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TWO NEW SPECIES OF ORIBATID MITES (ACARI: ORIBATIDA) FROM INDIA

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ABSTRACT

Two new oribatid mite species, *Epidamaeus parayunnanensis* sp. nov. and *Taiwanoppia* (*Taiwanoppia*) *paraflagellifera* sp. nov. (Acari: Oribatida) are described from India. In India, the genera *Epidamaeus* and *Taiwanoppia* are recorded for the first time. An identification key to all known species of the nominative subgenus *Taiwanoppia* is provided.

Key words: *Epidamaeus*, India, key, oribatid mites, new species, *Taiwannoppia*

ДВА НОВЫХ ВИДА ПАНЦИРНЫХ КЛЕЩЕЙ (ACARI: ORIBATIDA) ИЗ ИНДИИ

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РЕЗЮМЕ

Два новых вида панцирных клещей *Epidamaeus parayunnanensis* sp. nov. и *Taiwanoppia paraflagellifera* sp. nov. описаны из Индии. Роды *Epidamaeus* и *Taiwanoppia* впервые зарегистрированы в Индии. Приведен ключ к известным видам номинального подрода *Taiwanoppia* (*Taiwanoppia*).

Ключевые слова: *Epidamaeus*, Индия, ключ, панцирные клещи, новые виды, *Taiwannoppia*

INTRODUCTION

This paper is a part of our continuing studies on Indian oribatid mite fauna (Acari: Oribatida) and includes the descriptions of two new species belonging to the genera *Epidamaeus* Bulanova-Zachvatkina, 1957 (Damaeidae) and *Taiwanoppia* Tseng, 1982 (Oppiidae).

The genus *Epidamaeus* includes more than 80 species, which are distributed in the Holarctic, Neotropical and Oriental regions. The main characteristics of this genus were summarized by Miko (2006). The genus *Taiwanoppia* includes two subgenera and 12 species, which are distributed in the Neotropical and Oriental regions. The most important features of the genus and its subgenera were summarized by Subías and Balogh (1989). In India, both genera (*Epidamaeus*, *Taiwanoppia*) are recorded for the first time.

MATERIALS AND METHODS

Specimens were studied in lactic acid, mounted in temporary cavity slides for the duration of the study, and then stored in 70% alcohol in vials. All

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body measurements are presented in micrometers. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Formulae of leg setation are given according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae of leg solenidia are given (in square brackets) according to the sequence genu–tibia–tarsus. Terminology used in this paper follows that of Norton and Behan-Pelletier (2009).

SYSTEMATICS

Family Damaeidae Berlese, 1896

Genus *Epidamaeus* Bulanova-Zachvatkina, 1957

Epidamaeus parayunnanensis sp. nov.

(Figs. 1–2)

Diagnosis. Body size: 464–514 × 298–332. One pair of prodorsal tubercles (*Ba*) present. Interlamellar setae and sensilli long, with flagellate tips, slightly barbed. Spinae adnatae of medium size, straight. Dorsal notogastral setae thorn-like. Posterior setae p_1 longest on notogaster, setiform, with flagellate tips. Ventral setae slightly barbed. Parastigmatic tubercles *Sa* thorn-like, *Sp* tubercle-like.

Description. **Male**. Body length: 464 (holotype), 481–514 (4 paratypes); notogaster width: 298 (holotype), 315–332.

Integument. Body color yellow to light brownish. Surface of body with filamentous and microgranulate cerotegument. Spinae adnatae and parastigmatic tubercles with slightly larger cerotegumental granules. Setae of prodorsum, notogaster, and legs without cerotegument.

Prodorsum. Rostrum rounded. Propodolateral apophyses absent. One pair of prodorsal tubercles (*Ba*) developed, triangular, round-ended; *Bp*, *Da*, *Dp* absent. Also, small lateral tubercles (*La*) present. Rostral (*ro*, 73–86) and lamellar (*le*, 90–102) setae setiform, barbed. Interlamellar (*in*, 94–102) and exobothridial (*ex*, 41–45) setae and sensilli (*ss*, 155–164) setiform, with flagellate tips, slightly barbed.

