeastern ridge, 1300–1562 m, wet ground by rock in deep shade, T1535—type (KYO; isotype in BKY & SHIN).

Distr. Endemic.

This is a member of the *I. violae flora* group with the largest vegetative and the floral organs. As Craib (1926) pointed out, the *I. violae flora* group is well developed in Southeast Asia.

18. *I. patula* Craib in Kew Bull. 1926: 164, Fl. Siam. Enum. 1: 212. 1926.

Annual. Stems erect, 30–40 cm tall, branching, glabrous except pubescent on the upper part. Leaves alternate, lanceolate acuminate toward apex, narrowly cuneate at base, up to 8 cm long, 2 cm wide, pubescent above with scurfy hairs, pubescent beneath on nerves only or tomentose all over, crenulate on margin but spinulose-glandulose near base; petioles up to 3 cm long; stipular glands absent. Flowers violet, axillary, solitary; pedicels up to 2.5 cm long, sparsely pilose, bracteate at base, the bracts linear; lateral

sepals 2, linear-lanceolate, 3–3.5 mm long, slightly hirsute outside; lip funnel-shaped, 5 mm long, 5 mm across the mouth, puberulous, the spur 2–3 cm long, straight; standard cordate, 7 mm long, the costa sparsely hirsute, horned at apex, the horn 3 mm long; wing-petals separate, 14 mm long bilobed, the distal lobes much larger than the basal ones. Capsules turgid in the middle, hirsute. Seeds unknown.—Moist; 100–200 m alt.

THAILAND. Kamphaeng Phet: Kao Hua Mot, A. F. G. Kerr 6128—isotype (SING), Kanchanaburi: Rintin near In Sayok, about 14 km NW of Kanburi, A. Kostermans 1387 (SING); near Kannyu, about 100 km NW of Kanburi, A. Kostermans 1194 (SING).

Distr. Endemic.

As noted by Craib (1926), this is very near to *I. violae flora*. In my opinion, the present species is characterized by the narrow leaves, distinctly horned standard and considerably asymmetric lobes of the wing-petal. Likewise in *I. violae flora* the pubescence of the leaves is very variable. Kostermans 1194 has the leaves tomentose beneath, while the others are pubescent beneath only on the nerves. It is found at the lower elevations in western Thailand, while *I. violae flora* is a northern highland plant.

19. *I. muscicola* Craib in Kew Bull. 1926: 162, Fl. Siam. Enum. 1: 211. 1926.

Small annual, 10 cm or so tall. Leaves alternate, ovate, puberulous on both sides, apiculate at apex, up to 2 cm long, 8 mm wide, obscurely dentate and sparsely ciliate on margin, sometimes spinulose-glandulose at base; petioles less than 1 cm long; stipular glands present. Flowers violet, axillary, solitary; pedicels 5–15 mm long, sparsely pilose on one side, bracteate at base; lateral sepals 2, linear, about 1 mm long, sometimes pilose outside; lip boat-shaped, 3.5 mm across the mouth, sparsely pilose outside, without spur; standard orbicular-elliptic, 3.5 mm long, the costa narrowly winged, mucronulate at apex, sparsely pilose; wing-petals separate, 3.5 mm long. Capsules turgid in the middle, 7 mm long, hirsute. Seeds obovoid, compressed, granulate, 2 mm long. —Shady limestone crevices; 1900–2100 m alt.

THAILAND. Chiang Mai: Doi Chiang Dao, T10124 (BKF, KYO, SHIN).

Distr. Endemic.

This is the smallest of the Thai *Impatiens*, being characterized by small flowers without spur. It is known only from limestone crevices at the higher elevation of Doi Chiang Dao.

20. *I. saxicola* Craib in Kew Bull. 1926: 164, Fl. Siam. Enum. 1: 213. 1926.

THAILAND. Chanthaburi: Lem Dan Kao, Kaw Chang, ca. 400 m, on open rocks, A. F. G. Kerr 9303—isotype (BK), photo.

Distr. Endemic.

I have seen only a photograph of the isotype specimen. According to the original description, this species is distinguished from the previous one by the larger flowers and the lip with saccate base.

21. *I. smitinandii* T. Shimizu in Acta Phytotax. Geobot. 24: 39. 1969.

Stems erect, simple, 10–30 cm tall, stramineous, glabrous. Leaves alternately crowded on the upper part of stem, but remotely opposite with 2–3 pairs on the lower part, membranaceous, lanceolate to ovate, acute to acuminate toward apex, cuneate to attenuate toward base, 3–8 cm long, 1.2–3 cm wide, crenate, marginally 2–3-spinulose-glandulose at base, slightly pubescent on both sides; lateral nerves arcuate, 8–10-paired; petioles up to 2 cm long, gradually shortened upward; pedicels 1–1.5 cm long, hirsute, bracteate on the middle; the bracts ovate, 1 mm long, hirsute; lateral sepals 2, ovate, 1.5–2 mm long, usually hirsute outside; lip boat-shaped, 5–6 mm across the mouth, about 15 mm long including the spur, hirsute on back, the spur straight; standard elliptic 4–5 mm tall, emarginate at apex, hirsute outside, the costa slightly winged; wing-petals separate, 5–6 mm long, the distal lobe oblong, 3.5–4 mm long, the basal one orbicular, much shorter than the distal one. Capsules turgid in the middle, glabrous, 7 mm long. Seeds obovoid, compressed, 2.5 mm long, covered with short hairs. — Mossy rock in dense forest; 1400 m alt.

THAILAND. Phitsanulok: Phu Miang, T11633 — type (KYO; isotype in BKF & SHIN). Distr. Endemic.

The present species is nearest to *I. exilis* Hook. f. from East Himalaya. The samples of the latter available to me, viz. Sanguri Bhanjang to Dhara Pani, H. Hara et al. 6300493 (KYO, TI), Namli, H. Hara 6300495 (KYO, TI) and Gantok, H. Hara et al. 2988 (KYO, TI) cited in Hara's Fl. East. Himal. 195 (1966), have more or less pubescent stems, prominent stipular glands, mostly 2–5-fascicled glabrous pedicels and purple flowers, every segment of which is completely glabrous. In contrast, our plants have glabrous stems with the stipular glands slightly projected at the base of the petioles, always solitary hirsute pedicels bracteate in the middle, and yellow flowers with hirsute segments. I believe the differences in the bracts and the color of the flowers between these two species warrant specific distinction. Therefore, I described our plants as new.

22. *I. puttii* Craib in Kew Bull. 1928: 235.

Stems frutescent, glabrous, branching. Leaves succulent, alternate, broadly ovate, acute toward apex, truncate to shallowly cordate at base, up to 6 cm long, 4.5 cm wide, glabrous, nearly entire, sometimes biglandulose on the under surface at base; petioles up to 5 cm long; stipular glands absent. Flowers blue-purple or rarely white, axillary, solitary; pedicels 2–5 cm long, articulate on the bracteate middle, the bracts linear, 3 mm long; lateral sepals 2, elliptic, membranaceous, asymmetric, about 10 mm long, 6–8 mm wide; lip funnel-shaped, 2 cm across the mouth, shortly spurred; the spur 8–9 mm long, slightly concave at apex; standard cordate, 25 mm tall, 30 mm wide, distinctly winged on the lowest part of costa, wing-petals connate, 25 mm long, bilobed, the distal lobes much larger than the basal ones, the basal lobes flabelliform with stipe 10–12 mm long. Capsules glabrous, 17 mm long. Seeds globose, 1.5 mm across, prominently reticulate,

with spiral sculptured hairs. —Sunny rocky places of limestone ; 0-150 m alt.

