

A NEW SPECIES OF *BARBUTIA* (ACARI: BARBUTIIDAE) FROM CUBA

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ABSTRACT: A new species *Barbutia cubensis* sp. n. is described based on females and males collected from forest litter in Cuba. A key to adult females of *Barbutia* is provided.

KEY WORDS: Acarina, Raphignathoidea, systematics, morphology, SEM.

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INTRODUCTION

The family Barbutiidae is a small group of raphignathoid mites, which currently comprises six described extant and one fossil species, grouped into one genus *Barbutia* Oudemans, 1927 (Fan *et al.* 2003; Khaustov *et al.* 2021; Mohammad-Doustaresharaf and Bagheri 2021). Barbutiidae are distributed in Europe, Asia, North America, Australia and the Caribbean (Cuba). This family is currently unknown from Africa and South America (see Fig. 1 in Khaustov *et al.* 2021).

Little is known about the biology of Barbutiidae, except that they inhabit moist leaf litter and seasonally arid soils (Fan *et al.* 2003). Most likely, they are predators, as are most other representatives of the superfamily Raphignathoidea.

The species reported from Cuba was mentioned as *Barbutia* sp. in Klimov *et al.* (2018), who also provided sequences of five gene markers (Hsc70-5, COX1, Ef1alpha100E, 18S and 28S ribosomal RNA genes) deposited in GenBank. Based on our examination of the specimens of *Barbutia* sp. reported in Klimov *et al.* (2018), as well as numerous specimens recently collected from Cuba, we think *Barbutia* sp. represents a new species, which is described herein.

MATERIALS AND METHODS

Mites were extracted from samples of litter using Berlese funnels. Most of the collected mites were cleared in lactic acid and mounted in Hoyer's medium. In the description below, the palpal, idiosomal and the leg setation follows Grandjean (1939, 1944, 1946), respectively. The nomenclature of prodorsal setae follows Kethley (1990). All measurements are given in micrometres (µm). The measurement of the holotype is given first, followed by the range of five specimens. In the descriptions of leg setation, the number of solenidia

is given in parentheses. Differential interference contrast (DIC) and phase contrast micrographs were taken using the Carl Zeiss Axio Imager A2 compound microscope and Hitachi KP-HD20A and AxioCam ICc5 digital cameras. SEM micrographs were taken with the aid of a TESCAN Mira3 LMU SEM microscope.

SYSTEMATICS

Family **Barbutiidae Robaux, 1975**

Genus ***Barbutia* Oudemans, 1927**

Type species: *Stigmaeus (Maxrostigmaeus) anguineus* Berlese, 1910, by original designation.

***Barbutia cubensis* sp. n.**

(Figs. 1–11)

Description. *Female* (Figs. 1–8). Length of idiosoma 320 (300–325), width 98 (91–145). Body usually fusiform, some specimens with unusually swollen hysterosoma (Fig. 5C).

Idiosomal dorsum (Figs. 14A–C, 5, 6B). Body striated; cuticle posteriad gnathosoma and legs I–II, subpentagonal area posteriad prodorsum and transverse area posteriad setae *f* punctate; hysterosoma with small, densely distributed cuticular thickenings (Figs. 4A–C, 6B). Dorsal setae *vi*, *ve*, *sce*, *cl*, *c2*, *d2*, *e2*, *h1* and *h2* always pointed and usually smooth, sometimes with few weak barbs in basal part; other dorsal setae normally blunt-tipped, weakly barbed; in some specimens setae *vi* weakly blunt-tipped; in one specimen both setae *dl* long and pointed (Fig. 5A), some specimens with asymmetrical setae *dl* one long and pointed and another short and blunt-tipped (Fig. 5B); other specimens with short and blunt-tipped setae *dl* (Figs. 5C, D). Lengths of dorsal setae: *vi* 10 (14–17), *ve* 52 (50–53), *sci* 10 (10–13), *sce* 47 (45–48),

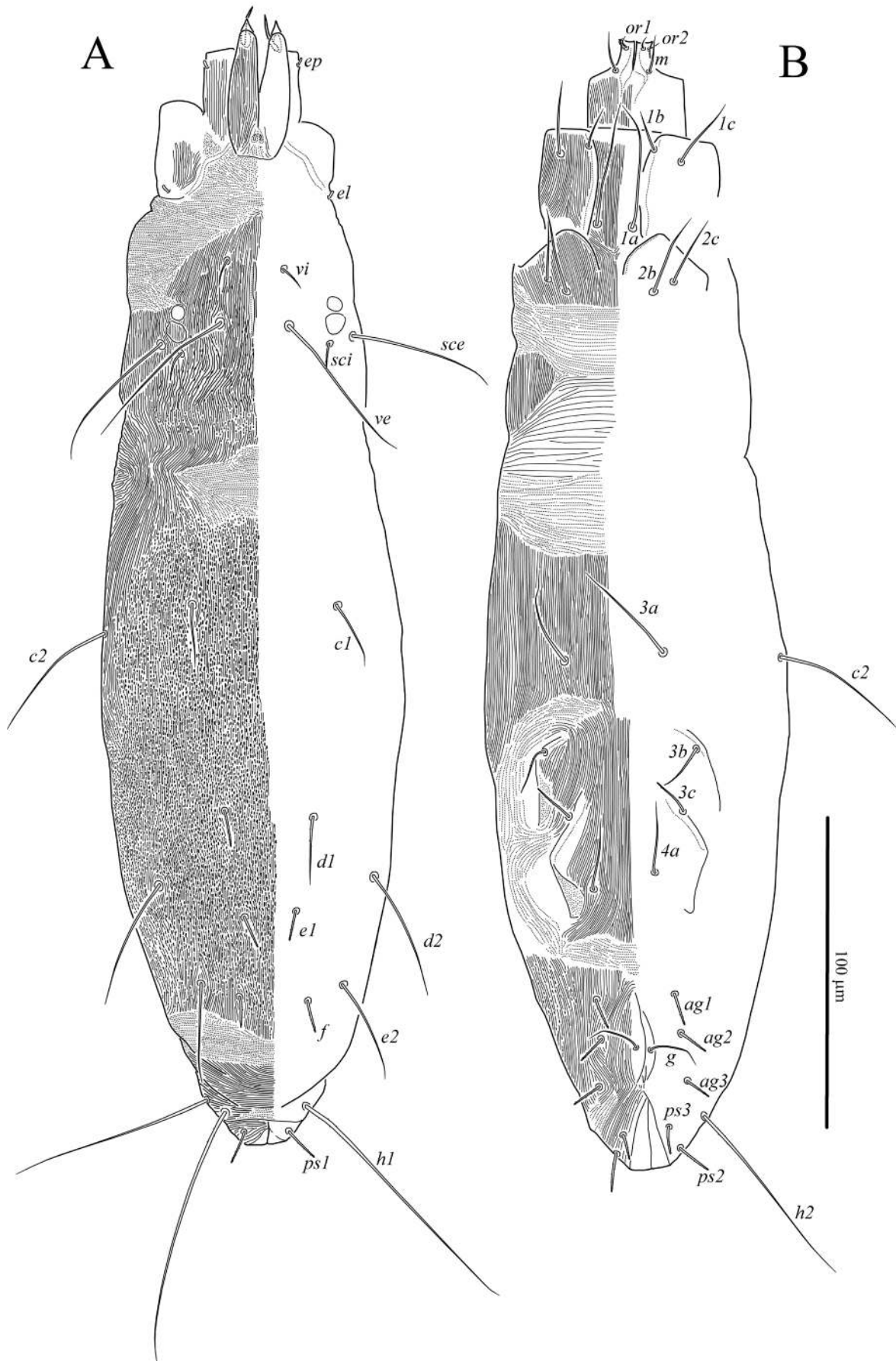


Fig. 1. *Barbutia cubensis* sp.n., female: A—dorsum of body, B—venter of body. Legs omitted.

