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THE SOIL MITE FAMILY ACHIPTERIIDAE (ACARI: ORIBATIDA) IN MONGOLIA AND THE RUSSIAN FAR EAST

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ABSTRACT — This paper deals with the oribatid mites of Achipteriidae, one of the common families in Mongolia and the Russian Far East. The family is represented by six and fourteen species in Mongolia and the Russian Far East, respectively. In this work, we studied six recently collected species in detail, and their supplementary descriptions with precise illustrations are presented. We briefly discuss the species validity of *Achipteria nitens* (Nicolet, 1855), as well as the generic placement of *Parachipteria nivalis* (Hammer, 1952) and *P. bella* (Sellnick, 1928). Furthermore, we present data on habitat ecology, distribution and diversity of all achipteriid species in various areas of Mongolia and the Russian Far East, and provide a key for the identification of hitherto recorded species in these regions. The majority of achipteriid species found in Mongolia and the Russian Far East are known to be widely distributed in the vast areas of the northern hemisphere. Only three species have restricted distributions in the Russian Far East, Siberia and Mongolia. Most species of Achipteriidae in Mongolia and the Russian Far East are inhabitants of the litter of various forests, soils of grasslands or mosses growing on rocks or on forest floor; only two species seem to be arboreal inhabitants.

KEYWORDS — Acari; Oribatida; *Achipteria*; *Anachipteria*; *Parachipteria*; Russian Far East; Mongolia

INTRODUCTION

The oribatid mites belonging to the family Achipteriidae occur frequently, even sometimes with high numbers in forest soils, litters, meadow soils, liverworts, bogs and at edges of lakes with mosses, but rarely found in arboreal habitats. Representatives of this family are diverse in both northern and southern hemispheres, but in the tropics, achipteriid species are mainly found at high elevations, for example, in cloud forest litter. Achipteriid species whose feeding habits have been studied are saprophages and mycophages that apparently feed

opportunistically on available resources of fungi, algae and decaying plant material (Root *et al.*, 2007; Seniczak and Seniczak, 2007; Lindo *et al.*, 2008; Norton and Behan-Pelletier, 2009).

Some species of Achipteriidae are sensitive to environmental changes, including pollutants, and therefore, they may indicate changes in habitats. Several species of this family serve as intermediate hosts of tapeworms of the superfamily Anoplocephalata, which parasitize on wild and domestic animals (Rajski, 1959; Denegri, 1993; Seniczak and Seniczak, 2007).

The family is known from the Holarctic, Oriental and Neotropical regions with most species described from the North America, Europe, Central America and East Asia. This family includes 15 genera, two subgenera and more than 110 species (including 19 subspecies), of which 56 species are known from Palaearctic region (Subías, 2004, 2011; Schatz *et al.*, 2011). Six species of Achipteriidae were recorded previously from Mongolia, and 14 species from Russian Far East (Pan'kov *et al.*, 1997; Ryabinin and Pan'kov, 2002; Bayartogtokh, 2010; Ryabinin, 2011). Members of this family typically collected from forest-floor organic soils and rarely in grassland soils.

Adults of Achipteriidae are characteristic among other groups of oribatid mites in having following combination of characters: prodorsum with lamellae, adjacent or fused medially; lamellar cusps, tutorium, translamella well-developed; genal notch present; dorsophragmata and pleurophragmata present; notogaster with immovable pteromorphs, which bears knifelike humeral process or not; notogastral setation represented by 10 pairs of setae or alveoli; octotaxic system developed as porose areas or saccules; chelicerae chelate-dentate; palpal eupathidium *acm* attached to solenidion; discidium and custodium present; pedotectum I large, extending to base of bothridium, pedotectum II small; anogenital setation: 6-1-2-3; genu IV often concave dorsally, subequal in length or longer than tibia IV; tibia IV with solenidion. Immatures have plicate cuticle, apherodermous, unidifferent; humeral organ absent; seta *d* present to tritonymph on tibiae and genera I-IV, or only IV, when respective solenidion exists (Seniczak, 1978; Chistyakov, 1987, 1988, 1994; Seniczak and Seniczak, 2007; Norton and Behan-Pelletier, 2009).

The aim of this work is to redescribe some recently collected species belonging to this family from Mongolia and Russian Far East. A review of the composition of the family Achipteriidae with remarks on biogeography, habitat ecology, and construction of an identification key to all known species in these regions are the other goal of this study.

MATERIALS AND METHODS

All materials used in this study were collected by the authors (with exceptions for few species), and the specimens were mounted in temporary slides to view the anterior, lateral and posterior aspects and then preserved in alcohol. All examined materials and data on their localities are given in the respective 'material examined' section. Species studied here are represented as adults.

Specimens were cleared in lactic acid, and a differential interference contrast microscope (Olympus CX 31) was used for investigation in transmitted light. Line drawings were made using a camera lucida attached to the compound microscope.

The morphological terminology used below is mostly that developed over many years by Grandjean (1932, 1952), and also that by Norton and Behan-Pelletier (2009). All measurements are given as a range, with the mean in parentheses. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. Notogastral length was also measured in lateral aspect (when the dorsosejugal groove is discernable), from the anterior to the posterior edge; notogastral width refers to the maximum width in dorsal aspect. Setal formulas of the legs are given as numbers per segment for appendages (from trochanter to tarsus) and as number per podosomal segment (I-IV) for epimeres.

RESULTS

Achipteria coleoptrata (Linnaeus, 1758) (Figs. 1 and 2)

Acarus coleoptratus: Linnaeus, 1758: 616.

Oribata ovalis: Nicolet, 1855: 438, pl. 4, fig. 5.

Oribates nicoletii: Berlese, 1883: fasc. 3(3).

Oribata intermedia: Michael, 1898: 21.

Oribates redux: Hull, 1914: 219.

Notaspis coleoptratus: Oudemans, 1914: 37, pl. 17, figs. 11-15; 1927: 124; Sellnick, 1928: 7, fig. 7; 1931: 699, figs. 4, 5; Willmann, 1931: 183, figs. 322-324; Balogh, 1943: 97, taf. 17, fig. 10.

Achipteria coleoptrata: van der Hammen, 1952: 112,

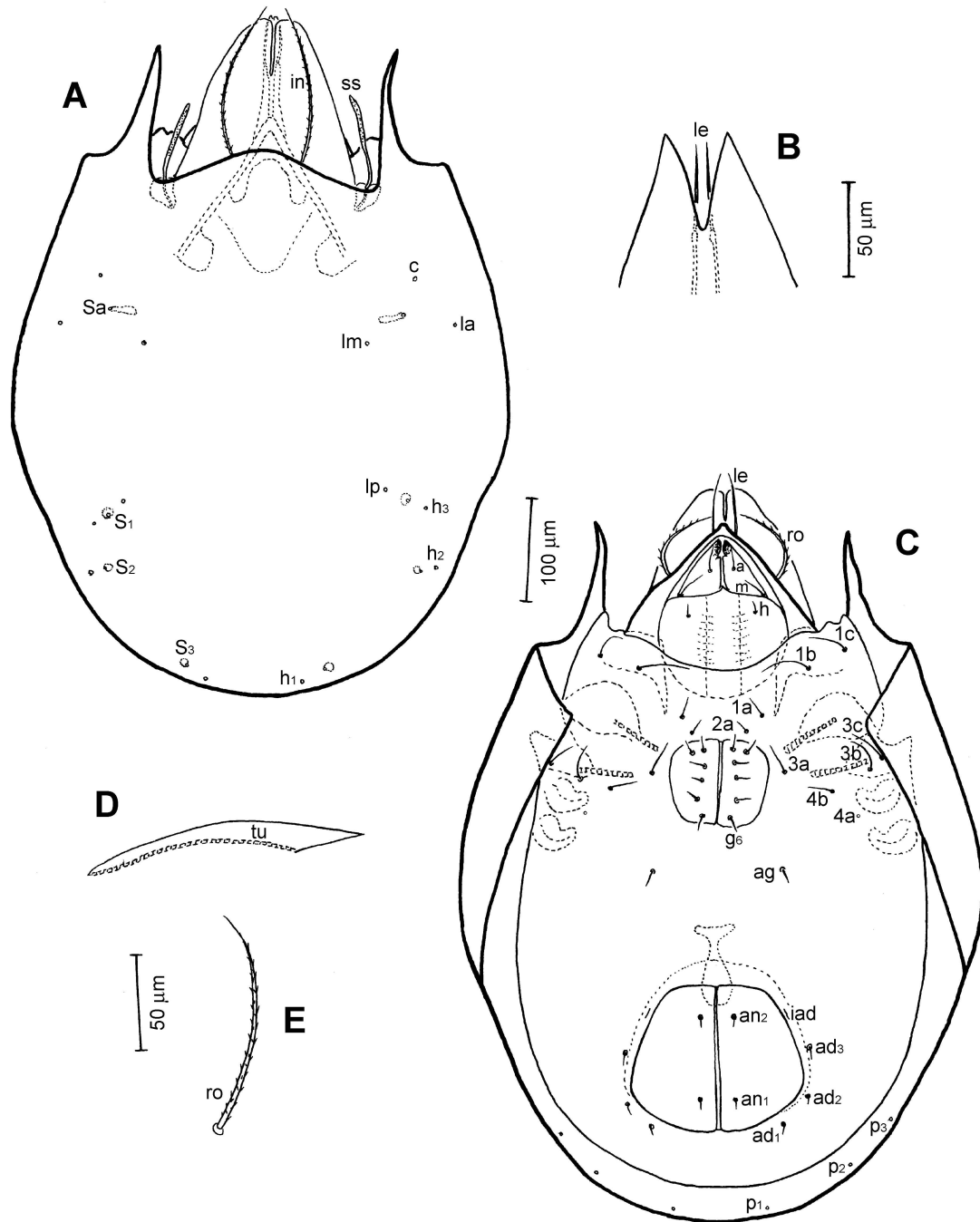


FIGURE 1: *Achipteria coleoprata* (Linnaeus, 1758): A – Dorsal view of idiosoma, legs omitted; B – Dorso-frontal view of lamellar cusps; C – Ventral view of idiosoma, legs omitted; D – Tutorium, right, lateral view; E – Rostral seta, right.