THAILAND. Prachuap Khiri Khan : Khao Chrongwan, T7680 (BKF, KYO, SHIN) ; Khao Chong Grackok near Bang Saphan, T7616 (BKF, KYO, SHIN). Chumphon : limestone hill, Haniff & Nur 4379 (SING).

Distr. Endemic.

This species resembles *I. ridleyi* Hook. f. in appearance. However, it is characterized by the articulate pedicels and prominently reticulate globose seeds with spirally sculptured hairs. These characters are peculiar to the present species among the Thai and the Malayan *Impatiens*.

It grows on sunny limestone outcrops in Lower Thailand. The pH value of the soils was found to be 8.0-8.2 in the case of Prachuap Khiri Khan.

23. *I. kerriae* Craib in Kew Bull. 1926 : 16, Fl. Siam. Enum. 1 : 210. 1926.

Frutescent perennial up to 1 m tall, glabrous. Leaves alternate, congested at apex of branches, ovate-lanceolate, thickened, shortly acuminate toward apex, broadly cuneate at base, 6-11 cm long, 2.5-6 cm wide, serrate, biglandulose at base ; lateral nerves 8-10-paired, arcuate, prominent beneath ; petioles up to 3 cm long ; stipular glands absent. Flowers pale yellow, axillary, solitary or binary ; pedicels 4-7.5 cm long, bracteate at base, the bracts linear 5 mm long ; lateral sepals 2, orbicular-ovate, membranaceous, long apiculate at apex, 15-20 mm long, 10-15 mm wide ; lip saccate, 25 mm across the mouth, subbasally spurred, the spur 5 mm long, bilobed, incurved ; standard obovate-elliptic, about 20 mm long, 18 mm wide, emarginate at apex, the costa shortly cuspidate, hardly winged ; wing-petals connate, 3.5 cm long. Capsules turgid in the middle, 3 cm long, glabrous. Seeds fusiform, compressed, 3.5 mm long, granulate-pubescent. —Sunny limestone ridge ; 1900-2100 m alt.

THAILAND. Chiang Mai : Doi Chiang Dao, T10137 (BKF, KYO, SHIN).

Distr. Annam.

This is a large frutescent species inhabiting limestone ridges and cliffs on Doi Chiang Dao. Tardieu-Blot (1944) mentions that this is one of the few examples in which the *Impatiens* species occur both in Annam and Thailand.

24. *I. vauhanii* Hook. f. in Kew Bull. 1911 : 250 ; Ridley, Fl. Malay Penin. 1 : 338. 1922 ; Craib, Fl. Siam. Enum. 1 : 213. 1926 ; Henderson in Jour. Malay. Br. Roy. As. Soc. 17 : 39. 1939.

Distr. Lower Thailand and Malay Peninsula.

No specimens of this plant have been seen. Of the three specimens Ridley (1922) cited, I found that the Perlis plant, Ridley 15035, was *I. macrosepala* Hook. f. Therefore three specimens Craib (1926) cited are all of authentic. Henderson (1939) suggests that this plant is probably confined to limestone and only in Johor, Setul, and Perlis.

25. *I. calcicola* Craib in Kew Bull. 1926 : 159, Fl. Siam. Enum. 1 : 209. 1926.

Stems fleshy, erect, more than 1 m tall, up to 5 cm in diameter at base, glabrous.

Branches and leaves radiant from few nodes on the stem. Ramular leaves alternate, usually smaller than radial leaves, with shorter petioles. Radial leaves membranaceous when dried, oblong, acuminate toward apex, cuneate but asymmetric at base, 8-23 cm long, 4-9 cm wide, obscurely crenate, distinctly biglandulose at base beneath, pubescent with scurfy hairs above, glabrous to tomentose beneath; lateral nerves nearly parallel, 12-17-paired; petioles 3-7 cm long; stipular glands absent. Ramular leaves alternate, 6-20 cm long, 1.5-6 cm wide, with petioles 0-1.5 cm long, same in other characters with the radial ones. Flowers blue-purple but sometimes white, axillary, solitary or 2-3-fascicled; pedicels 0.5-2 cm long, pendulous under the leaves, minutely bracteate at base; lateral sepals 4, the outer ones membranaceous, obovate, 18 mm long, 12 mm wide, apiculate at apex, sometimes pubescent outside, the inner ones linear-lanceolate, 3 mm long, 0.7 mm wide; lip funnel-shaped, 1.5 cm deep, 2 cm across the mouth, apiculate at apex, the spur yellowish orange, 5 mm long, deeply bifid, nipple-like; standard elliptic, 12 mm long, 8 mm wide, the costa winged and gibbose on the lower half; wing-petals connate, bifid at apex, the distal lobes oblong, 18 mm long, with confluent auricle at base, the basal lobes flabelliform, 13 mm long including the stipe. Capsules glabrous. Seeds oblong, compressed, sulcate. —Various rocky places, including limestone outcrops: 200-500 m alt.

THAILAND. Phitsanulok: Tung Salaeng Luang National Park, T11232 (BKF, KYO, SHIN). Saraburi: Muak Lek, T. Smitinand & H. Sleumer 1316 (SING); Hinlap, T. Smitinand & Sleumer 1104 (SING). Ratchaburi: without particular loc., A. F. G. Kerr 8991——isotype (BK), photo.

Distr. Endemic.

The key characters of the present species are in its congested leaves and branches, blue-purple flowers, 4 lateral sepals, connate wing-petals, and nipple-like bifid spurs of the lip. It is worth-noticing that the Phitsanulok plants growing on damp siliceous rocks are completely glabrous except on the leaves above, while the Saraburi and the Ratchaburi plants from limestone hills are densely pubescent on the upper portion of the branches, the leaves beneath, the pedicels, and even on the outer sepals. The similar relationship is seen in *I. macrosepala* Hook. f. (p. 290).

26. *I. harmandii* Hook., Ic. Pl. 29: t. 2858. 1908, in Kew Bull. 1909: 8, in Lecomte, Fl. Gén. Indo-Chine 1: 622. 1911.

Flaccid. Stems erect, simple, zigzag on the upper part, glabrous, 15-30 cm tall. Leaves alternate, crowded on the upper part of stem, ovate to elliptic, membranaceous, acute toward apex, round to cuneate and asymmetric at base, distinctly serrate, 6-13 cm long, 3-6.5 cm wide, pubescent with scurfy hairs above, hispidulous on nerves beneath, sometimes patently biglandulose at base beneath; lateral nerves arcuate, 10-18-paired; petioles 2-5 cm long; stipular glands absent. Flowers bluish, axillary, solitary; pedicels 1 cm long, bracteate at base; lateral sepals 4, the outer ones orbicular-obovate, membra-

naceous, glabrous, 15–20 mm long, apiculate at apex, connate the inner ones linear-lanceolate, 2 mm long; lip included in outer connate sepal, funnel-shaped, 10–12 mm and across the mouth, the spur short, incurved, bifid, nipple-like; standard obovate, 12 mm long, 8 mm wide, emarginate at apex, the costa winged on the lower half, mucronulate at apex; wing-petals 25 mm long, connate and bifid at apex, the distal lobe semiorbicular, the basal ones flabelliform. Ovary glabrous. Capsules unknown.

