



## New species and new records of millipedes of the genera *Nepalmatoiulus* Mauriès, 1983 and *Anaulaciulus* Pocock, 1895 (Diplopoda, Julida, Julidae) from mainland China

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### Abstract

Four new species of the millipede genus *Nepalmatoiulus* Mauriès, 1983 and one of *Anaulaciulus* Pocock, 1895 (Julida, Julidae) are described from Yunnan Province in China: *N. davidiani* **sp. nov.**, *N. jianchuanensis* **sp. nov.**, *N. lancangensis* **sp. nov.**, *N. shiguensis* **sp. nov.** and *A. shibaensis* **sp. nov.** New faunistic records are given for *N. degenensis* Mikhaljova, 2020b and *N. tuoxiaensis* Mikhaljova, 2023a. Taxonomic remarks are provided for nearly all new species. The occurrence of *Anaulaciulus inaequipipes* Enghoff, 1986 in China is being questioned.

**Key words:** new taxa, description, faunistics, southeast China

### Introduction

This paper continues to present the results of research on a collection of Chinese Julidae (mainly specimens of the genus *Nepalmatoiulus* Mauriès, 1983) stored in the Zoological Museum, State University of Moscow (Russia). This time, among the material, in addition to *Nepalmatoiulus*, samples of the genus *Anaulaciulus* Pocock, 1895 were found, which turned out to be representatives of a species new to science.

A historical account of research on the genus *Nepalmatoiulus* can be found in the publications of Enghoff (1987), Korsós & Lazányi (2013), Zhang *et al.* (1997), Mikhaljova (2020a, 2020b, 2023a, 2023b). A fairly large genus *Anaulaciulus* (ca. 50 species) is distributed in all Japan and Korea, the Russian Far East, northern Myanmar, Pakistan, India and Nepal, Taiwan, central and eastern China, as well as probably Bhutan. At present, 8 species of *Anaulaciulus* (including the new species described below) are known from mainland China (Golovatch & Liu 2020; Mikhaljova 2020a).

The present contribution describes five new species, four in the genus *Nepalmatoiulus*, one in the genus *Anaulaciulus*. In addition, new faunistic records are given for *N. degenensis* Mikhaljova, 2020b and *N. tuoxiaensis* Mikhaljova, 2023a.

### Material and methods

Material treated here is kept in the collection of the Zoological Museum of the State University of Moscow, Russia (ZMUM).

Specimens were kept in 70–75% ethanol. During the study, the gonopods and some other parts were dissected from a limited number of specimens and mounted in glycerin as temporary micro-preparations. Specimens were studied using standard stereomicroscopic and microscopic equipment. SEM micrographs were prepared at the Centre for Collective Use “Biotechnology and Gene Engineering” of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences (FSCB) in Vladivostok, Russia,

using a Merlin 62–15 scanning electron microscope. Mounts for SEM were cleaned in an ultrasonic bath (50 Hz) for 5 to 10 seconds, and then were further prepared by air-drying after transfer to acetone from 96% alcohol, mounting on stubs, and coating with chromium. After examination, SEM material was removed from stubs and returned to alcohol. SEM images were edited in Adobe Photoshop.

A “body ring formula” indicates the number of podous (including gonopod ring and collum) and apodous rings before the telson in an individual. This formula is  $x(-y)$  where  $x$  = sum of podous and apodous body rings excluding telson and  $y$  = number of apodous body rings before telson.

The term “nonapical stipital setae of gnathochilarium” means a field of setae at level with or slightly basal to promentum (after Enghoff 1987). The term “limbus” means the hyaline posterior edge of metazonite (after Enghoff 1987). The term “coxa 2 with one or two mesapical oral setae” means the setae directed to the body front (after Enghoff 1987).

The term “coloration of the usual julid type” means a colour pattern of dark/light spots and stripes similar to that of many other Julidae (after Enghoff 1982) such pattern is described for *Cylindroiulus* by Enghoff (1982, figs 11–12, 20–22).

## Taxonomic part

### *Nepalmatoiulus davidiani* sp. nov.

Figs 1–9

**Material examined.** Holotype: 1 male (ZMUM), China, Yunnan Province, NW of Jianchuan, 10.5 km WNW Shuanghecun, 26°36'59" N, 99°46'34" E, H = 2870 m, 16.05. 2016, leg. I. Kabak, G. Davidian.

