THE GENERA CYNANCHUM AND VINCETOXICUM  
(APOCYNACEAE–ASCLEPIADOIDEAE) IN MALESIA

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SUMMARY

The genera Cynanchum and Vincetoxicum are revised for the Flora Malesiana area. For Cynanchum, nine species are recognized and one new subspecies is described. For Vincetoxicum, only one species, the widespread V. carnosum, occurs in the area. Five published species of Cynanchum have to remain obscure, because the types most likely got destroyed in Berlin.

Key words: Cynanchum, Vincetoxicum, Malesia.

INTRODUCTION

For a long time, the relationships of Cynanchum and Vincetoxicum were not resolved and the two genera were merged or split depending on the preference of the author. Lately, clear evidence has been produced that Cynanchum and Vincetoxicum are entirely unrelated (Liede, 1996). Both genera belong in the tribe Asclepiadaceae; the large genus Cynanchum is the centre of the subtribe Metastelminae, while Vincetoxicum is most closely related to Tylophora R.Br. and a member of the Astephaninae, a subtribe characterized by the possession of clear latex and long, slender trichomes on the adaxial side of the corolla lobes (Liede, 1997). Liede (1994) recognized that V. carnosum was not a member of Cynanchum, but as the position of Vincetoxicum was by no means clear at this point, she placed the species in Pentatropis. This placement is supported by the contorted aestivation of V. carnosum and its preference for maritime habitats. However, the species lacks the defining character of Pentatropis, anther wings extending along the basal margin of the anther. Until further analyses will provide new insights, it seems therefore preferable to consider V. carnosum an aberrant species of Vincetoxicum.

The nine species of Cynanchum in the Flora Malesiana area all belong to sect. Cynanchum, characterized by strongly developed interstaminal corona parts (Ci). Cynanchum ovalifolium is widespread in the whole area and extends as far north as China (Li et al., 1995, as C. formosanum) and as far south as Australia. The other eight species are more restricted in distribution. It is not yet clear whether C. muricatum and C. corymbosum are conspecific, because flowering material of C. muricatum is restricted to a single bud on the type specimen. The distribution of C. corymbosum in Indochina and Peninsular Malaysia and of C. muricatum in Thailand and Java suggests this possibility.
The western border of *Cynanchum* is not yet established with certainty. At present, only *C. ovalifolium* has been found W of Timor, and *C. hoedimeerium* subsp. *timorense* establishes the western border of the Malesian species. However, as *C. neopommeranericum* from the Bismarck Archipelago belongs to the uncertain species, and there are several sterile collections from Flores which might well represent members of *Cynanchum*, this question has to remain unresolved until better material becomes available.

**MATERIALS AND METHODS**

Specimens were studied from the following herbaria: B, CAHUP, FI, G, K, L, P, PNH, S, TI, UPS-Thun, US.

The dimensions given in the descriptions are for dried material except for corona and gynostegium characters, that were measured after the flowers had been rehydrated.

'Stipules' designate leaflets in the position of true stipules, but constituting much reduced axillary short shoots according to Dr. W.D. Stevens (pers. comm.). 'Stipules' occur in many, but not all species of *Cynanchum* and constitute a valuable field character. Corona terminology according to Liede & Kunze (1993). The following abbreviations are used: Cs = staminal corona parts; Ci = interstaminal corona parts; C(is) = corona consisting of fused staminal and interstaminal corona parts.

**SYSTEMATIC TREATMENT**

*CYNANCHUM*


*Plants* scrambling or twining, leafy, glabrous or covered with multicellular trichomes, containing opaque, white to yellow latex. Stems usually green, often basally corky. *Leaves* petiolate, with 1–12 colleters, entire, ovate, obovate or elliptical, often basally cordate or reniform. *Inflorescences* extra-axillary, few- to multi-flowered, cymose to sciadioidal. *Floral buds* of various shapes; aestivation dextrorse, imbricate or contorted. *Flowers* 3–15 mm diam., frequently sweetly scented, nectariferous. *Corolla* rotate to tubular, white, yellow, green, or (reddish-)brown; adaxially glabrous or with short, verrucose trichomes. *Corona* gynostegial, white, rarely red, as high as or higher than the gynostegium, consisting of fused staminal (Cs) and interstaminal (Ci) parts; none of the Malesian species possesses an adaxial appendage (ligule). *Gynostegium* sessile or stipitate. *Anthers* with apical appendages and clearly differentiated lateral anther wings, the latter normally consisting of a proximal and a distal ridge; space between ridges mostly filled with upwardly oriented bristles; proximal ridge curved. *Pollinia* pendulous. *Stylar head* forming a protrusion at the upper end of the corpusculum;
part above this protrusion (upper part) flat, conical or umbonate. *Follicles* usually one per flower, thin-walled, winged or wingless, smooth or with protuberances, glabrous or with trichomes, often finely longitudinally striate. *Seeds* pyriform or ovate, brown, smooth, sculptured, papillate or with trichomes, winged or wingless, with coma. *Chromosome number* usually 2n = 22.

Worldwide distributed genus of more than 300 species. Here, only literature and synonyms for Malesian species have been included into the references.

**KEY TO THE MALESIAN SPECIES**

1a. Gynostegium highly stipitate (stipe at least half as long as the gynostegium), inflorescences richly branched, many-flowered .......................... 3. *C. dimidiatum*
b. Gynostegium sessile or stipe much shorter than gynostegium, inflorescences sparsely branched, few-flowered ................................................................. 2

2a. Leaves basally truncate, rounded or slightly heart-shaped ........................................... 3
b. Leaves basally reniform ........................................... 5

3a. Corolla lobes adaxially densely pubescent, follicles globose, inflated ............................... 8. *C. physocarpum*
b. Corolla lobes adaxially glabrous, leaves (sub)coriaceous ........................................... 4

4a. Leaves at least twice as long as broad, corona not complexly folded, caudicles cylindrical (follicles unknown) ........................................... 1. *C. celebicum*
b. Leaves less than twice as long as broad, corona complexly folded, caudicles follicles ellipsoid, thick-walled ........................................... 7. *C. ovalifolium*

5a. Follicles densely covered with long soft spines ........................................... 6
b. Follicles smooth or tuberculate, winged or wingless, but not with long soft spines ..................... 7