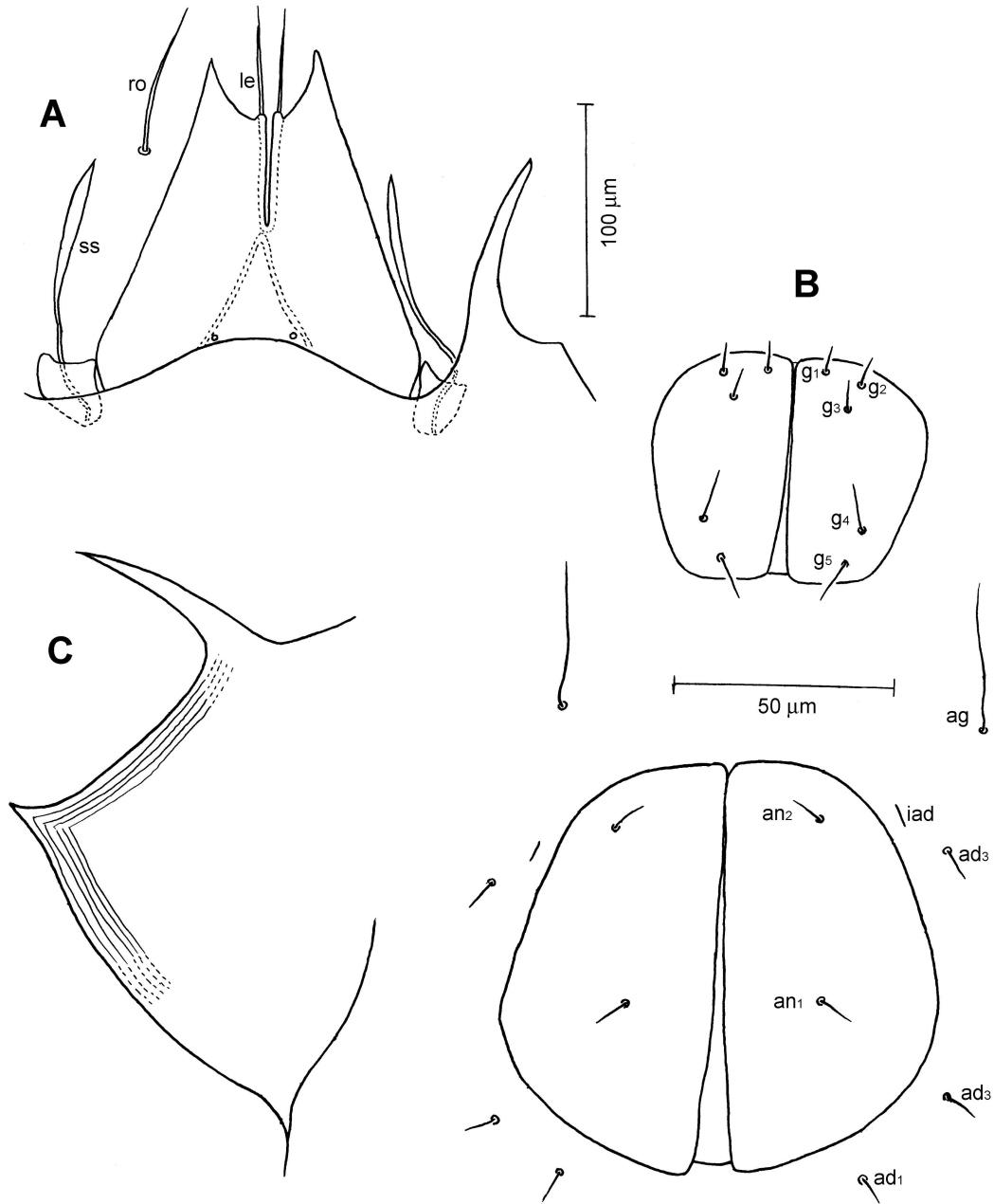


FIGURE 2: *Achipteria coleoprata* (Linnaeus, 1758): A – Part of prodorsum and anterior part of notogaster; B – Ano-genital region; C – Pteromorph, dorsal view, after dissection.

fig. 11d, g, i; Hammer, 1952: 64, fig. 102; Schweizer, 1956: 336, abb. 300; Bulanova-Zachvatkina, 1967: 217, fig. 294; Pérez-Iñigo, 1972: 269, fig. 18; 1980: 229; 1992: 365; 1993: 129, fig. 48C; Moskacheva, 1973: 278, fig. 1; Shaldybina, 1975: 344, fig. 866; Seniczak, 1977: 740, figs. 1A, 2A, 3A; 1978: 90, figs. 1-7, 10, 12, 13; Moraza *et al.*, 1980: 21, fig. 54; Marshall *et al.*, 1987: 323; Chistyakov, 1988: 2, figs. 2-10; Beck and Woas, 1991: 78; Maruyama, 2003: 25, figs. 1-6; Subías, 2004: 167; Weigmann, 2006: 351, fig. 187D & E; Bayartogtokh, 2007: 354, fig. 280; 2010: 326: fig. 83E-J.

Diagnosis — With character states of *Achipteria* (see Balogh and Balogh, 1992 and Weigmann, 2006 for generic diagnosis); total length 530 – 650 μm , dorsal and ventral plates with minute granular cerotegument; lamellae fused medially, but lamellar cusps well separated from each other; lateral dens large, projected; sensillus with slightly expanded fusiform or elongate-oval head, smooth or finely barbed; notogastral setae minute or represented by their alveoli; coxisternal setal formula 3-1-3-2(3); tutorium narrow, slightly widening anteriorly in long cusp pointed distally; pedotectum I without anterior tooth.

Measurements — Body length: 573 – 620 (604) μm , length of notogaster 520 – 533 (525) μm , width of notogaster 403 – 468 (430) μm .

Integument — Body color dark brown, heavily sclerotized species with minute microtubercles on lateral part of podosoma, exobothridial and lenticular regions. Granular cerotegument clearly evident at base of prodorsum and on mentum.

Dorsal aspect — Rostrum rounded in dorsal view, but curved and distinctly pointed ventrally in lateral aspect. Rostral seta (*ro*) long, barbed, curving medially, and extending well beyond tip of rostrum (Figs. 1E and 2A). Lamellae fused medially, lamellar cusp with large, sharp dens laterally; medial dens absent. Lamellar seta (*le*) shorter than *ro*, thin, smooth or finely barbed, inserted medially on ventral side of lamellar cusp (Figs. 1B and 2A). Interlamellar seta (*in*) long, lightly barbed, extending anteriorly beyond tip of lamella. Exobothridial seta (*ex*) short, thin, finely barbed, hardly discernable. Sensillus or bothridial seta with slightly ex-

panded fusiform or elongate-oval head about one-thirds to two-thirds total length (Figs. 1A and 2A). Notogaster longer than wide, ratio 1.2:1; anterior and posterior margins broadly rounded. Lenticular region subtriangular with diffuse margins, but weakly visible and lacking true lenticulus. Notogastral setae represented only by their alveoli. Sacculi small, but clearly visible; lyrifissures not evident. Pteromorph with large knife-like process, tip of which reaches level of rostrum (Figs. 1C, 2A and C).

Lateral aspect — Tutorium narrow, appearing pointed in dorsal aspect, but slightly widening anteriorly in distinct cusp ending with one or two small teeth (Fig. 1D). Genal tooth rounded to sharply pointed distally, with genal notch extending posterior to insertion of seta *ro*. Pedotectum I well developed, fully covering acetabulum I; pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II. Lateral edge of pteromorph with longitudinal striations (Fig. 2C).

Ventral aspect — Subcapitular mentum without tectum, relatively smooth throughout; setae *h*, *m* and *a* medium long, smooth. Chelicera chelate-dentate, cheliceral setae long, setiform, barbed, seta *cha* longer than *chb*. Palp typical for family, formula of setation: 0-2-1-3-10 including solenidion ω on tarsus; axillary sacculi absent from base of palp. Epimeral setae relatively long, thin, apparently smooth, formula 3-1-3-2, insertions of setae *3b* and *3c* closely adjacent, seta *4c* not evident. Six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae thin, smooth (one specimen from Russian Far East showed only five pairs of genital setae). Lyrifissure *iad* adjacent and parallel to anal aperture (Figs. 1C and 2B).

Legs — Each tarsus with large empodial claw and thin lateral claws. Setation of legs typical for family as in *Anachipteria deficiens* (see below). Most of setae finely barbed, except few distal or ventral setae on tarsi, femur and trochanter. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0). Homology of leg setae and solenidia showed in Table 1.

Material examined — Ten specimens (six males and four females): Close to village Plastun, District Ternei, Primorsk Krai, Russian Far East, oak forest litter, 15 June 2005, Col. A. Zaytsev; two specimens (females): Gurvan Golyn Belchir area, District Sumber, Province Dornod, Mongolia, southern slope of the hill, litter and soils under shrubs, 46°57'N, 119°30'E, 972 m. a.s.l., 27 May 2003, Col. B. Bayartogtokh.