Notogaster. Oval. Anterior margin with straight, thorn-like spinae adnatae (*sa*, 28–36). Dorsal notogastral setae (61–73) inserted in 2 sub-parallel rows, thorn-like, slightly barbed. Posterior setae p_1 longest on notogaster (98–102), setiform, with short flagellate tips, slightly barbed; p_2, p_3 (41–45) shortest on notogaster, setiform, slightly barbed. All lyrifissures (*ia*, *im*, *ip*, *ih*, *ips*) and opisthonotal gland openings (*gla*) located typically for Damaeidae.

Gnathosoma. Subcapitulum longer than wide (110–118 × 82–86). Subcapitular setae *h*, *m* (both 28–32), *a* (24–28) setiform, barbed. Adoral setae (or_1, or_1, 10–12) thin, smooth. Palps (94) with setation 0–2–1–3–8(+ω). Chelicerae (114) with 2 setiform setae; *cha* (32) barbed, *chb* (20) ciliate unilaterally in medio-distal part. One small tooth located posteriorly to *cha*. Trägårdh's organ (Tg) narrow, conical.

Epimeral and lateral podosomal regions. Two pairs of parastigmatic tubercles well developed: *Sa* thorn-like, *Sp* tubercle-like. Epimeral and ventrosejugal tubercles absent. Epimeral setal formula: 3–1–3–4. Epimeral setae (36–45) setiform, slightly barbed. Discidia (*dis*) presented, triangular.

Anogenital region. Six pairs of genital (g_1–g_6), 1 pair of aggenital (*ag*), 2 pairs of anal (an_1, an_2), 3 pairs of adanal (ad_1–ad_3) setae similar in length (24–32), setiform, slightly barbed. Adanal lyrifissures (*iad*) located in inverse apoanal position, anteriorly to ad_3.

Legs. Leg II shorter than body length; legs I, III, IV longer than body length (Table 1). Formulae of leg setation and solenidia: I (1–7–4–4–20) [1–2–2], II (1–6–4–4–17) [1–1–2], III (2–4–3–3–17) [1–1–0], IV (1–4–3–3–14) [0–1–0]; homology of setae and solenidia indicated in Table 2. Morphology of leg segments, setae and solenidia typical for *Epidamaeus* (e.g. Behan-Pelletier and Norton 1983; Bayartogtokh 2001; Mourek et al. 2011).

Table 1. Leg mean lengths (micrometers) of *Epidamaeus parayunnanensis* sp. nov.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus	All	Leg : body mean length
I	20	188	59	75	200	542	≈1.09
II	20	137	45	75	155	432	≈0.87
III	80	123	45	82	182	512	≈1.03
IV	108	162	59	112	229	670	≈1.35

