A NEW SPECIES OF *PETALOMIUM* CROSS, 1965 (HETEROSTIGMATA: NEOPYGMEPHORIDAE) AND RECORDS OF *TROCHOMETRIDIUM TRIBULATUM* CROSS, 1965 (HETEROSTIGMATA: TROCHOMETRIDIIDAE) FROM BRAZIL

Fernando C. Jacinavicius[1,2*], Rafaela A. Silva[3], Ricardo Bassini-Silva[2], Vinicius M. Lopez[4], Rogério Silvestre[5] and Alexander A. Khaustov[6]

[1]Butantan Institute, Special Laboratory for Zoological Collections, São Paulo, Brazil
[2]University of São Paulo, Faculty of Veterinary Medicine and Animal Husbandary, São Paulo, Brazil
[3]State University of Santa Cruz, Laboratory of Entomology, Ilhéus, Brazil
[4]University of São Paulo, Faculty of Philosophy, Sciences and Letters at Ribeirão Preto, Ribeirão Preto, Brazil
[5]Federal University of Grande Dourados, Faculty of Biological and Environmental Sciences, Dourados, Brazil
[6]Tyumen State University, Tyumen, Russia
[*]corresponding author; e-mail: fcjacinavicius@gmail.com

ABSTRACT: A new species, *Petalomium barrosbattestiae* sp.n. (Acari: Neopygmephoridae), associated with *Traumatomutilla rubroguttata* (Hymenoptera: Mutillidae) from Brazil, is described. Some new host records of *Trochometridium tribulatum* Cross, 1965 are reported, including the first record of this species in Brazil. The association between mites of the genus *Petalomium* and velvet ants is reported for the first time.

KEY WORDS: Phoresy, velvet ants, Mutillidae, Neotropics.

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INTRODUCTION

Mites of the family Neopygmephoridae Cross, 1965 *sensu* Khaustov 2004 are fungivorous. This family comprises 23 genera, which include both free-living mites as well as those associated with various arthropods (Arachnida, Chilopoda and Insecta) (Khaustov and Mandelshtam 2016; Khaustov and Minor 2018). One of these genera, *Petalomium* Cross, 1965 (Neopygmephoridae), includes 47 described species and is mainly associated with ants (Silva *et al.* 2018a, b). Four species are recorded for the Neotropical region. They include *Petalomium affinitum* Mahunka, 1981 from Santa Lucia, as well as three species from Brazil: *P. verenae* Silva, Khaustov et Oliveira, 2017; *P. megasolenidiatum* Silva, Khaustov et Oliveira, 2018; and *P. braziliensis* Silva, Khaustov et Oliveira, 2018 (Silva *et al.* 2018b).

The mites of the family Trochometridiidae Mahunka, 1970, as well as neopygmephorid mites, are fungivorous. They are phoretically associated with insects of the orders Coleoptera, Dermaptera, Diptera and Hymenoptera (Loghmani *et al.* 2014). The species *Trochometridium tribulatum* Cross, 1965 was reported in Nearctic (Canada, USA and Mexico), Palaearctic (Egypt) and Afrotropical regions (Sudan and South Africa) (Cross and Bohart 1979, Lindquist 1985, OConnor and Klimov 2012).

This work is a contribution to the knowledge of heterostigmatic mites from Brazil. We describe a new species from the genus *Petalomium* and report new records of *Trochometridium tribulatum* in association with velvet ants.

MATERIAL AND METHODS

Velvet ant species (Hymenoptera: Mutillidae), housed at the collection of the Laboratory of Ecology of Hymenoptera (HECOLAB—Universidade Federal da Grande Dourados, Dourados municipality, Mato Grosso do Sul state, Brazil), were examined. The mites were collected with a paint-brush; cleared in lactic acid; and slide-mounted in Hoyer's medium, following Walter and Krantz (2009).

Drawings were made using a combination of a Leica DM2500 microscope, camera lucida and Adobe Illustrator CC. Measurements were made with the help of a Leica DFC 500 digital camera and a Leica DM4000B compound microscope. All measurements are given in micrometers (μm), followed by the mean and the minimum and maximum measures (in parenthesis, when available).

The terminology of the idiosoma and legs follows Lindquist (1986); the nomenclature of subcapitular setae and the designation of cheliceral setae follow Grandjean (1944, 1947), respectively.

