

A Revision of the Genus *Povilla* (Ephemeroptera: Polymitarcyidae)

by

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The species of the genus *Povilla* are reviewed and a new subgenus, *Languidipes*, is established. Five new species, *P. (P.) andamanensis*, *P. (P.) heardi*, *P. (P.) junki*, *P. (P.) ulmeri*, and *P. (L.) taprobanes*, are described from the Oriental Region. Keys to the adults and nymphs of *Povilla* are included.

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INTRODUCTION

The genus *Povilla* Navás, 1912, has been represented previously by three described species. *Povilla corporaali* (Lestage, 1922), with both females and nymphs described, has been reported from Java to Sri Lanka (cf. Hubbard & Peters, 1978), and *P. cambodjensis* Ulmer, 1920, is known from males and females from Cambodia. The third species, *P. adusta* Navás, 1912, known from both nymphs and male and female adults, is widely distributed in Africa.

In this paper I describe five new species of *Povilla*, all from the Oriental Region: one from the Andaman Islands, one from Sri Lanka, and three from Thailand. Keys to the imagines and nymphs of *Povilla* are included.

Povilla can be distinguished from the other genera of the Polymitarcyidae by the following combinations of characters. In the imago: 1) prothorax is short and ring-like; 2) terminal filament is vestigial in both males and females; 3) fore wings with two long cubital intercalary veins (Figs. 1, 3-6); and 4) penes are straight and blade-like (Figs. 7-12). In the nymph: 1) frontal process is present but not prominent (Figs. 26-29); and 2) mandibular tusks are broad, with apex strongly toothed (Figs. 26-29).

The genus *Povilla* comprises two distinct groups of species, each of which I consider to be of subgeneric rank. Accordingly, the subgeneric composition of *Povilla* is elaborated below.

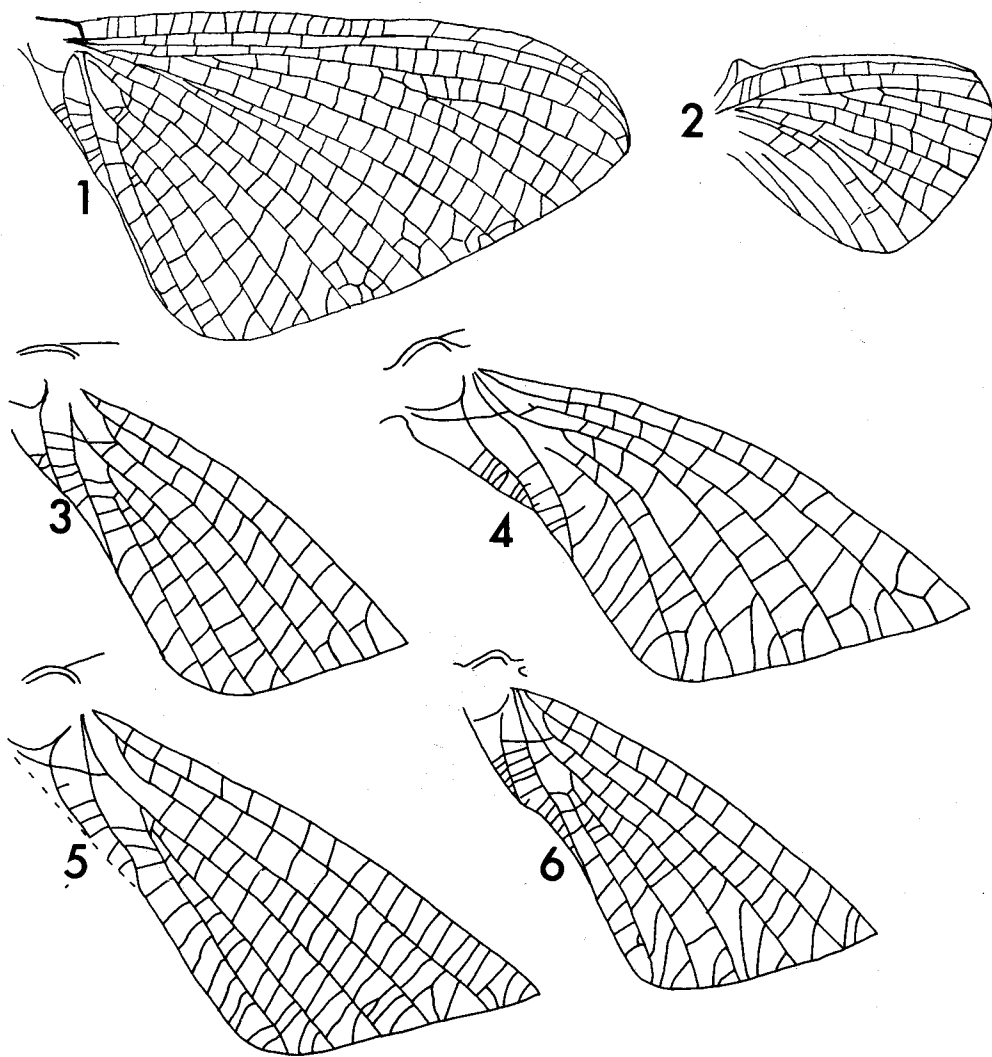
Povilla Navás, 1912

Imago. Length of ♂: body, 7.0-12.9 mm; fore wings, 9.9-13.7 mm; hind wings, 4.2-6.4 mm. Length of ♀: body, 9.6-19.7 mm; fore wings, 15.5-21.5 mm; hind wings, 6.0-8.0 mm. Eyes of ♂ separated on meson of head by distance equal to about 3 times width of median ocellus; eyes of ♀ separated on meson of head by distance equal to about 4 times width of median ocellus. Prothorax short and ringlike, more than 2 times as wide as long. Wings: maximum width of fore wings about 1/2 maximum length of fore wings; vein Rs of fore wings forked about 1/10 of distance from base of vein to margin; vein MA of fore wings forked 1/50 to 1/10 of distance from base of vein to margin, fork symmetrical; vein IMP of fore wings connected to vein MP₁, vein MP₂ shorter than vein IMP; two cubital intercalaries in fore wings; cross veins numerous. Costal margin of hind wing with acute projection; vein Sc of hind wings about 11/12 length of hind wings; 2 intercalary veins between vein MP and vein CuA of hind wings. Legs: claw of ♂ fore legs padlike distally as in Fig. 37; middle and hind legs of ♂ and all legs of ♀ atrophied. Male genitalia: forceps 3-segmented, distal segments not strongly sclerotized; penes straight, blade-like. Cerci of ♂ longer than body, cerci of ♀ shorter than body. Terminal filament of both ♂ and ♀ vestigial.