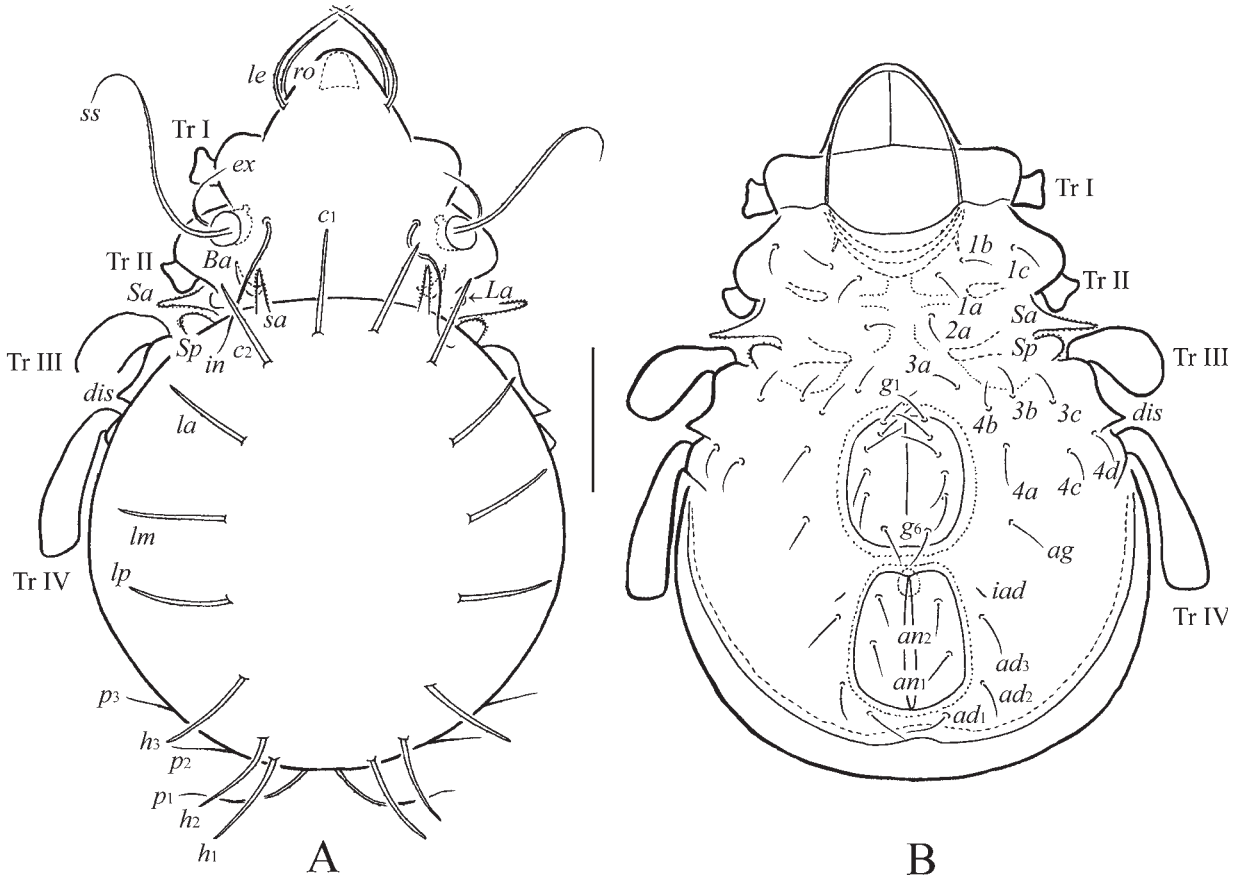

Fig. 1. *Epidamaeus parayunnanensis* sp. nov.: A – body dorsally (legs except left trochanters III, IV not illustrated); B – body ventrally (subcapitular setae and legs except trochanters not illustrated). Scale bar 100 μm.

Table 2. Leg setae and solenidia of *Epidamaeus parayunnanensis* sp. nov.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v´*	*d, (l), bv´´, (v_1), v_2´´*	*(l), v´, dσ*	*(l), (v), φ_1, φ_2*	*(ft), (tc), (it), (p), (u), (a), s, (pv), (pl), (v), e, ω_1, ω_2*
II	*v´*	*d, (l), bv´´, (v)*	*(l), v´, dσ*	*(l), (v), φ*	*(ft), (tc), (it), (p), (u), (a), s, (pv), (v), ω_1, ω_2*
III	*l´, v´*	*d, l´, ev´, v´*	*l´, v´, dσ*	*l´, (v), φ*	*(ft), (tc),(it), (p), (u), (a), s, (pv), (v)*
IV	*v´*	*d, l´, ev´, v´*	*d, l´, v´*	*l´, (v), φ*	*ft´´, (tc), (p), (u), (a), s, (pv), (v)*

Note. Roman letters refer to normal setae (*e* – famulus), Greek letters refer to solenidia, dσ – seta and solenidion coupled. One apostrophe (´) marks setae on anterior and double apostrophe (´´) setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

Female. Unknown.

Material examined. Male holotype, INDIA, Arunachal Pradesh, Hunli, 28°19´32´´N, 95°57´31´´E, 1300 m a.s.l. [soil], 26 May–01 June 2012, coll. L. Dembický and O. Šauša. Two male paratypes, INDIA, Assam, Bhalukpong, 27°00´48´´N, 92°39´08´´E, 150 m a.s.l. [soil], 01–08 May 2012, coll. L. Dembický and O. Šauša; 2 male paratypes, INDIA, Arunachal Pradesh, Etalin, 28°36´56´´N, 95°53´21´´E, 700 m a.s.l. [soil], 01–08 May 2012, coll. L. Dembický and O. Šauša.