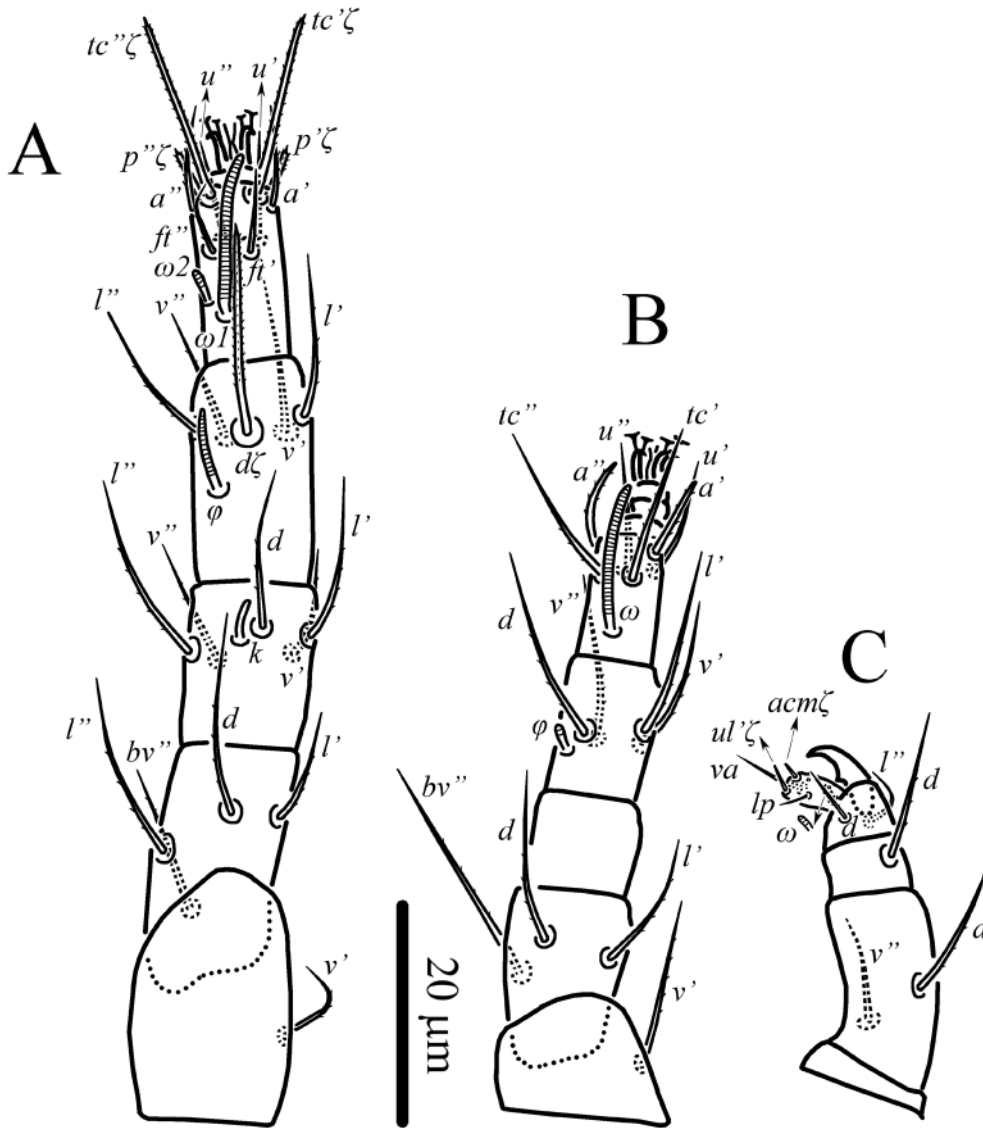


Fig. 2. *Barbutia cubensis* sp. n., female: A—left leg I, dorsal aspect, B—left leg II, dorsal aspect, C—right palp, lateral aspect.

c1 23 (23–27), *c2* 51 (42–53), *d1* 13/22 (10–22), *d2* 43 (35–43), *e1* 11 (9–11), *e2* 35 (33–35), *f* 11 (10–14), *h1* 85 (84–87), *h2* 69 (65–70).

Idiosomal venter (Figs. 1B, 4D, 6C). Coxal fields I with three pairs of setae *1a*, *1b*, *1c*; setae *1a* very long, whip-like; coxal fields II with two pairs of setae *2b*, *2c*; setae *3a* situated anteriorly coxal fields III; coxal fields III with two pairs of setae *3b*, *3c*; coxal fields IV with one pair of setae *4a*; three pairs of subequal aggenital setae; three pairs of pseudanal setae; one pair of genital setae distinctly longer than aggenital setae (Fig. 4D). Setae *ps1–3*, *ag1–3* and *3c* always blunt-tipped and weakly barbed; sometimes setae *3b* and *2c* weakly blunt-tipped, other ventral setae always pointed. Cuticle posteriorly setae *2b*, laterally and posteriorly

legs III–IV punctate. Lengths of ventral setae: *1a* 43 (43–46), *1b* 15 (13–15), *1c* 26 (22–26), *2b* 27 (24–35), *2c* 22 (19–22), *3a* 35 (35–36), *3b* 18 (17–18), *3c* 14 (12–14), *4a* 25 (23–25), *ag1* 11 (9–11), *ag2* 11 (10–12), *ag3* 11 (9–11), *g* 18 (17–19), *ps1* 13 (12–13), *ps2* 13 (10–13), *ps3* 9 (9).