Mature nymph. Head prognathous. Antennae shorter than length of head and mandibles. Frontal process of head reduced, but present. Transverse row of filter-like hairs between antennal bases. Mouthparts: labrum subquadrate with light median indentation; mandibles robust, strongly toothed distally with double basal row of long filtering hairs extending from ventral surface to outer lateral surface; galea-lacinia subtriangular, apex sharply pointed; maxillary palpi 2-segmented, segment 2 a little more than 2 times length of segment 1; lingua of hypopharynx triangular, superlinguae without well developed lateral processes; paraglossae subtriangular, extending much further than glossae; glossae dorsal to paraglossae; labial palpi 2-segmented, segment 2 a little less than 2 times length of segment 1; labial palpi held in vertical plane as in Figs. 23-25. Legs robust, fossorial; femur of fore legs with 2 rows of long filter-like hairs along ventral edge extending about 1/3 distance from base to apex; tibia of fore legs with transverse row of long filter-like hairs near base of anterior surface and another row of long filter-like hairs running along dorsal edge; claw of fore legs slightly curved, pointed, with row of evenly sized denticles; claw of middle and hind legs without teeth, hooked slightly more than claw of fore legs. Gills: gill 1, short, smooth, uniramous to triramous; gills 2-7 dorsal, bilamellate, long and lanceolate, margins fringed. Caudal filaments shorter than body.

Key to the imagines of Povilla

1. Large conspicuous violet patch at base of fore wings; vein CuA of fore wings strongly recurved (Fig. 4); (s.g. *Languidipes*) *corporaali*
 —No large conspicuous violet patch at base of fore wings; vein CuA of fore wings not strongly recurved (Fig. 1, 3, 5-6); (s.g. *Povilla*) 2
2. Vein MA of fore wings forked closer to base of wings than vein Rs 3
 —Veins MA and Rs of fore wings forked about equidistant from base of wings 4
3. Vein MA of fore wings forked less than 1/10 distance from base of vein to margin; thorax



Figs. 1-6. 1-2, *P. (P.) andamanensis*: 1, fore wing; 2, hind wing. 3-6. Anal region of fore wing: 3, *P. (P.) heardi*; 4, *P. (L.) corporaali*; 5, *P. (P.) cambodjensis*; 6, *P. (P.) adusta*.

- yellowish brown, washed with black; head dark brown to black; Africa *adusta*
 —Vein MA of fore wings forked about 1/10 distance from base of vein to margin; thorax whitish, washed with black; head whitish; Andaman Islands *andamanensis*
 4. Pronotum dark; penes sharply acuminate (Fig. 8, 11); Cambodia, Thailand 5
 —Pronotum with light patches laterally; penes blunt (Fig. 10); Thailand *heardi*
 5. Mesonotum and metanotum blackish; Thailand *ulmeri*
 —Mesonotum and metanotum yellowish brown; Cambodia *cambodjensis*

Key to the Nymphs of *Povilla*

1. Outer edge of mandibles toothed (Fig. 27-28); frontal process greatly reduced (Fig. 27-28); gill 1 biramous; (s.g. *Povilla*) 2
- Outer edge of mandibles entire (Fig. 26, 29); frontal process moderate (Fig. 26, 29); gill 1 uniramous; (s.g. *Languidipes*) 3
2. Gills 2-7 whitish with dark median line; Africa *adusta*
- Gills 2-7 whitish, washed with black on both lamellae and fringe; Thailand *junki*
3. Frontal process subtriangular (Fig. 26); Indonesia *corporaali*
- Frontal process semicircular (Fig. 29); Sri Lanka *taprobanes*

***Povilla* (*Povilla*) Navás, 1912**

Povilla Navás, 1912, Rev. Zool. Afr. 1, 402.

Type-species. *Povilla adusta* Navás, by original designation.

Adult. Vein MA of fore wings forked 0.04 to 0.1 times the distance from base of vein to margin (Fig. 1). Vein CuA of fore wings not strongly recurved (Fig. 1, 3, 5-6).

Nymph. Abdominal gill 1 bifid or trifid (Figs. 31-32). Outer edge of the mandibles toothed (Figs. 27-28). Frontal process of the head greatly reduced (Figs. 27-28).

Species included. *P. (P.) adusta* Navás, *P. (P.) andamanensis* sp. n., *P. (P.) cambodjensis* Ulmer, *P. (P.) heardi* sp. n., *P. (P.) junki* sp. n., and *P. (P.) ulmeri* sp. n.

Geographical distribution: Africa from South Africa to Ghana, Mali, and the Sudan; Andaman Islands; Cambodia; and Thailand.

***Povilla* (*Povilla*) *andamanensis* Hubbard, sp. n.**

(Fig. 1-2, 13-14, 17, 19-20)

Male imago. Unknown.

Male subimago (in alcohol). Length: body, 8.5-9.75 mm; fore wings, 9.0-10.5 mm; hind wings, 4.25-5.0 mm; Eyes black. Apical half of ocelli white, basal half black. Head whitish, dorsum washed with black, except large triangular whitish patch on vertex. Antennae whitish, scape and pedicel washed with black dorsally. Thorax: pronotum whitish, washed with black; mesonotum yellowish white washed with black, middorsal portion lighter than lateral portions, sutures darker; metanotum yellowish white washed with black; mesoepisternum brown. Legs: fore legs whitish, washed with black; middle and hind legs whitish, coxae and trochanters black, dorsal edge of femora washed with black. Wings (Fig. 1-2): membrane of fore and hind wings hyaline with brownish tint in costal and subcostal areas fading to translucent white distally; longitudinal veins brown, fading in color distally; longitudinal veins brown, fading in color distally; vein MA of fore wings forked closer to base of wings than vein Rs, about 1/10 distance from base of vein to margin. Abdomen (Fig. 13-14, 19): terga white with black markings as in Fig. 14; distal segments with posterior transverse white band; faint white longitudinal stripe running length of abdominal dorsum; sterna white. Genitalia white with black markings near base as in Fig. 7; penes sharply pointed. Cerci

whitish except first few segments of imaginal setae washed with black visible through integument.

Female imago (in alcohol). Length: body, 11.75 mm; fore wings, 15.5 mm; hind wings, 6 mm. Eyes and head colored as in male subimago. Thorax as in male subimago. Abdomen (Fig. 13, 17, 20): coloration and markings similar to male subimago except more pronounced.

Female subimago and nymph. Unknown.

Type-specimens. Holotype male subimago, SOUTH ANDAMAN ISLAND, stream by a ricefield nr Bimbleton at light (S-AND-20²), 22.XII.1976. F. Starmühlner, deposited in Florida A&M University. Paratypes: male subimago, same data as holotype, deposited in Naturhistorisches Museum, Wien; female imago, SOUTH ANDAMAN ISLAND, river nr Mungelutonge at light (S-AND-18), 20.XII.1976, F. Starmühlner, deposited in Zoological Survey of India, Calcutta. All types are in alcohol. Association of males and females is by color pattern.

Etymology. Adj., named for the type locality.

Geographical distribution. Andaman Islands.

Biology. The adults of *P. andamanensis* have been collected at lights near streams in the month of December.

Discussion. The adults of *P. andamanensis* can be distinguished from other species of *Povilla* by the following combination of characters: 1) a violet patch is lacking at the base of the fore wings; 2) vein MA of the fore wings forks closer to the base of the wings than vein Rs, about 1/10 of the distance from base of vein to margin; 3) head is whitish; and 4) thorax is whitish, washed with black.

