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ON ORIBATID MITES WITH AURICULATE PTEROMORPHS IN TAIWAN (ACARI, ORIBATIDA)

© 2019 г. S. G. Ermilov*

Tyumen State University, Tyumen 625003, Russia

*e-mail: ermilovacari@yandex.ru

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Data on the systematics of three species of oribatid mites (Acari, Oribatida) with auriculate pteromorphs from Taiwan are provided. A new species, *Neoribates* (*Neoribates*) *yangensis* sp. n. (Parakalummidae), is described; it is morphologically most similar to *Neoribates* (*N.*) *similis* Fujikawa 2007 and *Neoribates* (*N.*) *pyramidalis* (Tseng 1984), but differs in the body surface structure (lineolate in the new species vs. smooth in *N. similis* and *N. pyramidalis*). Descriptive notes on *Galumna* (*Galumna*) *tsengi* Ermilov et Liao 2017 and *Galumna* (*G.*) *alata* (Hermann 1804) (Galumnidae) are also presented.

Keywords: oribatid mites, *Neoribates*, *Galumna*, new species, descriptive notes, morphology, systematics, Oriental region

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This work is part of my continuing study of oribatid mites (Acari, Oribatida) from Taiwan (e.g., Ermilov, Liao, 2017, 2017a; Ermilov, 2018), and it includes data on three species with auriculate pteromorphs from the families Parakalummidae (Oripodoidea) and Galumnidae (Galumnoidea).

The primary goal of the paper is to describe and illustrate a new species of *Neoribates* Berlese 1914 (Parakalummidae). This genus includes four subgenera (see Ermilov, Corpuz-Raros, 2015) and 63 species (Subías, 2004, updated 2018; see also Ermilov, Stary, 2018), which collectively have a cosmopolitan distribution, occurring in all world regions except Antarctica (Subías, 2004, updated 2018). At present, only three species of *Neoribates* (all from the nominative subgenus) are known from Taiwan: *Neoribates* (*N.*) *pyramidalis* (Tseng 1984), *Neoribates* (*N.*) *rotundus* Aoki 1982 and *Neoribates* (*N.*) *roubali* (Berlese 1910) (Tseng, 1984; Aoki, 1991; Chu, Aoki, 1997).

The secondary goal of the paper is to present a morphological addition to descriptions of *Galumna* (*Galumna*) *tsengi* Ermilov et Liao 2017 and *Galumna* (*G.*) *alata* (Hermann 1804) (Galumnidae) based on specimens from Taiwan.

METHODS

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body lengths were measured in lateral view, from the tip of the rostrum to the posterior edge of the notogas-

ter. Notogastral width refers to the maximum width of the notogaster (behind pteromorphs). 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”.

Morphological terminology follows that of F. Grandjean (see Ermilov, Klimov, 2017 for review and application).

The following abbreviations are used: *lam* – lamella; *ar*, *pr*, *lr* – anterior, posterior and lateral ridges of prodorsum, respectively; *L* – lamellar line; *S* – sublammellar line; *N* – prodorsal leg niche; *E*, *T* – lateral ridges of prodorsum; *ro*, *le*, *in*, *bs* – rostral, lamellar, interlamellar and bothridial setae, respectively; *Ad* – sejugal porose area; *D* – dorsophragma; *P* – pleurophragma; *c*, *la*, *lm*, *lp*, *h*, *p* – notogastral setae; *Sa*, *S1*, *S2*, *S3* – notogastral saccules; *Aa*, *A1*, *A2*, *A3* – notogastral porose areas; *mp* – median pore; *ia*, *im*, *ip*, *ih*, *ips* – notogastral lyrifissures; *gla* – opisthonotal gland opening; *cs* – circumgastric scissure; *csb* – circumgastric sigillar band; *h*, *m*, *a* – subcapitular setae; *or* – adoral seta; *sac* – axillary saccule; *v*, *l*, *d*, *cm*, *acm*, *ul*, *sul*, *vt*, *lt* – palp setae; *ep* – postpalpal seta; ω – palp and leg solenidion; *cha*, *chb* – cheliceral setae; *Tg* – Trägårdh’s organ; *Pd I*, *Pd II* – pedotecta I, II, re-

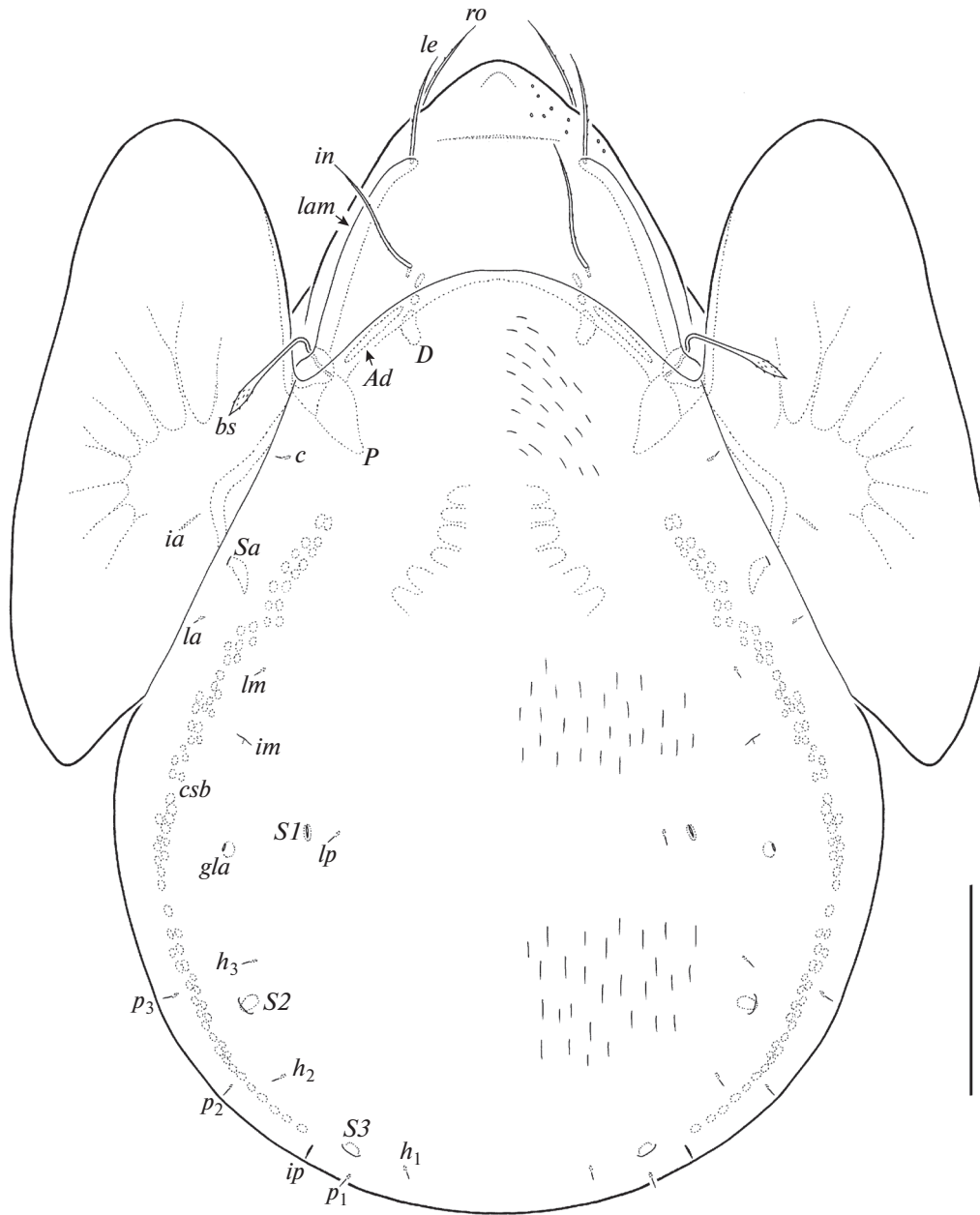


Fig. 1. *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: dorsal view (legs not shown). Scale bar: 100 μ m.

spectively; *1a, 1b, 1c, 2a, 3a, 3b, 3c, 4a, 4b, 4c* – epimeral setae; *dis* – discidium; *cp* – circumpedial carina; *g, ag, an, ad* – genital, aggenital, anal and adanal setae, respectively; *iad* – adanal lyrifissure; *Ap* – postanal porose area; *Amar* – marginoventral porose area; *p.o.* – preanal organ; *Tr, Fe, Ge, Ti, Ta* – leg trochanter, femur, genu, tibia and tarsus, respectively; *p.a.* – leg porose area; σ, φ – leg solenidia; ε – tarsus I famulus; *v, ev, bv, l, d, ft, tc, it, p, u, a, s, pv, pl* – leg setae.