THAILAND. Loei : Pha Nuk Khao, 150–400 m alt., limestone crevices in the open deciduous forest, T8716 (BKF, KYO, SHIN).

Distr. Laos and Cochin-China.

Although no authentic material was available, our samples cited above coincide with the explanation of this species by Hooker (1908, 1911) except in the shape of the lip.

The record of this species in Thailand is the first, coming from a limestone area where the pH value of the soils was 7.8.

27. *I. macrosepala* Hook. f. in Rec. Bot. Surv. Ind. 4: 55 & 56. 1906, in Kew Bull. 1909: 10; Ridley, Fl. Malay Penin. 1: 339. 1922; Craib, Fl. Siam. Enum. 1: 211. 1926.

Stems simple, glabrous except minutely pubescent on the upper part, 20–40 cm tall. Leaves alternate, crowded on the upper part of stem, membranaceous, oblong-lanceolate or broadly ovate, acuminate or caudate-acuminate toward apex, asymmetric and biglandulose at base, 5–17 cm long, 2–6 cm wide, minutely pubescent on both sides especially on nerves; lateral nerves arcuate, 10–12-paired; petioles up to 10 cm long. Flowers white, axillary, solitary or binary; pedicels 1.5 cm long, minutely pubescent, bracteate at base, the bracts linear, 1.5 mm long; lateral sepals 4, the outer ones ovate, membranaceous, pubescent or glabrous, apiculate, 10–12 mm long, connate, the inner ones linear-lanceolate, 3 mm long; lip funnel-shaped, 5 mm deep, 10 mm across the mouth, short-spurred, the spur bilobed, nipple-like; standard obovate, 8 mm long, the costa winged throughout, somewhat pubescent; wing-petals 14–18 mm long, connate, stipitate. Capsules turgid in the middle, glabrous. Seeds oblong, compressed, 4 mm long, bisulcate, minutely granulate. —Shady or sunny limestone rocks; 0–150 m alt.

THAILAND. Nakhon Si Thammarat: Thung Song, T8250 (KYO, SHIN), T8250 bis (BKF, KYO, SHIN). Phangnga: east of Phangnga, T7863 (BKF, KYO, SHIN); Phangnga, Haniff & Nur 3964 (SING). Kasoom, C. Curtis 3217 —isotype (SING). MALAYSIA. Perlis: Tebing Tinggi, Ridley 15035 (SING); Bukit Lagi, Ridley 15035 (SING), M. R. Henderson 22834 (SING).

Distr. Endemic.

This species was originally described from two specimens, 'Perak, near Ipoh, on limestone rocks, C. Curtis 3172' and 'Kasoom, C. Curtis 3217'. In 1909, however, Hooker named the former *I. cryptoneura*, when he erroneously cited the type specimen of *I. macrosepala* as 'Parak, rupibus calcareis prope Ipoh, C. Curtis 3217'. Therefore Ridley (1922) and Craib (1926) correctly omitted the present species from the Malayan flora.

On the other hand, the specimen 'Ridley 15035' above cited, which was referred to *I. vaughani* Hook. f. in Ridley's flora, was pointed out by Craib (1926) to be distinct. Henderson (1939) also did not determine 'Ridley 15035'.

On examining the isotype of *I. macrosepala*, C. Curtis 3217, I found that, contrary to the original description, it has connate sepals. Although I could not determine whether the lateral sepals are 2 or 4, because of the incomplete isotype specimen, it is characterized by the long-petiolate membranaceous leaves alternately crowded on the top of stem and having distinct large glands at leaf-bases on the under surface, and by the white flowers axillary and solitary with bilobed nipple-like spur on the lip. Ridley 15035 coincides with *I. macrosepala*. Some Phangnga plants cited above should be placed here, these found to have 4 lateral sepals. Consequently the description of *I. macrosepala* should be emended to have 4 lateral sepals and connate outer sepals.

Ecologically this species is a calciphile, restricted to the small area of Lower Thailand and north Malaya.

28. *I. scortechinii* Hook. f. in Rec. Bot. Surv. Ind. 4: 55 & 56. 1906, in Kew Bull. 1909: 11; Ridley, Fl. Malay Penin. 1: 339. 1922; Henders. in Jour. Malay Br. Roy. As. Soc. 17: 38. 1939, Malay. Wild Fl. pt. 1, 53, f. 46. 1949.

Succulent, glabrous. Stems 30-100 cm tall, 2-3 cm in diameter at base. Leaves alternate, more or less crowded on the upper part of stem, membranaceous, lanceolate, up to 25 cm long, 8 cm wide, serrulate; lateral nerves 8-15-paired, distinct, arcuate; infra-petiole glands distinct at base of blade; stipular glands absent. Flowers white with orange spots, axillary, solitary or 2-3-fascicled; pedicels 2.5-4 cm long, bracteate at base; lateral sepals 4, the 2 outer ones ovate to orbicular, membranaceous, 10-15 mm long, 2-9 mm wide, apiculate at the apex, 2 interior ones linear-lanceolate, about 3 mm long, 0.7 mm wide, acuminate; lip funnel-shaped, 15 mm deep, 20 mm across the mouth; the spur 1 cm long, bifid; standard obovate, 2 cm long, 1.5 cm wide, winged on lower half of the costa; wing-petals 2-3 cm long, connate. Capsules turgid in the middle, 2-5 cm long, glabrous. Seeds oblong, bisulcate, 5 mm long, glabrous, covered with long spiral hairs. —On limestone.

MALAYSIA. Perak: Sungit Siput, C. Curtis 3115 — isosyntype (SING); near Kwala Diepang, C. Curtis 3115 (SING); Gua Badak, Lenggong, ca. 400 ft., M. R. Henderson 23839 (SING); Seuggon, H. N. Ridley 14589 (SING); Gunong Pondok, north rock, Haniff 10338 (SING). Pahang: Bukit Cheras, on limestone, M. R. Henderson 25209 (SING). Distr. North Borneo.

According to Henderson (1939), the present species is confined to limestone. Two other specimens from North Borneo, Segarong Cave, without collector 9329 (SING) and Mapat R., Timbun Mata, F. R. Semporn, Keith 7340 (SING), though incomplete, agree with *I. scortechinii*.

29. *I. psittacina* Hook. f. in Curtis Bot. Mag. t. 7809. 1901, in Rec. Bot. Surv. Ind. 4:

30 & 35. 1905; Craib, Fl. Siam. Enum. 1: 213; 1926.

