

BOLETIM DO MUSEU NACIONAL

NOVA SÉRIE
RIO DE JANEIRO - BRASIL

ISSN 0080-312X

ZOOLOGIA

Nº 461

25 DE OUTUBRO DE 2001

NOTES ON *HOLCOBUNUS* ROEWER, 1910, WITH TWO NEW GENERIC SYNONYMIES (ARACHNIDA, OPILIONES, SCLEROSOMATIDAE) ⁽¹⁾

(With 38 figures)

ANA LÚCIA M. TOURINHO ⁽²⁾

ADRIANO B. KURY ⁽³⁾

Museu Nacional
Universidade Federal do Rio de Janeiro

Unlike the other Palpatores, which are much more diverse in temperate realms, the members of the subfamily Gagrellinae of the Sclerosomatidae are numerous in the tropics of the Oriental and Neotropical regions. This subfamily currently includes about 960 species. ROEWER (*e.g.* 1910, 1923, 1953) used the numbers of pseudoarticular nodules in femora I-IV as diagnostic characters for the genera of Gagrellinae. In the Roewerian system, each genus of the subfamily has a particular number of nodules in the femora of the legs (Fig.1). The other diagnostic characters applied by Roewer and traditional authors in the systematics of Gagrellinae were mainly the armature and shape of the eye mound, external features of pedipalps and armament of the dorsal scutum. However, results of our research (TOURINHO, 2000) revealed that some of these characters show intraspecific variation and others are diagnostic of subfamily rank only, and have been used in mistaken universality level, or are constant and therefore meaningless for generic diagnosis.

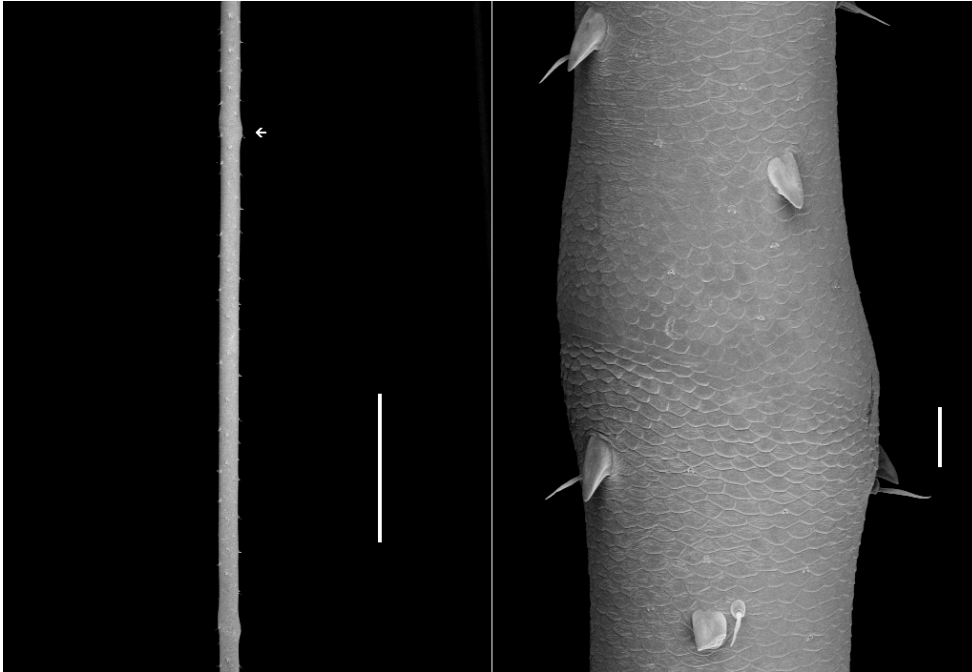
The genus *Holcobunus* was described by ROEWER (1910) based on a female from Brazil. The number of pseudoarticular nodules stated for the genus was one nodule in femora I, III and IV, and three in femora II (formula: 1/3/1/1). The examination of paratypes of the type species of the genus, *Holcobunus nigripalpis* Roewer, 1910, however, revealed that the number of the nodules of its legs is: 2/5/2/2-3, the same number found in *Symphithica* Mello-Leitão, 1933. The female of *H. nigripalpis* is conspecific with the female described as *Symphithica bisignata*, by Mello-Leitão (1933) 23 years later, and synonymized by the same author with *Tamboicus silvicola* Mello-Leitão, 1932b (MELLO-LEITÃO, 1938). Thereby, *Symphithica* Mello-Leitão, 1933 is considered in this paper a junior subject synonym of *Holcobunus* Roewer, 1910. The male of the species is studied, and the penis is described and illustrated.

The characters of the genital morphology are not currently used in the systematics of New World Gagrellinae, because the knowledge of this features is restricted to the work of CAPOCASALE (1967, 1976), for species of *Holmbergiana* Mello-Leitão, 1931, *Parageaya* Mello-Leitão, 1933 and *Pectenobunus* Roewer, 1910; COKENDOLPHER (1984) for *Carmenia* Roewer, 1915; COKENDOLPHER & HUNT (1993) for one species of *Pectenobunus* in the Neotropics, and COKENDOLPHER (1981) for species of *Trachyrhinus* Weed, 1892 in the Nearctic region.

¹ Received on December 18, 2000. Accepted on June 19, 2001.

² Graduate Student, Programa de Pós-graduação em Ciências Biológicas (Zoologia), Museu Nacional Universidade Federal do Rio de Janeiro (MN/UFRJ).

³ Fellow of Conselho Nacional do Desenvolvimento Científico e Tecnológico (CNPq).



Geaya sp. Roewer: fig.1- Pseudoarticulate nodules of the legs, ventral face (scale bar = 1mm); on the right, the same, detail (scale bar = 0.03mm).

Species of *Holcobunus* Roewer, 1910 are recorded from scattered localities throughout the Neotropics: Argentina, Bolivia, Brazil, Chile, Honduras and Mexico. In Brazil, the species are concentrated in the states of Rio de Janeiro and São Paulo of southeastern Brazil. Although ROEWER (1910, 1923, 1953) indicated southern Brazil as the type locality of the type species, there are no records of it outside of the States of Rio de Janeiro and São Paulo. All the other species currently referred to *Holcobunus* from Brazil should be transferred to other genera (TOURINHO, 2000).

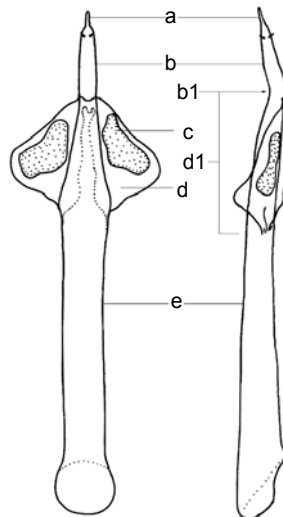
The genus *Paratamboicus* was described by MELLO-LEITÃO (1940), based on a juvenile. This monotypic genus is known only by that one specimen. In this paper, *Paratamboicus* Mello-Leitão, 1940 is synonymized with *Holcobunus*; based on the number and position of nodules of the femora of the legs (femoral Roewerian formula is: 2/6/2/3), the shape of dorsal scutum, and the morphology of pedipalpal tibiae. The generic diagnosis is emended to account for the recorded variation of nodular counts and these are used as meaningful characters, combined with other external and genitalic features.

Both Brazilian species of the genus *Holcobunus* are herein redescribed, emended diagnoses are given for the genus and species, scanning photographs of the penis and ovipositor are given, and standardized terminology is proposed. The morphological characters of the penis are included in the specific and generic diagnoses and the distribution of the genus in the Neotropics is discussed.

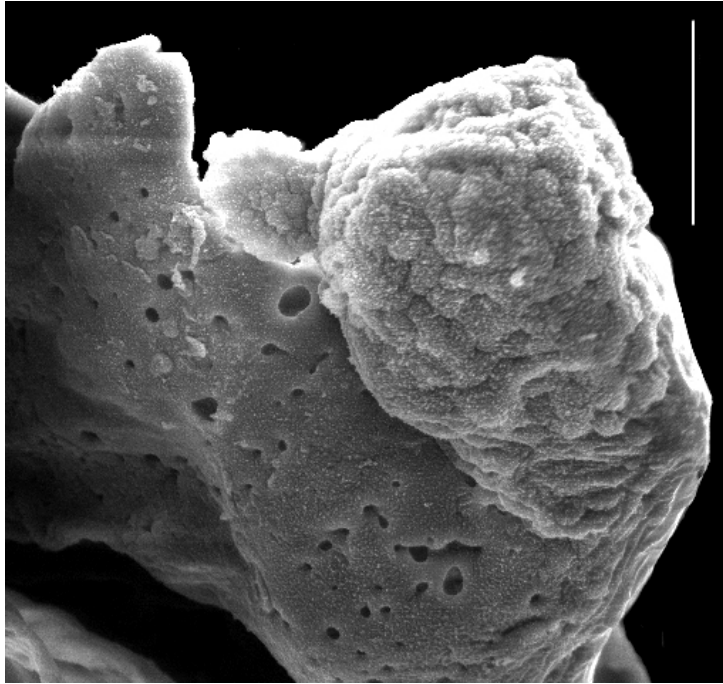
MATERIALS AND METHODS

All measurements were obtained with a binocular microscope equipped with an ocular micrometer. Illustrations were prepared with the aid of camera lucida. The preparation of the genitalic pieces for the scanning electron microscope followed PINTO-DA-ROCHA (1997), with a few modifications. The pieces were washed in water, and afterwards were transferred to liquid detergent diluted in tap water (1 to 3) for 3-5 minutes, and washed again in water. They were not agitated during the washing. The material was transferred to filter paper and air dried for 1-2 minutes (for Palpatores in general, it is not recommended to exceed two minutes, because their penis has a slim and long shaft, and after being washed the pieces tend to bend) and immediately mounted on metallic stubs.