Remarks — The character states of specimens examined here accord well with those studied by Pérez-Iñigo (1972, 1993), Shaldybina (1975), Seniczak (1977, 1978), Chistyakov (1988), Weigmann (2006) from Europe, and by Maruyama (2003) from Asia. Seniczak (1978) showed three pairs of setae on epimere IV in tritonymph of this species, but we observed only two pairs of setae. Chistyakov (1988) provided the epimeral setal formulas as 3-1-3-3 for tritonymph, but 2-1-2-3 for adult of this species.

***Achipteria nitens* (Nicolet, 1855)
(Fig. 3)**

Oribata nitens: Nicolet, 1855: 433, tab. 4, fig. 6.
Notaspis mixtus: Sellnick, 1943: 23.
Notaspis nitens: Oudemans, 1914: 40; 1927: 130, fig. 7-13; Sellnick, 1928: 8; Willmann, 1931: 178, fig. 302; Balogh, 1943: 97, tab. 17, fig. 13.
Achipteria nitens: Grandjean, 1929: 407; van der Hammen, 1952: 111, fig. 10c, i-k, 11c, h; Schweizer, 1956: 337, Abb. 302; Grandjean, 1962: 398, fig. 1; Dubinina *et al.*, 1966: 116, fig. 54-56; Bulanova-Zachvatkina, 1967: 217; Pérez-Iñigo, 1972: 270, fig. 19; 1980: 229; 1993: 129, fig. 48A, B; Moskacheva, 1973: 278, fig. 2; Seniczak, 1977: 741, figs. 2B, 3D;

1978, p. 93, figs. 8, 11, 14; Shaldybina, 1975: 344, fig. 867; Moraza *et al.*, 1980: 20, fig. 55; Marshall *et al.*, 1987: 324; Mahunka and Mahunka-Papp, 1995: 85; Weigmann, 2006: 352, fig. 187A-C; Seniczak and Seniczak, 2007: 534, figs. 9, 10; Bayartogtokh, 2007: 355, fig. 281; 2010: 327, fig. 83.

Achipteria acuta: *sensu* Subías, 2004: 167.

Diagnosis — Total length 600 – 780 µm, dorsal and ventral plates with minute granular cerotegument, with character states of *Achipteria*; lamellae fused medially, but lamellar cusps well separated from each other; lateral dens small or rounded; sensillus with slightly expanded fusiform or elongate-oval head, smooth or finely barbed; notogastral setae *c* and *la* very long, longer than other setae; coxisternal setal formula 3-1-3-2(3); tutorium narrow, slightly widening anteriorly in long cusp pointed distally; pedotectum I with distinct anterior tooth.

Measurements — Body length: 603 – 640 (626) µm, length of notogaster 429 – 472 (452) µm, width of notogaster 368 – 391 (379) µm.

Integument — Body color yellowish to dark brown, strongly sclerotized species with minute microtubercles on lateral part of podosoma, exobothridial and lenticular regions. Granular cerotegument clearly evident at base of prodorsum and ventral plate.

Dorsal aspect — Rostrum pointed in both dorsal and lateral views, curved ventrally. Rostral seta long, barbed, curving medially, and extending well beyond tip of rostrum (Fig. 3C and E). Lamellae fused medially, with large cusp; lateral dens small or rounded. Lamellar seta shorter than *ro*, thin, smooth, inserted medially on ventral side of lamellar cusp (Figs. 3A and B). In-

TABLE 1: Leg setation of *Achipteria coleoprata* (Linnaeus, 1758).

Legs	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ ₁ , φ ₂	(ft), (tc), (it), (p), (u), (a), s, (pv), v', (pl), I'', ε, ω ₁ , ω ₂
II	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv), ω ₁ , ω ₂
III	v', I'	d, ev', I'	I', σ	I', (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v''	d, ev'	d, I'	I', (v), φ	ft'', (tc), (p), (u), (a), s, (pv)

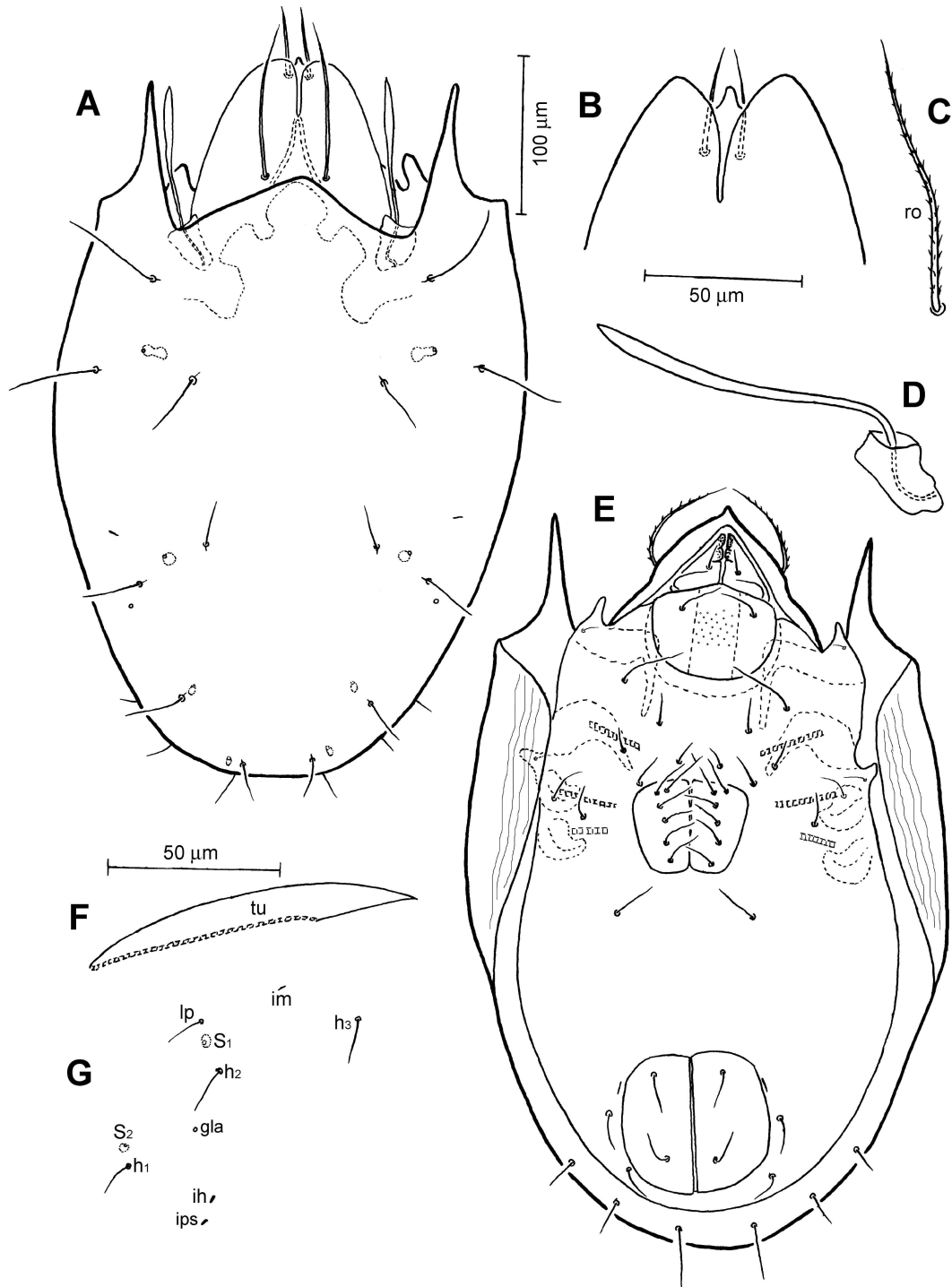


FIGURE 3: *Achipteria nitens* (Nicolet, 1855): A – Dorsal view of idiosoma, legs omitted; B – Lamellar cusps; C – Rostral seta, right; D – Sensillus and bothridium, lateral view; E – Ventral view of idiosoma, legs omitted; F – Tutorium, right, lateral view; G – Some of notogastral setae, opisthosomal gland opening and lyrifissures, dorso-lateral view.

terlamellar seta long, thin, smooth, extending anteriorly beyond tip of lamella. Exobothridial seta minute, hardly discernable. Sensillus with slightly expanded fusiform or elongate-oval head about half total length, smooth or finely barbed (Fig. 3D). Notogaster longer than wide, ratio 1.3:1, flat in lateral view; anterior margin nearly triangular, posterior margin broadly rounded. Lenticular region weakly visible and lacking true lenticulus. Notogastral setae nearly as long as lamellar seta, thin, smooth (Fig. 3A). Sacculi small, but clearly visible; lyrifissure *im*, *ih* and *ips* well developed, *ip* not evident (Fig. 3G). Pteromorph with large knife-like process, tip of which almost reaching level of rostrum.

Lateral aspect — Tutorium narrow, appearing pointed in dorsal aspect, but slightly widening anteriorly in distinct cusp pointed distally (Fig. 3F). Genal tooth rounded to sharply pointed distally, with genal notch extending posterior to insertion of seta *ro*. Pedotectum I well developed, fully covering acetabulum I, with anterior tooth; pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II. Lateral edge of pteromorph with striations.

