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## Phylogeny and new species of the Neotropical bee genus *Paroxystoglossa* Moure (Hymenoptera, Apoidea)



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### ABSTRACT

*Paroxystoglossa* is a solitary, ground-nesting bee genus. It was revised in 1960 and currently includes nine species from Argentina, Brazil and Paraguay. The objectives of this contribution are to provide a morphological phylogeny for the group and to describe two new species: *P. levigata* n.sp. and *P. mourella* n.sp. *Paroxystoglossa* is monophyletic and three species groups are recognized, *jocasta* species group: (*P. mourella* n.sp., (*P. brachycera*, (*P. jocasta*, *P. barbata*))), *transversa* species group: (*P. transversa*, *P. levigata* n.sp.), and *crossotos* species group: (*P. mimetica*, (*P. crossotos*, *P. seabrai*, (*P. andromache*, *P. spilopectera*))). The *crossotos* and *transversa* species groups were considered as sister groups. Interestingly *Paroxystoglossa* species have very similar male genital capsules an uncommon pattern among Augochlorini genera. The species groups have a widely redundant distribution indicating replication events in southeastern South America. An updated, illustrated key for species identification is also presented.

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### Introduction

The initial studies of Father Jesus Moure (1912–2010) were focused on halictid bees. *Paroxystoglossa* was described in Moure's first paper (1940) and surprisingly this was the only genus to be taxonomically revised by Moure (1960) during his prolific career. It is currently recognized for nine species distributed in southeastern South America (Moure, 1960, 2007): *P. andromache* (Schrottky, 1909), *P. barbata* Moure, 1960, *P. brachycera* Moure, 1960, *P. crossotos* (Vachal, 1904), *P. jocasta* (Schrottky, 1910), *P. mimetica* Moure, 1950, *P. seabrai* Moure, 1960, *P. spilopectera* Moure, 1960 and *P. transversa* Moure, 1943. Data on natural history are scarce and the known species of *Paroxystoglossa* are solitary ground-nesters (Michener and Lange, 1958a,b; Michener and Seabra, 1959). The species are probably polylectic and flight during spring and summer seasons.

*Paroxystoglossa* is currently considered as sister group to *Megaloptilla* Moure & Hurd, belonging to an augochlorine clade named the *Neocorynura* group (Gonçalves, 2016). No species level phylogeny is available for the genus and new species remain to be described since its 1960 taxonomic revision. Therefore, the purpose of the present study is: to provide a morphological phylogeny for its species, to describe new species, and to provide an updated identification key.

### Material and methods

Material studied herein is deposited in the following institutions: *Coleção Entomológica Pe. Jesus Santiago Moure*, Curitiba, Brazil (DZUP), *Coleção Entomológica Prof. J.M.F. Camargo*, Ribeirão Preto, Brazil (RPSP), Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG) and *Museu de Zoologia da Universidade de São Paulo*, São Paulo, Brazil (MZSP). The complete list of examined material is deposited in <http://morphobank.org/permalink/?P2576>. Quotation marks surround exact transcriptions of individual labels, while the backslash (\) indicates different lines on the same label.

The descriptions were made following the body organization, tagmata, segments, and sclerites, with special attention to the categories: structure (general organization), sculpturing (surface impressions and elevations), color and pubescence. Structure terminology follows Eickwort (1969) and Michener (2007) except here I here use “metapostnotum” for the “basal area of the propodeum”. I use the abbreviations T1, T2, etc., to denote the metasomal terga; S1, S2, etc., to denote metasomal sterna; and F1, F2, etc., to denote the flagellomeres. Sculpturing terminology follows Harris (1978), for features only visible above 50 times magnification I use the term ‘microsculpturing’. The following measurements were taken: head width (here the maximum distance between eye notch, abbreviation: hw); head length (distance from clypeus to vertex, hl); clypeus maximum width (clw); clypeus maximum length (cll); supraclypeal area length (distance from clypeus basis to lower tangent of antennal socket, scl); distance between upper antennal sockets and lower median ocellus tangent (aloc);

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intertegular distance (itd); metasomal width (maximum width of second tergum, mtw); total length (approximate by summing head, mesosoma and metasoma length, total). All measurements are given in millimeters. Puncture diameter (=pd) are given in relation to the interspaces among punctures (=i). Size comparison are also made relatively with compound eye width (=ew).

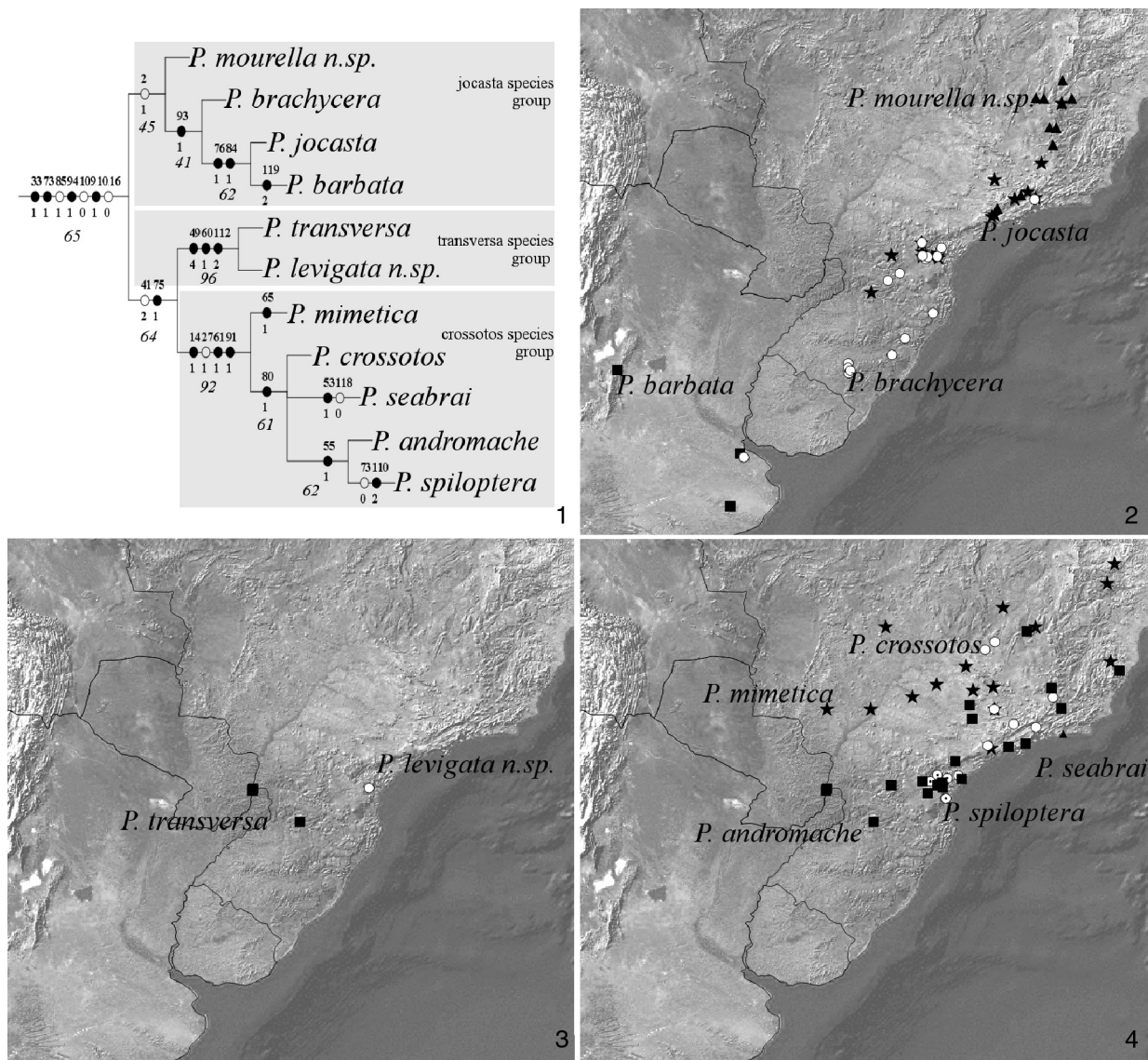
For the phylogenetic analysis, Gonçalves (2016) original character and terminal list and data matrix were compiled with new characters and terminals added (see <http://morphobank.org/permalink/?P2576> for matrix, character list and trees); the final matrix comprised 125 characters and 83 terminals. Parsimony analysis included new search methods (Goloboff et al., 2003), using the following settings in TNT (ratchet weighting probability 5%, 200 iterations), tree-drifting (50 cycles), and tree-fusing (five rounds, minimum length set to be hit 100 times). I used equal weighting and implied weighting with different constant values ( $k = 1-20$ ) and all analyses recovered *Paroxystoglossa* as monophyletic with the same topology for its species. However, only implied weighting with a  $k$  value of seven recovered the main augochlorine clades of Gonçalves (2016). Jackknife values (1000 replications) did not

increase for constant values superior to seven, so the results presented herein are based upon this value. Bootstrap values for the final tree were calculated after 1000 replications.