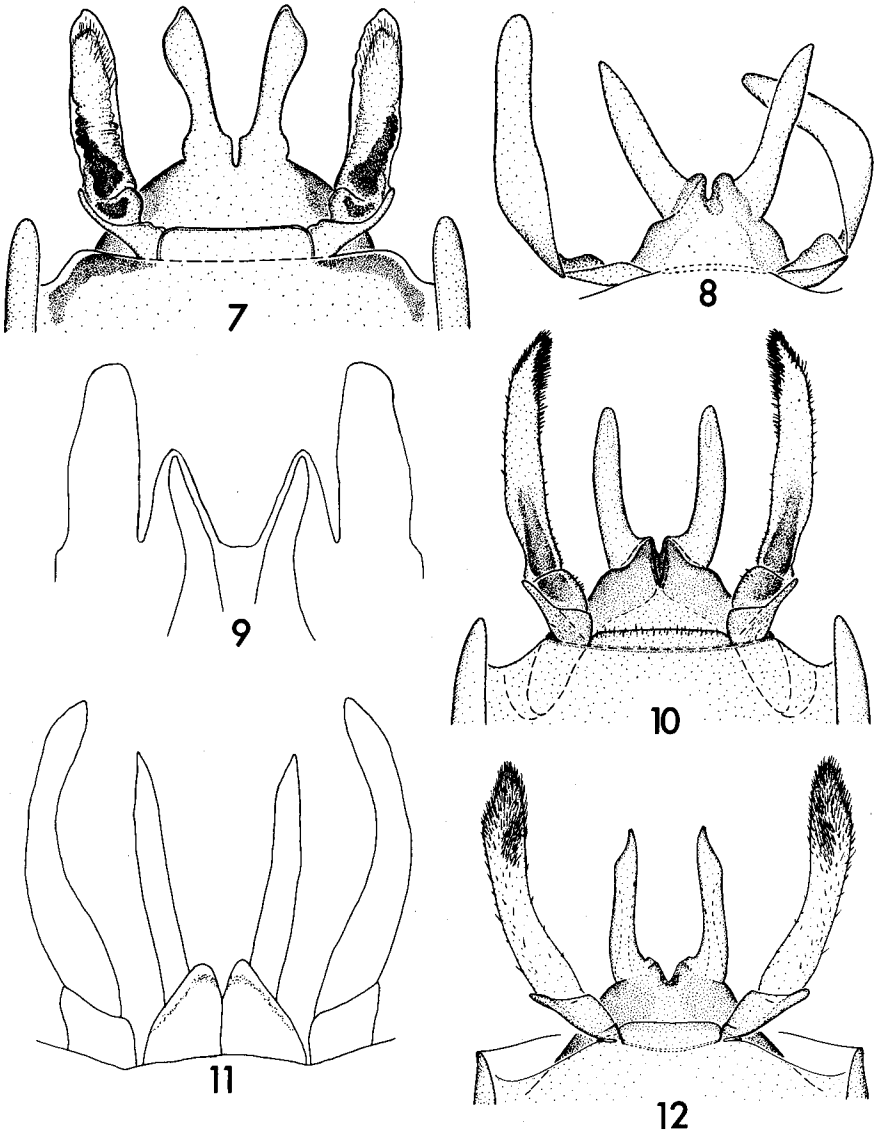
***Povilla (Povilla) heardi* Hubbard, sp. n.**

(Fig. 3, 10, 18, 37)

Male imago (in alcohol). Length: body, 7.0 mm; fore wings, 9.9 mm; hind wings, 4.7 mm. Eyes black. Ocelli white. Head yellowish, dorsum black. Antennae whitish, washed with black. Thorax: pronotum yellowish, dorsum black, lighter laterally, posterolateral margins edged in black; mesonotum and metanotum yellowish, darker around margins, sutures lightly marked in brown; pleurae and sterna yellowish, mesoepisternum smokey black. Legs: fore legs whitish, washed with black; middle and hind legs whitish yellow; middle femora washed with black, tarsi edged with faint black along dorsal and ventral edges; fore claws as in Fig. 37. Wings (Fig. 3): membrane of fore and hind wings hyaline with brownish tint in proximal 2/3 of costal and subcostal areas; longitudinal veins brownish, fading in color distally; veins MA and Rs of fore wings forked equidistant from wing base; vein MA forked about 1/10 distance from base of vein to margin. Abdomen: venter whitish; dorsum yellowish with black markings as in Fig. 18. Genitalia whitish with black markings near base of forceps as in Fig. 10; penes are blunt and rounded (Fig. 10). Cerci missing.

Male subimago, female imago and subimago, and nymph. Unknown.

Type-specimens. Holotype male imago (in alcohol), THAILAND, Khon Kaen Prov., Ban Nam Phong, Mae Nam Phong at Hwy. 2, 23.III.1971 (T-116), William H. Heard, deposited in Florida A&M University.



Figs. 7-12. Male genitalia. 7, *P. (P.) andamanensis*, subimago; 8, *P. (P.) ulmeri*, imago; 9, *P. (L.) taprobanes*, mature nymph; 10, *P. (P.) heardi*, imago; 11, *P. (P.) cambodjensis*, imago; 12, *P. (P.) adusta*, imago.

Etymology. Named for the collector, William H. Heard, Florida State University.
Geographical Distribution. Thailand.

Biology. The holotype imago of *P. heardi* was collected in March, immediately downstream from an impoundment (W. H. Heard, pers. comm.).

Discussion. The imagines of *P. heardi* can be distinguished from other species of *Povilla* by the following combination of characters: 1) veins MA and Rs of the fore wings are forked about equidistant from the wing base; 2) pronotum has light patches laterally; and 3) penes are blunt and rounded (Fig. 10).

***Povilla (Povilla) cambodjensis* Ulmer, 1920**

(Fig. 5, 34-36)

Povilla cambodjensis Ulmer, 1920, Archiv f. Naturgesch. 85A(11), 5.

I was able to examine a pinned male syntype and a pinned female syntype (both badly damaged) of *P. cambodjensis* Ulmer from the Museum für Naturkunde der Humbolt-Universität. Of the four syntypes originally deposited in Berlin, only these two specimens could be located. Unfortunately, they are too badly damaged for a formal redescription. The specimens (Fig. 34-36) agree fairly well with the description by Ulmer except that the abdomen of the male (the female abdomen is completely lacking) appears more white than yellow and the shadows on the abdomen do not form clear median and lateral spots as suggested by Ulmer. The cubital area of the fore wings is shown in Fig. 5. I am designating the female specimen (bearing, among other labels, a yellow printed label: "Kambodja a. Me Kong/Pnom-pech. 1.14/Friedrichs S. G."; a white handwritten label: "*Povilla/-cambodjensis* Ulm./Typen."; and an orange printed label: "Type") as lectotype of *Povilla cambodjensis* Ulmer, 1920, and am designating the male as paralectotype.

