

## A NEW GENUS AND TWO NEW SPECIES OF NEOPYGMEPHORIDAE (ACARI: PYGMEPHOROIDEA) PHORETIC ON SCARAB BEETLES

Alexander A. Khaustov<sup>1\*</sup> and Andrey V. Frolov<sup>2</sup>

<sup>1</sup>X-BIO Institute, Tyumen State University, Tyumen, Russia

<sup>2</sup>Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia

\*corresponding author; e-mail: alkhaustov@mail.ru

**ABSTRACT:** A new genus of Neopygmephorid mites (Acari: Neopygmephoridae), *Andrebochkovia* gen. n., and two new species—*A. cochlearis* sp. n., collected from the beetle *Apogonia destructor* Bos (Scarabaeidae: Melolontinae) in Indonesia; and *A. madagascariensis* sp. n., collected from the beetle *Adoretus* cf. *vittatus* Brenske (Scarabaeidae: Rutelinae) in Madagascar—are described.

**KEY WORDS:** Heterostigmata, systematics, new taxa, phoresy, Indonesia, Madagascar.

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### INTRODUCTION

The cosmopolitan family Neopygmephoridae includes 26 genera and about 300 species (Zhang *et al.* 2011; Khaustov and Sazhnev 2016; Khaustov and Mandelshtam 2017; Khaustov and Frolov 2018a, b; Khaustov and Minor 2018; Khaustov and OConnor 2019). All neopygmephorid mites are probably fungivorous. Representatives of five genera are known as associates of scarab beetles: *Nasutidania* Khaustov and Frolov, 2018; *Pseudokerdabania* Khaustov and Trach, 2012; *Pseudopygmephorus* Cross, 1965; *Scarabadania* Khaustov and Frolov, 2018; and *Troxodania* Khaustov and Trach 2014 (Khaustov 2010; Khaustov and Trach 2012, 2014; Sobhi *et al.* 2017; Khaustov and Frolov 2018a, b).

During the study of heterostigmatic mites phoretic on scarab beetles, a new genus of Neopygmephorid mites, *Andrebochkovia* gen. n., and two new species—*A. cochlearis* sp. n., collected from the beetle *Apogonia destructor* Bos in Indonesia; and *A. madagascariensis* sp. n., collected from the beetle *Adoretus* cf. *vittatus* Brenske in Madagascar—have been found. They are described herein.

### MATERIALS AND METHODS

Although the collecting circumstances of the host beetles, which are housed in the collection of Zoological Institute of RAS, Saint Petersburg, Russia, were not recorded, we think they were collected in light traps. The exact collecting localities are provided below. The mites were found attached to the setae on the dorsal sides of the head and on the pronotums of the beetles. Collected mites were preserved in 70–80% ethanol and later cleared in lactic acid and mounted in Hoyer's medium. Mite morphology was studied using a Carl Zeiss Axio-Imager A2 compound microscope equipped with

phase contrast and DIC objectives. Photomicrographs were taken with a Hitachi KP-HD20A digital camera. For SEM microscopy, alcohol-preserved mites were dried in a freeze-drying device JFD 320 (JEOL, Japan), dusted with gold, and scanned with the aid of a JEOL JSM-6510LV SEM microscope.

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. The taxonomic system of Pygmephorodea follows Khaustov (2004, 2008). All measurements for the holotype and, if available, for the five paratypes (in parentheses) are given in micrometers (μm). When it comes to leg chaetotaxy, the number of solenidia is given in parentheses.

### SYSTEMATICS

Family **Neopygmephoridae** Cross, 1965

Genus ***Andrebochkovia*** gen. n.

Type species: *Andrebochkovia cochlearis* sp. n.

**Diagnosis.** *Female.* Body oval. Gnathosomal capsule of about equal length and width, dorsally with two pairs of cheliceral setae (*cha*, *chb*); postpalpal setae (*pp*) present; palps short, with two pairs of dorsal setae (*dFe*, *dGe*). Palpal tibiotarsus completely covered by anterior part of femorogenu, small, with tiny tibial claw. Subcapitulum with one pair of setae *m*, alveolar pits *n* absent; palps ventrally with accessory setigenous structure, palpal solenidion absent; cheliceral stylets unusually thick and strong, about half as long as gnathosomal capsule, cheliceral levers large and well sclerotized (Fig. 5A). Pharyngeal pumps tripartite situated closely to each other; pharyngeal pump 1 small,

bow-shaped, striated, pharyngeal pump 2 very large and long, sausage-shaped and weakly striated laterally, pump 3 very small, smooth (Fig. 2B). Posterior margin of prodorsum slightly covered by anterior part of tergite C. Prodorsum with two pairs of simple setae ( $v_2$ ,  $sc_2$ ), pair of clavate trichobothria ( $sc_1$ ) and small, round stigmata located anteriorly to setae  $v_2$ . Dorsal idiosomal setae not modified. Tergite C with two pairs of setae ( $c_1$ ,  $c_2$ ); tergite D with one pair of setae ( $d$ ) and round cupules  $ia$ ; tergite EF with two pairs of setae ( $e$ ,  $f$ ); tergite H with two pairs of setae ( $h_1$ ,  $h_2$ ) and round cupules  $ih$ . Coxal fields I with two pairs of setae ( $1a$ ,  $1b$ ); coxal fields II with two pairs of setae ( $2a$ ,  $2b$ ); coxal fields III with three pairs of setae ( $3a$ ,  $3b$ ,  $3c$ ); coxal fields IV with three pairs of setae ( $4a$ ,  $4b$ ,  $4c$ ). Pseudanal segment with three pairs of setae ( $ps_{1-3}$ ). Apodemes 1 (ap1) and 2 (ap2) well developed and joined with prosternal apodeme (appr), sejugal apodeme (apsej) well developed and joined with appr; apodemes 3 (ap3) very weak, divided into several parts, apodemes 4 (ap4) long, reaching distinctly beyond bases of setae  $3b$ . Apodemes 5 absent. Secondary transverse apodeme absent. Posterior margin of posterior sternal plate entire. Anterior genital sclerite (ags) long, bell-like, posterior genital sclerite (pgs) U-shaped, shorter than ags, median genital sclerite (mgs) present. Ventral idiosomal setae not modified. Legs I and II subequal in length. Tibiotarsus I slightly thickened, with large claw, situated on short pretarsus; seta  $d$  of femur I hook-like, seta  $k$  long, pointed, seta-like; setae ( $tc$ ) situated on short pinnaculum. Claws on tarsus IV simple, claws on tarsi II and III thickened medially. Tarsus IV not strongly elongate; empodia on tarsi II–IV relatively short and wide. Solenidion on tibia IV absent. Femora III–IV divided into basi- and telofemur. Leg setation: leg I: Tr 1 ( $v'$ ), Fe 3 ( $d$ ,  $l'$ ,  $v''$ ), Ge 4 ( $l'$ ,  $l''$ ,  $v'$ ,  $v''$ ), TiTa 16(4) ( $d$ ,  $l'$ ,  $l''$ ,  $v'$ ,  $v''$ ,  $k$ ,  $tc'$ ,  $tc''$ ,  $p''$ ,  $ft'$ ,  $ft''$ ,  $pv'$ ,  $pv''$ ,  $pl'$ ,  $pl''$ ,  $s$ ,  $\omega_1$ ,  $\omega_2$ ,  $\phi_1$ ,  $\phi_2$ ); leg II: Tr 1 ( $v'$ ), Fe 3 ( $d$ ,  $l'$ ,  $v''$ ), Ge 3 ( $l'$ ,  $l''$ ,  $v'$ ), Ti 4(1) ( $d$ ,  $l'$ ,  $v'$ ,  $v''$ ,  $\phi$ ), Ta 6(1) ( $tc'$ ,  $tc''$ ,  $pl''$ ,  $pv'$ ,  $pv''$ ,  $u'$ ,  $\omega$ ); leg III: Tr 1 ( $v'$ ), Fe 2 ( $d$ ,  $v'$ ), Ge 2 ( $l'$ ,  $v'$ ), Ti 4(1) ( $d$ ,  $l'$ ,  $v'$ ,  $v''$ ,  $\phi$ ), Ta 6 ( $tc'$ ,  $tc''$ ,  $pl''$ ,  $pv'$ ,  $pv''$ ,  $u'$ ); leg IV: Tr 1 ( $v'$ ), Fe 2 ( $d$ ,  $v'$ ), Ge 1 ( $v'$ ), Ti 4 ( $d$ ,  $l'$ ,  $v'$ ,  $v''$ ), Ta 6 ( $tc'$ ,  $tc''$ ,  $pl''$ ,  $u'$ ,  $pv'$ ,  $pv''$ ).

