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A new species of *Lasiobelba* from Nepal, with overview of the genus

(Acari, Oribatida, Oppiidae)

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A new species of the genus *Lasiobelba* (Oribatida, Oppiidae) – *L. sandormahunkai* sp. nov. – is described, based on materials collected from soil-litter in *Quercus semecarpifolia* forest of Nepal. Generic diagnosis and an identification key to all known species of *Lasiobelba* are presented. Taxonomic status of the related genera *Antennoppia*, *Lasiobelba* and *Oppia* and systematic placement of some representatives from them are discussed.

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Introduction

The oribatid mite genus *Lasiobelba* (Acari, Oribatida, Oppiidae) was proposed by Aoki (1959) with *Lasiobelba remota* Aoki, 1959 as type species. According to Subías (2004, online version 2021), the genus comprises two subgenera and 38 species, which have a cosmopolitan distribution collectively. The main goals of the paper are: to describe and illustrate a new species of *Lasiobelba* collected from Nepal; to summarize generic morphological traits; to discuss the taxonomic status of the genera *Lasiobelba*, *Antennoppia* Mahunka, 1983 and *Oppia* Koch, 1835 and systematic placement of some representatives from them, and to provide an identification key to all known species of *Lasiobelba*.

Presently, three species of *Lasiobelba* have been registered in Nepalese fauna (Ermilov & Martens 2014a,b, Ermilov et al. 2014): *L. daamsae* Ermilov, Shtanchaeva, Subías & Martens, 2014; *L. remota* Aoki, 1959; and *L. nepalica* Ermilov, Shtanchaeva, Subías & Martens, 2014.

Material and methods

Specimens. Oribatid mites were collected from the Jochen Martens Expeditions to Nepal in 1988[1] and until recently were housed in the Institut für Organismische und Molekulare Evolutionsbiologie (Mainz, Germany).

Observation and documentation. Specimens were mounted in lactic acid on temporary cavity slides

[1] Results of the Himalaya Expeditions of J. Martens from 1969–2004, No. 293. Jochen Martens was sponsored by DAAD and DFG.

for measurement and illustration. Body length was measured in dorsal view, from the tip of the rostrum to the posterior edge of the notogaster. Notogastral width refers to the maximum width of the notogaster in dorsal view. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus. Drawings were made with a camera lucida using a Leica transmission light microscope "Leica DM 2500".

Terminology. Morphological terminology used in this paper follows that of F. Grandjean: see Travé & Vachon (1975) for references, Norton (1977) for leg setal nomenclature, and Norton & Behan-Pelletier (2009), for overview.

Abbreviations. Prodorsum: *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively; *mt* = median tubercle; *pt* = postbothridial tubercle. Notogaster: *c* = setal alveolus; *la*, *lm*, *lp*, *h*, *p* = setae; *ia*, *im*, *ip*, *ih*, *ips* = lyrifissures; *gla* = opisthonotal gland opening. Gnathosoma: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *v*, *cm*, *ul*, *su*, *vt*, *lt* = palp setae; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. Epimeral and lateral podosomal regions: *1a*–*1c*, *2a*, *3a*–*3c*, *4a*–*4c* = epimeral setae; *PdI* = pedotectum I; *dis* = discidium. Anogenital region: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal seta, respectively; *iad* = adanal lyrifissure; *po* = preanal organ. Legs: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively; ω, φ, σ = solenidia; ε = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = setae; *pa* = porose area.

Taxonomy

Family Oppiidae
Subfamily Oppiinae
Genus *Lasiobelba* Aoki, 1959
Type species: *Lasiobelba remota* Aoki, 1959

Main generic traits of *Lasiobelba* (adult)

Size. Length about 230–1300.

Integument. Mostly smooth; lateral side usually densely tuberculate; sometimes prodorsum and/or notogaster heavily wrinkled or granulate/tuberculate.

Prodorsum. Rostrum rounded/pointed/tripartite/truncate. Costula and transcostula absent; lateral prodorsal carina present or absent. Interbothridial and postbothridial tubercles present or absent. Interbothridial region with or without muscle sigillae. Rostral, lamellar, interlamellar, and exobothridial setae usually well developed, setiform; rarely, some of them very short or represented by alveolus; *le* inserted closer to *in* or to *ro*. Bothridial seta spindle-form, with long setiform or elongate conical apex.