SYSTEMATICS

Family **Neopygmephoridae Cross, 1965**
Genus ***Petalomium* Cross, 1965**
Type species: *Parapygmephorus* (*Petalomium*) *krczali* Cross, 1965, by original designation.

Petalomium barrosbattestiae Jacinavicius, Silva et Khaustov sp.n.

(Figs. 1–4)

Description. Female. Length of idiosoma 215 (211–220), width 165 (161–173).

Gnathosoma (Fig. 2): length of gnathosoma 28 (27–28), width 25 (23–26); Gnathosomal capsule slightly rounded, almost as wide as long; dorsally with two pairs of pointed and barbed cheliceral setae *cha* 14 (14–15) and *chb* 18 (17–18); dorsal medial apodeme well developed; a pair of minute palpcoxal setae *pp* located anterolaterally to bases of setae *cha*. Pharyngeal pump I small, umbrella-like, situated outside gnathosoma; pharyngeal pump II large, oval, more than two times longer than hart-like pump III; palpi compressed to gnathosomal capsule, dorsally bearing two smooth and pointed setae *dFe* 9 (8–9) and *dGe* 10, ventrally with a pair of accessory setigenous structure (*ass*) and proximal, well-developed long shark fin-shaped palpal solenidion (*pps*), palpi terminated with a tibial claw; subcapitulum with one pair of pointed and smooth subcapitular setae *m* 4 (4–5) located near to palp bases.

Idiosomal dorsum (Fig. 1A): dorsal plates smooth; all dorsal idiosomal setae thick, distinctly barbed and pointed, except v_2, which is smooth and needle-like, prodorsal shield (*Prs*) with two pairs of setae v_2 21 (18–22), sc_2 72 (67–77), one pair of barbed capitate trichobothria (sc_1) and one pair of distinctly rounded stigmata (*stg*) with well-developed atrium (*atr*) and tracheal system located near mid-level of the prodorsum; tergite C with concave posterior margin, bearing two pairs of setae c_1 84 (80–87) and c_2 100 (96–102), c_2 longer than c_1 and both inserted at the same transverse level; tergite D weakly convex in its middle part, bearing one pair of setae *d* 100 (94–104) and one pair of cupuli *ia* situated anterolaterally to seta *d*; tergite EF with nearly straight posterior margin, with two pairs of setae *e* 40 (38–43) and *f* 125 (123–128), setae *f* more than three times longer than *e* and inserted distally to *f*; tergite H with two pairs of setae h_1 98 (96–102), h_2 92 (91–93) and one pair of cupuli *ih* placed near the base of setae h_2, seta h_2 almost subequal to h_1; distances between dorsal idiosomal setae: v_2–v_2 41 (39–43), sc_2–sc_2 41 (38–44), c_1–c_1 72 (69–74), c_2–c_2 146 (141–148), c_1–c_2 38 (38–39), *d*–*d* 73 (69–76), *e*–*e* 106 (100– 110), *f*–*f* 83 (82–84), *e*–*f* 13 (12–15), h_1–h_1 34 (33–35), h_2–h_2 87 (83–91), h_1–h_2 27 (22–30).

Idiosomal venter (Fig. 1B): all ventral plates smooth; all ventral idiosomal setae barbed and pointed, seta 4*b* longest; ventral apodemes (ap1–4, appr, apsej, appo) well-developed, ap5 vestigial, situated near the base of trochanters IV; coxal fields I–II and III–IV with two and three pairs of setae each, respectively; coxal field I: 1*a* 45 (42–49), 1*b* 30 (27–33), 1*a* longer than 1*b*; coxal field II: 2*a* 47 (45–48), 2*b* 51 (50–53), seta 2*b* longest seta in anterior sternal plate; coxal field III: 3*a* 37 (37–38), 3*b* 38 (36–41), 3*c* 34 (32–36); coxal field IV: 4*a* 44 (42–44), 4*b* 58 (55–60), 4*c* 38 (37–39), setae 4*a* and 4*c* shorter than 4*b*; anterior genital sclerite (ags) hood-like shaped, median genital sclerite (mgs) very small, but distinct, posterior genital sclerite (pgs) triangular; posterior margin of aggenital plate (Ag) convex in the middle part; pseudanal plate with three pairs of setae ps_1 51 (48–53), ps_2 49 (48–50), ps_3 35 (34–36) and anal slit.

