

# A Review of *Roquettea*, with Description of Three New Brazilian Species and Notes on *Gryne* (Opiliones, Cosmetidae, Discosomaticinae)

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The genus *Roquettea* Mello-Leitão, hitherto monotypic and known from Brazilian state of Pará, is rediagnosed, the type species, *Roquettea singularis* is redescribed, including a report on two male morphs, being the second record of male polymorphism in Cosmetidae, the first in South America. Three new species are described from northern Brazil — *Roquettea taurina* n. sp. (which possesses a unique horned ocularium) and *Roquettea jalapensis* n. sp. (without notable scutal structures), both from the state of Tocantins, being the first record of the family Cosmetidae from Tocantins; and *Roquettea scrotalis* n. sp. (with a unique 2-balled dorsal tuberos complex) from Amapá state, being the first record of the subfamily Discosomaticinae from Amapá. *Roquettea* is compared to the closely related genus *Gryne*, both currently placed in Discosomaticinae, and also to *Protus*, the type genus of the subfamily. The unity of Discosomaticinae is discussed, and evidence for the monophyly of this subfamily is weak at best. Male genitalia are for the first time illustrated and described for genera *Protus*, *Roquettea* and *Gryne*, and SEM micrographs are used for the first time in descriptions of Cosmetidae.

**Key words:** Laniatores, Grassatores, Neotropics, cerrado, ocularium, tuberos complex

## INTRODUCTION

The northern Brazilian state of Tocantins was only recently (1988) made independent from Goiás. Natural biomes of Tocantins include basically the central Brazilian savannah (“cerrado”), with patches of northern Brazilian rainforest. Samplings of terrestrial arthropods have been made only occasionally, with scarce findings for most groups. Thus, due both to the xeric environment and to the paucity of collections, the literature records of Opiliones for Tocantins are meager, with only one laniator (Kury, 2003) and one Eupnoi (Mello-Leitão, 1939). Therefore, as expected, an expedition by Museu Nacional (MNRJ) to the state of Tocantins in June 2007 revealed a wealth of opiliono-fauna, with several hitherto unrecorded families (Kury et al., in press), among those 2 new species of the cosmetid *Roquettea*. Another expedition by MNRJ to the Brazilian state of Amapá revealed one more new species of *Roquettea*. Amapá is covered by broadleaf rainforest with a small stripe of cerrado. All three new species are treated below, along with the type species, in a review of this genus.

Cosmetidae is currently divided into 2 subfamilies — Cosmetinae C.L. Koch, 1839 with smooth claws on tarsi III–IV, and Discosomaticinae Roewer, 1923 with pectinate claws on tarsi III–IV (e.g., Roewer, 1923). This arrangement was rejected by Ringuélet (1959), because it does not use any information from other morphological characters.

Pectinate claws are apomorphic within the Cosmetidae, but in the absence of a cladistic analysis of the family, there is no secondary homology hypothesis supporting this as a synapomorphy for Discosomaticinae. Indeed, there is insufficient information on the fine structure of the pectinate claws to even consider them to be a primary homology. Kury (1994b) hypothesized the independent appearance of pectinate claws in many lineages of Gonyleptoidea. There is a great asymmetry in the diversity of cosmetid subfamilies; Cosmetinae has 685 species, while Discosomaticinae only 30. Therefore, even in the best scenario favoring Discosomaticinae, pectinate claws represent a synapomorphy for a very small group, perhaps making Cosmetinae a paraphyletic group. Different genera of Discosomaticinae appear each superficially closest to different genera of Cosmetinae, and there is no evidence other than the pectinate claws uniting all of them. Out of 10 genera in Discosomaticinae, five are monotypic — *Bodunius*, *Fortalezius*, *Paragryne*, *Roquettea* and *Sibambea*. *Gryne* is the largest with 11 species. Results of our research point to a special similarity between *Gryne* and *Roquettea*, regardless of whether Discosomaticinae forms a clade.

This is the first use of SEM micrographs in a description of Cosmetidae, only 2 images of *Metavononoides* sp. (earlier identified as *Paecilaemula* sp.) were previously used in a general characterization of the family (Pinto-da-Rocha, 1997; Kury and Pinto-da-Rocha, 2007).

## MATERIAL AND METHODS

A number of specimens of many genera of Cosmetidae have been examined for this project for comparative purposes, and we

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find it to be needlessly space-consuming to list all of them here. We have specially studied specimens of many species of *Protus* Simon, 1879 and *Gryne* Simon, 1879. Illustrations of some diagnostic features of related genera *Protus* and *Gryne* are given in Figs. 1–4.

Descriptions of colors use the standard names of the 267 Color Centroids of the NBS/IBCC Color System (<http://www.anthus.com/Colors/Cent.html>) as described in Kury and Orrico (2006). Scanning Electron Microscopy was carried out with a JEOL JSM-6390LV at the Center for Scanning Electron Microscopy of Museu Nacional/UFRJ. All measurements are in mm.

Abbreviations of the repositories cited are: HSPC (Private Collection Helia Soares, presently in MNRJ), IBSP (Instituto Butantan, São Paulo), MNRJ (Museu Nacional, Rio de Janeiro), ZMUC (Zoological Museum, University of Copenhagen). Abbreviations of relevant Brazilian states are AP = Amapá, MA = Maranhão, MT = Mato Grosso, PA = Pará, PI = Piauí, TO = Tocantins. Other abbreviations used: CL = carapace length, CW = carapace width, AL = abdominal scutum length, AW = abdominal scutum width, Tr = trochanter, Fe = femur, Pa = patella, Ti = tibia, Mt = metatarsus, Ta = tarsus.

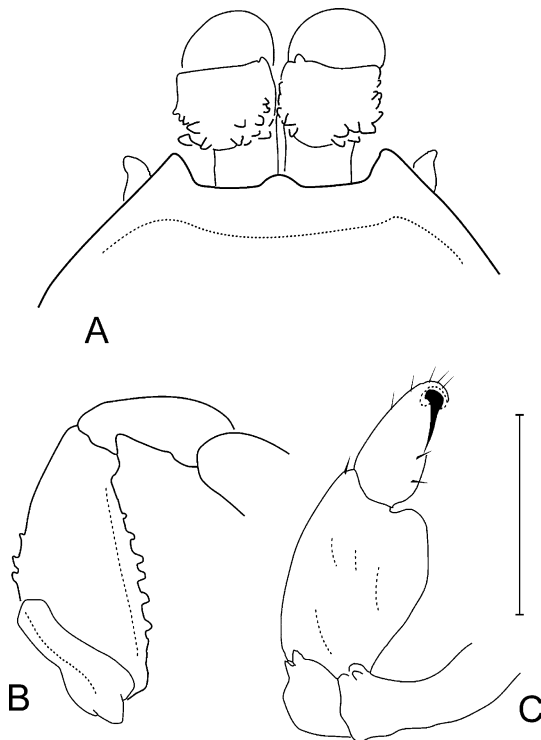
Tarsal formula: numbers of tarsomeres in tarsus I to IV, when an individual count is given, order is from left to right side (figures in parentheses denote number of tarsomeres only in the distitarsus I–II).

### SYSTEMATIC ACCOUNTS

#### *Gryne* Simon, 1879

*Gryne* Simon, 1879: 194; Kury, 2003: 87 (complete synonymy).

**Type species.** — *Gryne paraensis* Simon, 1879, by

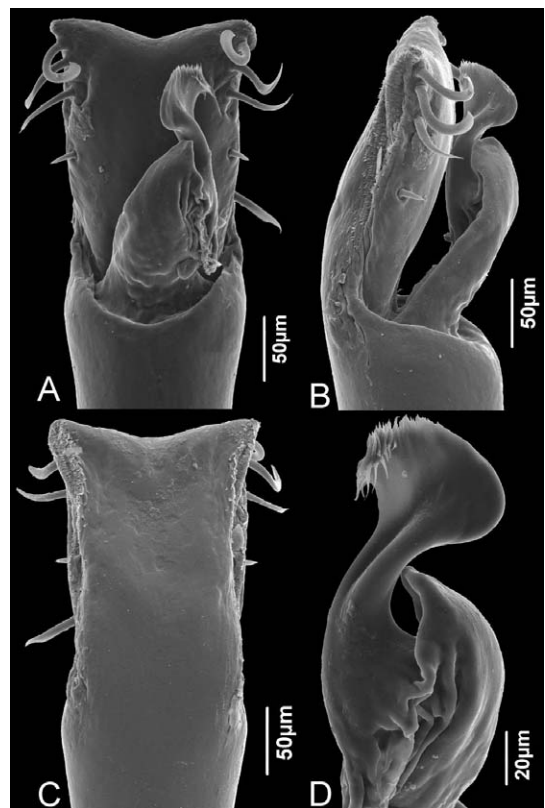


**Fig. 1.** *Protus rotundus* (Roewer, 1917): male (MNRJ 5776) from Selva Aliñahuí (Napo), A, basichelicerite and anterior border of carapace; B, left pedipalpus, C, Tr-Pa mesal view, Pa-Ta ventral view. Scale bars = 1 mm.