Terminology of the genital morphology: the penis in Gagrellinae is slightly depressed, and has four distinct morphological regions: shaft (= *truncus*) (Fig.2e), alate portion (Fig.2d1) from where the winglets (= *alatae*) are projected, glans (Fig.2b), and stylus (Fig.2a). Some of those names were proposed and used by HANSEN & SØRENSEN (1904), CAPOCASALE (1967), MARTENS (1987), and COKENDOLPHER & HUNT (1993). The beginning of the glans is evidenced by the superior margin of the winglets. On the surface of the glans there are many pores that delimit the end of the glans area, and the beginning of the stylus (Fig.38). In lateral view the distal end of shaft and the beginning of glans portion sometimes form an angle with different inclination levels, herein named shaft-glans angle (Fig.2b1). The stylus surface is smooth without pores. The left and right winglets (Fig.2d) are more or less fused to each other along the median line. Inside each winglet there is a symmetric glandular structure, here named opaque body (Figs.2c, 3). Above the winglets on lateral border of shaft there are pores, rifts, and depressions (Fig.35 in the detail and 37). Sometimes these structures can also be observed dorsally on the alate portion of the shaft.



Schematic Gagrellinae Fig.2- Penis ventral and lateral face, stylus (a), glans (b), lateral angle (b1), opaque matter (c), winglets (d), alate portion (d1) and shaft (e).



Geaya sp. Roewer: fig.3- opaque mater, ventral face. Bar: 0.1mm.

Terminology of the external morphology: the carapace (= *prodorsum* of VAN DER HAMMEN, 1985) includes prosomatic tergites of segments I-V (Figs.4a, 5a). Tergites are completely fused, but sometimes a partial groove can be detected between tergites IV and V, posterior to the eye mound. Also present are a pair of free lateral sclerites beside tergite V (posterior margin of first piece of prosomatic scutum) herein called FLS T5 (Figs.4c, 5c).

Second prosomatic tergite — This is the tergite VI, always distinct from carapace. The pair of free lateral sclerites are here named FLS T6 (Figs.4d, 5d).

Opisthosomatic tergites — These are the nine tergites of somites VII to XV. The first five are fused in a single plate and are here called the dorsalabdominal scute (Figs.4e, 5e). The next two tergites are free and tergites XIV and XV are fused (Fig.5f). On each side of the anal operculum (Fig.6f) rudiments of the *corona analis* are represented by a pair of small triangular pieces (Fig.6g).

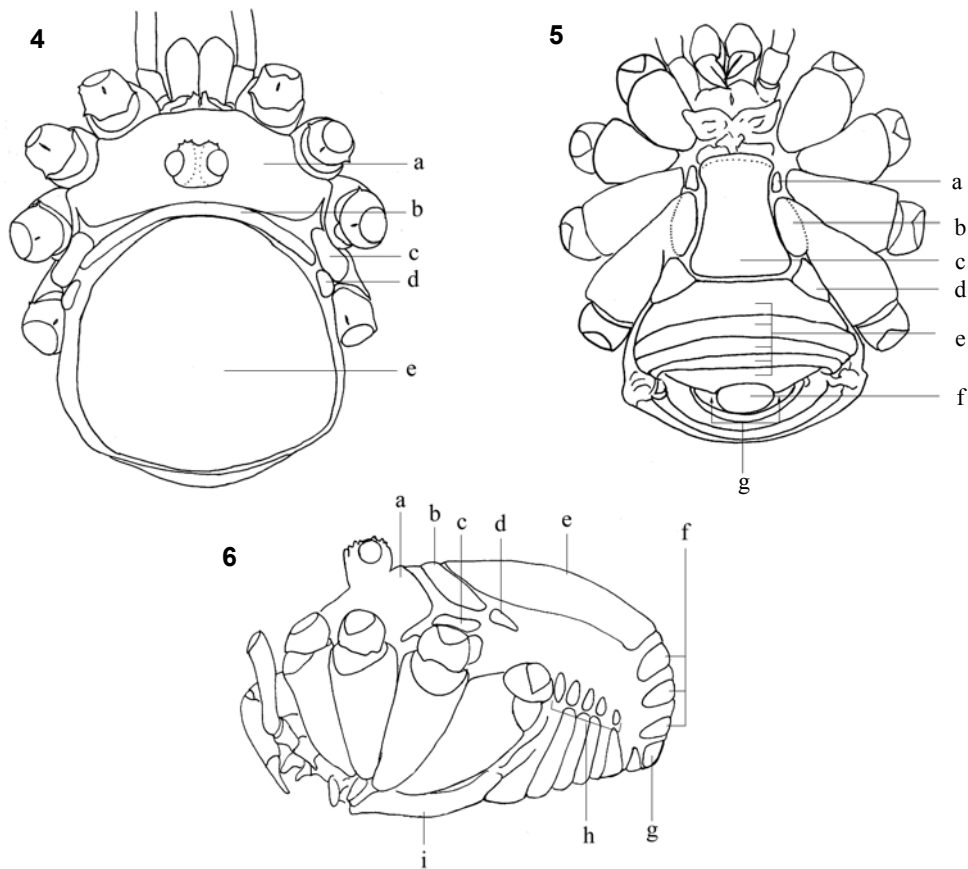
Opisthosomatic sternites — These are the 10 sternites of somites VII to XVI (Fig.6). Sternite VII forms an arch fragmented around the genital operculum. The operculum (Fig.6c) is a long plate that originates from by sternite VIII, which includes a pair of free lateral pieces, here called FLS S8 (Fig.6d). Sternites IX to XIV (XIII and XIV fused) include free lateral pieces (Fig.6e).

Arculi genitales — Paired free sternites located besides genital operculum, anterior pair is called *arculi genitales* I (Fig.6a) and posterior pair is called *arculi genitales* II (Fig.6b). They correspond to the free lateral pieces of sternites X and XI (HANSEN &

SORENSEN, 1904). The descriptions and illustrations of VAN DER HAMMEN (1985) refer to a phalangiid and in most cases the structures are not comparable.

In males of most species examined for this work, the free lateral sclerites of the carapace and opisthosoma are not sharply marked, because they have the body segments tightly arranged. Due to this, the limits between pieces are often indistinct.

Acronyms of repositories are - (MNRJ), Universidade Federal do Rio de Janeiro, Brazil; (ZMUH) Universität von Hamburg, Zoologisches Museum, Hamburg, Germany.



Schematic Gagrellinae: fig.4- Dorsal face, with the following segments indicated: carapace (a), second prosomatic tergite (b), FLS T5 (c), FLS T6 (d), dorsal scutum (e); fig.5- Lateral face, with the following segments indicated: carapace (a), second prosomatic sternite (b), FLS T5 (c) e FLS T6 (d), dorsal scutum (e), tergites XII, XIII and XIV + XV fused (f); sternit XVI (g), free lateral pieces of sternites IX to XIV (XIII and XIV fused) (h), genital operculum (i); fig.6- Ventral face, with the following segments indicated: *arculi genitales* I (a); *arculi genitales* II (b), genital operculum (c), FLS E8 (d), Sternites IX to XIV (XIII and XIV fused) (e), anal operculum (f), lateral pieces of *corona analis* (g).

Sclerosomatidae Simon, 1879

Gagrellinae Thorell, 1889

Gagrellini Thorell 1889:521.

Gagrellinae: WITH, 1903:466; ROEWER, 1910:13, 1923:924-925; MELLO-LEITÃO, 1938:320; ROEWER, 1953:180-181; RINGUELET, 1954:275-277; MARTENS, 1987:89-90; CRAWFORD, 1992:3-8, COKENDOLPHER & LEE, 1993:8.

Gagrellinas: MELLO-LEITÃO, 1932a:16.

Gagrellidae: STAREGA, 1976:95-96.

Distribution – Old World, Nearctic, and Neotropics (from Mexico to Argentina).

Holcobunus Roewer

Holcobunus Roewer, 1910:162, 1923:1069; MELLO-LEITÃO, 1932a:22, 1938:333; RINGUELET, 1954:291; ROEWER, 1953:243; CRAWFORD, 1992:24; COKENDOLPHER & LEE, 1993:8. (type species *Holcobunus nigripalpis* Roewer, 1910, by original designation).

Symphathica Mello-Leitão, 1933:101, RINGUELET, 1953:39; ROEWER, 1953:254; RINGUELET, 1954:301; CRAWFORD, 1992:44. (type species *Symphathica bisignata* Mello-Leitão, by original designation). NEW SYNONYMY.

Tamboicus (part) Roewer, 1912:157; 1923:1073; MELLO-LEITÃO, 1938:333; ROEWER, 1953:253; RINGUELET, 1954:304; CRAWFORD, 1992:44.

Paratamboicus Mello-Leitão, 1940:97, ROEWER, 1953:255 RINGUELET, 1954:297; CRAWFORD, 1992:37. (type species *Paratamboicus bicornutus* by original designation). NEW SYNONYMY.

Former Diagnoses

ROEWER, 1923 – (1) Eye mound as long as high as wide. (2) Eye mound on either side of median groove smooth or with denticles, never with major tubercles. (3) Scute unarmed. (4) denticles of coxae I-IV sharp and trifid. (5) Legs very long and thin. (6) Femur II twice as long as body. Femora III and IV 1.5 times as long as body. (7) Nodular formula: 1/3/1/1.

ROEWER, 1953 – (2) Eye mound on either side of median groove smooth or with denticles, never with major tubercles. (3) Scute uniformly convex, unarmed. (6) Femora I and III longer than body. (7) Nodular formula: 1/3/1/1.