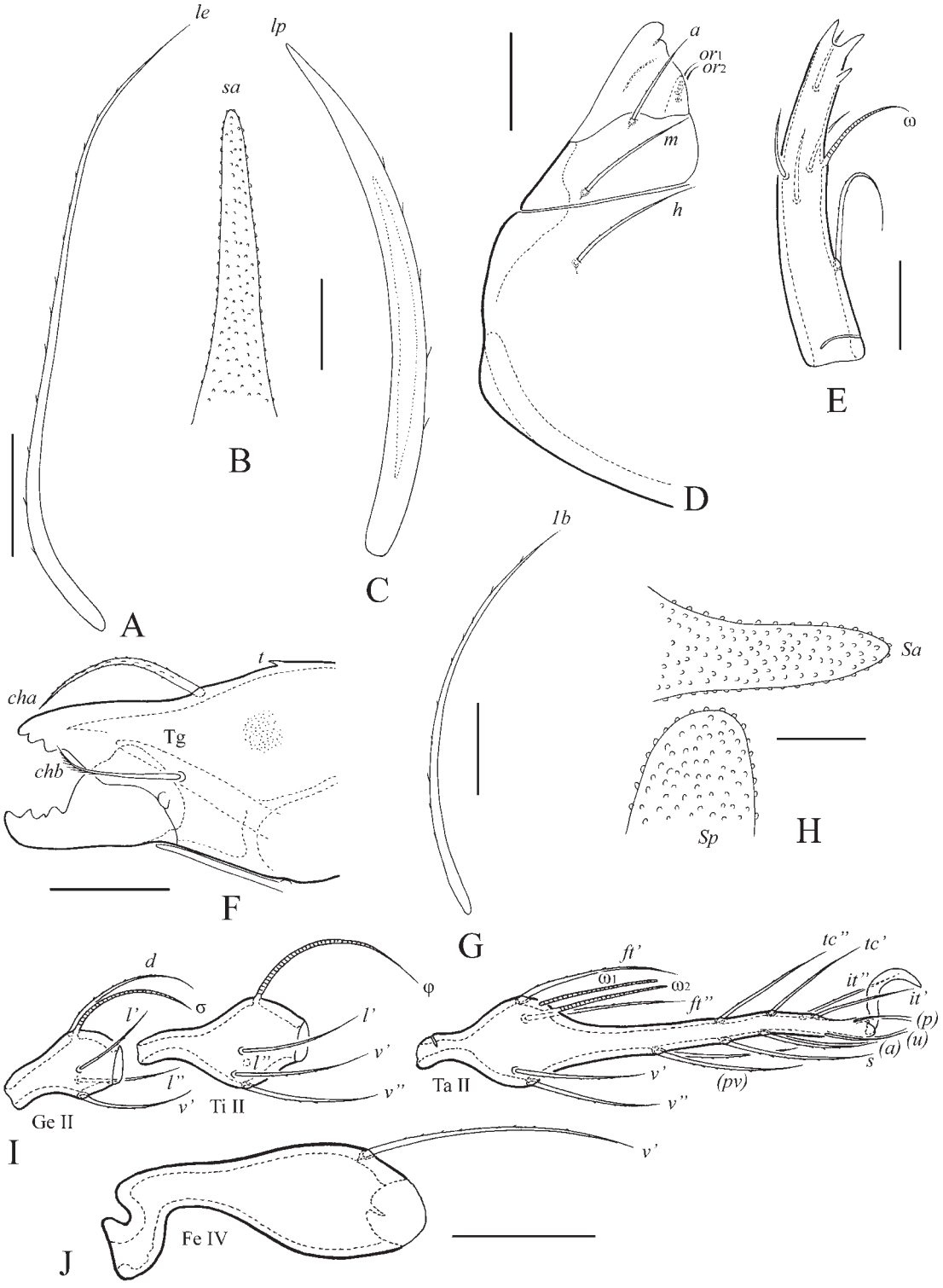

Fig. 2. *Epidamaeus parayunnanensis* sp. nov.: A – lamellar seta; B – spina adnata; C – notogastral seta *lp*; D – subcapitulum ventrally, right half; E – palptarsus; F – chelicera, anterior part; G – epimeral seta *1b*; H – parastigmatic tubercles; I – tarsus, tibia and genu of leg II, left, paraxial view; J – trochanter of leg IV, right, paraxial view. Scale bars: 20 µm = A, D, F; 10 µm = B, C, E, G, H; 50 µm = I and J.