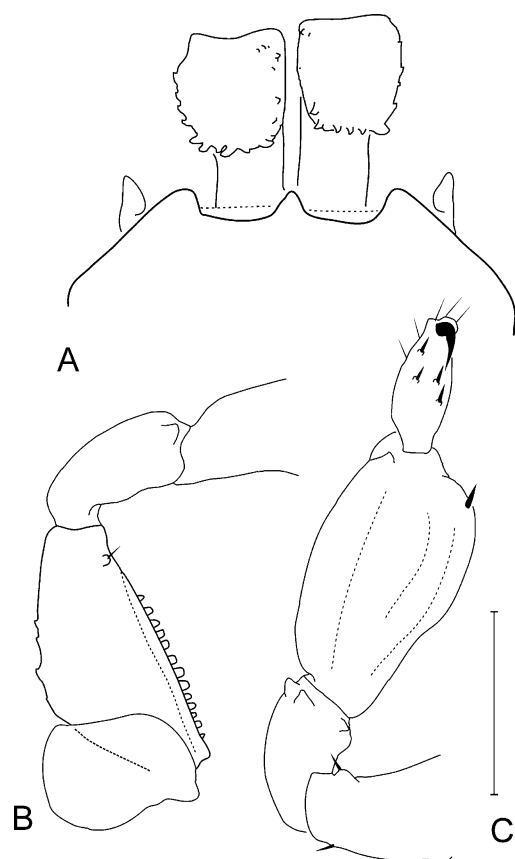
monotypy (currently under the synonymy of *Gryne marginalis*).

**Etymology.** — Genus name from Greek mythology, *Gryne* (the name of an Amazon loved by Apollo). Gender feminine.

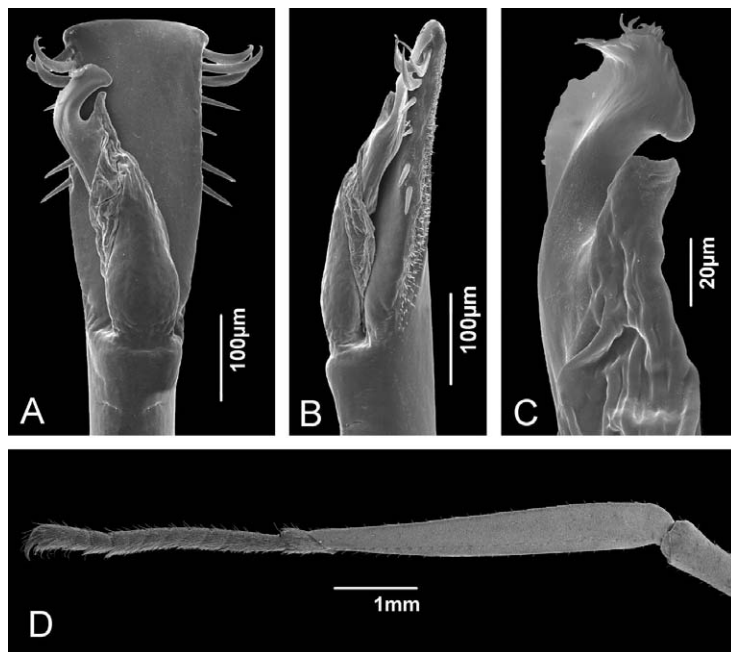
**Diagnosis.** — Dorsal scutum outline with both lateral constrictions attenuate, being posterior lateral constriction displaced posteriorly (thus, conforming to scutal type beta of Kury et al., 1997), tegument finely granular; area I armed with a pair of acuminate tubercles; area III armed with a pair of spines or tubercles, with granular base. Chelicerae not inflated in either sex, posterior margin of bulla with numerous simple acuminate tubercles (Fig. 3A). Pedipalpal femur without remarkable features, with a few dorsal teeth (Fig. 3B). Distal borders of pedipalpal tibia subsquare (Fig. 3C). All legs elongate and slender, III–IV not stouter than I–II. Leg IV sexually dimorphic: metatarsus of male much shorter and swollen (more notably in proximal part) and with polygonal cross-section (Fig. 4D); tibia longer and curved apically. Tarsal claws of legs III–IV with paramedial pectination, formed by 2 rows of 6 teeth each (variable, some specimens of *G. perlata* and *G. coccinelloides* show notable reduction of pectination). Penis (Fig. 4A–C): Ventral plate of penis subrectangular elongate, at least 3 times longer than width of truncus; pre-setal area (portion of lateral border of PV basal to the macrosetae) long, around 1.6 times longer than width of truncus. Macrosetae clustered in 3 groups: 1) distal group of 3 large spatulate curved setae + 1 shorter straight;



**Fig. 2.** *Protus* sp.: male (FMNH AK 121g) from Cusuimi, Pastaza, Ecuador, distal part of penis: A, dorsal view; B, lateral view; C, ventral view; D, glans, lateral view.



**Fig. 3.** *Gryne marginalis* (Perty, 1833): male (MNRJ 17579) from Belém (Pará), A, basichelicerite and anterior border of carapace; male (MNRJ 2156) from Belém (Pará), left pedipalpus, B, Tr-Pa mesal view, C, Pa-Ta ventral view. Scale bars = 1 mm.



**Fig. 4.** Features of genus *Gryne*: *Gryne marginalis* (Perty, 1833): male (MNRJ 17579) from Belém (Pará), distal part of penis, A, dorsal view; B, lateral view; C, glans, dorso-lateral view; d. *Gryne perlata* M-L, 1936, male (MNRJ 19162) from Una (Bahia), left metatarsus IV, prolateral.

2) 1 very short intermediate seta; 3) 2 straight long setae.

**Included species.** *Gryne amazonica* Roewer, 1947, *Gryne andina* Roewer, 1947, *Gryne coccinelloides* (Mello-Leitão, 1935), *Gryne dimorpha* Mello-Leitão, 1928, *Gryne leprosa* Sørensen, 1932, *Gryne marginalis* (Perty, 1833), *Gryne orensis* (Sørensen, 1879), *Gryne perlata* Mello-Leitão, 1936, *Gryne pluriarcuata* Mello-Leitão, 1936, *Gryne pustulata* Roewer, 1928 and *Gryne vermiculata* Mello-Leitão, 1944.

**Combined distribution.** The species of *Gryne* occur in 1) the semi-arid diagonal of South America (Chaco, Pantanal, Cerrado and Caatinga), 2) Amazonian lowland forest and 3) Atlantic forest (Pernambuco state only). In spite of having a Venezuelan species called “andina,” this genus is absent from the Andes, the so-called *Gryne andina* occurs in Maracay, which lies on the slope of the Cordillera de la Costa, very far from the Andes, as previously noted by González-Sponga (1992). It is possible that Roewer confused this locale with the similarly named Maracaibo.

#### **Roquettea Mello-Leitão, 1931**

*Roquettea* Mello-Leitão, 1931: 117; 1933: 104; 1935: 115; Kästner, 1937: 389, Kury, 2003: 89 [type species *Roquettea singularis* Mello-Leitão, 1931, by original designation].

*Tetracyphus* Sørensen, 1932: 312 [junior subjective synonym of *Roquettea* Mello-Leitão, 1931 by Mello-Leitão (1933); type species *Tetracyphus mirabilis* Sørensen, 1932, by monotypy].

**Etymology.** — Genus name honors Brazilian Anthropologist Edgar Roquette-Pinto (1884–1954), who was a colleague of Mello-Leitão in the Museu Nacional. Gender feminine.