RINGUELET (1959) – (2) Eye mound without high tubercles, smooth, granulous or with denticles. (3) Scute unarmed. (4) denticles of coxae I-IV sharp and trifid. (6) Length of femora: 1.8-4.4/3.4-7.6/2.0-4.4/2.8-5.2 male and 1.5-3.5/3.1-6.3/1.7-3.4/2.2-4.5 female. (7) Nodular formula: 1/3-4/1/1. (8) Tegument coriaceous, mostly with reticle of alveoli or granulous, rarely smooth.

Comments on the characters used in former diagnoses – (1) This character is highly variable among and within genera of Gagrellinae. (2) This is the plesiomorphic state, applicable to most species of Neotropical Gagrellinae. The horns are autapomorphic for *Holcobunus bicornutus* and appear convergently in *Carmenia*. Therefore this character state should be discarded of the present diagnosis because it does not apply to all species of *Holcobunus*. (3) This state matches the diagnosis of *Holcobunus* herein proposed, but it is useless because it is applicable to all species of Neotropical Gagrellinae, and in fact is the only alleged support for the tribe Zaleptini, although it is surely plesiomorphic at this level and not useful for characterizing the tribe. (4) This character state is so widespread among Neotropical Gagrellinae that is

useless in a diagnosis. (5) This applies to all Gagrellinae and most Phalangioidea. (6) The proportions of femoral lengths could be useful in comparisons with a few genera from the open formations of Brazil, but again too much constant among forest genera to serve as a handy diagnostic tool. (7) The nodular formulae are a good character, provided that their variation is acknowledged, but in this case, the paratype of *Holcobunus nigripalpis* possesses a count different of the reported by Roewer. (8) All the possible states are included in this definition.

Emended diagnosis – (1) eye mound dorsally armed with low spines with points either sharp or blunt, located on its anterior half or arranged in two parallel rows. (2) first proximal nodule closer to the base of the femora (0.1-0.3/0.1-0.15/0.1-0.4/0.1-0.3 of the femur length). (3) Lateral margins of supracheliceral lamina crenulate. (4) Dorsal scute in male trapezoid with posterior margin convex, in female markedly pyriform. (5) Pedipalpal tibia sinuous at base (Figs.12, 21). (6) Femoral nodule formula: 2/5-6/2/2-3. (7) Winglets (collapsible sacs) uniform narrow (longer than wide) along all its extension, borders undulated; anterior part in ventral view folding ventrally to form collar (Figs.31, 33). (8) Truncus strongly sinuous dorsoventrally, slightly bent without forming definite angle at glans (Fig.27). (9) Glans globous, stylus long (40% of glans length) (Figs.28, 32). Character states 7-9 are unknown for *H. bicornutus*. Character states 2,4 and 5 are putative synapomorphies for the genus *Holcobunus*.

Distribution of nominal species – South America: Argentina, Bolivia, Brazil, Chile, Colombia; Central America: Honduras; North America: Mexico (Figs.7, 8).

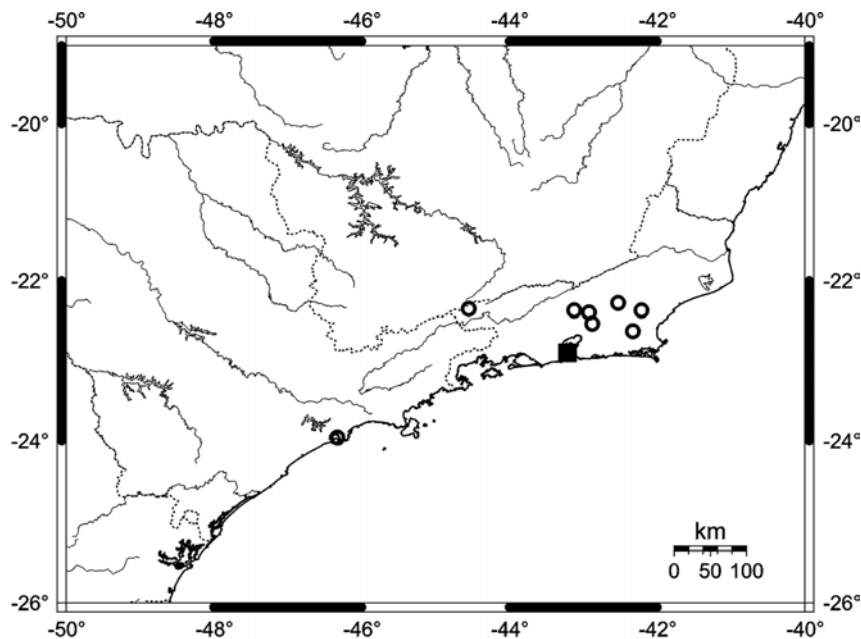


Fig.7- Southeastern Brazil, showing distribution of both species of *Holcobunus*. this map includes Rio de Janeiro State and part of states Espírito Santo, Minas Gerais, São Paulo and Paraná (from the North, counterclockwise). *H. nigripalpis* Roewer, 1910 (●) and *H. bicornutus* (Mello-Leitão, 1940) (■). Dotted lines = Brazilian state boundaries. Thin lines = rivers.



Fig.8- Neotropics, showing distributions of nominal species of *Holcobunus* (●). Dotted lines = Country boundaries. Thin lines = rivers.

Remarks: Both species from Brazilian Atlantic Forest (including the type species) form a very homogeneous group and probably constitute a monophyletic unit. Generic placement of species distributed outside this domain is questionable and will await on a review of those species and of other South American genera.

Species of Brazilian Atlantic Forest included – *Holcobunus bicornutus* Mello-Leitão and *Holcobunus nigripalpis* Roewer.

Species of Brazilian Atlantic Forest removed from *Holcobunus*: *Holcobunus argentatus* Roewer, 1953, *Holcobunus ater* Roewer, 1910, *Holcobunus dentatus* Roewer, 1910, *Holcobunus lineatus* Roewer, 1953, *Holcobunus luteovariatus* Mello-Leitão, 1932a, *Holcobunus quadrimaculatus* Roewer, 1953, *Holcobunus roseus* Mello-Leitão, 1940, and *Holcobunus sigillatus* Mello-Leitão, 1944. These eight species are probably most closely related to the hitherto monotypic *Jussara* Mello-Leitão, 1935. *Holcobunus citrinus* (Pocock, 1903) and *Holcobunus luteipalpis* Roewer, 1910. These two species probably form a group with other species from southern Brazil, currently placed in *Prionostemma* Pocock, 1903, but which will likely constitute a

new genus. *Holcobunus iguassuensis* Mello-Leitão, 1935 is surely a member of the *Pectenobunus* Roewer, 1910/*Acropiliops* Mello-Leitão 1933 assemblage.

Remark – Those species cited above should be removed to other genera as demonstrated in other papers still in preparation.

Key for identification of the species of *Holcobunus* from the Atlantic Forest

1. Eye mound armed with two anterior blunt single pointed tubercles, femur of leg one shorter than body femur of leg II with six pseudoarticular nodules *H. bicornutus*
2. Eye mound with 8-9 short spines, femur of leg II with five pseudoarticular nodules
..... *H. nigripalpis*

Holcobunus bicornutus (Mello-Leitão) new combination
(Figs.9-13)

Paratamboicus bicornutus Mello-Leitão, 1940:97; RINGUELET, 1954:297; ROEWER, 1953:256; CRAWFORD, 1992:37 (juvenile holotype, Brazil, Rio de Janeiro, Jacarepaguá, Pau-da-Fome, 700m, leg. H.Berla, MNRJ 273, examined).

Emended diagnosis – Eye mound armed with two high anterior blunt spines (Figs.9, 11). Femora of leg I shorter than body. Femoral nodule formula: 2/6/2/3.

Material examined: only the holotype.

Redescription of the holotype:

Measurements – body: 3.5mm, carapace: 1.2mm, dorsal scute: 2.3mm, chelicera [combination of lengths of the two joints]: 1.1mm, pedipalps [including trochanter]: 2.0mm, legs femora: 1.7/5.2/2/3.2mm.

Color – Body dull sandy in alcohol. Color information in MELLO-LEITÃO, 1940: body dull-brown, irregularly marbled lighter and black, with median dorsal whitish stripe. Ventral surface of body light-gray, coxae with proximal half as venter and distal half brown. Legs and pedipalps brown and tarsi gray.

Body (dorsal and ventral): Surface densely granulous. Anterior border of carapace with rounded outline (Fig.9). Supracheliceral lamina still in development. Eye mound wider than long. Dorsal scute as wide as long (Fig.9). Ventral surface densely granulous. Lateral borders of genital operculum substraight and unarmed, posterolateral angles with rounded outline, posterior border straight (Fig.10). Arculi genitales II unarmed.

Chelicerae: trochanter armed with an unarticulated ventrobasal blunt spine (Fig.12).