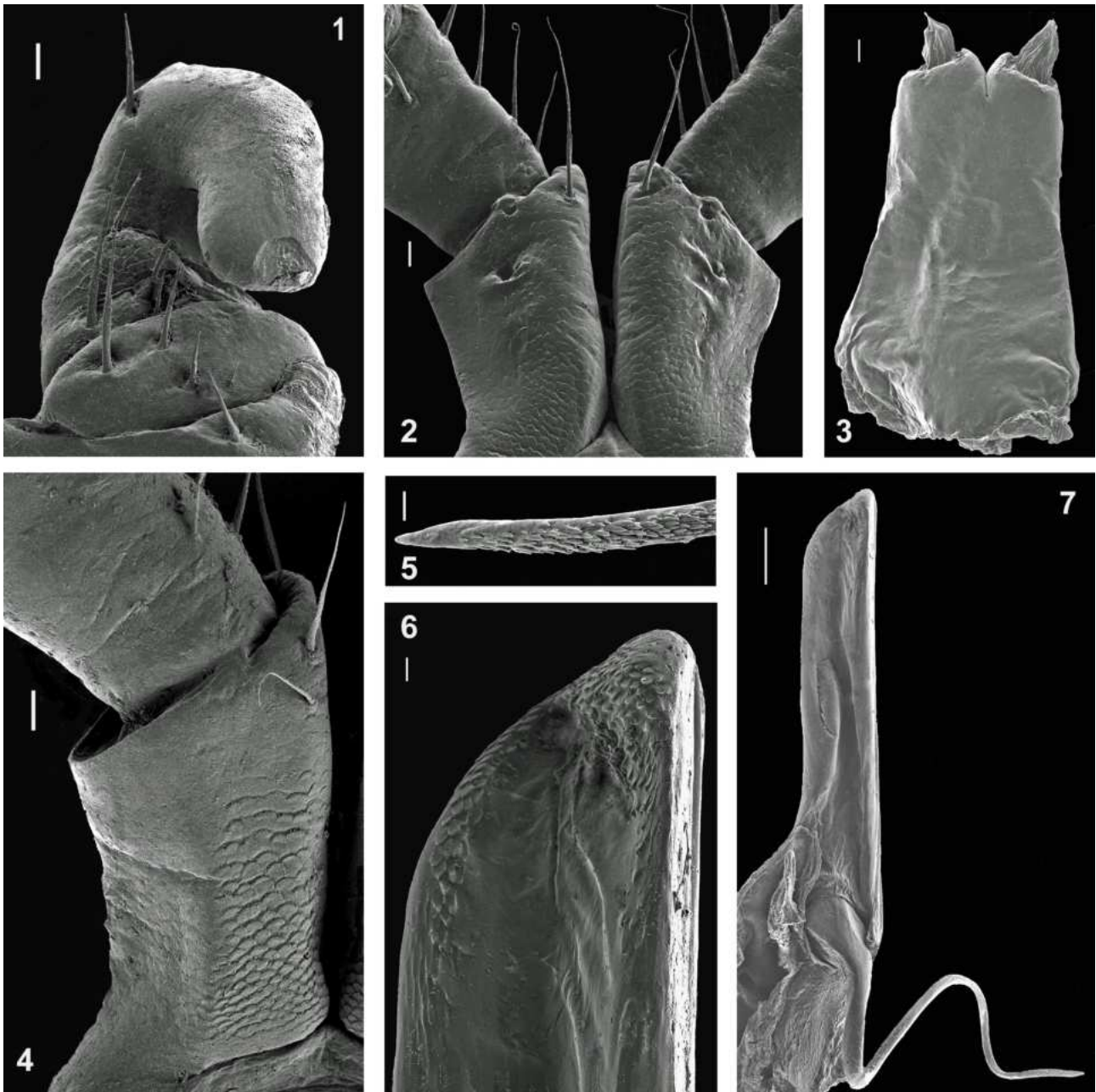
**Diagnosis.** Differs from Chinese congeners mainly by the combination of: male coxa 2 with one and two mesapical oral setae anteriorly and posteriorly, respectively; a strongly obliquely rounded apex of gonopod promere; relatively small body size; colour pattern of the usual julid type (after Enghoff 1982) of rings below ozopore level. Configuration of gonopod opisthomere in *N. davidiani* sp. nov. similar to *Nepalmatoiulus angustus* Mikhaljova, 2023b and *N. shiguensis* sp. nov., but differs from both of them by specific characters (see Remarks below).

**Description.** *Male.* Length in alcohol about 18.0 mm, midbody vertical diameter about 1.4 mm, with 53(-3) rings, excluding telson. Coloration in alcohol dark brown with broad longitudinal slightly lighter dorsal stripe; rings below ozopore level, head, collum and pregonopodal rings of the usual julid type (after Enghoff 1982). Venter including basal parts of legs beige. Distal parts of legs marbled brown. Antennae brown, eyes black.