**Diagnosis.** — Outline of dorsal scutum of the beta type, with slightly marked constrictions (Fig. 12A). Lateral projections of the cheliceral sockets very large and obtuse (Fig. 12B). Dorsum covered with abundant scattered white dots. Areas I and III armed with a pair of spines of variable size (Figs. 6A, 8A, 15), sometimes giving rise to immense globoid structures (Fig. 13A). The spines can be concolorous with background or darker (Figs. 5A, 7A). Other mesotergal areas, free tergites and anal operculum unarmed. Genital segment expanded, visible laterally (Fig. 13A). Genital operculum granular, with lateral projections, strongly concave. Chelicerae equal in both sexes, with posterior margin of bulla toothed (Fig. 5B). Pedipalpus sexually dimorphic in the male apical portion of tibia contains an ectal expansion with one to four spiniform projections, which is opposed to the tarsus, forming a pincer (Figs. 5D, 7D, 9D); the female pedipalpal tibia spatulate (Fig. 14D). Legs I–IV elongate, thin and straight. Tarsal claws of legs III and IV with paramedian pectination, formed by two rows of five teeth each. Fibrous outer covering of penis (velum) short, as broad as an ovipositor. Penis and velum projected frontwards (as opposed to ventro-frontal in most Cosmetidae). Ventral plate rectangular, with apex slightly wider (Fig. 11A, C), flattened dorso-ventrally (Fig. 11B), lateral border straight or slightly concave, apical bor-

der with mild or accentuated concavity (Fig. 11A, C). Body glans translucent (see-through without clarification). Four to five pairs of apical long macrosetae oriented distally, curved, sub-straight or straight (Fig. 11A–C). There may be a pair of sub-apical or medial macrosetae, short and straight, directed distally (Fig. 11A–C). One or two pairs of macrosetae basal sub-equal, long and straight, directed proximally. Glans narrow and diaphanous, with dorsal process finger-like, stylus elongate, with apex expanded, bearing a crest of hyaline fringes (Fig. 11D).

#### Key to the males of the species of *Roquettea*

1a: Area III of male armed with a pair of immense inflated globoid structures.... 2

1b: Area III of male armed with a pair of conical spiniform projections.... 3

2a: Dorsal protuberances formed by 2 balls....  
*Roquettea scrotalis* n. sp.

2b: Dorsal protuberances formed by 4 balls....  
*Roquettea singularis* Mello-Leitão, 1931 (alpha males)

3a: Ocularium modified, containing a pair of strong horn-like frontward-directed conical projections.... *Roquettea taurina* n. sp.

3b: Ocularium normal (not containing a pair of conical

projections).... 4

4a: Paired spines of area I well-developed; spines of area III in the middle of scutum, erect.... *Roquettea singularis* Mello-Leitão, 1931 (beta males)

4b: Paired spines of area I vestigial, as minute granules; spines of area III in the back of scutum, pointing backwards.... *Roquettea jalapensis* n. sp.

#### *Roquettea jalapensis* new species (Figs. 5–6)

**Type material.** — ♂ holotype (MNRJ 19046) Brazil, TO, Mateiros, Parque Estadual do Jalapão, Cachoeira do Formiga, 16.vi.2007, A. Chagas, A. Giupponi, A. Kury & A. Pérez leg. WWF Ecoregion NT0704 (Cerrado).

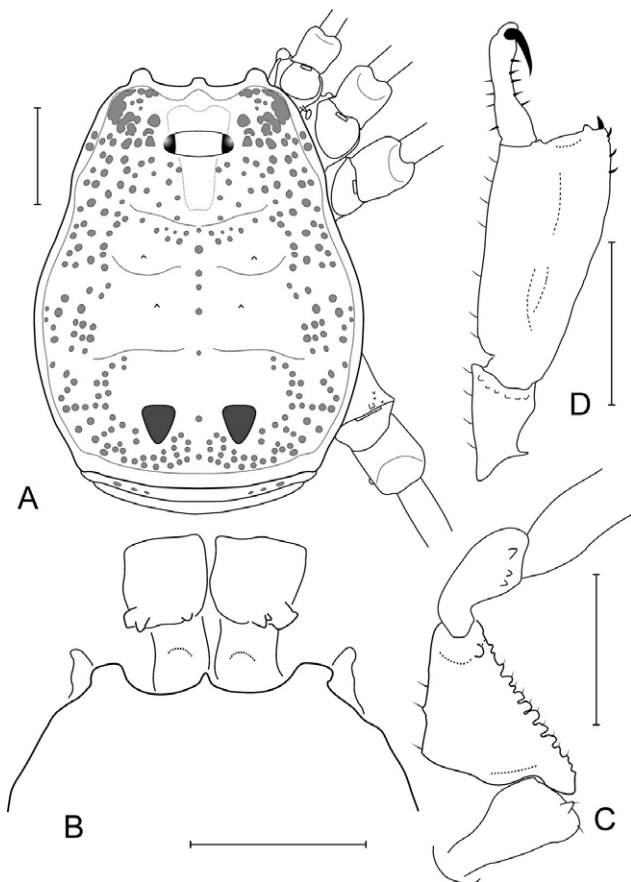
**Etymology.** — From Jalapão, the type locality.

**Diagnosis.** — White dots all around dorsal scutum except for the mesotergal region, which has only a median longitudinal row (Fig. 5A). Area III armed with a pair of large conical spiniform processes, darker than background (Fig. 5A). Eye mound normal, without horns, mesotergum without rounded protuberances (Fig. 6A). Pedipalpal femur with triangular dorsal projection (Fig. 5C).

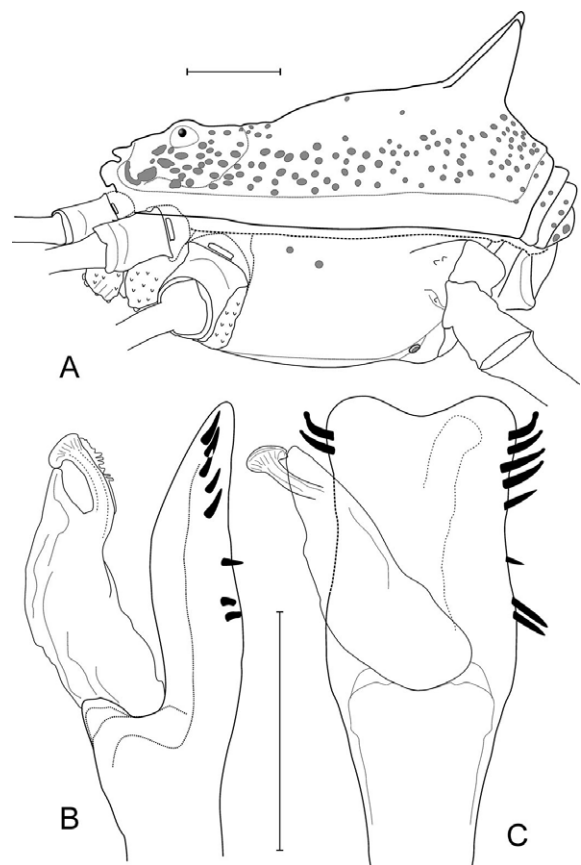
#### Description of ♂ holotype (MNRJ 19046)

**Measurements.** — CL: 1.62, CW: 2.66; AL: 2.63, AW: 3.34. Appendage measurements in Table 1.

**Dorsum (Figs. 5A–B, 6A).** — Anterior edge of dorsal



**Fig. 5.** *Roquettea jalapensis* new species, male holotype (MNRJ 19046) from Parque Estadual do Jalapão (Tocantins): A, habitus, dorsal view; B, basichepicerite and anterior border of carapace; left Pp, C, Tr-Pa mesal view; D, Pa-Ta ventral view. Scale bars = 1 mm.



**Fig. 6.** *Roquettea jalapensis* new species: male holotype (MNRJ 19046) from Parque Estadual do Jalapão (Tocantins): A, habitus, lateral view; B, distal part of penis, lateral view; C, same, dorsal view. Scale bars: A = 1 mm; B–C = 0.2 mm.

**Table 1.** Measurements of podomeres of ♂ holotype of *Roquettea jalapensis* (MNRJ 19046).

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Leg I	0.49	3.88	0.72	2.31	3.87	2.2	13.47
Leg II	0.56	8.67	1.36	6.82	8.8	4.77	30.98
Leg III	0.64	5.94	1.13	3.26	5.19	2.71	18.87
Leg IV	0.86	9.89	1.26	5.53	7.35	2.98	27.87

scutum smooth, with cheliceral sockets (protoglyphs) slightly concave, well defined. Central projection of protoglyphs short and acuminate, lateral projections of protoglyphs very large and blunt. Carapace little prominent in lateral view, finely granular, ocularium low and finely granular. Scutal areas II and IV unarmed. Area I armed with pair of small tubercles, area III armed with a pair of very thick paramedian conical processes. Lateral border of the dorsal scutum containing a longitudinal row of small granules, with greater width between areas II and III. Posterior edge, free tergites and anal operculum each containing a transverse row of small granules.