Notogaster. Without humeral tooth and crista. Usually ten pairs of setiform setae; *c* short or represented by alveolus; rarely, seta *c* and/or h_3 absent (eight or nine pairs of notogastral setae present in these cases).

Gnathosoma. Subcapitulum diarthric. Adoral seta present, setiform. Palp setation: 0-2-1-3-8 or 9 (+1 solenidion). Palp solenidion short, in medio-anterior part close to distal seta. Chelicera chelate-dentate.

Epimeral and lateral podosomal regions. Epimeral border IV present. Epimeral setal formula: 3-1-3-3; all setae setiform. Ventrosejugal tubercle absent. Pedotectum I represented by small lamina. Discidium present.

Anogenital region. Five pairs of genital, one pair of aggenital, two pairs of anal, and three pairs of adanal setae; all setae setiform. Adanal seta ad_1 posterior or posterolateral, ad_2 lateral, ad_3 anterolateral to anal plate; distance between ad_3-ad_3 larger than *ag*–*ag*, and ad_2–ad_2. Adanal lyrifissure close and parallel to anal aperture.

Legs. Tarsus I with 20 setae (*l"* and *v'* present), tarsus II with 15 or 16 setae (*l"* present or absent). Tarsus II with two solenidia.

Lasiobelba sandormahunkai sp. nov.