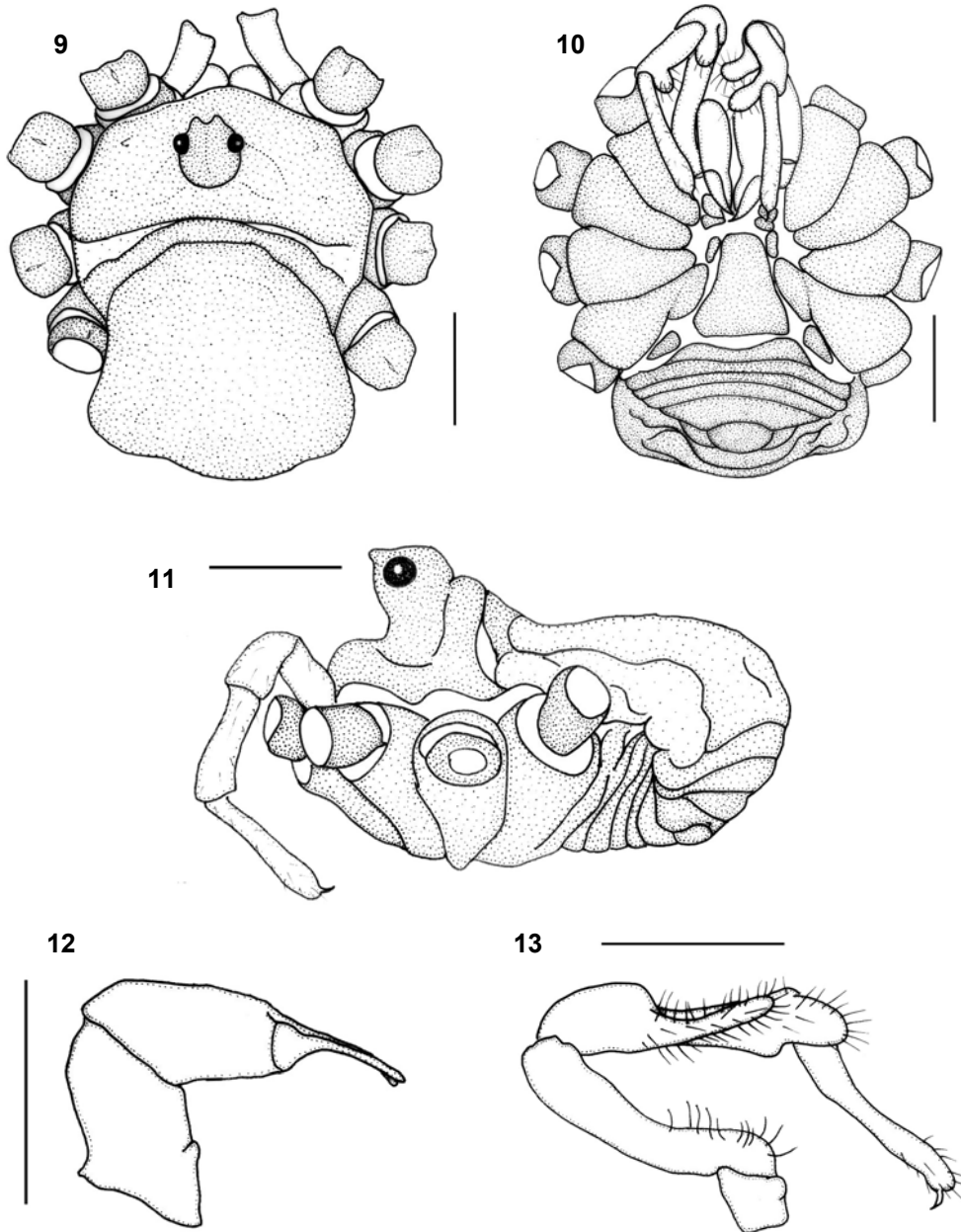
Pedipalps: trochanter, femur, patella, tibia and tarsus unarmed. Distal inner apophysis of patella unarmed, longer than wide, about as long as patella. Distal inner apophysis of tibia unarmed, three times as short and as wide as patella (Fig.13).

Legs: Femoral nodule formula: 2/6/2/3. Position of the proximal nodules: 0.1/0.1/0.1/0.06 of the femora length.

Penis: genitalia still in development, sex of specimen uncertain.

Type locality – Brazil, Rio de Janeiro, Jacarepaguá, Pau-da-Fome (700m).

Distribution – only known from the type locality (Fig.7). Collecting in forested places in Rio failed to yield more specimens.



Holcobunus bicornutus (Mello-Leitão) new combination, juvenile (holotype): fig.9- dorsal face, fig.10- ventral face, fig.11- lateral face (bars: 1.0mm); fig.12- right pedipalp, mesal face, fig.13- right chelicerae, lateral face (bars: 0.5mm).

Holcobunus nigripalpis Roewer, 1910
(Figs.14-38)

Holcobunus nigripalpis Roewer, 1910:163; 1923:1070, figs.1170-1171; MELLO-LEITÃO, 1932a:23, ROEWER, 1953:245. (♀ lectotype 3♂ paralectotypes herewith designed, Brazil, São Paulo, Santos, ZMUH, examined).

The female should be the lectotype because it was the only specimen illustrated by Roewer who wrongly considered it to be a male.

Tamboicus silvicola Mello-Leitão, 1932b:71, 1938:337 [= *S. bisignata*]; RINGUELET, 1954:254 (♀ holotype, Brazil, Rio de Janeiro, Nova Friburgo, MNRJ16133, examined). NEW SYNONYMY.

Sympathica silvicola: MELLO-LEITÃO, 1938:337 [by implication]; RINGUELET 1953:40.

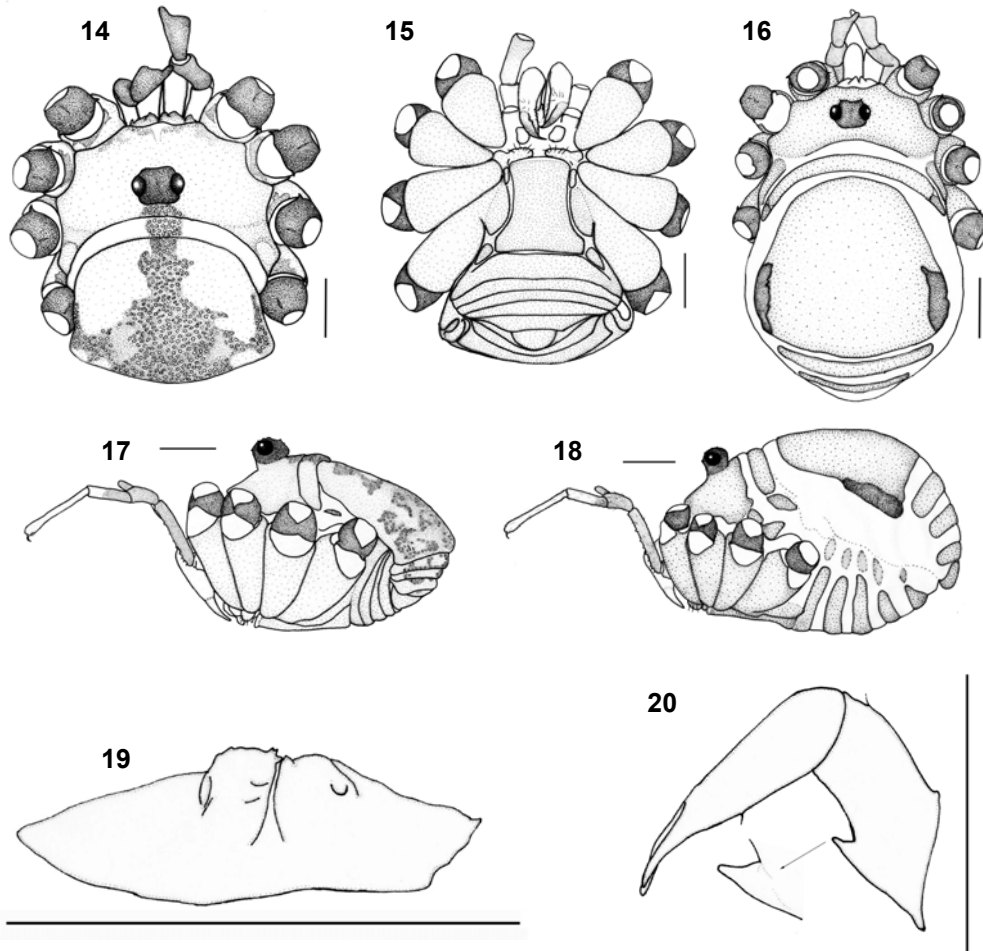
Sympathica bisignata Mello-Leitão, 1933:101; RINGUELET, 1954:301; ROEWER, 1953:255 (♀ holotype, Brazil, Rio de Janeiro, Nova Friburgo, MNRJ 41930, examined). Synonymy of *S. bisignata* with *T. silvicola* confirmed and newly transferred to *H. nigripalpis*.

Sympathica inermis Mello-Leitão, 1933:104, figs.5, 6; ROEWER 1953:255 [*nomen nudum* used by Mello-Leitão only in the figure caption of *S. bisignata*].

Emended diagnosis – body pale yellow and legs black, anterior border of carapace with black spots. Median posterior region of dorsal scute and anterior border of coxae covered by a faint black spot. Anterior median portion of scute and middle of second prosomatic tergite and carapace behind eye mound with longitudinal short stripe of same color. In females this stripe is absent, but with rounded black spot on posterolateral borders. Femur, patella and distal half of pedipalpal tibia black, proximal half of tibia and tarsi pale yellow (Figs.17-18). Eye mound armed with eight to nine sharp spines. Femoral nodule formula: 2/5/2/2-3.

Distribution – BRAZIL. Rio de Janeiro state. Guapimirim, Lumiar, Nova Friburgo, Petrópolis: Itaipava, Rezende: Serrinha do Alambari, Silva Jardim: Aldeia Velha, Teresópolis. São Paulo state. Santos.