Erect, branching, glabrous, 30 cm or so tall. Leaves alternate, ovate-lanceolate, membranaceous, acuminate to caudate-acuminate toward apex, rounded to broadly cuneate at base, crenate on margin, up to 13 cm long, 5 cm wide, patently biglandulose at base; lateral nerves 6-8-paired; petioles slender, up to 7 cm long; stipular glands absent. Flowers solitary or binary, pendulous from the upper leaf axile; pedicels filiform, 2.5-4 cm long, bracteate near base, the bract linear lanceolate, 3-4 mm long; lateral sepals 2, orbicular-elliptic, membranaceous, 10 mm long, 8 mm wide, apiculate at apex; lip funnel-shaped, 25 mm long, 18 mm across the mouth; the spur short, hooked 5 mm long; standard orbicular, 16-18 mm in diameter, emarginate at apex, the costa apiculate, with prominent wing on the lower half; wing-petals about 35 mm long, connate but deeply bifid, the basal lobes orbicular, stipitate, the distal ones oblong-elliptic, twice as long as the basal ones, emarginate at apex. Capsules clavate, elongate, 24 mm long, glabrous. Seeds fusiform, 2 mm long, minutely granulate. —On shady limestone; 1000-2000 m alt.

THAILAND. Chiang Mai: Doi Chiang Dao, T10228 (BKF, KYO, SHIN), T9886 (BKF, KYO, SHIN), T10135 (BKF, KYO, SHIN), A. F. G. Kerr 6531—cited in Craib l.c. (P)
Distr. Upper Burma.

This is a strikingly beautiful plant with colorful flowers. The dorsal half of the lip and the upper half of the distal lobes of the wing-petals are blue-purple and the other parts are white. It forms colonies on limestone rocks under the open forest.

30. I. ridleyi Hook. f. in Rec. Bot. Surv. Ind. 4: 55 & 56. 1906, in Kew Bull. 1909: 9; Ridley, Fl. Malay Penin. 1: 339. 1922; Henders., Gard. Bull. S. S. 4: 234. 1928, in Jour. Malay Br. Roy. As. Soc. 17: 38. 1939, Malay. Wild Fl. pt. 1, 53, f. 45. 1949.

Frutescent, branching, glabrous. Leaves succulent, alternate, orbicular-ovate, acute toward apex, broadly cuneate and patently biglandulose at base, 3-7 cm long, 2.5-4.5 cm wide; petioles up to 6 cm long; stipular glands absent. Flowers white, axillary solitary or binary; pedicels 2.5-4 cm long, bracteate at base; lateral sepals 4, the 2 outer ones orbicular-ovate, 6-7 mm long; the 2 inner ones minute, orbicular, 1-2 mm long; lip hemispheric, with short incurved spur 5 mm long; standard obovate, the costa thickened, mucronate at apex; wing-petals 2.5 cm long, the basal lobes long stipitate, the distal ones larger, connate. Capsules turgid in the middle, glabrous. Seeds obovoid, compressed, minutely granulate. —Shady or sunny limestone cliffs at ground level.

MALAYSIA. Selangor: Batu Cave, C. Curtis s.n. —isosynotype (SING), Hardial & Sidek 473 (SING), J. Sinclair 40064 (SING), M14147 (KYO, SHIN); Kuala Lumpur Cave, C. Curtis 2326 (SING); Gua Batu, H. N. Ridley 331 (SING). Pahang: Gunong Senyum, M. R. Henderson 22324 (SING).

Distr. Endemic.

Contrary to Hooker's description, I observed inner minute sepals in the isosynotype, C. Curtis 2326, and also in the specimen M14147. The other specimens are incomplete.

This species is a calciphile, occupying a small area in the Malay Peninsula.

31. *I. cryptoneura* Hook. f. in Kew Bull. 1909:9; Ridley, Fl. Malay Penin. 1:339. 1922; Henders., in Jour. Malay Br. Roy. As. Soc. 17:38. 1939.

Frutescent, ramose, glabrous. Leaves succulent, alternate, ovate-lanceolate, acuminate toward apex, cuneate at base, 3–6 cm long, 1–2.5 cm wide, crenulate, biglandulose at base; lateral nerves 4–5-paired, indistinct; petioles 1–5 cm long. Flowers axillary, solitary; pedicels 2.5 cm long, bracteate at base. Capsules turgid in the middle, glabrous.

MALAYSIA. Perak: near Ipoh, on limestone rocks, C. Curtis 3172—isotype (SING). Distr. Endemic.

The only material of this species available is the isotype cited above. It is too incomplete to examine the structure of the flower. However, it strongly resembles the previous species from which it could be separated by the shape and texture of the leaves, as Hooker (1909) pointed out in his key. Henderson mentions that this is confined to limestone.

32. *I. tipusensis* Henders. in Gard. Bull. S. S. 5:72. 1930.
Distr. Malay Peninsula.

I have seen no specimens referable to this species. According to the original description, it is characterized by creeping stems and orange-yellow flowers with 4 lateral sepals and geniculate wing-petals.

This is also a calciphile in the Malay Peninsula.

33. *I. nalampoonii* T. Shimizu in Acta Phytotax. Geobot. 24:39. 1969.

Frutescent, glabrous. Stems erect, ramose, 30–40 cm tall, tinged with purple. Leaves alternate, lanceolate or ovate, acuminate to caudate-acuminate toward apex, round to cuneate at base, 3–7 cm long, 1.5–3 cm wide, crenate on margin, with two distinct spreading glands near base or at the apex of the petiole; lateral nerves 6–7-paired; petioles 0.5–4 cm long; stipular glands absent. Flowers blue-purple, axillary, solitary or binary, pendulous; pedicels 1–2 cm long, bracteate at base, the bracts linear, 2 mm long; lateral sepals 2, orbicular, 8 mm long and wide, apiculate at apex; lip saccate, 2 cm deep, 23 mm across the mouth; the spur subbasally adnate, very short, hooked, turgid in the middle; standard obovate, 17 mm long, 15 mm wide, emarginate at apex, the costa winged only near base; wing-petals connate, bifid to 7 mm deep, the distal lobes semicircular, 25–27 mm long, 12 mm or so wide, emarginate, without auricles at base, the basal lobes obovate, stipitate, 18 mm long including the stipe. Capsules fusiform, turgid in the middle, rostrate at apex, 1.5 cm long, glabrous. Seeds oblong, somewhat compressed, 2 mm long, pustulate. —Shady limestone; 300–800 m alt.

THAILAND. Lampang: Tham Pha Thai in Huay Tak, T10642—type (KYO; isotype in BKF & SHIN), C. Hambanando 230 (BKF); Pang La to Huay Tak, T10755 (BKF, KYO, SHIN); Doi Pang La, Huay Tak, T10818 (BKF, KYO, SHIN). Saraburi: Muak Lek, T. Smitinand & H. Sleumer 1318a (SING). Kanchanaburi: Rintin near Kinsayok,

about 140 km NW of Kanchanaburi, A. Kostermans 1381 (SING).

Distr. Endemic.

This is a completely glabrous frutescent herb with bluish purple flowers. The two large lateral sepals, the turgid hooked spur of the lip subbasally adnate, and the connate wing-petals are the key characters for this species. It is nearest to *I. psittacina* in appearance, leaf-shape, spur outline and seed form. However, the latter has mottled flowers, the lip spurred basally, and the seeds pustulose, but unlike in those of the former. Meanwhile, it is easily separated from *I. ridleyi*, which is also a glabrous frutescent herb, by the bluish purple flowers and the 2 lateral sepals, and also from *I. bonii* Hook. f. by the branching stems, the saccate lip and the non-sulcate seeds.