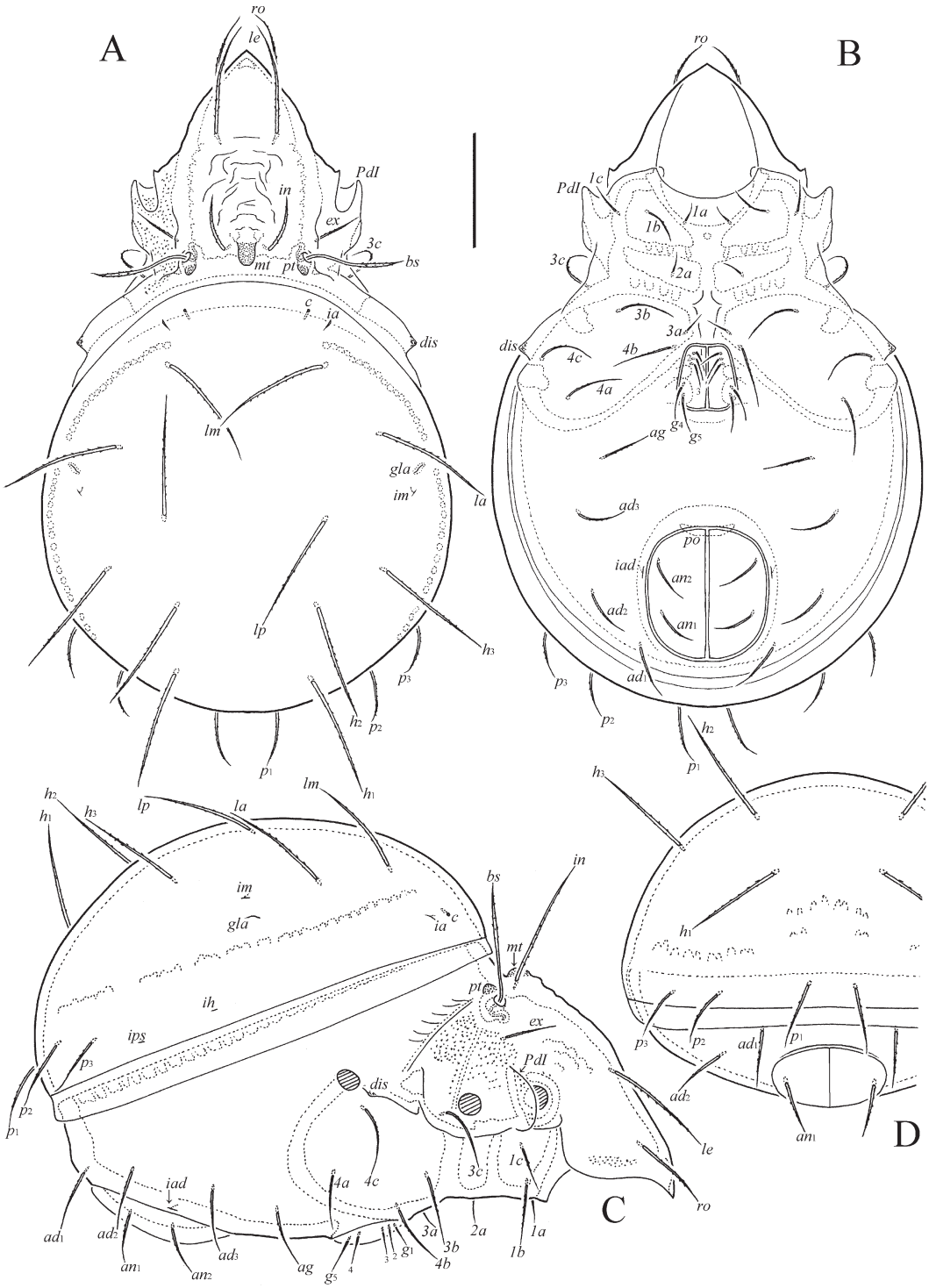
Figs 1-3

Diagnosis. Body size: 1095–1162 × 713–747. Prodorsum dorsally wrinkled. Rostrum pointed. Rostral, lamellar, interlamellar, and exobothridial setae long, setiform, barbed; *in* > *le* > *ro* > *ex*. Bothridial seta long, with slightly developed head, barbed. Interbothridial muscle sigillae absent. Interbothridial region with one strong unpair tubercle. Nine pairs of long, setiform, barbed notogastral setae (p_1–p_3 shorter than others); tenth pair of setae (*c*) represented by alveoli. Rutellum with mediodistal tooth. Epimeral and anogenital setae setiform, mostly slightly barbed. Discidium present. Adanal lyrifissure longitudinal.

Description

Measurements. Very large species. Body length: 1095 (holotype: male), 1095–1162 (13 paratypes, sex

Fig. 1. *Lasiobelba sandormahunkai* sp. nov., adult: **A.** dorsal view (not shown: legs); **B.** ventral view (not shown: ▷ gnathosoma and legs); **C.** right lateral view (not shown: gnathosoma and legs); **D.** posterior view. Scale bar 200 µm.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not identified); notogaster width: 713 (holotype), 713–747 (13 paratypes).

Integument. Body colour brown. Body surface mostly smooth. Prodorsal region between lamellar and interlamellar setae wrinkled. Lateral part of body between bothridium and acetabula I–III densely tuberculate (diameter of tubercle up to 4).

Prodorsum. Rostrum pointed, but often broken, therefore it may appear truncated or rounded. Rostral (131–139), lamellar (184–205), interlamellar (215–233), and exobothridial (94–98) setae setiform, barbed; *ex* thinnest. Bothridial seta (200–215) with slightly developed, elongate, lanceolate head, barbed; conical apex distinct. Interbothridial muscle sigillae not observed. Interbothridial region with one strong unpair tubercle located between interlamellar setae. Postbothridial tubercle present. Longitudinal row, comprising several muscle sigillae, present in front of the bothridium.

Notogaster. Anterior border convex medially. Nine pairs of notogastral setae (p_1-p_3: 110–114; others: 192–205) setiform, barbed; tenth pair of setae (*c*) represented by alveoli. All notogastral lyrifissures (except *ip* not observed) and opisthonotal gland opening distinct.

Gnathosoma. Subcapitulum size: 225–246 × 184–200. Rutellum with mediodistal tooth. Subcapitular setae (*a*: 49–57; *m*: 82–94; *h*: 94–106) setiform, barbed. Adoral seta (28–32) setiform, smooth. Palp length: 159–168. Solenidion short, bacilliform, located in dorsodistal part of tarsus. Postpalpal seta (10) spiniform, smooth. Chelicera length: 225–246. Cheliceral setae (*cha*: 69–73; *chb*: 49–53) setiform, barbed.