Type deposition. The holotype (in alcohol) is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; two paratypes (in alcohol) are deposited in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; two paratypes (in alcohol) are in the personal collection of the first author.

Etymology. The prefix *para* is Latin meaning "near" and refers to the similarity of the new species with *Epidamaeus yunnanensis* Enami, Aoki et Hu, 1994.

Remarks. *Epidamaeus parayunnanensis* sp. nov. is similar to *E. yunnanensis* Enami, Aoki and Hu, 1994 from Southern China (Enami et al. 1994). In both species, the sensilli and interlamellar setae are long with flagellate tips; the spinae adnatae have medium size and are straight; the dorsal notogastral setae are thorn-like; notogastral setae p_1 are longest on the notogaster, with flagellate tips; *Sa* are thorn-like, *Sp* – tubercle-like; *Ba* – present, *Da* – absent. However, the new species clearly differs from the latter one by the absence of the propodolateral apophyses and ventrosejugal tubercles *Va* (versus present in *E. yunnanensis*), by slightly barbed sensilli and ventral setae (versus smooth in *E. yunnanensis*) and by the interlamellar setae, which are not shorter than lamellar setae (versus clearly shorter in *E. yunnanensis*).

Family Oppiidae Sellnick, 1937

Subfamily Oppiinae Sellnick, 1937

Genus *Taiwanoppia* Tseng, 1982

Taiwanoppia (*Taiwanoppia*) *paraflagellifera* sp. nov.

(Figs. 3–4)

Diagnosis. Body size: 381–464 × 215–249. Sensilli with long stalk and indistinctly barbed head. Interlamellar setae shorter than sensilli. Interbothridial region with 4 pairs of small muscle sigillae. Notogastral setae *la*, *lm*, *lp*, h_2, h_3 very long, setiform, rather straight; p_1 longer than h_1, p_2, p_3.

Description. **Male**. Body length: 398 (holotype), 381–464 (5 paratypes); notogaster width: 215 (holotype), 215–249.

Integument. Body color light brown. Body surface smooth. Lateral sides of prodorsum microgranulate.

Prodorsum. Rostrum rounded. Rostral (41–49) and lamellar (82–90) setae setiform, straight, barbed. Rostral setae inserted laterally, lamellar setae inserted dorsally on prodorsum. Interlamellar (41–45) and exobothridial (24–28) setae thinner, setiform, slightly barbed. Sensilli (65–69) with long stalk and oval, indistinctly barbed head. Anteriobothridial region with 2–3 pairs of large muscle sigillae. Interbothridial region with 4 pairs of small muscle sigillae. Postbothridial tubercles presented, round-ended.

Notogaster. Oval. Setae *c* and their alveoli indistinct. Nine pairs of notogastral setae barbed: *la*, *lm*, *lp*, h_2, h_3 very long (123–143), setiform, thickened, nearly straight; p_1 (53–61) and h_1, p_2, p_3 (32–41) shorter and thinner than these setae. Lyrifissures and opisthonotal gland openings located typically for Oppiinae, poorly visible.

Gnathosoma. Subcapitulum longer than wide (94–102 × 73–77). Subcapitular setae setiform, slightly barbed; *h* and *m* (both 32–36) longer than *a* (20–24). Adoral setae (8–10) setiform, thin, smooth. Palps (65) with setation 0–2–1–3–8(+ω). Chelicerae (94) with 2 setiform, barbed setae; *cha* (28) longer than *chb* (16). Trägårdh's organ long, thin, conical.

Epimeral and lateral podosomal regions. Epimeral setal formula: 3–1–3–3. Epimeral setae (32–45) setiform, slightly barbed. Discidia triangular.

Anogenital region. Five pairs of genital (32), 1 pair of aggenital (61–73), 2 pairs of anal (32–41) and 3 pairs of adanal (61–73) setae setiform, slightly barbed. Lyrifissures *iad* located in para-anal position.

Legs. Formulae 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 3. Morphology of leg segments, setae and solenidia typical for Oppiinae (Bernini 1973; Ohkubo 2001; Ermilov and Kalúz 2012).

Female. Unknown.