Legs (Figs. 3, 4). leg I (Fig. 3A): setal formula (number of solenidia in parentheses): 1–3–4–16(4). Trochanter with seta *v'* barbed and pointed. Femur with seta *d* dilated and hook-like; setae *v"* and *l'* smooth, *v"* and *l'* subequal. Genu with four barbed setae (*v'*, *v"*, *l'* and *l"*). Tibiotarsus with nine barbed tactile setae (*v'*, *v"*, *l'*, *l"*, *pv'*, *pv"*, *k*, *d* and *s*), five eupathidia (*ft'*, *ft"*, *tc'*, *tc"* and *p"*), *tc"* located on short pinnaculum; setae *pl'* and *pl"* smooth and pointed, four solenidia slightly clavate (φ_1, φ_2, ω_1, ω_2) and ventro-apical finger-like structure. Lengths of solenidia: φ_1 6 (5–7), φ_2 8, ω_1 6 (5–7), ω_2 4 (4–5). Tarsal claw strong, sickle-shaped. Leg II (Fig. 3B); setal formula: 1–3–3–4(1)–6(1); Trochanter with seta (*v'*) barbed and pointed. Femur bearing two barbed setae (*v"* and *d*), *d* much larger than others, seta *l'* smooth and pointed. Genu with three barbed setae (*v'*, *l'* and *l"*). Tibia with four barbed setae (*l'*, *v'*, *v"* and *d*) and clavate solenidion φ 5 (5–6). Tarsus with six barbed setae (*tc'*, *pv'*, *pv"*, *u'*, *tc"* and *pl"*), and solenidion ω 6 (6–7) finger shaped. Pretarsus with pair of thickened basally claws and pad-like empodium. Leg III (Fig. 4A); setal formula: 1–2–2–4(1)–6; Trochanter with barbed seta (*v'*). Femur bearing two barbed setae (*v'* and *d*), *d* longer than *v'*. Genu with two barbed setae (*v'* and *l'*). Tibia with four barbed setae (*l'*, *v'*, *v"* and *d*) and one clavate solenidion φ 5. Tarsus with six