The following abbreviations of collections are used: NTU – National Taiwan University, Taipei, Taiwan;

TSUMZ – Tyumen State University Museum of Zoology, Tyumen, Russia.

SYSTEMATICS

Neoribates (Neoribates) yangensis Ermilov sp. n.
(Figs 1–5)

Material. The holotype (φ) and 6 paratypes (2 $\varphi\varphi$, 4 $\sigma\sigma$): Taiwan, Taipei City, Beitou Dist., Shamao Rd., Yangmingshan National Park, 25°8.573' N,

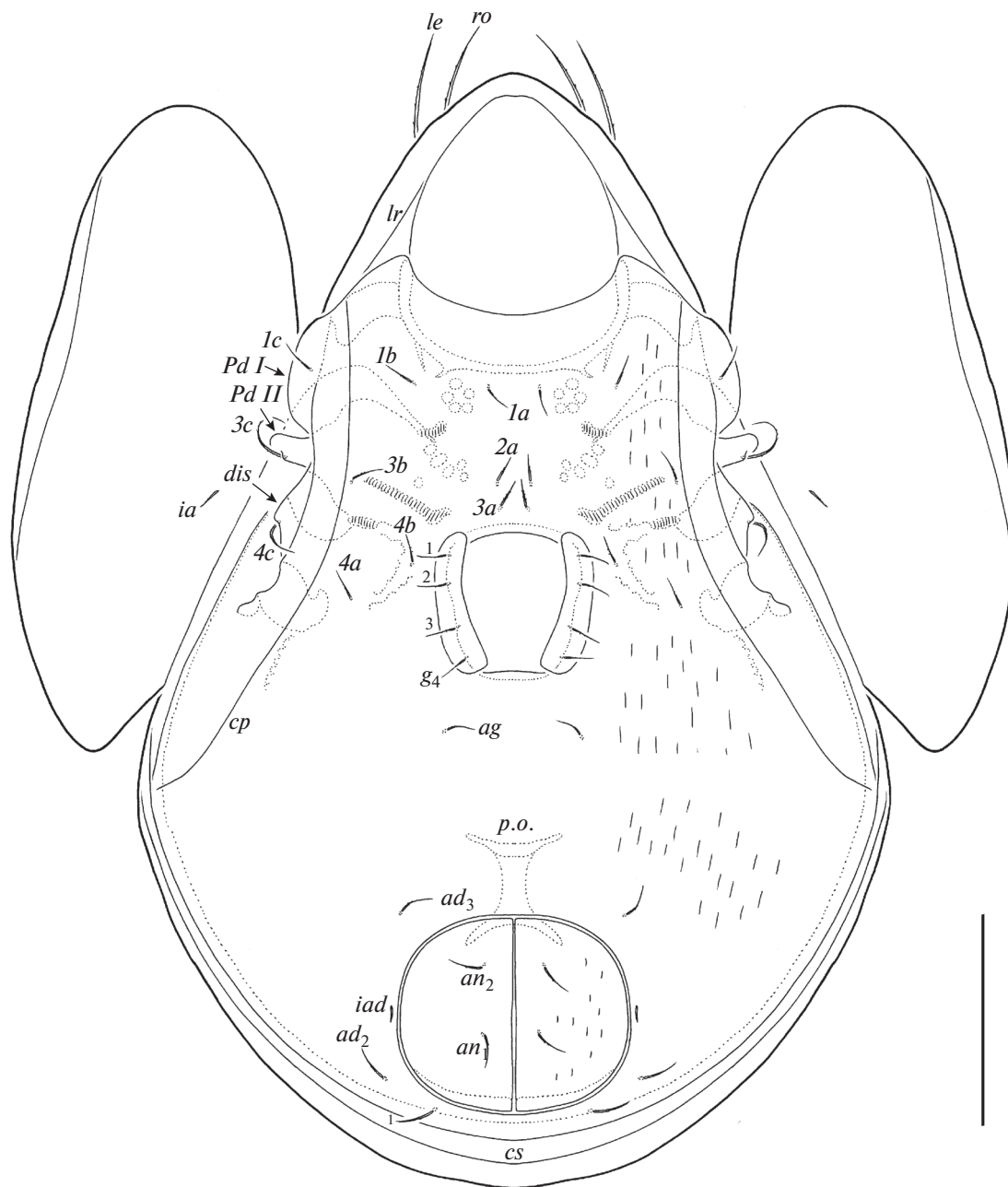


Fig. 2. *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: ventral view (gnathosoma and legs not shown). Scale bar: 100 μ m.

121°32.607' E, 352 m a.s.l., sample #16, lichen and soil, 17.IX.2017, collected by J.-R. Liao and H.C. Lee.

The holotype (ethanol with drop of glycerol) is deposited in NTU; six paratypes (ethanol with drop of glycerol) are deposited in TSUMZ.

Diagnosis. Body size: 464–564 \times 298–381. Notogaster, anogenital region and lateral parts of epimeres lineolate. Rostrum rounded. Rostral, lamellar and interlamellar setae long, setiform, barbed. Bothridial setae, lanceolate, barbed. Notogastral setae short, thin, smooth. Saccules with small openings and

channels. Subcapitular setae setiform, barbed, *a* longest and thickest, *h* shortest and thinnest. Epimeral and anogenital setae short, thin, slightly barbed. Four pairs of genital setae. Adanal setae *ad*₃ inserted anterolateral to anal aperture. Leg tarsi with three claws.

Description. Measurements. Body length: 564 (holotype), 464–564 (6 paratypes); notogaster width: 381 (holotype), 298–381 (6 paratypes). Females larger than males: 547–564 \times 365–381 versus 464–531 \times 298–348.