Geographical distribution. CAMBODIA [Pnom-Pech is probably a misprint for Pnom-Penh].

Biology. Nothing is known of the biology of *P. cambodjensis*.

Discussion. *Povilla cambodjensis* can be distinguished from the other known species of *Povilla* in the adult by the following combination of characters: 1) pronotum is dark; 2) mesonotum and metanotum are yellow-brown; and 3) veins MA and Rs in the fore wings are forked equidistant from base of wings.

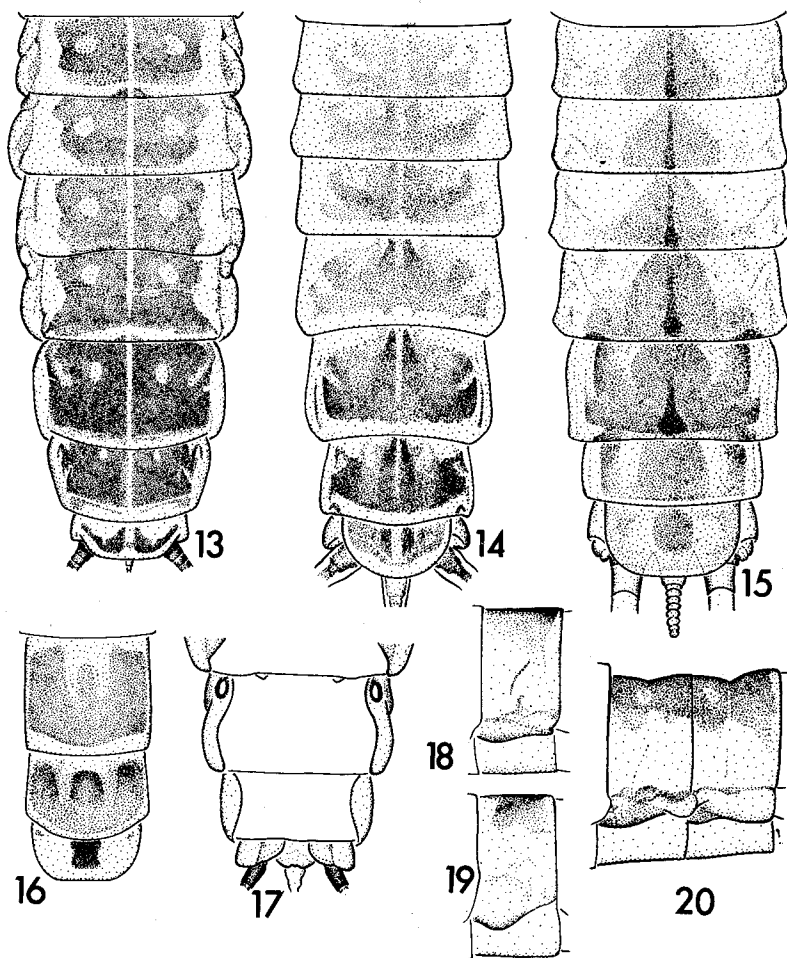
One other syntype (here designated as a paralectotype) of *P. cambodjensis* is a pinned male from the Institut Royal des Sciences Naturelles de Belgique listed by Ulmer (1920) as "ferner 1 ♂ Bangkok." It differs from the two Cambodian specimens in having a black thorax instead of yellow-brown. The coloration of the thorax of this specimen is so different than that of the two Cambodian specimens that I cannot justify leaving them placed as the same species at this time. Accordingly, I remove the Bangkok male to *Povilla ulmeri* sp. n. Unfortunately, this specimen is also very badly damaged.

***Povilla (Povilla) ulmeri* Hubbard, sp. n.**

(Fig. 8, 16)

Povilla cambodjensis [partim]: Ulmer, 1920, Archiv f. Naturgesch. 85A(11), 5.

Male imago (pinned). Length: body, 7.5 mm; fore wings, ca. 10 mm. Eyes black.



Figs. 13-20. Abdominal color pattern. 13-14. *P. (P.) andamanensis*, dorsal aspect of segments 4-10: 13, female; 14, male. 15. *P. (P.) heardi*, dorsal aspect of segments 4-10 of male; 16. *P. (P.) ulmeri*, dorsal aspect of segments 8-10 of male. 17. *P. (P.) andamanensis*, ventral aspect of segments 8-10 of female. 18. *P. (P.) heardi*, lateral aspect of segment 6 of male. 19-20. *P. (P.) andamanensis*, lateral aspect; 19. segment 6 of male; 20. segments 6-7 of female.

Head black. Thorax: pronotum black; mesonotum and metanotum blackish; mesosternum and metasternum blackish. Legs: fore legs brown; middle and hind legs white. Wings: membrane of fore and hind wings hyaline with brownish tint in approximately the proximal 1/2 of costal and subcostal areas; veins MA and Rs of fore wings forked about equidistant from wing base; vein CuA of fore wings not

strongly recurved. Abdomen: tergum whitish, darker on segments 8-10, markings as in Fig. 16. Genitalia as in Fig. 8. Cerci whitish.

Male subimago, female imago and subimago, and nymph. Unknown.

Type-specimens. Holotype male imago (misidentified paralectotype of *P. cambodjensis*, see above), "BANGKOK, P. Rolin", in Institut Royal des Sciences Naturelles de Belgique (Bruxelles).

Etymology. Named in honor of the late Prof. Georg Ulmer.

Geographical distribution. Thailand.

Biology. Nothing is known of the biology of *P. ulmeri*.

Discussion. The adults of *P. ulmeri* can be distinguished from other species of *Povilla* by the following combination of characters: 1) pronotum is black; 2) mesonotum and metanotum are blackish; and 3) veins MA and Rs in the fore wings are branched equidistant from wing base.

***Povilla (Povilla) junki* Hubbard, sp. n.**

(Fig. 28)

Male and female imago and subimago. Unknown.

Nymph (in alcohol). Length: body, > 17 mm; cerci, > 4.8 mm. Antennae yellowish. Mouthparts (Fig. 28): mandibles with notched tooth on outer border, dark brown in anterior half, yellow brown in basal half; mandibular incisors present. Head yellowish brown; dorsal setae whitish, ventral setae golden. Thorax: dorsum yellowish to whitish, lighter than head; pleurae and sternum whitish. Legs yellowish, tarsal claws margined with brown. Abdomen: dorsum whitish, washed with black; venter whitish; gill 1 bifid, whitish (similar to Fig. 31); gills 2-7 bifid, whitish washed with black on both lamellae and fringe. Caudal filaments yellowish.

Type-specimens. Holotype female nymph, THAILAND: Bung Borapet, floating vegetation, W. Junk 6-VII-71, deposited in University of Utah. Paratypes: 3 nymphs, same data as holotype; 7 nymphs, Bung Borapet, bottom fauna, W. Junk 6-VII-71. All types are in alcohol. Four paratypes are deposited in Florida A&M University, four are deposited in the University of Utah, and 2 are deposited in the National Museum of Natural History, Washington.

Etymology. Named for the collector, W. Junk.