*Male and larva unknown.*

**Differential diagnosis.** Among the genera with median genital sclerite, the new genus is most similar to *Pseudopygmephorus* Cross, 1965 in general appearance and in the shape of genital

sclerites (see Khaustov and Trach 2014). The new genus could be distinguished from *Pseudopygmephorus* by: an erect solenidion  $\omega_1$  (solenidion  $\omega_1$  fused with tibiotarsus in *Pseudopygmephorus*); very strong and well sclerotized cheliceral stylets and levers (cheliceral stylets and levers are very small and difficult to discern in *Pseudopygmephorus*); a very long, sausage-shaped pharyngeal pump 2 (pharyngeal pump 2 is usually small and oval in *Pseudopygmephorus*); and the absence of a palpal solenidion (palpal solenidion is present in *Pseudopygmephorus*).

**Species included.** The genus *Andrebochkovia* includes two species: *A. cochlearis* sp.n. and *A. madagascariensis* sp.n.

**Distribution and habitats.** *Andrebochkovia cochlearis* sp.n. is phoretic on beetles *Apogonia destructor* (Scarabaeidae: Melolontinae) in Indonesia; *A. madagascariensis* sp.n. is phoretic on beetles *Adoretus* cf. *vittatus* (Scarabaeidae: Rutelinae) in Madagascar.

**Etymology.** The genus is named in memory of a prominent Russian acarologist Andrei Bochkov.

#### *Andrebochkovia cochlearis* sp.n.

(Figs. 1–6)

**Description.** *Female* (Figs. 1–6). Length of idiosoma 220 (215–230), width 130 (125–135).

*Idiosomal dorsum* (Figs. 1A, 6A, B). All dorsal shields with numerous small dimples. All dorsal setae barbed. Setae  $sc_2$  and  $c_2$ , pointed, other dorsal setae blunt-ended. Trichobothria with short stem, clavate, sparsely barbed, with rounded apex. Posterior margins of tergites C and D weakly concave. Lengths of dorsal setae:  $v_2$  17 (17–19),  $sc_2$  45 (44–47),  $c_1$  34 (33–35),  $c_2$  46 (42–47),  $d$  38 (36–39),  $e$  25 (21–25),  $f$  41 (40–42),  $h_1$  52 (47–52),  $h_2$  27 (23–27). Distances between setae:  $v_2$ – $v_2$  31 (30–32),  $sc_2$ – $sc_2$  36 (35–38),  $c_1$ – $c_1$  48 (46–50),  $c_1$ – $c_2$  28 (26–29),  $d$ – $d$  36 (35–36),  $e$ – $f$  6 (6–7),  $f$ – $f$  32 (32–34),  $h_1$ – $h_1$  15 (13–15),  $h_1$ – $h_2$  15 (14–17).

*Idiosomal venter* (Figs. 1B, 6C, D). Ventral plates with numerous small dimples. All ventral setae pointed. Setae of posterior sternal plate smooth, other ventral setae barbed; setae  $1b$  and  $2a$  strongly barbed. Posterior margins of posterior sternal and aggenital plates straight. Lengths of ventral setae:  $1a$  27 (27–31),  $1b$  27 (24–28),  $2a$  34 (33–35),  $2b$  26 (24–30),  $3a$  20 (19–20),  $3b$  22 (20–22),  $3c$  20 (20–22),  $4a$  19 (19–21),  $4b$  28 (28–32),  $4c$  24 (23–25),  $ps_1$  20 (19–21),  $ps_2$  14 (12–15),  $ps_3$  18 (17–18).