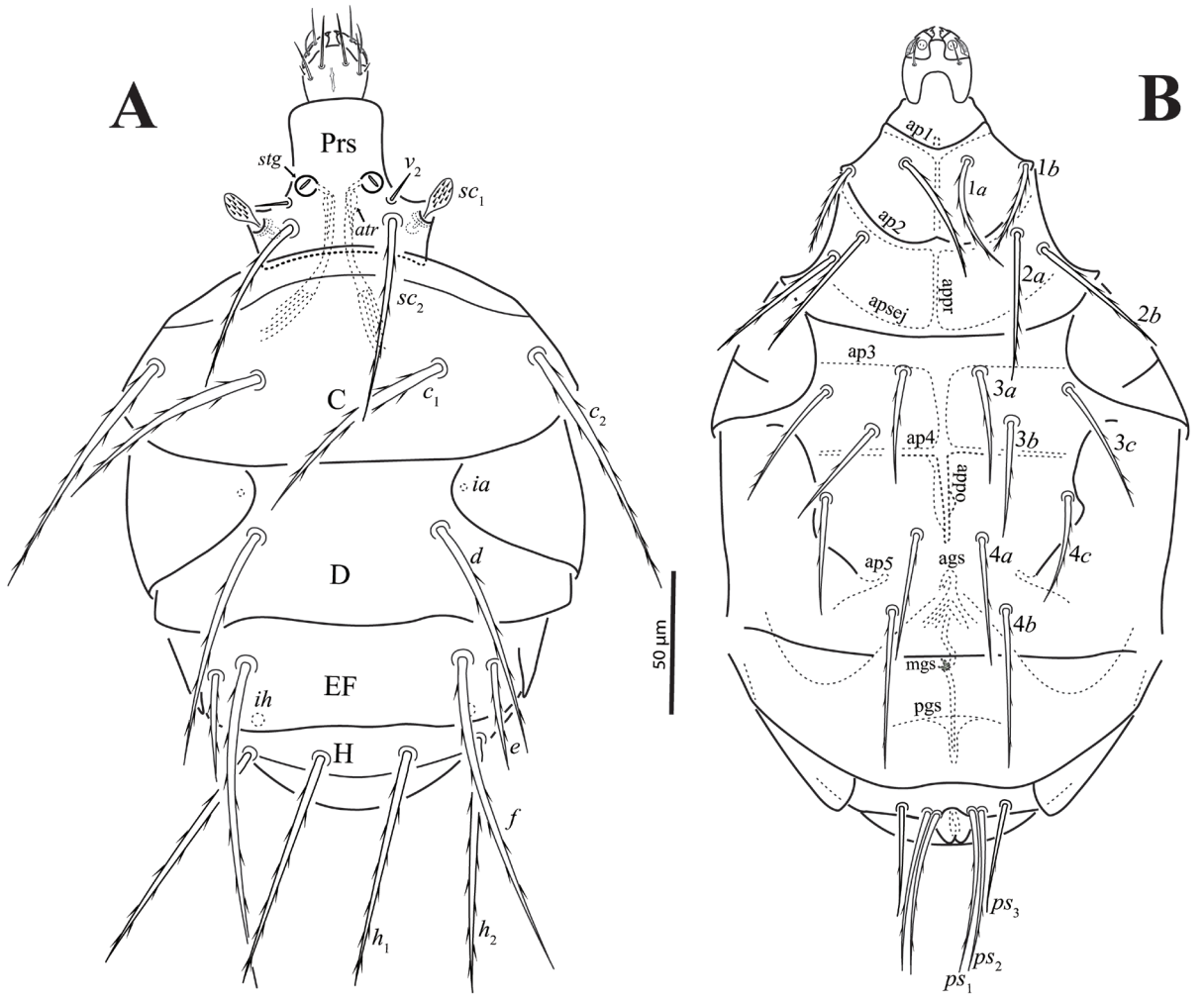

Fig. 1. *Petalomium barrosbattestiae* sp.n., female; A—dorsum of the body; B—venter of the body.

barbed setae (*tc'*, *tc" pv'*, *pv"*, *pl'* and *u'*), *tc"* longest. Pretarsus with pair of claws and pad-like empodium. Leg IV (Fig. 4B); setal formula: 1–2–1–4(1)–6; longer than other legs; Trochanter with barbed seta (*v'*). Femur bearing two barbed setae (*d* and *v'*), *d* longer than *v'*. Genu with barbed seta *v'*. Tibia with four barbed setae (*l'*, *v'*, *v"* and *d*) and one solenidion φ 3 finger shaped. Tarsus with six barbed setae (*pv'*, *pv"*, *tc'*, *tc"*, *pl"* and *u'*). Pretarsus with two small simple claws and empodium.

Male and **larva** unknown.

Type material. Holotype ♀ and two paratypes ♀ (IBSP 13463A), Cara da Onça, Bodoquena, Mato Grosso do Sul, Brazil (20°44′26″ S, 56°44′04″ W, elevation 310 m), XII.2012, *Traumatomutilla rubroguttata* (#Hym-00051-M) (Hymenoptera: Mutillidae).

Type depositories. Holotype and paratypes deposited at the Coleção Acarológica do Instituto Butantan, São Paulo, Brazil (IBSP).

Etymology. The name is given in honor of a Brazilian researcher Darci Moraes Barros-Battesti in recognition of her contribution to acarology.

Differential diagnosis. The new species is most similar to *Petalomium megasolenidiatum* Silva, Khaustov et Oliveira, 2018, also described from Brazil. Both species have unusually long palpal solenidion (*pps*); umbrella-shaped php I, distant from php II; h_1 and h_2 subequal; and 1*b* not birfucate. *Petalomium barrosbattestiae* sp.n. can be distinguished from *P. megasolenidiatum* by the following characters: php I situated outside gnathosoma (inside in *P. megasolenidiatum*); much longer dorsal idiosomal setae, especially sc_2 (short in *P. megasolenidiatum*); mgs present (absent in *P. megasolenidiatum*); leg I with setae *pl'* and *pl"* very long (shorter in *P. megasolenidiatum*); solenidia φ_2 and ω_2 short and clavate (longer and finger-shaped in *P. megasolenidiatum*); and leg II with seta *l'* smooth (barbed in *P. megasolenidiatum*).

