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CONTRIBUTION TO THE KNOWLEDGE OF THE ORIBATID MITE GENUS *ALEURODAMAÆUS* (ACARI, ORIBATIDA, ALEURODAMAÆIDAE), WITH DESCRIPTION OF A NEW SPECIES FROM ETHIOPIA

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A new species of the genus *Aleurodamaeus* (Oribatida, Aleurodamaeidae) is described from heather forest litter in central Ethiopia. *Aleurodamaeus aethiopicus* sp. n. differs from all related species of the genus by the presence of a thick cerotegument with specific ornamentations (densely cellular with a median longitudinal interruption) on the notogaster. An identification key to all known species of *Aleurodamaeus* is provided.

Keywords: aleurodamaeid mites, taxonomy, morphology, identification key, Afrotropical Region

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The oribatid mite genus *Aleurodamaeus* (Acari, Oribatida, Aleurodamaeidae) was proposed by Grandjean (1954) with *Damaeus setosus* Berlese 1883 as type species. So far, it comprises 17 species, which are collectively distributed in the Afrotropical, Neotropical and southern Palaearctic regions (Subías, 2004, online version 2022). The revised generic diagnosis and an identification key to nine species of *Aleurodamaeus* from South Africa were provided by Hugo-Coetzee (2013). Grandjean (1954) characterized *Aleurodamaeus* as retaining the exuvial scalps in the adult stage, while Hugo-Coetzee (2013) stated that the exuvial scalps are retained as adults, but they are weakly attached and are easily lost so that only a few or not any individuals with scalps may be found in a sample. However, there are clearly species that either retain the scalps or do not retain the scalps, i.e. there are a complete absence of scalps in all the studied individuals and also no loose scalps in the sample. Therefore, in our opinion, *Aleurodamaeus* adults either retain the scalps or not. Unfortunately ontogenetic studies of *Aleurodamaeus* are scarce with only juveniles of *A. africanus* and *A. setosus* known (both species retain the exuviae in the adult stage) (Norton, Ermilov, 2014). Ontogenetic studies (of preferably juveniles bred in the laboratory) of species which do not retain the exuviae

in the adult phase are necessary to clarify this characteristic.

The main goal of our paper is to describe and illustrate a new species of *Aleurodamaeus*, based on adults, collected from Ethiopia. Presently, the Ethiopian mite fauna is insufficiently studied, and only two species of the genus have been registered (e.g. Ermilov et al., 2010; Ermilov, Rybalov, 2012): *A. africanus* Mahunka 1984; *A. recenfesevpi* Ermilov et Rybalov 2012. The additional goal of our paper is to present an identification key to all known species of *Aleurodamaeus*.

METHODS

Observation and documentation. Specimens were mounted in lactic acid on temporary cavity slides 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". For SEM microscopy alcohol preserved mites were dusted with gold and scanned with the aid of a TESCAN Mira3 LMU SEM microscope.

Terminology and conventions. General morphological terminology used in this paper mostly follows that of Grandjean (see Travé and Vachon (1975) for references), Norton (1977), and Norton and Behan-Pelletier (2009).

Abbreviations. *Prodorsum*: *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively. *Notogaster*: *h*, *p* = notogastral setae; *ia*, *im*, *ip*, *ih*, *ips* = notogastral lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *sup*, *inf*, *cm*, *ul*, *sul*, *vt*, *lt* = palp setae; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a-c*, *2a*, *3a-c*, *4a-c* = epimeral setae; *PdI*, *PdII* = pedotectum I, II, respectively. *Anogenital region*: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal seta, respectively; *iad* = adanal lyrifissure; *p.o.* = 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* = leg setae; *p.a.* = porose area.

TAXONOMY

Aleurodamaeus aethiopicus Ermilov, Hugo-Coetzee et Rybalov sp. n. (Figs 1–6)

Material. Holotype and 20 paratypes: Ethiopia, Oromia Region, Arsi Zone, Arsi Mountains National Park, Mount Chilalo, 07°56'09.5" N, 039°11'54.7" E, 3177 m a.s.l., point № 8, sifting litter under *Hypericum* sp., *Thymus* sp. and green mosses in heather bushes (*Erica arborea*), Berlese's funnels, 27.11.2021 (leg. L.B. Rybalov) (Fig. 6).