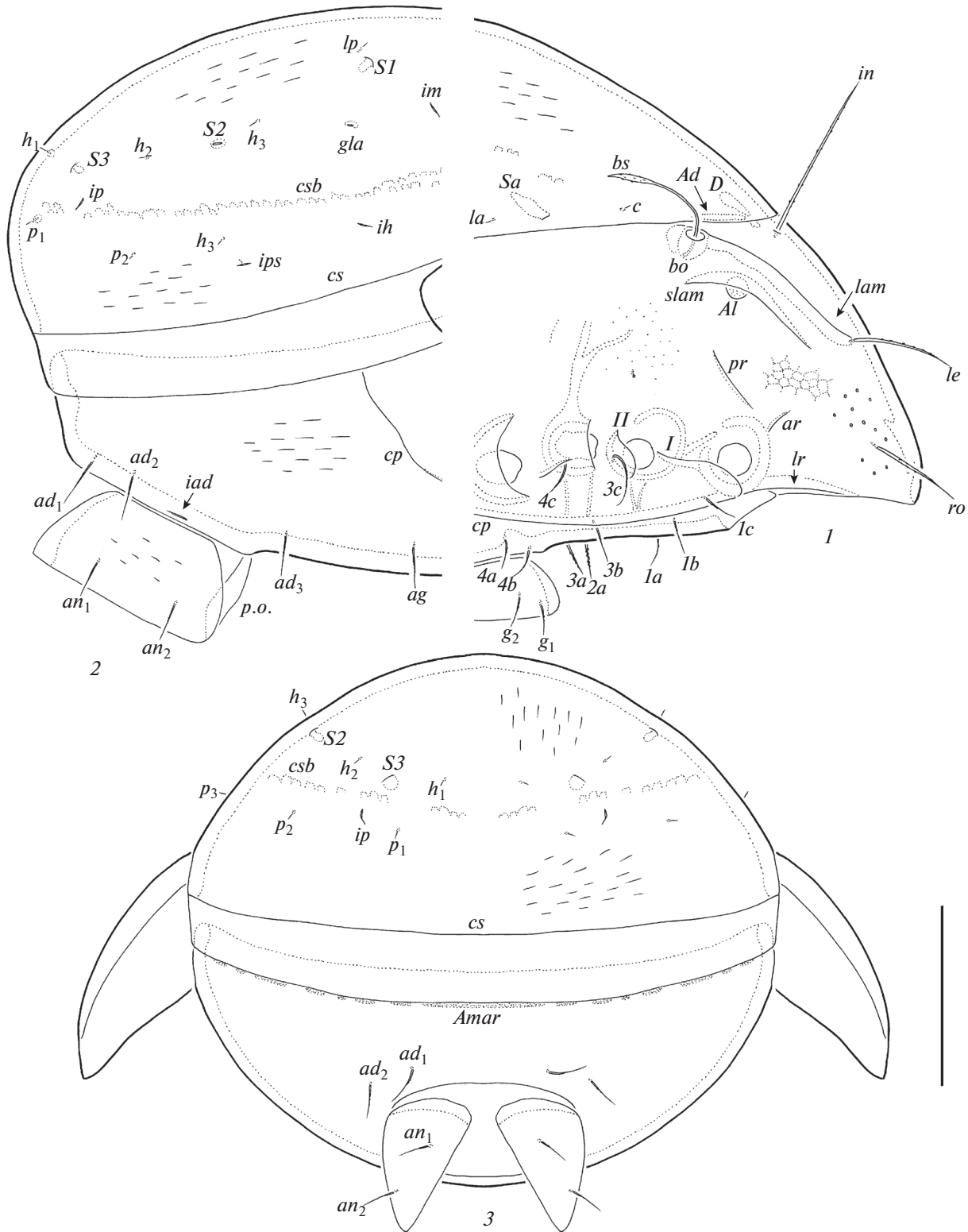


Fig. 3. *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: 1 – anterior part of body, lateral view (pteromorph, gnathosoma and legs not shown); 2 – posterior part of body, lateral view; 3 – posterior view. Scale bar: 100 μ m.

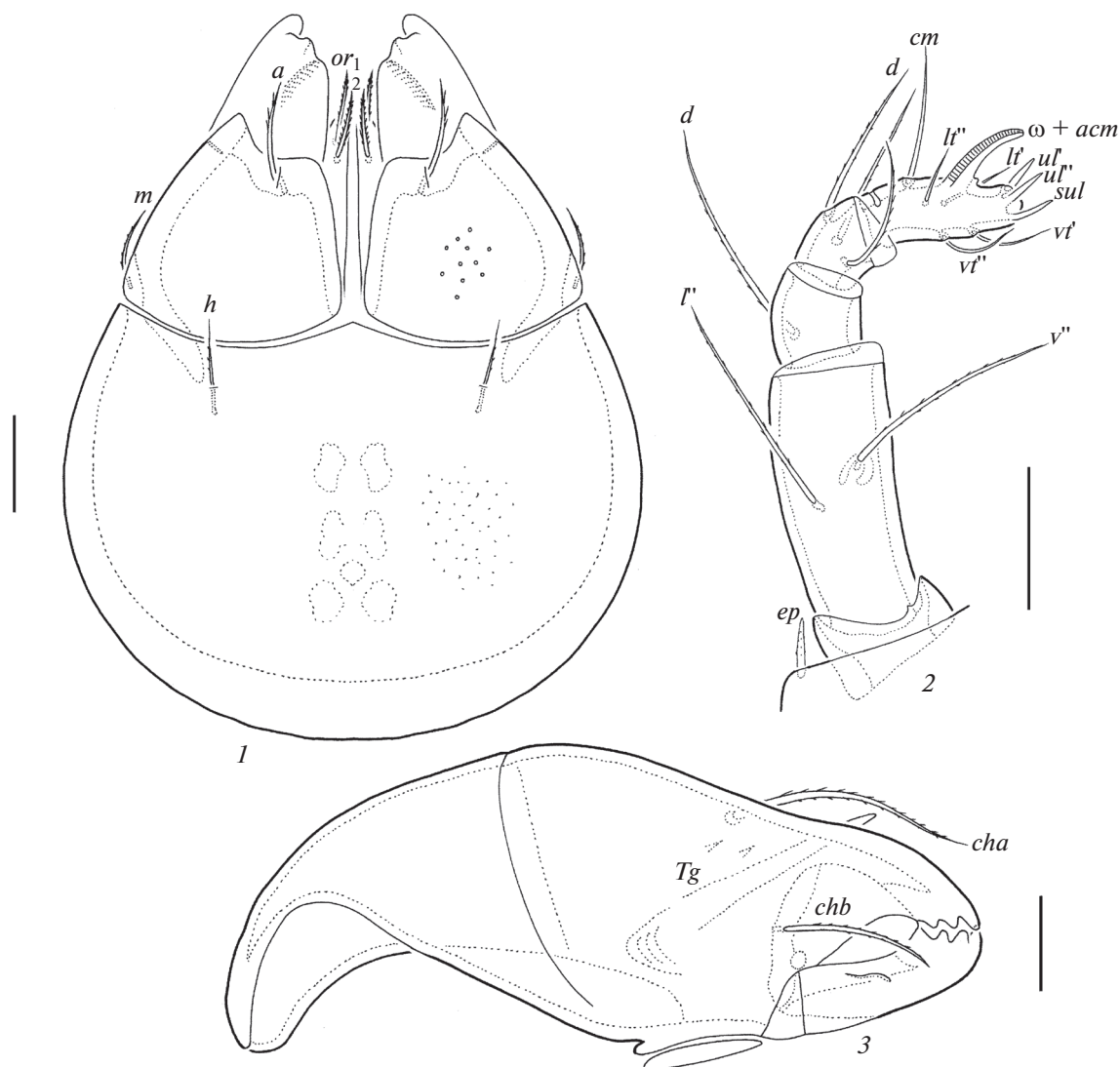


Fig. 4. *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: 1 – subcapitulum, ventral view; 2 – palp, right, antiaxial view; 3 – chelicera, right, antiaxial view. Scale bar (μm): 1, 3 – 17; 2 – 15.

Integument (Figs 1; 2; 3, 1–3; 4, 1). Body color brown. Body surface microfoveolate (visible under high magnification, $\times 1000$). Rostrum sparsely foveolate (diameter of foveoles up to 4). Surface of notogaster, anogenital region, anal plates and lateral parts of epimeres lineolate, with short (length up to 16) depressed, distinct lines. All leg femora and trochanters III, IV with elongate tubercles or thin ridges antiaxially.

Prodorsum (Figs 1; 3, 1). Rostrum rounded. Lamellae located dorsolaterally, about half of prodorsum length (measured in lateral view), their ends slightly curving anteromedially. Translamellar line absent. Sublamellae slightly shorter than lamellae. Sublamellar porose areas rounded (12–14), partially covered by sublamellae. Prodorsal setae strongly varies in

length in different specimens; rostral (53–57 up to 86), lamellar (61–65 up to 114) and interlamellar (94–98 up to 123) setae setiform, barbed, *le* inserted on the lamellae ends, bothridial setae (53–57 up to 90) with long stalk and shorter, lanceolate, barbed head. Exobothridial setae and their alveoli absent. Sejugal porose areas (36–41 \times 4–6) narrowly elongated. Anterior, posterior and lateral ridges simple.