Gnathosoma (Figs. 2C, 6A, D). Chelicerae dorsally finely striated; palpal supracoxal seta (*ep*) rod-like; palpfemur with two subequal pointed and weakly barbed setae (*d*, *v''*); palpgenu with one dorsal pointed and weakly barbed seta *d*; palptibia with two pointed and weakly barbed setae (*d*, *l''*), tibial claw large, with distinct ventral tooth; palptarsus short, with two smooth and blunt-tipped eupathidia (*acmζ*, *ul'ζ*), two pointed and smooth setae (*va*, *lp*), two vestigial setae (*ba*, *bp*) and

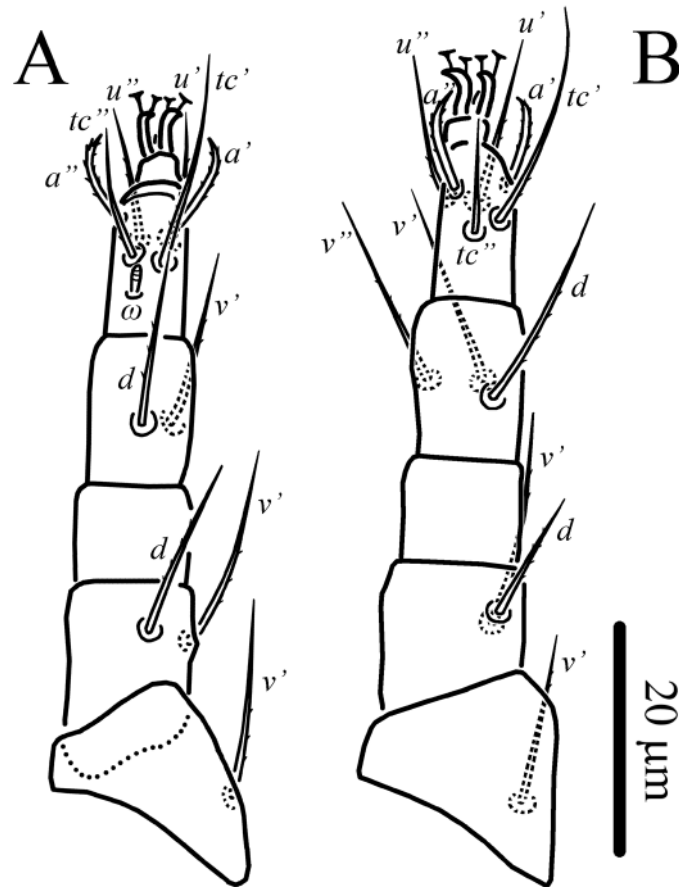


Fig. 3. *Barbutia cubensis* sp.n., female: A—left leg III, dorsal aspect, B—left leg IV, dorsal aspect.

solenidion ω (Fig. 6D). Subcapitulum with one pair of pointed and weakly barbed setae m and two pairs of short, smooth and pointed adoral setae ($or1$, $or2$).

Legs (Figs. 2A, B, 3, 7, 8). Lengths of legs: I 87 (83–89), II 60 (56–60), III 63 (59–63), IV 65 (64–68). All legs with a pair of claws with flattened and widened chaetoids, and empodium with three pairs of chaetoids (Figs. 8B, D). Leg I (Figs. 2A, 7, 8A–c). Leg setation: Tr 1 (v'), Fe 4 (d , l' , l'' , bv''), Ge 6 (d , l' , l'' , v' , v'' , k), Ti 5(1) ($d\zeta$, l' , l'' , v' , v'' , φ), Ta 10(2) (ft' , ft'' , $tc'\zeta$, $tc''\zeta$, $p'\zeta$, $p''\zeta$, a' , a'' , u' , u'' , $\omega1$, $\omega2$). Setae d of tibia, (tc) and (p) of tarsus eupathid-like, weakly barbed and with attenuate tip (Fig. 7D), other setae pointed and weakly barbed; solenidion $\omega1$ long, exceeding beyond tip of tarsus. Leg supracoxal seta (el) rod-like. Lengths of solenidia and seta k : $\omega1$ 16 (16), $\omega2$ 3 (3), φ 8 (8), k 3 (3). Leg II (Fig. 2B). Leg setation: Tr 1 (v'), Fe 3 (d , l' , bv''), Ge 0, Ti 4(1) (d , l' , v' , v'' , φ), Ta 6(1) (tc' , tc'' , a' , a'' , u' , u'' , ω). Setae (a) of tarsus blunt-tipped and distinctly barbed, other setae pointed and weakly barbed. Solenidion ω 14 (13–16) reaching tip of tarsus; solenidion φ 3 (2–3) rod-like. Leg III (Figs. 3A,

8D). Leg setation: Tr 1 (v'), Fe 2 (d , v'), Ge 0, Ti 2 (d , v'), Ta 6(1) (tc' , tc'' , a' , a'' , u' , u'' , ω). Setae (a) of tarsus blunt-tipped and distinctly barbed, other setae pointed and weakly barbed. Solenidion ω 3 (3) rod-like. One specimen with asymmetrical presence of third seta (l') on femur; several specimens with asymmetrical presence of third seta (v'') on tibia. Leg IV (Figs. 3A, 8D). Leg setation: Tr 1 (v'), Fe 2 (d , v'), Ge 0, Ti 3 (d , v' , v''), Ta 6 (tc' , tc'' , a' , a'' , u' , u''). Setae (a) of tarsus blunt-tipped and distinctly barbed, other setae pointed and weakly barbed. Solenidion ω absent.

Male (Figs 9–12). Length of idiosoma 225–230, width 83–87. Body much shorter and more ovate than in female.

Idiosomal dorsum (Fig. 9A). In general very similar to female; cuticular thickenings poorly visible only in posterior part of prodorsum and between setal pairs $c1$ and $d1$. Lengths of dorsal setae: vi 8–10, ve 31–40, sci 9–11, sce 34–36, $c1$ 10–14, $c2$ 33–35, $d1$ 9–10, $d2$ 24, $e1$ 8–9, $e2$ 22–28, $f8$ –10, $h1$ 32–40, $h2$ 50–54.

Idiosomal venter (Fig. 9B). Prosoma and metapodosomal as in female. Opisthosomal venter