Head smooth, 2 epicranial setae, 4 supralabral setae; at least 24 labral setae. Eye patch almost oval, composed of at least 40 ommatidia in holotype. Antennae medium-sized, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica. Mandibular stipites with subtriangular smooth lobes. Gnathochilarium with about 10 nonapical stipital setae; lamellae linguales each with 5 setae arranged longitudinally. Collum laterally with distinct striae of different lengths at posterior margin, the first of which (the longest striae) reaching to anterior margin, dorsally with distinct short striae at posterior margin. A transverse row of very sparse thin setae at hind edge of collum.

Body rings circular. Metazona with dense, regular, longitudinal striae reaching hind margin (15–16 striae in an approximate square with sides equal to metazonal length of a dorsal side of a midbody ring). Limbus straight, smooth (of Type 1 in Enghoff 1987). A transverse row of sparse, thin setae at hind edge of metazonites, setae gradually growing denser and longer toward telson. Ozopores small, lying behind suture dividing pro- and metazona, set off from the suture on almost all rings, in touch with suture only in the most posterior ones. Telson with caudal dorsal projection straight and long, covered with setae and carrying at tip a claw-shaped process curved dorsad. Preanal ring, anal valves, and subanal scale densely setose.

Legs relatively short and slender. Very delicately serrate ventral pads present on postfemur and tibia, starting from legs 2. Claw of all legs at base with a long (longer than claw) setiform accessory claw ventrally. Leg pair 1 forming hook, the distal podomere not coming into close contact with the basal podomeres (“open hook” type in Enghoff 1987); postfemur with inflated scaly-rugose ventral surface, tip indistinctly wrinkled, coxa with one seta, distal segment with one seta laterally and minute seta tarsal remnant (Fig. 1). Coxa 2 with one long mesapical oral seta anteriorly (Fig. 2) and shorter two ones posteriorly (Fig. 4), gland opening positioned in apical and axial position *sensu* Enghoff (1987). Penis subtrapezoidal, about 1.6 times longer than wide (Fig. 3).



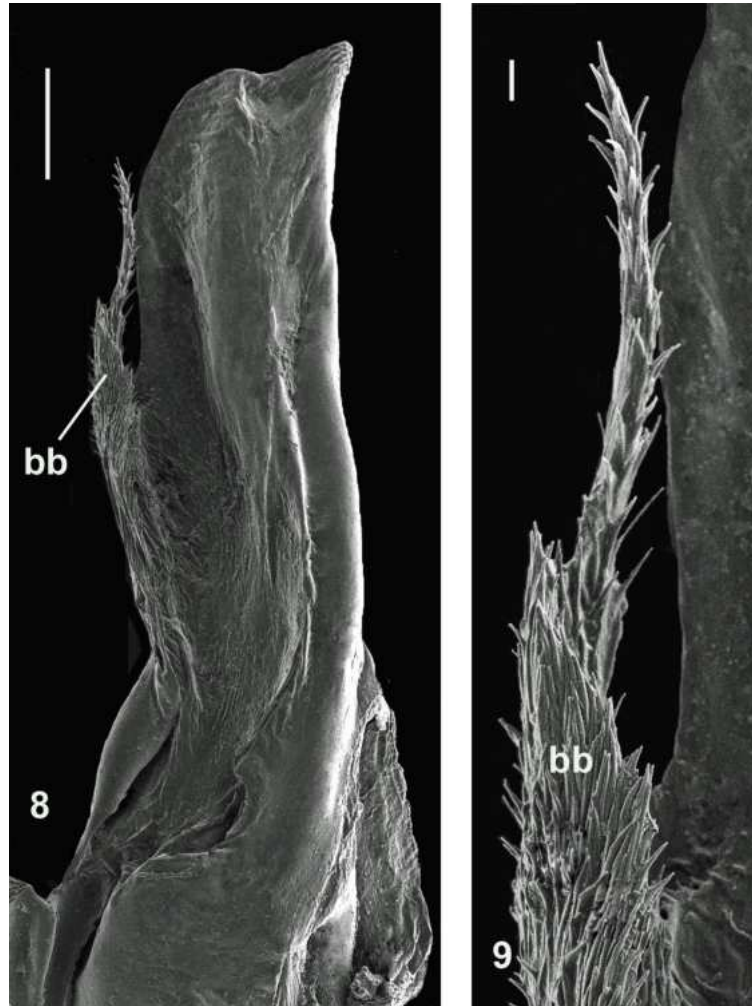
**FIGURES 1–7.** *Nepalmatoiulus davidiani* sp. nov., male holotype (ZMUM). 1. Leg 1, anterior view. 2. Coxae 2, anterior view. 3. Penis, caudal view. 4. Coxa 2, posterior view. 5. Apex of flagellum. 6. Distal part of right promere. 7. Right promere, posterior view. Scales: 10  $\mu$ m (Figs 5, 6), 20  $\mu$ m (Figs 1, 2, 3, 4), 100  $\mu$ m (Fig. 7).