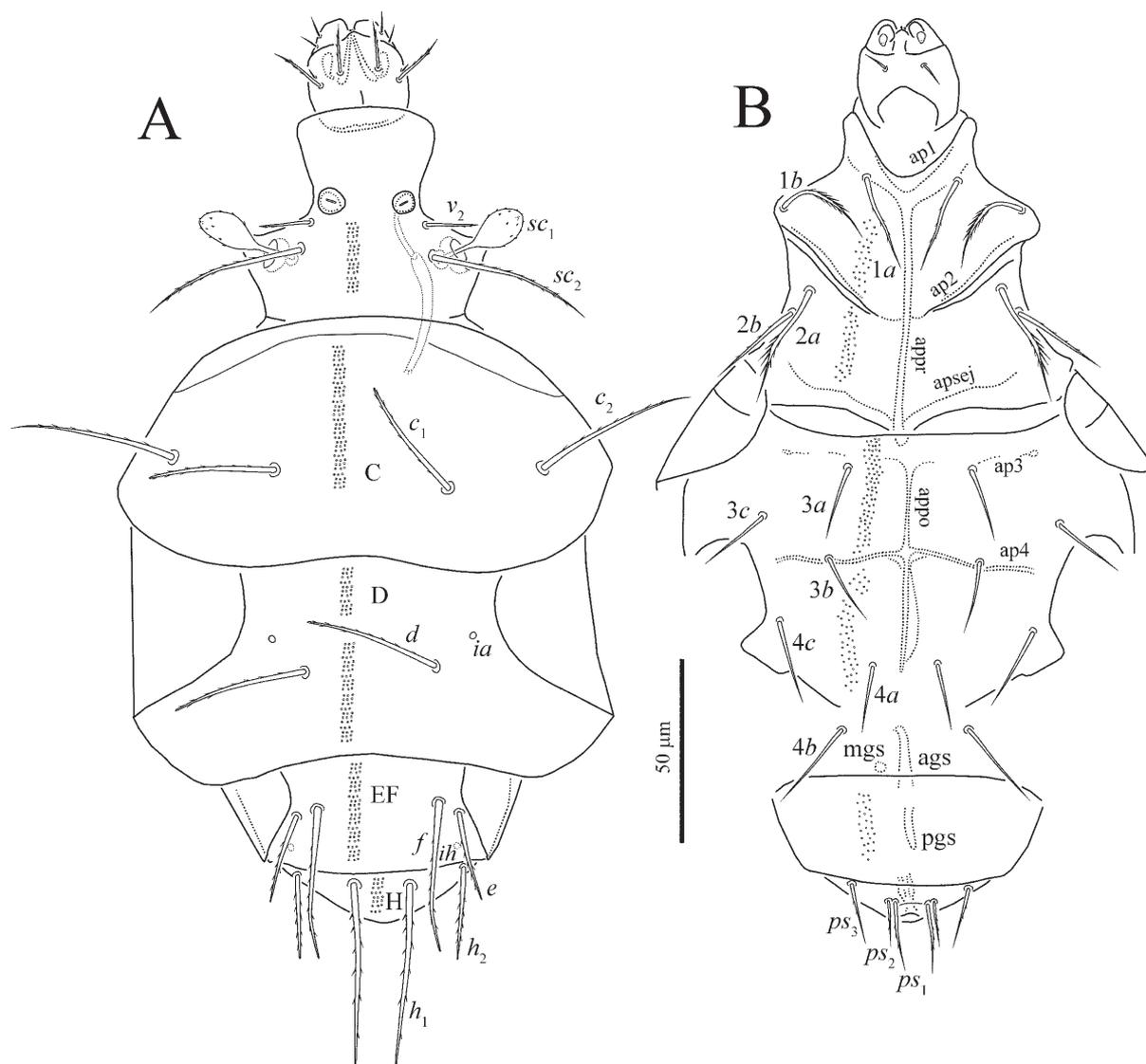


Fig. 1. *Andrebochkovia cochlearis* sp. n., female: A—dorsum of the body, B—venter of the body. Legs omitted.

*Gnathosoma* (Figs. 2, 5, 6D). Gnathosoma almost oval in outline. Length of gnathosoma 29 (28–30), width 26 (26–27). Dorsal median apodeme well developed. Cheliceral setae *cha* 15 (15–17) and *chb* 15 (15–18) distinctly barbed and pointed; postpalpal setae (*pp*) short, needle-like, situated anterolaterally to bases of *cha*. Setae *dFe* and *dGe* subequal, smooth and pointed; subcapitular setae *m* 7 (6–7) smooth and pointed.

*Legs* (Figs. 3, 4, 6B, E, F). Leg I (Figs. 3A, 6E). Lengths of solenidia  $\omega_1$  8 (7–8),  $\omega_2$  15 (15–16),  $\varphi_1$  13 (13),  $\varphi_2$  7 (7);  $\varphi_1$  digitiform,  $\omega_1$  short and wide, semi-oval,  $\omega_2$  and  $\varphi_2$  baculiform;  $\omega_2$  slightly curved. Seta *l'* of femur spoon-like, smooth, blunt-ended (Fig. 6B); other leg setae (except eupathidia (*ft*),

(*tc*), *p''* and hook-like seta *d* of femur) barbed and pointed. Leg II (Figs. 3B, 6F). Solenidium  $\omega$  10 (10–11) digitiform; solenidium  $\varphi$  4 (4) weakly clavate, situated in depression (Fig. 6F). All leg setae barbed; seta *d* of femur blunt-ended; other leg setae pointed. Leg III (Fig. 4A). Solenidium  $\varphi$  4 (4) weakly clavate, situated in depression. All leg setae barbed. Seta *d* of femur and *u'* of tarsus blunt-ended; other leg setae pointed. Leg IV (Fig. 4B). All leg setae barbed. Setae *d* of femur, *v'* of genu, and *v''* of tibia blunt-ended; other leg setae pointed.

**Differential diagnosis.** *Andrebochkovia cochlearis* differs from *A. madagascariensis* by: spoon-shaped seta *l'* of femur I (seta *l'* of femur I is not modified in *A. madagascariensis*); pointed