This species is a calciphile growing in shady rocky places. The Saraburi plant without flowers cited above is doubtfully referred here.

34. *I. parishii* Hook. f. Fl. Brit. Ind. 1 : 456. 1874, in Rec. Bot. Surv. Ind. 4 : 30 & 34. 1905 ; Craib, Fl. Siam. Enum. 1 : 212. 1926.

A succulent erect glabrous herb with whitish flowers. Leaves alternate, ovate or ovate-lanceolate, up to 21 cm long, 9.5 cm wide, crenate-serrate on margin, often biglandulose at base ; lateral nerves 7-9-paired ; petioles up to 7 cm long ; stipular glands absent. Flowers axillary, solitary pendulous ; pedicels filiform, 2-2.5 cm long, with minute bracts at base, lateral sepals 4, the 2 outer ones orbicular or dimidiate-ovate, 12 mm long, 11 mm wide, the 2 inner ones oval, 1-1.5 mm long ; lip funnel-shaped, 6 mm deep, 13 mm across the mouth, the spur gourd-shaped, 5 mm long, erect, subbasal, slightly bifid at apex ; standard elliptic, about 12 mm long, the costa winged on the lower half ; wing-petals connate but bifid at apex, the dorsal lobe oblong, the basal ones fan-shaped. Ovary glabrous. —Rocky places including limestone outcrops ; 380-1000 m alt.

THAILAND. Chiang Rai : foot of Doi Tam Tu Pu, Me Kok, near Chiang Rai, H. B. G. Garrett 179—cited in Craib, l. c. (BKF).

Distr. Lower Burma.

Since only one specimen has been available, determined by Craib (1926) as *I. parishii*, I do not yet understand the variation of this species. Contrary to Hooker's explanation (1905), this specimen has 4 lateral sepals. The short gourd-shaped spur subbasally adnate is peculiar to this species.

Craib (1926) reports that it grows on limestone rocks in Maharat and Kamphaeng Phet, too.

35. *I. peltata* Hook. f. in Kew Bull. 1911 : 249, with fig. ; Ridley, Fl. Malay Penin. 1 : 339. 1922, in nota ; Craib, Fl. Siam. Enum. 1 : 213. 1926.

Distr. Lower Thailand.

No specimen of the present species has been available. According to Hooker (1911), it is characterized by 'peltately attached petioles and a stiff, suberect, spiniform spur of the lip'.

36. *I. racemosa* DC., Prodr. 1: 688. 1824; Hook. f., Fl. Brit. Ind. 1: 479. 1874, in Rec. Bot. Surv. Ind. 4: 6, 15, 16, 21, 31 & 35. 1905; Craib, Fl. Siam. Enum. 1: 213. 1926; Hara, Fl. East. Himal. 196. 1966.

Stems erect, glabrous, 20–35 cm tall. Leaves alternate, lanceolate, crenate on the margin with bristles in the sinuses of the crenatures, up to 5.5 cm long, 1.5 cm wide, glabrous on both sides, shortly petiolate; stipular glands sometimes present. Racemes in the upper leaf axile, paniculate, 3–6 cm long, glabrous, 5–10-flowered; peduncles 2–3 cm long, ebracteate. Flowers small, yellow; pedicels up to 1 cm long, bracteate at base, the bracts oval, 1.5 mm long, aristate at apex; lateral sepals 2, oblique-ovate, 1.5 mm long, glabrous, uniglandulose on one side in the upper part, awned at apex; lip funnel-shaped, 3 mm across the mouth, apiculate at apex, 1.5 cm deep, usually long-spurred but sometimes spurless, the spur 7–8 mm long; standard 3.5 mm long, narrowly winged on the costa; wing-petals connate. Capsules linear-clavate, 12–15 mm long, glabrous. Seeds obovoid, compressed, 2 mm long, rugulose.

THAILAND. Chiang Mai: Doi Angka, Pa Ngem, North Peak, 2160 m alt., H. B. G. Garrett 83—cited in Craib, l. c. (BKF).

Distr. South Tibet, Himalaya (Kashmir to Sikkim), Khasia, Burma and North Thailand.

Craib (1926) mentions two Thai localities of this species, viz. Doi Chiang Dao and Doi Angka (Doi Inthanon).

The seeds of this species were found to have two kinds of hair; one granulate and the other spiniform.

37. *I. walleriana* Hook. f. ex Oliver, Fl. Trop. Afr. 1: 302. 1868; Gilg in Engler Bot. Jahrb. 43: 118. 1909.

I. sultani Hook. f. in Curtis Bot. Mag. t. 6643. 1882.

I. holstii Engl. & Warb. ex Engl. in Abh. Preuss. Akad. Wiss. 46 & 53. 1894; Engl., Pflanzw. Ost.-Afr. C254. 1895; Hemsl. in Curtis Bot. Mag. 131, t. 8029. 1905.

Glabrous. Stems succulent, decumbent below, often branching. Leaves alternate, crowded on the upper part of stem, ovate, acuminate toward apex, decurrent at base, 5–10 cm long, 2–5 cm wide, serrate, sparingly glandulose at base as well as on petiole; lateral nerves 6–9-paired; petioles shorter than 3 cm long; stipular glands conspicuous. Racemes axillary, 1–2-flowered; peduncles 2–4 cm long; pedicels 2–2.5 cm long, bracteate at base, the bracts linear-ovate, 2–3 mm long. Flowers violet; lateral sepals 2, ovate, acuminate, 3 mm long; lip boat-shaped, 12 mm across the mouth, apiculate, long-spurred, the spur 3.5 cm long; standard cordate, 15 mm long, 20 mm wide, the costa winged, apiculate at apex; wing-petals separate, 22 mm long, deeply bilobed, the lobes obovate, nearly same in size and shape. Capsules turgid in the middle, glabrous. Seeds obovoid, compressed, with hairs of spiral pattern. —Open rocky places, 0–1500 m alt.

MALAYSIA. Penang: Water-fall Botanic Garden, M12966 (KYO). Perak: Maxwell's Hill, J. Sinclair & Kiah 38754 (SING), Hardial & Samsuri 279 (SING). Pahang: Cameron

Highlands, A. Vesterdal 311 (SING), M13704 (KYO).

Distr. Tropical Africa.

The present African species has not been reported to be wild in the Malay Peninsula. J. Sinclair and Kiah determined their specimen No. 38754 as *I. holstii*. Identical specimens were found among our own collections and also among those preserved in SING. Although I could not see the original description and any African specimens of *I. holstii*, the material at hand agrees well with Hemsley's explanation of the species, except in flower color. Hemsley says it has 'flowers pure scarlet', while our specimens have pink flowers. On the other hand, Gilg (1909) discussed the variation of *I. holstii* and also of *I. sultani*, and reduced these species to synonymy under *I. walleriana*, when he pointed out that the flowers of *I. holstii* would vary in color to a great extent, viz. white, white-red, rose, cinnabar, violet and orange-red. Therefore, I adopt the name *I. walleriana* for the specimens cited above.

It grows in the famous tourist-visited places in the Malay Peninsula, viz. Isl. Penang, Maxwell's Hill, and Cameron Highlands. Probably it has escaped and naturalized during the last 30 or so years.

