2009. The Journal of Arachnology 37:39–44

A new micro-whip scorpion species from Brazilian Amazonia (Arachnida, Schizomida, Hubbardiidae), with the description of a new synapomorphy for Uropygi

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Abstract. *Surazomus uarini* n. sp. is described and illustrated based on specimens collected by beating on understory vegetation of Amazonian "terra firme" upland rain forests. A new cuticular structure, possibly a gland opening, is described on the female tarsus I and terminal flagellum. A putatively homologous structure is reported from the same body parts in an undescribed species of *Rowlandius* Reddell and Cokendolpher 1995; *Stenochrus portoricensis* Chamberlin 1922; *Mastigoproctus maximus* (Tarnani 1889); and *Thelyphonellus amazonicus* (Butler 1872); suggesting a new synapomorphy for the clade Uropygi (i.e., Schizomida + Thelyphonida).

Keywords: *Surazomus uarini*, *Rowlandius*, *Stenochrus*, *Mastigoproctus*, *Thelyphonellus*, gland opening, Neotropical, taxonomy

The schizomid fauna of Brazil is relatively poorly known. Currently, only nine species have been recorded for the country (Harvey 2003; Bonaldo & Pinto-da-Rocha 2007), one of them introduced into the Rio de Janeiro coast (Tourinho & Kury 1999) and the remaining species restricted to Amazon forest localities (Cokendolpher & Reddell 2000; Reddell & Cokendolpher 2002). Most of the Brazilian species have been described over the last 10 years as a result of the growing use of collecting methods designed to sample small, ground-dwelling arthropods in different sites of the Amazonian rain forest. The majority of Brazilian schizomid species are known from several specimens recorded only in their type-localities or vicinities. Since the leaf-litter sampling available so far are mainly from Central Brazilian Amazonia, especially in the vicinities of the city of Manaus, and schizomid species are usually endemic to narrow areas, we expect that several new species from Amazonia are waiting to be discovered and described. In this study, a new species of hubbardiid micro-whip scorpion is described and illustrated based on a few specimens collected in western Amazonia. In contrast to other species of the order, *Surazomus uarini* n. sp. was collected from understory vegetation, not leaf-litter. The description also includes a short note on a peculiar cuticular structure, supposedly a gland opening, discovered during SEM study.

METHODS

The material examined is lodged in the following collections (abbreviations and curators in parenthesis): Fundação Universidade do Amazonas, Manaus (UA, N.O. Aguiar); Instituto Butantan, São Paulo (IBSP, A.D. Brescovit); Instituto Nacional de Pesquisas da Amazônia, Manaus (INPA, A. Henriques); Museu de Zoologia, Universidade de São Paulo (MZSP, R. Pinto-da-Rocha). The specimens were examined and illustrated while immersed in 70% ethanol, under a Leica MZ12.5 stereomicroscope with a camera lucida. In order to examine internal female genitalia, the first opisthosomal sternite was excised, provisionally mounted on a microscope slide with clove oil and illustrated using a Zeiss Axioscope 2 Plus binocular microscope with a camera lucida. The appendages examined under a scanning electron microscope (SEM) were removed from specimens, air dried, and fixed on stubs with double-sided tape. The stubs were sputter-coated with gold and then examined with a JEOL (JSM 840A) SEM microscope at the Laboratório de Microscopia Eletrônica, Insituto de Física, USP. The description format follows Pinto-da-Rocha (1996), cheliceral setae were grouped according to Reddell & Cockendolpher (1995:fig. 14). All measurements are in mm.

Additional material examined.—*Rowlandius* new species: BRAZIL: *Paraíba*: 1 ♀, João Pessoa, Área de Proteção Permanente Mata do Buraquinho (07°06′S, 34°52′W), 14–22 October 2003, S.C. Dias (IBSP 003).

Stenochrus portoricensis: BRAZIL: *Bahia*: 1 ♀, Ilhéus, Campus CEPLAC (14°45′16″S, 39°13′50″W), 27 February–6 September 2007, P.P. Santos (IBSP 24).

Mastigoproctus maximus: BRAZIL: *Mato Grosso*: 1 ♀, Chapada dos Guimarães, Usina Hidrelétrica de Manso, 2000, equipe Resgate de Fauna (IBSP 240).