Gonopods slightly protruding. Anterior gonopod flattened, with parallel margins, apically strongly obliquely rounded, in posterior view apically excavated for accommodation of mesomeral process, distal margins of the excavation papillate (Figs 6–7). Flagellum slender, of medium length, caudally covered with cuticular conical spikes (Fig. 5). Opisthomere slender (Fig. 8). Mesomeral process slightly arched forward, its apex covered with papillae. Margin of velum smooth, arcuate, with a deep notch near the mesomeral process. Additional membrane with a serrate edge. Solenomere spinose throughout, basally with blade (**bb**) (Figs 8–9).

**Etymology.** Honours Genrikh Davidian, one of the collectors of this material. A noun in genitive.

**Remarks.** *Nepalmatoiulus davidiani* sp. nov. differs from *N. angustus* mainly by the smaller body length (about 18.0 mm) and larger midbody vertical diameter (about 1.4 mm) (vs. length—32.0–34.0 mm, midbody vertical diameter—about 2.5 mm in *N. angustus*), by the coloration of the usual julid type of rings below ozopore

level, (vs. from dark gray with a pale swoop to gray-dark brown in *N. angustus*), by the strongly obliquely rounded apex of gonopod promere, by the male coxa 2 with one mesapical oral seta anteriorly (vs. male coxa 2 with two ones anteriorly in *N. angustus*), by the distal podomere of the male legpair 1 with one seta laterally and minute seta tarsal remnant (vs. distal podomere of the male legpair 1 without seta laterally and tarsal remnant in *N. angustus*), by the long (longer than claw) setiform accessory claw ventrally in claw of all legs (vs. short, (equal to claw length) setiform accessory claw ventrally in claw of all legs in *N. angustus*).



**FIGURES 8–9.** *Nepalmatoiulus davidiani* sp. nov., male holotype (ZMUM). **8.** Opisthomere, mesal view. **9.** Solenomere, mesal view. **Abbreviation:** bb, basal blade. Scales: 10  $\mu$ m (Fig. 9), 100  $\mu$ m (Fig. 8).

### *Nepalmatoiulus deqenensis* Mikhaljova, 2020

*Nepalmatoiulus deqenensis* Mikhaljova 2020b: pp. 110–113, figs 37–46.

**Material examined.** 1 male (ZMUM), China, Yunnan Province, Mekong/Yangtze div. Ge Shiyingba, 4 km ENE Lidingguang, 27°47'08" N, 99°08'00" E, H = 3790 m, 3.06. 2017, leg. I. Belousov, I. Kabak.

**Distribution.** China.

**Remarks.** This species has hitherto been known only from China, Yunnan Province, Deqen, Weixi, Dewei Line Mt. Range between Xiaruolisuzuxiang & Yezhizhen, its *terra typica* (Mikhaljova 2020b).

*Nepalmatoiulus jianchuanensis* sp.nov.

Figs 10–20

**Material examined.** Holotype: 1 male (ZMUM), China, Yunnan Province, NW of Jianchuan, 12.4 km WNW Shuanghecun, 26°37'41" N, 99°45'34" E, H = 3270 m, 17.05. 2016, leg. I. Kabak, G. Davidian. Paratype: 1 female (ZMUM), same data as for holotype.

**Diagnosis.** Differs from Chinese congeners mainly by the combination of: slender opisthomere without a velum notch near apex of mesomeral process; broad setose solenomere with short subapical branch spinose anteriorly; apically strongly obliquely rounded promere. Similar to *Nepalmatoiulus arcuatus* Mikhaljova, 2023b and *N. lancangensis* sp. nov. in the general configuration of gonopods, but differs from both by specific characters (see Remarks below and Remarks to *N. lancangensis* sp. nov.).

**Description.** *Male.* Length in alcohol about 22.0 mm, midbody vertical diameter about 1.9 mm, with 51(-2) rings, excluding telson. Coloration in alcohol brown-gray, with a broad dorsal light longitudinal stripe. Venter including basal parts of legs beige. Distal parts of legs marbled dark brown. Antennae dark brown, eyes black.

Head smooth, 2 epicranial setae, 4 supralabral setae; at least 26 labral setae. Eye patch almost oval, composed of at least 40 ommatidia in holotype. Antennae medium-sized, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica. Mandibular stipites with oval smooth lobes. Gnathochilarium with at least 10 nonapical stipital setae; lamellae linguales each with 6–7 setae arranged longitudinally. Collum laterally with distinct striae of different lengths at posterior margin, the first of which (the longest striae) reaching to anterior margin, dorsally with distinct short striae at posterior margin. A transverse row of very sparse thin setae at hind edge of collum.