Notogaster (Figs 1; 3, 1–3). Anterior notogastral margin convex medially. Ten pairs of notogastral setae short (4–6), thin, smooth. Four pairs of saccules with small openings and channels. Setae *lp* inserted medial and close to *SI*. All lyrifissures and opisthonotal gland openings well visible, *im* located posterior to *lm*, *ip* between *p*₁ and *p*₂, *ih* and *ips* in lateral position, distanced

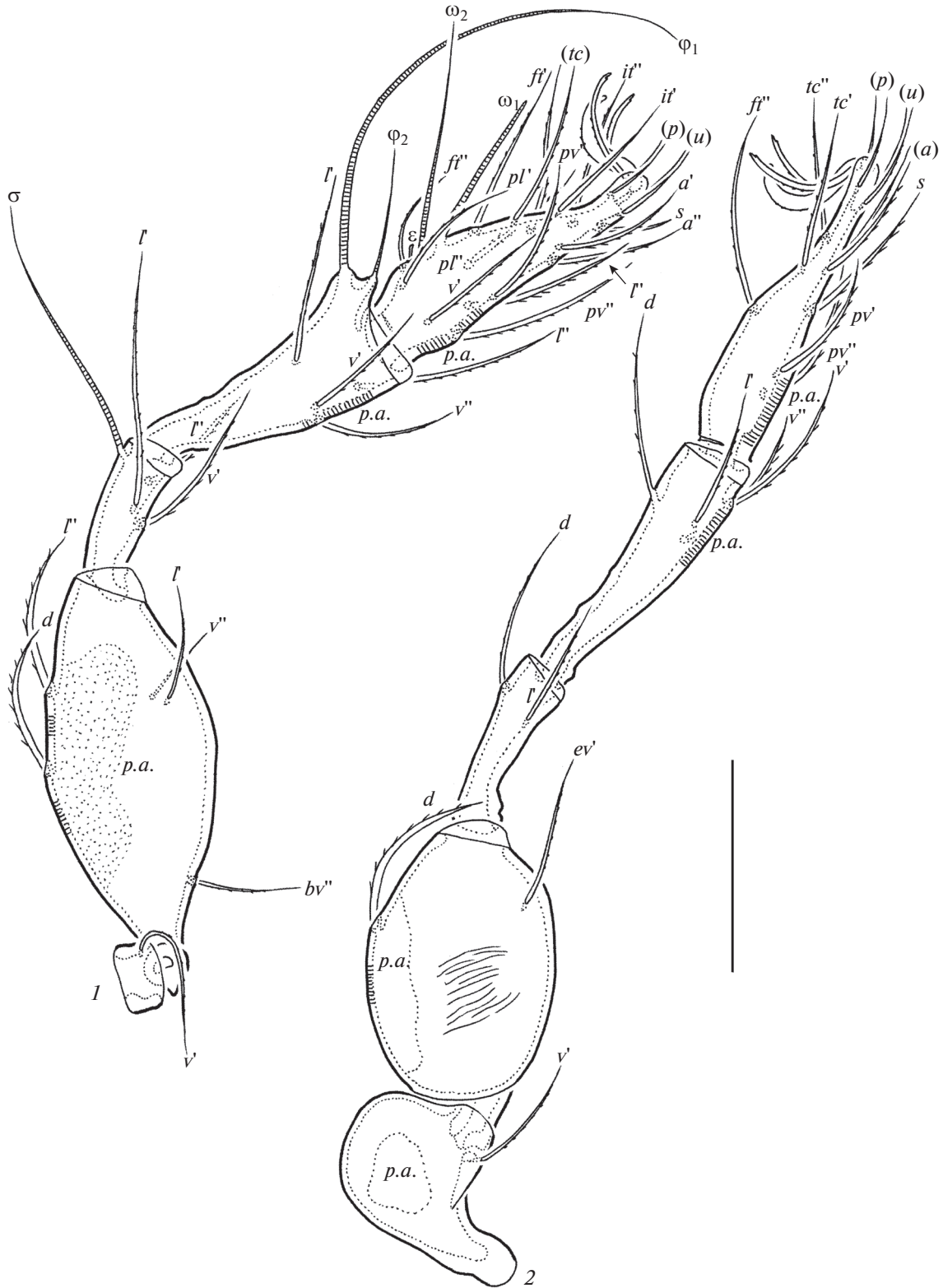


Fig. 5. *Neoribates (Neoribates) yangensis* Ermilov sp. n., adult: 1 – leg I, left, paraxial view; 2 – leg IV, left, antiaxial view. Scale bar: 50 μ m.

Table 1. Leg setation and solenidia of *Neoribates (Neoribates) yangensis* Ermilov sp. n.

Leg	Tr	Fe	Ge	Ti	Ta
I	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ ₁ , φ ₂	(fi), (tc), (it), (p), (u), (a), s, (pv), v', (pl), l'', ε, ω ₁ , ω ₂
II	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ	(fi), (tc), (it), (p), (u), (a), s, (pv), ω ₁ , ω ₂
III	l', v'	d, l', ev'	l', σ	l', (v), φ	(fi), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	d, l', (v)	fi'', (tc), (p), (u), (a), s, (pv)

Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus). Single prime (') marks setae on the anterior and double prime (') setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

from each other, *gla* posterior to *im*. Circumgastric scissure and circumgastric sigillar band distinct.

Gnathosoma (Fig. 4, 1–3). Subcapitulum longer than wide (123–135 × 90–98). Subcapitular setae setiform, barbed, *a* (20–24) longer and thicker than *m* (16–20) and *h* (12–16). Adoral setae (16–20) setiform, heavily barbed. Palps (69–73) with typical setation 0–2–1–3–9(+1 solenidion). Postpalpal setae (6) spiniform, smooth. Chelicerae (123–135) with two setiform, barbed setae, *cha* (41–49) longer than *chb* (28–32). Trägårdh's organ of chelicerae elongate triangular.

Epimeral and lateral podosomal regions (Figs 2; 3, 1, 2). Epimeral setal formula 3–1–3–3. Setae setiform, thin, slightly barbed, *3c* (32) longer than others (20); *2a* and *3a* thickest. Pedotecta II rectangular, rounded in ventral view. Discidia triangular. Circumpedial carinae long, reaching anterior margin of ventral plate.

Anogenital region (Figs 2; 3, 1–3). Four pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae similar in length (20), setiform, slightly barbed. Setae *ad*₃ inserted anterolateral and close to anal aperture. Adanal lyrifissures located close and parallel to anal plates. Marginoventral porose area represented by numerous rounded and elongate oval parts.

Legs (Fig. 5, 1, 2). Tridactylous, median claw thicker than laterals, all serrated on dorsal side. Lateral claws with one slightly developed tooth ventrodistally. Dorsoparaxial porose areas on femora and trochanters III, IV, posteroventral porose areas on tarsi and anteroventral porose areas on tibiae well visible. Formulas of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–15) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–4–12) [0–0–0]; homologies of setae and solenidia indicated in Table 1. Famulus of tarsi I short, erect, slightly dilated distally, inserted between solenidion ω₂ and seta *fi*'.

Differential diagnosis. *Neoribates (Neoribates) yangensis* sp. n. is morphologically most similar to *N. (N.) similis* Fujikawa 2007 from Japan (Fujikawa, 2017) and *N. (N.) pyramidalis* (Tseng 1984) from Taiwan (Tseng, 1984) in having rounded rostrum, lanceolate bothridial setae, minute notogastral

setae, four pairs of genital setae and localization of adanal setae *ad*₃ in preanal position, but differs by the lineolate body surface (versus lineolate ornamentation absent).

Etymology. The specific name *yangensis* refers to the [Yang] mingshan National Park, where the new species was found.

Galumna (Galumna) tsengi Ermilov et Liao 2017 (Fig. 6)

Material. Eight specimens (5 ♀♀, 3 ♂♂): Taiwan, Nantou County, Lugu Township, Fenghuang Nature Education Area, 23°43.735' N, 120°47.287' E, 875 m a.s.l., sample #5, soil and debris from tea tree, 6.VII.2017, collected by J.-R. Liao.

All specimens (ethanol with drop of glycerol) are deposited in TSUMZ.