Thelyphonellus amazonicus: BRAZIL: *Amapá*: 1 ♀, Serra do Navio, C.Froelich, W. Narchi (MZSP 14319).

Family Hubbardiidae Cook 1899

Genus *Surazomus* Reddell & Cokendolpher 1995

Surazomus Reddell & Cokendolpher 1995:116–117.

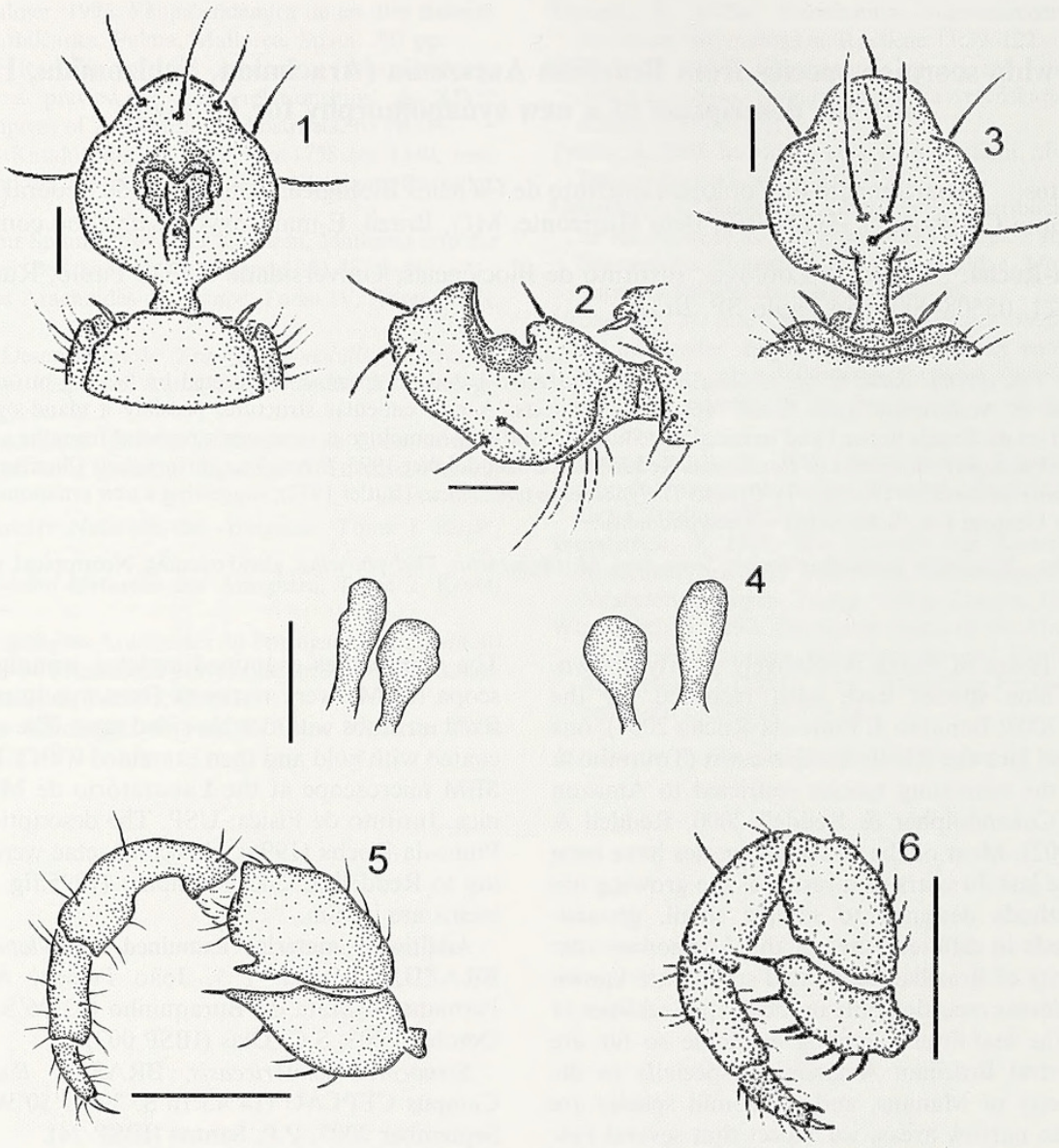
Type species.—*Trithyreus sturmi* Kraus 1957, by original designation.