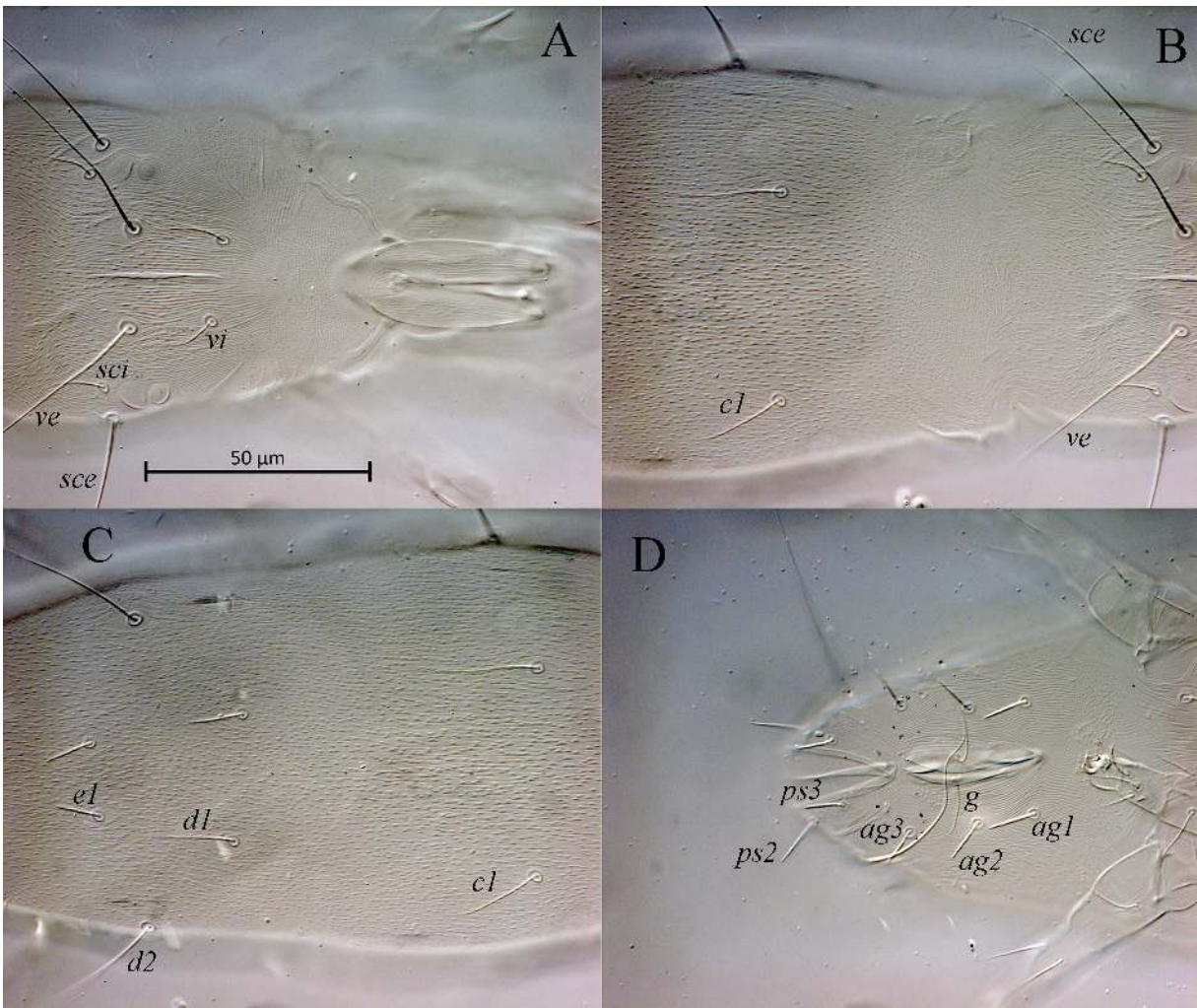


Fig. 4. DIC micrographs of *Barbutia cubensis* sp. n., female: A—prosoma, dorsal aspect, B—posterior part of prosoma and anterior part of hysterosoma, dorsal aspect, C—hysterosoma, dorsal aspect, D—opisthosoma, ventral aspect.

with one pair of blunt-tipped and weakly barbed setae *ag* and three pairs of pseudanal setae; setae *ps1* and *ps2* short, thickened and smooth; setae *ps3* blunt-tipped and weakly barbed. Number of ventral setae is variable in two available specimens; in both specimens right coxal field II with only one seta and right coxal field IV lacking seta *4a*; in one specimen right coxal field III without seta *3c* and in another specimen both coxal fields III lacking setae *3b*. Aedeagus weakly sclerotized (Fig. 12). Lengths of ventral setae: *1a* 29–38, *1b* 10, *1c* 15–18, *2b* 23, *2c* 15, *3a* 29–30, *3b* 14, *3c* 9, *4a* 15–16, *ag* 9–10, *ps1* 3, *ps2* 3, *ps3* 8.

Gnathosoma as in female.

Legs (Figs. 2A, B, 3, 7, 8). Lengths of legs: I 69–73 II 48, III 52, IV 51–54. Leg I (Fig. 10A). Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *l''*, *bv''*), Ge 4 (*d*, *l'*, *l''*, *k*), Ti 4(1) (*d*_ζ, *l'*, *l''*, *v'*, *φ*), Ta 8(1) (*ft'*, *ft''*, *tc'*_ζ, *tc''*_ζ, *a'*, *a''*, *u'*, *u''*, *ω*). Lengths of sole-

nidia and seta *k*: *ω* 13, *φ* 5, *k* 4. Solenidion *ω*2 absent in both specimens. Number of setae on legs highly variable. Left femur of one specimen with three setae (*l'* absent); right genu of one specimen with five tactile setae (*v''* present); left tarsus I of one specimen without seta *ft''*. Leg II (Fig. 10B). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *l'*), Ge 0, Ti 3(1) (*d*, *l'*, *v'*, *φ*), Ta 6(1) (*tc'*, *tc''*, *a'*, *a''*, *u'*, *u''*, *ω*). Solenidia *ω* 9–10, *φ* 2. Right femur II of one specimen with seta *v''* but lacking *l'*; left tibia II of one specimen with only one tactile seta *d*. Leg III (Fig. 11A). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 0, Ti 2 (*d*, *v'*), Ta 5(1) (*tc'*, *tc''*, *a'*, *u'*, *u''*, *ω*). Left femur of one specimen without seta *v'*. Solenidion *ω* 4. Leg IV (Fig. 11B). Leg setation: Tr 1 (*v'*), Fe 1 (*d*), Ge 0, Ti 2 (*d*, *v'*), Ta 6 (*tc'*, *tc''*, *a'*, *a''*, *u'*, *u''*). Right genu of one specimen with three setae (*v''* present); left tarsus of one specimen without seta *tc''*.