Ventral aspect — Subcapitular mentum with granular cerotegument; setae *h*, *m* and *a* medium long, smooth. Capitular angle of coxisternum strongly projecting as sharp tooth. Chelicera chelate-dentate. Axillary sacculae absent from base of palp. Epimeral setae relatively long, thin, apparently smooth, *1b* longest, formula 3-1-3-2, seta *4c* not evident. Six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae thin, smooth. Lyrifissure *iad* adjacent and parallel to anal aperture (Fig. 3E).

Legs — Each tarsus with large empodial claw and thin, longer lateral claws. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined — Four specimens (three males and one female): Sikhote-Alin Mountains, Chope stream, Tumnin river, Vanino District, Khabarovsk Krai, Russian Far East, litter and soils under larch forest with *Bergenia pacifica*, 700 m. a.s.l., 31 August 2005, Col. N. Ryabinin; two spec-

imens (females): Khonin Nuga area, District Mandal, Province Selenge, Mongolia, litter and soils under shrubs, 49°15'N, 108°40'E, 1420 m. a.s.l., 27 July 2002, Col. B. Bayartogtokh.

Remarks — The character states of specimens examined here accord well with those studied by Pérez-Iñigo (1972, 1993), Moskacheva (1973), Seniczak (1977, 1978), Weigmann (2006) from Europe. Only the slight difference is epimeral setae of the specimens examined by us were relatively longer than those of European specimens. Seniczak (1978) showed three pairs of setae on epimere IV in tritonymph of this species, but we observed only three pairs of setae. Mahunka and Mahunka-Papp (1995) synonymized *A. acuta* Berlese, 1908 with *A. nitens* as a junior synonym of the latter species, but more recently, Subías (2004) accepted *A. acuta* as a valid species. The latter author was contrarily listed *A. nitens* as a junior synonym of *A. acuta*. However, Weigmann (2006) correctly considered *A. nitens* as a valid species, and confirmed its priority over *A. acuta*. Additionally, according to the article 23.1 of the International Code of Zoological Nomenclature, *A. acuta* cannot be deemed a senior synonym of *A. nitens* as the latter species was described earlier than the former one.

Anachipteria deficiens Grandjean, 1932 (Figs. 4 and 5)

Anachipteria deficiens: Grandjean, 1932: 301, figs. 5-7; Kunst, 1971: 572, fig. 138; Krivolutsky, 1975: 335, fig. 846; Subías, 2004: 168; Weigmann, 2006: 355, fig. 188A-D; Bayartogtokh, 2007: 358, fig. 284; 2010: fig. 84A, B.

Diagnosis — With character states of *Anachipteria* (see Balogh and Balogh, 1992 and Weigmann, 2006 for generic diagnosis); total length 510 – 620 μ m, dorsal and ventral plates with minute granular cerotegument; lamellae fused medially, but lamellar cusps well separated from each other, with large lateral dens; sensillus with fusiform head, smooth; notogastral porose areas large, round to oval in shape; coxisternal setal formula 3-1-3-2; tutorium narrow, slightly widening anteriorly in long cusp pointed distally; pedotectum I without anterior tooth.

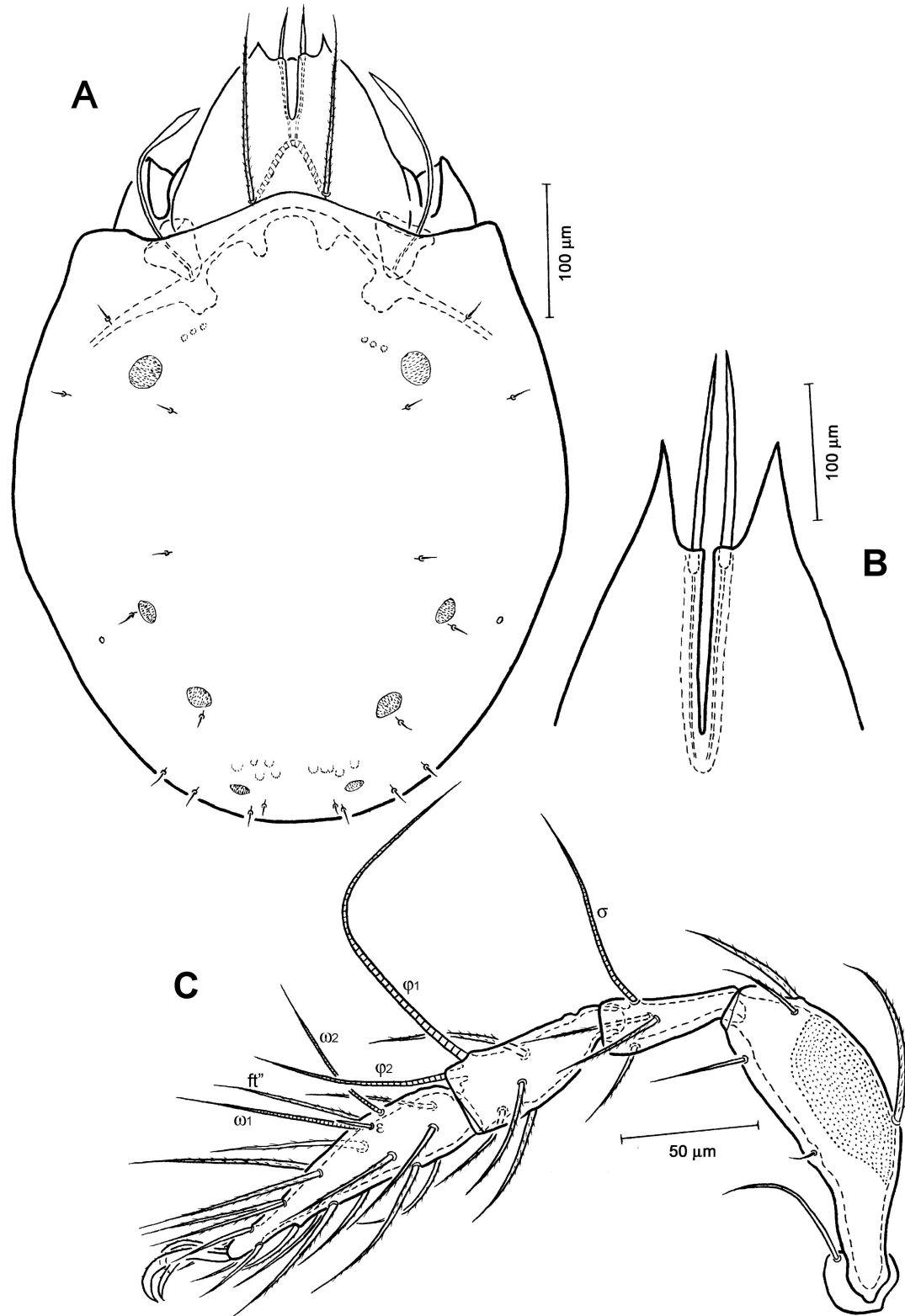


FIGURE 4: *Anachipteria deficiens* Grandjean, 1932: A – Dorsal view of idiosoma, legs omitted; B – Lamellar cusps; C – Leg I, left, antiaxial view.

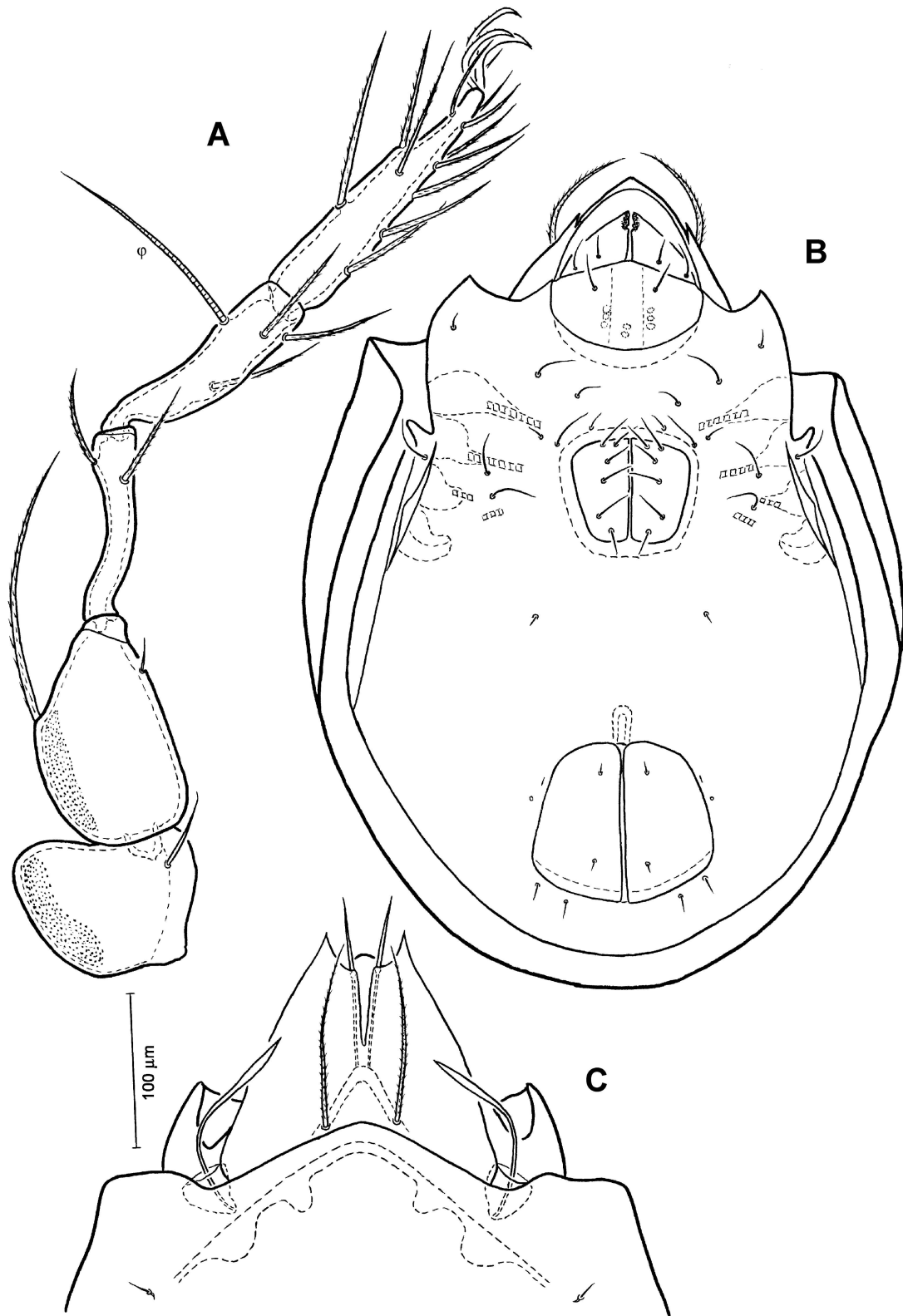


FIGURE 5: *Anachipteria deficiens* Grandjean, 1932: A – Leg IV, left, antiaxial view; B – Ventral view of idiosoma, legs omitted; C – Prodorsum and anterior part of notogaster.