Material examined – BRAZIL. 1♂, 2 juveniles MNRJ 58844, Brazil, Rio de Janeiro, Guapimirim, Serra dos Órgãos, 5-6/II/2000 leg. Alessandro Giupponi. 1♀ holotype (*S. bisignata*) MNRJ 41930, 1♀ holotype (*T. silvicola*) MNRJ 16133, 1♂ MNRJ 5965, 1♂ MNRJ 5966, Brazil, Rio de Janeiro, Nova Friburgo. 1♂ MNRJ 6000, Brazil, Rio de Janeiro, Nova Friburgo, 3/II/1991 leg. Adriano Kury. 3♂ 3♀ MNRJ 6496, Brazil, Rio de Janeiro, Nova Friburgo: Lumiar, 6/VIII/1989 leg. Adriano & Leila Kury. 1♀ MNRJ 5497, Brazil, Rio de Janeiro, Nova Friburgo: Rio Grande de Cima, Faz. São João, 11/II/1990 leg. Adriano & Leila Kury. 1♂ 1♀ MNRJ 58835, Brazil, Rio de Janeiro, Petrópolis: Itaipava, 21-23/I/2000 leg. Santiago Rompani. 1♂ 1♀ MNRJ 4349, Brazil, Rio de Janeiro, Rezende: Serrinha do Alambari, 29-31/XII/1992 leg. Adriano Kury. 1♂ MNRJ 6841, Brazil, Rio de Janeiro, Silva Jardim: Aldeia Velha, Faz. Bom Retiro, 20/I/1994 leg. Adriano Kury, Mônica Khalil & Adriana Duran. 1♀ MNRJ 5957, Brazil, Rio de Janeiro, Teresópolis, Parque Nacional Serra dos Órgãos. 3/II/1990. 1♂ MNRJ 5956, 5♂ 1♀ MNRJ 5895, Brazil, Rio de Janeiro, Teresópolis, Parque Nacional Serra dos Órgãos, 3/II/1989 leg. Adriano Kury & Leila Kury. 1♂ MNRJ 5752, Brazil, Rio de Janeiro, Teresópolis, Parque Nacional Serra dos Órgãos, 1/XI/1998 leg. Alessandro Giupponi & Aline Pires. ♀ lectotypes 3♂ paralectotypes ZMUH 125, (*H. nigripalpis*), Brazil, São Paulo, Santos, 1894 leg. Metz.



Holcobunus nigripalpis Roewer – ♂ (MNRJ 5956): fig.14- dorsal face; fig.15- ventral face; fig.17- lateral face; fig.20- right chelicerae with ventrobasal spine in the detail, lateral face. Bars: 1.0mm. fig.19- suprachelical lamina, dorsal face. Bar: 0.5mm. ♀ (MNRJ 5895): fig.16- dorsal face; fig.18- lateral face. Bars: 1.0mm.

Description of male paralectotype

Measurements – body: 4.2mm, carapace: 1.5mm, dorsal scute: 2.3mm, chelicera: 0.8mm, pedipalps: 4.0mm, penis: 1.1mm. Femora: 10.1/19.2/9.5/14.2mm.

Color – Ventral surface uniform pale yellow (Fig.15).

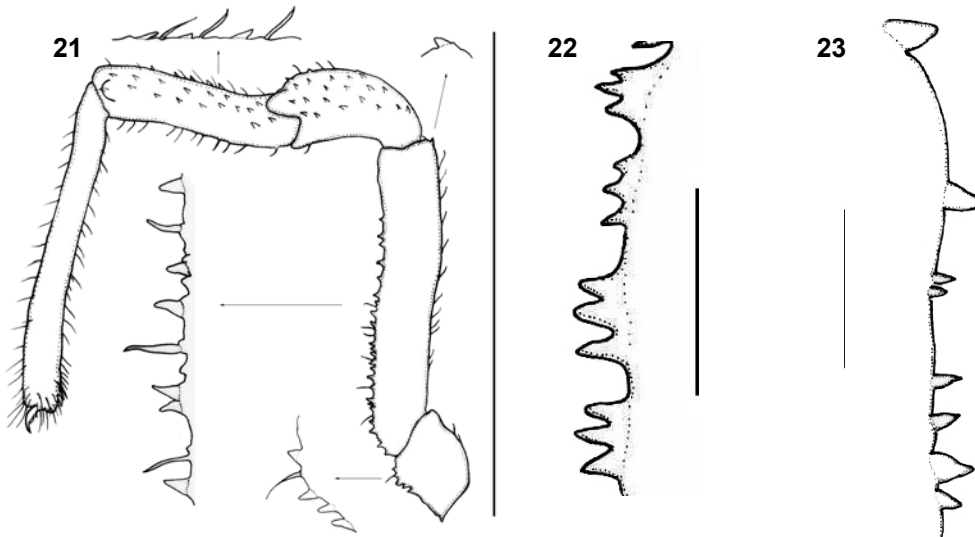
Dorsal surface – body surface densely granulous. Anterior border of carapace with outline slightly sinuous (Fig.14). Suprachelical lamina armed distally with one or two blunt tubercles on each lobe (Fig.19). Eye mound as wide as long, armed with two rows of 10-12 sharp spines. Dorsal scute as wide as long (Fig.14).

Ventral surface – surface densely granulous. lateral margins of genital operculum concave (Fig.15) and armed with a row of sharp spines (Fig.23), posterolateral angles and posterior border with straight outline (Fig.15). Inner lateral border of *arculi genitales* II armed with a row of denticles with three sharp points (Fig.22).

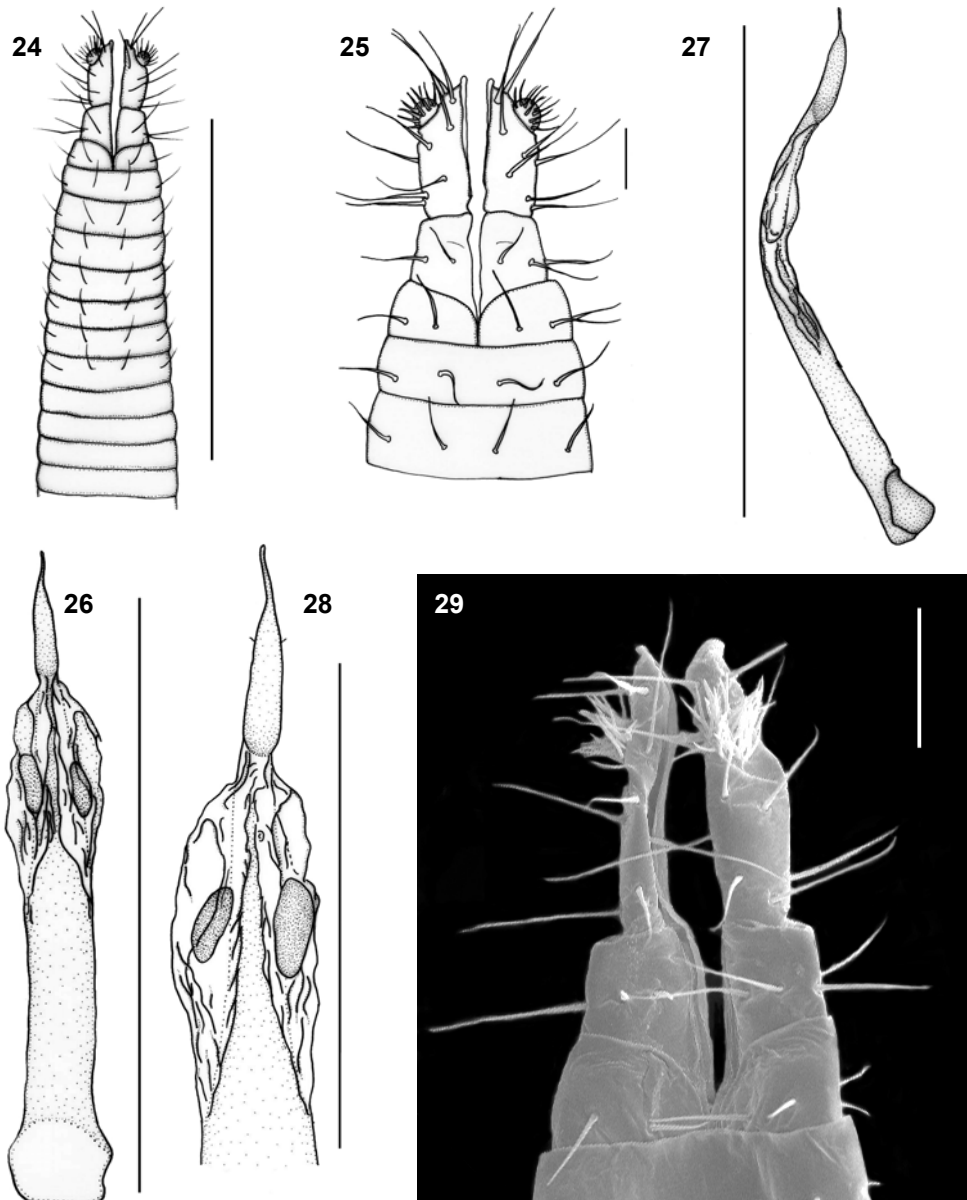
Chelicerae: Trochanter armed with stout ventrobasal unarticulated blunt spine (Fig.20).

Pedipalps. ventral apophysis of trochanter armed with sharp pointed spines irregularly distributed. Femur armed with a ventral row of sharp pointed spines. Patella armed with dorsolateral single-pointed sharp spines, inner apical apophysis as wide and long and unarmed. Tibia armed with dorsolateral single-pointed sharp spines irregularly distributed, inner apical apophysis unarmed and half as long as the patella. Tarsus unarmed (Fig.21). Legs: Femoral nodule formula: 2/5/2/2-3. Position of the proximal nodules: 0.30/0.15/0.44/0.30 of the femora lenght.

Penis: truncus three times wider than glans (Figs.26, 31). Dorsal surface of truncus covered with dorsolateral slit depressions which extend from the base to alate region (Figs.35, 37) and then with large anterior orifice in dorsal view (Figs.35-36). Winglets projected laterally. Dorsal and ventral laminae of winglets fused only in their posterior portion in lateral view (Figs.31, 33-34). Opaque bodies oval and small, located in the middle of winglet (Figs.26-27). Dorsal surface of glans strongly depressed forming a pit (Fig.34), and ventral surface strongly projected. Glans densely covered by simple pores (Figs.27-28), two pairs of lateroapical setae present, superior pair inserted more anteriorly (Figs.31-32). Stylus, in ventral view, slightly bent to the right (Figs.31-32).



Holcobunus nigripalpis Roewer. ♂ (MNRJ 5956): fig.21- right pedipalp, mesal face. Bar: 1.0mm. fig.22- lateral border armature of *arculi genitales* II, dorsal face; fig.23- lateral border armature of genital operculum, dorsal face. Bars: 0.1mm.