Epimeral and lateral podosomal regions. All epimeral setae (*1a*, *2a*, *3a*: 32–41; *1b*: 94–102; *1c*: 73–77; *3b*, *3c*, *4a*, *4b*, *4c*: 110–123) setiform, slightly barbed. Discidium strong, triangular.

Anogenital region. Genital setae (g_1–g_3: 32–41; g_4: 45–53; g_5: 61–69) setiform, roughened. Aggenital, adanal and anal setae (110–114) setiform, barbed. Adanal lyrifissure distinct.

Legs. All leg claws slightly barbed on dorsal side. Porose area on femora I-IV slightly visible. Formulas of leg setation and solenidia: I (1-5-2-4-20) [1-2-2], II (1-5-2-4-16) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology of setae and solenidia indicated in Table 1. Famulus of tarsus I erect, slightly swollen and blunted distally, inserted between solenidion ω_1 and seta *ft"*. Seta *p* eupathidial on tarsus I, and conical on tarsi II–IV. Seta *s* eupathidial on tarsus I, located before setae *a'* and *a"*. Solenidion ω_1 on tarsus I, ω_1 and ω_2 on tarsus II slightly thickened, rounded apically, others setiform.

Material examined. Holotype and 13 paratypes: Nepal, Katmandu Distr., Sheopuri Mt., 27°47' N, 85°23' E, 2100–2300 m a. s. l., soil-litter in *Quercus semecarpifolia* forest, 25.VI.1988 (collected by J. Martens and W. Schawaller).

Type deposition. The holotype and two paratypes are deposited in the collection of the Senckenberg Museum of Natural History, Görlitz, Germany; 11 paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in ethanol with a drop of glycerol.

Etymology. The new species is named after late Prof. Dr. S. Mahunka (1937–2012), the Hungarian acarologist, for his extensive contributions to our knowledge of fauna and taxonomy of oribatid mites.

Remarks. The new species differs from the all known species of the genus by the presence (versus absence or presence of one pair) of one unpair tubercle between interlamellar setae.

Discussion

The oribatid mite genus *Oppia* was proposed by Koch (1835) with *Oppia nitens* Koch, 1835 as type species. Later, Aoki (1959) proposed the genus *Lasiobelba* with *Lasiobelba remota* Aoki, 1959 as type species, and Mahunka (1983) proposed the genus *Antennoppia* with *Antennoppia minor* Mahunka, 1983 as type species. These genera differ from each other by one main generic trait (bothridial seta clavate/fusiform/lanceolate, without long apex in *Oppia*;

Table 1. Leg setation and solenidia of *Lasiobelba sandormahunkai* sp. nov. Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus); single quotation mark (') designates setae on the anterior and double quotation mark (") setae on the posterior side of a given leg segment; parentheses refer to a pair of setae.

Leg	Tr	*Fe*	*Ge*	*Ti*	*Ta*
I	*v'*	*d*, (*l*), *bv"*, *v"*	(*l*), σ	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), (*pl*), *l"*, *v'*, ε, ω_1, ω_2
II	*v'*	*d*, (*l*), *bv"*, *v"*	(*l*), σ	(*l*), (*v*), φ	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), *l"*, ω_1, ω_2
III	*l'*, *v'*	*d*, *l'*, *ev'*	*l'*, σ	*l'*, (*v*), φ	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*)
IV	*v'*	*d*, *ev'*	*d*, *l'*	*l'*, (*v*), φ	*ft"*, (*tc*), (*p*), (*u*), (*a*), *s*, (*pv*)