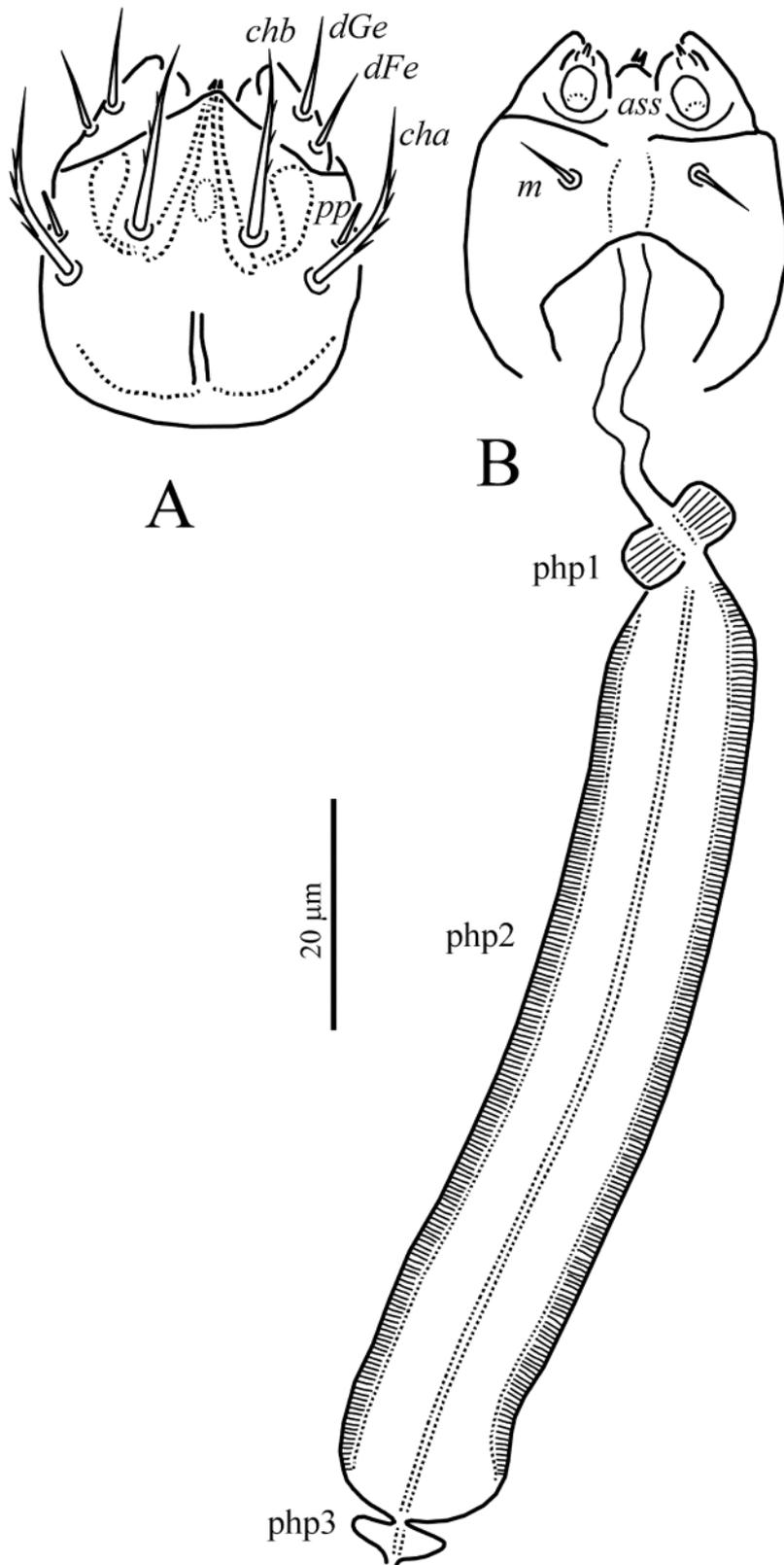


Fig. 2. *Andrebochkovia cochlearis* sp.n., female: A—gnathosoma in dorsal view, B—gnathosoma and pharyngeal pumps in ventral view.

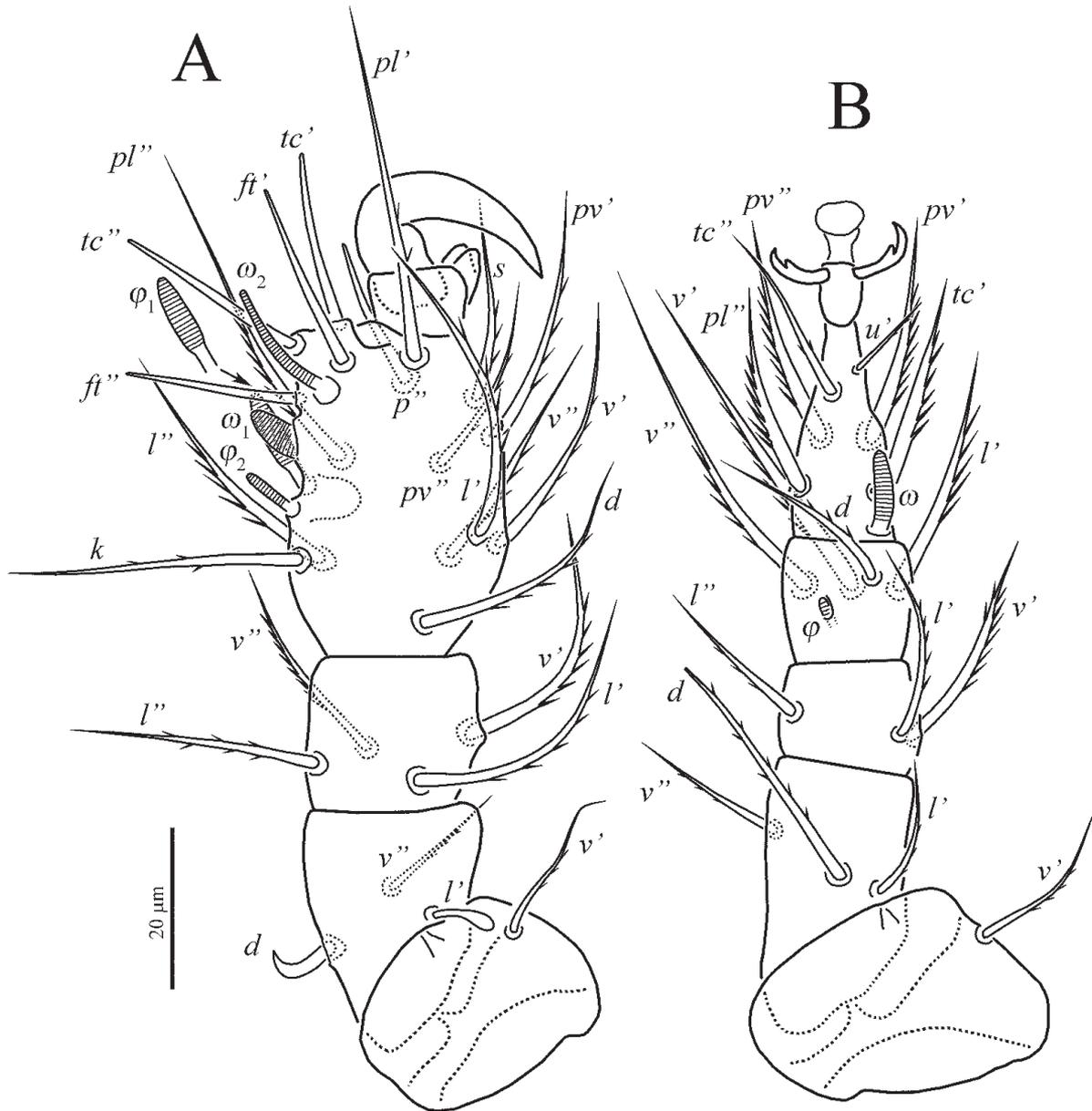


Fig. 3. *Andrebochkovia cochlearis* sp. n., female: A—left leg I in dorsal view, B—left leg II in dorsal view.

setae  $sc_2$  and  $c_2$  (setae  $sc_2$  and  $c_2$  are blunt-ended in *A. madagascariensis*); and pointed seta  $v'$  of trochanter IV (seta  $v'$  of trochanter IV is blunt-ended in *A. madagascariensis*).