**Venter.** — Coxae I to IV and stigmatic area granular. Genital segment expanded, visible laterally, slightly granular. Free sternites each with a transverse row of granules.

**Chelicera (Fig. 5B).** — Ectal-posterior corner of the basichelicerite bulla with 2 blunt apophyses, the ectalmost squared.

**Pedipalpus (Fig. 5C–D).** — Femur projected dorsally. Tibia spatulate, contains in its apical expansion a two keeled ectal projection, opposing the tarsus, to form a chela.

**Legs.** — Coxae I to IV, with a prolatero-dorsal apophysis, coxae I and II with a apophysis retrolatero-dorsal. Legs I–IV long, thin and straight. Claws of legs III and IV with paramedian pectination, formed by two rows of five teeth each. Tarsal formula 8(3)-8(3), 13(3)-?, 9-9,10-10.

**Color.** — dorsal scutum, free tergites and anal operculum Moderate Orange (centroid 53), spines of area III and eyes of Deep Brown (centroid 56). Dorsal scutum densely covered with small Yellowish White (centroid 92) spots, except the central region of the carapace, near ocularium and the mesotergum, where spots are confined to a longitudinal row of a few spots. Posterior margin of scutum and free tergites Brownish Orange (centroid 54) with a longitudinal row of small Yellowish White (centroid 92) spots. Coxae I–IV Moderate Orange (centroid 53), genital segment Brilliant Orange (centroid 49), free sternites and genital operculum Deep Orange (centroid 51).

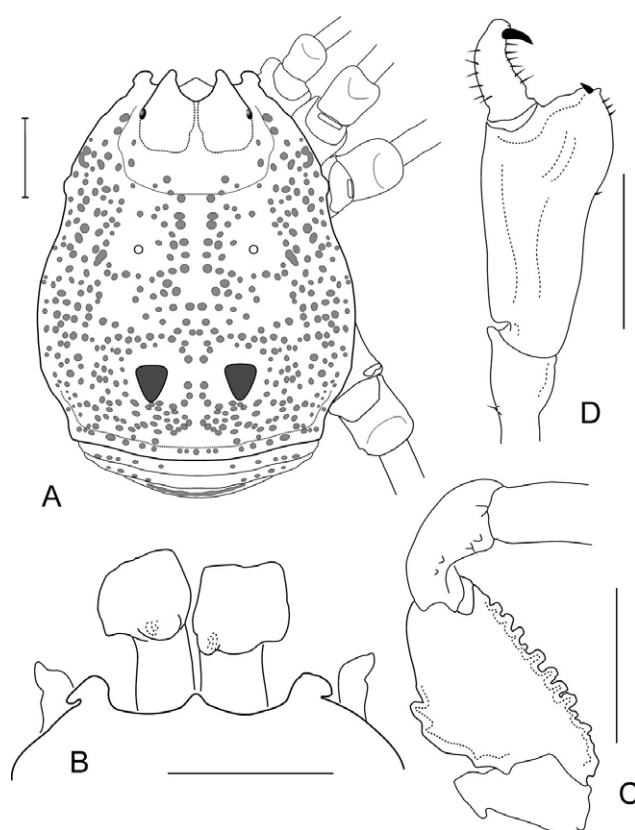
**Genitalia (Fig. 6B–C).** Lateral border of the ventral plate slightly concave, apical border clearly concave. Five pairs of apical long sub-straight macrosetae, directed distally, a pair of medial macrosetae, shorter and straight, and two pairs of basal macrosetae sub-equal, long and straight, directed proximally.

**Female.** — Unknown.

**Distribution.** — Known from type locality alone (Fig. 16).

### *Roquettea taurina* new species (Figs. 7–8)

**Type material.** — ♂ holotype (MNRJ 18966) Brazil, TO, Taquaruçu: Vai Quem Quer, Mr. Judson's property,



**Fig. 7.** *Roquettea taurina* new species: male holotype (MNRJ 18966) from Taquaruçu (Tocantins): A, habitus, dorsal view; B, basichelicerite and anterior border of carapace; left Pp, C, Tr-Pa mesal view; D, Pa-Ta ventral view. Scale bars = 1 mm.

10.vi.2007, A. Chagas, A. Giupponi, A. Kury & A. Pérez leg. WWF Ecoregion NT0140 (Mato Grosso seasonal forests).

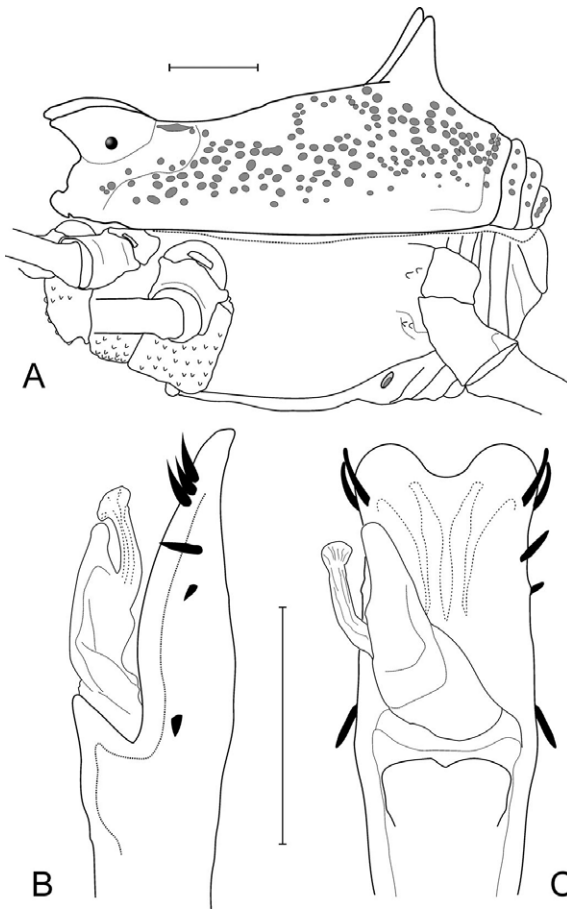
**Etymology.** — From Latin *taurina* (bull-like), referring to the unusual armature of ocularium, resembling bovine horns.

**Diagnosis.** — Ocularium heavily modified, with two strong conical projections leaned frontwards (Fig. 8A). Area I armed with a pair of very small tubercles concolorous with background; area III armed with a pair of large spines darker than background (Fig. 7A). All dorsal scutum covered with white dots except in paired regions close to ocularium, the anterior border and in areas I–III (Fig. 7A).

#### **Description of ♂ holotype (MNRJ 18966)**

**Measurements.** — CL: 1.85, CW: 3.16; AL: 3.01, AW: 4.01. Appendage measurements in Table 2.

**Dorsum (Figs. 7A–B, 8A).** — Anterior edge of dorsal scutum smooth, with cheliceral sockets (protoglyphs) slightly concave, well defined. Central projection of protoglyphs short and obtuse, broad-based, lateral projections of protoglyphs very large and obtuse, excavated ectally. Carapace low, not prominent in lateral view, totally smooth. Ocularium narrow, low, armed with 2 huge subconic protuberances strongly inclined frontwards. Scutal areas II and IV unarmed. Area I armed with a pair of very small tubercles, area III armed with a pair of very thick paramedian conical processes. Lateral border of the dorsal scutum containing a



**Fig. 8.** *Roquettea taurina* new species: male holotype (MNRJ 18966) from Taquaruçu (Tocantins): A, habitus, lateral view; B, distal part of penis, lateral view; C, same, dorsal view. Scale bars: A = 1 mm; B–C = 0.2 mm.

**Table 2.** Measurements of podomeres of ♂ holotype of *Roquettea taurina* (MNRJ 18966).

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Leg I	0.52	4.57	1.09	2.89	4.95	2.51	16.53
Leg II	0.71	11.4	1.38	9.24	12.07	5.85	40.65
Leg III	0.77	8.16	1.35	4.27	6.75	3.03	24.33
Leg IV	0.96	13.03	1.59	7.93	9.28	3.7	36.49

longitudinal row of small granules, widest between areas II and III. Posterior edge, free tergites and anal operculum each with a transverse row of small granules.

**Venter.** — Coxae I to IV, stigmatic area and genital operculum finely granular. Genital segment large enough to be visible laterally, slightly grainy. Free sternites with a transverse row of granules. Stigmatic area Y-shaped, with deep transverse posterior groove.

**Chelicera (Fig. 7B).** — Bulla of basichelicerite smooth, without teeth, only a triangular projection on ectal-posterior corner and a large rounded apophysis near mesal-posterior corner.