Body rings circular. Metazona with dense, regular, longitudinal striae reaching hind margin (15–16 striae in an approximate square with sides equal to metazonal length of a dorsal side of a midbody ring). Limbus straight, smooth (of Type 1 in Enghoff 1987). A transverse row of sparse, thin setae at hind edge of metazonites, setae gradually growing denser and longer toward telson. Ozopores small, lying behind suture between pro- and metazona without touching it. Telson with caudal dorsal projection straight and long, covered with setae and carrying at tip a claw-shaped process curved dorsally. Preanal ring, anal valves, and subanal scale densely setose.

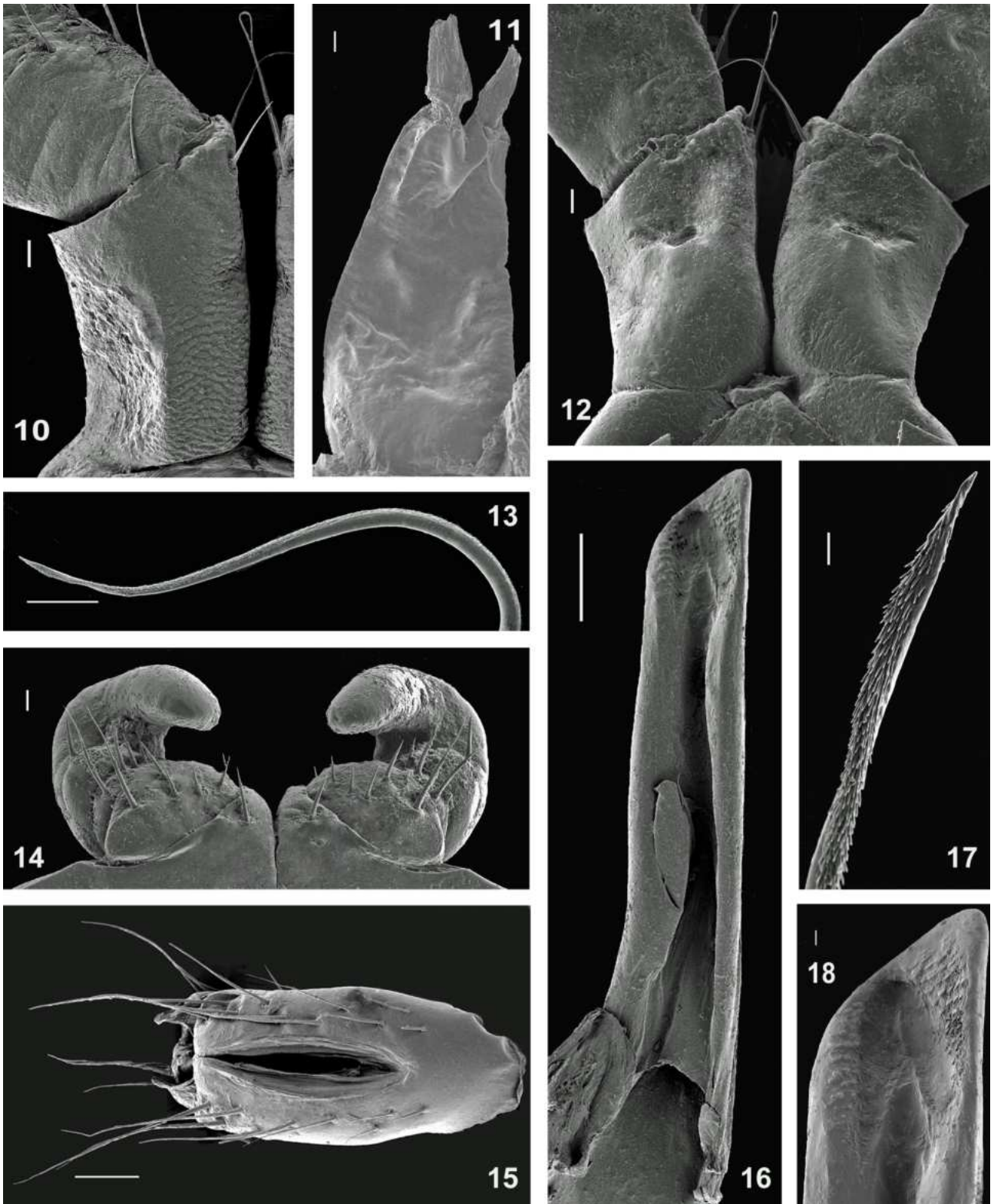
Legs relatively short and slender. Very delicately serrate ventral pads present on postfemur and tibia, starting from legs 2. Claw of all legs at base with a setiform accessory claw ventrally, accessory claw relatively short (equal to claw length) in the anterior body part and very short (shorter than claw) in the hind most legs. Leg pair 1 forming hook, the distal podomere not coming into close contact with the basal podomeres (“open hook” type in Enghoff 1987); postfemur with inflated scaly-rugose ventral surface, tip indistinctly wrinkled, coxa with one seta, distal podomere without lateral seta and seta tarsal remnant (Fig. 14). Coxa 2 with one long mesapical oral seta anteriorly (Fig. 12) and a shorter one posteriorly (Fig. 10), gland opening positioned in apical and axial position *sensu* Enghoff (1987). Penis subtrapezoidal, about 1.9 times longer than wide (Fig. 11).