Measurements — Body length: 570 – 620 (596) μm , length of notogaster 472 – 526 (494) μm , width of notogaster 416 – 462 (435) μm .

Integument — Body color dark brown, strongly sclerotized species with minute microtubercles on posterior part of notogaster, exobothridial and lenticular regions. Granular cerotegument clearly evident on subcapitular mentum, at base of prodorsum and ventral plate.

Dorsal aspect — Rostrum triangular in both dorsal and ventral views, but pointed and curved ventrally in lateral view. Rostral seta long, barbed, curving medially, and extending well beyond tip of rostrum. Lamellae fused medially, with large cusp; lateral dens of cusp large, pointed distally. Lamellar seta shorter than *ro*, moderately thick, but smooth, inserted medially on ventral side of lamellar cusp (Figs. 4B and 5C). Interlamellar seta long, fairly thick, barbed, extending anteriorly beyond tip of lamella. Exobothridial seta minute, hardly discernible. Sensillus with slightly expanded fusiform head about half total length, smooth (Figs. 4A and 5C). Notogaster slightly longer than wide, ratio 1.1:1, robust in lateral view; anterior margin subtriangular, posterior margin broadly rounded. Lenticular region weakly visible and lacking true lenticulus. Notogastral setae short, thin, smooth. Porose areas round to oval in shape, *Aa* largest, *A3* smallest; lyrifissures not evident (Fig. 4A). Lateral edge of pteromorph smooth, without striations.

Lateral aspect — Tutorium narrow, appearing pointed in dorsal aspect, but slightly widening anteriorly in distinct cusp pointed distally. Genal tooth sharply pointed distally, with genal notch extending posterior to insertion of seta *ro*. Pedotectum I well developed, fully covering acetabulum I; pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II.

Ventral aspect — Subcapitular mentum with granular cerotegument; setae *h*, *m* and *a* medium long, smooth. Capitular angle of coxisternum projecting as sharp tooth. Chelicera chelate-dentate. Axillary sacculae absent from base of palp. Epimeral setae medium long, thin, apparently smooth, formula 3-1-3-2, seta *4c* not evident. Six pairs of genital, one pair of aggenital, two pairs of anal and three

pairs of adanal setae thin, smooth. Lyrifissure *iad* adjacent and parallel to anal aperture (Fig. 5B).

Legs — Each tarsus with large empodial claw and thin, longer lateral claws serrated dorsally. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0). Setation of legs I and IV as shown in figures 4C and 5B.

Material examined — Two specimens (females): Northern slope of the Mt. Shiliin Bogd, District Dariganga, Province Suhbaatar, soils under sweetbrier, 45°28'N, 114°35'E, 1687 m a.s.l., 02 June 2003, soils under grasses; 14 specimens (six females and eight males): Basin river Minj Gol, District Batshireet, Province Khentii, Mongolia, lichens growing on the bark and twigs of larch trees in a cool temperate larch forest (*Larix sibiricus* Ledebour, 1833), 49°15'N, 108°40'E, 1420 m. a.s.l., 27 July 2002, Col. B. Bayartogtokh.

Remarks — The character states of specimens examined here accord well with those studied by Kunst (1971) and Weigmann (2006) from Europe, and some supplementary characteristics are provided here.

***Parachipteria nivalis* (Hammer, 1952)**
(Fig. 6)

Achipteria nivalis: Hammer, 1952: 64, fig. 103.

Parachipteria nivalis: Shaldybina, 1975: 342, fig. 859; Marshall *et al.*, 1987: 328.

Campachipteria nivalis: sensu Subías, 2004: 168.

Diagnosis — With character states of *Parachipteria* (see Balogh and Balogh, 1992 and Weigmann, 2006 for generic diagnosis); total length 510 – 640 μm , dorsal and ventral plates with minute granular cerotegument; lamella fused medially, lamellar cusp with large lateral dens; sensillus with club-shaped head, finely barbed; notogastral porose areas small, but clearly visible; coxisternal setal formula 3-1-3-2; tutorium narrow, slightly widening anteriorly in long cusp not pointed distally; pedotectum I without anterior tooth.

Measurements — Body length: 533 – 640 (569) μm , length of notogaster 422 – 494 (449) μm , width of notogaster 322 – 439 (362) μm .

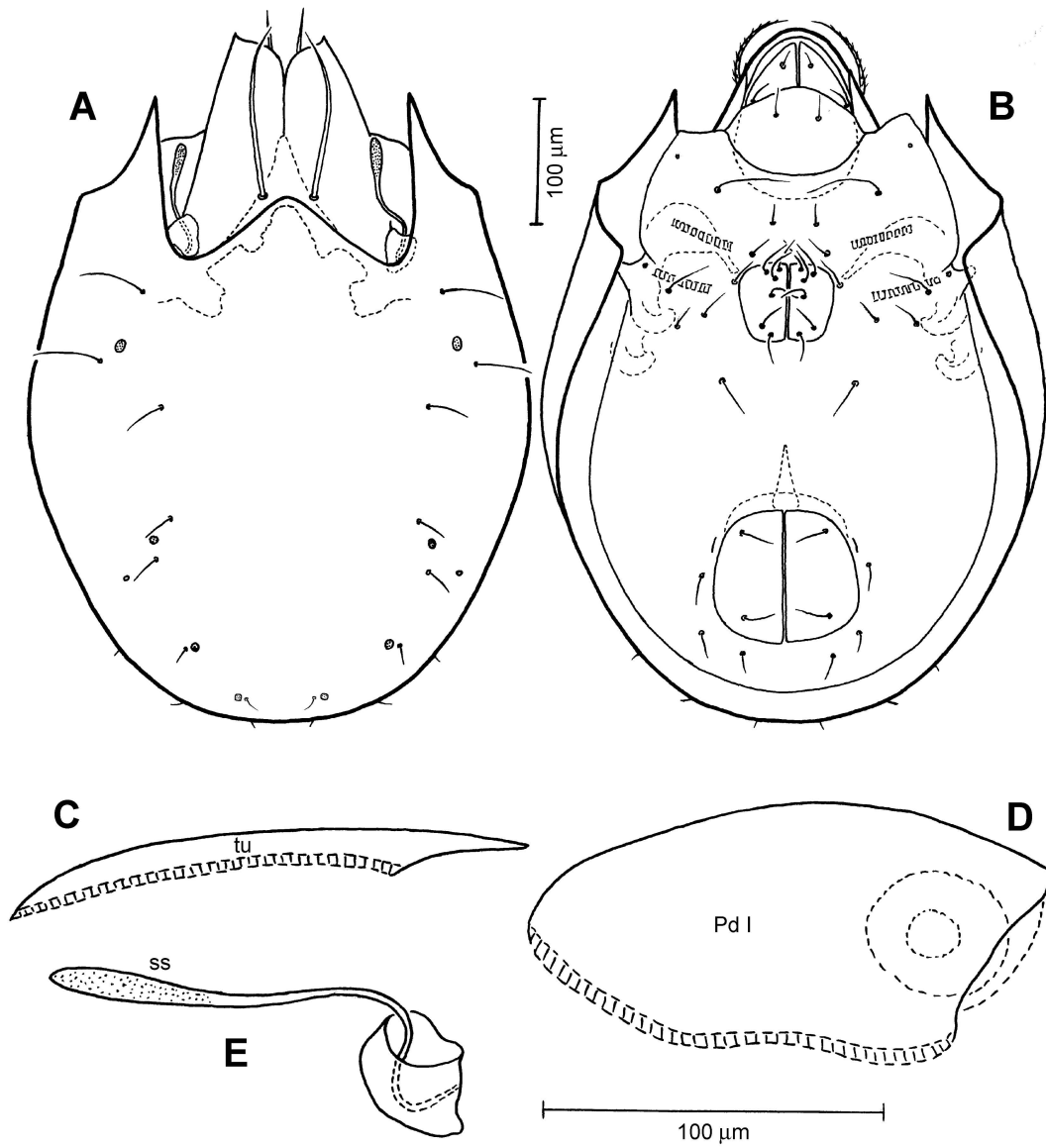


FIGURE 6: *Parachipteria nivalis* (Hammer, 1952): A – Dorsal view of idiosoma, legs omitted; B – Ventral view of idiosoma, legs omitted; C – Tutorium, right, lateral view; D – Pedotectum I, right, lateral view; E – Sensillus and bothridium, lateral view.

