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The Imago of *Simothraulopsis* Demoulin with a Redescription of the Nymph (Ephemeroptera: Leptophlebiidae: Atalophlebiinae)

E. DOMINGUEZ, W.L. PETERS*, J.G. PETERS and H.M. SAVAGE

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Simothraulopsis surinamensis Demoulin, 1966, a synonym of *Simothraulopsis demerara* (Traver, 1947) new synonym, is redescribed from associated adults and nymphs from French Guiana and Surinam, with additional records from northern Brazil and Venezuela. The type species *of Simothraulopsis* becomes *S. demerara* new combination. We confirm that the presumed nymph of *Homothraulus* described by Traver (1960) is correctly associated with imagines.

Keywords: Ephemeroptera, Leptophlebiidae, *Simothraulopsis*, new synonym, South America.

E. DOMINGUEZ, Department of Entomology, Cornell University, Ithaca, NY 14853, USA, and CONICET, Facultad de Ciencias Naturales, Universidad Nacional de Tucuman, Miguel Lillo 251, 4.000 Tucuman, Argentina.
W.L. PETERS, J.G. PETERS, H.M. SAVAGE, Center for Studies in Entomology, Florida A&M University, Tallahassee, FL 32307-4100, USA.

INTRODUCTION

The *Homothraulus*-group of Neotropical Leptophlebiidae was defined by Savage (1987 "*Farrodes*-group") to include *Homothraulus* Demoulin, 1955, *Simothraulopsis* Demoulin, 1966, and *Farrodes* Peters, 1971. We now use the older generic name for this group, a group distinguishable by adult wing venation (MA fork strongly asymmetrical with reinforcing cross vein to R_{4+5}, stem of MA straight; two intercalaries in CuA field detached at base or attached to CuA by cross vein) and compact, characteristic male genitalia featuring a dorsally curved styliger plate and penes with ventral projections. Except for the curvature, the styliger plate of *Homothraulus* is unmodified, whereas that of *Farrodes* is extended into projections lateral or dorsal to the penes. Nymphs of the group have an enlarged apical denticle on the claws, posterolateral projections on abdominal terga 8–9 only, and generalized atalophlebiine mouthparts and gills.

Homothraulus contains three species – *H. misionensis* (Esben-Petersen, 1912, *Thraulus), H. larensis* (Navás, 1926, *Thraulus),* and *H. lucretiae* Traver, 1960. The association of the "presumed nymph of *Homothraulus*" by Traver (1960)

* Address for correspondence.

with imagines was confirmed by the authors (ED, WLP) in independent rearings in northern Argentina and southern Brazil. Additional distribution records for *Homothraulus* include Uruguay and Paraguay, and figures and descriptions of *Homothraulus* are found in the above publications, Ulmer (1943, as *Thraulus misionensis),* and Traver (1959). Of two other species listed in *Homothraulus* by Hubbard (1982), *H. convexus* (Spieth, 1943, *Thraulus)* is now the type species of *Paramaka* Savage and Dominguez, 1992, a member of the *Hermanella*-group of genera (Flowers and Dominguez 1991); and *Homothraulus maculatus* (Needham and Murphy, 1924, *Thraulus)* is a species of *Farrodes* (Dominguez, in press). *Farrodes* contains seven nominal species, *F. maculatus, F. caribbeanus* (Traver, 1943, *Thraulus), F. roundsi* (Traver, 1947, *Thraulus),* and many new species ranging from Argentina through Central America to Texas (Dominguez et al., in press).

The third member of the group, *Simothraulopsis,* has previously been known only from *S. surinamensis* Demoulin, 1966, a species based on six nymphs collected in Surinam. *Thraulus demerara* Traver, 1947, another enigmatic species from the region, was described from male and female imagines from Guyana [British Guiana] and one female imago from Surinam. Traver (1960) stated that *T. demerara* did not belong in *Thraulus,* but she did not reassign it to another genus. We have now studied the type material of *T. demerara,* nymphs with associated subimagines of *S. surinamensis* collected near the type locality, nymphs with associated subimagines and imagines of *T. demerara* from French Guiana, and collections of mostly subimagines from the Amazon Basin and the Guiana Shield region of Brazil and Venezuela. All are conspecific. Thus, the type species of *Simothraulopsis* becomes *S. demerara* new combination.