Remarks.—The genus *Surazomus* currently comprises thirteen species, distributed in Costa Rica and northern South America (Harvey 2003; Bonaldo & Pinto-da-Rocha 2007). Most species occur in the Amazonian forest, mainly in Brazil (six species), Colombia (three species), Ecuador, Peru, and Bolivia (one species each). The new species described below is the seventh known species from Brazilian Amazonia.

Surazomus uarini new species

(Figs. 1–14)

Material examined.—BRAZIL: *Amazonas*: holotype male, Uarini, 03°02′57″S, 65°41′42″W, 22 July–3 August 1995, P.F.



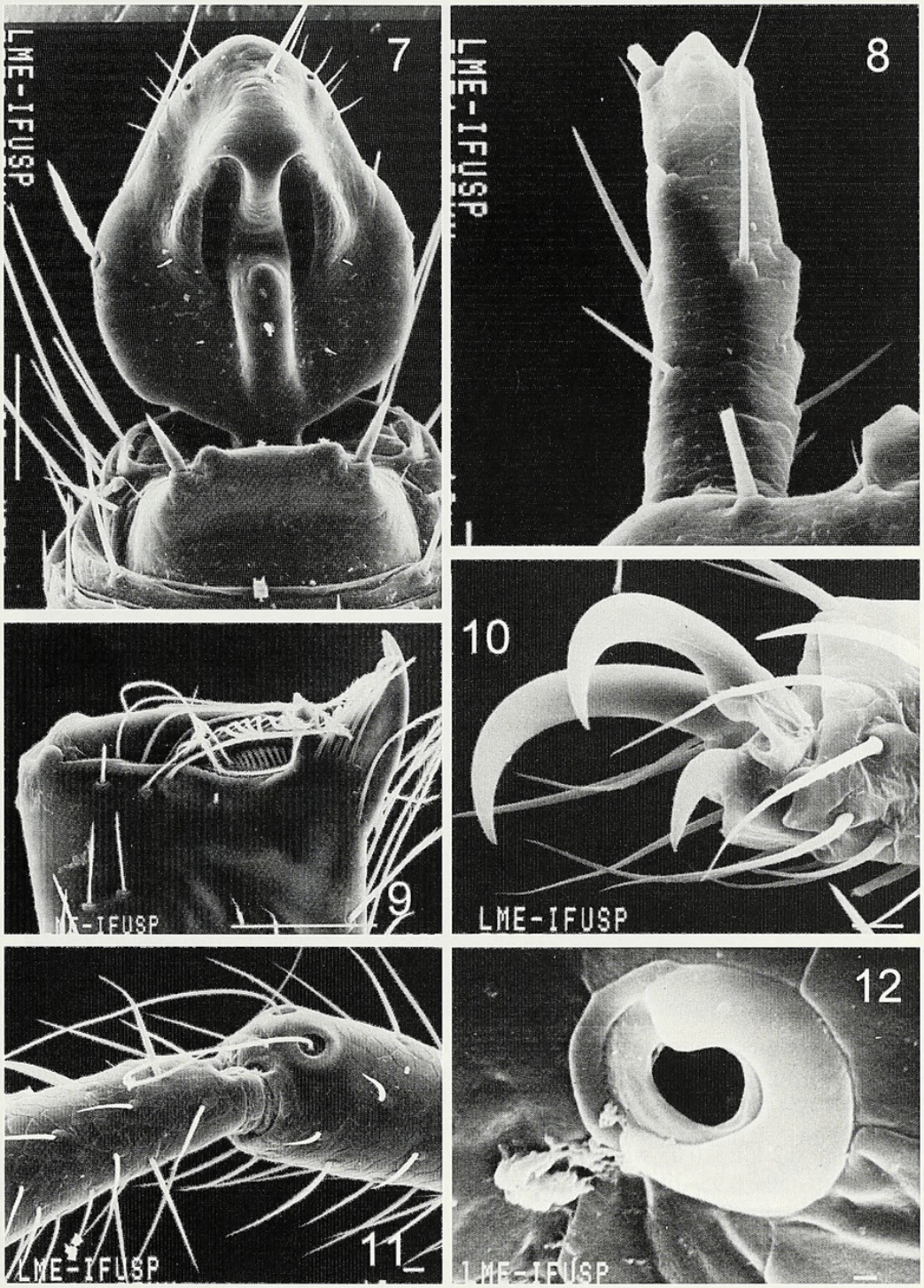
Figures 1–6.—*Surazomus uarini* new species: 1. Male flagellum, dorsal view; 2. Same, lateral view; 3. Same, ventral view; 4. Female internal genitalia, dorsal view; 5. Left male pedipalpus, retrolateral view; 6. Left female pedipalpus, retrolateral view. Scale lines = 0.1 mm (Figs. 1–3), 0.05 mm (Fig. 4), 0.5 mm (Figs. 5, 6).