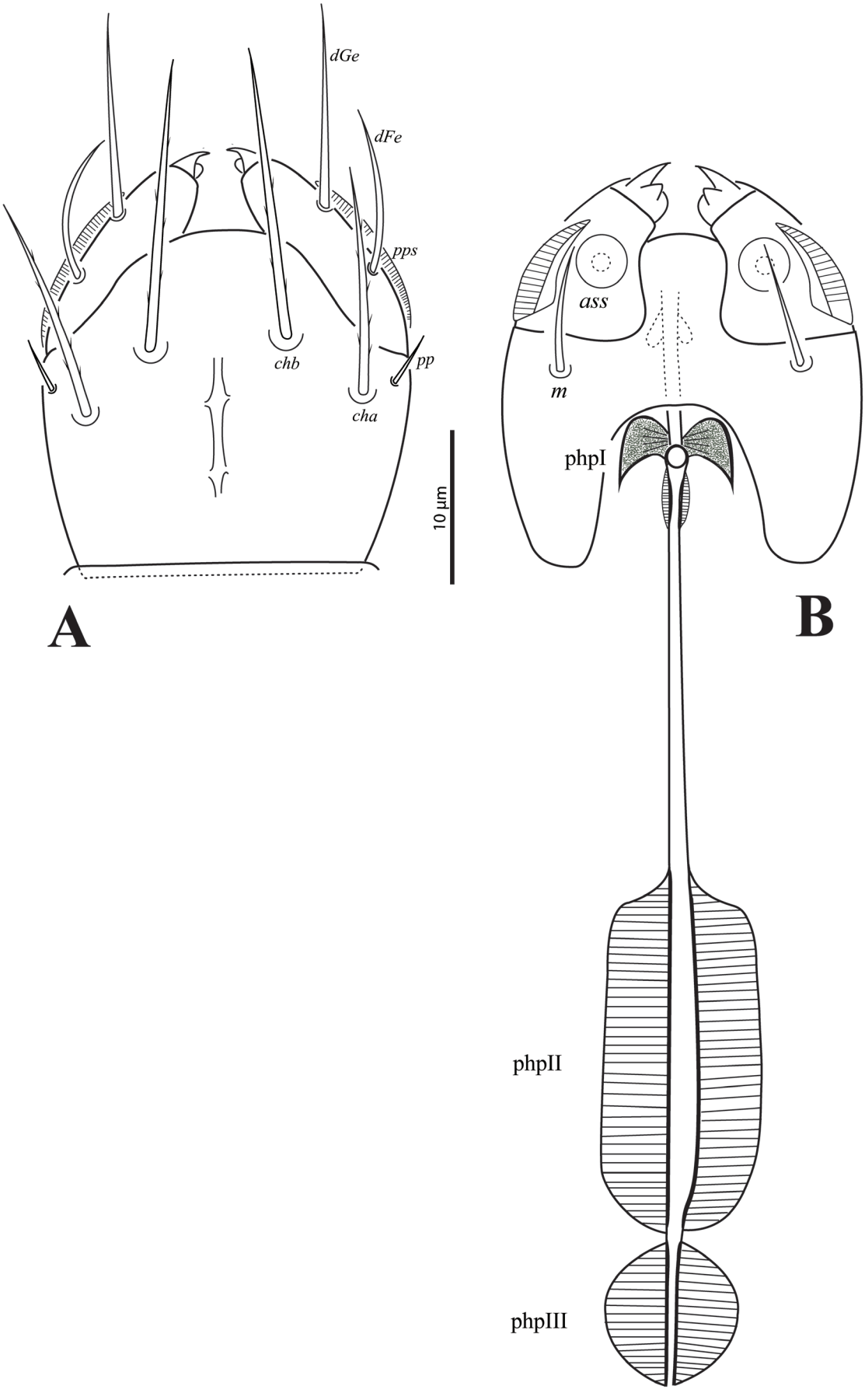

Fig. 2. *Petalomium barrosbattestiae* sp.n., female; A—gnathosoma in dorsal view; B—gnathosoma in ventral view.