Integument — Body color dark brown, strongly sclerotized species with minute microtubercles on prodorsum, notogaster and podosomal region. Granular cerotegument clearly evident on notogaster, subcapitular mentum, at base of prodorsum and ventral plate.

Dorsal aspect — Rostrum rounded in dorsal view, but slightly projected and curved ventrally in lateral view. Rostral seta long, barbed, curving medially, and extending well beyond tip of rostrum. Lamellae fused medially, with large cusp; lateral dens of cusp large, pointed distally. Lamellar seta nearly as long as *ro*, moderately thick, but smooth, inserted medially on ventral side of lamellar cusp. Interlamellar seta long, fairly thick, barbed, slightly extending anteriorly beyond tip of lamella (Fig. 6A). Exobothridial seta minute, hardly discernable. Sensillus with slightly expanded club-shaped head about half total length, smooth or minutely barbed (Fig. 6E). Notogaster slightly longer than wide, ratio 1.2:1, robust in lateral view; anterior margin rounded or subtriangular, posterior margin broadly rounded. Lenticular region weakly visible and lacking true lenticulus. Notogastral setae medium long, thin, smooth; setae *c* and *la* conspicuously longer than other setae. Porose areas round to oval in shape, *Aa* and *A1* slightly larger than two others; lyrifissures not evident. Lateral edge of pteromorph smooth, without striations (Fig. 6A).

Lateral aspect — Tutorium narrow, appearing pointed in dorsal aspect, but slightly widening anteriorly in distinct cusp not sharply pointed distally (Fig. 6C). Genal tooth sharply pointed distally, with genal notch extending posterior to insertion of seta *ro*. Pedotectum I well developed, fully covering acetabulum I, without anterior tooth (Fig. 6D); pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II.

Ventral aspect — Subcapitular mentum with granular cerotegument; setae *h*, *m* and *a* medium long, smooth. Capitular angle of coxisternum not projecting. Chelicera chelate-dentate. Axillary sacculus absent from base of palp. Epimeral setae relatively long, thin, smooth, *1b* longest, setae *1c* and *3c* represented by their alveoli, seta *4c* not evident; formula 3-1-3-2. Six pairs of genital, one pair of aggen-

ital, two pairs of anal and three pairs of adanal setae thin, smooth. Lyrifissure *iad* adjacent and parallel to anal aperture (Fig. 6B).

Legs — Each tarsus with large empodial claw and thin, longer lateral claws serrated dorsally. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined — Three specimens (females): Basin river Minj Gol, Mts. Khentii, District Batshireet, Province Khentii, Mongolia, mosses growing on bark of larch tree trunk, 49°15'N, 108°40'E, 1420 m. a.s.l., 27 July 2002, Col. B. Bayartogtokh.

Remarks — The character states of specimens examined here accord well with those studied by Hammer (1952) and Shaldybina (1975) from North America and Europe, respectively, and some supplementary characteristics are provided here. Subías (2004) included *P. nivalis* in the genus *Campachipteria* Aoki, 1995, but this combination is not acceptable as the latter genus being with monodactylous legs, while *Parachipteria* have tridactylous legs, and therefore, *P. nivalis* can not be a member of the former genus.

Parachipteria bella (Sellnick, 1928)

(Fig. 7)

Notaspis bellus: Sellnick, 1928: 8.

Notaspis bellus: Willmann, 1931: 184, fig. 326.

Achipteria bellus: Grandjean, 1942: 52; 1946: 13.

Parachipteria bella: van der Hammen, 1952: 107; Sellnick, 1960: 54; Shaldybina, 1975: 340, fig. 858; Chistyakov, 1987, 2: figs. 1-9; Marshall *et al.*, 1987: p. 327; Weigmann, 2006: 357, fig. 190D, E; Seniczak and Seniczak, 2007: 535, figs. 1-37.

Campachipteria bella: sensu Subías, 2004: 168.

Diagnosis — With character states of *Parachipteria* (see Balogh and Balogh, 1992 and Weigmann, 2006 for generic diagnosis); total length 390 – 450 µm; lamellae fused medially, lamellar cusps well separated from each other, lateral dens of cusp medium in size, not sharply pointed, but nearly blunt distally; notogastral porose areas large, oval;

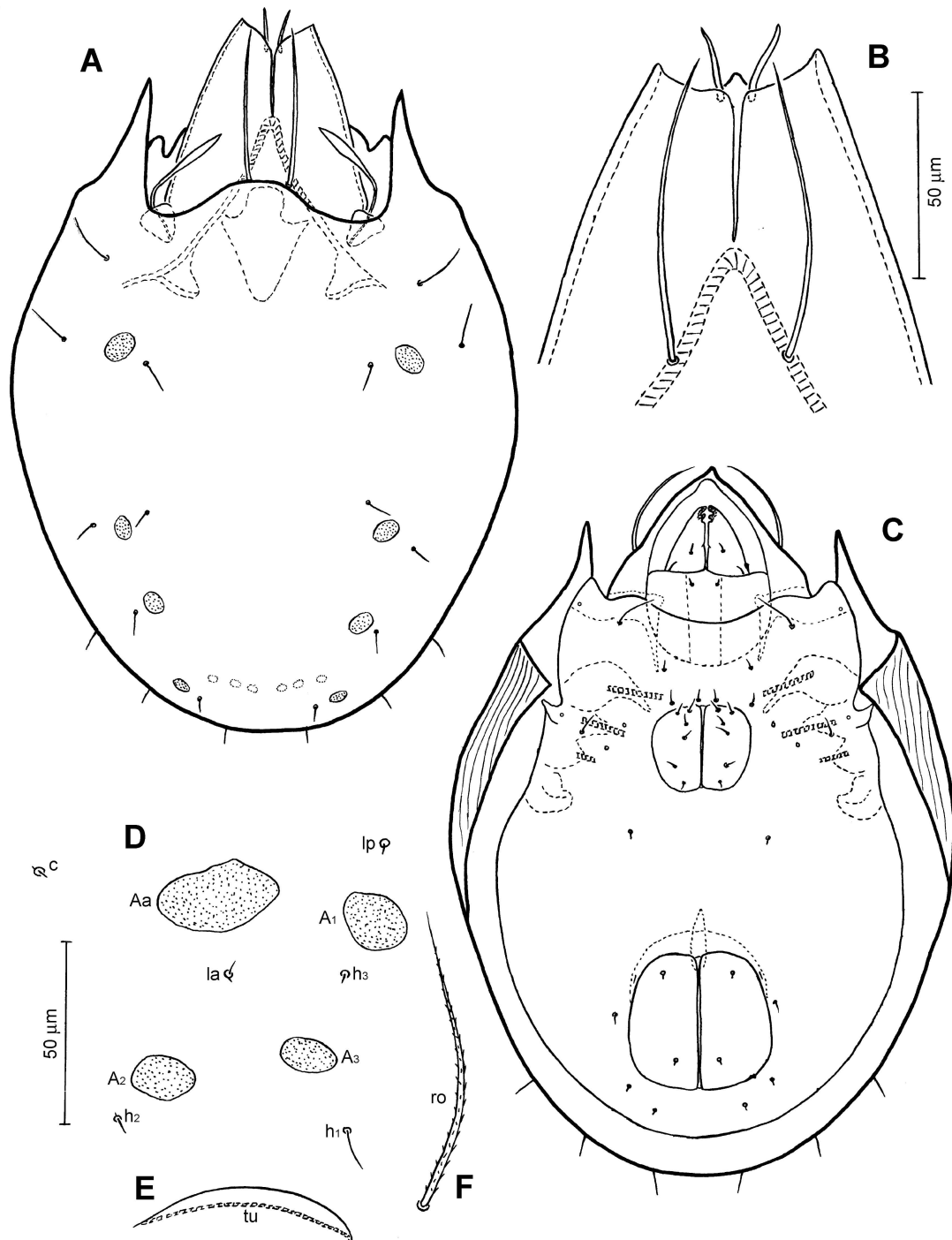


FIGURE 7: *Parachipteria bella* (Sellnick, 1928): A – Dorsal view of idiosoma, legs omitted; B – Lamellar cusps; C – Ventral view of idiosoma, legs omitted; D – Porose areas and some setae of notogaster; E – Tutorium, right, lateral view; F – Rostral seta, right.

coxisternal setal formula 3-1-3-2; tutorium narrow, without pointed cusp distally; pedotectum I smoothly rounded, without anterior tooth.

Measurements — Body length: 403 – 445 (428) μm , length of notogaster 323 – 366 (345) μm , width of notogaster 281 – 323 (303) μm .

Integument — Body color dark brown, strongly sclerotized species with minute microtubercles on prodorsum and podosomal region. Granular cerotegument clearly evident on notogaster, subcapitular mentum, at base of prodorsum and ventral plate.

Dorsal aspect — Rostrum projected in both dorsal and ventral views, curved ventrally in lateral view. Rostral seta long, smooth or finely barbed, curving medially, and extending well beyond tip of rostrum (Fig. 7C, F). Lamellae fused medially, with large cusps separated from each other; lateral dens of cusp medium in size, not sharply pointed, but nearly blunt distally. Lamellar seta shorter than *ro*, moderately thick, but smooth, inserted medially on ventral side of lamellar cusp (Fig. 7B). Interlamellar seta long, fairly thick, smooth or very finely barbed, reaching tip of lamella. Exobothridial seta minute, hardly discernable. Sensillus with slightly expanded fusiform head about half total length, smooth (Fig. 7A). Notogaster slightly longer than wide, ratio 1.2:1, robust in lateral view; anterior margin rounded or subtriangular, posterior margin broadly rounded. Lenticular region clearly visible, but lacking true lenticulus. Notogastral setae medium long, thin, smooth; setae *c* and *la* conspicuously longer than other setae. Porose areas oval in shape, *Aa* largest, *A3* smallest, two other porose areas same in size; lyrifissures not evident (Fig. 7A and D). Lateral edge of pteromorph with striations (Fig. 7C).