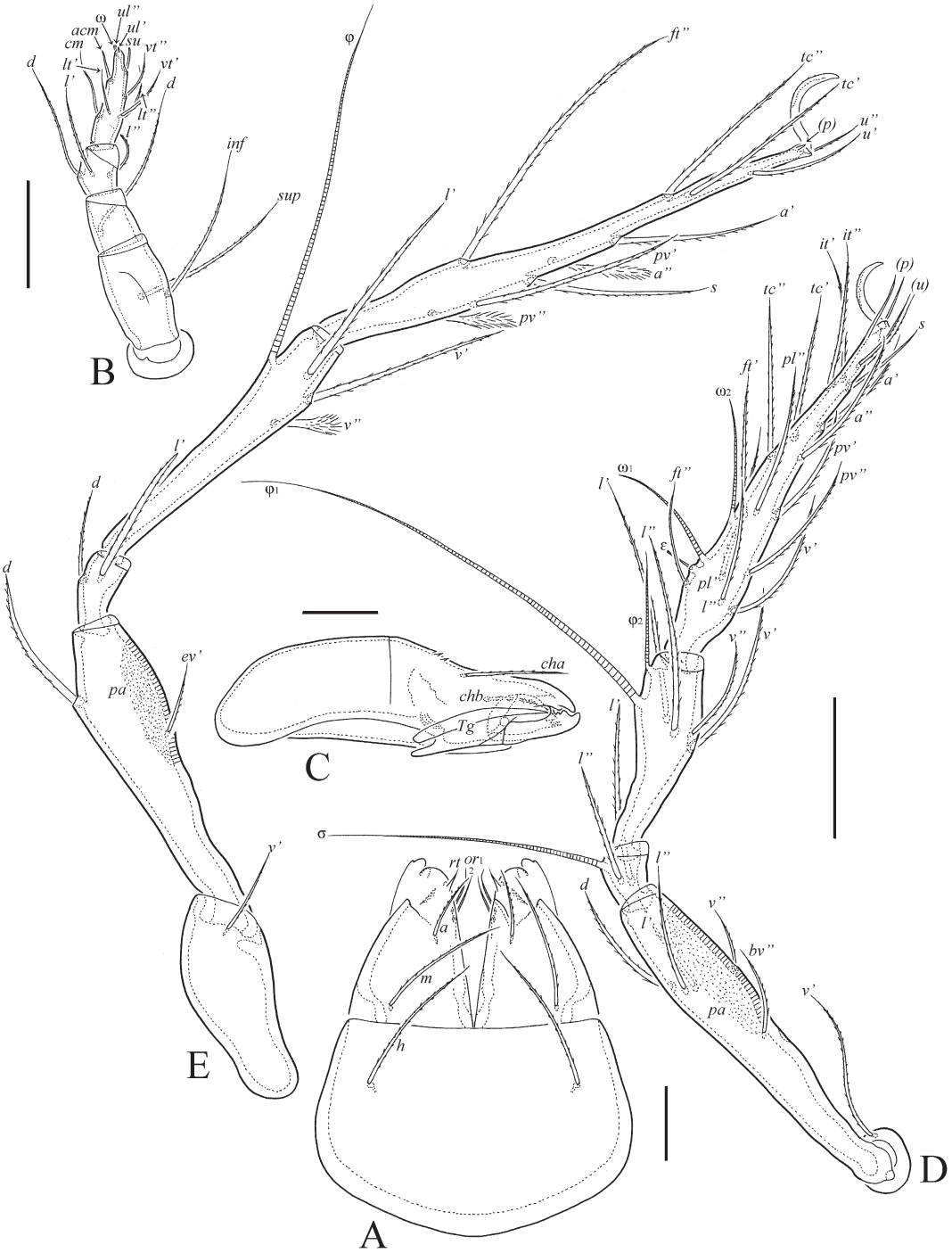

Fig. 2. *Lasiobelba sandormahunkai* sp. nov., adult: **A.** subcapitulum, ventral view; **B.** palp, left, paraxial view; **C.** chelicera, left, paraxial view; **D.** leg I, right, antiaxial view; **E.** leg IV, left, antiaxial view. Scale bar 50 µm (A,C), 100 µm (D,E).