The holotype is deposited in the collection of the Senckenberg Museum of Natural History, Görlitz, Germany; 20 paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

Diagnosis. Body length: 713–830. Notogaster with thick, gel-like, densely cellular cerotegument, with a longitudinally elongate central part with interrupted or very thin cerotegument. Rostral and lamellar setae setiform, barbed; interlamellar seta spiniform, roughened; bothridial seta long, rod-like, roughened. Exuvial scalps always absent. Four pairs of notogastral setae barbed (*h*₁, *p*₁ very long, flagellate; *p*₂ long, flagellate; *p*₃ medium-sized, setiform). Epimeral and anogenital setae setiform, barbed. Nine pairs of genital setae. Two pairs of adanal setae. Discidium and parastig-

matic enantiophysis absent. Leg famulus sunken in cylindrical apophysis.

Description. Measurements. Large species. Body length: 796 (holotype), 713–830 (20 paratypes); body width: 498 (holotype), 448–514 (20 paratypes). Sex not identified.

Integument. Body color brown. Surface with dense microtuberculate sculpturing (visible under high magnification in dissected specimens). Notogaster, dorsal part of prodorsum and marginal zone of ventral plate covered by thick (large masses), gel-like, densely cellular layer of cerotegument; central part of notogastral with longitudinally elongated region with interrupted or very thin cerotegument. Body, legs and setae partially covered by dense microgranules and filaments; microgranule is hollow and multicellular (Fig. 5c, 5d).

Prodorsum. Rostrum broadly rounded. Rostral (123–143), lamellar (143–154) and exobothridial (53–61) setae setiform, flexible, slightly barbed. Interlamellar seta (24–32) spiniform, roughened. Bothridial seta (164–172) rod-like, roughened.

Notogaster. Exuvial scalps always absent. Dorsose-jugal furrow deep, narrow. Four pairs of flexible, slightly barbed setae; *h*₁, *p*₁ (205–287) and *p*₂ (90–98) flagellate, *p*₃ (53–61) setiform. Opisthonotal gland opening and all lyrifissures distinct.

Gnathosoma. Subcapitulum size: 164–184 × 123–143. Subcapitular setae (*a*: 32–41; *m*, *h*: 45–49) and adoral (20–24) setae setiform, flexible, slightly barbed. Palp (length: 94–102) setation: 0-2-1-3-9(+ ω). Postpalpal seta (6) spiniform, smooth. Chelicera (length: 164–184) with two setiform, barbed setae (*cha*: 45–53; *chb*: 36–41).

Epimeral and lateral podosomal regions. Epimeral setal formula: 3-1-3-3; setae (*1a*, *2a*, *3a*: 32–41; *1b*, *3b*, *4a*, *4b*: 53–61; *1c*, *3c*, *4c*: 86–98) setiform, flexible, slightly barbed. Discidium and tubercles of parastigmatic enantiophysis *S* absent.

Anogenital region. Genital (32–41), aggenital (49–61), anal (24–32), and adanal (49–61) setae setiform, flexible, slightly barbed. Nine pairs of genital setae and two pairs of adanal setae present. Adanal lyrifissure poorly observed.

Legs. Tridactylous; median claw slightly thicker than lateral claws, all roughened on dorsal side. Porose area on leg femora I–IV and trochanters III, IV well observed. Formulas of leg setation and solenidia: I (1-5-4-5-20) [1-2-2], II (1-5-4-5-16) [1-1-2], III (2-3-3-4-15) [1-1-0], IV (1-2-3-4-13) [0-1-0]; homology of setae and solenidia indicated in Table 1. Famulus on tarsus I minute, sunken in cylindrical apophysis. Seta *s* on tarsus I setiform, barbed (not eupathidial), located between setae *a* and *pv*.

Remarks. In having four pairs of notogastral setae (e.g. *h*₁, *p*₁ very long, flagellate; *p*₂ long, flagellate; *p*₃ medium-sized, setiform), thick and gel-like cerote-



Fig. 1. *Aleurodamaeus aethiopicus* sp. n., adult: *a* – dorsal view (not shown: legs); *b* – dorsal view (not shown: legs, prodorsal and notogastral cerotegument); *c* – right lateral view (not shown: gnathosoma, legs, prodorsal and notogastral cerotegument). Scale bar 100 μ m.