**Pedipalpus (Fig. 7C–D).** — Femur with a row of 10 ventral teeth, and 2 mid-dorsal teeth. Tibia spatulate, ecto-

distal lobe with two short spiniform projections. This lobe is opposed to the tarsus, forming a subchela. Tarsus subtriangular, with ventro-distal and ventro-ectal rows of spines.

**Legs.** — Coxae I–IV with a prolatero-dorsal apophysis, and I–II also with a large curve retrolatero-dorsal apophysis. Tarsal counts: 9 (3) -9 (3), 14 (3) -15 (3), 9-9, 10 -?

**Color.** — Dorsal scutum, free tergites and anal operculum Deep Orange (centroid 51), spines of area III and ocularium Strong Brown (centroid 55), tubercles of area I concolorous with the background. Dorsal scutum densely covered with small spots of Yellowish White (centroid 92) except for regions close to ocularium, and the anterior border of carapace and paired circular patches in carapace and areas I, II, and III (around the paramedian armature, if present). Posterior border of scutum and free tergites I and II with a transverse row of small spots of Yellowish White (centroid 92), tergite III with a transverse line of the same color. Coxae and genital segment Moderate Orange (centroid 53), free sternites and genital operculum Deep Orange (centroid 51). Metatarsi and tibia I–IV with several lighter rings.

**Genitalia (Fig. 8B–C).** — Ventral plate rectangular with apex slightly wider, lateral border straight, apical border with well-marked C-shaped cleft. Four apical pairs of macrosetae of similar size and structure, oriented distally, first three pairs sub-straight and long, fourth pair slightly shorter and straight. Sub-apical pair of macrosetae, short and straight. Basal pair of macrosetae, long and straight, directed proximally.

**Female.** — Unknown.

**Distribution.** — Known from type locality alone (Fig. 16).

#### *Roquettea scrotalis* new species (Figs. 9–10)

**Type material.** — ♂ holotype (MNRJ 7016) Brazil, AP, Ferreira Gomes: Sítio Otimari, 20.x.2007, C. Costa & P. Magno leg. WWF Ecoregion NT0707 (Guyanan savanna).

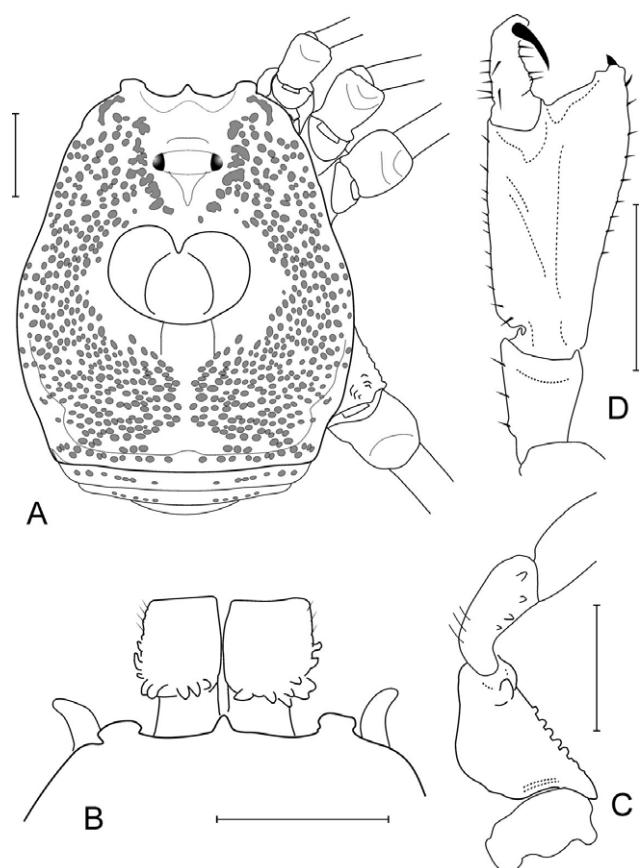
**Etymology.** — From Latin *scrotum* (scrotum) referring to the superficial resemblance of the paired scutal protuberances to a pair of mammal testicles.

#### **Description of ♂ holotype (MNRJ 7016)**

**Measurements.** — CL: 1.66, CW: 3.34; AL: 3.12, AW: 4.12. Appendage measurements in Table 3.

**Diagnosis.** — Mesotergum armed with a pair of large globoid protuberances, located on a common thick columnar structure (Fig. 10A). Dorsum covered with white dots except mesotergum in the area encircling the tuberos complex (Fig. 9A).

**Dorsum (Figs. 9A–B, 10A).** — Dorsal scutum without marked constrictions, with greater width between areas II and III. Anterior edge of dorsal scutum smooth, with cheliceral sockets (protoglyphs) slightly concave, well defined. Central projection of protoglyphs short and acuminate with a wide base, lateral projections of protoglyphs very large and blunt. Carapace little prominent in lateral view, finely granular, ocularium low and finely granular. Mesotergum (area III?) armed with a pair of large globoid protuberances, located on a thick common column, elsewhere unarmed. Lateral border of the dorsal scutum containing a longitudinal row of small granules. Posterior border, free tergites and anal operculum, each containing a transverse row of small granules.



**Fig. 9.** *Roquettea scrotalis* new species: male holotype (MNRJ 7016) from Ferreira Gomes (Amapá): A, habitus, dorsal view; B, basichelicerite and anterior border of carapace; left Pp, C, Tr-Pa mesal view; D, Pa-Ta ventral view. Scale bars = 1 mm.

**Venter.** — Coxae I to IV, stigmatic area and genital operculum granular. Free sternites with a transverse row of granules.

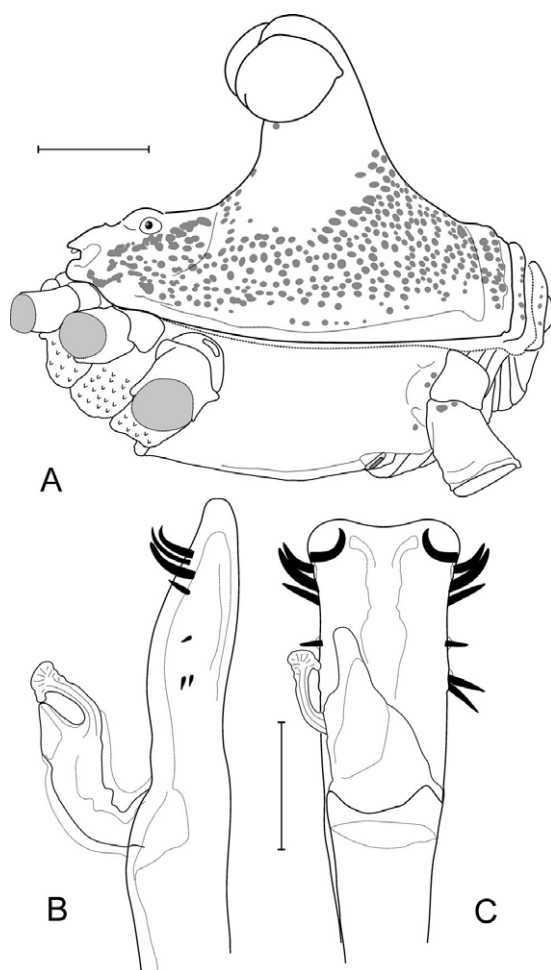
**Chelicera (Fig. 9B).** — Ectal and posterior edges of basichelicerite bulla with a rim of 7–8 small apophyses, the one on ectal-posterior corner the largest, bifid and somewhat squared.

**Pedipalpus (Fig. 9C–D).** — Femur strongly convex dorsally. Tibia spatulate, with ectal-apical expansion projections with two teeth, opposed to the tarsus, forming a chela.

**Legs.** — Coxae I to IV, with a prolatero-dorsal apophysis, coxae I and II with a retrolatero-dorsal apophysis. Tarsal counts: 8 (3) -8 (3), 11 (3) -11 (3), 9-9, 10-?

**Color.** — Dorsal scutum, free tergites and anal operculum Moderate Orange (centroid 53), eyes Deep Orange (centroid 51). Dorsal scutum densely covered with small Yellowish White spots (centroid 92), except the anterior region near the ocularium, and around the tuberos complex. Posterior edge and free tergites Brownish Orange (centroid 54), with a longitudinal row of small spots of Yellowish White (centroid 92). Coxae and genital segment Moderate Orange (centroid 53), free sternites and genital operculum Deep Orange (centroid 51).