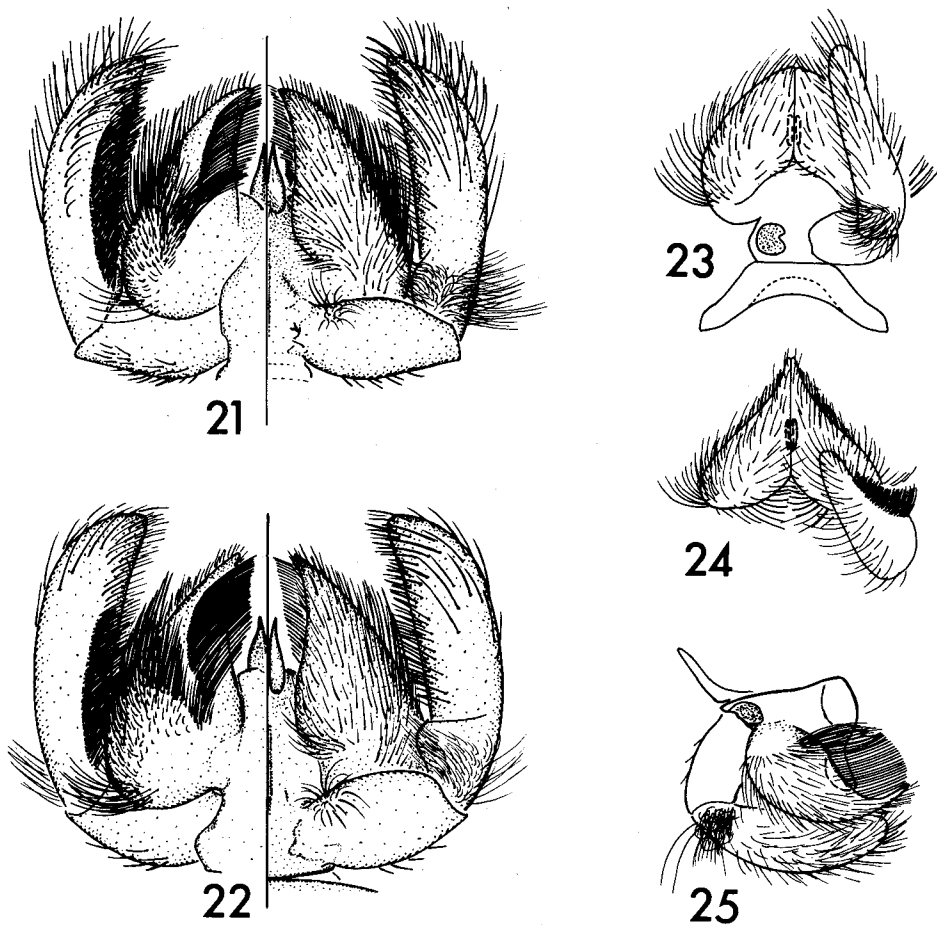
Geographical distribution. Thailand.

Biology. Nymphs of *P. junki* have been collected from floating vegetation and as bottom fauna.

Discussion. The nymph of *P. junki* can be distinguished from other known nymphs of *Povilla* by the following combination of characters: 1) gill 1 is biramous; 2) frontal process is greatly reduced; 3) notched tooth on the outer edge of each mandible; and 4) gills 2-7 are whitish, washed with black on both lamellae and fringe.

The other two species of *Povilla (Povilla)* recorded from Thailand are known only from the adult stage. However, *P. junki* should be easily distinguishable from these species on the basis of its much larger size.

Vejabhongse (1937) reported on the biology of some nymphs of *Povilla* from Bung Borapet. The figures are not sufficient for species determination, but because of their small size they probably were not *P. junki*.



Figs. 21-25. Labium. 21-22, view of slide preparation (ventral view on right, dorsal view on left): 21, *P. (L.) taprobanes*; 22, *P. (L.) corporaali*. 23-25, *P. (L.) taprobanes*, actual orientation: 23, ventral aspect; 24, anterior aspect; 25, lateral aspect.

***Povilla (Povilla) adusta* Navás, 1912**

(Fig. 6, 12, 27, 31-33)

Povilla adusta Navás, 1912, Rev. Zool. Afr. 1, 402; Ulmer, 1916, Archiv f. Naturgesch. 81A (7), 6; Lestage, 1918, Rev. Zool. Afr. 6, 79; Hartland-Rowe, 1953, Nature, 172, 1109; Demoulin, 1956, Exp. Hydrobiol. Lac Tanganika (1946-1947), 3 (7), 3; P. Corbet, 1957, Bull. Ent. Res. 48, 243; S. Corbet, Sellick & Willoughby 1974, J. Zool. 172, 491.

Male imago (in alcohol). Length: body, 8.0-12.9 mm; fore wings, 8.8-13.7 mm; hind wings, 4.2-6.4 mm. Eyes black. Basal half of ocelli black, apical half white.

Head whitish, black dorsally. Antennae whitish, scape and pedicel washed with black. Thorax yellowish brown; pronotum strongly washed with black; meso- and metanota lightly washed with black; pleurae and sterna yellowish brown. Legs whitish; prothoracic legs strongly washed with black. Wings (Fig. 6): longitudinal and cross veins of fore and hind wings washed with black, darker in basal half of wings; wing membrane hyaline except costal and subcostal areas of fore wings washed with black in basal half, translucent white in apical half; vein MA of the fore wings forked closer to wing base than vein Rs, less than 1/10 distance from base of vein to margin. Abdomen whitish, terga washed with black; segments 2-7 with prominent yellow "gill scars" laterally. Genitalia as in Fig. 12, penes with wedge-like point apically. Caudal filaments yellowish white.

Male subimago (in alcohol). Coloration and markings of head, thorax, legs, and abdomen as in male imago.

Female imago (in alcohol). Length: body, 9.6-19.7 mm; fore wings, 16.1-18.5 mm; hind wings, 6.4-8.0 mm. Coloration and markings of head, thorax, legs, and abdomen as in male imago.