Bührnheim, N.O. Aguiar (UA). Paratypes: 1 female, collected with holotype (UA); 2 males, 2 females, 2 juveniles, Coari, Rio Urucu, near the airport (04°53′05″S, 65°22′09″W), 17–23 February 1996, P.F. Bührnheim, N.O. Aguiar (IBSP 001); 1 male, 1 female, same data (INPA); 2 males, 2 females, 2 juveniles, same data (UA); 1 male, 1 female, 2 juveniles, same data except 26–29 April 1996 (MZSP 28375).

Etymology.—The specific name is a noun in apposition taken from the type locality.

Diagnosis.—*Surazomus uarini* is similar to *S. rodriguesi* Cokendolpher & Reddell 2000 and *S. mirim* Cokendolpher & Reddell 2000 by the absence of a dorso-apical apophysis on the penultimate segment of the flagellum (Fig. 8). It also shares with *S. rodriguesi* the presence of a pair of plumose setae (vl1) and a pair of hollow depressions on the dorsal surface of the male flagellum (Figs. 1, 7). These species can be distinguished by the normal vl2 setae (plumose in *S. rodriguesi*), hollow depressions in a median position (median-anteriorly positioned in *S. rodriguesi* and *S. mirim*), and the dorsal surface more pronounced posteriorly to the hollow depressions (dorsal surface flattened in *S. rodriguesi*) (Figs. 1–3, 7).