**Genitalia (Fig. 10B–C).** — Ventral plate (VP) rectangular elongate, with apical corners rounded and a shallow para-



**Fig. 10.** *Roquettea scrotalis* new species: male holotype (MNRJ 7016) from Ferreira Gomes (Amapá): A, habitus, lateral view; B, distal part of penis, lateral view; C, same, dorsal view. Scale bars: A = 1 mm; B–C = 0.2 mm.

**Table 3.** Measurements of podomeres of ♂ holotype of *Roquettea scrotalis* (MNRJ 7016).

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Leg I	0.56	4.73	0.98	2.85	4.6	2.5	16.22
Leg II	0.59	11.2	1.26	9.09	10.96	6.22	39.32
Leg III	0.71	7.78	1.33	4.17	6.44	3.13	23.56
Leg IV	0.92	12.98	1.67	7.67	8.83	3.73	35.8

bolic cleft on distal margin. Base and apex of equal width (sides parallel) in ventral view. Middle part thicker (in lateral view). Inner septum of ventral plate (“trabecula”) tripartite, median axis very thin, left and right lateral branches curved, not reaching the distal margin. VP with six pairs of lateral setae forming three groups. (1) basal group with one pair of short and straight setae pointing oblique/proximally; (2) intermediate group with one pair of very short and straight setae pointing transversely; (3) distal group with 4 pairs of setae, proximal pair straight, others curved. Glans columnar, stylus cylindrical with apex compressed forming an axe-blade, dorsal process thumb-shaped.

**Female.** — Unknown.

**Distribution.** — Known from type locality alone (Fig. 16).

***Roquettea singularis* Mello-Leitão, 1931 (Figs. 11–15)**

*Roquettea singularis* Mello-Leitão, 1931: 117, Figs. 3–4; 1932: 446, Fig. suppl. 6–7; 1933: 105; Soares, 1945: 346; Dumitrescu, 1976: 18.

*Tetracyphus mirabilis* Sørensen, 1932: 312, Figs. 13–14 [junior subjective synonym of *Roquettea singularis* Mello-Leitão, 1931 by Mello-Leitão (1933)].

**Type material.** — *Roquettea singularis*: ♂ holotype (MNRJ 1383) Brazil, PA, Utinga, E.E. May leg. (examined). *Tetracyphus mirabilis*: ♂ holotype (ZMUC) Brazil, PA, Cameté, at Rio Tocantins [misspelled as “Vacantia” by Sørensen] not examined.

**Other material examined.** — 3 ♂ (HSPC 0798) Brazil, PA, Ananindeua: Seminário Pio X BR 316 km 6, 26.vi.1976, F. S. Romeu leg.; 6 ♂ (IBSP 0223) Brazil, PA, Ilha Tocantins, 27.vii.1984, M. Costa leg.; 9 ♀ 2 ♂ (HSPC 0594) Brazil, PA, Belém, 1973; ♂ (HSPC 0377) same loc., 12.vi.1966, J. Becker leg.; 1 ♀, 6 ♂ (MNRJ 14317) same loc., 1972; 2 ♂ (MNRJ 1979) same loc., 1972.

**Distribution.** — BRAZIL, Pará, Belém (including vicini-

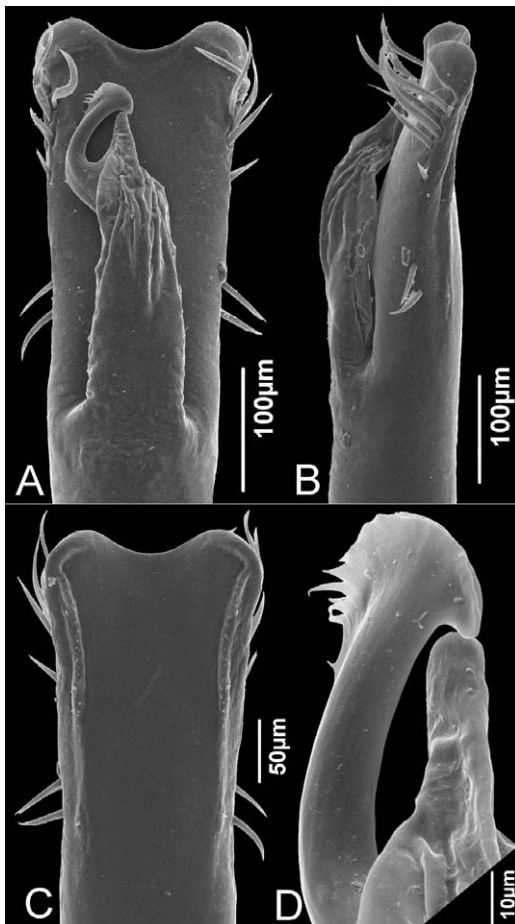
ties such as Ananindeua and Utinga); Cameté and Tucuruí. WWF Ecoregion NT0170, Tocantins/Pindaré moist forests.

**Diagnosis.** — Mesotergum armed with a central tuberos complex formed by a common shaft ending in two pairs of large globoid protuberances in male (Fig. 13A) and two pairs of paramedian spines on areas I and III in the female (Figs. 14A, 15D). Dorsal scutum covered with Yellowish White dots except mesotergum, around the tuberos complex.

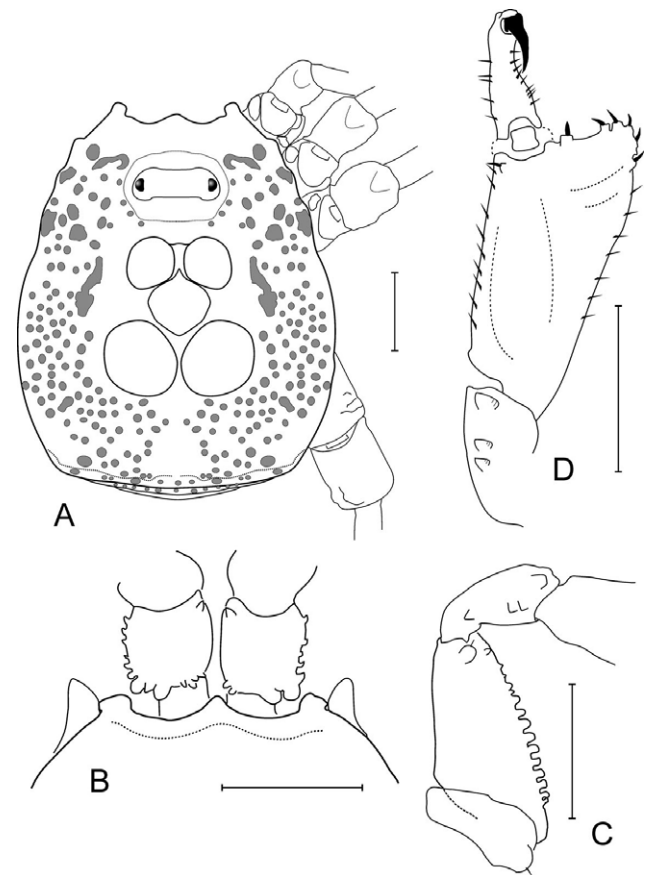
**Redescription of ♂ holotype (MNRJ 1383)**

**Measurements.** — Body and appendage measurements in Tables 4–5.

**Dorsum (Figs. 12A, 13A).** — Greater width of dorsal scutum between areas II and III. Anterior edge of dorsal scutum smooth, with cheliceral sockets (protoglyphs) well defined, slightly concave. Central projection of protoglyphs short and blunt, broad-based, lateral projections of protoglyphs very large and obtuse. Carapace somewhat prominent in lateral view, finely granular, ocularium low and finely granular. Mesotergum (areas I and III) armed with two pairs of large globoid protuberances, located on a thick common column, elsewhere unarmed. Lateral border of the dorsal scutum containing a longitudinal row of small granules. Posterior edge, free tergites, and anal operculum containing

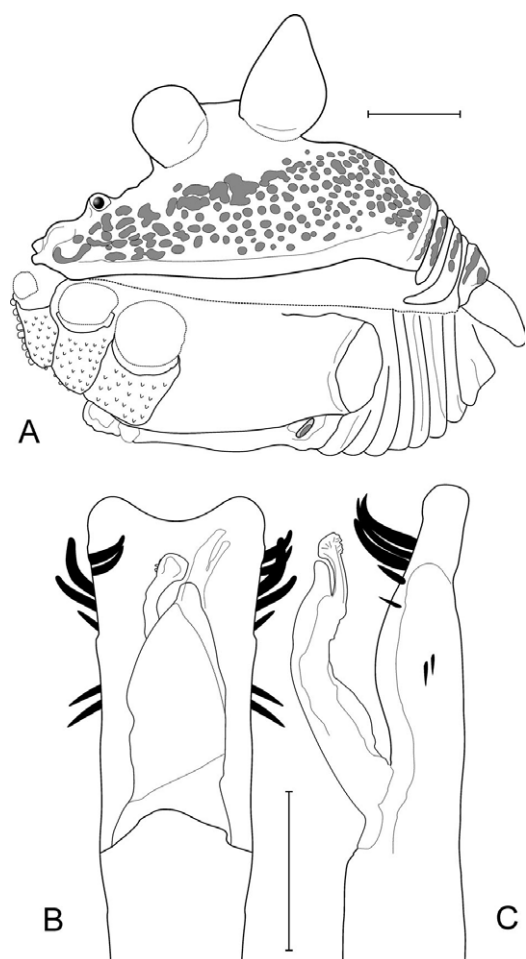


**Fig. 11.** *Roquettea singularis* Mello-Leitão, 1931, male (HSPC 798) from Ananindeua, near Belém (Pará): distal part of penis: A, dorsal view; B, lateral view; C, ventral view; D, glans, lateral view.