6a. Gynostegium sessile, follicles strongly beaked ........................................... 2. *C. corymbosum*
b. Gynostegium stipitate, follicles acute, but not beaked ........................................... 6. *C. muricatum*

7a. Follicles tuberculate, but not winged ........................................... 9. *C. tuberculatum*
b. Follicles smooth, winged ........................................... 8

8a Corolla lobes abaxially conspicuously hispid ........................................... 4a. *C. hoedimeerium* subsp. *hoedimeerium*
b. Corolla lobes abaxially (almost) glabrous ........................................... 9

9a. Seeds with patchily distributed trichomes ........................................... 4b. *C. hoedimeerium* subsp. timorense
b. Seeds smooth ........................................... 5. *C. loheri*

1. *Cynanchum celebicum* Schltr. — Fig. 1

*Cynanchum celebicum* Schltr., Repert. Nov. Spec. 3 (1907) 305. — *Type*: Warburg 16818 (holo Bt), Indonesia, Celebes, Tjamba Manipi; neotype (here designated): Kjellberg 2106 (S), Indonesia, Celebes, Karebbe, 15 Aug. 1929.

*Plants* ascending, twining. *Shoots* perennial, herbaceous, glabrescent, sparsely covered along a single line with appressed trichomes, 150–200 μm long. Internodes 15–20 cm long, 1.5 mm diam. *‘Stipules’* ovate; 8–10 mm long; 6–8 mm wide. *Leaves* with petiole 8–20 mm long, collerters absent; *leaf* blades coriaceous, discolorous, blades 60–80 mm long, 20–30 mm wide, oblong to ovate, basally rounded, blades adaxially and
Fig. 1. *Cynanchum celebicum* Schltr. a. Branch with inflorescences; b. flower; c. corona; d. gynostegium; e. pollinarium; f. stylar head (from Kjellberg 2106). — Drawn by Ulrike Frensch.
abaxially glabrous. *Inflorescences* always one per node; extra-axillary; 3–6-flowered, 2–4 flowers open synchronously, sciadioidal. *Peduncles* 20–30 mm long, sparsely covered along a single line with appressed trichomes 150–200 μm long. *Floral bracts* 0.7 mm long, 0.3 mm wide at the base, triangular, with trichomes; pedicels 4–6 mm long, sparsely covered along a single line with appressed trichomes, 150–200 μm long. *Floral buds* 3–4 mm long, 1.5–2 mm diam., ovoid. *Calyx* basally fused; rotate, abaxially glabrous, lobes c. 2.5 mm long, c. 2 mm wide, ovate, apically obtuse. *Corolla* 3.5–4 mm long, green to yellow, lobes almost entirely free, 1.2–1.5 mm wide, incurved, ovate, apically acute. *Gynostegial corona C(is)* white, 1.8–2 mm high, equalling the gynostegium in height, cyathiform, consisting of Cs and Ci fused for more than 3/4 of total corona length, only Cs differentiated; lobes of Cs laminar, ovate, apically erect, with denticulate margins. *Gynostegium* 2.2–2.5 mm high, sessile. *Stamens* with filament of 0.3–0.5 μm height, anthers higher than broad, hexagonal, abaxially biconvex, anther wings 1.3–1.5 μm long, extending along the whole length of the anther, consisting of distal and curved proximal ridge; adjacent anther wings parallel to each other, centrifugal; connective appendages 0.8–0.9 μm long, 1.2–1.3 μm wide; broadly ovate; broader than the stamen, slightly inflexed. *Pollinarium*: corpusculum c. 350 μm long, ovoid, margins of the corpuscular cleft centrally widened; caudicles 150 μm long, (sub)basally inserted at the corpusculum, cylindrical, straight, declinate; pollinia laterally attached to the caudicles, pendulous, c. 850 μm long, c. 250 μm wide, ovate in cross section, ovoid. *Stylar head* white, 1–1.2 mm diam., 0.7–0.8 mm high, upper part 0.4–0.5 mm high, equalling the lower part in height, depressed-conical.

**Distribution** — Malesia: Indonesia: Sulawesi.

**Habitat & Ecology** — In scrub. Flowering: August.

Note — Known only from the neotype collection. The original type (Warburg 16816, B) has been destroyed. The collection matches the description of *C. celebicum* perfectly and is therefore chosen as neotype for the species.

2. *Cynanchum corymbosum* Wight — Fig. 2


*Plants* ascending, twining, richly branched. *Shoots* perennial, herbaceous, densely covered along a single line with recurved trichomes, 375–400 μm long; internodes 8–15 cm long. ‘*Stipules*’ ovate, 37 mm long, 68 mm wide. *Leaves* with 30–70 mm long petioles, 8–12 colleters at the base of the leaves; leaf blades herbaceous, slightly discolored, 40–90 mm long, 25–70 mm wide, ovate, basally lobate (lobes 8–12 mm long), apically acuminate (acumen 2–3 mm long), adaxially and abaxially glabrous. *Inflorescences* one, very rarely two per node, extra-axillary, 10–15-flowered, 4–6 flowers open synchronously, basally dichasial, apically bostrychoid. *Peduncles* 20–60 mm long, sparsely covered along a single line with recurved trichomes, 150–200 mm long; rachis 5–25 mm long. *Floral bracts* 1 mm long, 0.25 mm wide at the base, triangular, with trichomes; pedicels 6–10 mm long, densely covered over the whole surface with flexuous trichomes, 150–200 mm long. *Floral buds* 4 mm long, 2 mm diam., conical. *Calyx* basally fused, abaxially with trichomes; lobes 1.5 mm long,
1 mm wide, ovate, apically acute. Corolla c. 4 mm long, very dark when dry; lobes fused for about 1/4 of total corolla length, patent to declinate, oblong, apically obtuse. Gynostegial corona C(is) 2.5–3 mm high, tubular, exceeding the gynostegium, partly obscuring it, consisting of Cs and Ci fused for more than 3/4 of total corona length, Cs and Ci differentiated, lobes of Cs laminar, triangular, producing a pronounced convex fold along the upper 2/3 of corona height, sulcate, apically erect, with laterally involute margins; Ci a little shorter than Cs, lobes of Ci laminar, triangular, erect. Gynostegium 1.8 mm high, 2 mm diam., sessile. Anthers broader than high, pentagonal, abaxially planar, 0.75 mm long, parallel to each other, extending along the whole length of the anther; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.75 mm long, 0.75 mm wide, equalling the stamen in width, erect. Pollinarium: corpusculum 250 μm long; caudicles 125 μm long, cylindrical, straight, declinate, thickened at the insertion of the pollinium; pollinia apically attached to the caudicles, 375 μm long, 150 μm wide, ovate in cross section, ovoid. Stylar head 0.5 mm diam., 0.37 mm high, upper part 0.175 μm high, umbonate. Follicles one per flower, 7–9 mm long, 8–20 mm diam., obclavate, round in cross section, apically shortly to strongly beaked, densely covered with 5–10 mm long protuberances. Seeds 7–8 mm long, 5 mm wide, ovate, seta side smooth, aseta side sculptured with longitudinal ridges, with patchily arranged trichomes, 250 μm long, marginally with 0.25 mm wide wing with entire, apically denticulate margin.