We also have examined one reared female subimago of an indeterminable species of *Simothraulopsis* from Rio Cuieiras, north of Manaus (Amazonas State, 19–XII–1961, E.J. Fittkau), confirming the generic association. In this paper we redescribe the genus and the nymph of the type species.

In the following description of the male fore legs, the length of each segment is compared to that of the tibiae and expressed as a ratio; the average length (mm) of the tibiae is given in parentheses.

Genus ***Simothraulopsis*** Demoulin, 1966 (Figs. 1–28)

"Thraulus" (in part); Traver, 1947:150; 1960:73.
Simothraulopsis Demoulin, 1966:15.

Imago. Length of ♂: body 4.8–5.5 mm, fore wings 4.8–5.5 mm, hind wings, 0.60–0.62 mm. Length of ♀: body 5.2–5.3 mm, fore wings 5.0–5.2 mm, hind wings 0.61–0.65 mm. Eyes of ♂ meet on meson of head, lower portion of eyes approximately 3/5 length of upper portion (Figs. 12–13), eyes of ♀ separated on meson of head by a length 4 to 5 times as great as maximum width of an eye. Wings (Figs. 1–5): vein Rs of fore wings forked approximately 1/4 of distance

from base to margin; vein MA forked about 1/2 of distance from base to margin, fork asymmetrical, stem portion of vein MA straight; vein MP forked a little more than 1/3 to less than 1/2 distance from base to margin, fork slightly asymmetrical to symmetrical (see discussion); cubital area as in Fig. 1; cross veins few. Hind wings: costal projection well developed, acute (Figs. 2–4), apex located approximately 2/3 distance from base to margin with vein Sc ending at base of costal projection; MA forked from R_1 at 2/3 distance from base; apex of wings acute and angularly truncated (Figs. 2–4); cross veins few. Legs: ratios of segments in ♂ fore legs, 0.64: 1.00 (1.67 mm): 0.05: 0.38: 0.37: 0.14: 0.10. Claws of a pair dissimilar, one apically hooked, the other obtuse, pad-like (Fig. 6). Genitalia of ♂ (Figs. 7–9): forceps segment 3 3/5 length of segment 2; basal segment long, broadly curved basally; length of styliger plate along median line 1/5 maximum width; penes fused basally, divided in apical 2/3 with ventral appendage arising from apex of each penis lobe (Figs. 7–9). Ninth sternum of ♀ obtuse, truncated to indented apically (Fig. 15); posterior margin of sternum 7 broadly convex, anterior portion of sternum 8 with median elevation and sublateral depressions for extrusion of eggs (Figs. 14–15) [Caudal filaments broken-off apically and lost].

Mature nymph. Head prognathous. [antennae partially broken apically, but at least 1.75 times length of head]. Mouthparts (Figs. 16–21, 26–28): clypeus with lateral margins subparallel, maximum width of labrum 1.15 times maximum width of clypeus; length of labrum ca. 1/2 maximum width, lateral margins rounded, with widest part located 2/3 distance from base (Figs. 19, 21); anteromedian emargination broad, with 5 subequal denticles (Fig. 20). Left mandible (Fig. 16): outer margin evenly rounded with a tuft of setae in the medial area and a few scattered setae in the basal half. Maxillae (Fig. 18): segment 2 of palpi equal to slightly longer than segment 1, segment 3 2/5 to 1/2 length of segment 2. Lingua of hypopharynx with well-developed lateral processes, anterior margin with narrow V-shaped cleft; superlingua with long setae along anterior margin (Fig. 26). Labium (Figs. 27–28): segment 1 of palpi subequal to slightly longer than segment 2, segment 3 slightly less than 1/2 to 2/5 of segment 2, dorsal setae on segment 3 as in Fig. 28; submentum with thick setae on lateral margins. Anterolateral margins of pronotum with 2–4 small spines. Legs (Figs. 22–24): coxae with a few spines as in Fig. 24; femora apically indented so that tibiae can be withdrawn partially into femora, with a row of long spines along outer margin, small spines along inner margin and apical 1/3 of dorsal surface; tibiae sub-triangular in cross section (Fig. 23); tibiae with scattered long setae along outer margin and thick short spines along inner margin; hind tibia with a few pectinate setae on ventral surface; tarsi with scattered setae on outer margin and a row of spines on inner margin; apex of claws hooked and narrow, denticles as in Fig. 24, apical denticle much larger (Fig. 24). Gills (Fig. 25): gills on segment 1–7, lanceolate, dorsal and ventral portions similar, greatest width 1/10 to 1/6 length, progressively smaller posteriorly, tracheae unbranched. Posterolateral