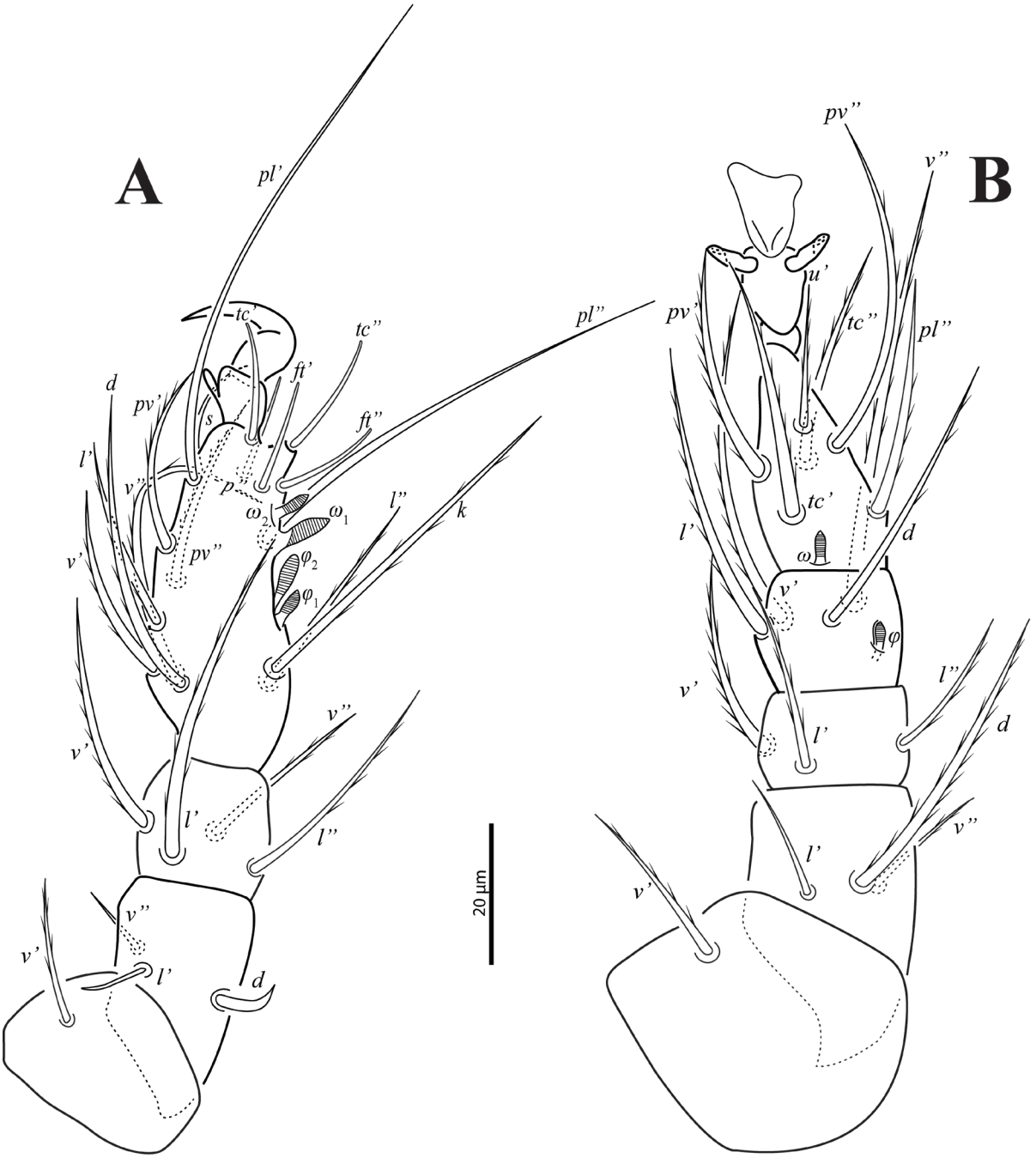

Fig. 3. *Petalomium barrosbattestiae* sp.n., female; A—right leg I in dorsal view; B—right leg II in dorsal view.

Family **Trochometridiidae Mahunka, 1970**
Genus ***Trochometridium* Cross, 1965**
Type species: *Trochometridium tribulatum* Cross, 1965, by original designation.

Trochometridium tribulatum Cross, 1965

New records. 5 ♀ (IBSP 13456), Fazenda Santa Maria, Jardim, Mato Grosso do Sul (21°32′46″ S, 56°55′29″ W, elevation 251 m), II.2008, *Traumatomutilla graphica* (#Hym-00003-M) (Hymenoptera: Mutillidae); 2♀ (IBSP 13465), Balneário Municipal, Jardim, Mato Grosso do Sul (21°25′13″ S, 56°23′22″ W, elevation 270 m) V-2010, *Cephalomutilla* sp. (Hym-00269-M) (Hymenoptera: Mutillidae); 1 ♀ (IBSP 13466), Balneário do Assis, Jardim, Mato Grosso do Sul (21°07′16″ S, 56° 28′55″ W, elevation 270 m), X.2014, *Tallium* sp. (Hym-00339-M) (Hymenoptera: Mutillidae); 1♀ (IBSP 13470), same locality, V-2010, *Tallium* sp. (Hym-00340-M); 1♀ (IBSP 13468), same locality, X.2014, *Darditilla* sp. (Hym-00374-M) (Hymenoptera: Mutillidae); 2♀ (IBSP 13471), same local-