Fig. 2. Cynanchum corymbosum Wight. a. Leaf; b. flower; c. gynostegium; d. pollinarium; e. fruit (from Pételot 4922). — Drawn by Ulrich Meve.
Distribution — Asia: Thailand, Vietnam; Malesia: Peninsular Malaysia, Singapore.

Habitat & Ecology — Altitude 50–600 m. Flowering: December–January.

Note — The insufficient flowering material of *C. muricatum* does not allow the decision whether it is identical with *C. corymbosum* or whether these two species form two geographically separated sister-species or subspecies. The species is illustrated in Tsiang & Li (1977: 138).

Collections studied: PENINSULAR MALAYSIA. *King 5301* (P), Larut, Perak, 100–160 m, Dec. 1883; *Kerr 13658* (P), Hatgai, ± 50 m, 26 Dec. 1927. — SINGAPORE. *Haniff & Nur 10111* (K), Kuala Krai, Kelantan, 22 Jan. 1923.

3. *Cynanchum dimidiatum* (Hassk.) Boerl. — Fig. 3

*Cynanchum dimidiatum* (Hassk.) Boerl., Handl. Fl. Ned. Ind. 2 (1890) 436. — *Cynoctonum dimidiatum* Hassk., Flora 40 (1857) 98 — Type: *Teijjsman s.n.* (BO, n.v.).

Plants ascending, twining, richly, irregularly branched. Shoots herbaceous, glabrescent, densely covered over the whole surface with flexuous trichomes, 200–300 μm long; internodes 10–20 cm long, 1–1.5 mm diam. ‘Stipules’ ovate, 7–10 mm long, 5–7 mm wide. Leaves with petioles 30–40 mm long, 9 coluters at the base of the leaves; leaf blades herbaceous, 40–80 mm long, 30–65 mm wide, ovate, basally lobate (lobes 8–15 mm long), apically acuminate (acumen 3–5 mm long), adaxially isolatedly covered over the whole surface with flexuous trichomes, 200–300 μm long, abaxially finely papillose (resulting in a pale green colour), isolatedly covered mainly on veins and margins with flexuous trichomes, 200–250 μm long. Inflorescences frondulose, supported by bracts different from the vegetative leaves, 40–50-flowered, 20–25 flowers open synchronously, bostrychoïd, partial inflorescences geminiflorous. Peduncles 30–40 mm long, sparsely covered along a single line with flexuous trichomes, 250–300 μm long; inflorescence bracts 10–20 mm long, 5–8 mm wide, ovate (small versions of normal leaves), papillose and with trichomes; rachis 30–80 mm long; straight. Floral bracts 0.3–0.5 mm long, 0.15–0.25 mm wide at the base, triangular, densely covered with trichomes; pedicels 3–6 mm long, densely covered over the whole surface with flexuous trichomes, 250–300 μm long. Floral buds 1.5 mm long, 1.5 mm diam., globose, with imbricate aestivation. Calyx basally fused, abaxially densely covered with trichomes; lobes 1–1.2 mm long, 0.6–0.7 mm wide, ovate, apically acute. Corolla subglobose, 2–2.5 mm long, abaxially yellow (fide *Iboet 274*); corolla lobes fused for about 1/3 of total corolla length, 1–1.2 mm wide, incurved, oblong, apically obtuse, with revolute margins. Gynostegial corona *C(is)* abaxially glabrous, equaling the gynostegium in height, cyathiform, consisting of Cs and Ci completely fused, annular, with straight, lacerate upper margin, Cs not connate to the filament, appressed to the back of the stamens. Gynostegium 0.6–0.7 mm high, 1.2–1.3 mm diam., atop a stipe of 0.35–0.45 mm length. Stamens without filament; anthers broader than high, rectangular, abaxially planar; anther wings 0.35–0.4 mm long, parallel to each other, not extending along the whole length of the anther; the anther forming a ‘pseudostipe’ of 0.25 mm length; adjacent anther wings parallel to each other, basally widened, in the same plane as the anther; connective appendages 0.4 mm long, 0.4 mm wide, obcordate, narrower than the stamen, strongly inflexed. Pollinarium: corpusculum 200 μm long,
between 1.5 times and twice as long as broad, ovoid; caudicles 75–100 μm long, (sub)basally inserted at the corpusculum, cylindrical, s-shaped, convex-concave, not thickened at the insertion of the pollinium; pollinia laterally attached to the caudicles, 350 μm long, 150 μm wide, ovate in cross section, ovoid. Stylar head 0.75 mm diam., 0.2 mm high, upper part 0.05 mm high, umbonate. Follicles one per flower, 70 mm long, 20 mm diam., obclavate, obtusely deltate in cross section, apically shortly beaked, keeled, black, sparsely covered with 1–1.5 mm long protuberances, sparse indumentum of erect trichomes, 150 μm long. Seeds 7–8 mm long, 5–6 mm wide, ovate, dark brown, seta side sculptured with longitudinal ridges, seta side with regularly arranged papillae, with trichomes arranged in longitudinal ridges, 200–250 μm long, aseta side sculptured with longitudinal ridges, papilllose with regularly arranged papillae, with patchily arranged trichomes, 200–250 μm long, marginally with 0.5–0.7 mm wide wing with denticulate margin; coma 7–10 mm long, brownish.

Distribution — Malesia: Indonesia: Java, Lesser Sunda Islands (Bali, Sumba, Flores), Sulawesi.

Habitat & Ecology — Lower altitudes. Flowering: April–August.


a. subsp. hoedimeerium — Fig. 4

_Cynanchum hoedimeerium_ Bakh.f., Blumea 6 (1950) 369. — Type: Den Hoed & Van der Meer 488 (holo L), Java, Purmerend, 30 April 1940.