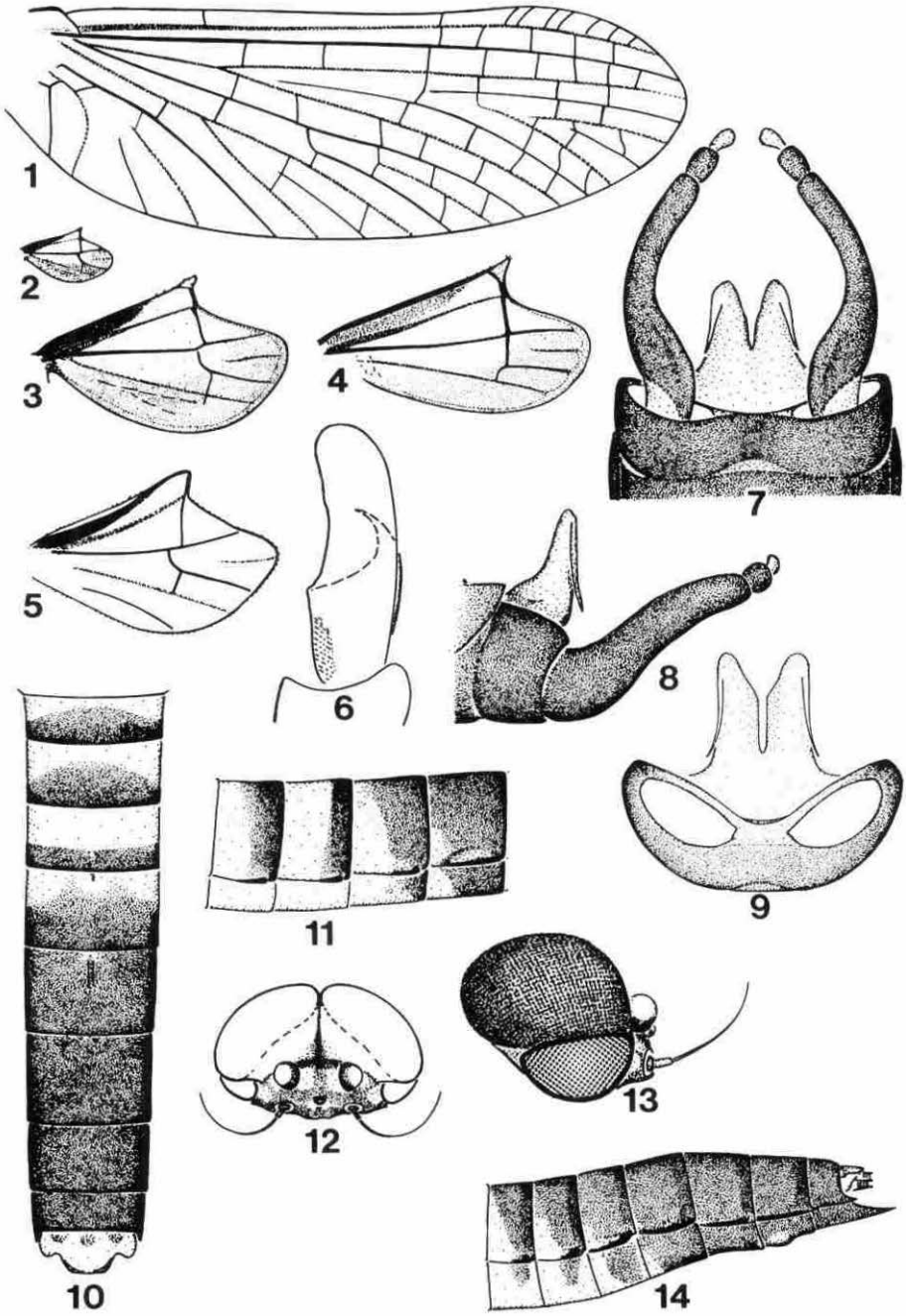
spines present on abdominal segments 8–9. Posterior margins of terga with short denticles. Caudal filaments with whorl of delicate setae in each intersegmental joint [broken at apex].