Holcobunus nigripalpis Roewer. ♂ (MNRJ 5956): fig.26 penis, ventral face; fig.27- penis, lateral face(bars: 1.0mm); fig.28- distal portion of penis; ventral face (bars: 0.5mm); ♀ (MNRJ 5895): fig.24- distal portion of ovipositor, dorsal face (bar: 1.0mm); fig.25- median anterior portion of ovipositor, dorsal face (bar: 0.1mm); ♀ (MNRJ 58835): fig.29- distal portion of ovipositor, dorsal face (bar: 1.0mm).

Redescription of female lectotype:

Measurements – body: 5.2mm, carapace: 1.3mm, abdominal dorsal scute: 2.6mm, chelicera: 0.9mm, pedipalps: 4.2mm, ovipositor: 1.2mm

Color – as in male, excepted for a dark spot on posteriolateral margins of scute (Figs.16, 18).

Dorsal and ventral surfaces: as in male, except the body swollen dorsoventrally and by having an articular membrane isolating all sclerites. Membrane much evident, widely surpassing sclerites (Figs.16, 18).

Chelicerae and pedipalps: as in male.

Legs – presence of 18-20 pseudosegments in the tibiae of leg II.

Ovipositor – body with 7-9 segments. Second furcal segments each with a distal lirifissure on both the dorsal and ventral surfaces (Figs.25, 29-30).

Description of the juvenile:

Color – juveniles males with color as in adult males. Dorsal and ventral surface of the juveniles females covered with brown spots.

Body (dorsal and ventral) – as in adult, excepted for the supracheliceral lamina still in development. Sharp spines present in the eye mound.

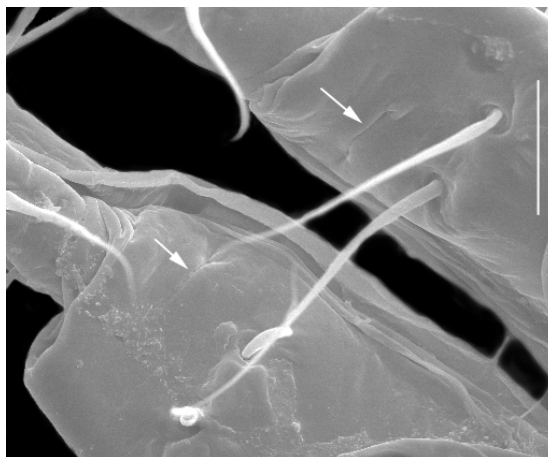
Chelicerae – as the male

Pedipalps – trochanter, femur, patella, tibia and tarsus unarmed. Distal inner apophysis of patella about as long as patella. Distal inner apophysis three times as short and as wide as patella.

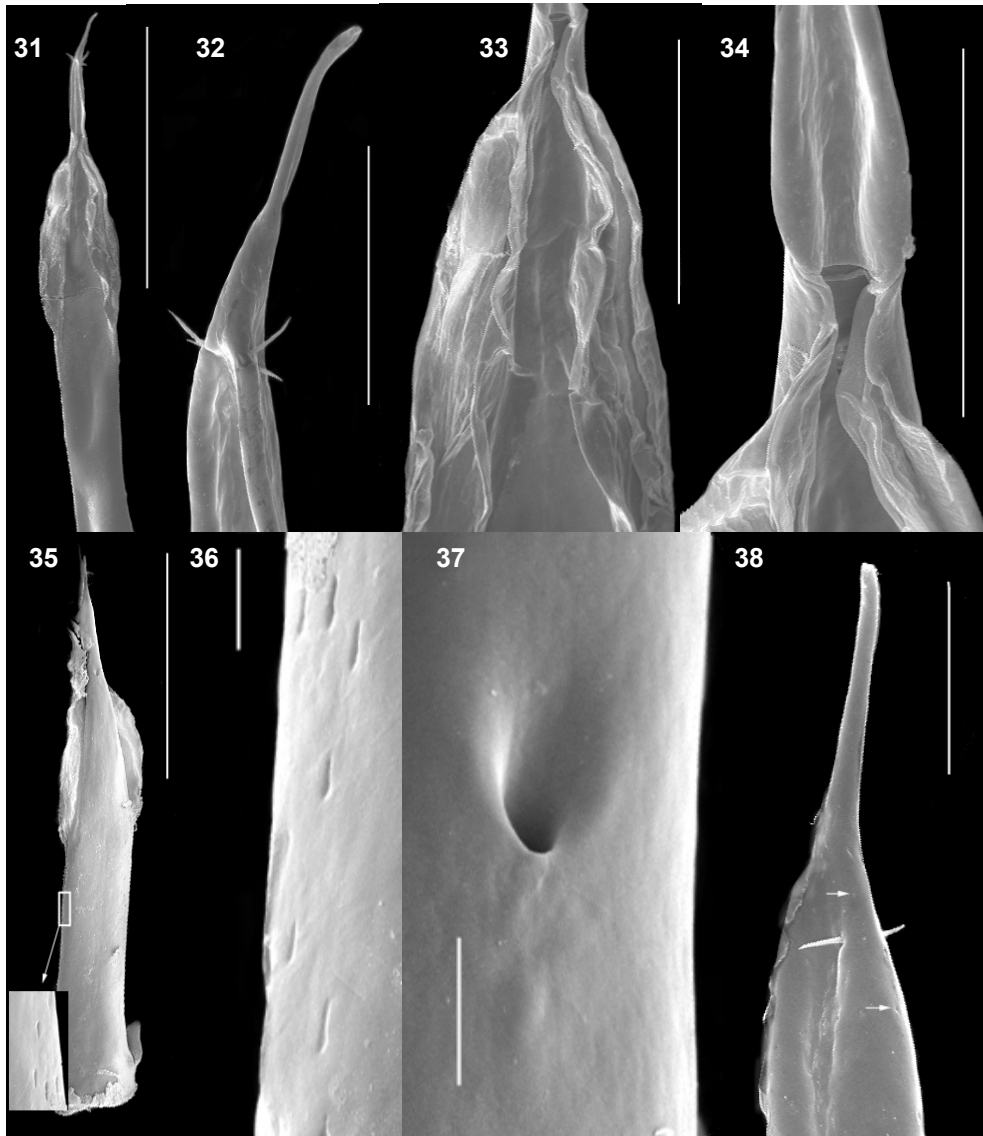
Type locality – Brazil, São Paulo State, Santos.

Distribution – Brazil, Rio de Janeiro State (Guapimirim, Nova Friburgo, Petrópolis, Rezende, Rio de Janeiro, Teresópolis) and São Paulo State (Santos) (Fig.7).

Remark – ROEWER (1910,1923 and 1953) stated that the type locality of *H. nigripalpis* was “South Brazil.” This area includes Paraná, Santa Catarina, and Rio Grande do Sul states. The label in the vial reads “São Paulo - Santos”



Holcobunus nigripalpis Roewer. ♀ (MNRJ 58835): fig.30- segment II of ovipositor furca, with a pair of lirifissures indicated by the arrows, dorsal face. Bar: 0.5mm.



Holcobunus nigripalpis Roewer – ♂ (MNRJ 58835): fig.31- penis, ventral face. Bar: 0,5mm; fig.32- anterior portion of glans, showing lateral-apical setae and stylus, ventral face; fig.33- median anterior portion of winglets, ventral face; fig.34- collar-shaped anterior portion of winglets, ventral face. Bars: 0.1mm. ♂ (MNRJ 5895): fig.35- penis with rift depressions in the detail, dorsal face. Bar: 0.5mm; fig.36- anterior portion of shaft showing the anterior orifice, dorsal view; fig.37- lateral margin of shaft covered with rift depressions, dorsal face. Bars: 0.1mm; fig.38- anterior portion of glans, showing inferior setae, stylus and simple pores indicated by the arrows, dorsal face. Bar: 0,05mm.

DISCUSSION

The subfamily Gagrellinae is a difficult group for systematic study, mainly because the homogeneous morphological pattern of the species. External characters for generic diagnosis are scant, and sometimes inconsistent. There are a lot of possible numeric combinations of pseudoarticular nodules on the femora of gagrellines. It is likely that Roewer (1910, 1912, 1923, 1953, 1954, and 1959) used these counts because they were easily observed and counted, much as he did with the tarsal numbers in his genera of Laniatores. Roewer did not consider the morphology of the genitalia in his studies and therefore was limited to external features in his taxonomy. Thereby, the classification system created by Roewer is arbitrary, and the generic groups raised by that author, and the others that followed his discretionary rules, are formed by species with morphological patterns that do not make any phylogenetic sense.

In the literature, the specific descriptions and diagnoses are confusing. The species of Gagrellinae show a great diversity of body color and design (MARTENS, 1987 and TOURINHO, 2000). However, these patterns are not adequately detailed in descriptions presented by the classical authors, and furthermore, many species were not illustrated. Presently, to identify species of New World Gagrellinae with the characters presented in the literature is time consuming and almost impossible. When it is possible, it is difficult for the researcher to be sure about a positive identification.

CANALS (1935) detected the intraspecific variation of the nodules, when he created the genus *Varinodulia*. MELLO-LEITÃO (1938) followed Canals' concept, and synonymized *Varinodulia* and *Symphathica* with *Tamboicus*. However, ROEWER (1953) did not adopt the proposal of Mello-Leitão. RINGUELET (1953) noted that *Symphathica* and *Tamboicus* were both females of the same species, and revalidated and made the new combination of the names to *S. silvicola*. MARTENS (1987) worked with Nepalian Gagrellinae, and noted that nodules are difficult to work with, because sometimes they are imperceptible and can be confounded with femoral stains. Almost thirty years without any publication on the subfamily in the Neotropics, may be the result of the conflict caused by the classification of Roewer followed by classical authors (MELLO-LEITÃO, 1933 and 1938, RINGUELET, 1954 and GOODNIGHT & GOODNIGHT, 1943; 1945). In this study the pseudoarticular nodules are not discarded, but they are considered as generic characters with variation, and this is combined with other external and genital characters.