Photographs were taken with a ToupCam (©ToupTek Photonics) with a Stereomicroscope (SZ61TR Olympus Corporation) using a ring light guide (SZ2-LGR Olympus Corporation). ToupView software (©ToupTek Photonics) was used for image capture and CombineZP (©Adam Hadley) for image stacking (best image selected from all methods approach). Final image adjustments (unsharp mask and level control) were made with GIMP 2.8.16 (©The GIMP Team).

## Results and discussion

*Paroxystoglossa* belongs to the *Neocorynura* group and according to Gonçalves (2016) and the present analysis *Paroxystoglossa* and *Megaloptilla* are sister groups. This relationship is based on the fine and serrate inner hind tibial spur, a unique state among non cleptoparasite augochlorines. Unfortunately, there is no available DNA



**Figs. 1–4.** *Paroxystoglossa* phylogeny and distribution records: 1, the most parsimonious tree under implied weights (length: 247 steps, consistency index: 60, retention index: 86,  $k: 7$ , fit: 9.0439), bootstrap is indicated below each node. 2, distribution of *jocasta* species group (squares: *P. barbata*, circles: *P. brachycera*, stars: *P. jocasta*, triangles: *P. mourella n.sp.*). 3, distribution of *transversa* species group. 4, distribution of *crossotos* species group (squares: *P. andromache*, circles: *P. crossotos*, stars: *P. mimetica*, triangles: *P. seabrai*, dotted circle: *P. spiloptera*).



sequence for *Megaloptilla* to independently test its position among Augochlorini (Gonçalves, 2016).

Fig. 1 presents the phylogenetic tree for *Paroxystoglossa* species. The monophyly of the genus is strongly supported by seven unambiguous morphological character states (Fig. 1): truncate and appendiculate marginal cell apex (33:1), setose gena (73:1), concave apical margin of S4 medially (85:1), depressed median surface of S5 (94:1), broad gonapophysis (109:0), indentate outer surface of gonapophysis (110:1) and the absence of dorsal process of gonostylus (116:0).

The internal relationships are almost entirely resolved and the three monophyletic lineages are recognized: *jocasta*, *transversa* and *crossotos* species groups. The *jocasta* species group includes four species, which are entirely green and have the orthogonal epistomal angle (2:1). The *transversa* group include two species with darkened tergal marginal areas, the three synapomorphies for the group are: pronotum with incomplete lamella from lobe to lateral angle (49: 4), depressed and dark marginal areas of terga (60:1), broadly excavated dorsal lobes of gonobase (112:2). This group is sister group to *crossotos* group supported with two synapomorphies: acuminate mesoscutal anterior border (41:2) and carinate male preoccipital area (75:1). The *crossotos* group includes five dark species with four synapomorphies: elliptical basal elevation of labrum (14:1), carinate preoccipital area (27:1), marginal area of terga with colored bands (61:1) and basal patches of appressed setae on fourth sternum (91:1). Compared to the other two groups, the *crossotos* lineage is morphologically homogeneous. Some autapomorphies for the species but only two synapomorphies for internal clades were recovered, leaving an internal trichotomy (Fig. 1). Perhaps this group diverged recently; this would also explain its geographic distribution (see below).

*Paroxystoglossa* species have very similar male genital capsules, only four characters from terminalia were informative and three of these were autapomorphies (110:2 for *P. spilopectera*, 118:1 for *P. seabrai*, 119:2 for *P. barbata*). The unique synapomorphy was the broadly excavated dorsal lobes of gonobase (112:2) for *P. levigata* n.sp. and *P. transversa*. Four informative sex-associated are seen from modifications of the male sterna (characters 84 and 86 from S4, 91 and 93 from S4). This lack of information from the genital capsule when compared with other male attributes,

is uncommon among Augochlorini. Most augochlorine genera with available phylogenies have more than one half of informative characters derived from genital capsules (Coelho, 2004; Gonçalves, 2010, 2015; Gonçalves and Melo, 2012). Only *Thectochlora* has relatively little information from genital capsule when compared with other attributes (Gonçalves and Melo, 2006). There may be an evolutionary trade-off among these structures that could be subject to sexual selection (Simmons, 2014). There are still many lineages to be studied in order to understand the evolution of these remarkable patterns within Augochlorini.

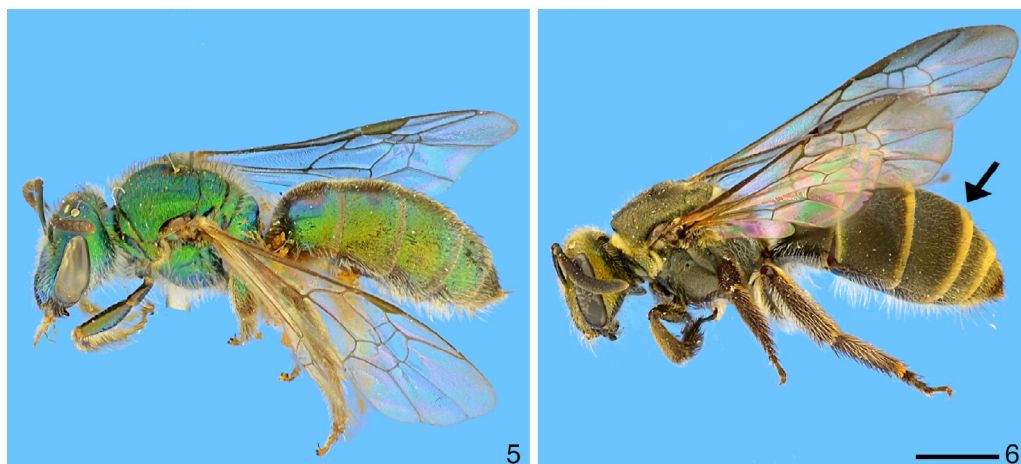
According to Gonçalves (2016) *Paroxystoglossa* diverged from *Neocorynura* group in the beginning of the Oligocene (about 33 Ma) and its diversification, the first split, between *P. barbata* and *P. transversa* lineages, occurred in the Miocene (about 16 Ma). *Paroxystoglossa* species occur in southeastern South America and most species are associated with inland and semideciduous formations of Atlantic forest (Figs. 2–4). This pattern is different from other lineages of the *Neocorynura* group: *Andinaugochlora* Eickworth, *Chlerogas* Vachal, *Megaloptilla* and *Neocorynurella* Engel are associated with Andean forests and *Neocorynura* Schrottky has a widespread distribution in the Neotropical region. The early isolation of lineages, such as *Paroxystoglossa*, in the east side of the Neotropical region is a recurrent pattern for Augochlorines as noted by Gonçalves and Melo (2012) and discussed in Gonçalves (2016).

The three *Paroxystoglossa* species groups have a widely redundant distribution indicating geographically replicated patterns of speciation in southeastern South America. The *jocasta* group species are distributed to the South, including Argentina (Fig. 2), a distribution not found in other *Paroxystoglossa* lineages. In this group, *P. mourella* n.sp. has a restricted distribution along Espinhaço Mountains. The two members of *transversa* group, *P. transversa* and *P. levigata* n.sp., have allopatric distributions (Fig. 3), with *P. transversa* occurring in semideciduous forests of western Paraná and *P. levigata* n.sp. only known for a locality in eastern Paraná region. The distributions of *crossotos* group are widely overlapping (Fig. 4). The lineage contains species which are distributed in forest areas in the Cerrado biome (*P. mimetica* and *P. crossotos*), one species only known for the type locality in Rio de Janeiro (*P. seabrai*), and *P. spilopectera* with overlapped distribution with the widespread *P. andromache*.