**Type material.** Female holotype, slide ZISP T-Neop-002, on the beetle *Apogonia destructor*: Indonesia, Rinca Island, 12.VII.1962, L.Darevskiy leg.; paratypes: 4 females, same data; 59 females on the beetle *Apogonia destructor*: Indonesia, Java, Bogor, 11.VII.1960, S. Khrushchev leg.

**Type deposition.** The holotype and four paratypes are deposited in the collection of Zoological Institute

of RAS, Saint Petersburg, Russia; other paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

**Etymology.** The name of the new species is derived from Latin *cochlearis*, meaning *spoon* and refers to the unusual spoon-shaped seta  $l'$  on femur I.

***Andrebochkovia madagascariensis* sp. n.**

(Figs. 7–9)

**Description.** *Female* (Figs. 7–9). Length of idiosoma 240, width 120.

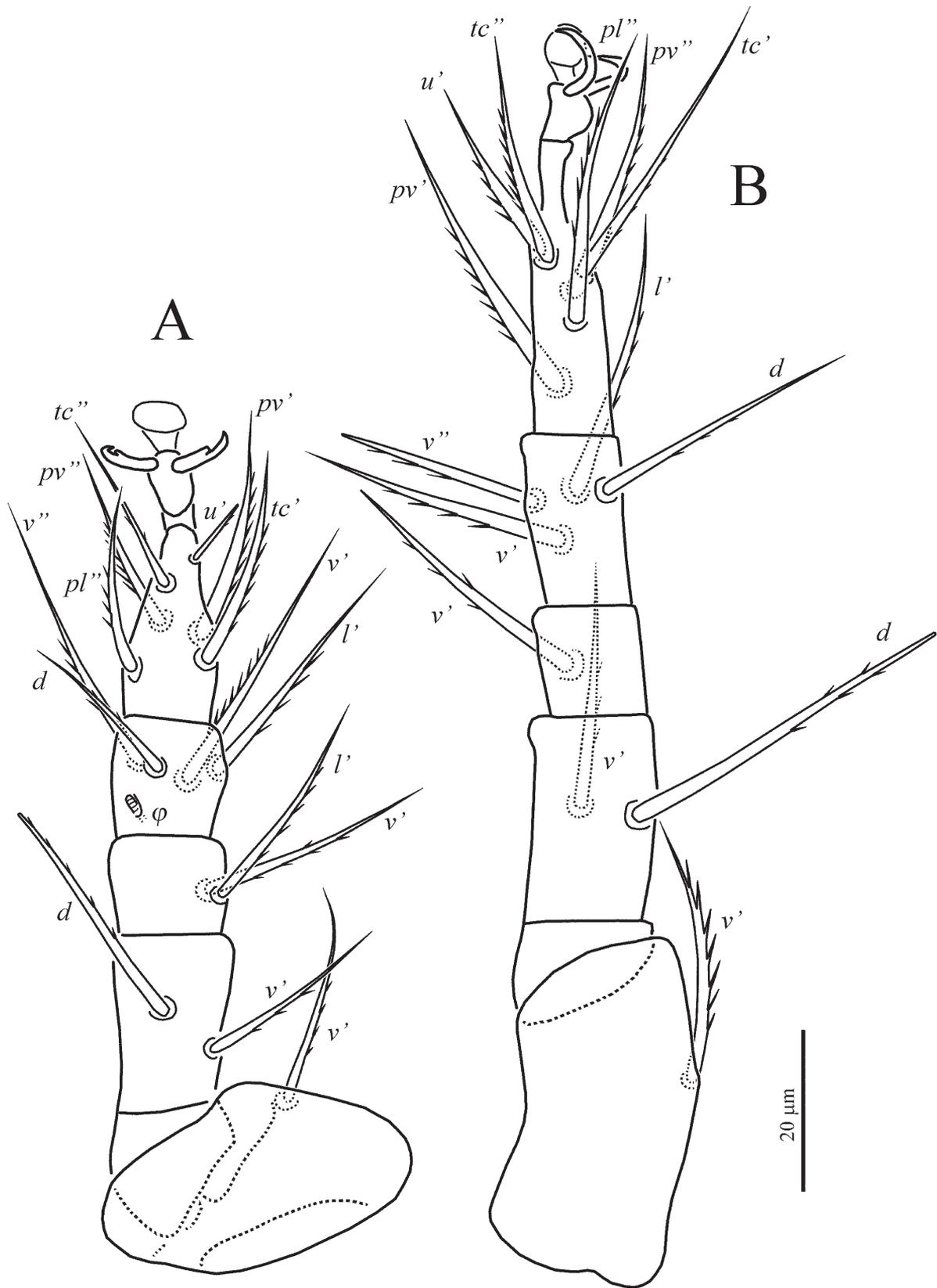


Fig. 4. *Andrebochkovia cochlearis* sp. n., female: A—left leg III in dorsal view, B—left leg IV in dorsal view.