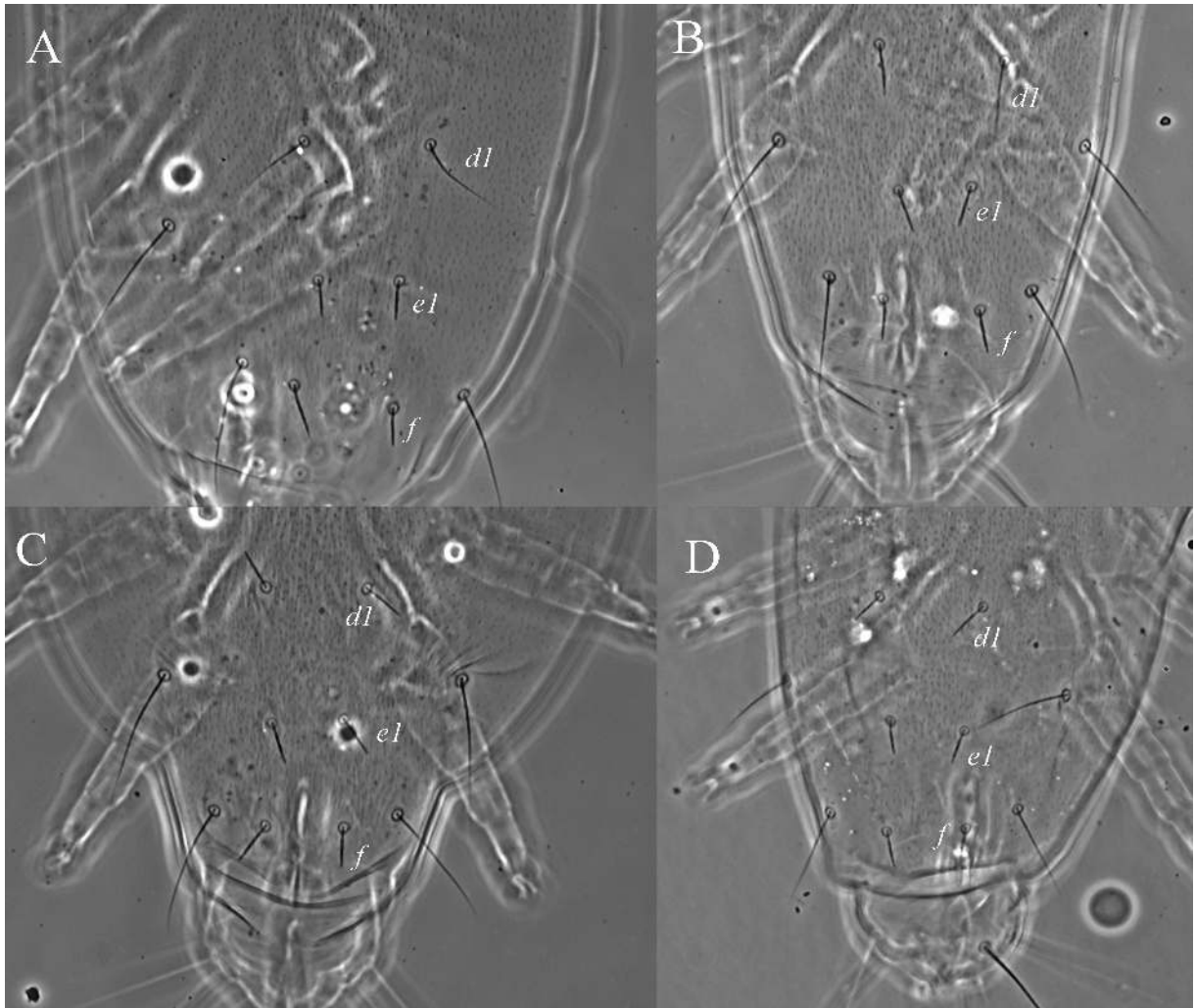


Fig. 5. Phase contrast micrographs of *Barbutia cubensis* sp.n., female, dorsum of hysterosoma showing variability of setae *dl*: A—both setae *dl* long and pointed, B—right seta *dl* long and pointed, C, D—both setae *dl* short and blunt-tipped.

Immatures unknown.

Type material. Female holotype, slide ZISP T-Barb-001, Cuba, Bahía de Corrientes, María la Gorda, Península de Guanahacabibes, Pinar del Río Province, 21°48'49"N, 84°29'57"W, coastal vegetation, in litter, 4 January 2022, coll. A. V. Tolstikov. Paratypes: 23 females, 2 males, same data; 16 females, Cuba, Jardín Botánico de Cienfuegos, Pepito Tey, 22°07'20.50"N, 80°19'31.00"W, from litter, 21 July 2015, coll. A. V. Tolstikov.

Type deposition. The holotype and six female paratypes are deposited in the acarological collection of the Zoological Institute of RAS, Saint Petersburg, Russia; other paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Differential diagnosis. Female of the new species is most similar to *B. longinqua* Fan, Walter

and Proctor, 2003 in having tarsus IV without solenidion ω , setae *4b* absent, setae *ve* and *sce* subequal, tarsus I with 10 setae and two solenidia, and genital setae distinctly longer than aggenital setae. Female of the new species differs from *B. longinqua* in the following: numerous cuticular thickenings on idiosomal dorsum (absent in *B. longinqua*), two setae on tibia III (normally) (three in *B. longinqua*), setae *dl* subequal to *e1* and *f* (normally) (*dl* about three times longer than *e1* and *f* in *B. longinqua*), and by a distinctly longer (8) solenidion ϕ on tibia I (4 in *B. longinqua*).

Etymology. The name of the new species refers to its geographical distribution (Cuba).

Key to known adult females of *Barbutia* (including deutonymph of *B. anguineus*)

1. Setae *ve* subequal with *sce*, not reaching bases of *e1* 2

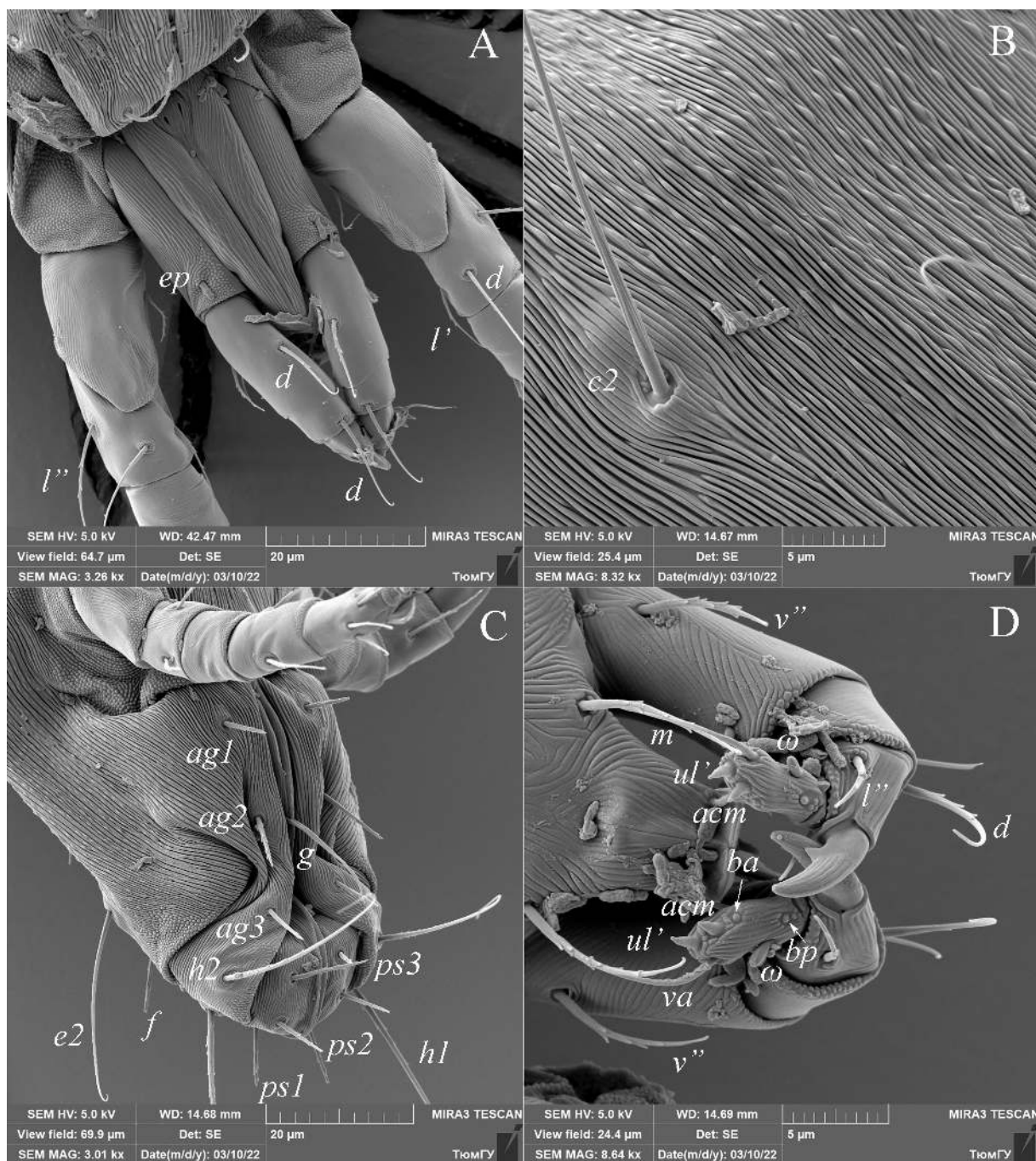


Fig. 6. SEM micrographs of *Barbutia cubensis* sp.n., female: A—gnathosoma, dorsal aspect, B—dorsal cuticular pattern, C—opisthosomal venter, D—gnathosoma, ventral aspect.