Remarks. *Galumna tsengi* was described from soil of the Fushan Botanical Garden of Taiwan by Ermilov and Liao (2017a). Some specimens (2 females, 1 male) of this species from new materials (see Material section) from Taiwan are identical to the original description, but the other specimens (3 females, 2 males) with important difference: median pore located anterior to the virtual line between notogastral porose areas *Aa* (Fig. 6) versus posterior to the virtual line between *A1* (Ermilov, Liao, 2017a). Hence, the variable localization of median pore in *G. tsengi* should be considered in future identification of this species.

Galumna (Galumna) alata (Hermann 1804) (Figs 7–11)

Material. Nine specimens (5 ♀♀, 4 ♂♂): Taiwan, New Taipei City, Tamsui Dist., Balaka Highway, Yangmingshan National Park, 25°10.969' N, 121°30.564' E, 703 m a.s.l., sample #20, soil, 17.IX.2017, collected by J.-R. Liao and H.C. Lee.

All specimens (ethanol with drop of glycerol) are deposited in TSUMZ.

Supplementary description (based on specimens from Taiwan). **Measurements.** Body length: 381–431 (9 specimens); notogaster width: 249–298

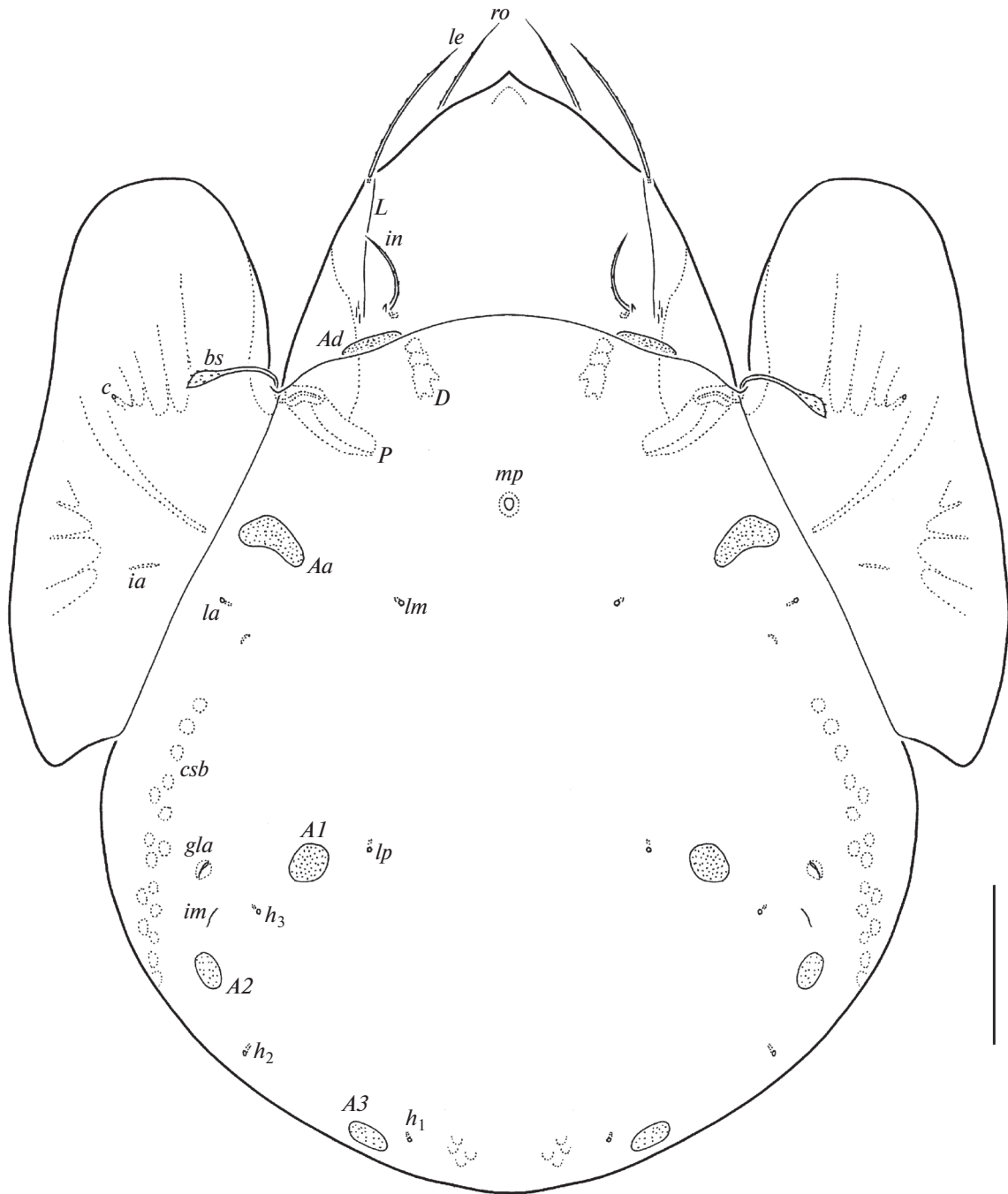


Fig. 6. *Galumna (Galumna) tsengi* Ermilov et Liao 2017, adult: dorsal view (legs not shown). Scale bar: 100 μ m.

(9 specimens). Females larger than males: 415–431 \times 282–298 versus 381–398 \times 249–265.

Integument. Body color brown. Body surface microfoveolate (visible under high magnification, $\times 1000$). All leg femora and trochanters III, IV with elongate tubercles antiaxially.

Prodorsum (Figs 7; 9, 1). Rostrum pointed. Lamellar and sublamellar lines thin, slightly divergent distally, *S* curving backwards at ventral ends, *L* directed to

lateral sides of prodorsum. Prodorsal leg niches and lateral ridges of prodorsum well-developed. Rostral (45–53), lamellar (41–49) and interlamellar (69–77) setae setiform, barbed. Bothridial setae (77–86) with long, smooth stalks and short, lanceolate, barbed heads. Exobothridial setae and their alveoli absent. Sejugal porose areas (12–14 \times 4–6) elongate oval, transversely orientated, posterolateral to *in*. Dorsophragmata elongated, represented by group of low,