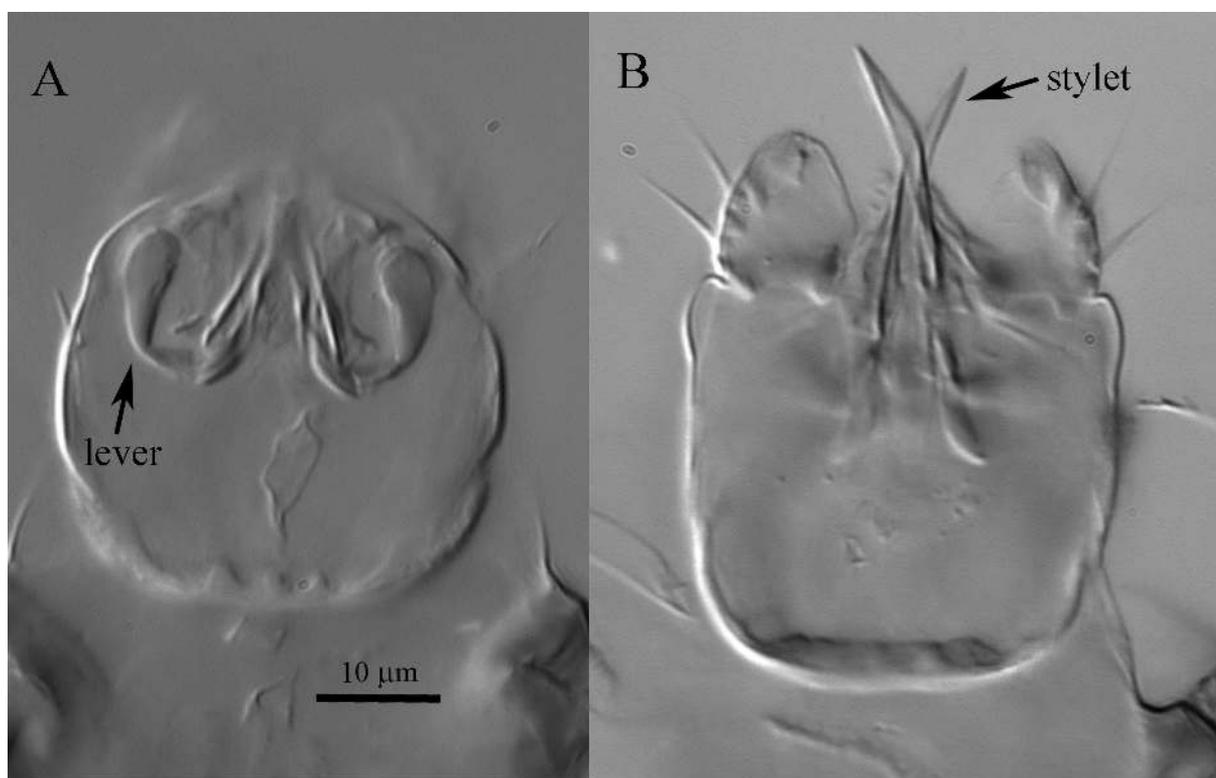


Fig. 5. DIC micrographs of *Andrebochkovia cochlearis* sp. n., female: A—gnathosoma with focus on cheliceral levers, B—gnathosoma with focus on cheliceral stylets.

*Idiosomal dorsum* (Fig. 7A). All dorsal shields with numerous small dimples. All dorsal setae barbed and blunt-ended. Trichobothria with short stem, clavate, sparsely barbed, with rounded apex. Posterior margins of tergites C and D almost straight. Lengths of dorsal setae:  $v_2$  15,  $sc_2$  35,  $c_1$  27,  $c_2$  33,  $d$  30,  $e$  21,  $f$  34,  $h_1$  40,  $h_2$  22. Distances between setae:  $v_2-v_2$  30,  $sc_2-sc_2$  32,  $c_1-c_1$  47,  $c_1-c_2$  25,  $d-d$  39,  $e-f$  8,  $f-f$  35,  $h_1-h_1$  18,  $h_1-h_2$  15.

*Idiosomal venter* (Fig. 7B). Ventral plates with numerous small dimples. All ventral setae pointed. Setae of posterior sternal plate and  $ps_2$  smooth, other ventral setae barbed; setae  $1b$  and  $2a$  strongly barbed. Other characters as in *A. cochlearis*. Lengths of ventral setae:  $1a$  26,  $1b$  25,  $2a$  31,  $2b$  29,  $3a$  20,  $3b$  24,  $3c$  20,  $4a$  19,  $4b$  34,  $4c$  23,  $ps_1$  21,  $ps_2$  12,  $ps_3$  18.

*Gnathosoma*. In general, very similar to that of *A. cochlearis*. Setae  $cha$  12,  $chb$  17.

*Legs* (Figs. 8, 9). Leg I (Fig. 8A). In general, as in *A. cochlearis*, except the following: seta  $l'$  of femur not modified, smooth and pointed; lengths of solenidia  $\omega_1$  11,  $\omega_2$  13,  $\varphi_1$  13,  $\varphi_2$  7. Leg II (Fig. 8B) as in *A. cochlearis*. Solenidia  $\omega$  12,  $\varphi$  5. Leg

III (Fig. 9A) as in *A. cochlearis*. Leg IV (Fig. 9B). All leg setae barbed. Setae  $v'$  of trochanter,  $d$  of femur, and  $v''$  of tibia blunt-ended; other leg setae pointed.

**Differential diagnosis.** See diagnosis for *A. cochlearis*.

**Type material.** Female holotype, slide ZISP T-Neop-003, on the beetle *Adoretus* cf. *vittatus* Brenske (Scarabaeidae, Rutelinae), Madagascar, 6.I.2001, D. Suarez leg.

**Type deposition.** The holotype is deposited in the collection of Zoological Institute of RAS, Saint Petersburg, Russia.

**Etymology.** The name of the new species refers to its distribution in Madagascar.

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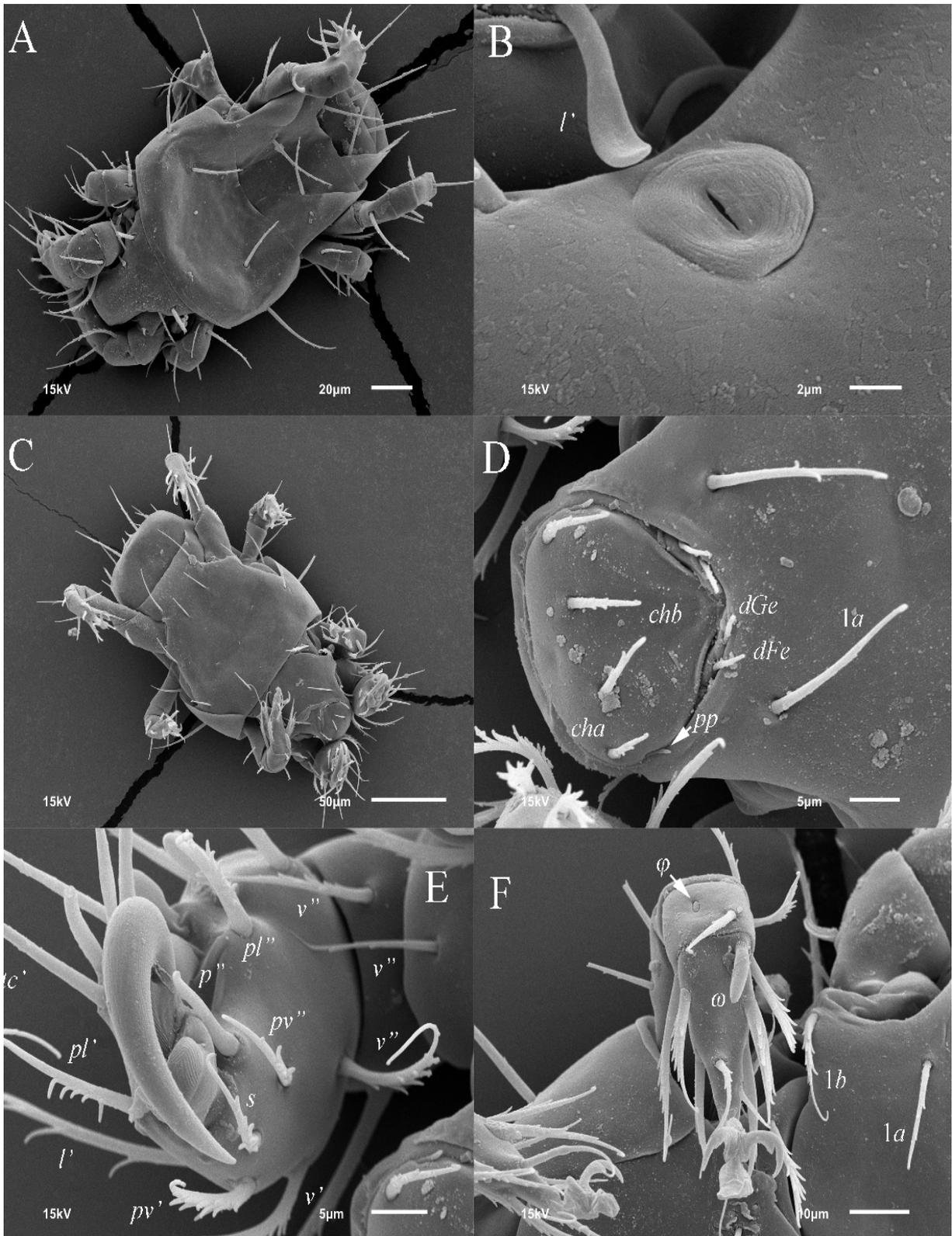