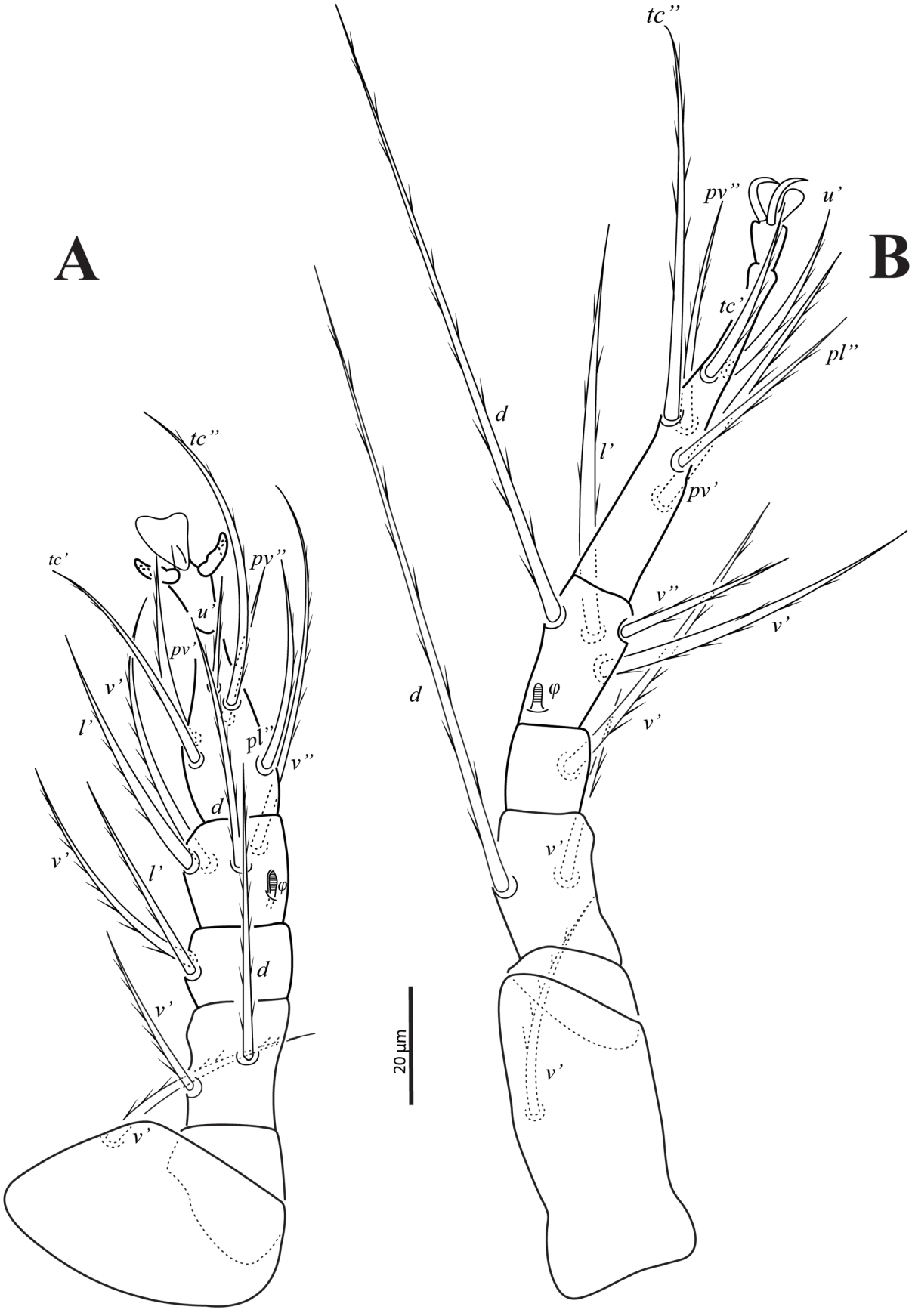

Fig. 4. *Petalomium barrosbattestiae* sp.n., female; A—right leg III in dorsal view; B—right leg IV in dorsal view.