Discussion. The above nymphal description of *Simothraulopsis* differs from the illustrations of Demoulin (1966) only in the shape of the gills, which are broader than illustrated. Perhaps this resulted from the immaturity of the nymphs studied by Demoulin (the species is described without a color pattern). Gills of young nymphs are narrower than those of mature nymphs, and the length/width ratio of gills of the largest mature female nymph of *S. surinamensis* from Brokopondo, Surinam, is approximately 6 to 1. There is some variation in the hind wings, with a convex vein (CuA ?) posterior to vein MP in some specimens (Fig. 5), and reduced or absent in others (Figs. 2–4).

Simothraulopsis can be separated from all genera of the Atalophlebiinae by the following combination of characters. In the imago: 1) fork of vein MA of forewings asymmetrical, stem of MA straight (Fig. 1); 2) costal projection of hind wings (Figs. 2–5) strongly developed, about 2/3 distance from wing base to margin, with vein Sc ending at base of costal projection; 3) vein MP of hind wings not forked (Figs. 2–5); 4) claws of a pair dissimilar, one apically hooked, the other obtuse, pad-like (Fig. 6); 5) styliger plate curved dorsolaterally (Figs. 7, 9); and 6) penes divided in apical 2/3 with one ventrally directed spine on each lobe (Figs. 7–9). In the nymph: 1) lateral margins of labrum rounded, with widest part located 2/3 distance from base (Figs. 19, 21); 2) mandibular tuft present (Fig. 16); 3) paraglossae of labium ventral to glossae (Fig. 27); a row of 3 thick setae on dorsum of labial palp 3 (Fig. 28); 4) claw with apical denticle greatly enlarged (Fig. 24); 5) posterolateral spines on segments 8–9 only; and 6) gills of moderate width (Fig. 25).

Simothraulopsis is most closely related to *Homothraulus.* It is distinguished in the imagines by the costal projection of the hind wings which is strongly developed and ends about 2/3 of the distance from the wing base, and in the nymph by gills of moderate width (width ≤ 1/6 length). In published illustrations of the fore wings of *Homothraulus misionensis,* a cross vein from vein MP_2 to vein CuA distal to the fork with vein MP_1 may be present or absent. Depending on the position of this cross vein, variation within *Homothraulus* ranges from "vein MP_2 attached to MP_1 by cross vein" to "vein MP asymmetrically to symmetrically forked." The cross vein appears to be absent in *H. lucretiae* (Traver 1960) and it is absent in the series of *Simothraulopsis* imagines which we examined although illustrated in the nymphal wing pad by Demoulin (1966) and

Figs. 1-14. *Simothraulopsis demerara,* winged stages. 1-5, wings: 1-3 ♂ imago (1, fore wing; 2-3, hind wing to scale and enlarged); 4, hind wing of ♀ imago enlarged; 5, hind wing of ♂ subimago enlarged. 6, fore claw of ♂ subimago. 7-9, genitalia of ♂ imago: 7, ventral; 8, lateral; 9, posterior view (forceps removed); 10-11, abdomen of ♂ imago: 10, terga 2-10; 11, lateral view of segments 3-6. 12-13, eyes of ♂ imago: 12, frontal, 13, lateral. 14, lateral of abdominal segments 3-10 of ♀ imago.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present in some subimago wings. This developmental change has led to some confusion in the placement of *Simothraulopsis;* Kluge (1994) used the MP fork and an error in interpretation of the imaginal claw to incorrectly remove *Simothraulopsis* from the *Homothraulus-Farrodes* group.