It is possible to study other morphological complexes of the Gagrellinae by using the genital morphology of the males with the scanning electron microscope. The morphological diversity of the penial characters provides a more accurate generic identification. On the penis of the new world gagrellines there are regions with useful sets of characters, which are very well defined when shared among groups of species. By using these features it is possible to easily diagnose the morphological patterns of the penis of each genus, despite the higher homogeneity of the external morphology. SUZUKI (1963, 1969, 1970 and, 1977a e b) described the penis in his studies of Asian species. However, he only illustrated the penis of the species, not providing any comparison or diagnoses. CAPOCASALE (1967, 1976) described and illustrated the penis of species included in *Holmbergiana* Mello-Leitão, 1931,

Pectenobunus Roewer, 1910, *Parageaya* Mello-Leitão, 1933 and *Psammogeaya* Mello-Leitão, 1946. Although he did not compare or define the morphological pattern of the penis in each of these genera, he suggested the use of the angle formed between the end of the shaft and the beginning of glans. This feature was successfully applied in this study, as diagnostic of a genus. MARTENS (1987) carefully studied the penes of the Himalayan species. He named the structures, compared, and used them in the generic and specific diagnoses, but the morphological groups defined by Martens are not applicable to the species of the Atlantic Forest. The penis of the Neotropical Gagrellinae has three morphological regions that have great systematic value: the glans which includes the stylus, the alate portion and the shaft. The surface and shape of the glans, the surface, shape, and sculpture of the alate portion and shaft, and the lateral angle of the shaft-glans junction, all can be used to diagnosis genera of the Gagrellinae. We did not detected variation in the shape or the surface morphology of the ovipositor or of the seminal receptacles. Based on our results, the characters of the ovipositor can only be used for higher level groupings.

CAPOCASALE (1967) suggested the armature of the pedipalps as an important generic diagnostic character. The species distributed in the Brazilian Atlantic forest have no effective difference in the armature of pedipalps. However, the morphology other than the armature of the pedipalpal tibiae has been here efficiently applied, in order to separate *Holcobunus* from all other genera distributed in the Atlantic forest. In the species of *Holcobunus* the tibia is sinuous, while it is straight in the other species examined.

Another potentially useful new character is the distance from the pseudoarticular nodules to the base of the femora, here expressed as a ratio. The species of *Holcobunus* have the nodules consistently closer to the base than all other genera of the Atlantic Forest.

H. nigripalpis and *S. silvicola* were both described from females, that have the pattern of dorsal face color different from the pattern of the male. The type material of the two species were examined in this study, and it is quite clear that the same species were described under two different names, *H. nigripalpis* and *S. silvicola*. As both are type species of the genera *Holcobunus* and *Sympathica* respectively, *Sympathica* is herein considered as a junior subjective synonym of *Holcobunus*. It is not known why ROEWER (1910) described the pseudoarticular number of nodules in the femora of *H. nigripalpis* as I, III and IV femora with one, and II with three nodules. When in fact the males, and females of the species have femora I and III with two nodules, II with five, and IV with two or three nodules. The penis of *Holcobunus* is easily recognized by the presence of a sinuous glans and shaft, anterior quarter of winglets collar-shaped, and glans forming cavity in ventral view.

The only species of *Paratamboicus*, *P. bicornutus* Mello-Leitão, 1940, has femoral formula: 2/6/2/3. The presence of one more nodule in the leg II was, for MELLO-LEITÃO (1940), the evidence that supported the inclusion of the cited species in a new genus. The genus *Paratamboicus* is considered in this paper a junior subjective synonym of *Holcobunus*; *P. bicornutus* shares with *H. nigripalpis* a trapezoidal dorsal scutum with convex posterior border, dorsal face of pedipalpal tibiae, and the number and position of nodules in the femora the legs – which were

the morphological evidences used to establish the synonym. The genital morphology has not been defined, because the genital complex of the juvenile holotype is under development.

The species of the genus *Holcobunus* distributed in the Brazilian Atlantic forest and Southern Brazil are here considered to belong elsewhere. The exceptions are *Holcobunus marmoratus* Mello-Leitão, 1938, from Espírito Santo state, and *Holcobunus segadasi* Mello-Leitão, 1949, from Rio de Janeiro state. Neither of them can be recognised from the original descriptions and the holotypes have been lost. Most of the species removed from *Holcobunus* should be transferred to *Jussara* Mello-Leitão, 1935 (unpubl. data). The species referred incorrectly to *Holcobunus* have affinities that were not detected in the type species *H. nigripalpis* in the features of the penis (the winglets wider than longer, strongly expanded laterally, and a longer glans), pattern of body color (trochanter of the legs II is a different color than the other trochanters, frequently a light color or a light tone) and variation of the number of femoral nodules (0-2/3-5/0-1/0-1). The inclusion of *S. aureopunctata* Roewer, 1953 from Trinidad and *Sympathica formosa* Ringuélet, 1953 from Argentina in another genus will await a future revision of the other Neotropical species of Gagrellinae. The two species of *Holcobunus* share external characters that have not been observed in any other species studied for this paper, are endemic to Southeast Brazil, and there are no records of others species of the genus in the Atlantic forest and Southern Brazil. Therefore, it is less probably that the species distributed in the Southeast and Central America and the Amazon species recorded in *Holcobunus* constitute a monophyletic unit with *H. bicornutus* and *H. nigripalpis*.

ACKNOWLEDGEMENTS

We thank Dr. Helene S. Barbosa (Fundação Instituto Oswaldo Cruz) and her staff who provided laboratory facilities and helped with technical procedures in SEM; to Dr. Hieronymus J. Dastych (Zoologisches Museum, Universität Hamburg) for loan of type material, and to Dr. Ricardo Pinto-da-Rocha (Museu de Zoologia, USP, São Paulo) for the SEM micrograph of pseudoarticular nodules. This study was supported by scholarship #132934/1998-1 from CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) to ALMT and grant #300175/94-9 to ABK.

RESUMO

NOTAS SOBRE O GÊNERO *HOLCOBUNUS* ROEWER, 1910, COM DOIS NOVOS SINÔNIMOS PARA O GÊNERO (ARACHNIDA, OPILIONES, GAGRELLINAE)

Os caracteres nos quais está baseada a sistemática do gênero *Holcobunus*, Roewer, 1910 são revisados, e uma diagnose emendada para o gênero é oferecida. Um novo arranjo sistemático baseado na utilização dos caracteres genitais dos machos combinados com os caracteres externos é proposto. A contribuição da morfologia genital para a sistemática dos gênero e a uma distribuição do gênero no Neotrópico são discutidas. A hipótese da redução da área de distribuição para o sudeste Brasileiro é levantada. As espécies registradas ao gênero *Holcobunus* distribuídas na Mata Atlântica são removidas do gênero, todas as remoções são baseadas em

caracteres do pênis combinados com os do pedipalpo, a variação do número e a posição dos nódulos e a cor. Os gêneros *Sympathica* Mello-Leitão, 1933 e *Paratamboicus* Mello-Leitão, 1940 são sinonimizados com *Holcobunus*. Uma diagnose emendada para a espécie-tipo *H. nigripalpis* Roewer, 1910 e para *H. bicornutus* (Mello-Leitão, 1940) nova combinação é proposta. Ambas espécies são redescritas, habitus, pedipalpos, quelicera e lâmina supraqueliceral são ilustrados. O pênis e o ovipositor de *H. nigripalpis* são descritos pela primeira vez, e fotos de microscopia eletrônica de varredura são mostradas.

Palavras-chaves: Palpatores, *Holcobunus*, *Sympathica*, *Tamboicus*, morfologia genital, Gagrellinae, Neotrópico, MEV.

ABSTRACT

The characters used to define the systematics of the genus *Holcobunus* Roewer, 1910 are revised and an emended diagnosis for the genus is provided. A new systematic arrangement based on the use of characters of the male genitalia combined with external characters is proposed. The contribution of the genital morphology to the systematic of the genus and its distribution in the Neotropics is discussed. The hypothesis of the reduction of its distribution to Southeastern Brazil is raised. The species recorded in *Holcobunus* that are from the Atlantic forest are removed from the genus. This action is based on the morphology of the penis and pedipalps, variation of the number and position of leg femoral nodules, and color characters. The genera *Sympathica* Mello-Leitão, 1933 and *Paratamboicus* Mello-Leitão, 1940 are synonymized with *Holcobunus*. Emended diagnoses for the type species *H. nigripalpis* Roewer, 1910 and *H. bicornutus* (Mello-Leitão, 1940) new combination are proposed. Both species of *Holcobunus* are redescribed and the body habitus, pedipalps, chelicerae and supracheliceral lamellae are illustrated. The penis and ovipositor of *H. nigripalpis* are described for the first time under the SEM.

Keys words: Palpatores, *Holcobunus*, *Sympathica*, *Tamboicus*, morfologia genital, Gagrellinae, Neotropics, SEM.

LITERATURE CITED

- CANALS, J., 1935 – Opiliones de la Argentina. El alotipo de *Neopucroliella borgmeieri* (Mell.-Leit.), y descripción de tres generos y cuatro especies nuevos. **Estudios Aracnológicos**, Buenos Aires, **6**:1-12, 5 figs.
- CAPOCASALE, R.M., 1967 – Opiliones del Uruguay, II. Palpatores: revision, adiciones y notas a especies uruguayas. Estudio del pedipalpos y pene como caracteres de valor taxionomico. **Comun. Mus. arg. Cien. nat. "Bernardino Rivadavia", Sec. Ent.**, Buenos Aires, **1**(2):19-36, 6 figs.
- CAPOCASALE, R.M., 1976 – Las especies del genero *Parageaya* Mello-Leitão, 1933 (Opiliones, Phalangiidae). **Physis** (Sec. C), Buenos Aires, **35**(90):33-41.
- COKENDOLPHER, J.C., 1981 – Revision of the genus *Trachyrhinus* Weed (Opiliones, Phalangioidae). **J. Arachnol.**, Indianapolis, **99**(1):1-18.