#### Key for the species of *Paroxystoglossa* (based on Moure, 1960)

##### Females

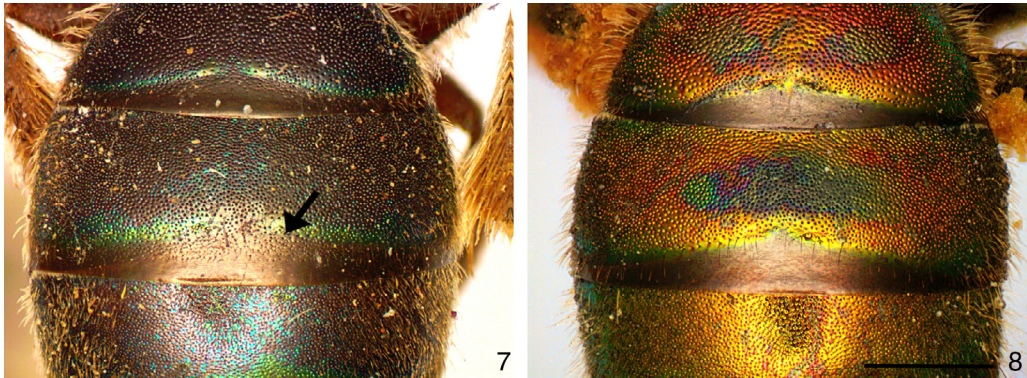
1. Metasoma subelipsoid, metallic green or metallic reddish without apical bands of appressed setae (Fig. 5) ..... 2  
 1'. Metasoma subpedunculate, darkened with apical rows of appressed setae (Fig. 6) ..... 7



Figs. 5–6. Habitus of *Paroxystoglossa* species: 5, *P. mourella* n.sp. 6, *P. spilopectera*, arrow: apical band of appressed setae. Scale bar: 1 mm.

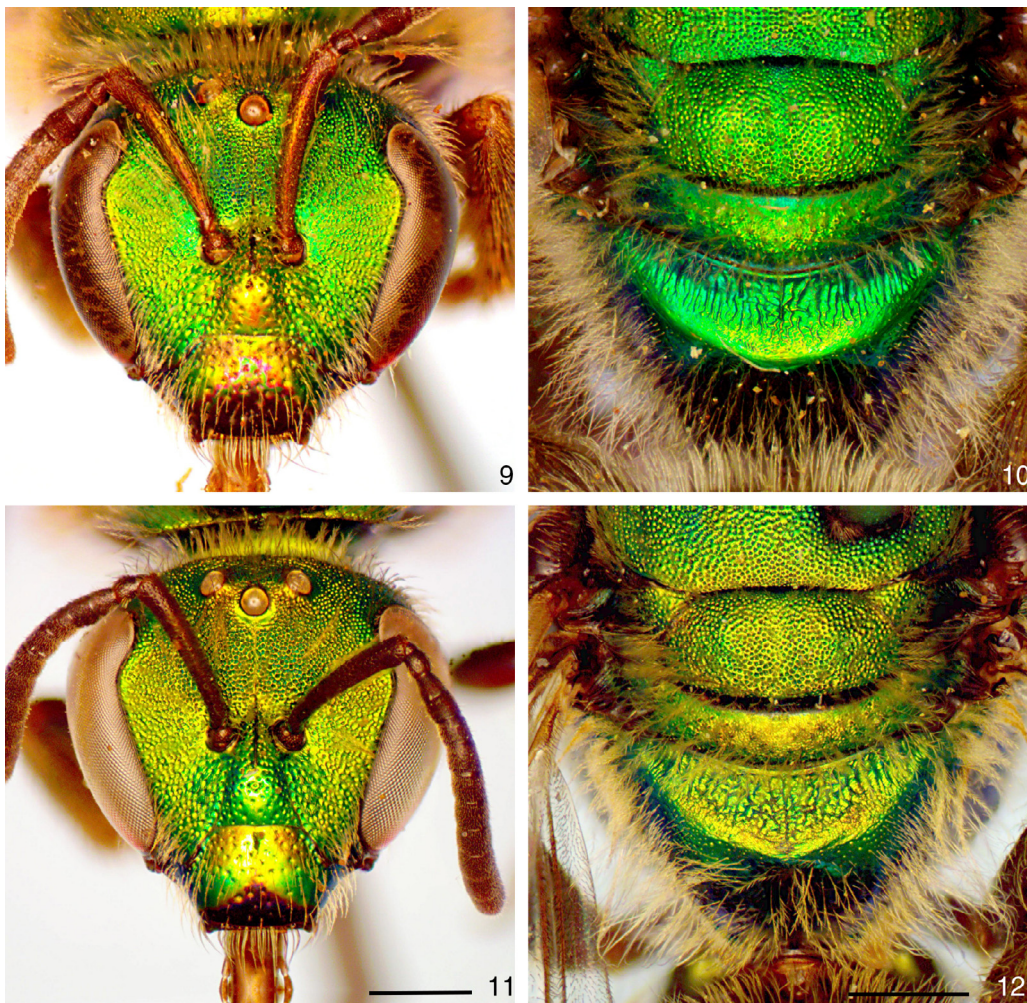


2. Marginal area of terga long and dark, depressions almost impunctate (Figs. 7–8); metapostnotum not depressed, and with fine transverse carina in the middle near posterior declivity ..... 3  
 2'. Marginal area of terga similar in color to rest of discs, with sparse punctures; metapostnotum sometimes depressed, with well-marked striations (Figs. 10, 12) ..... 4  
 3. Marginal depression of terga with fine punctures near the disk, terga without conspicuous row of simple erect setae (Fig. 7) ..... *P. transversa*  
 3'. Marginal depression impunctate, terga with conspicuous row of simple erect setae between disk and marginal depression (Fig. 8) ..... *P. levigata* n.sp.



Figs. 7–8. Second metasomal tergum: 7, *P. transversa*, arrow: punctuation on marginal area. 8, *P. levigata* n.sp. Scale bar: 1 mm.

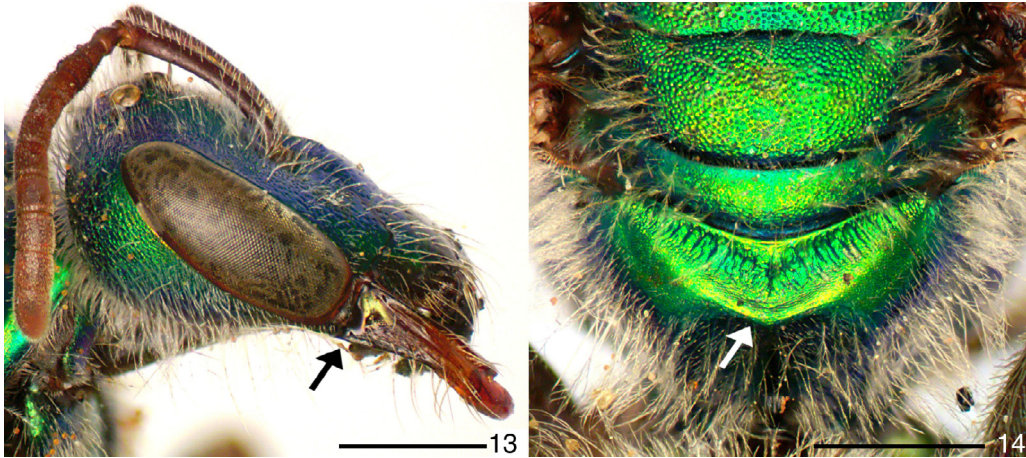
4. Scape with metallic reflections (Figs. 9–11); metapostnotum sculpturing occupying more than one half of surface (Figs. 10–12) ..... 5  
 4'. Scape entirely black; metapostnotum sculpturing restricted to its base (Fig. 14) ..... 6  
 5. Head round; scape with strong metallic reflections (Fig. 9); metapostnotum striation weakly rugose (Fig. 10) ..... *P. jocasta*  
 5'. Head elongate; scape with weaker metallic reflections (Fig. 11); metapostnotum striation strongly rugose, almost reticulate (Fig. 12) ..... *P. mourella* n.sp.



Figs. 9–12. Head and posterior mesosoma: 9, *Paroxystoglossa jocasta*, face. 10, mesosoma; 11, *P. mourella* n.sp., face; 12, mesosoma. Scale bar: 0.5 mm (Figs. 9 and 11); 1 mm (Figs. 10 and 12).