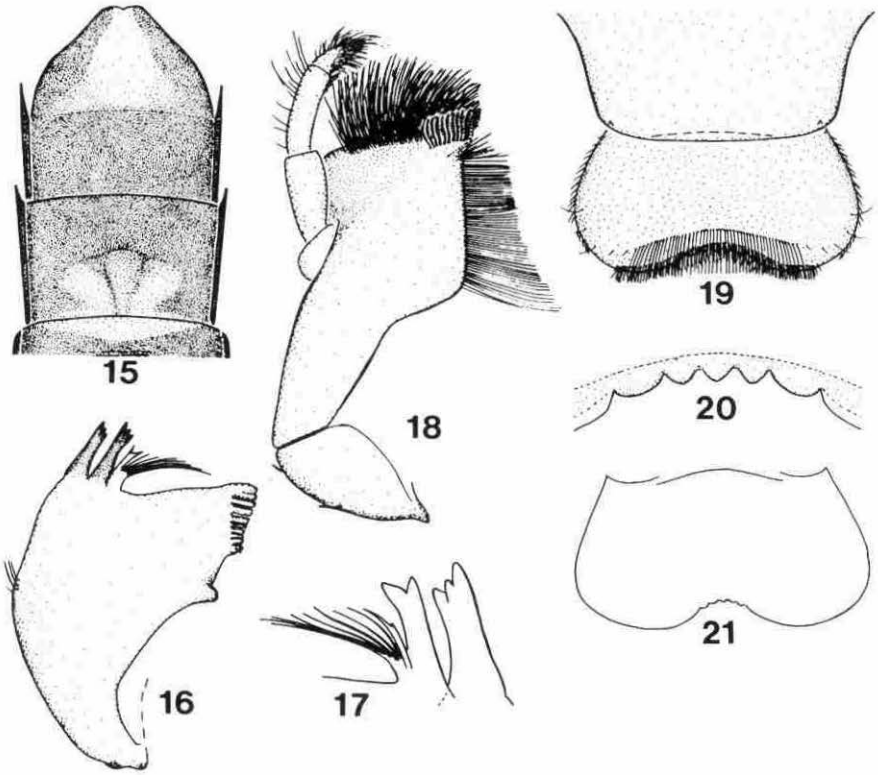
Homothraulus and *Simothraulopsis* may prove to be congeneric, perhaps with subgeneric status for *Simothraulopsis,* but we prefer to maintain the generic status of *Simothraulopsis* at present. No morphological or distributional intermediates are known, and such a taxonomic placement emphasizes the vicariant distribution of the two genera. *Homothraulus is* known from the southern Brazilian Shield and Parana Basin and *Simothraulopsis* from the Guiana Shield and adjacent Amazon Basin. Of numerous subimagines of *Simothraulopsis* examined, only a few specimens were outside the approximate limits of the Guiana Shield illustrated in Savage (1987). An apparent second species of *Simothraulopsis* from Brazil also falls within the Guiana Shield: Amazonas State, rapids, S. Antonio Creek near S. Antonio Mission, NW of Taparaquara, 8–I–1962, E.J. Fittkau (subimagines, specimens at Florida A&M University).

Simothraulopsis demerara (Traver) new combination (Figs. 1–28)

Thraulus demerara Traver, 1947:150; 1960:73.
Simothraulopsis surinamensis Demoulin, 1966:15 new synonym.

Subimagines (in alcohol). Thorax: pronotum yellowish-brown, with carinae and margins blackish; mesonotum pale brown with inner parapsidal sutures and posteromedian area brownish-black, anterolateral margins brownish-black; metanotum light brown, with posterior margin washed with black; pleural sclerites slightly washed with black membranous parts and sterna yellowish. Wings: forewings translucent with veins C, Sc and R yellowish, remainder of veins lighter; hind wings with veins C and Sc black basal to the costal projection, without apical markings (Fig. 5). Abdomen as in imagines (Figs. 10–11, 14), except hyaline portions are translucent yellow. Male genitalia not fully formed, ventral projections of penis lobes extend bladelike at right angles to penes. Caudal filaments: basal two segments black, next three black at apex, apical segments paler.

Mature nymph (in alcohol). Head yellowish washed with brown on frons and between ocelli. Mouthparts (Figs. 16–21, 26–28) yellowish, with lateral area of mandible and basal part of labium washed with brown. Thorax brown with lateral areas of nota and carinae blackish; pleura black, anterior and lateral areas of pro-furcasternum and meso-basisternum black. Legs: yellowish; apical and medial area of femora brownish, subapical band on tibiae and basal band on tarsi brownish (Fig. 22). Claws (Fig. 24) greyish-brown, apex orangish. Abdomen: terga yellowish with posterior band on terga 1–8 blackish, similar to markings of ♀ and ♂ imagines and subimagines (Figs. 10–11, 14–15); terga 9–10 lighter; posterolateral corners of sterna 1–8 with black pigment. Gills (Fig. 25) translucent to pigmented, with black tracheae. Caudal filaments orange-brown.