**Fig. 12.** *Roquettea singularis* Mello-Leitão, 1931: A, male holotype (MNRJ 1383) habitus, dorsal view. Male (HSPC 617) from Belém (Pará): B, basichelicerte and anterior border of carapace; left Pp, C, Tr-Pa mesal view; D, Pa-Ta ventral view. Scale bars = 1 mm.





**Fig. 13.** *Roquettea singularis* Mello-Leitão, 1931: A, male holotype (MNRJ 1383) habitus, lateral view. Male (HSPC 617) from Belém (Pará): B, distal part of penis, lateral view; C, same, dorsal view. Scale bars: A = 1 mm; B–C = 0.2 mm.

a transverse row of small granules.

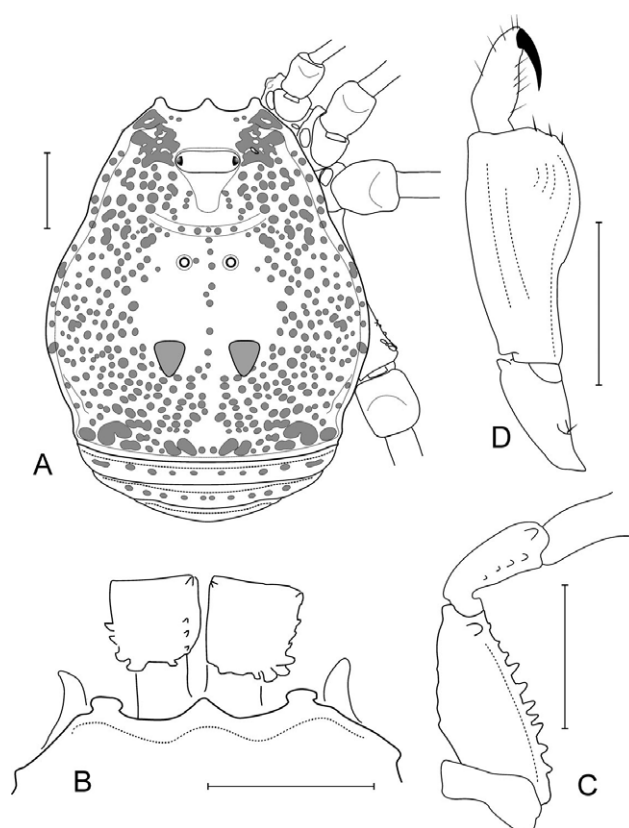
**Venter.** — Coxae I to IV, stigmatic area and genital operculum granular. Genital segment expanded, visible laterally, slightly grainy. Free sternites with a transverse row of granules.

**Chelicera (Fig. 12B).** — Ectal and posterior edges of basichepicerite bulla with a rim of small apophyses, the one on ectal-posterior corner the largest, blunt and three-lobed, meso-anterior corner with 3 small apophyses.

**Pedipalpus (Fig. 12C–D).** — Tibia spatulate, ectal-apical expansion with three to four spiniform projections, opposed to the tarsus, forming a chela.

**Legs.** — Coxae I to IV, with a prolatero-dorsal apophysis, coxa I with retrolatero-dorsal apophysis. Tarsal counts: 9 (3) -9 (3), 14 (3) -14 (3), 9-9, 10-10.

**Color.** — Dorsal scutum, free tergites and anal operculum Light Orange (centroid 52). Dorsal scutum densely covered with small Yellowish White (centroid 92) spots, except the carapace near the ocularium, and around the spines. Posterior border and free tergites with a transverse row of small Yellowish White (centroid 92) spots. Coxae and genital segment Light Orange (centroid 52), free sternites and



**Fig. 14.** *Roquettea singularis* Mello-Leitão, 1931: A, female (MNRJ 14317) habitus, lateral view. Female (HSPC 617) Belém (Pará): B, basichelicerite and anterior border of carapace; left Pp, C, Tr-Pa mesal view; D, Pa-Ta ventral view. Scale bars = 1 mm.

**Table 4.** Measurements of podomeres of ♂ *Roquettea singularis* (HSPC 594).

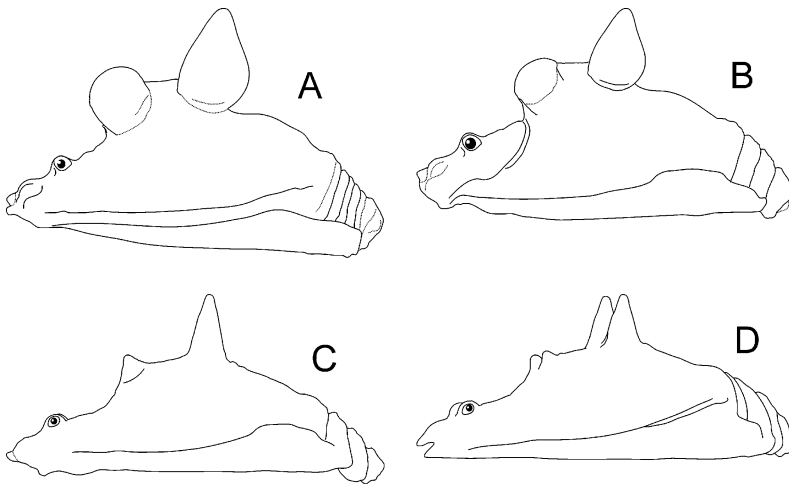
	Tr	Fe	Pa	Ti	Mt	Ta	Total
Leg I	0.4	6.14	1.15	3.32	3.31	2.33	16.65
Leg II	0.57	13.35	1.51	10.89	14.72	7.08	48.12
Leg III	0.71	10.28	1.6	5.19	8.88	3.23	29.89
Leg IV	0.71	15.23	1.63	9.56	12.09	4.23	43.45

**Table 5.** Dorsal scutum measurements of selected specimens of *Roquettea singularis*.

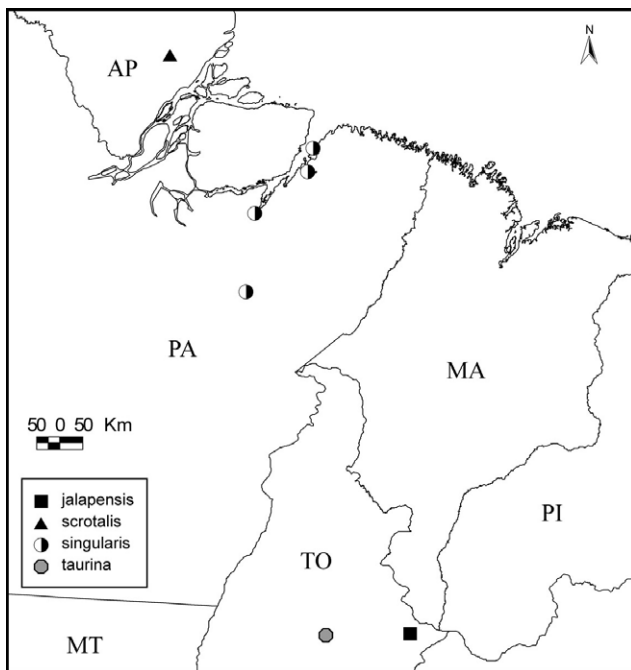
	CL	CW	AL	AW
Male holotype - alpha (MNRJ 1383)	1.49	2.73	2.46	3.59
Alpha male (HSPC 594)	1.53	2.75	2.92	3.8
Beta male (HSPC 616)	1.69	3.45	2.99	4.49
Female paratype (MNRJ 1383)	1.83	3.38	3.34	4.55

genital operculum Moderate Orange (centroid 53).