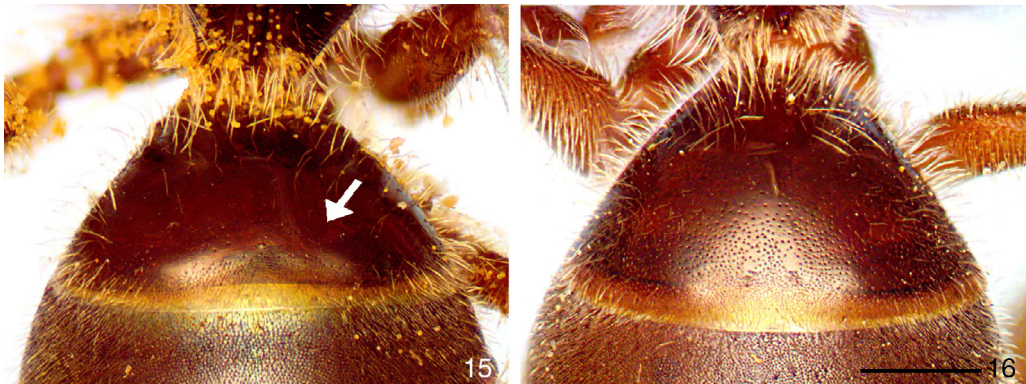


6. Mandibular base with metallic green spot (Fig. 13); metapostnotum as long as or shorter than metanotum, marginally defined by an elevation (Fig. 14); tibiae with metallic green reflections ..... *P. barbata*  
 6'. Mandibular base without metallic green spot; metapostnotum slightly longer than metanotum, grading into posterior surface without marginal elevation; tibiae without metallic green reflections, sometimes with purpureous reflections ..... *P. brachycera*



**Figs. 13–14.** *P. barbata*. 13, head in profile, arrow: mandible spot. 14, detail of mesosoma, arrow: elevation on metapostnotum posterior margin. Scale bar: 1 mm.

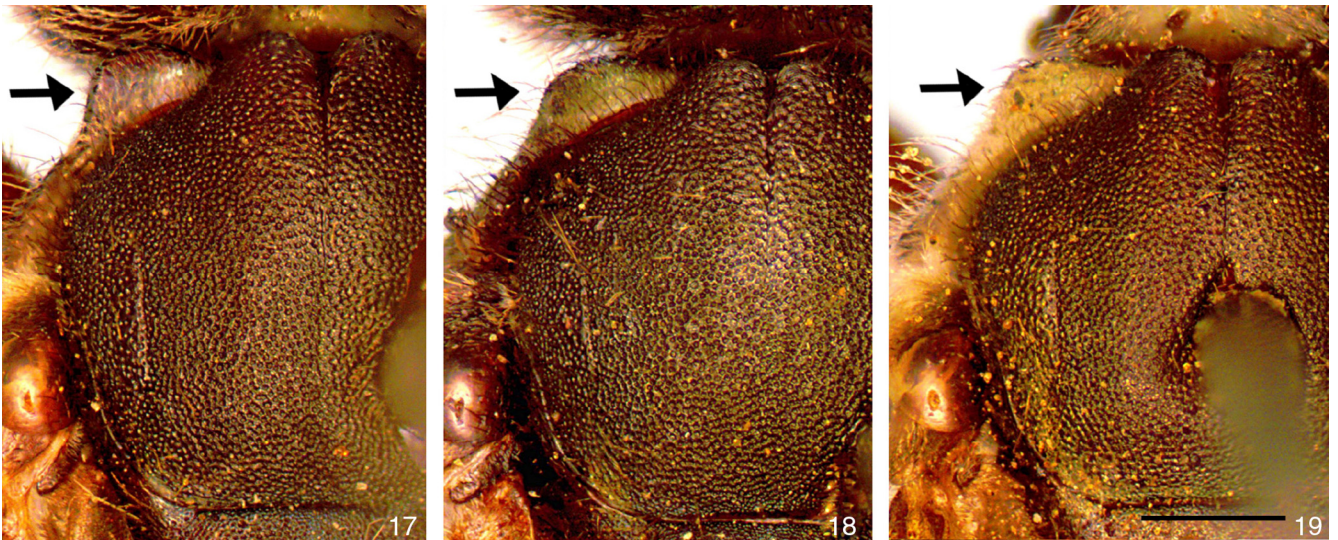
7. Supraclypeal and parocular area smooth; T1 almost impunctate except for a few punctures near marginal area (Fig. 15) ..... *P. mimetica* Moure, 1950  
 7'. Supraclypeal and parocular area microreticulate; T1 with at least apical third quite densely punctate (Fig. 16) ..... 8



**Figs. 15–16.** First metasomal tergum. 15, *P. mimetica*, arrow: T1 almost smooth. 16, *P. spilopectera*. Scale bar: 0.5 mm.



8. Pronotum lateral angle not densely covered with appressed setae (Fig. 17, 18) ..... 9  
 8'. Pronotum lateral angle densely covered with appressed setae (Fig. 19) ..... 10



**Figs. 17–19.** Pronotum lobe (indicate with arrows). 17, *P. seabrai*. 18, *P. crossotos*. 19, *P. spilopectera*. Scale bar: 0.5 mm.

9. Pronotum lateral angle projected (Fig. 17); tergal bands not strongly developed, that of T1 generally little noticeable (Fig. 20) ..... *P. seabrai*  
 9'. Pronotum lateral angle not projected (Fig. 18); apical margins of T1–T4 with yellow pubescence well developed, especially on T2–T4 (Fig. 21) ..... *P. crossotos*



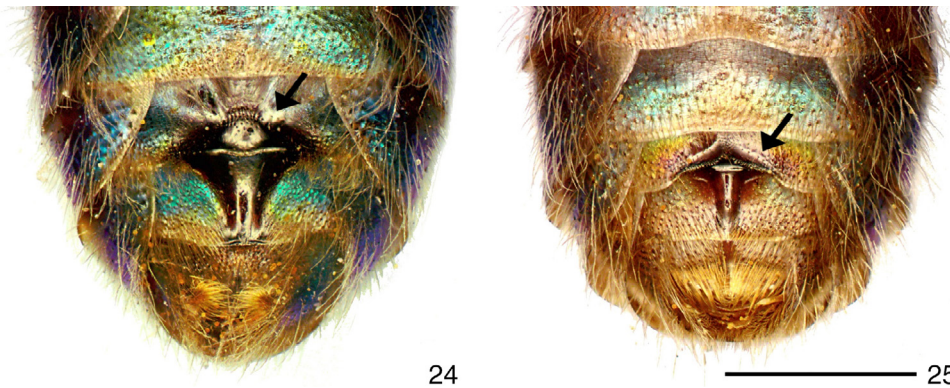
**Figs. 20–23.** Metasoma, length of T3 bands indicated. 20, *P. seabrai*. 21, *P. crossotos*. 22, *P. andromache*. 23, *P. spilopectera*. Scale bar: 1 mm.



10. Tergal bands more developed, especially on T3, T4 bright green with abundant golden pubescence (Fig. 22) ..... *P. andromache*  
 10'. Tergal bands narrow, T4 olivaceous green with few scattered golden setae (Fig. 23) ..... *P. spilopectera*

**Males**

1. F2 but little longer than F1, distinctly shorter than first and pedicel together; scape relatively long and slender, almost reaching level of anterior ocellus ..... 2  
 1'. F2 distinctly longer than F1, equal to or longer than F1 and pedicel together; scape short and thick, terminating more than its diameter below margin of anterior ocellus ..... 3  
 2. Flagellomeres longer than their diameters; metapostnotum as long as metanotum and depressed; hind femur and tibia swollen; S4 and S5 with broad depressions, occupying most of visible sternum (Fig. 24) ..... *P. barbata*  
 2'. Flagellomeres approximately as long as their diameters; metapostnotum longer than metanotum, only slightly depressed; hind femur and tibia not swollen; S4 and S5 with narrow depressions (Fig. 25) ..... *P. brachycera*



**Figs. 24–25.** Metasomal S4 and S5, modifications indicated by arrows. 24, *P. barbata*. 25, *P. brachycera*. Scale bar: 1 mm.

3. Metasoma elongate elipsoid, metallic green or reddish without apical bands of appressed setae (Figs. 26–27) ..... 4  
 3'. Metasoma decidedly claviform, blackened with apical bands of appressed setae (Figs. 28–29) ..... 7