Fig. 2. *Aleurodamaeus aethiopicus* sp. n., adult: *a* – ventral view (not shown: gnathosoma, legs); *b* – posterior view; *c* – subcapitulum, ventral view; *d* – palp, left, paraxial view; *e* – chelicera, left, paraxial view. Scale bar (µm): *a, b* – 100; *c, e* – 50; *d* – 20.

gument on the notogaster, two pairs of adanal setae, rod-like bothridial seta, and sunken leg famulus, *Aleurodamaeus aethiopicus* sp. n. is most similar to *A. woasi* Hugo-Coetzee, 2013 from South Africa. However, the new species can be distinguished from the latter by the larger body length (713–830 versus 318–420), the presence of densely cellular cerotegumental layer on

the notogaster (versus cerotegument represented by large polygonal parts), the number of genital setae (nine pairs versus seven pairs), and the absence (versus presence) of parastigmatic tubercle *Sp*.

Etymology. The species name *aethiopicus* refers to the country of origin, Ethiopia.

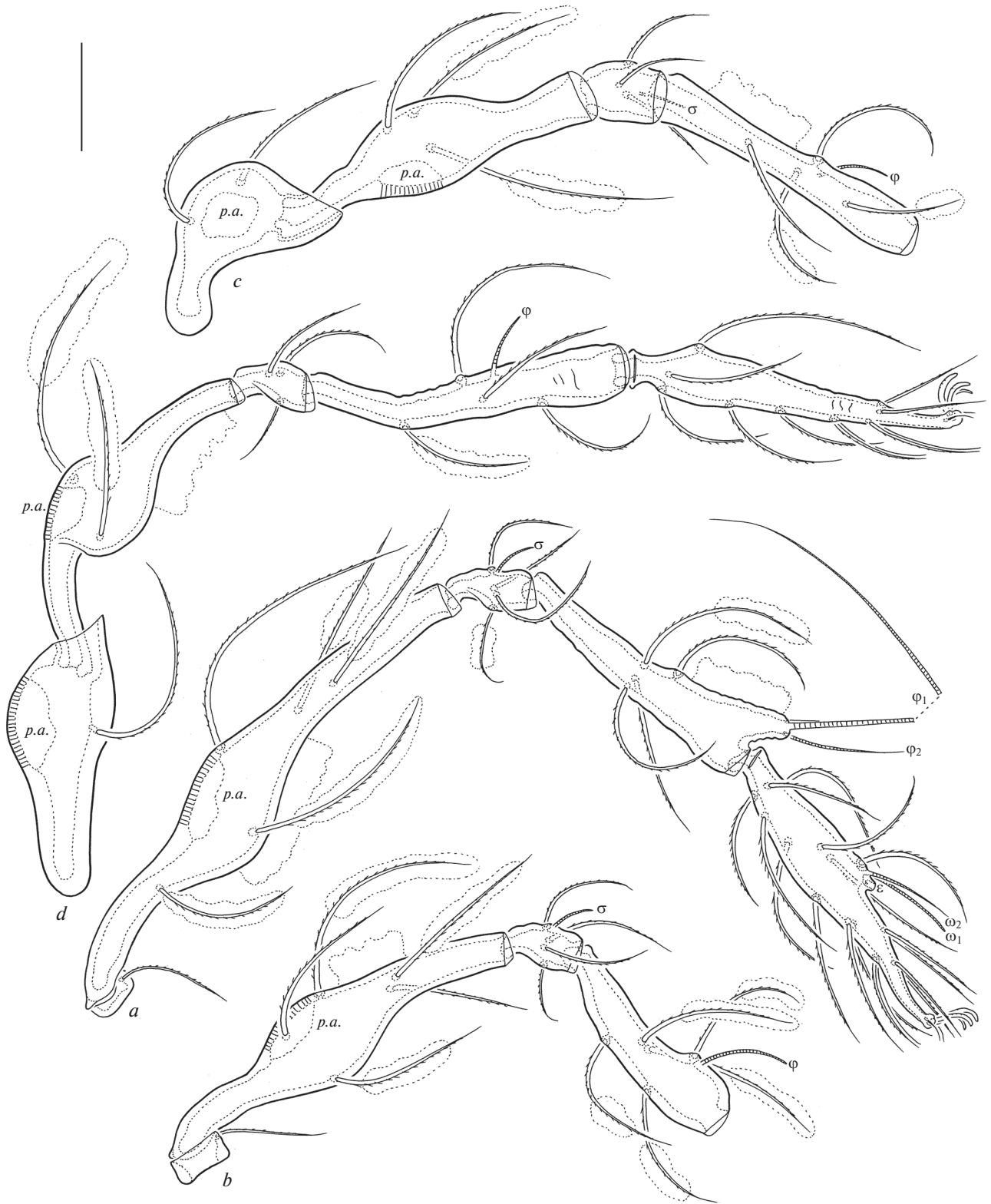


Fig. 3. *Aleurodamaeus aethiopicus* sp. n., adult: *a* – leg I, right, antiaxial view; *b* – leg II, without tarsus, right, antiaxial view; *c* – leg III, without tarsus, right, ventral view; *d* – leg IV, left, antiaxial view. Scale bar 50 μm.