**Genitalia (Fig. 13B–C).** — Ventral plate rectangular with apex slightly wider, lateral border straight, apical edge concave. Four pairs of apical macrosetae oriented distally, first to third pair long, curved, fourth pair slightly shorter and sub-straight, a pair of sub-apical short and straight macrosetae, two pairs of basal macrosetae sub-equal, long and



**Fig. 15.** *Roquettea singularis*, schematic representation of the scutum outline in some males and a female, lateral view: A (MNRJ 1383) and B (MNRJ 1979), larger morph ("alpha") males with the protuberances immensely developed, one more than the other; C, smaller morph ("beta") male (HSPC 0798), with large spines replacing the protuberances; D, female (MNRJ 14317), with spines still smaller than those of beta male.



**Fig. 16.** Northern Brazil, showing distribution of the 4 species of *Roquettea*. Coordinates are: Cameté (−2.2500 −49.5000); Ananindeua (−1.0000 −48.3833); Belém (−1.4500 −48.4833); Jalapão, Córrego do Carrapato (−10.3716 −46.5142); Taquaruçu, Vai Quem Quer (−10.3942 −48.1323); Ferreira Gomes (0.8000 −51.1333) and Tucuruí (−3.7678 −49.6728). Abbreviations of relevant Brazilian states are AP = Amapá, MA = Maranhão, MT = Mato Grosso, PA = Pará, PI = Piauí, TO = Tocantins.

straight oriented proximally.

**Female (Figs. 14A–D, 15D).** — Area I armed with a pair of broad-based conical spines, and area III armed with a pair of large spines, not coalesced into a 4-balled protuberance. Both pairs of spines darker than background. Pedipal-

pal tibia only little expanded laterally in the form of a spatula, lacking the strong process of males.

**Variation (Fig. 15).** — This species has two male morphs (see also "discussion section" below). Larger male morph ("alpha") alone has the basally fused rounded scutal protuberances, with some differences in development (Fig. 15A–B). Smaller male morph ("beta") (Fig. 15C) is similar to the female, in that the protuberances of area I and III are replaced by loosely connected spines, but the paired spines of area I are clearly larger and darker than in females.

## DISCUSSION

### Ocularium in *Roquettea*

The ocularium (common eye mound) in Laniatores is generally dome-shaped or globoid. In some Gonyleptoidea it is medially depressed, e.g., Metasarcinae and Bourgyiinae (Gonyleptidae), Cosmetidae (Kury, 1994a). In most Cosmetidae the carapace and the eye

mound are very low and little detached from the scutum outline in the lateral view. The ocularium in *Roquettea taurina* is sui generis, as there is no similar conformation in Laniatores. The most roughly similar structure that we can think of is the ocularium of *Ampycus* and *Hexabunus* (Gonyleptidae, Ampycinae), or that of Hernandariinae (Gonyleptidae) such as *Multumbo*, all of which are low, armed with two wide spines leaned frontwards. But none of these matches the immense and broad horns that occupy the whole width of ocularium as in *R. taurina*.

### Location of scutal protuberances in *Roquettea*

Mello-Leitão (1931) claimed that the tuberos complex of *R. singularis* would correspond to areas I–II, while Sørensen (1932) avoided the problem, mentioning only a "central structure". The precise homology of the immense dorsal balls present in *R. singularis* and *R. scrotalis* is not obvious. As for the former, evidence comes from the females and beta males, which have well-developed conical processes in areas I and III, allowing homology with these. Also the pattern in which areas I and III are armed while all others are unarmed is very common in Cosmetidae. In the case of *R. scrotalis*, of which a single male is known, we cannot be sure if they correspond to paramedian armature of either area I or III. Topology does not help much, as the tuberos complex is located centrally. A safe assumption, based on comparison with other *Roquettea* and *Gryne* is that the balls are homologous with spines of area III – because they have only much reduced armature in area I and well-developed spines in area III only.

### Pectinate tarsal claws in Cosmetidae

The monophyly of Discosomaticinae is weakly supported by the presence of pectinate tarsal claws III–IV, which may not even be a primary homology, due to the different type of pectination. In *Acantholibitia* the pectination of claws III and IV is formed by one middle row of three large teeth. In *Protus*, *Roquettea* and *Gryne*, pectination is formed

by two paramedian rows of five to seven smaller teeth. These three genera may form a clade (see also discussion below). Other characters point to similarities of other Discosomaticinae with other smooth-clawed Cosmetidae.

### Relationships of *Roquettea*

*Protus*, *Roquettea* and *Gryne* may form a monophyletic Discosomaticinae supported by the kind of tarsal claw pectination, hypothesis also supported by the great development of the serrate caruncle of the stylus (Figs. 2D, 4C and 11D), which may be synapomorphic at this level. There is considerable evidence that *Roquettea* and *Gryne* are sister groups, and putative synapomorphies are: (1) ventral plate much elongate; (2) glans column much elongate; (3) grooves of ventral plate (VP) well-marked, extending to distal border, lined with scale-spines; (4) no latero-distal projections on distal border of VP; (5) velum thick and short, ovipositor-shaped; (6) four pairs of distal macro-setae (DMS) on VP; (7) DMS in distal cluster only slightly curved and (8) two rows of 6–7 long barbells at the anterior peak of caruncle of glans. Also the armature of posterior margin of bulla is very similar in both genera, but these are very variable in Cosmetidae, its status as a synapomorphy needs more study. *Roquettea* and *Gryne* also have similar habitus and habitats, being large, thin-legged cosmetids which inhabit open formations (savannahs) as well as evergreen rainforest formations. A possible synapomorphy for the species of *Gryne* is: (1) Mt IV short, prismatic in males (Fig. 4D). Possible synapomorphies for the species of *Roquettea* are: (1) ecto-apical lobe of pedipalpal tibia strongly projected more anteriorly than ventrally (Figs. 5D, 7D, 9D, 12D), and (2) distal cluster of DMS pointing distally (Fig. 11A, C).

### Male dimorphism in Cosmetidae

Harvestmen, like many arthropods, have a polygamous mating system, which generates a variance in fitness among males. Intrasexual (male) polymorphism is common when sexual selection is strong. Under such conditions, the evolution of male dimorphism is somewhat expected to occur (Shuster, 1992). Sex dimorphism may involve size, shape, color, behavior, physiology, and life history, and in at least one case it is shown to involve difference in the chromosomal number (Tsurusaki, 2007). In Opiliones, the presence of a second male morph, usually smaller and with attenuate secondary sexual characters (called “femaliform”, “effeminate”, “poecilandric” or “beta” male), has been described or at least mentioned in Triaenonychidae (widespread, Forster, 1954; Hunt, 1985), Epedanidae (Suzuki, 1973), Sclerosomatidae (Tsurusaki and Cokendolpher, 1990), Cosmetidae (only one species, Pérez-G. and Vasconcelos, 2003), Gonyleptidae (many species, Mendes, 2005; Kury, 1991; Kury, 2008; DaSilva and Kury, 2007; Kury pers. obs.; Machado et al., 2009), Monoscutidae (Taylor, 2004) and Stygnidae (one species, R. Pinto-da-Rocha, pers. comm., 2008). The differences between two male morphs have been said to reflect different sexual strategies (Tsurusaki and Fujikawa, 2004), but there is also another hypothesis that they are two different adult instars (Gnaspini et al., 2004). Goodnight & Goodnight (e.g., 1947a, b, 1953a, b) studied large series of Cosmetidae, mainly species from Mexico and the Caribbean. They reported seemingly random variation in color (in depth, sat-

uration, and pattern of white markings of scutum), number of articles in tarsi II–IV and armature of scutal areas, free tergites, and femur IV of males. In some occasions they described morphoclines: “a gradual transition in which animals from intermediate areas... had tubercles intermediate in size.” (1953a: 23). González-Sponga (1992) also reported some variation in Venezuelan species, but none of these authors ever recognized male dimorphism. Pérez and Vasconcelos (2003), studying genus *Arucillus* from Cuba, stated: “Two male paratypes are poecilandric, having small chelicerae and so are similar to (although slightly larger than) females.” This is the single report in the literature of male dimorphism in Cosmetidae. In *Roquettea* the beta male has dorsal spination similar to female. The pedipalp of beta males and is equal to the female’s, and to *Gryne* as well. Male dimorphism is thus here reported for the first time in a South American species of Cosmetidae and it seems to be more widespread in the family than earlier thought.

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