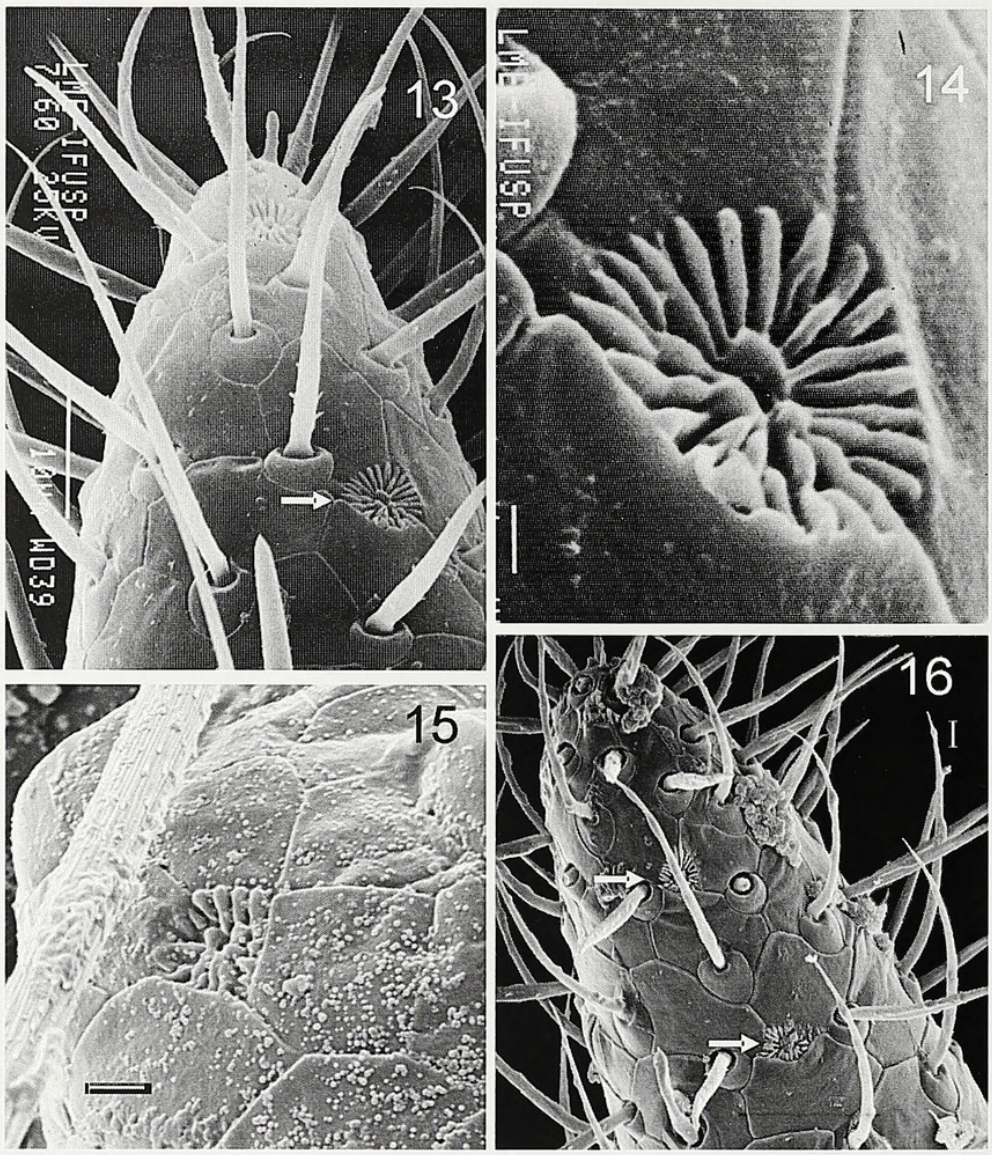
Description.—*Male (holotype)*: propeltidium, metapeltidium, and tergites brownish. Pedipalpus, chelicerae and legs brownish, patella I white in the apical third. Eye spots white and irregular. Propeltidium with three pairs of setae and two setae in a row on the anterior process. Metapeltidium narrowly divided. Anterior sternum with 12 setae, abdominal tergites with two setae each. Opisthosomal tergite XII with two lateral simple and two dorsal spatulate setae. Posterodorsal process vestigial. Terminal flagellum slightly trilobate, with two median hollow depressions delimited laterally by a keel (Figs. 1–3). Flagellum with two lateral paired setae, three dorsal unpaired (Fig. 1), one paired and four unpaired (Fig. 3). Chelicerae (Fig. 9) fixed finger with three smaller denticles between two primary teeth. Serrula of movable finger with 11 teeth. Guard tooth absent, without accessory teeth. Number of setae in group 1 = 3, 2 = 3, 3 = 4, 4 = 2, 5 = 5,



Figures 7–12.—*Surazomus uarini* new species, scanning electron micrographs: 7. Male flagellum, dorsal view; 8. Female flagellum, dorsolateral view; 9. Male chelicerae, ventral view; 10. Male leg IV, tarsal claws; 11. Male tarsus I, penultimate segment, apical trichobothria; 12. Male pedipalpus, base of trichobothrium. Scale lines = 100 μm (Figs. 7, 9), 10 μm (Figs. 8, 10, 11), 1.0 μm (Fig. 12).

6 = 1. Trochanter of pedipalpus with strong acute apical spur and short mesal spur, femur with strong, curved and short (1/3 the length of femur) ventromesal spur (Fig. 5). Patellae curved and constricted in the first half. Penultimate segment of tarsus I with a pair of long dorsal trichobothria, each with a simple base (Fig. 11). Remaining leg trichobothria shorter and with sculptured bases (Fig. 12). Tarsal claws unarmed (Fig. 10), about 1/3 the tarsus length. Tarsal spur ~ 1/5 tarsus length. Total length (excluding flagellum) 2.7, carapace 1.1 long. Flagellum 0.35 long, 0.27 wide. Length of leg segments: I – Femur 0.77/patella 0.85/tibia 0.62/basitarsus-telotarsus 0.62; II – 0.57/0.25/0.35/0.65; III – 0.5/0.2/0.25/0.52; IV – 0.85/0.22/0.52/0.72. Basitarsus-telotarsus I segment lengths: 0.2/0.4/0.4/0.5/0.5/0.5/0.1.