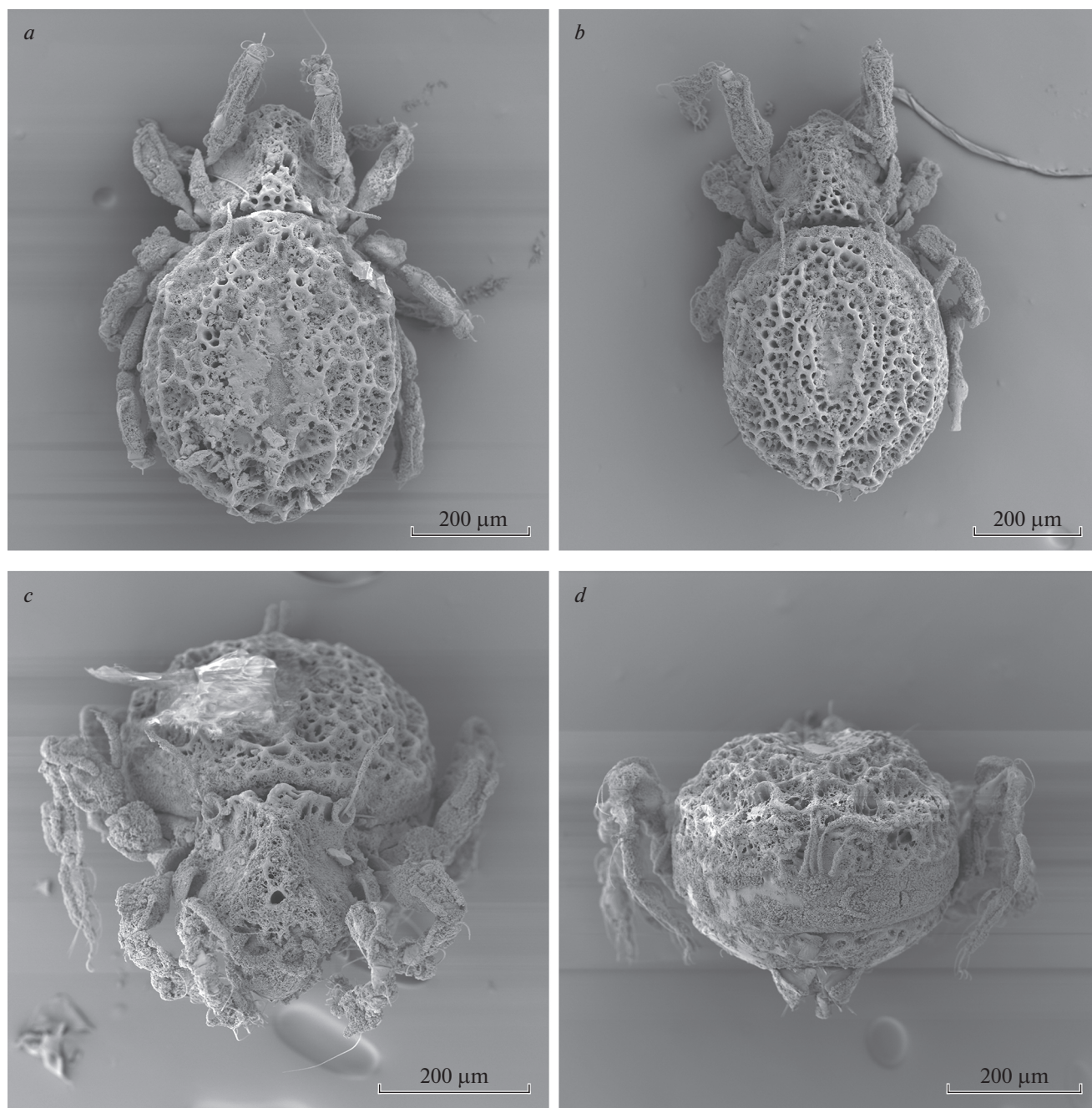


Fig. 4. *Aleurodamaeus aethiopicus* sp. n., adult, SEM micrographs: *a*, *b* – dorsal view; *c* – anterodorsal view; *d* – posterior view.

KEY TO KNOWN SPECIES OF *ALEURODAMAEUS*

Aleurodamaeus hungaricus Paschoal et Johnson 1985 from south-central Europe and *A. trichosus* (Kulijev 1979) from Caucasus are excluded from this key. The description of *A. hungaricus* is complicated and confusing, with much information on the ratio of leg segments, but little about the characteristics of the body. It has a body length of 504, cerotegument piled on prodorsum and notogaster, long bothridial seta,

four pairs of notogastral setae, all on tubercles, with h_1 , p_2 (could be p_1) long, seven pairs of genital setae, two pairs of adanal setae with ad_1 posterolateral to anal plates and ad_2 paraanal (Paschoal, Johnson, 1985). *Aleurodamaeus trichosus* is also not well described. It has a body length of 775, presumably three pairs of notogastral setae, all subequal in length, long flagellate bothridial seta, cerotegumental granules on the notogaster and cerotegument in a sideways 'I' form on both sides on the prodorsum (Kulijev, 1979).