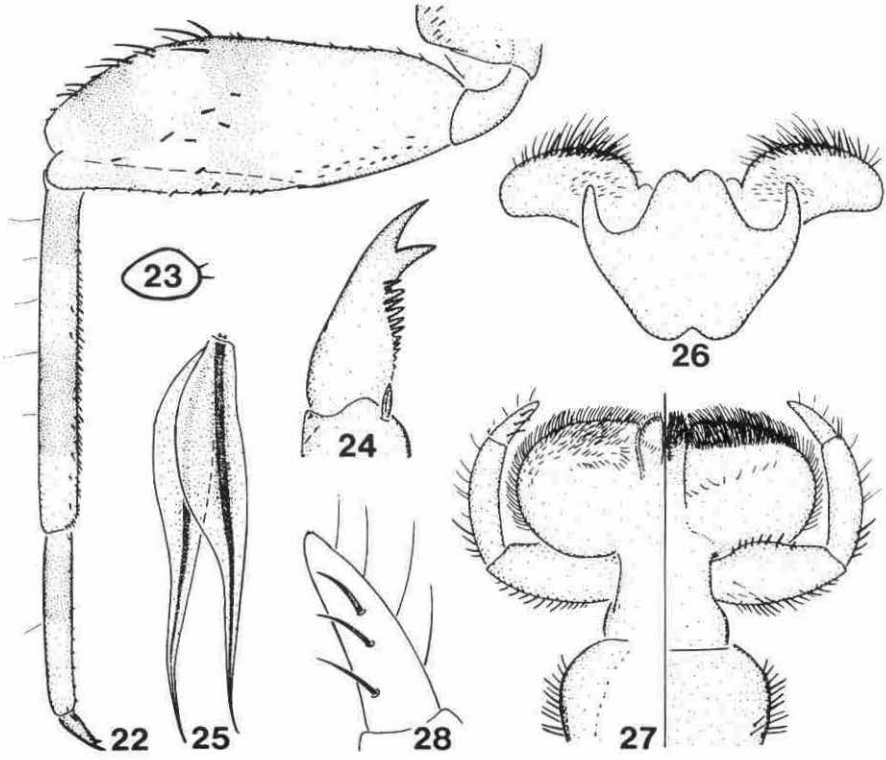


Figs. 15-21. *Simothraulopsis demerara.* 15, posterior abdominal sterna 7-9 of ♀ imago. 16-21, mouthparts of nymph: 16, left mandible; 17, detail of incisor area of right mandible; 18, right maxilla (ventral); 19, clypeus and labrum, 20, detail of anteromedian emargination of labrum; 21, labrum (French Guiana).

Discussion. Imagines of this species were well described by Traver (1947). In this paper, we describe the subimagines, redescribe the nymph and discuss interspecific variation from a large series of subimagines and a smaller series of nymphs and imagines. Illustrations of imagines were made from specimens from French Guiana; illustrations of nymphs were made from specimens from Surinam and compared against nymphs from French Guiana. Association of the stages was based principally on the hind wings and the color pattern of male terga. The black bases of veins C and Sc in the hind wings are present in developing nymphs before the adult coloration is completely formed. The extent to which this black tint extends onto the wing membrane between C and Sc in imagines is variable (Traver 1947 Fig. 5; Figs. 2–5). The brown area in the posterior half of the hind wings of imagines is not evident in nymphs or subimagines (Fig. 5), but it can be seen under the subimago cuticle in strong transmitted

light (compound microscope), confirming that subimagines and imagines represent the same species.