Material examined. Male holotype, INDIA, Arunachal Pradesh, Etalin, 28°36′56′′N, 95°53′21′′E, 700 m a.s.l. [soil], 01–08 May 2012, coll. L. Dembický and O. Šauša. Five male paratypes, INDIA, Arunachal Pradesh, Hunli, 28°19′32′′N, 95°57′31′′E, 1300 m a.s.l. [soil], 01 June 2012, coll. L. Dembický and O. Šauša.

Type deposition.The holotype (in alcohol) is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; two paratypes (in alcohol) are deposited in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; three paratypes (in alcohol) are in the personal collection of the first author.

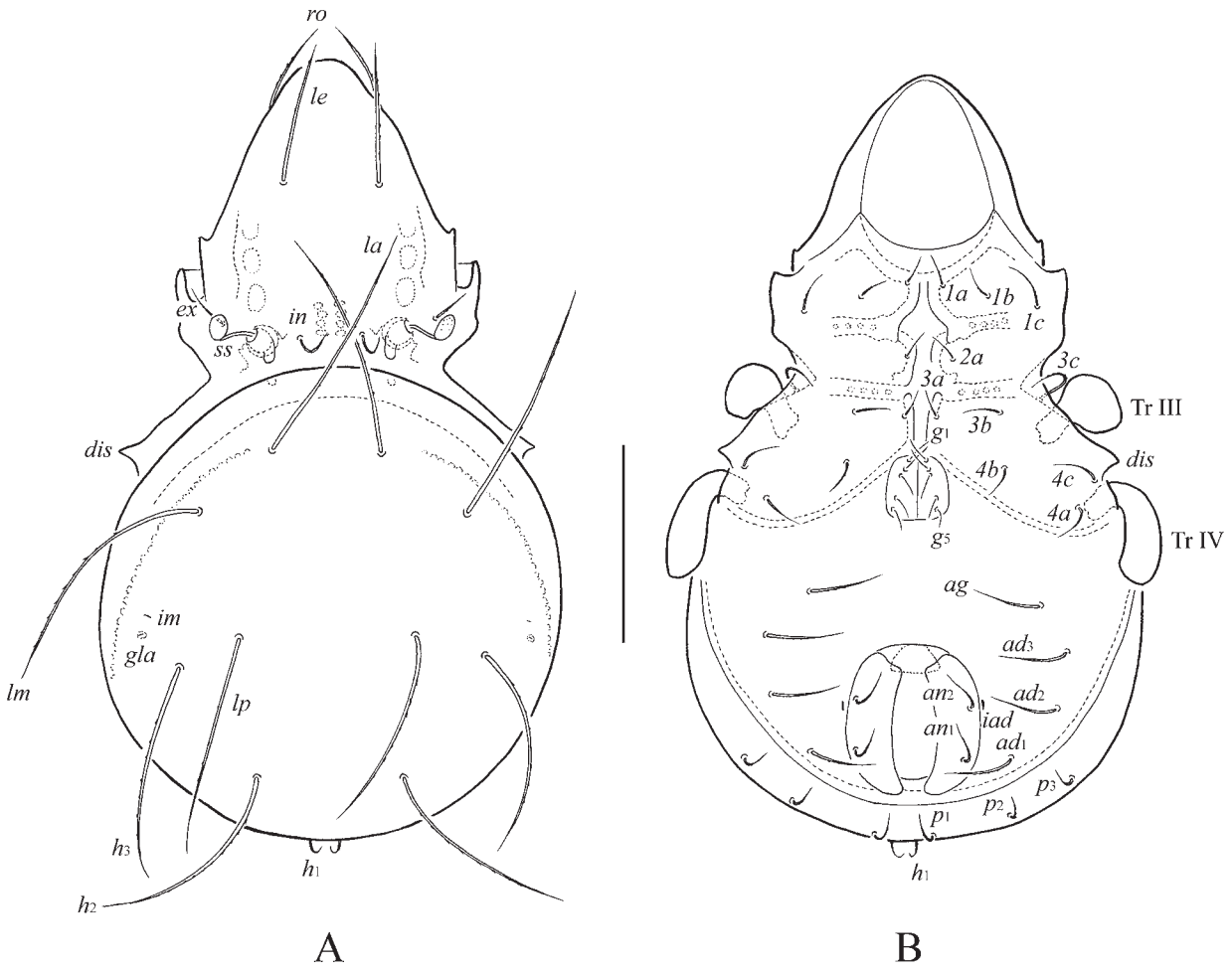

Fig. 3. *Taiwanoppia* (*T.*) *paraflagellifera* sp. nov.: A – body dorsally (legs not illustrated); B – body ventrally (gnathosoma and legs except trochanters III, IV not illustrated). Scale bar 100 μm.