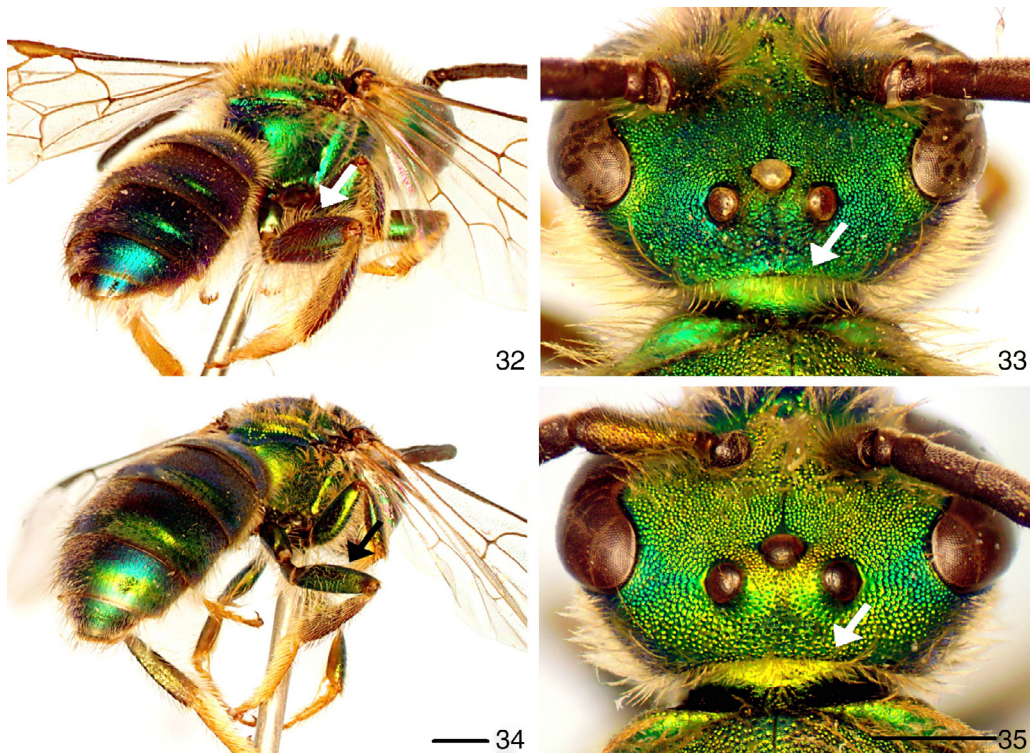
**Figs. 26–29.** Shapes and color bands on of metasoma. 26, *P. transversa*, arrow indicating marginal area. 27, *P. mourella* n.sp. 28, *P. crossotos*, length of T3 band indicated. 29, *P. andromache*, length of T3 band indicated. Scale bar: 1 mm.

4. Marginal depressions of terga long and dark, depressions almost impunctate, disk punctuation coarse (Fig. 26) ..... 5  
 4'. Marginal depressions of terga short, depressions punctate, disk punctuation fine (Fig. 27) ..... 6  
 5. S4 with narrow depression, S5 with inconspicuous depression (Fig. 30) ..... *P. levigata* n.sp.  
 5'. S4 and S5 with broad, conspicuous depressions (Fig. 31) ..... *P. transversa*



**Figs. 30–31.** Metasomal S4 and S5, modifications indicated by arrows. 30. *P. levigata* n.sp. 31. *P. transversa*. Scale bar: 0.5 mm.

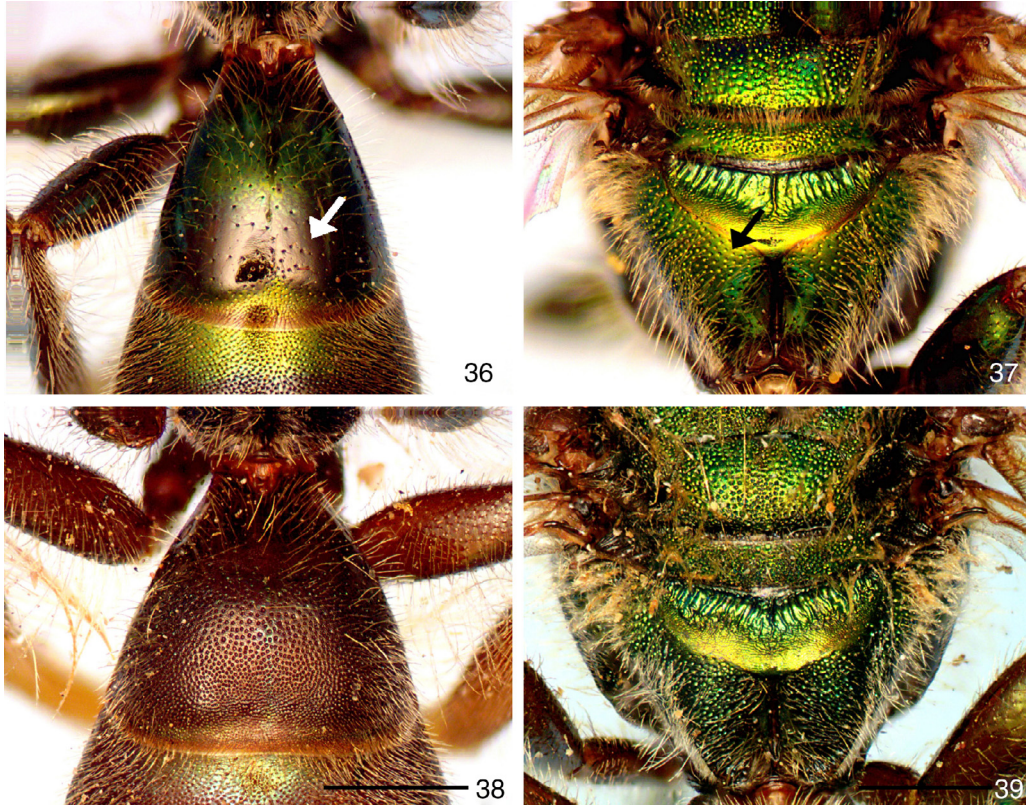
6. Mid and hind femora swollen (Fig. 32); preoccipital area ridged (Fig. 33); S4 and S5 with broad and deep depressions ..... *P. jocasta*  
 6'. Mid and hind femora not swollen (Fig. 34); preoccipital area rounded (Fig. 35), S4 with narrow modification, S5 with shallow depression ..... *P. mourella* n.sp.



**Figs. 32–35.** Postero lateral view and vertex. 32, *P. jocasta*, arrow: swollen femur. 33, arrow: preoccipital area ridged. 34, *P. mourella* n.sp., arrow: not swollen femur. 35, arrow: preoccipital area not ridged. Scale bar: 1 mm.

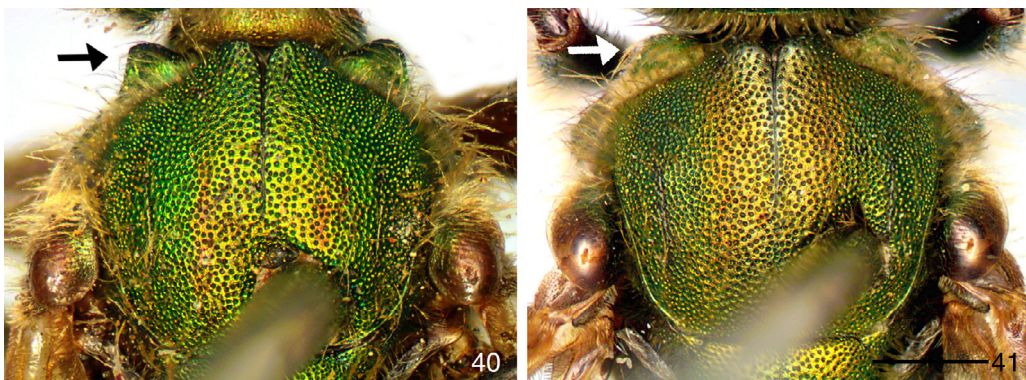


7. Head and mesosoma with dark brown, sometimes metanotum weekly greenish ..... 8  
 7'. Head and thorax metallic green, sometimes dark spots on mesonotum and episterna ..... 9  
 8. T2-T4 marginal area with dense long yellow setae (Fig. 28) ..... *P. crossotos*  
 8'. T2-T4 marginal area with sparse long yellow setae (Fig. 29) ..... *P. andromache*  
 9. T1 smooth and shining, with punctuation very sparse (at sides punctures separated by over 5x their diameters) (Fig. 36); propodeum polished among punctures (Fig. 37) ..... *P. mimetica*  
 9'. T1 rather densely punctate, intervals less than twice a puncture diameter (Fig. 38); propodeum microreticulate (Fig. 39) ..... 10



**Figs. 36–39.** Detail of metasoma and mesosoma. 36, *P. mimetica* T1, arrow: smooth T1. 37, propodeum, arrow: shining metapostnotum. 38, *P. seabrai* T1. 39, propodeum. Scale bar: 0.5 mm.

10. Pronotum lateral angle projected and with a few appressed setae (Fig. 40) ..... *P. seabrai*  
 10'. Pronotum lateral angle not projected and with dense appressed setae (Fig. 41) ..... *P. spiloptera*



**Figs. 40–41.** Pronotum lobe (indicate with arrows). 40, *P. seabrai*. 41, *P. spiloptera*. Scale bar: 0.5 mm.

## Taxonomy

### *Paroxystoglossa levigata*, new species

#### Diagnosis

*Paroxystoglossa levigata* n.sp. is similar to *P. transversa*: pronotum with incomplete lamella from lobe to lateral angle, marginal areas of terga are depressed and dark and male gonobase lobes are broadly excavated. Females of *P. levigata* n.sp. can be separated from *P. transversa* by the marginal area not punctate and terga with conspicuous row of simple erect setae between disk and marginal area in; the males can be distinguished by fourth sternum with small elevations and fifth sternum with shallow depression.