38. *I. garrettii* Craib in Kew Bull. 1926 : 160 ; Fl. Siam. Enum. 1 : 210. 1926.

Stems 20 cm tall, glabrous. Leaves alternate, ovate-oblong to oval, membranaceous, acute to acuminate toward apex, round to cuneate at base, crenate on margin, marginally 2-3-spinulose-glandulose on both sides near base, pubescent with scurfy hairs above, glabrous beneath ; lateral nerves 9-11-paired ; petioles up to 1.5 cm long, glabrous ; stipular glands absent. Racemes axillary in the upper leaf axiles, 2-3-flowered ; peduncles 1-2.5 cm long, puberulous near base, ebracteate ; pedicels 5-8 mm long, glabrous, bracteate at base, the bracts linear-lanceolate, 2-3 mm long. Flowers violet ; lateral sepals 2, ovate, 4-5 mm long ; lip boat-shaped, 10 mm across the mouth, attenuate toward spur, the spur 3 cm long ; standard ovate, 6 mm long, 5 mm wide, the costa winged in the middle ; wing-petals 2.2 cm long, separate. Capsules glabrous. Seeds unknown. — Moist places ; 1300-1500 m.

THAILAND. Chiang Mai : Doi Angka, Pa Ngem, north slopes, H. B. G. Garrett 94 — isotype (BKF).

Distr. Endemic.

39. *I. mengtzeana* Hook. f. in Nuov. Arch. Mus. Par. sër. IV, 10 : 256. 1908, in Lecomte, Fl. Gén. Indo-Chine 1 : 613. 1911, in key ; Craib in Kew Bull. 1911 : 25, Fl. Siam. Enum. 1 : 211. 1926.

Stems fleshy, creeping and radicant below, ascendent upward, 20-50 cm tall, glabrous. Leaves alternate, obovate or lanceolate, acute toward apex, attenuate on to petiole at base, 3.5-8 cm long, 1-3 cm wide, crenate on margin, sometimes 2-3-spinulose-glandulose near base, glabrous ; lateral nerves 5-8-paired ; petioles up to 2.5 cm long, the upper the shorter to be indistinct ; stipular glands absent. Racemes axillary, 1-2-flowered ; pedun-

cles 3-5 cm long, ebracteate; pedicels 10-25 mm long, bracteate at base, the bracts ovate-lanceolate, 7 mm long, 2 mm wide; lateral sepals 2, orbicular-ovate, about 10 mm long, 8 mm wide, apiculate at apex; lip funnel-shaped, 20 mm deep, 18 mm across the mouth, apiculate at apex, attenuate toward spur, the spur 15-20 mm long, incurved; standard nearly orbicular, 13 mm tall, cordate at apex; wing-petals separate, 3 cm long, the distal lobes oblong, 15 mm long, 10 mm wide, with prominent auricle at base, the basal lobes orbicular, 10 mm across. Capsules linear, elongate, glabrous. Seeds unknown.—In or by streams; 600-1300 m alt.

THAILAND. Chiang Mai: Doi Pa Mawn, an easterly spur of Doi Angka, H. B. G. Garrett 311 (BKF); Ban Yang, at middle elevation of Doi Inthanon, T2455 (BKF, KYO, SHIN).

Distr. Yunnan.

This yellowish-flowered species grows in water, at stream-sides or by waterfalls. When some authentic material from Yunnan is available, a comparative examination should be made.

40. I. oncidiioides Ridley ex Hook. f. in Kew Bull. 1909: 11; Ridley, Fl. Malay Penin. 1: 337. 1922; Henders., Malay. Wild Fl. pt. 1, 51, f. 43. 1949.

Stems simple, glabrous. Leaves alternate, crowded on the upper part of stem, lanceolate, submembranaceous, 8-17 cm long, 3-6 cm wide, crenate, acuminate toward apex, cuneate at base, slightly pubescent above, glabrous beneath; lateral nerves 7-11-paired; petioles 1-4 cm long, sparsely spinulose-glandulose; stipular glands absent. Racemes axillary, 2-3-flowered; peduncles about 5 cm long, glabrate. Flowers bright-yellow; pedicels 1-2 cm long, bracteate at base, the bracts linear-oblong, 8 mm long; lateral sepals 2, ovate, oblique, about 10 mm long, apiculate at apex; lip boat-shaped, 15 mm across the mouth, with long spur 3.5-4 cm long; standard ovate, 10 mm tall, 7 mm wide, the costa thickened, mucronate at apex; wing-petals large, separate, 3 cm long, the distal lobes dimidiate-cordate, 2 cm wide, much larger than the basal ones. Capsules turgid in the middle, glabrous, 1.5-1.7 cm long. Seeds globose, brownish, smooth, 1.5 mm across. — Edge of the forest; 1000-2000 m alt.

MALAYSIA. Perak: Gunong Kerbau, H. C. Robinson s.n. — cited in Ridley l.c. (SING), Haniff 3903 (SING); Biyong Malacca, Ulu Palas, C. Curtis s.n. (SING). Selangor: Mennang Gasing Langet, C. B. Kloss s.n. — cited in Ridley l.c. (SING); Gunong Mengkuang, H. C. Robinson s.n. — cited in Ridley l.c. (SING). Pahang: Cameron Highlands, M. Togashi 6222139 (KYO), M. R. Henderson 11646 & 17818 (SING), H. M. Burkill 846 (SING), J. Sinclair 9957 (SING), M13703, M13309 & M13477 (KYO, SHIN); Fraser's Hill, G. Hose s.n. (SING), J. H. Burkill & R. E. Holttum 8589 & 8943 (SING), J. W. Purseglove 4175 (SING), M. R. Henderson 11305 (SING); Telom, H. N. Ridley 13559 — cited in Ridley l.c. (SING); Lubok Tamang, M. R. Henderson 10940 (SING).

Distr. Endemic.

41. *I. longiloba* Craib in Kew Bull. 1926 : 161, Fl. Siam. Enum. 1 : 211. 1926.

Glabrous. Stems decumbent below, ascendent above, ramose. Leaves alternate, chartaceous, oblong-elliptic, acuminate toward apex, cuneate at base, 3–11 cm long, 1.2–5 cm wide, crenate, spinulose in the sinus of teeth, spinulose-glandulose near base; petioles 3 cm long to nearly absent; stipular glands present. Racemes axillary, 3–5 cm long, glabrous, 2–4-flowered, ebracteate. Flowers yellow; pedicels 1–1.5 cm long, bracteate; the bracts boat-shaped, 3.5–4 mm long, 3 mm wide, apiculate at apex, caducous; lateral sepals 4, the 2 outer ones ovate, 6 mm long, 4 mm wide, mucronate at apex, truncate at base, the 2 inner ones subulate, 4 mm long; lip saccate with oblique mouth, 8 mm long across the mouth, attenuate toward spur, about 3 cm long including the spur; standard ovate, 11–13 mm tall, 8 mm wide, the costa narrowly winged, rounded at apex; wing-petals 2.5 cm long, bilobed, the distal lobes lorate, elongate, 4 times longer than the basal lobes. Capsules linear, glabrous, 25 mm long. Seeds globose, 3 mm long, minutely granulate. —Mossy forest; 1000–2000 m alt.