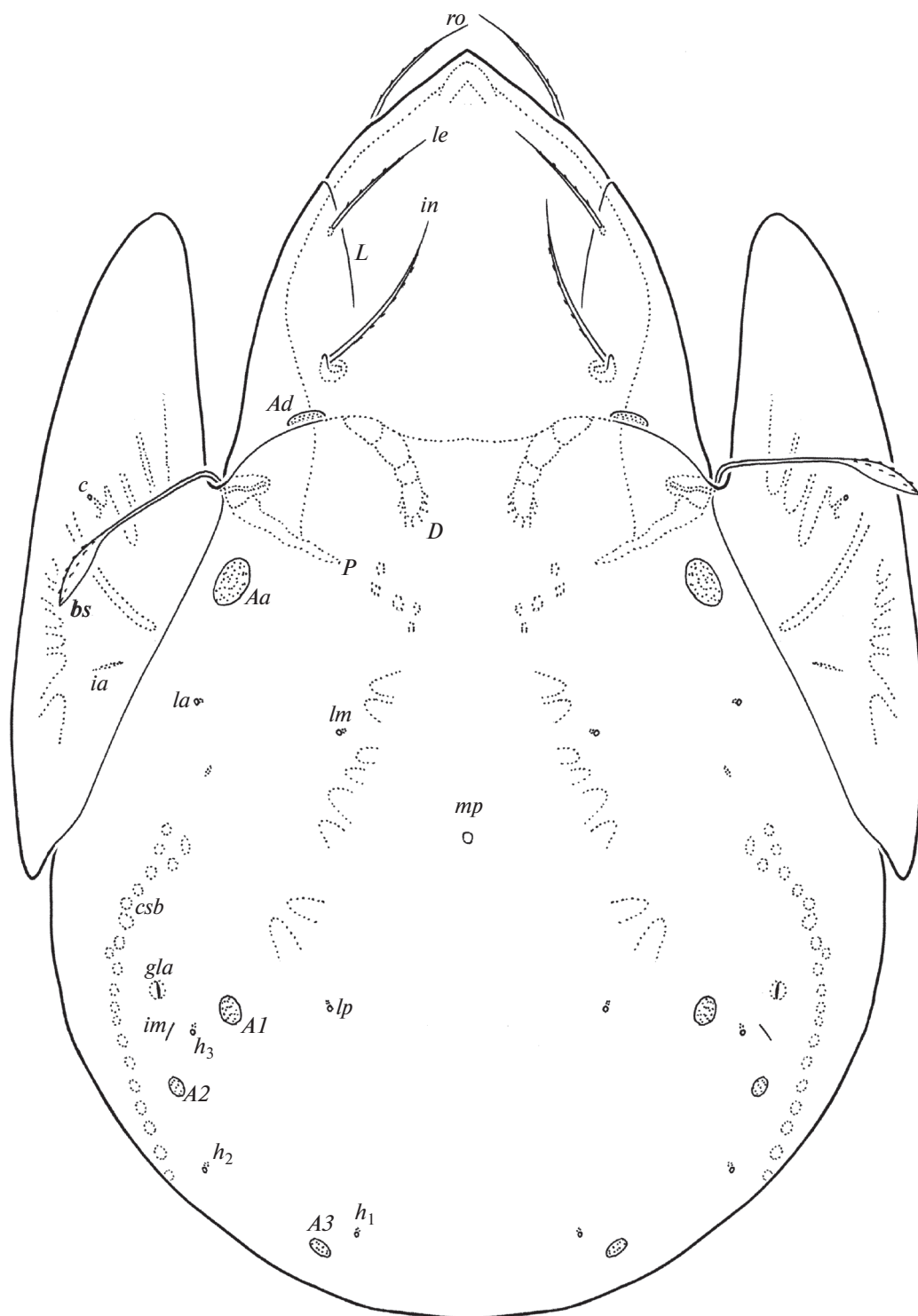


Fig. 7. *Galumna (Galumna) alata* (Hermann 1804), adult: dorsal view (legs not shown). Scale bar: 100 μ m.

roughened thickenings collectively elongated longitudinally, with variable number of components.

Notogaster (Figs 7; 9, 1–3). Dorsosejugal suture complete, but very poorly visible medially. With 10 pairs of setal alveoli and four pairs of rounded po-

rose areas, *Aa* (18–20) larger than others (8–10). Setal alveoli *la* located close to the pteromorphal hinges, posterior to *Aa*. Median pore present, represented by one part, located clearly anterior to the virtual line between *A1*. All lyrifissures distinct, *im* located postero-

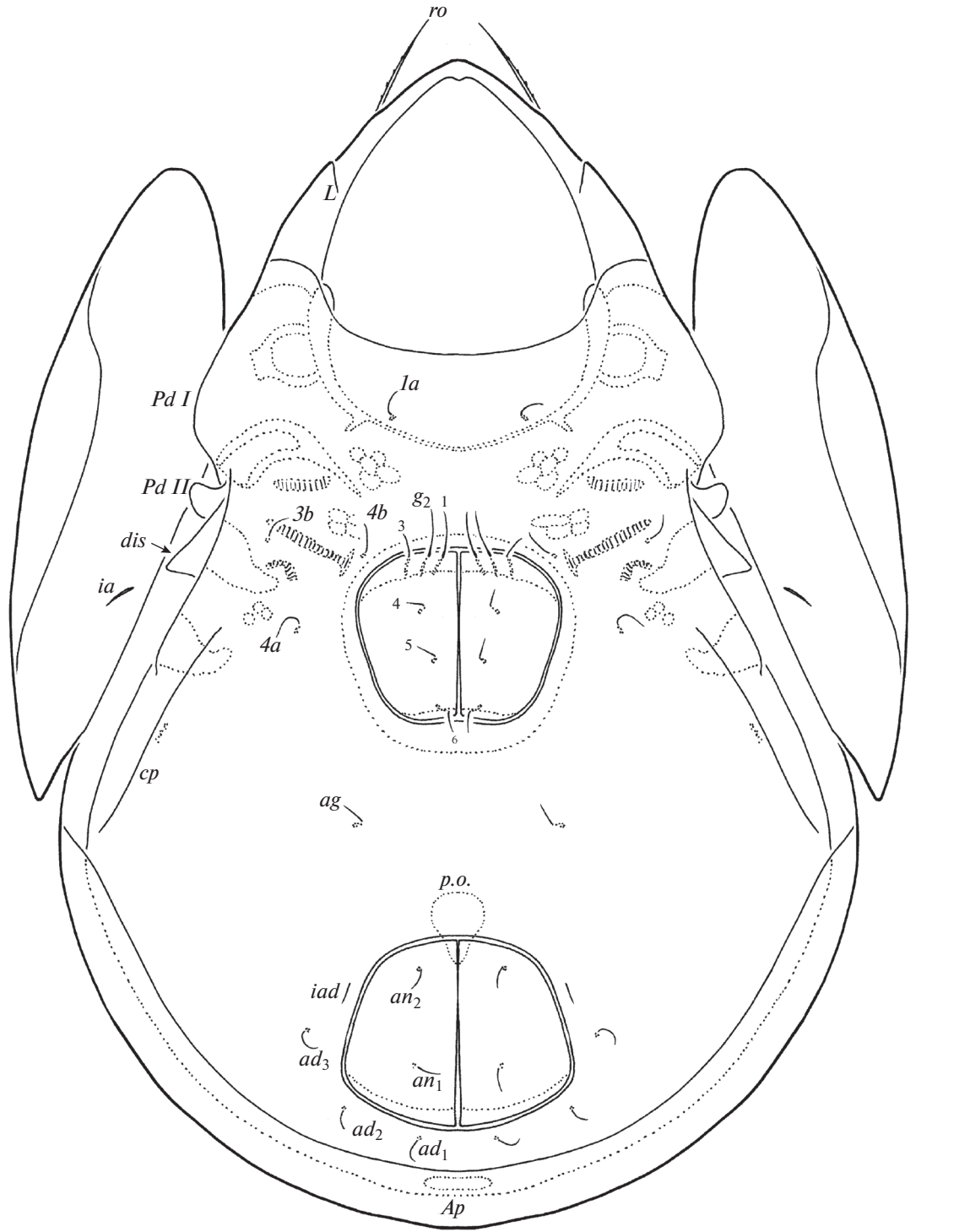


Fig. 8. *Galumna (Galumna) alata* (Hermann 1804), adult: ventral view (gnathosoma and legs not shown). Scale bar: 100 μ m.

lateral to *Aa*, *ip* between *p*₁ and *p*₁, *ih* and *ips* close to each other, anterior to *p*₃. Opisthonotal gland openings located lateral to *Al*.

Gnathosoma (Fig. 10, 1–3). Subcapitulum longer than wide (123–135 \times 98–106). Subcapitular setae

setiform, slightly barbed, *a* (20–24) longer and thicker than *m* (16–20) and *h* (14–18). Adoral setae (16–20) setiform, heavily barbed. Palps (90–94) with typical setation 0–2–1–3–9(+1 solenidion). Postpalpal setae (4) spiniform, smooth. Chelicerae (155–164) with