The mesothorax of male imagines varies from solid brown to brown with a medial blackish wash posteriorly. The dark, blackish-brown color pattern of abdominal terga of males varies little between nymphs, subimagines, and imagines: there is some variation in the width of the dark band on terga 2, 3, and 5 (Figs. 10–11); some specimens have a paler median area on terga 8 and 9; and there is variation in the number and intensity of markings on tergum 10. The sternal color pattern of males and females is more variable, with dark markings usually beginning on sternum 3 (Fig. 14) but sometimes beginning on sternum 2 and sometimes not until sternum 5 (Fig. 11); lighter sterna are frequently found in specimens from the Upper Sinnamary River (Saut Maïpouri, French Guiana). During nymphal development, the sternal coloration appears in younger nymphs on the lateral margins of sterna and, as the nymph grows, the color gradually



Figs. 22-28. *Simothraulopsis demerara,* nymph. 22-24, fore leg: 22, leg; 23, cross section of tibia; 24, claw. 25, abdominal gill 4. 26-28, mouthparts: 26, hypopharynx; 27, labium (venter on right, dorsum on left); 28, dorsum of labial palp 3.

extends medially until it covers sterna 5 or 6–9 entirely. In some specimens, the sternal color never closes completely and the median area of some or all sterna is pale. Female coloration varies from reddish-brown to blackish-brown; in cases where color is lighter, the posterior margin of each tergum has a darker blackish band. The markings on the tibiae of the female mesothoracic legs extend from 3/4 to 7/8 the length of the tibiae, sometimes with a paler mark near the base. In females which have not oviposited, the median elevation and lateral grooves on sternum 8 are not as pronounced as those illustrated (Figs. 14–15) which were drawn from a dark-bodied imago void of eggs. Figures of male genitalia were drawn from free-floating specimens to complement Traver's 1947 Fig. 7 which was drawn from a slide.

Material examined. Holotype, ♂ imago, BRITISH GUIANA, Mackenzie, Demerara River, C.U. Entomological Expedition, 24–VI–1927; Allotype, ♀ imago; SURINAM, Kwakoegron, Saramacca River, C.U. Entomological Expedition, 12–VI–1937; paratypes same data as holotype. Additional material: SURINAM Brokopondo Dist., creek on N side of Brokopondo, 26/27–XII–1968, W.L. & J. Peters (3 ♂ and 2 ♀ subimagines, 4 nymphs); Foengoe; 16–IV–1975, Messer col. (4 ♂ and 3 ♀ subimagines). The following material is represented mostly by ♂ and ♀ subimagines (other stages, when present, are specified). VENEZUELA: Bo. Morichal Tauca, 22 mi. E. Rio Caura, 8–9–II–1976, C.M & O.S. Flint, Jr. FRENCH GUIANA: Sinnamary River, V. Horeau col.: Saut Dalles, 8–III–1992, 17–18–VII–1992 (3 ♀), 25–VII–1993 (3 ♀), 8–III–1992 (6 ♀), 10–V–1994 (1 ♂), 7–II–1994; Saut Maïpouri, 24–26–V–1993 (8 ♀), 23–XI–1993 (1 ♀); Saut Aïmara, 14–VI–1994 (1 ♀); No 1817 piége. lum. (2 ♂, 7 ♀).); Saut Deux Roros, 1–XI–1992 (24 nymphs). BRAZIL: Pará State, Rio Paru, Cachoeira below Tiriyo Maloca, 20–III–1961, W. Sattler (1 ♂); Rio Branco, Bôa Vista, 17–IX–1941, H. Sioli (1 nymph); Amazonas State, Rio Aripuana, Beneficente, 18-I-1962, at light, E.J. Fittkau; Amazonas State, at light on R/V Alpha Helix, S. Antonio do Ica, Rio Solimões, 22–II–1977. J.B. Wallace. All other records (2 ♂ and 3 ♀ imagines, 59 ♂ and 35 ♀ subimagines) are from 35 localities in BRAZIL collected at light by E .J. Fittkau between II–1961 and II–1963 from three major areas: Pará State, area around Paru River near Brazil-Surinam border; Pará State, Rio Cururu and area around Cururu Mission; and Amazonas State, Rio Negro and tributaries above Manaus, particularly Rio Cuieiras and Rio Maurauia NW of Taparuquara. Material is located at Cornell University (Ithaca, NY), Florida A&M University (Tallahassee, FL), the U.S. National Museum (Washington, DC), ORSTOM (Fr. Guiana), the Fundacion Miguel Lillo (Tucuman, Argentina) and Zoologische Staatssammlung (Munich, Germany).

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