THAILAND. Chiang Mai : Doi Angka, Pa Ngem, North Peak, H. B. G. Garrett 72——isotype (BKF), A. F. G. Kerr 6298——isoparatype (SING). Chiang Rai : Doi Pa Hom Pok, NW of Phan, T9613 (BKF, KYO, SHIN).

Distr. Endemic.

This is a yellow-flowered species characterized by the caducous bracteoles and the elongate distal lobes of the wing-petal. In this respect, it is very near to *I. stenantha* Hook. f. of East Himalaya, from which it is distinguished merely by the broader boat-shaped bracteoles and the apiculate lip at the mouth tip. The bracteoles of *I. stenantha* are setaceous and the lip is awned at the tip. The seeds are minutely granulate. It is also true of the East Himalayan specimens of *I. stenantha* which were examined by Hara and others, 6306739 (KYO).

I. stenantha is a temperate plant growing above 1500 m in altitude in Himalaya (Hara 1966) and *I. longiloba* is an inhabitant of the higher elevation of North Thailand.

42. *I. jurpia* Hamilt. ex Hook. f. & Thoms. in Jour. Linn. Soc. 4 : 140. 1860; Hook. f., Fl. Brit. Ind. 1 : 471. 1874, in Rec. Bot. Surv. Ind. 4 : 14, 20, 30 & 35. 1905; Toppin in Kew Bull. 1920 : 359. 1920; Craib, Fl. Siam. Enum. 1 : 210. 1926; Hara, Fl. East. Himal. 196. 1966.

Stems erect, simple, 60–120 cm tall, frutescent, glabrous or pubescent. Leaves alternate, ovate- or elliptic-lanceolate, caudate-acuminate toward apex, round to cuneate at base, glabrous to hispidulous on both sides, crenate, marginally biglandulose near base, 5–12 cm long, 2–5 cm wide; petioles up to 6 cm long, the upper the shorter, glabrous or pubescent, sometimes 1–3-glandulose; stipular glands absent. Racemes axillary, glabrous or pubescent, 4–8-flowered; peduncles 1–3 cm long; pedicels up to 2 cm long, bracteate at base, the bracts boat-shaped, 2.5–3 mm long, caducous. Flowers mottled with yellow and orange; lateral sepals 4, the 2 outer ones dimidiately orbicular-ovate, 2.5–4 mm long,

mucronate at apex, the 2 inner ones very minute; lip saccate, 15–20 mm deep and so across the mouth, apiculate at apex, the spur short, hooked; standard orbicular, 16–18 mm long and so wide, usually spurred behind, the spur 5–6 mm long; wing-petals 3.5 cm long the distal lobes oblong, 2 cm long, the basal lobes orbicular, 1 cm or so across. Capsules linear-clavate, 3 cm long, glabrous. Seeds rugulose. —Open or closed marshy places; 1200–1900m alt.

THAILAND. Chiang Mai: Doi Angka, range of the Pa Ngem Appiorok, H. B. G. Garrett 48—cited in Craib, l.c. (BKF); Doi Inthanon, middle elevation, T2624 (KYO).

Distr. E. Himalaya, Khasia and Upper Burma.

Hooker and Thomson (1860) and Hooker (1874) mention that the lateral sepals of this species are minute. Also the specimens available, viz. Birsh Hill, Darjeeling, H. Hara & M. Togashi 2991 (KYO, TI) and Farm pauding, Chakanpil, Darjeeling, J. M. Cowan s.n. (SING), show the small ovate lateral sepals, 3.5–4 mm and 2–2.5 mm long, respectively. Garrett 48 with lateral sepals 3.5–4.5 mm long is surely referable to *I. jurpia*, as Craib determined. However, T2642 has larger sepals extending to 7 mm long. Since both the Thai specimens from Doi Inthanon (Doi Angka) are represented by only one sheet with few flowers, variation of the floral size is unknown. On the other hand, Garrett 48 was found to have very minute inner sepals, contrary to the explanation of Toppin (1920). The Thai specimens are nearly glabrous on the leaves and also on the inflorescences, while the Indian plants are more or less pubescent. The seeds from the specimen T2624 are rugulose without hairs.

43. *I. jurpioides* T. Shimizu in Acta Phytotax. Geobot. 24: 39. 1969.

Stems erect but procumbent and radicant below, simple, 50 cm tall, glabrous but pubescent on the upper parts. Leaves alternate, ovate-lanceolate, caudate-acuminate toward apex, rounded to cuneate at base, 5–10 cm long 2–4 cm wide, hirsute on both sides, crenate-serrate on margin, stipitate-biglandular near base; lateral nerves 6–8-paired; petioles up to 4 cm long; stipular glands absent. Racemes axillary, 3–8-flowered, glabrous peduncles 2–3 cm long. Flowers orange-yellow; pedicels up to 3 cm long, bracteate at base; the bracts boat-shaped, 3 mm long; lateral sepals 4, the 2 outer ones dimidiately ovate to orbicular, 10–12 mm long, 9–10 mm wide, the 2 inner ones triangular, 0.7 mm long and as wide; lip saccate, 2 cm deep, 2 cm across the mouth, the spur short, hooked; standard orbicular, 18 mm tall, 16 mm wide, the costa spurred behind; wing-petals separate, 3.3 cm long, 2 cm wide, the distal lobes obovate, 28 mm long, dimidiately emarginate at apex, distinctly auricled at base, the basal lobes orbicular, 12 mm across, smaller than the distal ones. Ovary glabrous. Seeds unknown. —Mossy evergreen forest; 2300 m alt.

THAILAND. Chiang Rai: Doi Pa Hom Pok, NW of Phan, T9687—type (KYO; isotype in BKF & SHIN).

Distr. Endemic.

This species is very near to the previous one. The key character on which both are separated is merely the size of the lateral sepals. The above cited specimens are all having larger lateral sepals up to 10–12 mm long. In this respect, the specimen T2642, referred to the previous species, is an intermediate. Another ally from Assam, *I. laevigata* Wall., has larger bracts than the present species.

44. *I. claviger* Hook. f. in Hook. Ic. Pl. 29: t. 2863. 1908, in Kew Bull. 1909: 12, in Lecomte, Fl. Gén. Inde-Chine 1: 627. 1911; Craib, Fl. Siam. Enum. 1: 210. 1926.

An erect frutescent glabrous herb. Leaves alternate, obovate or oblanceolate, 5–18 cm long, 3–7.5 cm wide, glabrous on both sides, remotely crenate on margin, marginally biglandulose at base, acute toward apex, cuneate at base; lateral nerves 5–6-paired; petioles up to 2 cm long; stipular glands absent. Racemes axillary, paniculate, many-flowered; pedicels up to 2 cm long, bracteate at base, the bracts caducous. Flowers whitish with reddish stripe; lateral sepals 4, the 2 outer ones broadly dimidiate-ovate, mucronate at apex, about 12 mm long, the inner ones linear, longer than the outer, about 17 mm long; lip saccate, 2–2.5 cm long, 2 cm across the mouth, the spur 1 cm long, incurved but not hooked; standard obovate, 2 cm long emarginate at apex, the costa gibbose on the upper part. Capsules clavate, glabrous. Seeds unknown. —Marshy ground.