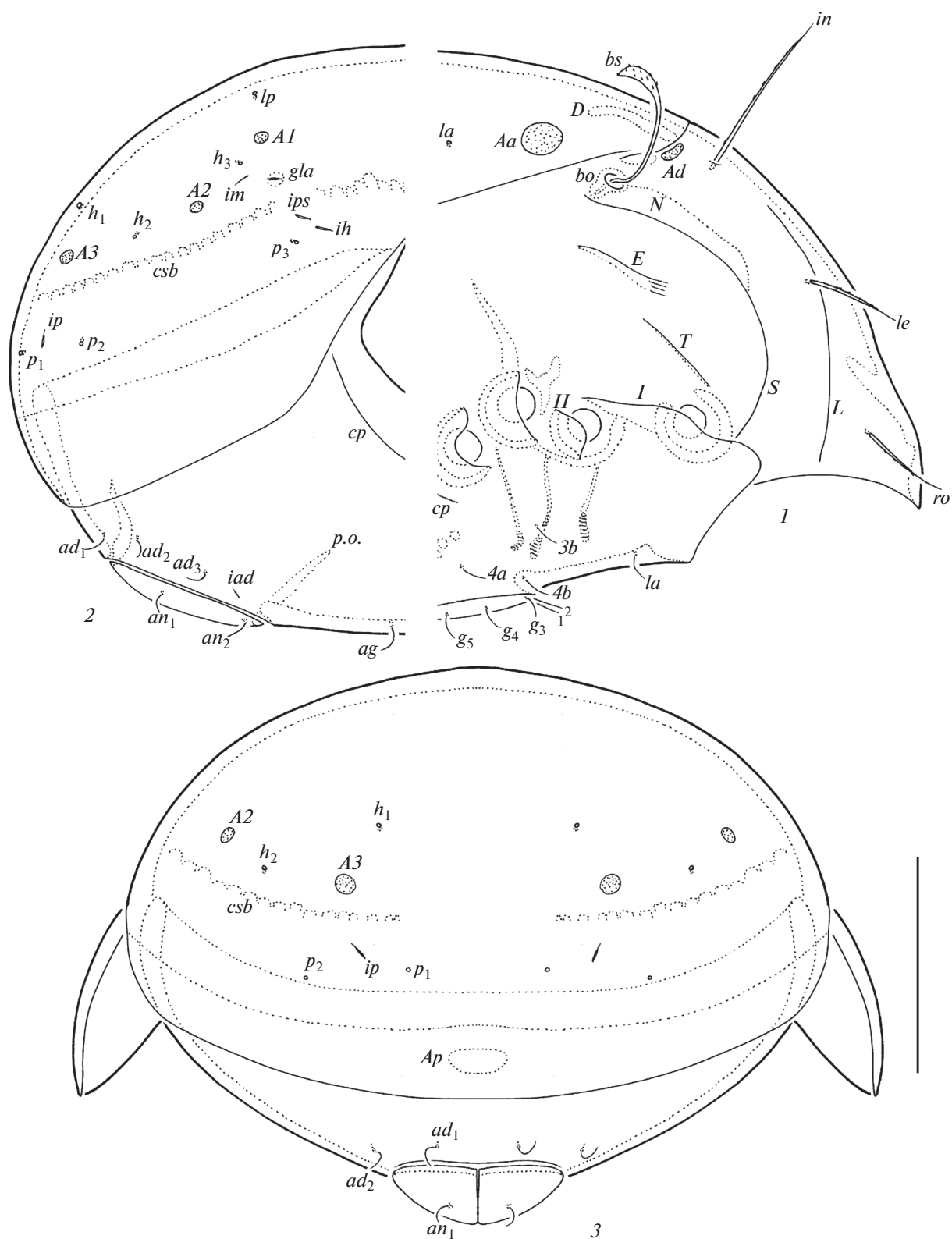


Fig. 9. *Galumna (Galumna) alata* (Hermann 1804), adult: 1 – anterior part of body, lateral view (pteromorph, gnathosoma and legs not shown); 2 – posterior part of body, lateral view; 3 – posterior view. Scale bar: 100 μ m.

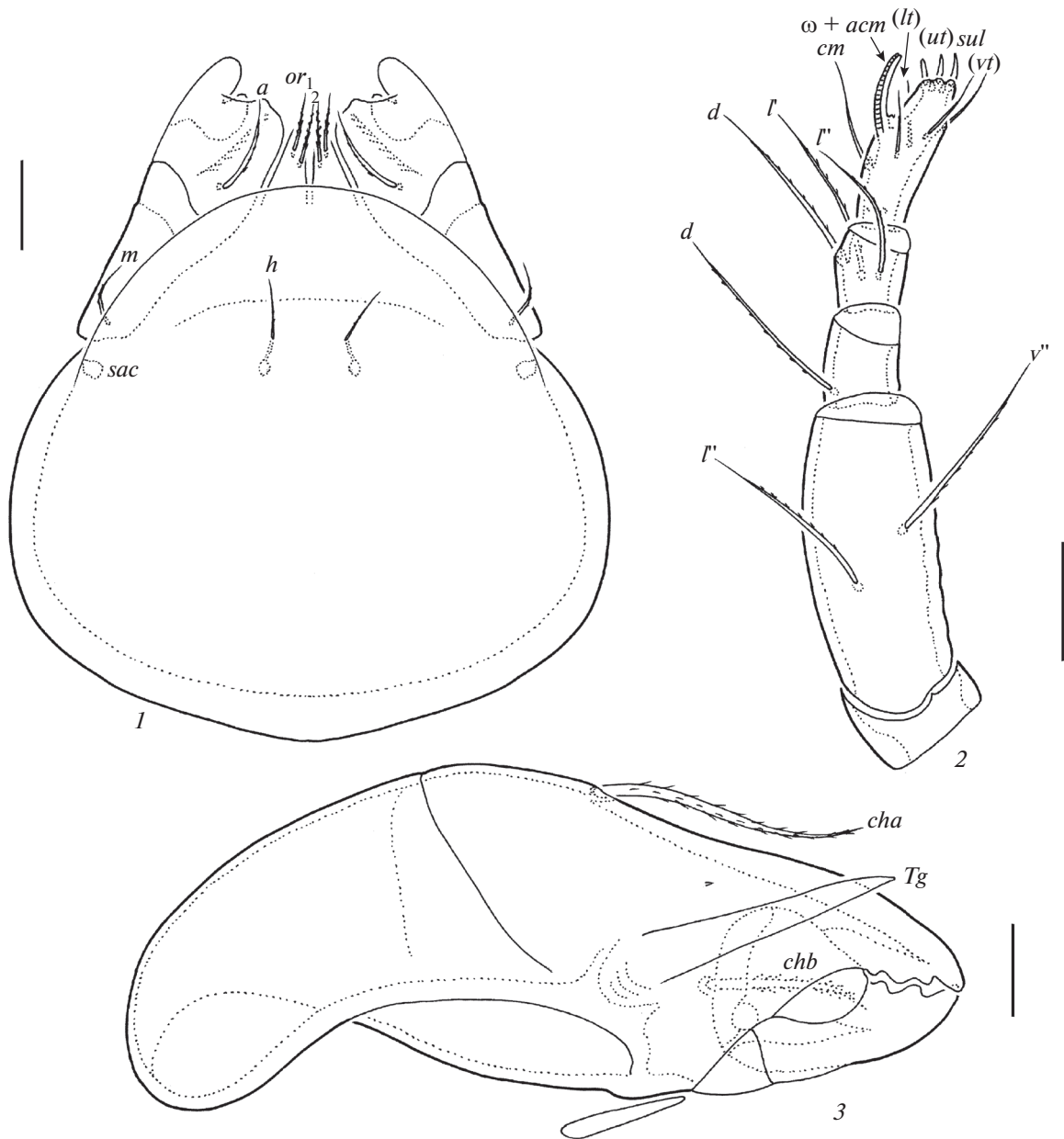


Fig. 10. *Galumna (Galumna) alata* (Hermann 1804), adult: 1 – subcapitulum, ventral view; 2 – palp, right, antiaxial view; 3 – chelicera, left, paraxial view. Scale bar (μm): 1, 3 – 17; 2 – 15.

two setiform, barbed setae, *cha* (49–57) longer than *chb* (28–36). Trägårdh's organ of chelicerae elongate triangular.

Epimeral and lateral podosomal regions (Figs 8; 9, 1, 2). Anterior tectum of epimere I smooth. Pedotecta I and II rounded in ventral view. Discidia triangular. Epimeral setal formula: 1–0–1–2. Epimeral setae (10–14) setiform, thin, slightly barbed. Circumpedial carinae thin, directed to insertions of *3b*, but clearly not reaching them.

Anogenital region (Figs 8; 9, 1–3). Six pairs of genital ($g_1, g_2, 12–16; g_3–g_6, 8–10$), one pair of aggenital (8–10), two pairs of anal (8–10) and three pairs of adanal (8–10) setae setiform, thin, slightly barbed. Anterior edges of genital plates with three setae. Aggenital setae located between genital and anal apertures, equal distanced from them. Adanal lyrifissures located close and parallel to anal plates. Adanal setae ad_1 and ad_2 postanal, ad_3 paraanal and posterolateral to *iad*. Distance $ad_1–ad_2 = ad_2–ad_3$. Unpaired postanal porose area elongate oval ($24–26 \times 6–10$).