Table 3. Leg setae and solenidia of *Taiwanoppia* (*T.*) *paraflagellifera* sp. nov.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v´*	*d, (l), bv´´, v´´*	*(l),* σ	*(l), (v),* φ_1, φ_2	*(ft), (tc), (it), (p), (u), (a), s, (pv), v´, (pl), l´´, e,* 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)*

Note. See Table 2 for explanations.

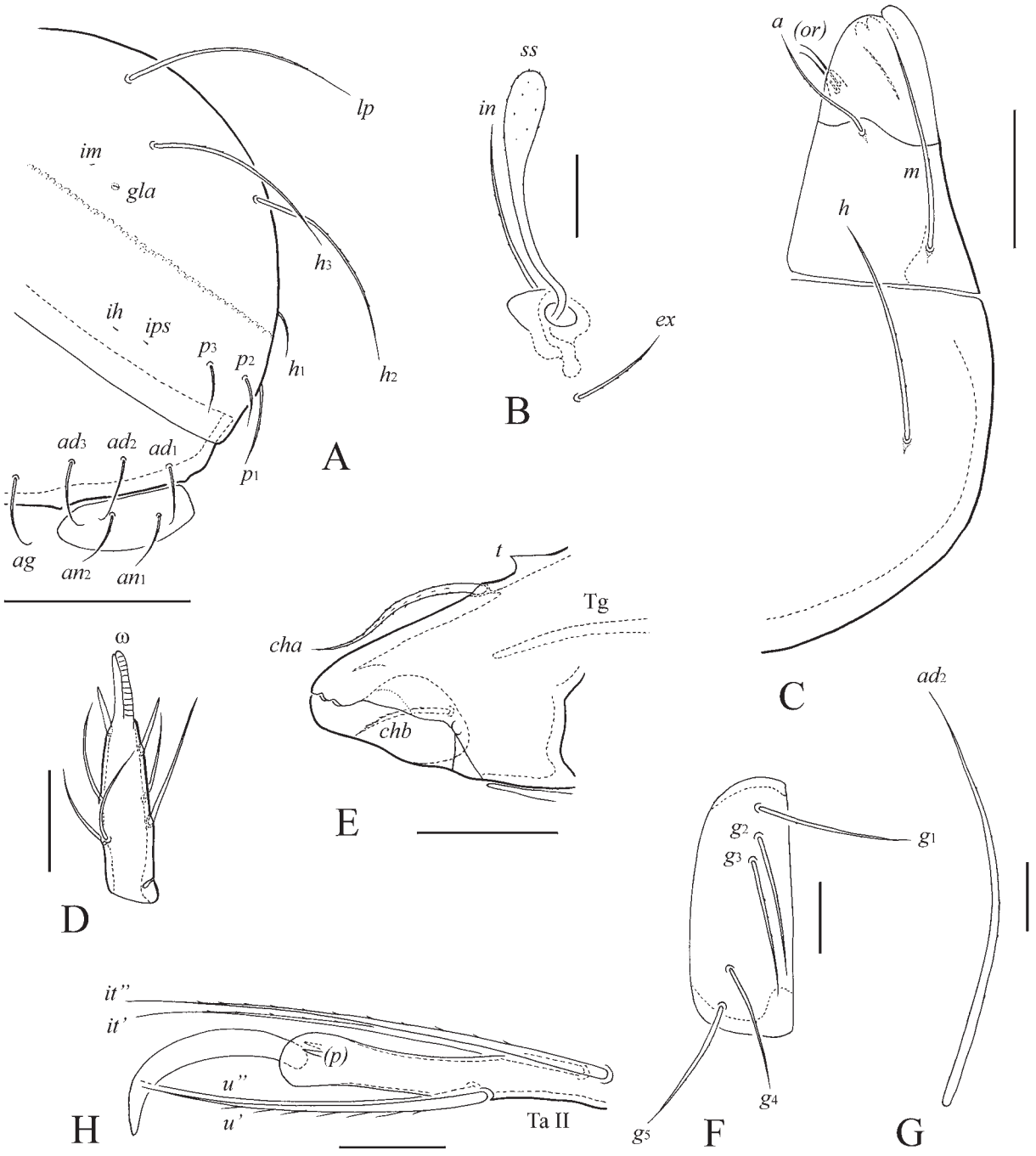

Fig. 4. *Taiwanoppia* (*T.*) *paraflagellifera* sp. nov.: A – posterior part of body laterally; B – sensillus, interlamellar and exobothridial setae laterally; C – subcapitulum ventrally, left half; D – palptarsus; E – chelicera, anterior part; F – genital plate, right; G – adanal seta ad_2; H – anterior part of tarsus II, left, antiaxial view. Scale bars: 100 μm= A; 20 μm = B, C, E; 10 μm = D, F–H.

Etymology. The prefix *para* is Latin meaning "near" and refers to the similarity of this new species with *Taiwanoppia* (*T.*) *flagellifera* (Wang, 1993) comb. nov.

Remarks. In proportional length of the notogastral setae, *Taiwanoppia* (*T.*) *paraflagellifera* sp. nov. is similar to *Taiwanoppia* (*T.*) *flagellifera* (Wang, 1993) comb. nov. from Southern China (see Wang 1993). *T. flagellifera* was mistakenly described by Wang (1993) in the genus *Oppia* Koch, 1836. However, this species is close to mites of the nominal subgenus of the genus *Taiwanoppia* (length and localization of the notogastral and anogenital setae, structure of sensilli). Similarities of this species with *Taiwanoppia* were also mentioned by Umukusum Y., Shtanchaeva and Luis S. Subías (personal communication). Therefore, in this paper we included this species in the subgenus *Taiwanoppia*. Our new species clearly differs from *T. flagellifera* by the nearly straight, five pairs of notogastral setae (versus flagelliform in *T.* (*T.*) *flagellifera*) and by the smaller body size (381–464 × 215–249 versus 573–599 × 333–373 in *T.* (*T.*) *flagellifera*).

Key to species of the subgenus *Taiwanoppia*