Lateral aspect — Tutorium narrow, without pointed cusp distally (Fig. 7E). Genal tooth not sharply pointed distally, but indistinct. Pedotectum I well developed, fully covering acetabulum I, without anterior tooth; pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II.

Ventral aspect — Subcapitular mentum with minute granular cerotegument; setae *h*, *m* and *a* short, smooth. Capitular angle of coxisternum not

projecting. Chelicera chelate-dentate. Axillary sacculus absent from base of palp. Epimeral seta *1b* long, other setae minute or represented by their alveoli, formula 3-1-3-2, seta *4c* not evident. Six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae short, thin, smooth. Lyrifissure *iad* adjacent and parallel to anal aperture (Fig. 7C).

Legs — Each tarsus with large empodial claw and thin, longer lateral claws serrated dorsally. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined — Twenty-one specimens (15 males and six females): Close to village Plastun, District Ternei, Primorsk Krai, Russian Far East, litter of oak forest, 15 June 2005, Col. A. Zaytsev.

Remarks — The character states of specimens examined here accord well with those studied by Sellnick (1928), Willmann (1931) and Weigmann (2006) from Europe, and some supplementary characteristics are provided here. In the species list of world oribatid mites, Subías (2004) included *P. bella* in the genus *Campachipteria* Aoki, 1995, but this combination was not accepted by Weigmann (2006). Indeed, *Campachipteria* being with monodactylous legs, while *Parachipteria* have tridactylous legs, and therefore, *P. bella* can not be a member of the former genus.

Parachipteria punctata (Nicolet, 1855) (Fig. 8)

Oribata punctatus: Nicolet, 1855: 434.

Notaspis punctatus: Sellnick, 1928: 8; Willmann, 1931: 183, figs. 315-317; Balogh, 1943: 97, tab. 17, fig. 11; Tuxen, 1943: 333.

Achipteria punctatum: Forsslund, 1944: 102; Schweizer, 1956: 335, fig. 296.

Notaspis italicus: *sensu* Willmann, 1931: 183 (non Oudemans).

Parachipteria punctata: van der Hammen, 1952: 107, figs. 10a, d-f, 11a, e; Bulanova-Zachvatkina, 1956: 217, fig. 295; Sellnick, 1960: 54; Shaldybina, 1975: 342, fig. 856; Marshall *et al.*, 1987: 328; Beck and

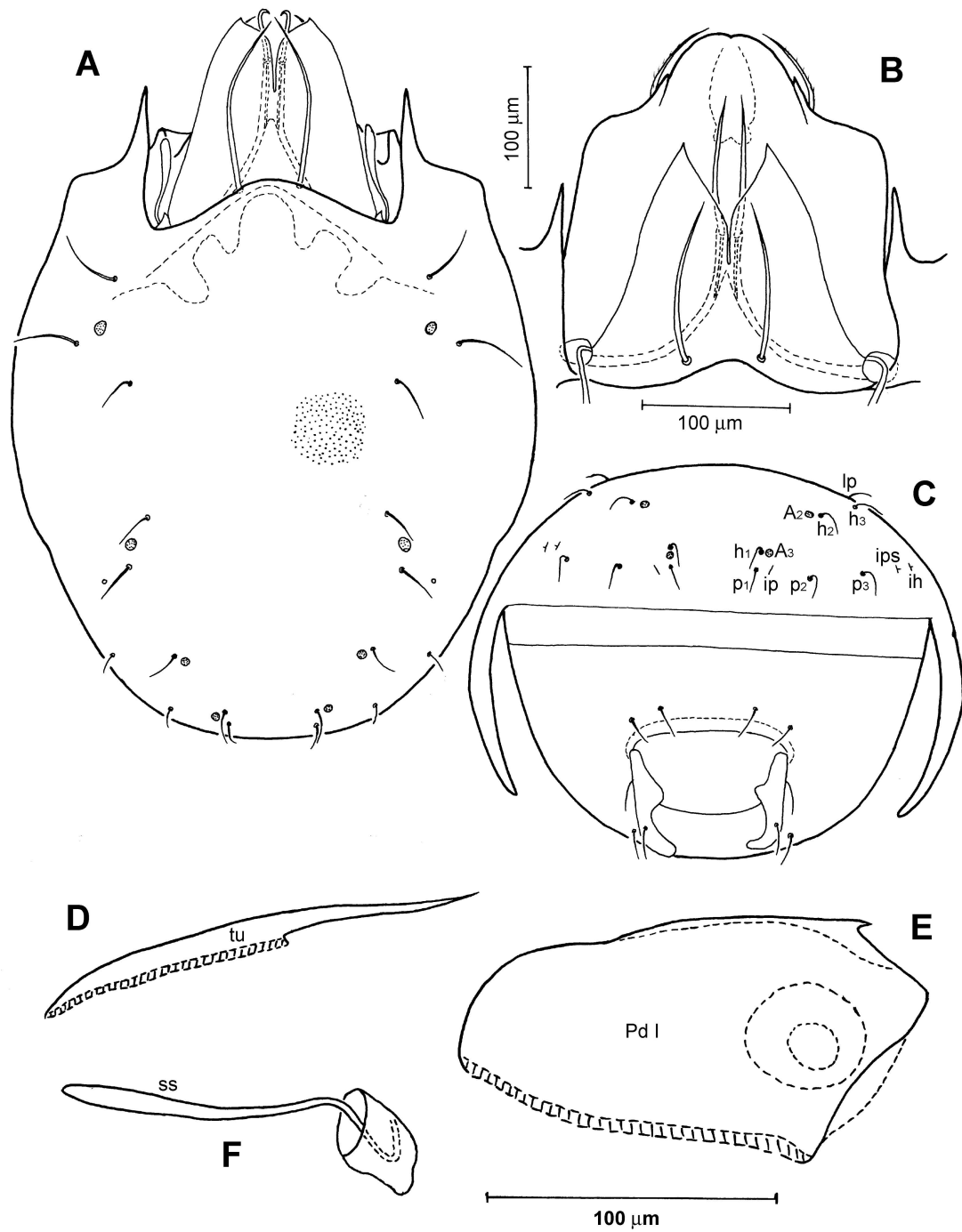


FIGURE 8: *Parachipteria punctata* (Nicolet, 1855): A – Dorsal view of idiosoma, legs omitted; B – Dorso-frontal view of prodorsum; C – Posterior view of opisthosoma; D – Tutorium, right, lateral view; E – Pedotectum I, right, lateral view; F – Sensillus and bothridium, lateral view.

Woas, 1991: 79, fig. 18; Pérez-Iñigo, 1993: 126; Subías, 2004: 169; Weigmann, 2006: 357, fig. 190A, B; Bayartogtokh, 2007: 360, fig. 285; 2010: 330, fig. 84O.

Diagnosis — With character states of *Parachipteria* (see Balogh and Balogh, 1992 and Weigmann, 2006 for generic diagnosis); total length 475 – 605 μm , dorsal and ventral plates with strong granular cerotegument; lamellae fused medially, lamellar cusp with large lateral dens; sensillus with club-shaped head, smooth; notogastral porose areas small, poorly visible; coxisternal setal formula 3-1-3-2; tutorium narrow, slightly widening anteriorly in long, narrow cusp pointed distally; pedotectum I with distinct anterior tooth.

Measurements — Body length: 563 – 605 (586) μm , length of notogaster 452 – 496 (469) μm , width of notogaster 392 – 441 (418) μm .

Integument — Body color dark brown, strongly sclerotized species with minute microtubercles on prodorsum, notogaster and podosomal region. Granular cerotegument strongly developed at base prodorsum, notogaster, subcapitular mentum, and ventral plate.

Dorsal aspect — Rostrum rounded or slightly concave in dorsal view, but conspicuously projected and curved ventrally in lateral view. Rostral seta long, barbed, curving medially, and extending well beyond tip of rostrum. Lamellae fused medially, with large cusp; lateral dens of cusp large, pointed distally. Lamellar seta nearly as long as *ro*, moderately thick, but smooth, inserted medially on ventral side of lamellar cusp. Interlamellar seta long, fairly thick, smooth, slightly extending anteriorly beyond tip of lamella (Fig. 8A and B). Exobothridial seta minute, hardly discernable. Sensillus with slightly expanded club-shaped head about half total length, smooth (Fig. 8F). Notogaster slightly longer than wide, ratio 1.1:1, robust in lateral view; anterior margin rounded, posterior margin broadly rounded. Lenticular region weakly visible and lacking true lenticulus. Notogastral setae medium long, thin, smooth; setae *c* and *la* conspicuously longer than other setae. Porose areas nearly round in shape, *Aa* and *A1* slightly larger than two others; lyrifissures *im* not evident, *ih*, *ips* and *ip* well devel-

oped (Fig. 8A and C). Lateral edge of pteromorph with granules.