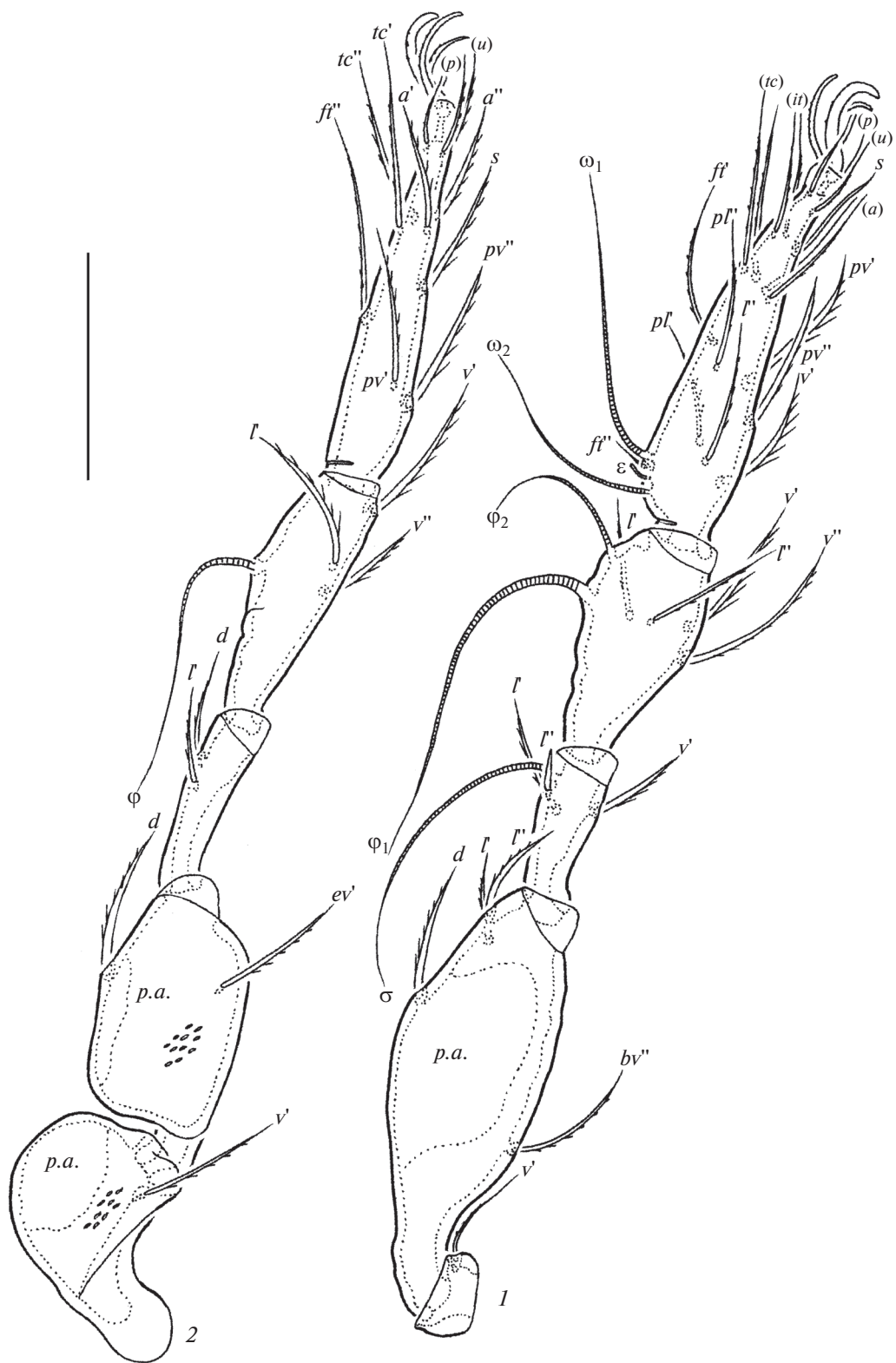


Fig. 11. *Galumna (Galumna) alata* (Hermann 1804), adult: 1 – leg I, right, antiaxial view; 2 – leg IV, left, antiaxial view. Scale bar: 50 μ m.

Table 2. Leg setation and solenidia of *Galumna (Galumna) alata* (Hermann 1804)

Leg	Tr	Fe	Ge	Ti	Ta
I	v'	d, (l), bv''	(l), v', σ	(l), (v), φ ₁ , φ ₂	(fi), (tc), (it), (p), (u), (a), s, (pv), v', (pl), l'', ε, ω ₁ , ω ₂
II	v'	d, (l), bv''	(l), v', σ	(l), (v), φ	(fi), (tc), (it), (p), (u), (a), s, (pv), ω ₁ , ω ₂
III	v'	d, ev'	l', σ	l', (v), φ	(fi), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	l', (v), φ	fi'', (tc), (p), (u), (a), s, (pv)

See Table 1 for explanations.

Legs (Fig 11, 1, 2). Median claw distinctly thicker than laterals, all barbed on dorsal sides. Dorsoparaxial porose areas on all femora and on trochanters III, IV well visible. Formulas of leg setation and solenidia: I (1-4-3-4-20) [1-2-2], II (1-4-3-4-15) [1-1-2], III (1-2-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homologues of setae and solenidia indicated in Table 2. Solenidion of tibiae IV inserted in medio-anterior part of the segments. Famulus of tarsi I short, erect, slightly dilated distally, inserted posterior to solenidia ω₁.

Remarks. *Galumna alata* has a semicosmopolitan distribution (Subías, 2004, updated 2018). An adult of this species was described by Hermann (1804); it was later redescribed and illustrated by several authors: e.g., Oudemans (1917), Jacot (1934), Grandjean (1936), Bayartogtokh (2010), Seniczak *et al.* (2012). The specimens of *G. alata* from Taiwan are similar in general appearance to those from redescrptions according to the following traits: rostrum pointed; lamellar and sublamellar lines slightly divergent distally; bothridial setae lanceolate; rostral, lamellar and interlamellar setae long, *in* longest; notogastral suture present; four pair of rounded notogastral porose areas; setal alveoli *la* inserted posterior to *Aa*; *im* located lateral or posterolateral to *AI*; anogenital setae short; postanal porose area oval; surface without sculpturing and ornamentation. However, some differences in the morphology and localization of median pore are present: a) median pore is represented by one part (versus several parts or absent in redescrptions); b) median pore located clearly anterior to the virtual line, between notogastral porose areas *AI* (Fig. 7), (versus being posterior (if present) to the virtual line between *AI* in redescrptions). Hence, the variable morphology and localization of median pore in *G. alata* should be considered in the future identification of this species.

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К ИЗУЧЕНИЮ ПАНЦИРНЫХ КЛЕЩЕЙ С УХООБРАЗНЫМИ ПТЕРОМОРФАМИ НА ТАЙВАНЕ (ACARI, ORIBATIDA)

С. Г. Ермилов*

Тюменский государственный университет, Тюмень 625003, Россия

*e-mail: ermilovacari@yandex.ru

Представлены данные по систематике трех видов панцирных клещей (Acari, Oribatida) с ухообразными птероморфами из Тайваня. Описан новый вид *Neoribates* (*Neoribates*) *yangensis* sp. n. (Parakalumnidae); он морфологически схож с *Neoribates* (*N.*) *similis* Fujikawa 2007 и *Neoribates* (*N.*) *pyramidalis* (Tseng 1984), но отличается от них покровами тела (штрихованные против гладких). Даны морфологические дополнения к описаниям *Galumna* (*Galumna*) *tsengi* Ermilov et Liao 2017 и *Galumna* (*G.*) *alata* (Hermann 1804) (Galumnidae).

Ключевые слова: панцирные клещи, *Neoribates*, *Galumna*, новый вид, переописание, морфология, систематика, Ориентальная область