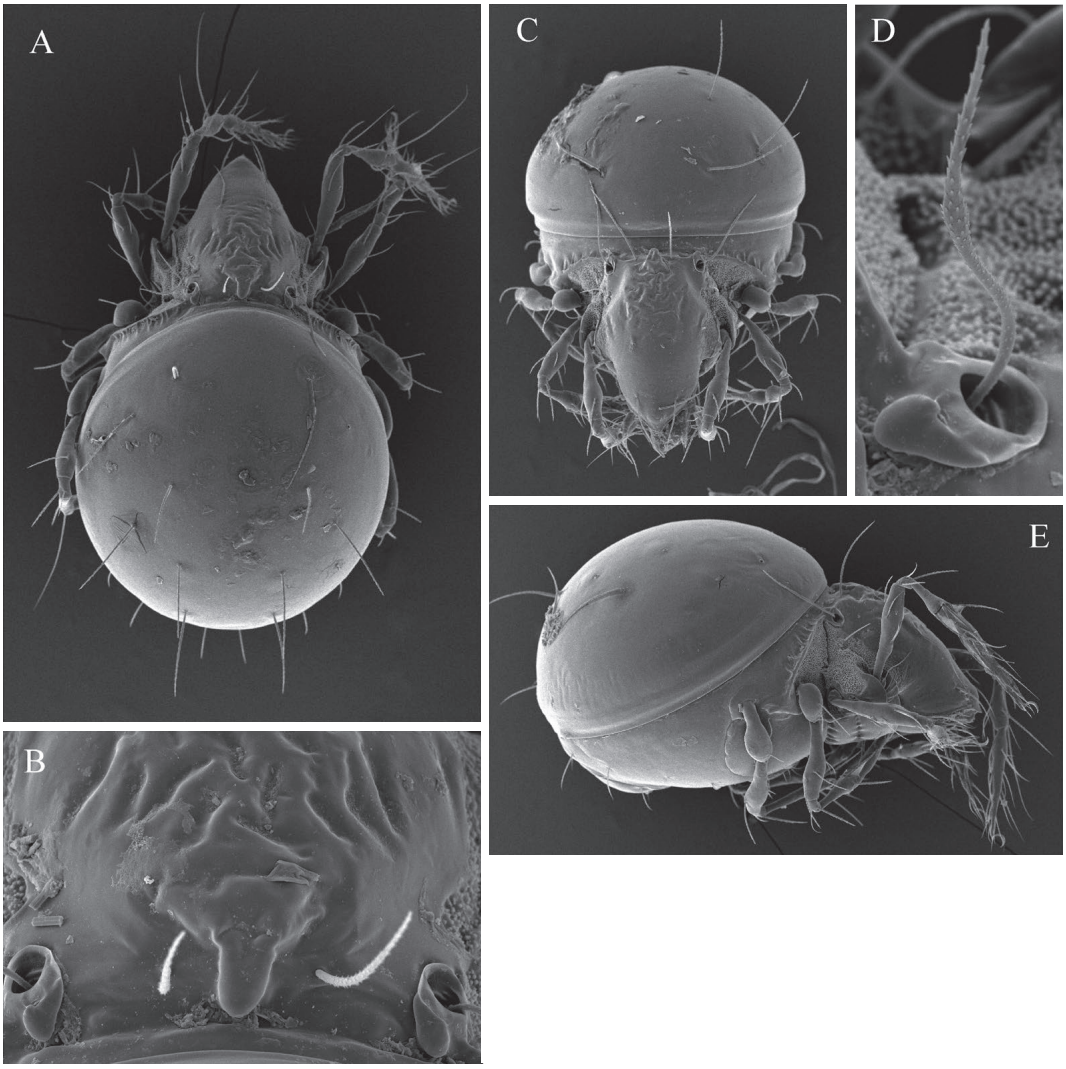

Fig. 3. *Lasiobelba sandormahunkai* sp. nov., adult, SEM micrographs: **A.** dorsal view; **B.** mediobasal part of prodorsum, dorsal view; **C.** dorsoanterior view; **D.** bothridial seta, right, lateral view; **E.** lateral view.

spindle-form having long conical/setiform apex in *Lasiobelba*; setiform in *Antennoppia*), however, in general appearance they are morphologically very similar, therefore, the opinion on their taxonomic status was different. For example, Subías & Balogh (1989) synonymized *Antennoppia* with *Lasiobelba*; Subías (2004) included *Antennoppia* as subgenus in *Lasiobelba*; Balogh & Balogh (2002) included representatives of *Lasiobelba* and *Antennoppia* in *Oppia*, implying the synonymy of them.