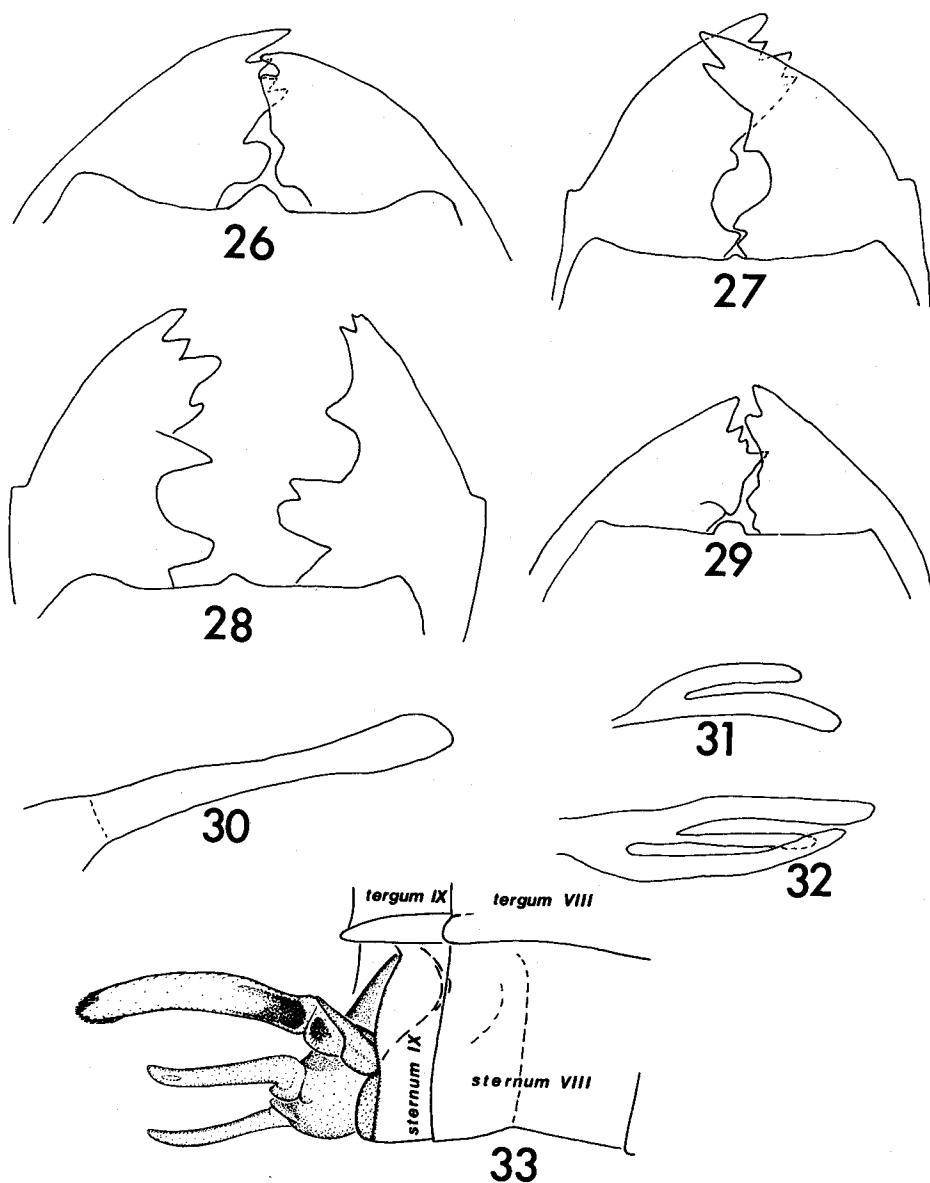
Female subimago (in alcohol). Coloration and markings of head, thorax, legs, and abdomen as in male imago.

Nymph (in alcohol). Head yellowish with brown mottling, darker transverse band between lateral ocelli. Mouthparts yellowish brown; mandibles with apex of teeth and lateral edges dark reddish brown; mandibles with tooth on outer border (Fig. 27); mandibular incisors present; remainder of mouthparts as figured by Demoulin (1955). Thorax: dorsum yellowish brown, pleurae lighter, mesoepisternum washed with brown, sterna whitish. Legs whitish, apex of tarsal claws reddish brown, fore legs washed with brown. Abdomen whitish; dorsum washed with brown; gill 1 (Fig. 31) bifurcate, whitish; gills 2-7 bifurcate, whitish with dark median line. Caudal filaments yellowish with brownish spines and golden setae.

Specimens examined. GHANA: Volta Lake, Kpandu; KENYA: Athi River, 1550 m; MALAWI: Ntundu; NIGERIA: Benin, MW State; Iseri, Lagos Colony; REPUBLIC OF SOUTH AFRICA: Mooketsi; locality unknown; SENEGAL: Podar River Region; SUDAN: Nile River between Bor and Kosti; TANZANIA: Lac Tanganika, baie de la Malagarsi; UGANDA: Kaazi; Lake Nabugabo, near Lake Victoria; Uny ro[?]; ZAIRE: Elizabethville, 1280 m; Lac Tanganika, Albertville; 39 km S of Walikale, 700 m; 69 mi S of Sampwe, 980 m; ZIMBABWE: 58 km SE Lupane, Embezi River.

Geographical distribution. Africa, from the Republic of South Africa north to Senegal, Mali, Lac Tchad, and the Sudan.

Biology. *Povilla adusta* is the only species of *Povilla* whose biology has been investigated in any detail. Among the authors who have published on the biology of this species are Kimmins (1949); Hartland-Rowe (1953, 1955, 1958); P. Corbet (1957); Petr (1970, 1973); S. Corbet, Sellick & Willoughby (1974); and Bidwell (1979). The nymphs of *P. adusta* bore tunnels in wood, as well as freshwater sponges and mud. They have even been found boring into sandstone rocks. They can often be a nuisance to docks and wooden boats. The tunnels are lined with a substance with a papery texture. The younger instars filter phytoplankton from the water, while the larger nymphs prefer browsing on periphytic algae. Female adults usually outnumber males at a ratio of about three to one. The adults at



Figs. 26-33. 26-29, dorsal aspect of mandibles and frontal process of nymph: 26, *P. (L.) corporaali*; 27, *P. (P.) adusta*; 28, *P. (P.) junki*; 29, *P. (L.) taprobanes*. 30-32, abdominal gill 1: 30, *P. (L.) taprobanes*; 31, *P. (P.) adusta*, typical nymph; 32, *P. (P.) adusta*, nymph from Embezi (see text). 33, lateral view of male genitalia of *P. (P.) adusta*

some locations have a well defined lunar rhythm of emergence, while at other localities there is no evidence of synchronization in emergence.

Discussion. *Povilla adusta* is the only species of *Povilla* recorded from Africa and all known populations on the continent appear to be conspecific. It can be distinguished in the adult stage from the other species of *Povilla* by the following combination of characters: 1) vein MA of the fore wings is forked closer to the wing base than vein Rs, and less than 1/10 of the distance from base of vein to margin; 2) lack of conspicuous violet area at the base of the fore wings; 3) distal portions of the costal and subcostal areas are translucent white; and 4) dorsum of head is dark brown to black. The adult male genitalia are illustrated in Fig. 12. The nymph of *P. adusta* may be distinguished from nymphs of other species of *Povilla* by the following combination of characters: 1) gill 1 is biramous (Fig. 31; but see discussion below); 2) greatly reduced frontal process (Fig. 27); 3) notched tooth on the outer edge of each mandible (Fig. 31); and 4) gills 2-7 are whitish with a dark median line.

Other partial or whole illustrations of the nymph of *P. adusta* are presented in papers by Hartland-Rowe (1953), Demoulin (1956), P. Corbet (1957), and S. Corbet, Sellick & Willoughby (1974). It should be noted that the illustration of Corbet, Sellick & Willoughby (1974) incorrectly depicts gill 1 as equal to gills 2-7 in size, instead of correctly as greatly reduced and non-fringed as in Fig. 31.