Fig. 6. SEM micrographs of *Andrebochkovia cochlearis* sp.n., female: A—general view dorsally, B—stigma and modified seta *l'* of femur I, C—general view ventrally, D—hypognathous gnathosoma and anterior part of anterior sternal plate, E—tibiotarsus I in frontal view, F—tibia and tarsus II in dorsal view.

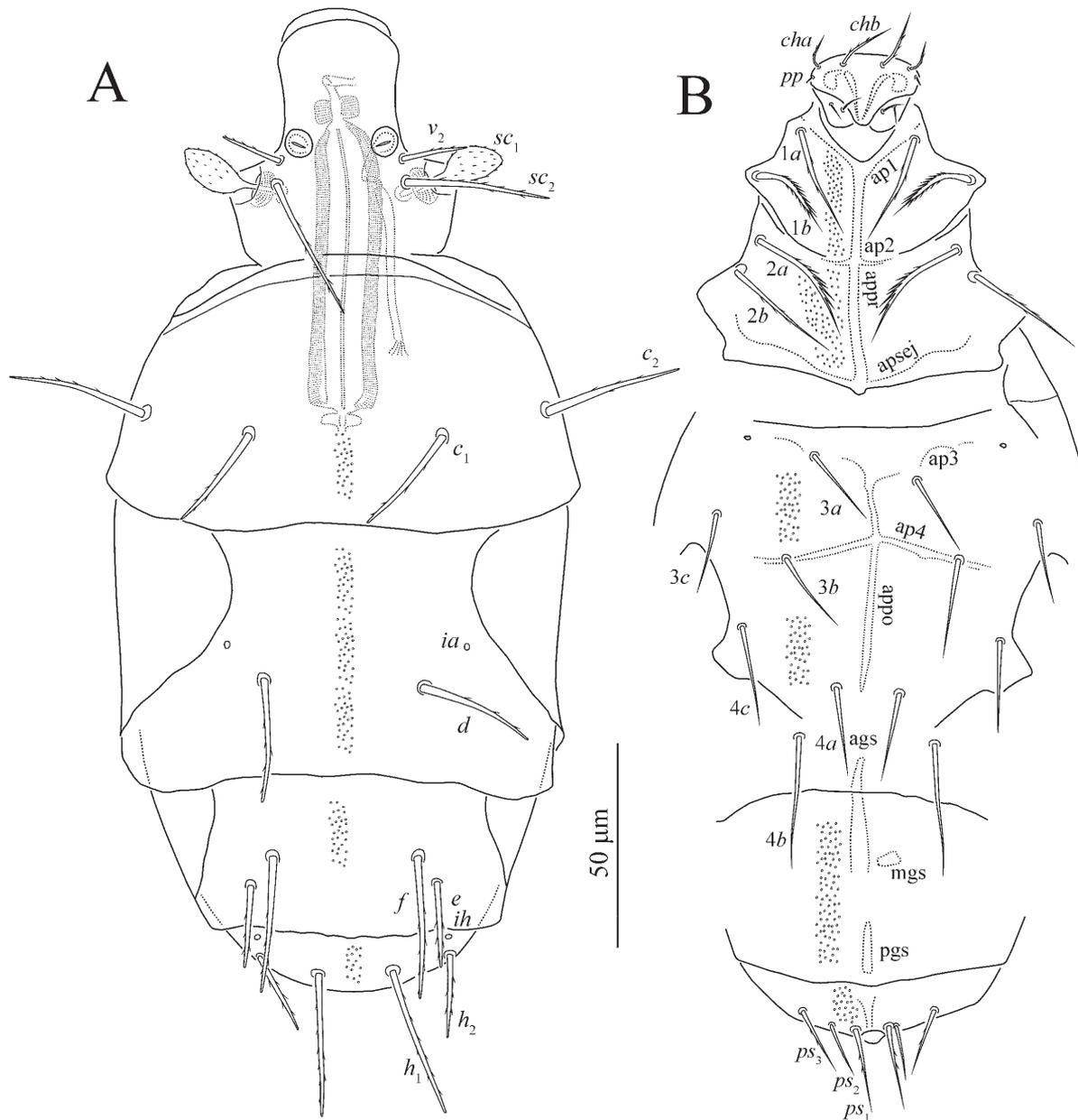


Fig. 7. *Andrebochkovia madagascariensis* sp. n., female: A—dorsum of the body, B—venter of the body. Legs omitted.