So far, in relation to the above listed genera, the Subías's system (2004) is supported, in which *Oppia* and *Lasiobelba* are independent genera, and *Antennoppia* is the subgenus of *Lasiobelba* (e.g. Ermilov et al. 2014, Ermilov & Friedrich 2016, Subías online version 2021). However, in our current opinion, if these genera differ only in morphology of bothridial seta, then it is unjustifiable to support the different taxonomic status for *Oppia*, *Lasiobelba* and *Antennoppia* (genus versus subgenus); it would be more logical for all them to support the initial generic statuses or, as an alternative, to include *Lasiobelba* and *Antennoppia* as subgenera in *Oppia* with the formation of subgenera *Oppia* (*Oppia*), *Oppia* (*Lasiobelba*) and *Oppia* (*Antennoppia*).

Thus, we decided to preliminarily support (and reject our early opinions – e. g. Ermilov et al. 2014, Ermilov & Friedrich 2016) the taxonomic independence of genera *Oppia*, *Lasiobelba* and *Antennoppia* until additional studies (e. g. molecular or phylogenetic) are presented.

After an explanation above listed, we were able to identify the incorrect taxonomic placement of several species of *Lasiobelba*, because morphology of their bothridial seta corresponds to the generic diagnosis of *Oppia*, therefore, we offer combinations for these species: *O. decui* (Vasiliu & Ivan, 1995) comb. nov., *O. hesperidiana* (Pérez-Íñigo, 1986) comb. nov., *O. pontica* (Vasiliu & Ivan, 2011) comb. nov., *O. sakhalinensis* (Ryabinin & Zaitsev, 2019) comb. nov., and *O. suchetae* (Sanyal, 1992) comb. nov. Initial generic placement for *Oppia arcidiaconoae* Bernini, 1973 and *O. kuehnelti* Csiszár, 1961 (= *O. yodai* Aoki, 1965, = *O. yodai africana* Kok, 1967, = *Cilioppia pori* Vasiliu & Ivan, 1995, = *Lasiobelba arabica* Mahunka, 2000, = *L. neonominata* Subías, 2004)[2] is supported.

Also, we support initial systematic placement for some members of *Antennoppia* (*A. granulata* Mahunka, 1986, *A. major* Mahunka, 1983, *A. minor* Mahunka, 1983, *A. trichoseta* Mahunka, 1983, and *A. yoshii* Mahunka, 1987) and offer combinations for other *Antennoppia*-species from *Lasiobelba* (*Antennoppia*) in *Antennoppia*: *A. abchasica* (Golosova & Tarba, 1974) comb. nov., *A. capilligera* (Berlese, 1916) comb. nov., *A. chistyakovi* (Ermilov & Kalúz, 2012) comb. nov., *A. heterosa* (Wallwork, 1964) comb. nov., *A. insignis* (Balogh, 1970) comb. nov., *A. izquierdoae* (Arillo, Gil-Martín & Subías, 1994) comb. nov., *A. nepalica* (Ermilov, Shtanchaeva, Subías & Martens, 2014) comb. nov., *A. parachistyakovi* (Ermilov, 2016) comb. nov. (in Ermilov & Friedrich 2016), *A. quadriseta* (Subías, 1989) comb. nov. (in Subías & Balogh 1989), *A. rigida* (Ewing, 1909) comb. nov., *A. subnitida* (Sellnick, 1924) comb. nov., and *A. ultraciliata* (Jacot, 1934) comb. nov.

Key to known species of *Lasiobelba*

After the taxonomic acts proposed in the previous section, *Lasiobelba* comprises 14 species, which have distributed collectively in the Ethiopian and Oriental region, Argentina, Japan and Santa Helena Island.

1. Notogastral setae *la* and *lm*[3] distinctly shorter than bothridial seta 2

– Notogastral setae *la* and *lm* longer than bothridial seta, or they slightly differ in length 7

2. Dorsal notogastral setae comparatively short (*la* and *lm* distinctly not reaching insertion of *lp*) body length: 787–825 ..... *Lasiobelba rubida* (Wallwork, 1977). Distribution: Santa Helena Island.