- COKENDOLPHER, J.C., 1984 - Clarification of the Colombian harvestman genus *Carmenia* with a review of the New World Gagrellinae (Opiliones: Gagrellidae). **Florida Entomol.**, Lutz, **67**(3):471-478.
- COKENDOLPHER, J.C. & HUNT, G.S. - 1993. South American harvestmen of the genus *Pectenobunus* Roewer (Arachnida, Opiliones: Gagrellidae). **Aracnologia**, Montevideo, **16**:1-5.
- COKENDOLPHER, J.C. & LEE, V.F., 1993 - **Catalogue of the Cyphopalpatores and bibliography of the harvestmen (Arachnida, Opiliones) of Greenland, Canada, U.S.A., and Mexico**. Lubbock: Privately Published. iii, 82p.
- CRAWFORD, R.L., 1992 - Catalogue of the genera and type species of the harvestman superfamily Phalangioidea (Arachnida). **Burke Mus. Contr. Anthropol. Nat. Hist.**, Seattle, **8**:1-60.
- GOODNIGHT, C.J. & GOODNIGHT, M.L., 1943 - Phalangida from South América. **Amer. Mus. Novit.**, New York, **1234**:1-19.
- GOODNIGHT, C. J. & GOODNIGHT, M. L., 1945 - Additional Phalangida from Mexico. **Amer. Mus. Novit.**, New York, **1281**:1-17.
- HAMMEN, L. VAN DER, 1985 - Comparative studies in Chelicerata III. Opilionida. **Zool. Verhand.**, Leiden, **220**:1-60, plates 1-34.
- HANSEN, H.J. & SØRENSEN, W., 1904 - **On two orders of Arachnida Opiliones, especially the suborder Cyphophthalmi, and Ricinulei, namely the family Cryptostemmatoidae**. Cambridge: University Press. 174 p., il.
- MARTENS, J., 1987 - Opiliones aus dem Nepal-Himalaya. VI. Gagrellinae (Arachnida: Phalangidae). **Cour. Forschungsinst. Senckenberg**, Frankfurt, **93**:87-202.
- MELLO-LEITÃO, C.F., 1931 - Notas sobre Arachnideos Argentinos. **Ann. Acad. brasil. Sci.**, Rio de Janeiro, **3**(2):83-97, 2 plates.
- MELLO-LEITÃO, C.F., 1932a - Opiliões do Brasil. **Revta Mus. paul.**, São Paulo, **17**(2):1-505, 61 pranchas.
- MELLO-LEITÃO, C.F., 1932b - Pequenas notas aracnológicas: Nota sobre o genero *Iheringia* Keiserl. Um novo Lycosida halophilo. Dois novos opiliões. Três novos Thomisidas. **Bolm Mus. Nac.**, Rio de Janeiro, **8**(1/4):67-75.
- MELLO-LEITÃO, C.F., 1933 - Quatro novos Palpatores neotropicicos. **Ann. Acad. brasil. Sci.**, Rio de Janeiro, **5**(3):99-103, 1 plate.
- MELLO-LEITÃO, C.F., 1935 - A propósito de alguns Opiliões novos. **Mem. Inst. Butantan**, São Paulo, **9**:369-411.
- MELLO-LEITÃO, C.F., 1938 - Palpatores Sul Americanos. **Ann. Acad. brasil. Sci.**, Rio de Janeiro, **10**(4):317-337, 2 plates.
- MELLO-LEITÃO, C.F., 1940 - Mais alguns novos Opiliões Sul-Americanos. **Ann. Acad. brasil. Sci.**, Rio de Janeiro, **12**(2):93-107.
- MELLO-LEITÃO, C.F., 1944 - Alguns curiosos e interessantes opiliões brasileiros. **Ann. Acad. brasil. Sci.**, Rio de Janeiro, **16**(1):13-22
- MELLO-LEITÃO, C.F., 1946 - Nuevos Arachnidos Sudamericanos de las colecciones del museo de Historia Natural de Montevideo. **Comum. zool. Mus. Hist. nat. Montevideo**, Montevideo, **35**(2):1-11.
- MELLO-LEITÃO, C.F., 1949 - Famílias, subfamília, espécies gêneros novos de Opiliões e notas de sinonímia. **Bol. Mus. Nac., N.S., Zool.**, Rio de Janeiro, **94**:1-33, 9 figs.
- PINTO-DA-ROCHA, R., 1997 - Systematic review of the neotropical family Stygnidae (Opiliones, Laniatores, Gonyleptoidea). **Arq. Zool. São Paulo**, **33**(4):163-342.

- RINGUELET, R.A., 1953 – Opiliones de la Argentina: Rehabilitación de los géneros *Symphitica* M.L. y *Varinodulia* C. con la descripción de una especie nueva (Palp. Gagrellinae). **Revta Soc. Ent. argent.**, Buenos Aires, **16**(2):37-41.
- RINGUELET, R. A., 1954 – Opiliones de la Argentina: Dos géneros nuevos de Palpatores. **Acta Zool. Lilloana**, Tucumán, **13**:257-264.
- ROEWER, C.F., 1910 – Revision der Opiliones Plagiostethi (= Opiliones Palpatores). I. Teil: Familie der Phalangiidae. (Subfamilien: Gagrellini, Liobunini, Leptobunini.) **Abhandl. Geb. Naturwiss. herausg. Naturwiss. Verein Hamburg**, Hamburg, **19**(4):1-294, plates 1-6.
- ROEWER, C. F., 1912 [1914] – Beitrag zur Kenntnis der Weberknechte Kolumbiens. In FÜHRMANN, O. & MAYOR, E. (Eds.), Voyage d'exploration scientifique en Colombie, **Mém. Soc. Neuchâteloise Sci. Nat.**, Neuchâtel (5):139-159, pl.7.
- ROEWER, C.F., 1923 – **Die Weberknechte der Erde Systematische Bearbeitung der bisher bekannten Opiliones**. Jena: Gustav Fischer. 1116p.
- ROEWER, C.F., 1953 – Neotropische Gagrellinae (Opiliones, Arachnidae). (Weitere Weberknechte XVII). **Mitt. Zool. Mus. Berlin**, Berlin, **29**(1):180-265.
- ROEWER, C.F., 1954 – Indoaustralische Gagrellinae (Opiliones, Arachnidae). (Weitere Weberknechte XVIII). 1. Teil. **Senckenberg. Biol.**, Frankfurt, **35**(3/4):181-236.
- ROEWER, C.F., 1955 – Indoaustralische Gagrellinae (Opiliones, Arachnidae). (Weitere Weberknechte XVIII). 3. Teil. **Senckenberg. Biol.**, Frankfurt, **36**(1/2):71-121.
- ROEWER, C.F., 1959 – Neotropische Arachnida Arthrogastra zumeist aus Peru, IV. **Senckenberg. Biol.**, Frankfurt, **40**(1/2):69-87.
- RINGUELET, R.A., 1954 – Opiliones de la Argentina: Dos géneros nuevos de Palpatores. **Acta Zool. Lilloana**, Tucumán, **13**:257-264.
- SIMON, E., 1879 – Opiliones. In: **Les Arachnides de France. vii. Contenant les ordres des Chernetes, Scorpiones et Opiliones**. Paris: Librairie Encyclopédique de Roret. p.116-332, il.
- SUZUKI, S., 1963 – A new genus of Gagrellinae (Opiliones) from Japan. **Annot. Zool. Japon.**, Tokyo, **36**(2):97-101.
- SUZUKI, S., 1969 – On a collection of opilionids from southeast Asia. **J. Sci. Hiroshima Univ.**, Hiroshima, **22**(2):11-77, pls.I-IV. (Series B, Division 1 - Zoology)
- SUZUKI, S., 1970 – Report on a collection of opilionids from Nepal. **J. Sci. Hiroshima Univ.**, Hiroshima, **23**:29-57, pls.I-III. (Series B, Division 1 - Zoology)
- SUZUKI, S., 1977a – Opiliones from Taiwan (Arachnida). **J. Sci. Hiroshima Univ.**, Hiroshima, **27**(1):121-157. (Series B, Division 1 - Zoology)
- SUZUKI, S., 1977b – Report on a collection of opilionids from the Philippines. **J. Sci. Hiroshima Univ.**, Hiroshima, **27**:1-120. (Series B, Division 1 - Zoology)
- STAREGA, W., 1976 – Die Weberknechte (Opiliones, excl. Sironidae) Bulgariens. **Ann. Zool.**, Polska Akademia Nauk, Warszawa, **33**(18):287-433.
- THORELL, T.T.T., 1889 – Viaggio di Leonardo Fea in Birmania e regioni vicine. XXI. Aracnidi artrogastri birmani raccolti da L. Fea nel 1885-1887. **Ann. Mus. Civ. Storia Nat.**, Genoa, **7**(2):521-729, pl.5.
- TOURINHO, A.L.M., 2000 – Revisão sistemática dos gêneros da subfamília Gagrellinae no domínio da Mata Atlântica (Opiliones, Palpatores, Sclerosomatidae). Rio de Janeiro, xii, 200p. Unpublished M.Sc. Dissertation, Museu Nacional, UFRJ.
- WITH, C.J., 1903 – New and old Phalangiidae from the Indian region. **J. Linn. Soc.**, Zoology, London, **28**(186):466-509.