_Plants_ ascending, twining. _Shoots_ perennial, herbaceous, sparsely covered along two lines with recurved trichomes, 250 μm long; internodes 8–15 cm long. ‘_Stipules_’ ovate to obovate, 4–5 mm long, 5–6 mm wide. _Leaves_ with petiole 15–25 mm long, 8–10 collaters at the base of the leaves; leaf blades herbaceous, slightly discolorous, 35–50 mm long, 20–35 mm wide, ovate, basally lobate (lobes 5–7 mm long), apically acuminate (acumen 1–3 mm long), adaxially sparsely covered over the whole surface with recurved trichomes, 500 μm long, abaxially isolated to sparsely covered mainly on veins and margins with recurved trichomes, 400 μm long. _Inflorescences_ bostrychoid, 10–15-flowered, 8–10 flowers open synchronously. _Peduncles_ 10–20 mm long, densely covered over the whole surface with recurved trichomes, 150 μm long; rachis 2–3 mm long. _Floral bracts_ 0.7–0.9 mm long, 0.2–0.4 mm wide at the base, triangular, with trichomes; pedicels 4–7 mm long, sparsely covered with recurved trichomes, 150–200 μm long. _Floral buds_ 2 mm long, 1.5 mm diam., ovoid. _Calyx_ basally fused, abaxially with trichomes; lobes 1.5–2 mm long, 0.5–0.7 mm wide, ovate, apically mucronate. _Corolla_ rotate, 2–2.5 mm long, abaxially hispidulous with trichomes, 200 μm long (very characteristic!); lobes basally fused, 1–1.5 mm wide, decline, oblong, apically obtuse. _Gynostegial corona C(is)_ 2 mm high, equaling the gynostegium in height, urceolate, consisting of Cs and Ci completely fused, Cs and Ci differentiated, Ci as long as Cs, thinner than Cs. Cs appressed to the back of the stamens, solid, rectangular; lobes of Ci laminar, rectangular, producing a pronounced doublefold along the upper 2/3 of corona height (so that the central part is closer to the gynostegium than the lateral parts), erect, with emarginate margins. _Gynostegium_ 1.5 mm high, 1.2 mm wide, atop a stipe of 0.5 mm length. _Anthers_ higher than broad, rectangular, abaxially planar; anther wings 1 mm long, parallel to each other, not extending along the whole length of the anther, the anther forming a ‘pseudostipe’ of 0.3 mm length; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.3 mm long, 0.4 mm wide, ovate, equaling the stamen in width, strongly inflexed. _Pollinarium:_ corpusculum 200 μm long, ovoid; caudicles 100 μm long, flattened, straight, declinate, trapezoid; pollinia subapically attached to the caudicles, 260 μm long, 160 μm wide, ovate in cross section, ovoid. _Stylar head_ 1 mm diam., 0.45 mm high; upper part 0.3 mm high, umbonate. _Follicles_ one per flower, 50–60 mm long, 13 mm diam., obclavate, obtusely delinate in cross section, apically strongly beaked, winged (wings 0.5 mm wide), light brown, longitudinally grooved, with sparse indumentum. _Seeds_ 65 mm long, 45 mm wide, ovate, medium brown, seta side sculptured with longitudinal ridges, with patchily arranged trichomes, 250 μm long, aseta side sculptured with longitudinal ridges, with patchily arranged trichomes, 300 μm long, marginally with 500 μm wide wing with entire margin; coma 25 mm long.

_Distribution_ — Indonesia: Java, Sulawesi, Wetar Island.

Note — *Cynanchum hoedimeerium* displays the most complex corona and seed structure of all South-East Asian taxa.

Collections studied: **INDONESIA.** Java: Junghuhn s.n. (L, L 898.166-402); Den Hoed 3107 (L), P. Purmerend (central), 1 Aug. 1948; Backer 8209 (L), Asam Bagoes, 1913; Koorders 42517 (L), Tjabak E of Blora, Res. Rembang, Sept. 1915. Sulawesi: Rachmat 323 (exp. Van Vuuren) (L), Mt Padang, 29 April 1913. Wetar Is.: Dunlop & Leach 9669 (L), Kali Kuning River, S 07° 43', E 126° 16', 17 May 1993.
b. subsp. timorense Liede, subsp. nov.

Ad subspecies typica affinis, sed differt in lobis corollae glabris, lobis coroneae stamina-libus minoribus. — Typus: Walsh 136 (holo BM), Indonesia, Timor, Soë, South Central Timor, 830 m, 25 Feb. 1929.

Plants ascending, twining. Shoots perennial, herbaceous, densely covered over the whole surface with recurved trichomes, 300–400 μm long; internodes 6–10 cm long. ‘Stipules’ ovate, 4–5 mm long, 4 mm wide. Leaves with petioles 5–20 mm long, 5 col-leters at the base of the leaves; leaf blades herbaceous, slightly discolored, 25–45 mm long, 18–28 mm wide, ovate, basally lobate (lobes 3–6 mm long), apically truncate to obtuse, adaxially and abaxially sparsely covered with erect trichomes, 400 μm long. Inflorescences 8–12-flowered, 4–6 flowers open synchronously, bostrychoid. Peduncles 10–15 mm long, densely covered over the whole surface with erect trichomes, 300 μm long; rachis 3–5 mm long. Floral bracts 0.75 mm long, 0.2 mm wide at the base, oblong, with trichomes; pedicels 3–5 mm long, densely covered over the whole surface with erect trichomes, 300 μm long. Floral buds 3 mm long, 2 mm diam., ovoid. Calyx basally fused, abaxially with trichomes; lobes 1.5–2 mm long, 4 mm wide, apically acute. Corolla 3 mm long, with numerous tannin idioblasts; corolla lobes fused for about 1/3 of total corolla length, 1 mm wide, incurved, ovate, apically acute. Gynostegial corona C(is) 1.5 mm high, shorter than the gynostegium, cyathiform, consisting of Cs and Ci completely fused, Cs and Ci differentiated, Ci as long as Cs, thinner than Cs. Cs appressed to the back of the stamens, solid (but thinner than in typical subsb.), rectangular, apically erect; lobes of Ci laminar, ovate, producing a pronounced doublefold along the upper 2/3 of corona height (so that the central part is closer to the gynostegium than the lateral parts), erect, with straight margins. Gynostegium 1.5 mm high, 1.25 mm diam., atop a stipe of 0.5 mm length. Anthers higher than broad, rectangular, abaxially planar; anther wings 0.9 mm long, extending beyond the anther proper, forming a basal arch; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.4 mm long, 0.6 mm wide, obcordate, narrower than the stamens, slightly inflexed. Pollinarianum: corpusculum 225 μm long, ovoid, margins of the corpuscular cleft parallel, basally widened; caudicles 125 μm long, flattened, straight, declinate, trapezoid; pollinia subapically attached to the caudicles, 150 μm long, 125 μm wide, ovate in cross section, ovoid. Stylar head 0.75 mm diam., 0.4 mm high; upper part 0.15 mm high, umbonate. Follicles one per flower, 55–65 mm long, 8 mm diam., obclavate, obtusely deltate in cross section, apically strongly beaked, winged (wings 0.5 mm wide), light brown, isolatedly indumented. Seeds 60 mm long, 40 mm wide, ovate, medium brown, seta and aseta side sculptured with longitudinal ridges, with patchily arranged trichomes, 250–300 μm long, marginally with 500 μm wide wing, with entire margin; coma 25 mm long.