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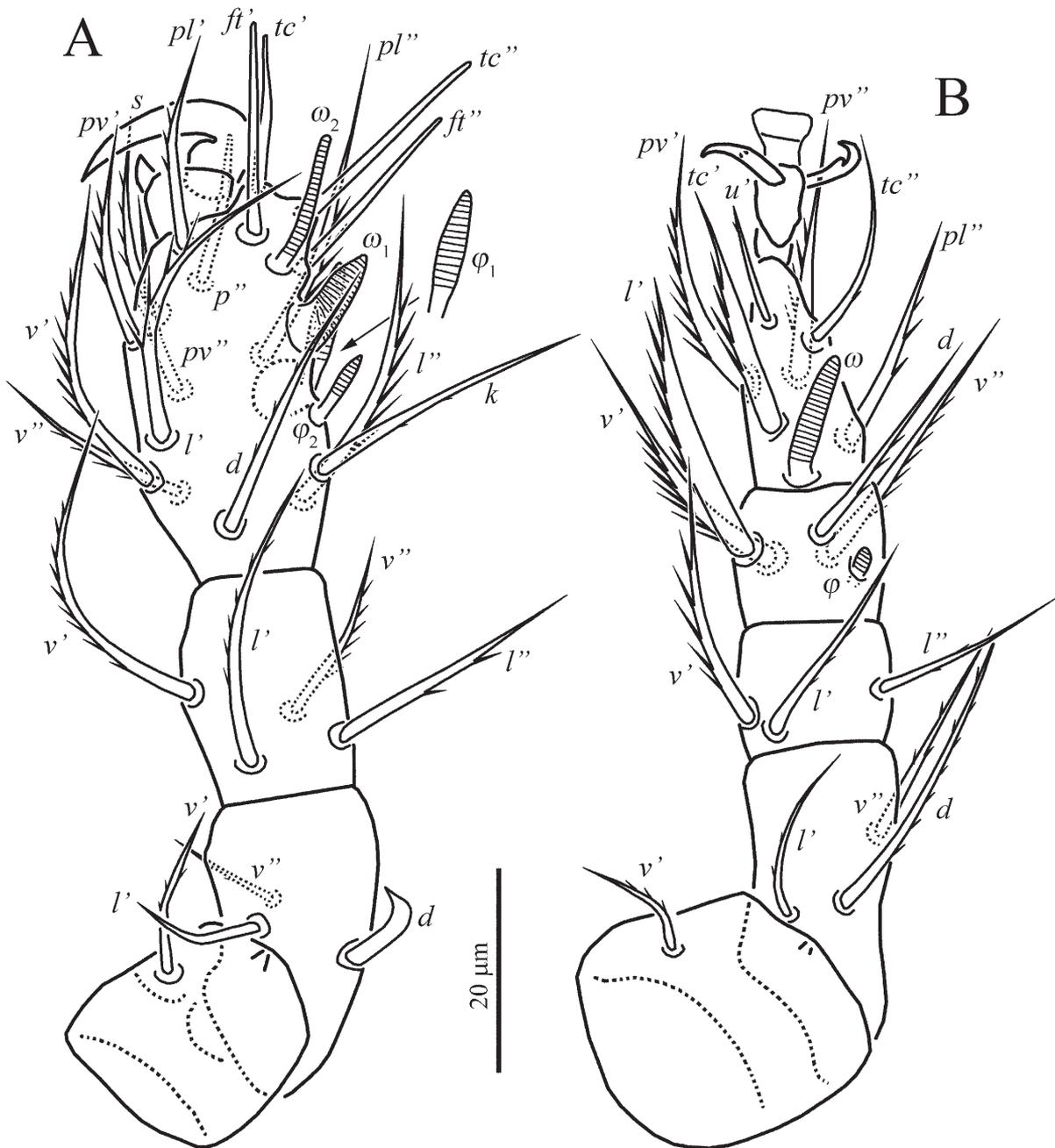


Fig. 8. *Andrebochkovia madagascariensis* sp. n., female: A—right leg I in dorsal view, B—right leg II in dorsal view.

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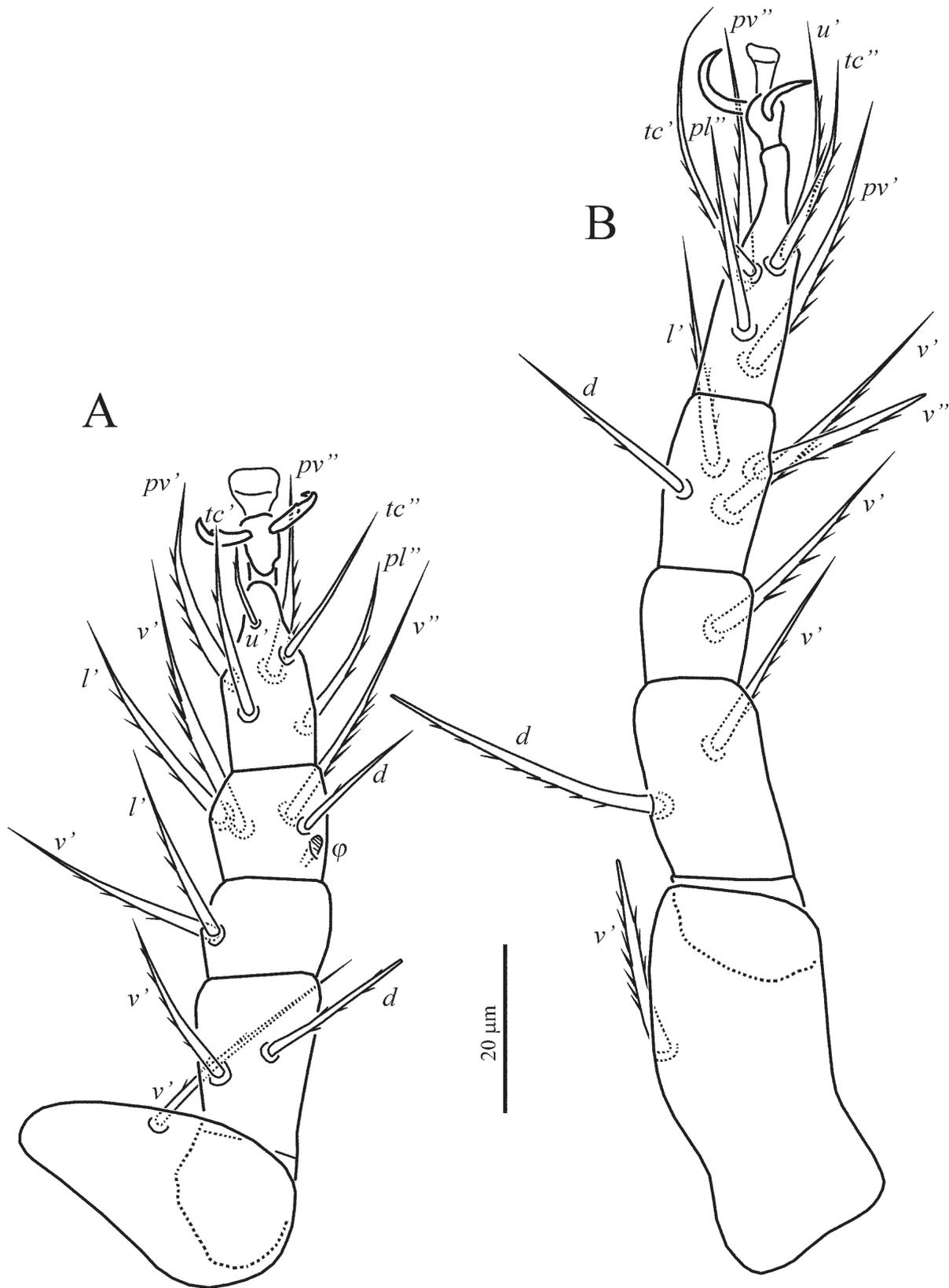


Fig. 9. *Andrebochkovia madagascariensis* sp. n., female: A—right leg III in dorsal view, B—right leg IV in dorsal view.

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