Lateral aspect — Tutorium narrow, appearing pointed in dorsal aspect, but slightly widening anteriorly in long, narrow cusp pointed distally (Fig. 8D). Genal tooth sharply pointed distally, with genal notch extending posterior to insertion of seta *ro*. Pedotectum I well developed, fully covering acetabulum I, with distinct anterior tooth (Fig. 8E); pedotectum II small, ear-shaped, covering less than a quarter of acetabulum II.

Ventral aspect — Subcapitular mentum with granular cerotegument; setae *h*, *m* and *a* medium long, smooth. Capitular angle of coxisternum not projecting. Chelicera chelate-dentate. Axillary sacculcule absent from base of palp. Epimeral setae relatively long, thin, apparently smooth, formula 3-1-3-2, seta *4c* not evident. Six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae thin, smooth. Lyrifissure *iad* adjacent and parallel to anal aperture.

Legs — Each tarsus with large empodial claw and thin, longer lateral claws serrated dorsally. Formula of setation, including famulus: I (1-5-3-4-20), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-2-3-12), formula of solenidia I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0).

Material examined — Twenty-three specimens (nine males and 14 females): Sevsuul valley, Eastern shore of the Lake Hövsgöl, District Khankh, Province Hövsgöl, lichens growing on the bark of larch tree trunk in a cool temperate larch forest (*Larix sibiricus* Ledebour, 1833), 51°16'N, 100°74'E, elevation 1680 m, 8 July 2007, Col. B. Bayartogtokh.

Remarks — The body size of the Mongolian specimens were relatively larger than those of the European specimens. The other character states of specimens examined here accord well with those studied by van der Hammen (1952), Beck and Woas (1991), Pérez-Iñigo (1993), Weigmann (2006) from Europe, and some supplementary characteristics are provided here.

DISCUSSION

In the comprehensive checklist of oribatid mites of Russian Far East, Pan'kov *et al.* (1997), and Ryabinin and Pan'kov (2002) presented 15 species of Achipteriidae belonging to three genera, of which 14 are named species. According to Ryabinin (2011), Achipteriidae is one of the 12 largest families of oribatid mites in the Russian Far East in terms of species richness. Among Achipteriidae known from Russian Far East, two genera, *Achipteria* Berlese, 1885 and *Parachipteria* van der Hammen, 1952 are distinguished from the third genus, *Anachipteria* Grandjean, 1935 by their high species diversity, where these taxa involving five, six and three species, respectively.

Most of achipteriid species found in Russian Far East are known and widely distributed in vast areas of the northern hemisphere. Thus, *Achipteria coleoptrata* (Linnaeus, 1758), *A. curta* Aoki, 1970, *A. nitens* (Nicolet, 1855), *Anachipteria howardi* (Berlese, 1908), *Parachipteria bella* (Sellnick, 1928), *P. nivalis* (Nicolet, 1855), *P. punctata* (Nicolet, 1855) and *P. willmanni* van der Hammen, 1952 are known to be distributed through Holarctic region. Some of these species were also recorded from other biogeographic regions, e.g. in addition to their common distributions in Europe (everywhere), North America (USA and Canada), and Asia (Russian Far East, Siberia, Kazakhstan, Mongolia and Japan), *A. coleoptrata*, *A. curta* and *P. punctata* are reported from India, Vietnam, subtropical part of China and Santa Helena islands (Wallwork, 1977; Haq and Suman-gala, 2003; Wang *et al.*, 2003; Chen *et al.*, 2010; Subías, 2011). Several other species, such as *Anachipteria deficiens* Grandjean, 1935, *A. grandis* Aoki, 1966 and *Parachipteria distincta* (Aoki, 1959) have also fairly wide distributions in the Palaearctic region. Only three species, *Achipteria setulosa* Golosva, 1981, *A. verrucosa* Ryabinin, 1974 and *Parachipteria sibirica* Krivolutsky and Grishina, 1970 have restricted distributions in the Russian Far East, Siberia and Mongolia (Grishina and Krivolutsky, 1970; Krivolutsky and Ryabinin, 1974; Golosova, 1981; Golosova *et al.*, 1983; Ryabinin and Pan'kov, 2002; Bayartogtokh, 2010).

The continental part of the Russian Far East con-

tains 13 species, in the meantime, the island part, such as Sakhalin, Kamchatka and the Kuril Islands are involved only five known species of Achipteriidae. Among the various areas in the Russian Far East, two of them, such as Khabarovsk and Primorie areas differ from others with high diversity of achipteriid mites (10 spp. each), followed by Amur area (9 spp.). Two other areas as Sakhalin and Kuril islands show relatively low diversity, where only five and two species are recorded, respectively. The Kamchatka, Magadan and Chukotka areas have no recorded species of Achipteriidae (Ryabinin, 2011).

As for Mongolian Achipteriidae, only six species are known from this country, and all of them were recorded in the Russian Far East. Among them, *A. coleoptrata*, *A. nitens*, *Anachipteria deficiens* and *Parachipteria nivalis* are rather common in the country, especially in its northern, central and eastern regions. Two other species, *Achipteria verrucosa* and *Parachipteria punctata* are relatively rare, and found only in central and northeastern parts of the country (Bayartogtokh, 2010, 2011).

Most species of Achipteriidae in Mongolia and Russian Far East are the inhabitants of the litter of various forests, soils of grasslands and mosses growing on rocks or forest floor. Only two species seem to be arboreal inhabitants. They are *P. nivalis* and *A. deficiens*, and both the species are found to be inhabitants of corticolous covers like epiphytic lichens and mosses growing on larch trees. This is well known that some species of Achipteriidae abundantly found and to be numerically dominant in the arboreal habitats and sampling frequently yields new taxa that appear restricted to this specific environment (Behan-Pelletier and Winchester, 1998; Behan-Pelletier and Walter, 2000; Lindo and Winchester, 2006; Root *et al.*, 2007; Lindo *et al.*, 2008).

In conclusion, the following key can be used to identify the adults of all known species of Achipteriidae in Mongolia and Russian Far East.

**A key to adults of known species of
Achipteriidae in Mongolia and Russian Far East**

1. Octotaxic system expressed as four pairs of notogastral porose areas 2
— Octotaxic system expressed as four pairs of notogastral saccules instead of porose areas (*Achipteria*)..... 3
2. A knife-like humeral projection of pteromorph lacking (*Anachipteria*).....7
— Pteromorph with a knife-like humeral projection (*Parachipteria*) 9
3. Lamellar and interlamellar setae long, extending beyond anterior tip of lamella 4
— Lamellar and interlamellar setae short, not reaching anterior tip of lamella.....
.....*Achipteria setulosa* Golosova, 1981
4. Lamellar cusp with large lateral dens or rounded, sensillus long 5
— Lamellar cusp without lateral dens, but medially with 3-4 small dens, sensillus short.....*A. curta* Aoki, 1970
5. Notogastral setae well developed; lamellar cusp rounded distally or with relatively small lateral dens 6
— Notogastral setae minute or represented by their alveoli; lamellar cusp with large lateral dens.....*A. coleoptrata* (Linnaeus, 1758)
6. Notogastral setae long, especially setae *c* and *la* very long; lamellar cusp with small lateral dens or blunt at tip; pedotectum I with anterior tooth.....*A. nitens* (Nicolet, 1855)
— Notogastral setae short; lamellar cusp rounded, without lateral dens; pedotectum I without anterior tooth.....*A. verrucosa* Rjabinin, 1974
7. Sensillus fusiform or lanceolate, long, extending far anterior to pedotectum I; lamellar seta smooth; lamellar cusp without medial dens 8
— Sensillus club-shaped, short, not reaching level of the anterior end of pedotectum I; lamellar seta

- barbed; lamellar cusp with small, but distinct medial dens *Anachipteria grandis* Aoki, 1966
8. Lateral dens of lamellar cusp large; sensillus fusiform, smooth *A. deficiens* Grandjean, 1932
— Lateral dens of lamellar cusp small; sensillus lanceolate, barbed *A. howardi* (Berlese, 1908)
9. Interlamellar setae long, reaching to or extending beyond tip of lamellar cusp; humeral projection of pteromorph extending anterior level of pedotectum I; sensillus without long setiform distal part 10
— Interlamellar setae very short, not reaching to middle level of lamella; humeral projection of pteromorph not reaching anterior level of pedotectum I; sensillus fusiform, with long setiform distal part.....
Parachipteria sibirica Krivolutsky and Grishina, 1970
10. Relatively small species with 390-450 µm body length; notogastral porose areas large 11
— Relatively large species with larger than 500 body length; notogastral porose areas small 12
11. Lamellar cusp with blunt, but distinct medial dens; region between medial and lateral dens of lamellar cusp deeply concaved; interlamellar setae extending beyond anterior end of lamella; notogastral setae relatively long, flagellate.....*P. distincta* (Aoki, 1959)
— Lamellar cusp without medial dens; region between medial and lateral dens of lamellar cusp not concaved; interlamellar setae not extending beyond anterior end of lamella; notogastral setae relatively short, not flagellate *P. bella* (Sellnick, 1928)
12. Porosa area *Aa* relatively large, distinct; pedotectum I without anterior tooth; tutorium with medium-sized distal cusp; notogaster without granular punctuations 13
— Porosa area *Aa* very small, almost indistinct; pedotectum I with small anterior tooth; tutorium with large, distally tapered cusp; notogaster with large granular punctuations ... *P. punctata* (Nicolet, 1855)

13. Pedotectum I with strong distal tooth; tutorium with narrow, thin cusp.....
.....*P. willmanni* van der Hammen, 1952
— Pedotectum I without distal tooth, but smoothly rounded; tutorium with wide, distally rounded cusp *P. nivalis* (Hammer, 1952)

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