Distribution — Malesia: Indonesia: Timor.
Habitat & Ecology — Flowering: February.

Note — The most obvious distinction from the typical subspecies is the glabrous corolla. As it is found on Timor, where the typical subspecies does not occur, it seems warranted to describe it as new, as subspecies ought to be separated both geographically and by at least one qualitative character.
Fig. 5. Cynanchum loheri Schltr. a. Nodium with infructescence; b. flower; c. corona and gynostegium (frontal part of corona removed); d. pollinarium; e. styal head; f. seed (from Merrill 532).
— Drawn by Jim Conrad.
5. Cynanchum loheri Schltr. — Fig. 5

*Cynanchum loheri* Schltr. in Perkins, Fragm. Fl. Philipp. 1 (1904) 120. — Type: *Loher 4053* (lecto K; designated here), Philippines, Luzon, Luzon Channel.

Plants ascending, twining. Shoots perennial, herbaceous, sparsely covered along two lines with erect trichomes, 250–350 µm long; internodes 15–25 cm long, 1.5–2 mm diam. *Stipules* ovate. Leaves with petiole, 30–40 mm long, 9 colleters at the base of the leaves; leaf blades herbaceous, 80–110 by 50–65 mm, ovate, basally lobate (lobes 1.4–2 mm long), apically acute to acuminate (acumen 3–5 mm long), adaxially and abaxially sparsely to densely covered over the whole surface with erect to appressed trichomes, 250–400 µm long. Inflorescences 4- or 5-flowered, 1 or 2 flowers open synchronously, scacioidal. Peduncles 30–40 mm long, densely covered along a single line with flexuous trichomes, 200–250 µm long. *Floral bracts* 1.5–2 mm long, 0.5 mm wide at the base, elongatedly triangular, with trichomes; pedicels 6 mm long, densely covered over the whole surface with flexuous trichomes, 350–400 µm long. *Floral buds* 2.5–3 mm long, 1.5–2 mm diam., globose to ovoid, with imbricate aestivation. Calyx basally fused, ciliate; lobes 1.2 mm long, 0.4–0.5 mm wide, ovate, apically acute. Corolla 3.5–4 mm long; corolla lobes basally fused, 1–1.5 mm wide, straight, horizontal to decurved, oblong, apically obtuse. Gynostegial corona *C(is)* white to ivory, cyathiform, 2–2.5 mm high, equalling to exceeding the gynostegium, but not obscuring it, consisting of *Cs* and *C*; fused for more than 3/4 of total corona length, *Cs* and *C* differentiated; lobes of *Cs* trifid, apically erect, with lacerate upper margin; *C* shorter than *Cs*; lobes of *C* laminar, rectangular, producing a pronounced convex fold along the upper third of corona height, erect, emarginate. Gynostegium 1.2–1.5 mm high, 1.2–1.5 mm diam., sessile. Stamens without filament; anthers about as high as broad, trapezoidal, abaxially planar; anther wings 0.7–0.8 mm long, parallel to each other, extending along the whole length of the anther; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.5 mm long, 0.7 mm wide, triangular, broader than the stamen, erect, emarginate. Pollinarium: corpusculum 220 µm long, ovoid; caudicles 80–100 µm long, cylindrical, straight, deicinate, thickened at the insertion of the pollinium; pollinia subapically attached to the caudicles, 300–350 µm long, 150–170 µm wide, ovate in cross section, ovoid. Stylar head c. 1 mm diam., c. 0.5 mm high, upper part c. 0.3 mm high, conical. Follicles pendulous, 60–65 mm long, 0.7–1 mm diam., obclavate, obtusely delicate in cross section, apically strongly beaked, distinctly keeled, medium brown, smooth, with sparse to dense indumentum. Seeds 5.5–6 mm long, 3–4 mm wide, ovate, medium brown, seta side smooth, aseta side sculptured with longitudinal ridges, tuberculate, marginally with 250–300 µm wide wing with entire margin; coma yellowish, 25–30 mm long.

Distribution — Malesia: Borneo, Philippines.

Habitat & Ecology — Flowering: December.