#### Description

**Holotype male.** Measurements, hw: 1.78; hl: 2.25; clw: 1.25; cll: 0.65; scl: 0.25; aloc: 0.57; itd: 1.87; mtw: 2.9; total: 11. **Head,** Labrum basal elevation absent; polished; black. Mandible simple; microrugose; metallic green on base, black apically; long setae on ventral margin. Clypeus epistomal angle obtuse; apical margin: straight; longitudinal depression absent; punctate,  $i=2-3$  dp; very long (almost scape length), plumose (short branches) setae on margins; metallic green. Supraclypeal area pronounced; punctate as clypeus, upper surface microreticulate; plumose (very short branches) setae. Parocular area not foveate; near clypeus sparsely punctate, remaining surface punctate, becoming conflated; plumose (very short branches) setae. Antennae, position of antennal sockets: on middle of face; F2 twice as long as F1; F11 unmodified; black; apex (obliquely) of F1 and F2-11 with trichodea sensilla. Frons not depressed above antennal sockets; coarsely punctate; long plumose (short branches) setae. Ocelli, distance between the lateral ocellus and the upper margin of compound eye three times greater than F1 length. Eyes rounded notched; amber; pubescence: inconspicuous. Vertex, furrow absent; ridge absent; preoccipital area carinate; coarsely punctate; very long plumose (short branches) setae. Gena punctate; metallic green; long (2 ew) plumose setae. Hypostomal area, hypostomal ridge carinate; anterior angle rounded; polished; long (1.5 ew) plumose setae. Malar space short. **Mesosoma,** Pronotum, ridge carinate, not expanded to ventral surface; dorsal surface short, mostly covered by mesoscutum; dorsal surface carinate; lateral angle not projected; punctulate; metallic green; without row of setae. Propleura, depressed on anterior margin; metallic green; fine setae. Prosternum not expanded; metallic green; short appressed setae. Fore leg, trochanter not swollen; punctulate and microlineate; coxa, trochanter, femur and outer tibia metallic green, remaining leg yellow, including femur apex; long setae (0.5 ew) on coxa and ventral trochanter, femur and tibia. Mesoscutum, anterior border: acuminate; median sulcus weak; parapsidial lines conspicuous; punctate, microlineate; long plumose and short simple setae intermixed. Scutellum, structure: median sulcus impressed; punctate; long plumose and short simple setae intermixed. Mesepisternum, sculpturing: conflated punctate above, rugose on scrobal sulcus, punctate ( $i=2$  dp) on lateral and ventral surface, microreticulate; metallic green; long plumose setae. Mid leg, not expanded, trochanter without hook; coxa, trochanter, femur and outer tibia metallic green, remaining leg yellow, including femur apex; long setae (1 ew) on coxa and ventral trochanter, femur and tibia. Tegula, oval; punctulate anteriorly, polished posteriorly; metallic green anteriorly, amber posteriorly. Fore wing, venation strong; intersection 1a. M-cu and basal cell: between 2a. rs-m and Rs; marginal cell apex truncate and appendiculate; submarginal cells: three; pubescence: black microtrichia. Metanotum, median sulcus: not impressed; punctulate; long plumose and short simple setae intermixed. Metepisternum punctate, rugose near wing, microlineate; metallic green; pubescence as mesepisternum. Metasternum

densely covered with long yellow setae. Hind leg, basitibial plate absent; coxa to tibia metallic green, the apex of femur, basis and apex of tibia and entirely tarsus yellow; long plumose setae on ventral coxa to femur, ventral tibial setae not too long and with short branches inner spur: serrate, without basal enlargement; basis of second tarsomere: not fused. Hind wing, seven hamuli; amber; black microtrichia. Metapostnotum weakly inclined; not depressed; as long as metanotum; carinate rugose anteriorly, microrugose posteriorly; metallic green. Propodeum, posterior surface sculpturing: punctulate and microreticulate; lateral surface sculpturing punctate and microreticulate; metallic green; long plumose setae on posterior surface and upper lateral surface. **Metasoma,** T1 not depressed; punctate, marginal area microlineolate; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T2 punctate, marginal area weakly lineolate, translucent; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T3 punctate, marginal area polished, translucent; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T4 sparsely punctate, marginal area polished, translucent; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T5 sparsely punctate, marginal area polished, translucent; mostly metallic green, marginal area light brown; long setae on anterior and antero lateral surface, short on disk. T6 coarsely punctate; mostly metallic green; long setae on anterior and antero lateral surface, short on disk. T7, carina: absent; notch: absent; proctiger: without filaments and microtrichia. S1, structure: without tubercle; sculpturing: lineate; color: brown; pubescence: very long plumose setae. S2 lineate; brown; long curved setae. S3: margin straight; lineate anteriorly, microlineate posteriorly; brown, some metallic reflections; long curved setae. S4 medially concave, with median elevations; sculpturing: microlineate; anteriorly amber, metallic green on disk, except for black elevation; long setae laterally. S5: with a median depressed area, weakly emarginate; microlineate; anteriorly amber, metallic green on disk; curved setae on disk, longer and finer on lateral surface. S6 margin straight; lineate; light brown; long yellow setae. S7, apical margin: with median process. S8, apical margin: with median process; spicule: present: fusion with S7: not at apodeme apex. **Genital capsule** (Figs. 42 and 43), dorsal surface of gonapophysis without ridge; dorsal surface of gonapophysis, process: absent; shape of gonapophysis: medially broad; outer surface of gonapophysis: indentate; ventral surface of gonapophysis: with broad prong; gonobasal dorsal lobes: broadly excavated; gonocoxite: unmodified; basal process of gonostylus: absent; dorsal process of gonostylus: absent; gonostylus: constricted at basis; parapenial lobe: present; ventral process of gonostylus, shape: globose; ventral process of gonostylus, size: not enlarged; ventral surface of gonostylus: with projection; inner apical corner of volsella: without hook; outer basal corner of volsella: rounded; volsellar axis: parallel.

**Paratype female.** Measurements, hw: 1.9; hl: 2.4; clw: 1.4; cll: 0.7; scl: 0.4; aloc: 0.7; itd: 1.9; mtw: 3.5; total: 11. **Head,** Labrum, basal elevation present; not divided; transversal; distal process keeled; quadrate; keel: thin ridge; polished; black; long setae. Mandible teeth not widely separated; microrugulose; black; long setae on outer and ventral margins. Clypeus, epistomal angle obtuse; apical margin straight; not depressed; punctate,  $i=2-3$  dp; plumose (very short branches) setae on margins, row of long erect setae on apex; basally metallic green, dark apically. Supraclypeal area pronounced; punctate as clypeus; plumose (very short branches) setae. Parocular area not foveate; punctate, becoming conflated; plumose (very short branches) setae. Antennae, number of flagellomeres: 10; position of antennal sockets: on middle of face; F2 as long as F1; black; F1, F2 and most of F3 with microtrichia, F4-10 also with trichodea sensilla. Frons



not depressed above antennal sockets; coarsely punctate; long plumose (short branches) setae. Ocelli, distance between the lateral ocellus and the upper margin of compound eye: three times greater than F1 length. Eyes weakly rounded notched; amber; inconspicuous. Vertex, furrow absent; ridge absent; preoccipital area angled; coarsely punctate; long plumose (short branches) setae. Gena punctate; metallic green; long (2 ew) setae, some with very short branches. Hypostomal area, hypostomal ridge carinate; anterior angle rounded; polished; long (1.5 ew) plumose setae. Malar space short. Labium, glossa apex pointed; prementum unmodified, less than  $7\times$  longer than wide. Maxilla, galea apex lobed; galea base extending posterad or near to base of stipes; palpi not elongate; sixth palpomere as long as fifth. **Mesosoma**, Pronotum, ridge carinate, not expanded to ventral surface; dorsal surface short, mostly covered by mesoscutum; carinate; lateral angle not projected; punctulate; metallic green; without row of setae. Propleura: depressed on antero margin; metallic green; fine plumose setae; Prosternum, not expanded; metallic green; short appressed setae. Fore leg, trochanter without hook; punctulate and microlineate; coxa to femur metallic green, tibia and tarsus brown; long setae on coxa apex and femur outer surface. Mesoscutum, anterior border acuminate; median sulcus weak; parapsidial lines conspicuous; punctate, microlineate; long plumose and short simple setae intermixed. Scutellum median sulcus impressed; punctate, conflated punctate on middle, near mesoscutum; long