Female (paratype, UA): color and body setation as in male. Flagellum three segmented. Internal genitalia with two lateral pairs of spemathecae. Ectal spermathecae finger-shaped, mesal ones oval, with short ducts (Fig. 4). Trochanter of pedipalpus with rounded apex, without spur (Fig. 6). Patella spur replaced by a short rounded projection. Total length 3.13,



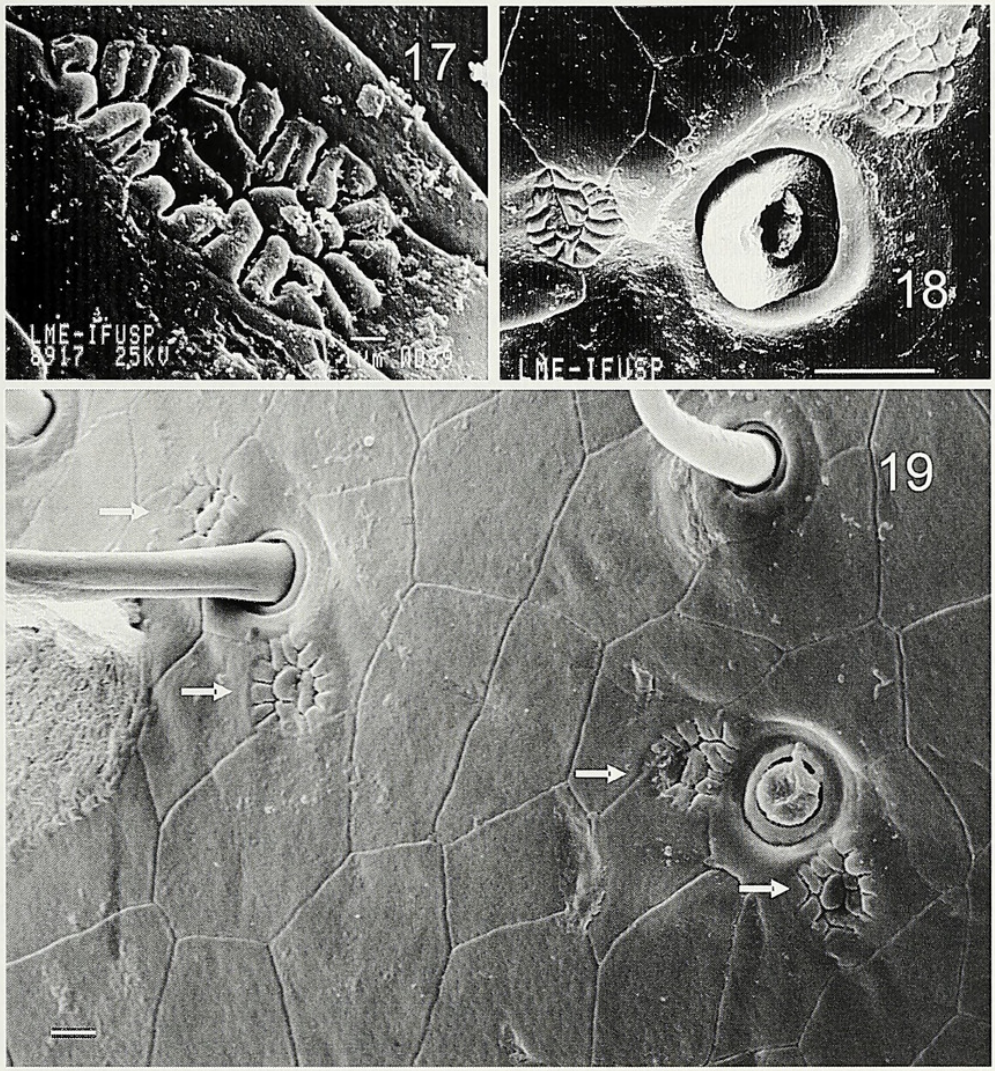
Figures 13–16.—Glandular openings of Schizomida. 13, 14. *Surazomus uarini* new species: 13. Female tarsus I, last segment (arrow: glandular opening); 14. Same, magnified; 15. *Rowlandius* new species, female flagellum, glandular opening; 16. *Stenochrus portoricensis* Chamberlin, 1922, female tarsus I (arrows: glandular openings). Scale lines = 10 μm (Fig. 13), 1.0 μm (Fig. 14), 3.0 μm (Figs. 15, 16).

carapace 1.25 long. Flagellum 0.2 long, 0.05 wide. Length of leg segments: I – femur 0.8/patella 0.95/ tibia 0.6/basitarsus 0.55; II – 0.62/0.32/0.35/0.6; III – 0.5/0.22/0.27/0.5; IV – 0.87/ 0.35/0.6/0.82. Basitarsus-telotarus segment lengths: 0.2/0.3/0.4/ 0.4/0.5/0.5/0.1.