There is a great deal of variation in size and intensity of coloration in the imagines of *P. adusta*. Some specimens are quite dark while others are much lighter. I have seen no obvious correlation of this variation with geographical distribution.

One nymph from Zimbabwe (Rhodesia: 58 km SE Lupane, Embezi River, 4-IV-1968, P. J. Spangler) deposited in Florida A&M University has gill 1 tritamous (Fig. 32) on both the left and right sides. In other respect it resembles typical *P. adusta*. The significance of this deviation from the typical condition remains unknown.

***Povilla* (*Languidipes*) Hubbard, subgen. n.**

Type-Species. *Asthenopus corporaali* Lestage.

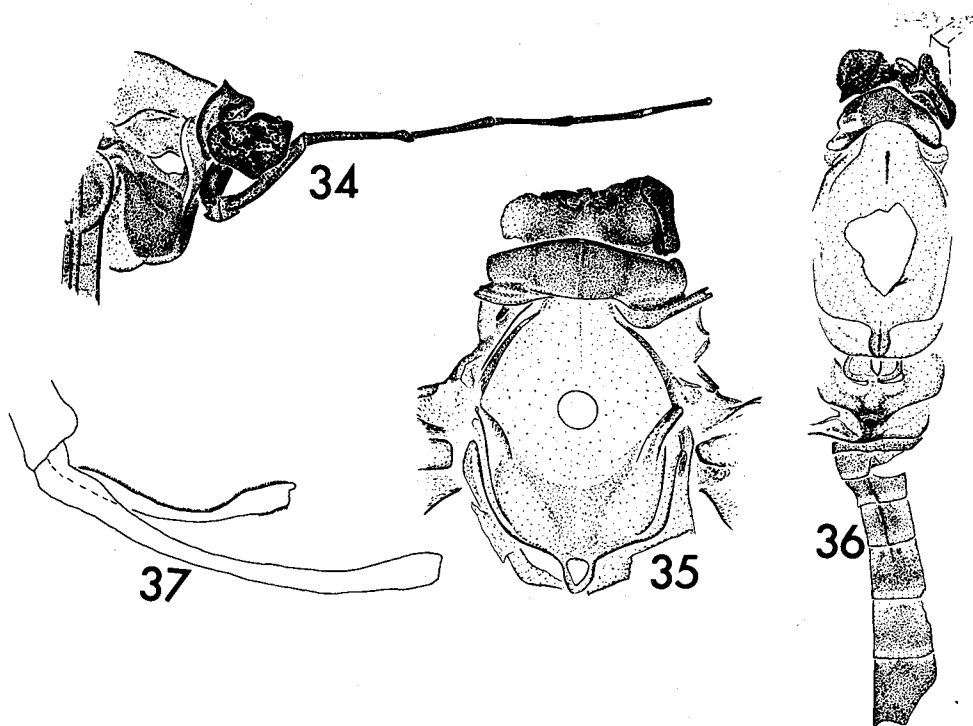
Adult. Vein MA of fore wings forked about 0.02 times the distance from base of vein to margin. Vein CuA of fore wings strongly recurved (Fig. 4).

Nymph. Abdominal gill 1 uniramous (Fig. 31). Outer edge of each mandible entire, not toothed (Fig. 26, 29), and mandibular incisors greatly reduced or absent. Frontal process not greatly reduced (Fig. 26, 29).

Etymology. *Languidus*, L., meaning "weak", and *pes*, L., meaning "foot"; masculine. By analogy with *Asthenopus*, a related genus, referring to the atrophied legs of the adults, a character shared with both subgenera of *Povilla*.

Species included. *P. corporaali* (Lestage) and *P. taprobanes* sp. n.

Geographical distribution. Indonesia; Sri Lanka; India [?].



Figs. 34-37. 34-36, detail of specimens of *P. (P.) cambodjensis*: 34, anterolateral aspect of male; 35, anterodorsal aspect of female; 36, dorsal aspect of male. 37, *P. (P.) heardi*, male fore claw.

***Povilla (Languidipes) taprobanes* Hubbard, sp. n.**

(Fig. 9, 21, 23-25, 29-30)

Palingenia (Anagenesia) sp. Eaton, 1884, Trans. Linn. Soc. London, 2nd Ser. Zool., 3, 25, pl. 25, fig. 1-19.

Male and female imago and subimago. Unknown.

Mature nymph (in alcohol). Length: body, 19 mm. Head yellowish brown mottled with dark brown, except brown along anterior frontal border; frontal process moderately developed, semicircular (Fig. 29). Mouthparts: mandibles lacking tooth on outer border (Fig. 29); mandibles brown in distal half, yellowish in basal half; mandibular incisors greatly reduced; labium as in Fig. 21, 23-25. Antennae yellowish. Thorax: pronotum yellowish gold; mesonotum brownish; pleura and sternum whitish. Legs white, with whitish to yellowish setae. Abdomen: terga whitish, washed with black; sterna whitish; gill 1 uniramous (Fig. 30); gills 2-7 biramous, white, median line and fringe washed with black. Male genitalia: penes as viewed through nymphal exoskeleton illustrated in Fig. 9. Caudal filaments yellowish.

Type-specimens. Holotype male nymph, SRI LANKA, Ratnapura District, Pubbarapotha, Katupat Oya, 120 m, 14-X-1970, O. S. Flint, Jr., deposited in the National Museum of Natural History, Washington. Paratypes: 6 nymphs, same data as holotype, 2 deposited in the National Museum of Natural History, Washington, 2 deposited in the National Museum Colombo, and 2 deposited in Florida A&M University; 22 nymphs, CEYLON, Kollonawa, tunneling in teak lock-gates, IV-1934 [collector unknown], 15 deposited in Florida A&M University, 7 deposited in University of Utah.

Etymology. From the Greek name for Sri Lanka.

Geographical distribution. Sri Lanka.

Biology. The nymphs of *P. taprobanes* have been collected in October, from a stream at 120 m altitude, and in April, while burrowing in teak lock-gates.

Discussion. The nymph of *P. taprobanes* can be distinguished from other known nymphs of *Povilla* by the following combination of characters: 1) gill 1 is uniramous; 2) outer edge of each mandible lacks notched tooth; and 3) frontal process is moderately developed and semicircular.

Eaton (1884) figured the nymph of this species as *Palingenia* (*Anagenesia*) *sp.* Ulmer (1940, p. 595) referred to Eaton's description as of "einer verwandten (wenn nicht gar derselben) Art". Eaton's illustrations are generally accurate, except for the labium and gill 1, which are refigured in this paper (Fig. 21, 23-25, 30). Eaton missed the delicate glossae, drawing only the paraglossae and palpi. Eaton also mistakenly thought that the gill was absent on abdominal segment 1. Until now, this species has generally been referred to as *P. corporaali*, which does not occur in Sri Lanka. In 1978 I searched several areas of Ratnapura in the general vicinity of the type locality, but was unable to collect adult specimens of *P. taprobanes*.

***Povilla* (*Languidipes*) *corporaali* (Lestage, 1922)**

(Fig. 4, 22, 26)

Asthenopus corporaali Lestage, 1922, Ann. Soc. Ent. Belg. 62, 145.