THAILAND. Chiang Mai: Doi Chiang Dao, P. Suvarnakoses 1045 (BKF, SHIN).
Distr. Tonkin.

This is a tall frutescent plant characterized by the obovate leaves and the large flowers with 4 lateral sepals.

It is one of few examples in which *Impatiens* species occur both in Thailand and Indo-China.

45. *I. damrongii* T. Shimizu in Acta Phytotax. Geobot. 24: 38. 1969.

Stems erect, simple, stramineous, glabrous, 60 cm or so tall, radican from the lower nodes. Leaves alternate, chartaceous, glabrous, oblong-lanceolate, acute to attenuate-acuminate toward apex, cuneate at base, 7–12 cm long, 2–4 cm wide, remotely crenate on margin, marginally biglandular at base; lateral nerves arcuate, 6–7-paired; petioles up to 5 cm long, gradually shorter upward; stipular glands absent. Racemes axillary, glabrous, 1–3-flowered; peduncles 1–4 cm long. Flowers yellowish; pedicels 1–1.5 cm long, bracteate at base, the bracts ovate, 8 mm long, 4 mm wide, crenulate, embracing the pedicel; lateral sepals 4, the 2 outer ones obliquely orbicular-ovate, 18 mm long, 11 mm wide, membranaceous, 3–4-crenulate-glandulose, mucronate at apex, the 2 inner ones linear, 20 mm long, 3 mm wide; lip funnel-shaped, 1.5 cm deep, 2.5 cm across the mouth, apiculate at apex, the spur 7 mm long, hooked; standard cordate, 2 cm tall, 2.5 cm wide, the costa shortly spurred; wing-petals separate, 3 cm long, 15 mm wide, the distal lobes oblong, larger than the basal ones. Capsules elongate, clavate, 3 cm long, glabrous. Seeds ellipsoid, bisulcate, 5 mm long, smooth, glabrous. —Mossy evergreen forest; 1200–1650 m alt.

THAILAND. Phitsanulok: one of the highest peaks of Phu Miang, T11634—type (KYO; isotype in BKF & SHIN).

Distr. Endemic.

Since this species is characterized by narrowly clavate capsules, glabrous seeds, few-flowered racemes and glandular sepals, it comes nearest to *I. wallichii* Hook. f. from East Himalaya. According to Hooker (1904), however, this has membranaceous leaves and saccate lips. The leaves of the present species are chartaceous, and the lip funnel-shaped.

This is an inhabitant of the mossy evergreen forest.

46. *I. opinata* Craib in Kew Bull. 1926: 163, Fl. Siam. Enum. 1: 212. 1926.

I. foxworthyi Henders. in Gard. Bull. S. S. 4: 50. 1927, 5: 94. 1930; in Jour. Malay. Branch. Roy. As. Soc. 17: 38. 1939.

Succulent, glabrous. Leaves alternate, crowded on the upper part of stem, broadly ovate to elliptic, 3–12 cm long, 2–6.5 cm wide, crenulate; lateral nerves indistinct, few-paired; petioles up to 7 cm long. Racemes axillary or subterminal, protruding, more than 30 cm long, branching, many-flowered; pedicels 0.5–2 cm long, conspicuously bracteate at base; the bracts orbicular, 2–3 mm long, persistent. Flowers yellow; lateral sepals 4, the 2 outer ones ovate-orbicular, 6–8 mm long, 5–6 mm wide, the 2 inner ones linear, 4–7 mm long; lip funnel-shaped, 1 cm across the mouth, the spur 7–8 mm long, incurved; standard ovate, 8 mm long, the costa prominent at base; wing-petals 15 mm long, connate but bifid at apex, punctate with black-purple spots, the basal lobes larger than the distal ones, stipitate. Capsules clavate, glabrous, 12 mm long. Seeds globose, 1.8 mm long, sulcate, pustulose. —On limestone under the forest; 30–300 m alt.

THAILAND. Pattani: Banang Sta, A. F. G. Kerr 7304—(isotype (BK), photo. MALAYSIA. Pahang: Gunong Senyum, M. R. Henderson 22374 (SING); Bukit Sagu, M. R. Henderson 25087 (SING). Kelantan: Gua Panjang, Gua Ninik, M. R. Henderson 19558 & 19509 (SING), UNESCO Limestone Exped. 535, 580 & 602 (SING); Gua Musang, UNESCO Limestone Exped. 5 & 491 (SING), M14355 (KYO).

Distr. Endemic.

The present species is characterized by elongate protruding racemes and yellow flowers with black-purple spots. Though I have only a photograph of the type specimen of *I. opinata*, its description agrees well with the specimens hitherto referred to *I. foxworthyi* cited above. From the specimen, Henderson 25087, pustulose seeds with hairs of spiral pattern were seen.

It is confined to limestone as noted by Henderson (1939).

47. *I. mirabilis* Hook. f. in Curtis Bot. Mag. 117: t. 7195. 1891; King in Jour. Beng. As. Soc. 62 (2): 203. 1895; Hook. f. in Kew Bull. 1892: 187; Williams in Bull. Herb. Boiss. sér. 2, 5: 223. 1905; Hook. f. in Rec. Surv. Ind. 4: 45 & 55. 1906, in Kew Bull. 1909: 10; Ridley, Fl. Malay. Penin. 1: 337, f. 34. 1922; Craib, Fl. Siam. Enum. 1: 211. 1926; Henders.

in Jour. Malay. Branch Roy. As. Soc. 17 : 38. 1939, Malay. Wild Fl. pt. I, 52, f. 44. 1949.

Fleshy, glabrous, perennial. Stems columnar, branching, scarred. Leaves crowded on the top of branch, ovate to obovate 6-25 cm long, 4-15 cm wide, acute toward apex, cuneate at base, crenate, long petiolate; petioles 3-15 cm long. Racemes axillary, branching, many-flowered; pedicels 1-2 cm long, bracteate at base; the bracts orbicular, apiculate 5-6 mm long; lateral sepals 4, the 2 outer ones orbicular-ovate, 10-12 mm long, 8-10 mm wide, mucronulate at apex, the 2 inner ones linear-lanceolate, 1.5-2.5 mm long; lip hemispheric, 17 mm across the mouth, the spur 1.5 cm long, incurved; standard orbicular, 13-15 mm tall, retuse at apex, the costa winged on the lower half; wing-petals connate, 3 cm long, the distal lobes oblong, the basal orbicular. Capsules clavate, glabrous. Seeds unknown. —Sunny limestone cliffs at lower elevation.

THAILAND. Puket: Trutow, C. Curtis 1678 —isotype (SING), W. Fox s.n. —cited in Craib, l.c. (SING). Nakhon Si Thammarat: Ton Song, Haniff & Nur 4278 —cited in Craib, l.c. (SING). MALAYSIA. Perlis: Langkaw Islands, C. Curtis s.n. (SING); Tebing Tinggi, M. R. Henderson 23023 (SING).

Distr. Endemic.

It is worth noting that, contrary to Hooker's statement (1891, 1906, 1909), I could detect two inner sepals, minute and linear-ovate, in the isotype specimen Curtis 1678, and also in Haniff & Nur 4278. The others are too poor for precise examination.

This is also a limestone species which is nearest related to the previous species.