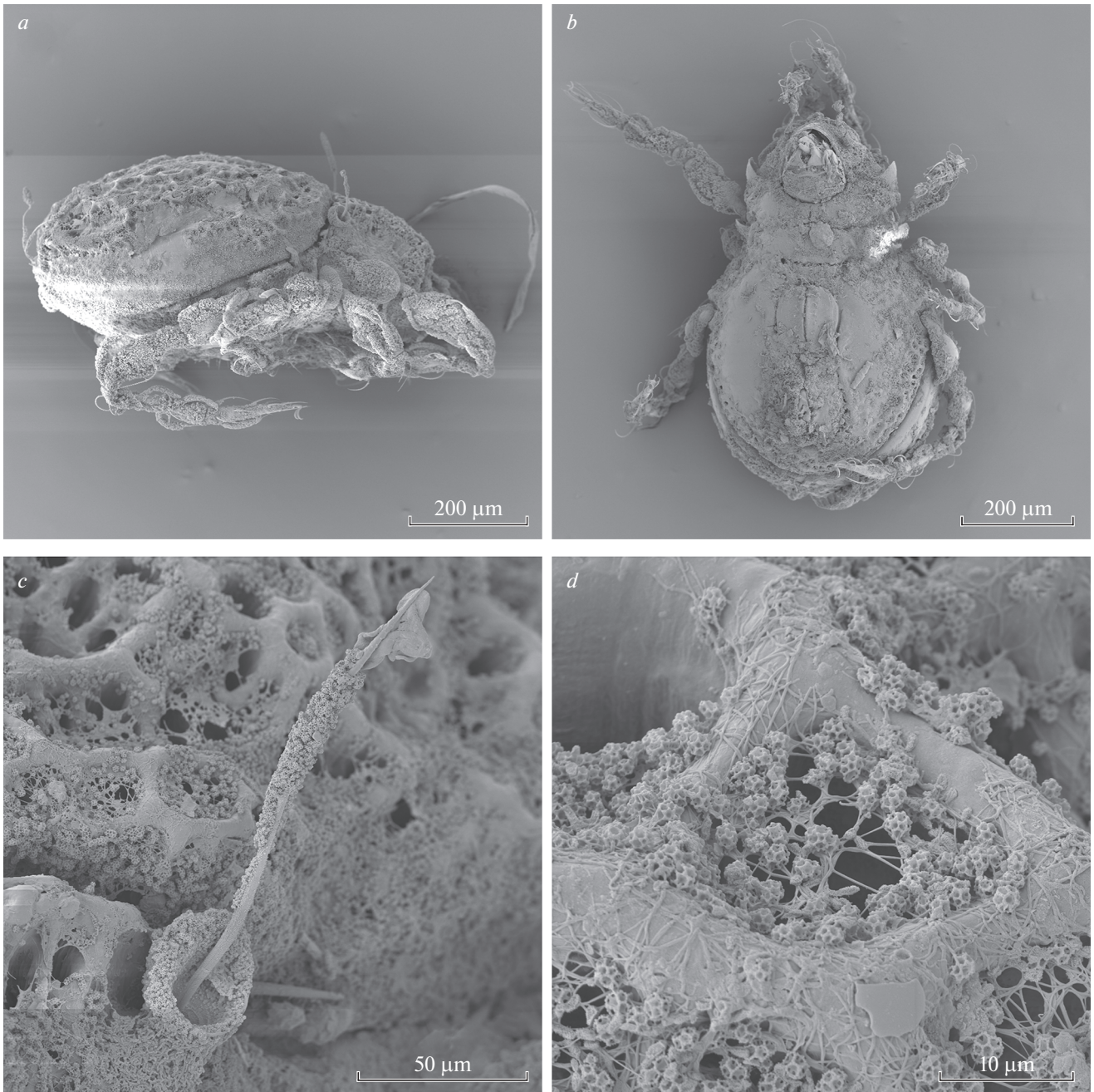


Fig. 5. *Aleurodamaeus aethiopicus* sp. n., adult, SEM micrographs: *a* – right lateral view; *b* – ventral view; *c* – bothridium and bothridial seta; *d* – notogastral cerotegument.

1 Five pairs of notogastral setae, i.e. seta h_2 present 2
 – Three¹ or four pairs of notogastral setae, i.e. seta h_2 absent 3

¹ *Aleurodamaeus cephalotes* was described and figured with three pairs of notogastral setae (Kulijev, 1979; Mahunka, Mahunka-Papp, 1995). This number needs to be confirmed by studying the original material since it may be possible that one or two additional setae could have been overlooked.

2 Notogastral seta h_2 setiform, curving laterally; anterior transverse ridge on notogaster absent; cerotegument on prodorsum in the form of a sideways ‘m’ on both sides; body length: 491–555 *A. salvadordalii* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.

– Notogastral seta h_2 flexible, twisted; anterior transverse ridge on notogaster present; cerotegument on prodorsum in the form of an ‘A’; body length: 455–



Fig. 6. Collecting place of *Aleurodamaeus aethiopicus* sp. n.

550*A. deswardti* (Hugo 2010) (see Hugo, 2010). Distribution: South Africa.

3 All notogastral setae distinctly shorter than the bothridial seta 4
 – All or some notogastral setae similar or longer in length to the bothridial seta 7

4 Large masses of notogastral cerotegument forming four longitudinal bands; prodorsum with a large mass of cerotegument; body length: 359–439 *A. angelae* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.