1. Notogaster with 5 pairs (*la*, *lm*, *lp*, h_2, h_3) of long notogastral setae, notogastral setae p_1 longer than h_1; interlamellar setae shorter than sensilli 2
– Notogaster with 7 pairs (*la*, *lm*, *lp*, h_1, h_2, h_3, p_1) of long notogastral setae, notogastral setae p_1 shorter than h_1; interlamellar setae longer than sensilli 3
2. Notogastral setae *la*, *lm*, *lp*, h_2, h_3 setiform, nearly straight; body size: 381–464 × 215–249 . . . . . ***T. paraflagellifera* sp. nov.** (India)
– Notogastral setae *la*, *lm*, *lp*, h_2, h_3 flagelliform; body size: 573–599 × 333–373 . . . ***T. flagellifera* (Wang, 1993)** (Wang 1993: Southern China)
3. Notogastral setae *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 weakly lanceolate; adanal setae ad_1 inserted postanally . . . . . ***T. subtropica* Tseng, 1982** (Tseng 1982: Taiwan)
– Notogastral setae *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 not lanceolate; adanal setae ad_1 inserted latero-postanally or paraanally 4
4. Bothridia posteriorly with long, thorn-like processes; very short costular lines, bearing the lamellar setae, present; body size: 510–582 × 312–325 . . . . . ***T. insitiva* (Mahunka, 2008)** (Mahunka 2008: Thailand)
– Bothridia posteriorly without long, thorn-like processes; costular lines absent 5
5. Rostrum rounded; interbothridial region with 1 pair of short, convergent ridges; body size: 526–559 × 313–339 . . . . . ***T. fujiaensis* Wang, 1993** (Wang 1993: Southern China)
– Rostrum pointed; interbothridial region without ridges 6
6. Notogastral setae *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 straight; adanal setae ad_1 inserted paraanally; body size: 459 × 271 . . . . . ***T. hungarorum* (Mahunka, 1988)** (Mahunka 1988: Vietnam and Mexico)
– Notogastral setae *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 weakly flagelliform; adanal setae ad_1 inserted latero-postanally . . . . . ***T. papillaris* Tseng, 1982** (Tseng 1982: Taiwan)

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