**6. Cynanchum muricatum** (Blume) Boerl. — Fig. 6


*Plants* ascending, twining. *Shoots* perennial, sparsely covered along a single line with erect trichomes, 250–400 μm long. ‘*Stipules*’ ovate, 8–9 mm long, 7–8 mm wide. *Leaves* with 30–60 mm long petiole, 10–12 colleters at the base of the leaves; leaf blades herbaceous, discolorous, 50–80 mm long, 25–55 mm wide, ovate, basally lobate (lobes 8–15 mm long), apically acute, adaxially and abaxially almost glabrous. *Inflorescences* 6–10-flowered, bostrychoid. *Peduncles* 25–40 mm long, densely covered along two lines with flexuous trichomes, 150–300 μm long; rachis 2–3 mm long. *Floral bracts* 0.75 mm long, 0.2 mm wide at the base, triangular, glabrous; pedicels 6–8 mm long, densely covered along a single line with recurved trichomes, 250 μm long. *Floral buds* 3.5 mm long, 2 mm diam., conical. *Calyx* basally fused, abaxially glabrescent; lobes 1–1.2 mm long, 0.6 mm wide, ovate, apically acute. *Corolla* adaxially glabrous. *Gynostegial corona C(is)* cyathiform, 1.2 mm high, shorter than the gynostegium, consisting of Cs and Ci completely fused, annular, with crenulate upper margin. *Gynostegium* 1.4 mm high, 1.1 mm diam., atop a stipe of c. 1 mm length. *Anthers* about as high as broad, pentagonal, abaxially convex; anther wings 0.5 mm long, extending along the whole length of the anther; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.75 mm long, 0.5 mm wide, ovate, equalling the stamen in width, erect. *Pollinarium*: corpusculum 350 μm long, more than twice as long as broad, elliptic. *Stylar head* 0.75 mm diam.,
0.9 mm high; upper part 0.4 mm high, shortly obinfun dibuliform. **Follicles** always one per flower, 7–10 cm long, 12–20 mm diam., obclavate, round in cross section, apically acute, but not beaked, wingless, brown, densely covered with 5–10 mm long protuberances. **Seeds** 8 mm long, 6 mm wide, ovate, medium brown, seta side smooth, aseta side sculptured with longitudinal ridges, with patchily arranged trichomes along ridges, 350 µm long, marginally with 500 µm wide wing, with entire, but papilllose margin; coma 10 mm long.


**Habitat & Ecology** — Altitude 0–500 m. Fruiting: December–May.

Notes — Well preserved flowering material of this species has not been found. Therefore it cannot be determined at present whether it is conspecific with *C. corymbosum*. The fruits of the Thailand collection are slightly broader than those of the Indonesian material.

Collections studied: **THAILAND. Van Beusekom & Santisuk 2838 (L)**, Uttag Thani, Nong Chang, Khao Pla Ra, N 15° 25', E 99° 55', 150 m, 18 Feb. 1970. — **INDONESIA. Sumatra: Lörzing 7026 (K, L), Sibolangit, 500 m, 16 Dec. 1919; Lampung: Mochtar 1144A (L), Way Kambas, 80 m, 10 Feb. 1972. Java: s. coll. 694 (L), May 1849.**

7. *Cynanchum ovalifolium* Wight — Fig. 7


*Cynanchum celebicum* Koord., Meded. Lands Plantentuin 19 (1898) 533, nom. nud. — Type: Koorders 1097 (lecto L; designated here); annotated by Koorders as 'C. celebicum sp. nov.'.


*Cynanchum luzonicum* Schltr., Feddes Repert. 12 (1915) 538, syn. nov. — Type: Merrill 7702 (BM, lecto designated here), Philippines, Luzon, Bontoc, May 1911.


Plants ascending, twining. **Shoots** perennial, herbaceous, glabrescent, densely covered along a single line with recurved trichomes, 400–500 µm long; internodes 12–20 cm long, 1.5–2 mm diam. 'Stipules' ovate, 8–10 mm long, 7–9 mm wide. **Leaves** with
petioles 25–35 mm long, 2 or 3 colleters at the base of the leaves; leaf blades herbaceous, 55–120 mm long, 40–70 mm wide, ovate, basally cordate, apically acuminate (acumen 5–7 mm long), adaxially and abaxially almost glabrous. Inflorescences 6–9-flowered, 1 or 2 flowers open synchronously, bostrychoid, partial inflorescences gyniniflorous. Peduncles 35–55 mm long, densely covered along a single line with recurved trichomes, 250–300 µm long; rachis 6–8 mm long. Floral bracts 1.5 mm long, 0.6 mm wide at the base, triangular, with trichomes; pedicels 5–6 mm long, densely covered over the whole surface with appressed trichomes, 250 µm long. Floral buds 1.5 mm long, 1.5 mm diam., globose. Calyx basally fused, ciliate and abaxially with trichomes; lobes 1.2–1.5 mm long, 1.2–1.5 mm wide, ovate, apically obtuse. Corolla rotate, 3.5–5.5 mm long; corolla lobes basally fused, 1–3 mm wide, abaxially cream, adaxially brown, yellow along the main nerves, horizontal, oblong, slightly dolabriform, apically obtuse. Gynostegial corona C(is) creamish white, 2.5–3 mm high, equaling the gynostegium in height, cyathiform, consisting of Cs and Ci fused for more than 3/4 of total corona length, Cs and Ci differentiated, Ci slightly shorter than Cs; Cs not connate to the filament, laminar, triangular, flat, apically erect with lacerate margins; lobes of Ci laminar, triangular, flat, erect, with lacerate margins. Gynostegium 2–2.5 mm high, 2–2.5 mm diam., atop a bulge of 0.4 mm length. Anthers higher than broad, rectangular, abaxially convex, basally normally with a pronounced hump; anther wings 1–1.5 mm long, extending along the whole length of the anther; adjacent anther wings parallel to each other, centrifugal, basally forming a distinct ‘mouth’ with the basal lateral margin of the anther; connective appendages 400–800 µm long, 400–800 µm wide, rectangular, narrower than the stamen, strongly inflexed. Pollinarium: corpusculum 300–400 µm long, ovoid; caudicles 180 µm long, flattened, straight, horizontal, trapezoid; pollinia laterally attached to the caudicles, 350–370 µm long, 250–300 µm wide, ovate in cross section, ovoid. Stylar head 1.5 mm diam., 0.5 mm high; upper part 0.15 mm high, umbonate. Follicles one per flower, 7–8.5 cm long, 30–35 mm wide, ellipsoid, ovate in cross section, apically beaked, smooth,
with comparatively thick pericarp. Seeds 6-7 mm long, 4 mm wide, ovate, medium brown, seta and aseta side vaguely sculptured with longitudinal ridges, marginally with 0.5 mm wide wing with entire margin; coma 2-2.5 mm long.


Habitat & Ecology — Margins of primary and secondary forests, thickets in grassland, weed in coconut plantations; sometimes on limestone rocks near the sea. Altitude 0-1700 m. Flowering all year.

Notes — Cynanchum celebicum Koord. differs from the 'typical' C. ovalifolium only in slightly more cordate leaf bases. Cynanchum ovalifolium represents the most frequent species of Cynanchum throughout the area.

The species is discussed and illustrated in Forster (1991: 458-460, f. 8).