Variation.—Carapace length, males: 0.95–1.1 (n = 6), females: 1.1–1.2 (n = 5). One of the male paratypes (INPA) has the pedipalpus similar to those of females, without spurs on trochanter and femur.

Natural history.—All specimens were collected by beating understory vegetation, mainly on Araceae and Palmae. Amazonian schizomids are usually found in litter or the superficial soil layer, although one species (*Surazomus arboreus* Cokendolpher & Reddell 2000) was observed climbing trees in seasonally flooded Amazonian forests (Cokendolpher & Reddell 2000). *Surazomus uarini* was collected only in non-flooded, upland "terra-firme" forest localities.

Gland opening.—A peculiar cuticular structure was observed in male and female sensorial tarsus I (Fig. 13) and the flagellum. It consists of an aperture with several grooves radiating from a central pore (Fig. 14), and is distributed over much of the segment (Fig. 13). This structure could be a sensory organ or a glandular opening. Several arachnid orders have pore-like chemosensory organs on the tarsus, including Amblypygi (Weygoldt 2000), Araneae (Foelix 1996), and Ricinulei (Talarico et al. 2005). Similar structures are also present in other arthropod groups, although they are usually simple, with only one aperture (see Hallberg & Hansson 1999). The shape of this structure is more consistent with an exocrine gland opening derived from the epidermis (see Noirot & Quennedy 1974, 1991); only histological studies using electron microscopy can fully elucidate its nature. To verify whether this presumed glandular opening is present in other genera of Schizomida and Thelyphonida, we examined other specimens by using a scanning electron microscope. Similar openings were found on tarsus I and flagellum of two other hubbardiid species: in the female of an undescribed species of *Rowlandius* Reddell & Cokendolpher 1995 from northeastern Brazil (Fig. 15), and in the female of *Stenochrus portoricensis*



Figures 17–19.—Glandular openings of Thelyphonida: 17, 18. *Mastigoproctus maximus* (Tarnani 1889): 17. Female tarsus I, glandular opening; 18. Female flagellum, glandular opening. 19. *Thelyphonellus amazonicus* (Butler, 1872): Female tarsus I (arrows: glandular openings). Scale lines = 1.0 μm (Fig. 17), 10 μm (Fig. 18), 3 μm (Fig. 19).

Chamberlin 1922 (Fig. 16). This structure was also observed in the tarsus I and flagellum of *Mastigoproctus maximus* (Tarnani 1889) (Figs. 17, 18) and *Thelyphonellus amazonicus* (Butler 1872) (Fig. 19). As far as we know, nothing similar to that has been reported in other arachnid orders, suggesting that these gland openings could be synapomorphic for the clade Uropygi (sensu Shultz 1990). This hypothesis can be tested in the future with a larger sample of schizomids and thelyphonids, as well as detailed comparisons with other arachnids. It is not impossible that this uropygid gland opening is homologous to the "pit organ" or the "plate organ," two sculptured pore-like structures commonly found in sensory first tarsi of amblypygids, also with unknown function (Weygoldt 2000). In that case, the Uropygi-synapomorphy hypothesis would depend on determining which shape of this structure is apomorphic.

ACKNOWLEDGMENTS

The authors are grateful to Nair O. Aguiar for the loan of the material examined. Scanning electron microscopy was made possible by Pedro Kyohara and Simone Perche de Toledo, from the Laboratório de Microscopia Eletrônica, Instituto de Física da USP. The first versions of the manuscript were improved by Rodrigo Willemart, James Cokendolpher, Mark S. Harvey, Alexandre B. Bonaldo, and an anonymous referee. A.J. Santos received financial support by FAPESP through a doctoral grant (99/05695-8) at Programa de Pós-Graduação em Zoologia, IB/USP; and a post-doctoral grant (03/04868-3) at Laboratório de Artrópodes, Instituto Butantan. R. Pinto-da-Rocha is sponsored by CNPq.

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Manuscript received 26 October 2007, revised 25 May 2008.