Gonopods relatively strongly protruding. Anterior gonopod flattened, with parallel margins, apically strongly obliquely rounded, in posterior view apically excavated for accommodation of mesomeral process, distal margins of the excavation papillate, rudimentary telopodite with seta (Figs 16, 18). Flagellum slender, of medium length, caudally covered with cuticular conical spikes (Figs 13, 17). Opisthomere slender (Figs 19–20). Mesomeral process slightly arched forward, its apex covered with papillae. Margin of velum smooth, arcuate, without a notch near the mesomeral process (in Fig. 20 the opisthomere is slightly turned back, as a result, the mesomeral process protrudes forward and hides the absence of a notch on the margin of velum). Solenomere relatively short, with dense long thin spines basally and spinose anteriorly.

*Female.* Length in alcohol about 24.0 mm, midbody vertical diameter about 2.1 mm, with 48(-2) rings, excluding telson. Vulva as in Fig. 15.

**Etymology.** The specific epithet refers to the type locality, Jianchuan. Adjective.

**Remarks.** *Nepalmatoiulus jianchuanensis* sp. nov. differs from *N. arcuatus* mainly by the smaller body length (about 22.0 mm) and larger midbody vertical diameter (about 1.9 mm) (vs. length—about 29.0 mm, midbody vertical diameter—about 1.5 mm in *N. arcuatus*), relatively short and broad solenomere (vs. relatively long and slender in *N. arcuatus*), by the distal podomere of male leg 1 without seta laterally (vs. with one seta laterally in *N. arcuatus*), by the subtrapezoid penis (vs. like an hourglass figure penis in *N. arcuatus*).



**FIGURES 10–18.** *Nepalmatoiulus jianchuanensis* sp. nov., male holotype and female (Fig. 15) paratype (ZMUM). **10.** Coxa 2, posterior view. **11.** Penis, caudal view. **12.** Coxae 2, anterior view. **13.** Flagellum. **14.** Leg pair 1, anterior view. **15.** Vulva, posterior view. **16.** Right promere, posterior view. **17.** Distal part of flagellum. **18.** Distal part of right promere, posterior view. Scales: 10  $\mu\text{m}$  (Figs 17, 18), 20  $\mu\text{m}$  (Figs 10, 11, 12, 14), 100  $\mu\text{m}$  (Figs 13, 15, 16).



FIGURES 19–20. *Nepalmatoiulus jianchuanensis* sp. nov., male holotype (ZMUM). 19. Opisthomere, mesal view. 20. Opisthomere, mesal view (slightly turned back). Scale: 100  $\mu$ m.