8. Cynanchum physocarpum Schltr. — Fig. 8

Cynanchum physocarpum Schltr. in Perkins, Fragm. Fl. Philipp. 1 (1904) 121. — Type: Warburg 13766, not traced and probably destroyed in B.

Cynanchum schlechterianum Warb. in Perkins, Fragm. Fl. Philipp. 1 (1904) 121. — Type: Warburg 13003, Philippines, Luzon, Tayabas, Sampaloc; not traced and probably destroyed in B.


Plants ascending, twining, richly irregularly branched. Shoots perennial, herbaceous; internodes 10-20 cm long, 1-1.5 mm diam. Stipules ovate, 5-7 mm long, 4-6 mm wide. Leaves with 16-27 mm long petiole, 2 or 3 colleters at the base of the leaves; leaf blades coriaceous, 65-80 mm long, 20-45 mm wide, ovate, basally rounded to indistinctly cordate, apically acuminate (acumen 3-5 mm long), axially and abaxially glabrous. Inflorescences always one per node, 10-17-flowered, 5-7 flowers open synchronously, bostrychoïd. Peduncles 15-40 mm long, densely covered along a single line with recurved trichomes, 150-200 μm long; rachis 1-25 mm long, persistent. Floral bracts 0.8-1.1 mm long, 0.3-0.5 mm wide at the base, elongatedly triangular, ciliate; pedicels 3-5 mm long, densely covered along a single broad line with recurved trichomes, 150-200 μm long. Floral buds 1-1.2 mm long, 1.6-1.8 mm diam., ovoid, with imbricate aestivation. Calyx fused for more than 1/2 of its length, campanulate, ciliate; lobes 0.3-0.5 mm long, 0.5-0.6 mm wide, deltate, apically obtuse. Corolla cyathiform, 4-5 mm long, abaxially and adaxially white, adaxially with 200-250 μm long trichomes concentrated on the apical and lateral parts of the lobes; corolla lobes...
Ramos 30352). In most specimens, the corona is higher than in the flower drawn, which was rather young. — Drawn by Jim Conrad.

Fig. 8. Cynanchum physocarpum Schltr. a. Nodium with infructescence; b. young flower (frontal petal removed); c. gynostegium and corona (frontal part of corona removed); d. pollinarium; e. stylar head (from Ramos 30352). In most specimens, the corona is higher than in the flower drawn, which was rather young. — Drawn by Jim Conrad.
basally fused, 1.6–1.8 mm wide, patent, ovate, apically obtuse. *Gynostegial corona* *C(is)* white, cyathiform, 1.5–1.7 mm high, shorter than the gynostegium, consisting of Cs and Ci completely fused, annular, with straight, crenulate upper margin. *Gynostegium* 2–2.2 mm high, 1.8–2 mm diam., sessile. *Stamens* without filament; anthers higher than broad, trapezoidal; anther wings 1.3–1.4 mm long, parallel to each other, extending beyond the anther proper, forming a basal arch; adjacent anther wings parallel to each other, in the same plane as the anther; connective appendages 0.6–0.65 mm long, 1–1.1 mm wide, obcordate, broader than the stamen, erect. *Pollinarium*: corpusculum 250 μm long, caulicles 120–150 μm long, (sub)basally inserted at the corpusculum, flattened, straight, declinate, triangular; pollinia subapically attached to the caulicles, 300–350 μm long, 180–200 μm wide, ovate in cross section, ovoid. *Stylar head* 1.2–1.3 mm diam., 0.75–0.8 mm high; upper part 0.3–0.4 mm high, conical. *Follicles* one per flower, pendulous, 40–80 mm long, 35–50 mm diam., ovoid, round in cross section, apically obtuse, smooth, glabrous, inflated. *Seeds* unknown.

**Distribution** — Malesia: Philippines.

**Habitat & Ecology** — Degraded scrub. Altitude 0–1000 m. Flowering: September–July.

**Notes** — The fruits of the type (and only existing material) of *C. denigratum* are seemingly not physocarpous; however, fruits of *C. physocarpum* immaturesly picked or parasitized look exactly like those of this widely distributed specmin.

Two specimens from Sabah, *Krispinus 86689* (L) and *Nordin Abas 86086* (L), both with fruits only, had been tentatively identified as *C. physocarpum*. However, no flowering material of *C. physocarpum* has ever been collected outside the Philippines and J. Schmidt (pers. comm.) associates the two specimens with the *Tylophora wallichii* Hook. f. group.


**9. Cynanchum tuberculatum** (Blume) Boerl. — Fig. 9


**Plants** ascending, twining. **Shoots** perennial, herbaceous, glabrous; internodes 10–15 cm long. **Stipules** ovate, 8–10 mm long, 8–10 mm wide. **Leaves** with petiole, 35–45 mm long, 10–12 colleros at the base of the leaves; leaf blades herbaceous, 50–80 mm long, 30–55 mm wide, ovate, basally lobate (lobes 10–12 mm long), apicidal and abaxially almost glabrous. **Inflorescences** 4–10-flowered, no mature inflorescences present, bostrychoid. **Peduncles** 30–40 mm long, sparingly covered along a single line with appressed trichomes, 250–300 μm long. **Floral bracts** 1 mm long, 0.75 mm wide at the base, ovate, with trichomes; pedicels 5–7 mm long, densely covered along a single line with recurved trichomes, 250 μm long. **Calyx** basally fused, abaxially with trichomes; lobes 1.5 mm long, 1 mm wide, ovate, apicidal acute. **Corolla** 4 mm long; lobes 1.5 mm wide, incurved, oblong, apicidal acute. **Gynostegial corona** *C(is)* 4 mm high, cyathiform, exceeding the gynostegium, partly obscuring it,
consisting of Cs and Ci fused for more than 3/4 of total corona length, Cs and Ci differentiated, Cs not connate to the filament, laminar; lobes of Cs triangular, apically erect, with lacerate margins; Ci shorter than Cs; lobes of Ci laminar, erect, with straight, emarginate margins. Gynostegium 2 mm high, 2 mm diam., sessile. Anthers about as high as broad, trapezoidal, abaxially convex; anther wings 1.3 mm long, convergent, extending along the whole length of the anther, forming a basal arch; adjacent anther wings parallel to each other, centrifugal; connective appendages 1 mm long, 0.75 mm wide, obcordate, broader than the stamen, slightly inflexed. Pollinarium: corpusculum 280 μm long, ovoid; caudicles 125 μm long, straight, declinate, thickened at the insertion of the pollinium; pollinia apically attached to the caudicles, 385 μm long, 175 μm wide, ovate in cross section, ovoid. Stylar head 1 mm diam., 0.5 mm high; upper part 0.2 mm high, umbonate. Follicles one per flower, 65–80 mm long, 5–7 mm diam., obclavate, round in cross section, apically strongly beaked, wingless, light brown,
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minutely and isolatedly tuberculate, isolatedly covered with trichomes, 155 μm long. Seeds 5 mm long, 3 mm wide, ovate, brownish-yellow, marginally with 0.25 mm wide wing, with entire margin; coma 20 mm long.