plumose and short simple setae intermixed. Mesepisternum, conflated punctate above, rugose on scrobal sulcus, punctate ( $i = 2 dp$ ) on lateral and ventral surface, microreticulate; metallic green; long plumose setae; Mid leg, not expanded; trochanter without hook; coxa to femur metallic green, tibia and tarsus brown, tibia with metallic reflections on outer surface; long setae (0.5 ew) on coxa and ventral trochanter, femur and tibia. Tegula, oval; punctulate anteriorly, polished posteriorly; metallic green anteriorly, amber posteriorly. Fore wing, venation strong; intersection 1a. M-cu and basal cell: between 2a. rs-m and Rs; marginal cell apex truncate and appendiculate; submarginal cells: three; black microtrichia. Metanotum, median sulcus: not impressed; punctulate; long plumose and short simple setae intermixed. Metepisternum, punctate, rugose near wing, microlineate; metallic green; as mesepisternum. Metasternum densely covered with long yellow setae. Hind leg, basitibial plate: oval, acuminate apex; coxa to femur metallic green, tibia and tarsus brown; long setae on coxa and trochanter, femur with scopa, tibia with scopa, black setae on outer surface; inner spur serrate, without basal enlargement; basis of second tarsomere not fused. Hind wing, structure: seven hamuli; amber; black microtrichia. Metapostnotum, weakly inclined; not depressed; two thirds scutellum; rugulose anteriorly, microrugose posteriorly; metallic green. Propodeum, posterior surface sculpturing: punctulate and microreticulate; lateral surface sculpturing irregularly punctate and microreticulate; metallic



42



43



44



45

**Figs. 42–45.** Genital capsules. 42, *P. levigata* n.sp., ventral view, 43, dorsal view. 43, *P. mourella* n.sp., ventral view. 44, dorsal view. Scale: 0.25 mm.

green; long plumose setae on posterior surface and upper lateral surface. **Metasoma**, T1, not depressed; punctate, marginal area lineolate; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T2, punctate, marginal area lineolate; mostly metallic green, marginal area dark brown; long setae on anterior and antero lateral surface, short on disk. T3, punctate, marginal area mostly lineolate; mostly metallic green, marginal area with bluish stripe and dark brown; long setae on anterior and antero lateral surface, short on disk. T4: punctulate, marginal area mostly lineolate; mostly metallic green, marginal area with bluish stripe and dark brown; long setae on anterior and antero lateral surface, short on disk. T5, cleft, with fimbriae; dark; mostly covered with black long setae, row of bristles on apex. S1, without tubercle; lineate; brown; very long plumose setae. S2, lineate; brown; long curved setae. S3, margin straight; lineate anteriorly, microlineate posteriorly; brown, some metallic reflections; long curved setae. S4, margin straight; lineate; brown, some metallic reflections; long curved setae. S5, margin straight; lineate; brown, some metallic reflections; long curved setae. S6, margin straight; lineate; light brown; long setae.

#### Type material

Holotype male (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 25°30'S 48°59'W 13.IX.xi.2002, Melo & Aguiar”. Paratypes, Paraná: two females (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 25°30'S 48°59'W 3.xii.2000, G.A.R. Melo”; three females (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 25°30'S 48°59'W 4.xii.2000, G.A.R. Melo”; two females (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 1000 m, 3.xii.2002 25.496°S 48.981°W J. G. Rozen Jr.”; three females (DZUP) “Brasil, PR, Piraquara, Mananciais da Serra, 25°29'S 48°59'W 1050 m, 5.xii.2004, Melo & Aguiar”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 25°30'S 48°59'W 27.i.2001, G.A.R. Melo” “*Paroxystoglossa transversa* Moure, 1943”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra, 25°29'S 48°59'W 27.i.2001, G.A.R. Melo”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra 25°29'45.5”S 48°58'58.2”HO Garcia, E.Q., coleta ativa 12-xi-2002 Trilha mata”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra 25°29'45.5”S 48°58'58.2”HO Garcia, E.Q., coleta ativa 14-xi-2002 Trilha mata”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra 25°29'45.5”S 48°58'58.2”HO Garcia, E.Q., coleta ativa 02-xi-2002”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra 8.ii.2003, Melo”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra 11.xii.2003, Melo, Rozen, Gonçalves”; one female (DZUP) “Brasil, Paraná, Piraquara, Mananciais da Serra S25°29'18” W 48°58'26” 20.XII.2007 A. C. B. Bergamaschi”; one female (DZUP) “Brasil, Paraná, Piraquara, 22 xi.2005, R. Gonçalves leg”.

#### Etymology

Specific epithet meaning smooth, polished, in reference to impunctate metasomal marginal areas.

#### *Paroxystoglossa mourella*, new species

#### Diagnosis

*P. mourella* n.sp. is entirely green and have orthogonal epistomal angle. This is species can be distinguished from other species from *jocasta* group by the faint metallic coloration in scape, the elongate shape of head and the fine punctures on terga. The male of *P. mourella* n.sp. can be distinguished by short body pubescence, the not swollen tibia and lesser prominent tubercles on fourth and fifth sterna.

#### Description

**Holotype male.** Measurements, hw: 1.5; hl: 2.15; clw: 0.8; cll: 0.6; scl: 0.4; aloc: .45; itd: 1.65; mtw: 2.4; total: 10. **Head**, Labrum, basal elevation absent; polished; black. Mandible, simple; microrugose; metallic green on basis, black apically; pubescence: long setae on ventral margin. Clypeus, epistomal angle approximately orthogonal; apical margin straight; not depressed; punctate,  $i = 3$  dp; long plumose (short branches) setae on margins; metallic green. Supraclypeal area, pronounced; punctate as clypeus; long plumose (short branches) setae. Parocular area, not foveate; punctate; long plumose setae. Antennae, number of flagellomeres: 11; position of antennal sockets on middle of face; F2 twice as long as F1; F11 unmodified; black; apex (obliquely) of F1 and F2-11 with trichodea sensilla. Frons, not depressed above antennal sockets; coarsely punctate; long plumose (short branches) setae. Ocelli, distance between the lateral ocellus and the upper margin of compound eye: three times greater than F1 length. Eyes, rounded notched; amber; inconspicuous pubescence. Vertex, furrow: absent; ridge: absent; preoccipital area rounded; coarsely punctate; long plumose (short branches) setae. Gena, punctate; metallic green; long (2 ew) plumose setae. Hypostomal area, hypostomal ridge carinate; anterior angle rounded; polished; long (1.5 ew) plumose setae. Malar space short. **Mesosoma**, Pronotum, ridge carinate, not expanded to ventral surface; dorsal surface: short, mostly covered by mesoscutum; dorsal surface not carinate; lateral angle not projected; punctulate; metallic green; pubescence: long plumose setae on dorsal surface. Propleura, depressed on antero margin; metallic green; fine setae. Prosternum not expanded; metallic green; short appressed setae. Fore leg, trochanter: not swollen; punctulate and microlineate; coxa, trochanter, femur and outer tibia metallic green, remaining leg yellow, including femur apex; long setae (0.5 ew) on coxa and ventral trochanter, femur and tibia. Mesoscutum, anterior border broadly rounded; median sulcus weak; parapsidial lines conspicuous; punctate, microlineate; long plumose and short simple yellow setae intermixed. Scutellum, median sulcus weakly impressed; punctate; long plumose and short simple setae intermixed. Mesepisternum, conflated punctate, rugose on scrobal sulcus; metallic green; long plumose setae. Mid leg, not expanded, trochanter without hook; coxa to tibia metallic green, the apex of femur, tibia and entirely tarsus yellow; long setae (0.5 ew) on coxa and ventral trochanter, femur and tibia. Tegula, oval; sculpturing: punctulate anteriorly, polished posteriorly; metallic green anteriorly, amber posteriorly. Fore wing, venation strong; intersection 1a. M-cu and basal cell between 2a. rs-m and Rs; marginal cell apex truncate and appendiculate; submarginal cells: three; black microtrichia. Metanotum, median sulcus: not impressed; punctulate; long plumose and short simple setae intermixed. Metepisternum, punctate and microlineate; metallic green; pubescence as mesepisternum. Metasternum densely covered with long yellow setae. Hind leg, basitibial plate: absent; coxa to tibia metallic green, the apex of femur, basis and apex of tibia and entirely tarsus yellow; long plumose setae on ventral coxa to femur, ventral tibial setae not too long and with short branches inner spur serrate, without basal enlargement; basis of second tarsomere not fused. Hind wing, five hamuli, one of them isolate on middle; amber; black microtrichia. Metapostnotum, weakly inclined; weakly depressed; almost as scutellum; carinate rugose anteriorly, microrugose posteriorly; metallic green. Propodeum, posterior surface sculpturing: punctulate and microreticulate; lateral surface sculpturing punctate and microreticulate; metallic green; long plumose setae on posterior surface and upper lateral surface. **Metasoma**, T1, not depressed; punctulate; mostly metallic green; long setae on anterior and antero lateral surface, short on disk. T2, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, much longer on