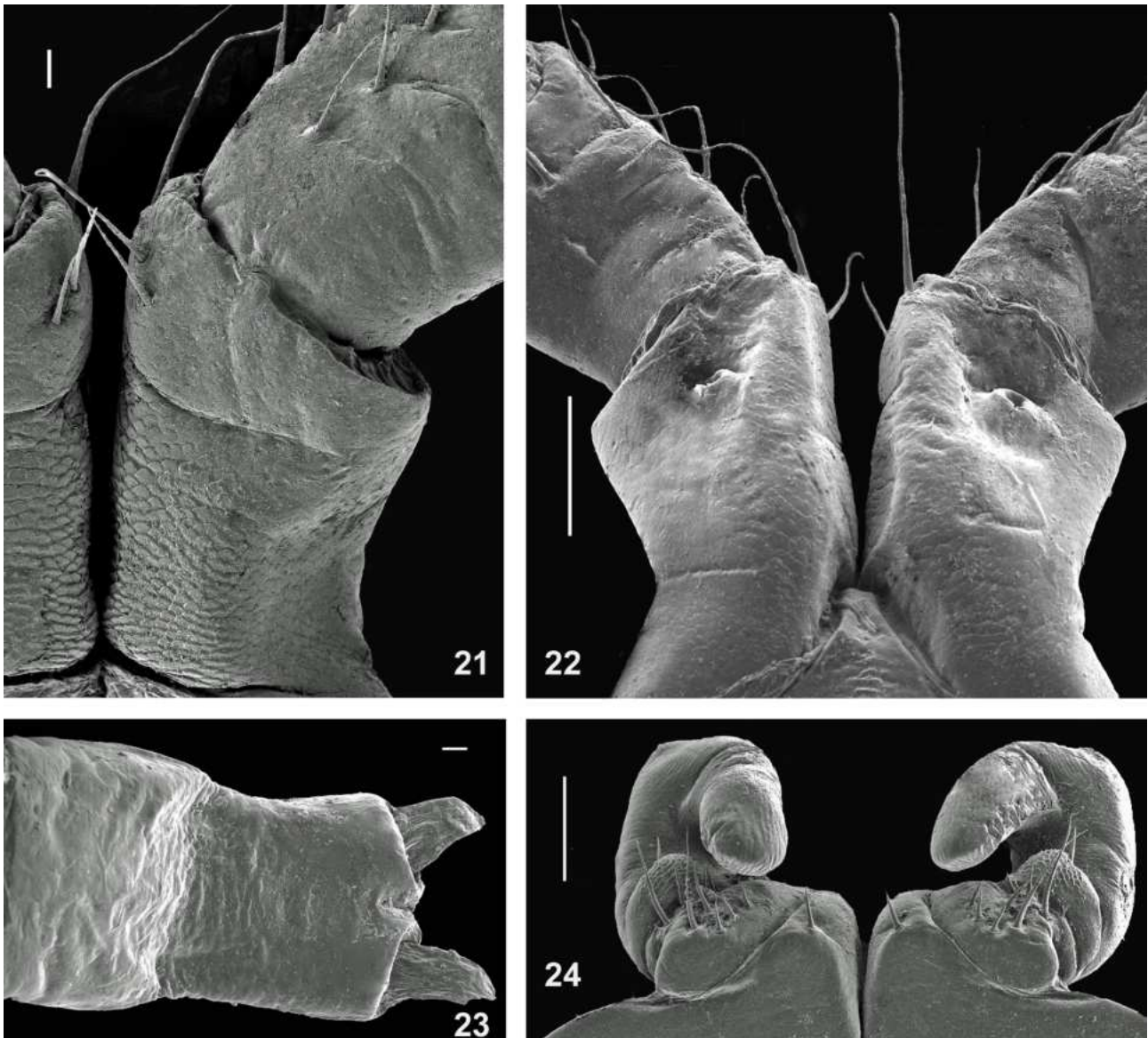
*Nepalmatoiulus lancangensis* sp. nov.

Figs 21–30

**Material examined.** Holotype: male (ZMUM), China, Yunnan Province, SW Lanping, Qijing & Lancang div., 3.5 km ESE Tuowudi village, 26°21'23" N, 99°14'26" E, H = 3330 m, 23.05. 2018, leg. I. Belousov, I. Kabak.

**Diagnosis.** Differs from Chinese congeners mainly by the combination of: a strong, dentiform apically papillate mesomeral process devoid of outgrowth; presense of a notch of velum margin near mesomeral process; male coxa 2 with one mesapical oral seta anteriorly and two ones posteriorly. To a certain degree similar to *Nepalmatoiulus weixi* Mikhaljova, 2020a and *Nepalmatoiulus jianchuanensis* sp.nov. but differs from them by specific characters (see Remarks below).

**Description.** *Male.* Length in alcohol about 32.0 mm, midbody vertical diameter about 2.2 mm, with 52(-1) rings, excluding telson. Coloration in alcohol gray with broad longitudinal slightly lighter dorsal stripe and filamentary longitudinal dark brown stripes laterally. Axial suture dark brown. Venter including basal parts of legs beige. Distal parts of legs marbled brown. Antennae brown, eyes black.



**FIGURES 21–24.** *Nepalmatoiulus lancangensis* sp. nov., male holotype (ZMUM). **21.** Coxa 2, posterior view. **22.** Coxae 2, anterior view. **23.** Penis, posterior view. **24.** Leg pair 1, anterior view. Scales: 20  $\mu\text{m}$  (Fig. 23), 100  $\mu\text{m}$  (Fig. 24).

Head smooth, group of setae on each lateral side (below of antenna), 2 epicranial setae, 4 supralabral setae; at least 28 labral setae. Eye patches almost oval, composed of about 50 ommatidia. Antennae medium-sized, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica. Mandibular stipites with subtriangular smooth lobes. Gnathochilarium with not less than 12 nonapical stipital setae; lamellae linguales each with 7–8 setae arranged longitudinally. Collum laterally with distinct striae of different length at posterior margin not reaching to anterior margin, dorsally with distinct short striae at posterior margin. A transverse row of very sparse thin setae at hind edge of collum.