Povilla corporaali: Ulmer, 1924, Treubia, 6, 34; Ulmer, 1940, Archiv Hydrobiol. Suppl. 16, 595.

Male imago and subimago. Unknown.

Female imago (in alcohol). Length: body, 13.2 mm; fore wings, 21.5 mm; hind wings, 5.3 mm. Eyes black. Ocelli white. Head whitish, dorsum strongly washed with black except for light area in center of dorsum. Antennae whitish, scape and pedicel washed with black. Thorax: pronotum yellowish brown; mesonotum brown, carinae and sutures darker, lighter mesally; metanotum brown; sclerotized area of pleura brown; remainder of pleura and sternum white. Legs whitish. Wings (Fig. 4): membrane of fore and hind wings hyaline except marked with purple-brown in basal half, distal portion of costal and subcostal areas of fore wings translucent white; longitudinal and cross veins of fore and hind wings washed with black in basal half; vein CuA of fore wings recurved (Fig. 4). Abdomen: dorsum washed with brown, terga 5-10 darker, terga 5-8 with dark brown band distally; segments 2-7 with whitish gill scars laterally; sterna whitish; cerci whitish.

Female subimago. Unknown.

Nymph (in alcohol). Eyes black. Ocelli white, marked with black at base. Head mottled brown, frontal area lighter, frontal process and anterior frontal border dark brown. Frontal process reduced, triangular (Fig. 26). Mandibles yellowish brown, edged with dark brown; teeth on apex of mandibles dark brown, mandibular incisors absent; labium as in Fig. 22. Thorax: pronotum yellowish brown; mesonotum of mature nymphs whitish, washed with black; base of mesothoracic wings pads marked with black, similar to marking of wings of female imago. Pleurae and sterna white. Legs white. Abdomen whitish; abdominal terga washed with black. Gills 2-7 whitish, with slightly darker median line. Caudal filaments yellowish.

Type-specimens. Dr. G. Demoulin, Institut Royal des Sciences Naturelles de Belgique, has informed me (in litt.) that the type of *P. corporaali* (Lestage) has apparently been destroyed. At his suggestion I therefore designate as neotype of *Asthenopus corporaali* Lestage (now *Povilla corporaali*) a female imago, in alcohol, bearing the white handwritten label "Java occ./Siteo Goenoeng/b. Soekaboemi/1000 m 14.VI.31/LIEFTINCK" and having slide preparation number "mdh 79-6". The neotype and wing slide preparation are deposited in Florida A&M University.

Specimens examined. OST JAVA: Ranu Lamongon, "Holzbohren"; Tjigombong [?] Meer, 500 m; SÜD SUMATRA: Tambang-Sawah (Bohren in Holz von Wasserleitungsröhren): JAVA OCC., Siteo Goenoeng, b. Soekaboemi, 1000 m.

Geographical distribution. Java, Sumatra, Simeulue (Hubbard & Peters, 1978). Records of distribution reported for *P. corporaali* west of Burma are probably all in error, as I have seen no specimens from this area which can be attributed to this species. The description and figure by Chopra (1927) of a female from Assam as "*P. corporaali*?" indicate that that specimen differs from the Javanese neotype specimen in coloration, in wing venation (especially in the radial sector), and in that the pronotum is shaped slightly differently. This specimen may represent an undescribed species, but I have not seen it or similar specimens.

Biology. Nymphs of *P. corporaali* have been collected boring into wood and bamboo. Although Kimmens (1949) thought that *P. corporaali* did not line its burrows as does *P. adusta*, some of the Javanese specimens which I have examined were collected along with pieces of tunnel lining.

Discussion. *Povilla corporaali* can be distinguished from other species of *Povilla* by the following combinations of characters. In the imagines: 1) vein CuA of the fore wings is recurved; and 2) basal section of fore wings has large conspicuous violet area. In the nymphs: 1) gill 1 is uniramous as in Fig. 30; 2) tooth is absent on outer edge of each mandible (Fig. 26); and 3) frontal process of head is moderately developed and triangular (Fig. 26).

Ulmer (1940) illustrated the labium of *P. corporaali* incorrectly, apparently losing the delicate glossae in dissection, as did Eaton (1884) with his nymph from Sri Lanka (cf. discussion of *P. taprobanes*, above). The labium is redrawn in Fig. 22.

The violet patch present on the basal portion of the fore wings and also distinguishable on the wing pads of older nymphs of *P. corporaali*, may vary somewhat in perceived color depending upon the light, and upon the age and condition of the specimen. At different times, it may appear from distinctly brown to blackish gray.

DISCUSSION

Birket-Smith (1971) reported that in *Povilla adusta* the gonopore is situated on the gonocoxa and not on the gonostylus (penis) as is the case in all other Ephemeroptera which have been investigated (Brinck, 1957). I have been unable to find any evidence of a gonocoxal gonopore in *P. adusta*. On the contrary, it appears that the vas deferens extends through the penes to open distally in a medial gonopore similar to the general mayfly pattern. The same situation appears to exist in *P. andamanensis* and *P. heardi*. The single male specimens of *P. ulmeri* and *P. cambodjensis* are not in good enough condition to yield beneficial observations on this subject.

It is very difficult to distinguish between imagines and subimagines of *Povilla*. Hairs on the subimaginal wings, a common clue in many groups, are sparse in *Povilla* and therefore not very useful. In subimaginal males, the forceps, fore legs, and cerci are not fully developed and the subimaginal cuticle is fairly easy to distinguish on these structures. The females, however, have no forceps, do not develop extended fore legs, and have short cerci. Therefore in most cases, determination of whether a female of *Povilla* is actually an imago or subimago has a wide margin of error. Indeed, until now, females of the Polymitarcyidae were not believed to molt to imagines (Edmunds & Edmunds, 1980). I have seen, however, specimens of female *P. adusta* in which the subimaginal cuticle has separated from the imaginal body and is clearly visible. One female specimen (from "Nyassaland, Ntundu"; deposited at Florida A&M University) has the shed subimaginal cuticle still attached to one wing. This specimen is still ovigerous, with the egg packets intact, clear evidence that the females of *Povilla* (at least *some* females) molt to the imaginal stage before laying eggs.

Nymphal caudal filaments of *Povilla* (other than in very small nymphs) exhibit an interesting sexual dimorphism. In males, the cerci are longer than the terminal filament and have few spines in relation to the terminal filament, especially in other than their basal portions. In females, the terminal filament is longer than the cerci, and all three caudal filaments, not just the terminal filament, are heavily spinose.

Because both nymphs and adults of only two species of *Povilla* are known, the keys included in this paper will of necessity have to be considered tentative. The lack of knowledge of both stages also renders phylogenetic reconstruction difficult. It will require the discovery of both stages of more species before phylogenetic hypotheses at the specific level will be profitable. A detailed discussion of the phylogenetic relationships of *Povilla* and the other genera of the subfamily Asthenopodinae will appear in another paper.

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