– Dorsal notogastral setae comparatively long (*la* or/and *lm* reaching insertion of *lp*) 3

3. Notogastral seta *c* short; body length: 478–522 ..... *Lasiobelba lemuria* Mahunka, 1997. Distribution: Madagascar.

– Notogastral seta *c* represented by alveolus or absent 4

4. Surface of notogaster and dorsal part of prodorsum not wrinkled or granulate; lamellar seta shorter than rostral and interlamellar setae..... 5

– Surface of notogaster and dorsal part of prodorsum wrinkled or granulate; lamellar seta not shorter than rostral and interlamellar setae..... 6

5. Notogastral seta h_3 present; notogastral seta h_2 of medium length; body length: 237–246..... .....*Lasiobelba longisensilla* Ermilov, 2017. Distribution: Vietnam.

– Notogastral seta h_3 absent; notogastral seta h_2 short; body length: 265–315..... .....*Lasiobelba tsaoshanensis* Ermilov, 2018 (see Ermilov & Liao 2018). Distribution: Taiwan.

[2] Subías (2004, online version 2021) considered *Lasiobelba arabica* Mahunka, 2000 (= *Oppia yodai africana* Kok, 1967, = *Lasiobelba neonominata* Subías, 2004) and *Oppia kuehnelti* Csiszár, 1961 (= *Oppia yodai* Aoki, 1965, = *Cilioppia pori* Vasiliu & Ivan, 1995) as independent species.

[3] There is confusion with the designation of notogastral setae *la* and *lm*. In our current opinion, if setae *la* and *lm* are not arranged in one longitudinal row, then *lm* is located anteromedially (often very clearly) or medially to *la*. Hence, designations of *la* and *lm* are not correct in some papers and must be swapped (e.g. Ermilov et al. 2014, Ermilov & Starý 2018).

6. Surface of notogaster and dorsal part of prodorsum wrinkled; interbothridial region with one pair of strong tubercles; body length: 693..... .....*Lasiobelba sculptra* Wang, 1993. Distribution:southeastern China.

– Surface of notogaster and dorsal part of prodorsum granulate; interbothridial region without one pair of strong tubercles; body length: 610-644..... ..... *Lasiobelba yunanensis* Wen, 1999. Distribution: southeastern China.

7. Rostrum tripartite; notogastral seta h_3 absent; body length: 464–514..... ..... *Lasiobelba camerunica* Ermilov & Starý 2018. Distribution: Cameroon.

– Rostrum not tripartite; notogastral seta h_3 present 8

8. Rostrum pointed 9

– Rostrum not pointed 11

9. Surface of dorsal part of prodorsum wrinkled; interbothridial region with one unpair strong tubercle; body length: 481–531..... .....*Lasiobelba sandormahunkai* sp. nov. Distribution: Nepal.

– Surface of dorsal part of prodorsum not wrinkled; interbothridial region without one unpair strong tubercle..... 10

10. Anterior part of pedotectum I elongate, forming specifically curved tooth; notogastral setae p_1–p_3 longer than adanal setae; body length: 1278–1310..... *Lasiobelba daamsae* Ermilov, Shtanchaeva, Subías & Martens, 2014. Distribution: Nepal.

– Anterior part of pedotectum I not elongate and not forming specifically curved tooth; notogastral setae p_1–p_3 not longer than adanal setae; body length: 772–891.....*Lasiobelba gibbosa* (Mahunka, 1985). Distribution: Ethiopian region.

11. Rostrum truncate with one pair slight lateral teeth; body length: 794–834..... .....*Lasiobelba insulata* Ohkubo, 2001.Distribution: Japan, Taiwan.

– Rostrum rounded..... 12

12. Interlamellar seta distinctly shorter than bothridial seta body length: 625–684 ....*Lasiobelba vietnamica* Balogh, 1983 (as *Oppia remota* in Balogh & Mahunka 1967). Distribution: Vietnam.

– Interlamellar seta longer than bothridial seta, or they slightly differs in length..... 13

13. Notogastral setae p_1–p_3 located comparatively close to each other (distance p_3–p_3 equally to ad_2-ad_2; body length: 560..... .....*Lasiobelba subuligera* (Berlese, 1916) (see also Mahunka & Mahunka-Papp 1995). Distribution: Argentina.

– Notogastral setae p_1–p_3 clearly distanced from each other (distance p_3–p_3 larger than ad_2-ad_2; body length: 858–1030.....*Lasiobelba remota* Aoki, 1959 (see also Ohkubo 2001). Distribution: Oriental region and East of eastern Palaearctic region.

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