– Large masses of notogastral cerotegument mostly absent, except sometimes anterior and posterior parts of notogaster; prodorsum without a large mass of cerotegument or with narrow cerotegument across the lamellar region 5

5 Large masses of cerotegument present in anterior and posterior parts of the notogaster; insertions of notogastral setae p_2 and p_3 very close to each other, almost touching; body length: 491–550 *A. vicinus* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: Afrotropical region.

– Large masses of cerotegument absent in anterior and posterior parts of the notogaster; insertions of notogastral setae p_2 and p_3 clearly distanced from each other 6

6 Notogastral setae h_1 and p_1 much longer than p_2 and p_3 ; all notogastral setae smooth; body length: 319–367 *A. minutus* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.

Table 1. Leg setation and solenidia of adult *Aleurodamaeus aethiopicus* sp. n.

Leg	<i>Tr</i>	<i>Fe</i>	<i>Ge</i>	<i>Ti</i>	<i>Ta</i>
I	v'	$d, (l), bv'', v''$	$d, (l), v', \sigma$	$(l), (v), d\phi_1, \phi_2$	$(fi), (tc), (it), (p), (u), (a), s, (pv), l'', v', (pl), \varepsilon, \omega_1, \omega_2$
II	v'	$d, (l), bv'', v''$	$d, (l), v', \sigma$	$d, (l), (v), \phi$	$(fi), (tc), (it), (p), (u), (a), s, (pv), l'', \omega_1, \omega_2$
III	l', v'	d, l', ev'	d, l', v', σ	$d, l', (v), \phi$	$(fi), (tc), (it), (p), (u), (a), s, (pv)$
IV	v'	d, ev'	d, l', v'	$d, l', (v), \phi$	$(fi), (tc), (p), (u), (a), s, (pv)$

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.