— Setae *ve* very long, more than two times longer than *sce*, exceeding beyond bases of *c1*
 *B. anguineus* (Berlese, 1910)
 2. Solenidion ω on tarsus IV present 3
 — Solenidion ω on tarsus IV absent..... 4
 3. Genital setae distinctly longer than aggenital setae..
B. iraniensis Bagheri, Navaei and Ueckermann, 2010
 — Genital setae minute, distinctly shorter than
 aggenital setae
 *B. australia* Fan, Walter and Proctor, 2003

4. Tarsus I with 10 setae and two solenidia; setae
4b absent 5
 — Tarsus I with eight setae and two solenidia;
 setae *4b* present.....*B. perretae* Robaux, 1975
 5. Dorsal idiosomal striation with numerous
 densely distributed cuticular thickenings; tibia III
 normally with two setae; solenidion ϕ on tibia I 8
 micrometers long*B. cubensis* sp.n.
 — Dorsal idiosomal striation without numerous
 cuticular thickenings; tibia III normally with three

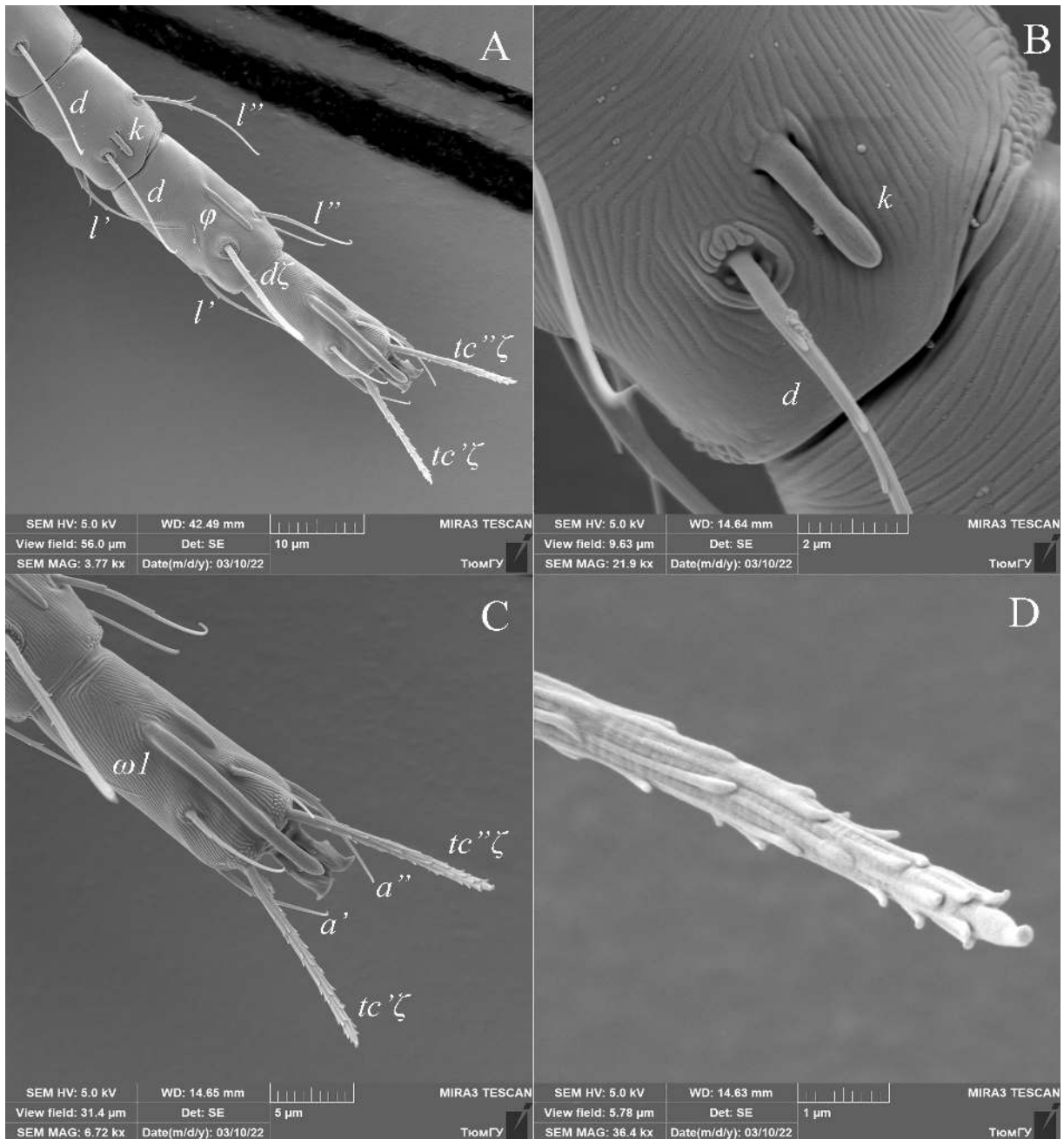


Fig. 7. SEM micrographs of *Barbutia cubensis* sp.n., female: A—right leg I, dorsal aspect, B—right genu I, dorsal aspect, C—right tarsus I, dorsal aspect, D—eupathid-like seta *te''* of tarsus I.

setae; solenidion ϕ on tibia I 4 micrometers long.....
 *B. longinqua* Fan, Walter and Proctor, 2003

DISCUSSION

Fan *et al.* (2003) reported the presence of five setiform structures (two eupathidia *acm* and *ul'* and three tactile setae *va*, *lp* and *ba*) on the palptarsus of the mites of the genus *Barbutia*. Using scanning electron microscopy, we have also established the presence of vestigial seta *bp* (Fig. 6C). In contrast

to other species, seta *ba* is also vestigial. Thus, in barbutiid mites, only eupathid-like setae *ul''* and *sul* are absent, in comparison with closely related family Stigmaeidae. SEM has also revealed the unusual structure of eupathidia on leg I. In most mites of the superfamily Raphignathoidea, eupathidia are smooth. In *Barbutia cubensis*, on the other hand, eupathid-like setae with numerous tiny barbs (Fig. 7D). Previously, all authors have illustrated smooth eupathid-like setae in *Barbutia* mites (Fan *et al.* 2003).