Distribution — Malesia: Indonesia: Java.

Habitat & Ecology — Flowering: March.

Note — This species has not been collected for almost a century and might be endangered or extinct.

Collections studied: INDONESIA. Java: s.coll., s.n. (L, L 179.10-43/44); s.coll., s.n. (L, L 898.166-449); Link 2207b (L), Sullack, March.

INSUFFICIENTLY KNOWN TAXA

Quite a few species are still obscure because the types were destroyed in B or PNH and no isotypes or at least specimens identified by the author have been found in the course of this study.


EXCLUDED SPECIES


VINCETOXICUM


Pycnostelma Bunge ex Decne. in DC., Prodr. 8 (1844) 512. — Type species: Pycnostelma chinensis Bunge ex Decne.

Plants mostly erect, rarely twining, leafy, glabrous or covered with multicellular trichomes, containing clear latex. Roots fleshy, fascicled. Leaves petiolate, with few colleters, entire, ovate, to triangular, basally slightly cordate to slightly decurrent. Inflorescences extra-axillary, few- to multi-flowered, usually scadioidal. Floral buds mostly globose, aestivation dextrorse, imbricate or contorted. Flowers 3–10 mm diam., frequently sweetly scented, nectariferous. Corolla rotate, white, yellow, green, or (redish-)brown; adaxially glabrous or with long, smooth trichomes and short, verrucose trichomes. Corona gynostegial, white, green or red, about as high as the gynostegium, consisting either of staminal (Cs) parts or of fleshy staminal parts connected by much thinner interstaminal (Ci) parts. Gynostegium sessile. Anthers with apical appendages and clearly differentiated lateral anther wings. Pollinia pendulous; caudicles cylindrical. Stylar head forming a protrusion at the upper end of the corpusculum; part above this protrusion (upper part) flat, conical or umbonate. Follicles often two per flower, thin-walled, wingless, smooth or finely longitudinally striate. Seeds ovate, brown, smooth, with coma. Chromosome number usually 2n = 22.

Eurasian genus of c. 70 species with its centre of diversity in China and the Caucasus. Only one seashore species, V. carnosum, extending through the Flora Malesiana area to Australia.

1. Vincetoxicum carnosum (R. Br.) Benth.


Ischnostemma selangorica King & Gamble, J. Asiat. Soc. Bengal, Pt. 2 Nat. Hist. 74 (1907) 532. — Type: Ridley 7564, Selangor, at KwaI Selangor (n. v.).

Pentatropis novoguineensis Valeton, Bull. Dép. Agric. Ind. Néerl. 10 (1907) 49. — Type: Atasrip 96 (n. v.).

Plants straggling or decumbent. Shoots herbaceous, glabrous; internodes to 9 cm long, to 2 mm diam. Leaves with petiole, to 10 mm long, colleters absent; leaf blades fleshy, to 65 mm long, 20–25 mm wide, elliptic to obovate, basally cuneate, apically acuminate, adaxially and abaxially glabrous. Inflorescences 1–5-flowered, scadioidal. Peduncles 30–35 mm long, glabrous. Floral bracts 1.5 mm long, 0.8 mm wide at the base, lanceolate, glabrous; pedicels 5–15 mm long, glabrous. Floral buds conical, with contorted aestivation. Calyx basally fused, glabrous; lobes c. 2 mm long, 1 mm wide, ovate, apically acute. Corolla greenish-yellow, 7–10 mm long; lobes 1.5 mm
wide, horizontal, lanceolate, apically acute. *Gynostegial corona* greenish cream, 2.5–3 mm long, slightly exceeding the gynostegium, consisting of Cs only; lobes of Cs fleshy, basically rectangular, tapering to a subulate tip. *Gynostegium* 2–2.5 mm high, 2–2.5 mm diam., sessile. *Anthers* higher than broad; anther wings 1–1.3 mm long; connective appendages 0.75–1 mm long, 0.5–0.75 mm wide, triangular, narrower than the stamen, inflexed. *Pollinarium:* corpusculum 250 μm long, elliptic; caudicles 125 μm long, straight, declinate, thickened at the insertion of the pollinium; pollinia apically attached to the caudicles, 250–300 μm long, 100–125 μm wide, round in cross section, oblongoid. *Stylar head* umbonate. *Follicles* c. 75 mm long, 1.5 mm diam., fusiform, apically strongly beaked, wingless, glabrous. *Seeds* 4–5 mm long, 3 mm wide, ovate, winged; coma 15–20 mm long.


**Habitat & Ecology** — Near seashore, in mangrove and swamps. Altitude 0–300 m. Flowering: throughout the year.

**Notes** — The question whether the latex of this species is clear or milky has not been resolved satisfactorily. Forster (1991) stated it as white; on his specimens he stated it as clear. The possibilities of a seasonal colour change or infraspecific variability cannot be excluded at present.


Collections studied: INDONESIA. Timor: *Van Steenis* 18065 (K), betw. Baucau and Vermassi, 100–350 m, 17 Dec. 1953. — PHILIPPINES. Luzon: *Loher* 4039, 4040 (K), Luzon Central, Playa, 30 Aug. 1896; *Williams* 387 (K), Bataan, Lamoo, Mt Mariveles, 30 Dec. 1903. Sulu Prov.: *BS* (Ramos & Edaho) 44077 (K), Tawitawi, July/Aug. 1924. — PAPUA NEW GUINEA. Central Prov.: *Frodin* 5240 (K), Morupore, bootless inlet; NE comer of island, 0 m, 31 March 1979; *Rau* 37 (K), Goloa (Aroma) Kupiano, 6 m, 27 June 1977.

**ACKNOWLEDGEMENTS**

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**REFERENCES**


Voss, Leipzig.

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