- Notogastral setae h_1 , p_1 , p_2 , and p_3 similar in length; all notogastral setae ciliate; body length: 431–481 *A. murombodziensis* Ermilov 2021 (see Ermilov, Bąkowski, 2021). Distribution: Mozambique.
- 7 Exuvial scalps present on the notogaster 8
- Exuvial scalps absent on the notogaster 10
- 8 Nine to ten pairs of genital setae; body length: 662–739 *A. africanus* Mahunka 1984 (see Mahunka, 1984). Distribution: Afrotropical region.
- Seven pairs of genital setae 9
- 9 Notogastral setae h_1 and p_1 long, similar in length, both inserted on strong tubercles; body length: 550–660 *A. setosus* (Berlese 1883) (see Berlese, 1883; Pérez-Íñigo, 1970, 1986; Seniczak et al., 2012). Distribution: southern Palearctic region, Mexico.
- Notogastral seta h_1 long, distinctly longer than medium-sized seta p_1 , both not inserted on tubercles; body length: 727–858 *A. ermilovi* (Hugo-Coetzee 2014) (see Hugo-Coetzee, 2014). Distribution: South Africa.
- 10 Discidium well developed, prominent 11
- Discidium weak or absent 12
- 11 Large masses of cerotegument in central part of notogaster forming two longitudinal parallel bands; two pairs of adanal setae; body length: 543–620 *A. prominens* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.
- Large masses of cerotegument in central part of notogaster forming elongate diamond-shaped structure; three pairs of adanal setae; body length: 770 *A. cephalotes* (Berlese 1916) (see Berlese, 1916; Mahunka, Mahunka-Papp, 1995). Distribution: Afrotropical region.
- 12 Large masses of cerotegument in central part of notogaster forming three longitudinal parallel bands 13
- Large masses of cerotegument in central part of notogaster not forming longitudinal parallel bands 14
- 13 Notogastral setae p_1 and h_1 similar in length; adanal setae ad_1 located posterior to anal aperture; body length: 547–664 *A. recenseseypi* Ermilov et Rybalov 2012 (see Ermilov, Rybalov, 2012). Distribution: Ethiopia.
- Notogastral seta p_1 longer than h_1 ; adanal setae ad_1 located lateral to anal aperture; body length: 447–532 *A. niedbalai* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.
- 14 Nine pairs of genital setae; body length: 713–830 *A. aethiopicus* sp. n. Distribution: Ethiopia.

- Seven pairs of genital setae 15
- 15 Large masses of notogastral cerotegument forming polygonal structures; cerotegument on prodorsum without alveoli; anterior transverse ridge on notogaster present; body length: 318–420 *A. woasi* Hugo-Coetzee 2013 (see Hugo-Coetzee, 2013). Distribution: South Africa.
- Large masses of notogastral cerotegument with craterlike alveoli and lines; cerotegument on prodorsum with small alveoli; anterior transverse ridge on notogaster absent; body length: 430 *A. australis* Woas 1992 (see Woas, 1992). Distribution: South Africa, Mozambique.

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К ИЗУЧЕНИЮ ПАНЦИРНЫХ КЛЕЩЕЙ РОДА *ALEURODAMAEUS* (ACARI, ORIBATIDA, ALEURODAMAEIDAE) С ОПИСАНИЕМ НОВОГО ВИДА ИЗ ЭФИОПИИ

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Описан новый вид рода *Aleurodamaeus* (Oribatida, Aleurodamaeidae), собранный из лесной подстилки верескового леса в центральной Эфиопии. *Aleurodamaeus aethiopicus* sp. n. отличается от всех похожих видов рода присутствием толстого церотегумента, имеющего специфический орнамент (плотно ячеистый со срединным продольным прерыванием) на ногогастре. Представлен ключ для определения известных видов *Aleurodamaeus*.

Ключевые слова: клещи, таксономия, морфология, идентификационный ключ, Афротропическая область