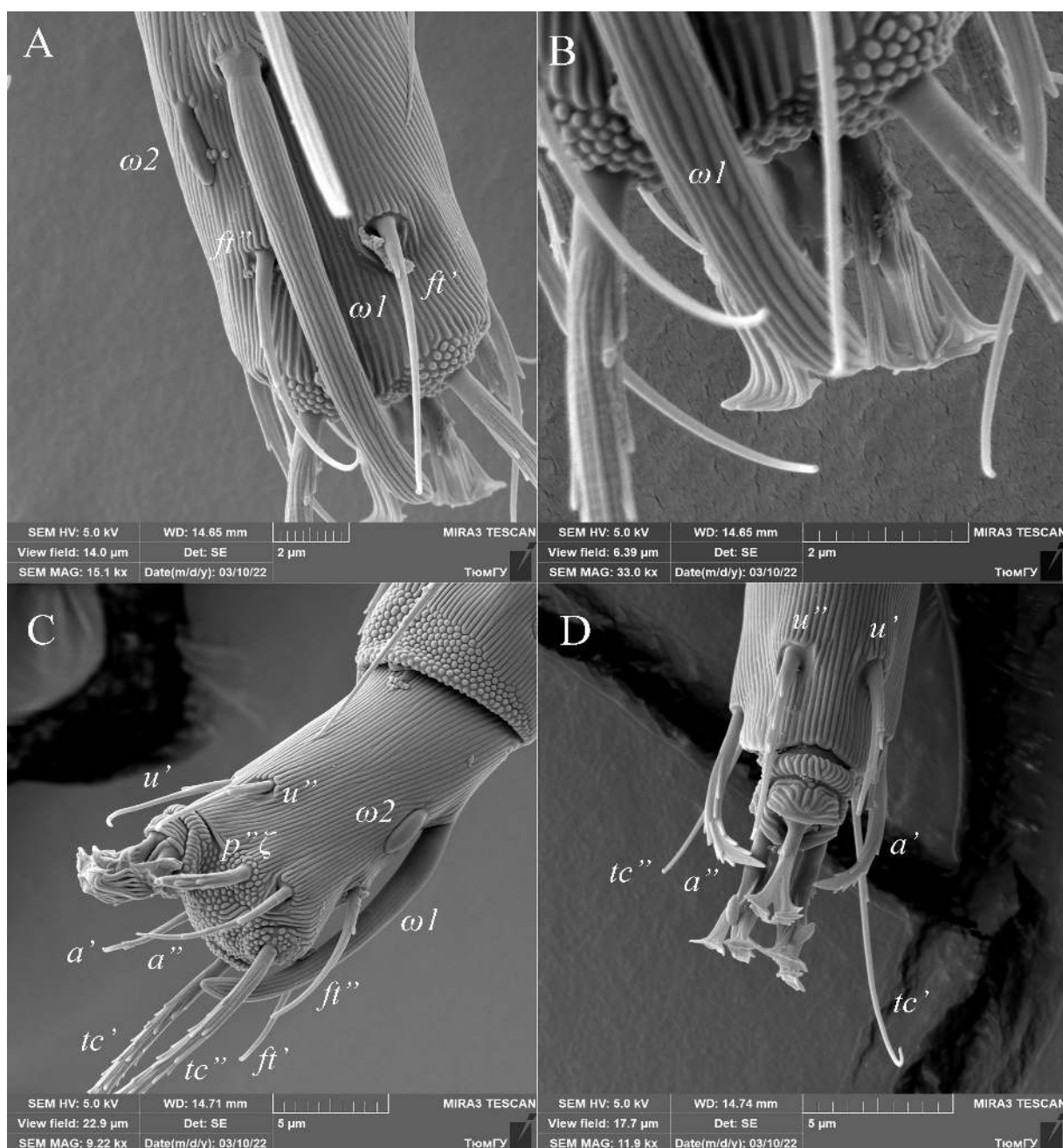


Fig. 8. SEM micrographs of *Barbutia cubensis* sp.n., female: A—right tarsus I, dorsal aspect, B—distal part of right tarsus I, dorsal aspect, C—right tarsus I, lateral aspect, D—left tarsus III, ventral aspect.

During this study, we have discovered an unusual morphological variability of dorsal setae *d1*, as well as a number of setae on leg segments in *B. cubensis*. Normally, setae *d1* blunt-tipped and subequal to *e1* and *f*. However, in some specimens, one of the setae *d1* is pointed and distinctly longer than *e1* and *f*; there are even cases when both setae *d1* are long and pointed (Fig. 5). Also, tibia III is normally with two setae (*d*, *v'*), but in some specimens, one of tibia III asymmetrically with three setae (*v''* present). Previously, the length of

setae *d1* and the number of setae on leg segments was considered a good character for separating species (Fan *et al.* 2003). However, the discovery of such variability requires the study of at least several specimens for understanding the “normal” structure of dorsal setae and the number of setae on leg segments. Previously, such variability in the number of setae on leg segments has been identified in a stigmatid mite *Stigmaeus scrobiculatus* (Khaustov 2021). Interestingly, such variability has only been observed in specimens