ventral surface. T3, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, much longer on ventral surface. T4, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, long black setae on posterior surface, much longer yellow setae on ventral surface. T5, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, long black setae on posterior surface, much longer yellow setae on ventral surface. T6, punctulate; mostly metallic green; long black setae on posterior surface. T7, carina absent; notch: absent; proctiger without filaments and microtrichia. S1, without tubercle; microlineate; metallic green; very long plumose setae. S2, microlineate; pale green; long setae. S3, margin straight; microlineate; amber anteriorly, pale green posteriorly; long setae. S4, medially concave, with median elevations; microlineate; anteriorly amber, metallic green on disk, except for black elevation; long setae laterally. S5, with a median depressed area, weakly emarginate; microlineate; anteriorly amber, metallic green on disk; long setae. S6, gradulus continuous, margin cleft; microlineate; light brown; long plumose setae. S7, apical margin: with median process. S8, apical margin: with median process; spicule: present; fusion with S7: not at apodeme apex. **Genital capsule** (Figs. 42 and 43), dorsal surface of gonapophysis, ridge: without ridge; dorsal surface of gonapophysis, process: absent; shape of gonapophysis: medially broad; outer surface of gonapophysis: indented; ventral surface of gonapophysis: with broad prong; gonobasal dorsal lobes: narrow; gonocoxite: unmodified; basal process of gonostylus: absent; dorsal process of gonostylus: absent; gonostylus: constricted at basis; parapenial lobe: present; ventral process of gonostylus, shape: globose; ventral process of gonostylus, size: not enlarged; ventral surface of gonostylus: with projection; inner apical corner of volsella: without hook; outer basal corner of volsella: rounded; volsellar axis: parallel.

**Paratype female.** Measurements, hw: 1.5; hl: 5; clw: 0.7; cll: 0.5; scl: 0.45; aloc: 0.55; itd: 1.6; mtw: 2.65; total: 9. **Head**, Labrum, basal elevation present, not divided; shape of basal elevation transversal; distal process keeled; shape of distal process quadrate; keel thin ridge; polished; black; keel pubescence: long setae. Mandible, teeth not widely separated; mostly polished, some microrugulations; amber; long setae on outer and ventral margins. Clypeus, epistomal angle: approximately orthogonal; apical margin: straight; longitudinal depression: not depressed; sparsely and irregularly punctate,  $i = 1-6$  dp; long plumose (short branches) setae on margins, row of long erect setae on apex; apex dark, most surface metallic green. Supraclypeal area, pronounced; more densely punctate than clypeus; long plumose (short branches) setae. Parocular area, not foveate; punctate, becoming conflated; long plumose (short branches) setae. Antennae, number of flagellomeres: 10; position of antennal sockets on middle of face; F2 length as long as F1; amber; F1 and F2 with microtrichia, F3-10 also with trichodea sensilla. Frons, not depressed above antennal sockets; coarsely punctate; long plumose (short branches) setae. Ocelli, distance between the lateral ocellus and the upper margin of compound eye: three times greater than F1 length. Eyes, rounded notched; amber; inconspicuous pubescence. Vertex, furrow absent; ridge absent; preoccipital area rounded; coarsely punctate; long plumose (short branches) setae. Gena, punctate-lineate; metallic green; long (1.5 ew) plumose setae. Hypostomal area, hypostomal ridge: carinate; anterior angle: rounded; polished; long (1.5 ew) plumose setae. Malar space short. Labium, glossa apex pointed; prementum unmodified, less than 7x longer than wide. Maxilla, galea apex lobed; galea base extending posterad or near to base of stipes; palpi not elongate; sixth palpomere: as long as fifth. **Mesosoma**, Pronotum, ridge carinate, not expanded to ventral surface; dorsal surface short, mostly covered by Mesoscutum, not carinate; lateral angle not projected; punctulate; metallic green; without row of setae. Propleura, depressed on antero margin; metallic

green; fine setae. Prosternum not expanded; metallic green; short appressed setae. Fore leg, trochanter: without hook; punctulate and microlineate; coxa to femur metallic green with amber spots, tibia and tarsus yellow; long setae on coxa apex, femur outer surface. Mesoscutum, anterior border broadly rounded; median sulcus weak; parapsidial lines conspicuous; punctate, microlineate; long plumose and short simple setae intermixed. Scutellum, median sulcus weakly impressed; punctate; long plumose and short simple setae intermixed. Mesepisternum, conflated punctate, rugose on scrobal sulcus; metallic green; long plumose setae. Mid leg, not expanded, trochanter without hook; mostly yellow except for metallic green reflections; trochanter with long plumose setae, femur with basal inner patch of yellow and simple setae, tibia and tarsus with plumose setae on outer margin, some of them black. Tegula, oval; punctulate anteriorly, polished posteriorly; metallic green anteriorly, amber posteriorly. Fore wing, venation strong; intersection 1a. M-cu and basal cell: between 2a. rs-m and Rs; marginal cell apex truncate and appendiculate; submarginal cells: three; black microtrichia. Metanotum, median sulcus not impressed; punctulate; long plumose and short simple setae intermixed. Metepisternum, punctate and microlineate; metallic green; pubescence as mesepisternum. Metasternum densely covered with short white setae. Hind leg, basitibial plate: oval; yellow with some metallic green reflections on coxa to femur; long setae on coxa and trochanter, femur with scopa, tibia with scopa, black setae on outer surface; inner spur serrate, without basal enlargement; basis of second tarsomere not fused. Hind wing, five hamuli, one of them isolate on middle; amber; black microtrichia. Metapostnotum, weakly inclined; weakly depressed; almost as scutellum; sculpturing: rugose anteriorly, microrugose posteriorly; metallic green. Propodeum, posterior surface punctulate and polished; lateral surface punctate and microreticulate; metallic green; long plumose setae on posterior surface and upper lateral surface, simple long setae on lower lateral surface. **Metasoma**, T1, not depressed; punctulate; mostly metallic green; long setae on anterior and antero lateral surface, short on disk. T2, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, much longer on ventral surface. T3, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, much longer on ventral surface. T4, punctulate; mostly metallic green; short yellow setae, longer and plumose on lateral surface, long black setae on posterior surface, much longer yellow setae on ventral surface. T5, cleft, with fimbriae; dark; mostly covered with black long setae, row of bristles on apex. S1, without tubercle; microlineate; metallic green; pubescence: very long plumose setae. S2, microlineate; pale green; long curved setae. S3, margin straight; lineate anteriorly, microlineate posteriorly; amber anteriorly, pale green posteriorly; long curved setae. S4, margin straight; lineate anteriorly, microlineate posteriorly; amber anteriorly, pale green posteriorly; long curved setae. S5, margin straight; lineate anteriorly, microlineate posteriorly; amber anteriorly, pale green posteriorly; long curved setae. S6, margin straight; microlineate; light brown; long setae.

#### Variation

Color variation on terga is known among females from Serra do Cipó (Minas Gerais). Most of females (about 80%) have mostly green discs sometimes with bluish or amber shades, especially on second and third terga. Some females have subtle to conspicuous cupreous reflections. None female have entirely red terga. A continuous size variation is evidenced (intertegular distance from 1.45 mm to 1.875 mm), but it is not associate with the color variation.

#### Type material

Male holotype (DZUP), "Brasil, MG, 6 km S de Itamarandiba, pista de pouso, 1015 m, 17.913°S 42.871°N, 9-17.ii.2013, G.

Melo, \ Arm. Malaise". Paratypes, *Minas Gerais*: one female (DZUP), "Brasil, Minas Gerais, \ 25 km S de Santana do \ Riacho, Cardeal Mota, \ 850 m, 10.I.2012, \ 19.322°S 43.611°N, \ G. Melo", three females (DZUP), "Brasil, Minas Gerais, \ Serra do Cipó, 1200m \ 19° 17'S 43° 55'W, \ 10.II.2001, G.A.R. Melo, \ entre 6-8h"; one female (DZUP) "Brasil, Minas Gerais \ Catas Altas, Serra do \ Caraça, 1200 m, \ 2.IV.1999, GAR Melo"; one female (DZUP) "Brasil, Minas Gerais \ 15 km de Delfim \ Moreira, 1500 m, \ 22.I.2004, Mielke & Casagrande".

#### Etymology

The specific epithet honors Pe. Jesus Santiago Moure.

#### Conflicts of interest

The authors declare no conflicts of interest.

#### Acknowledgements

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