ity and date, *Tallium* sp. (Hym-00372-M); 2 ♀ (IBSP13457A), São João, Porto Murtinho, Mato Grosso do Sul (21°03′05″ S, 56°54′57″ W, elevation 241 m), X.2007, *Traumatomutilla* sp. (#Hym-00020-M); 5 ♀ (IBSP 13458A), same locality and date, *Traumatomutilla* sp. (#Hym-00022-M); 2♀ (IBSP 13461), Conceição, Porto Murtinho, Mato Grosso do Sul (21°26′56″ S, 57°54′30″ W, elevation 91 m), 19.X.2010, *Traumatomutilla* sp. (Hym-00039-M); 2♀ (IBSP 13476), same locality and date, *Traumatomutilla* sp. (Hym-00404-M); 2♀ (IBSP 13464), Santa Virginia, Porto Murtinho, Mato Grosso do Sul (21º58′00″ S, 57º52′55″ W elevation 74 m), 31.V.2011, *Traumatomutilla* sp. (Hym-00055-M); 1♀ (IBSP 13460), Fazenda Califórnia, Bodoquena, Mato Grosso do Sul (20°42′07″ S, 56°52′47″ W, elevation 250 m), II.2007, *Traumatomutilla rubroguttata* (Hym-00032-M); 1♀ (IBSP 13467), Aldeia São João, Bodoquena, Mato Grosso do Sul (21°03′05″ S, 56°44′57″ W, elevation 242 m), X.2007, *Darditilla* sp. (Hym-00369-M); 2♀ (IBSP 13469), Cara da Onça, Bodoquena, Mato Grosso do Sul (20°44′26″ S, 56°44′04″ W, elevation 310 m), XII.2012, *Darditilla* sp. (Hym-00386-M); 6♀ (IBSP 13462), Reserva Particular do Patrimônio Natural Quintas do Sol, Corguinho, Mato Grosso do Sul (19°46′26″ S, 55°14′38″ W elevation 284 m), 30.X.2011, *Traumatomutilla* sp. (Hym-00043-M); 1♀ (IBSP 13473), Parque Nacional da Chapada dos Guimarães, Mato Grosso (15°26′ S, 55°50′ W, elevation 680 m), III.2016, *Traumatomutilla graphica* (Hym-00399-M); 2♀ (IBSP 13474), Parque Nacional da Chapada dos Guimarães, Casa do Morro, Mato Grosso (15°24′26″ S, 55°49′56″ W, elevation 598 m) 24–30.IV.2016, *Traumatomutilla latevittata* (Hym-00396-M); 1♀ (IBSP 13477), same locality and date, *Tallium* sp. (Hym-00397-M); 1♀ (IBSP 13475), Itahum, Dourados, Mato Grosso do Sul (21°59′ S, 55°19′ W, elevation425 m), 03.VIII.2016, *Traumatomutilla latevittata* (Hym-00405-M); 2♀ (IBSP 13164), same locality, 03.VII.2017, *Tallium* sp. (Hym-00456-M); 8♀ (IBSP 13459), Serra da Mesa, Colinas do Sul, Goiás (14°02′24″ S, 48°13′21″ W, elevation 510 m), XII.1995, *Traumatomutilla latevittata* (Hym-00028-M); 64♀ (IBSP 13472), Itu, São Paulo (23°15′43″ S, 47°20′51″ W, elevation 561 m), 2006, *Darditilla bejaranoi* (Hym-00390-M); 1♀ (IBSP 13478), Parque Estadual Costas do Sol, Saquarema, Rio de Janeiro (22°54′04.7″ S, 42°26′29.7″ W, elevation 19 m), 02.I.2016, *Timulla* sp. (Hym-00455-M) (Hymenoptera: Mutillidae).

DISCUSSION

The newly described *Petalomium barrosbattestiae* represents the first association between velvet ants (Hymenoptera: Mutillidae) and neopygmephorid mites. Most other *Petalomium* species are associated with various ants (Hymenoptera Formicidae), and only *P. uralensis* Sevastianov, 1974 has been recorded as phoretic on centipedes (Chilopoda).

Petalomium barrosbattestiae and *P. megasolenidiatum* form a distinct species group, characterized by the unique shape and length of the palpal solenidion. Since such characteristic is unknown in other neopygmephorid mites (Silva *et al.* 2018), this may suggest that after the discovery of other species with a very long palpal solenidion, it would be possible to create a new generic-level taxon. However, the shape and length of the palpal solenidion is undescribed for many *Petalomium* species, as well as for other neopygmephorid mites. So, in this study, we retain *P. barrosbattestiae* and *P. megasolenidiatum* in the genus *Petalomium*.

The species *T. tribulatum* has already been recorded in association with velvet ants in the USA (Cross 1965, Cross and Bohart 1979). This work is the first record of this species associated with velvet ants in Brazil.

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