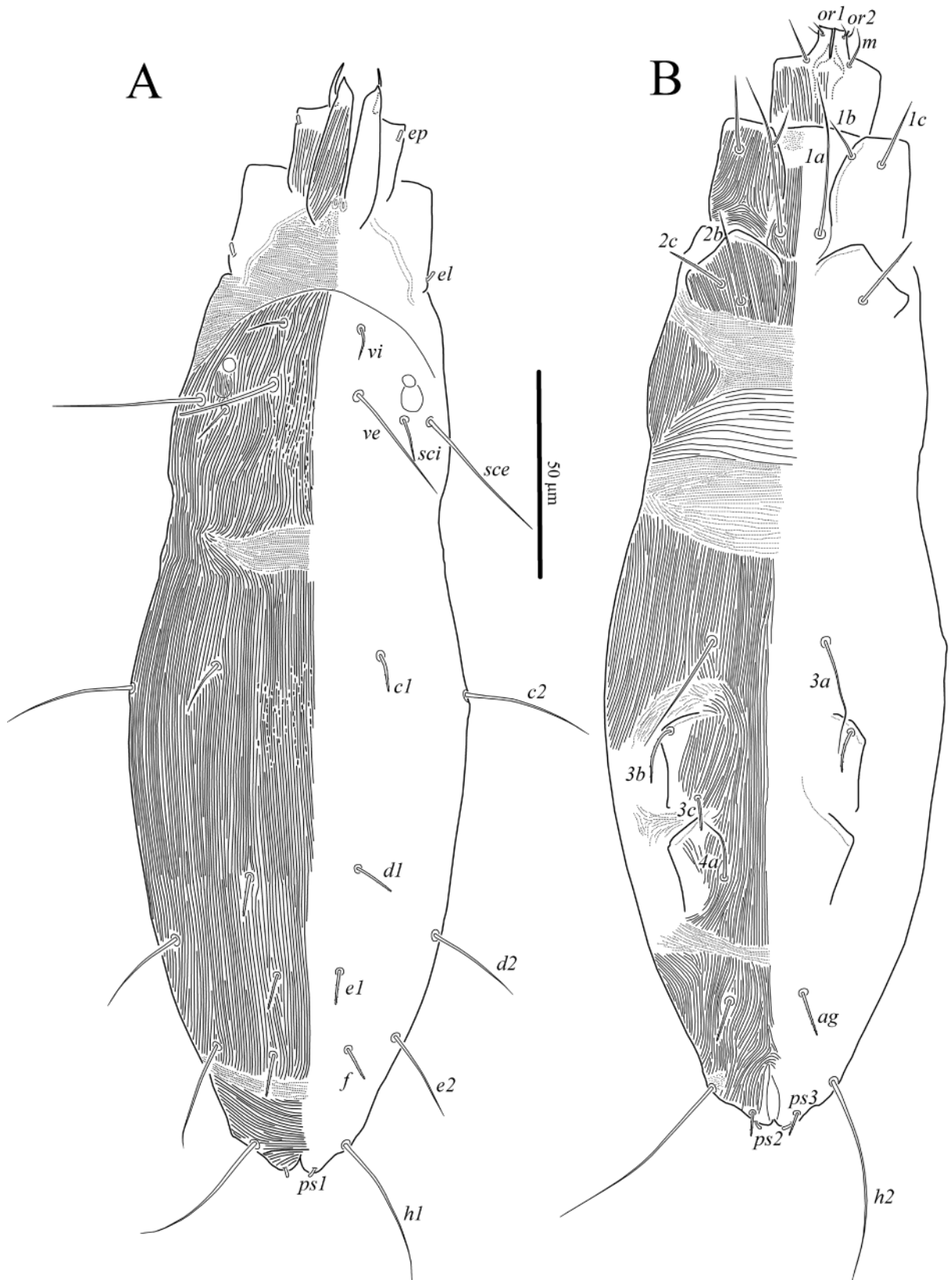


Fig. 9. *Barbutia cubensis* sp.n., male: A—dorsum of body, B—venter of body. Legs omitted.

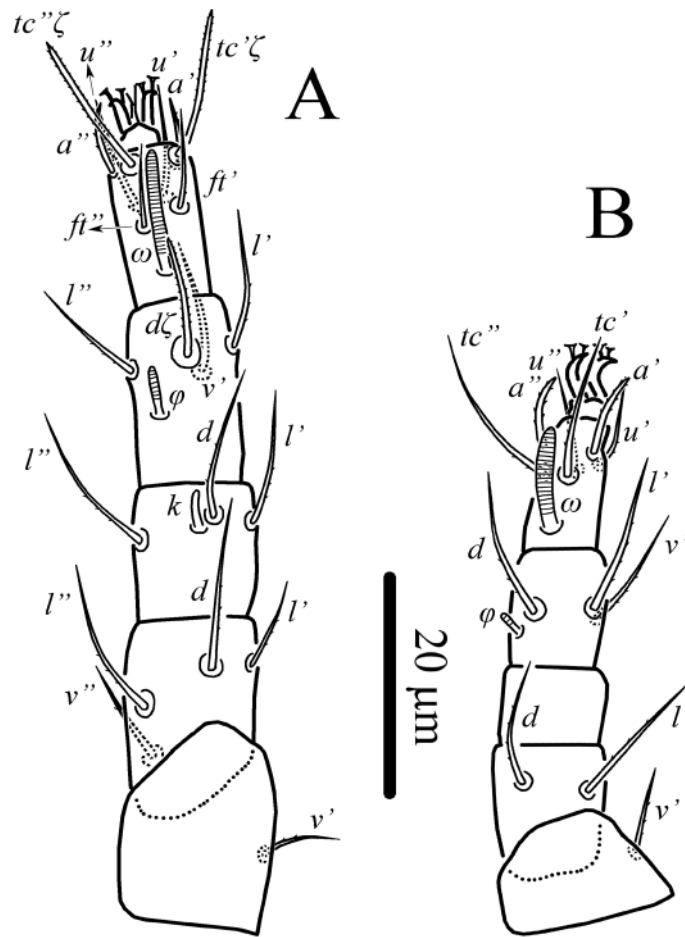


Fig. 10. *Barbutia cubensis* sp. n., male: A—left leg I, dorsal aspect, B—left leg II, dorsal aspect.

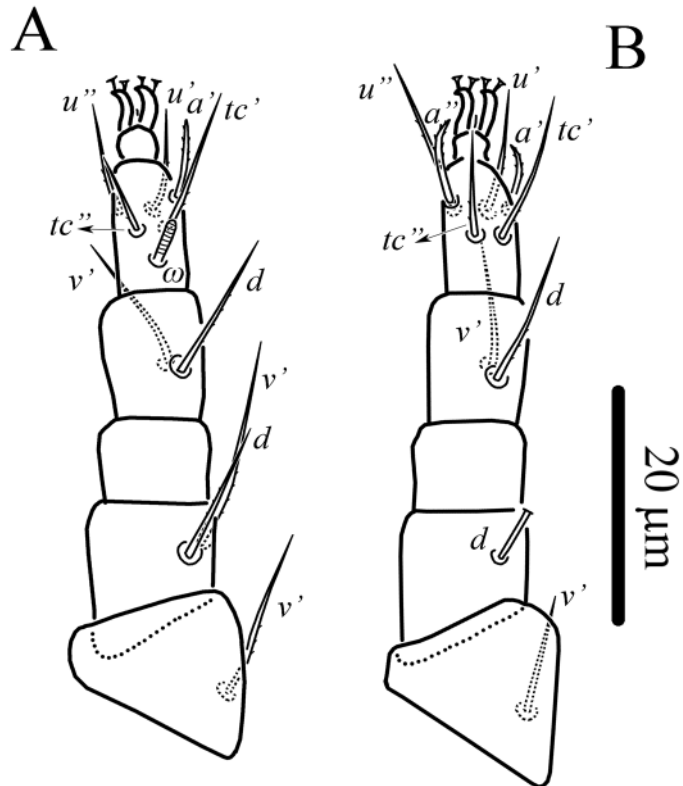


Fig. 11. *Barbutia cubensis* sp. n., male: A—left leg III, dorsal aspect, B—left leg IV, dorsal aspect.

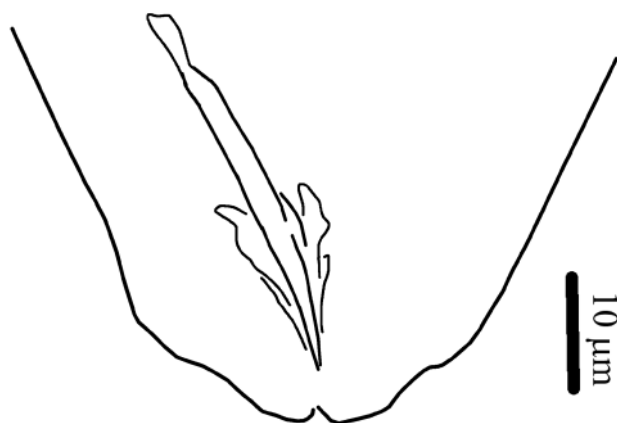


Fig. 12. *Barbutia cubensis* sp.n., male: aedeagus.

collected this year. Specimens (16 females) collected in 2015 are monomorphic.

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