Body rings circular. Metazona with dense, regular, longitudinal striae reaching hind margin (16–18 striae in an approximate square with sides equal to metazonital length of a dorsal side of a midbody ring). Limbus straight, smooth (of Type 1 in Enghoff 1987). A transverse row of sparse, thin setae at hind edge of metazonites, setae gradually growing denser and longer toward telson. Ozopores small, lying behind suture between pro- and metazona without touching it. Caudal dorsal projection of telson straight and long, covered with setae and carrying at tip a claw-shaped process curved dorsally. Preanal ring and subanal scale setose, anal valves densely setose.





**FIGURES 25–30.** *Nepalmatoiulus lancangensis* sp. nov., male holotype (ZMUM). **25.** Right promere, posterior view. **26.** Opisthomere, mesal view. **27.** Opisthomere, mesal view (slightly turned forward). **28.** Solenomere. **29.** Flagellum apex. **30.** Part of flagellum. Scales: 2  $\mu\text{m}$  (Fig. 30), 10  $\mu\text{m}$  (Fig. 29), 20  $\mu\text{m}$  (Fig. 20), 100  $\mu\text{m}$  (Figs 25, 26, 27).

Legs relatively short and slender. Very delicately serrate ventral pads present on postfemur and tibia, starting from legs 2. Claw of all legs at base with a long (longer than claw) setiform accessory claw ventrally. Leg pair 1 forming hook, the distal podomere not coming into close contact with the basal podomeres (“open hook” type in Enghoff 1987); postfemur with inflated scaly-rugose ventral surface, tip indistinctly wrinkled, coxa with one seta,

distal podomere without seta, with low seta tarsal remnant (Fig. 24). Coxa 2 with one long mesapical oral seta anteriorly (Fig. 22) and shorter two ones posteriorly (Fig. 21), gland opening positioned in apical and axial position *sensu* Enghoff (1987). Penis subrectangular, about 1.8 times longer than wide (Fig. 23).

Gonopods slightly protruding. Anterior gonopod flattened, with parallel margins, apically obliquely rounded, in posterior view apically excavated for accommodation of mesomeral process, distal margins of the excavation papillate, rudimentary telopodite with seta and small protrusion (Fig. 25). Flagellum slender, of medium length, caudally covered with cuticular conical spikes (Figs 29–30). Opisthomere with strong, dentiform mesomeral process slightly arched forward, its apex covered with papillae (Figs 26–27). Margin of velum smooth, arcuate, with a notch near the mesomeral process. Solenomere twisted to the mesal side. It relatively short and broad, with dense long thin spines basally, spinose anteriorly (Fig. 28).

**Etymology.** The specific epithet refers to the type locality, Lancang. Adjective.

**Remarks.** It is possible to assume that the twist of the solenomere on the mesial side occurred due to mechanical pressure during collection of the material (not during preparation because the holotype that came to me was intact and undestroyed but already had a twisted solenomere). However, this circumstance is not decisive and has no diagnostic significance, therefore it does not affect the independence of the new species in any way; the independence of the new species is not in doubt, taking into account the main distinctive characters.

*Nepalmatoiulus lancangensis* **sp. nov.** differs from *N. weixi* and *N. jianchuanensis* **sp. nov.** mainly by the larger body length (about 32.0 mm) and midbody vertical diameter (about 2.2 mm) (vs. length—about 26.0–27.0 mm, midbody vertical diameter—about 1.0 mm in *N. weixi*; length—about 22.0 mm, midbody vertical diameter—about 1.9 mm in *N. jianchuanensis* **sp. nov.**), by the gray body coloration (vs. marbled brown in *N. weixi* and brown-gray in *N. jianchuanensis* **sp. nov.**), by the solenomere shifted forward with a twist to the mesal side (vs. the solenomere not twisted mesally, and a notch between velum and solenomere broad, ovale in *N. weixi* and narrow ovale in *N. jianchuanensis* **sp. nov.**), by the presense of a velum noch near apex of the mesomeral process (vs. the absence of a notch in *N. jianchuanensis* **sp. nov.**), by the subtriangular lobes of the mandibular stipites (vs. ovale ones in *N. jianchuanensis* **sp. nov.**), by the male coxa 2 with two mesapical oral setae posteriorly (vs. one mesapical oral seta posteriorly in *N. jianchuanensis* **sp. nov.**).

### *Nepalmatoiulus shiguensis* **sp. nov.**

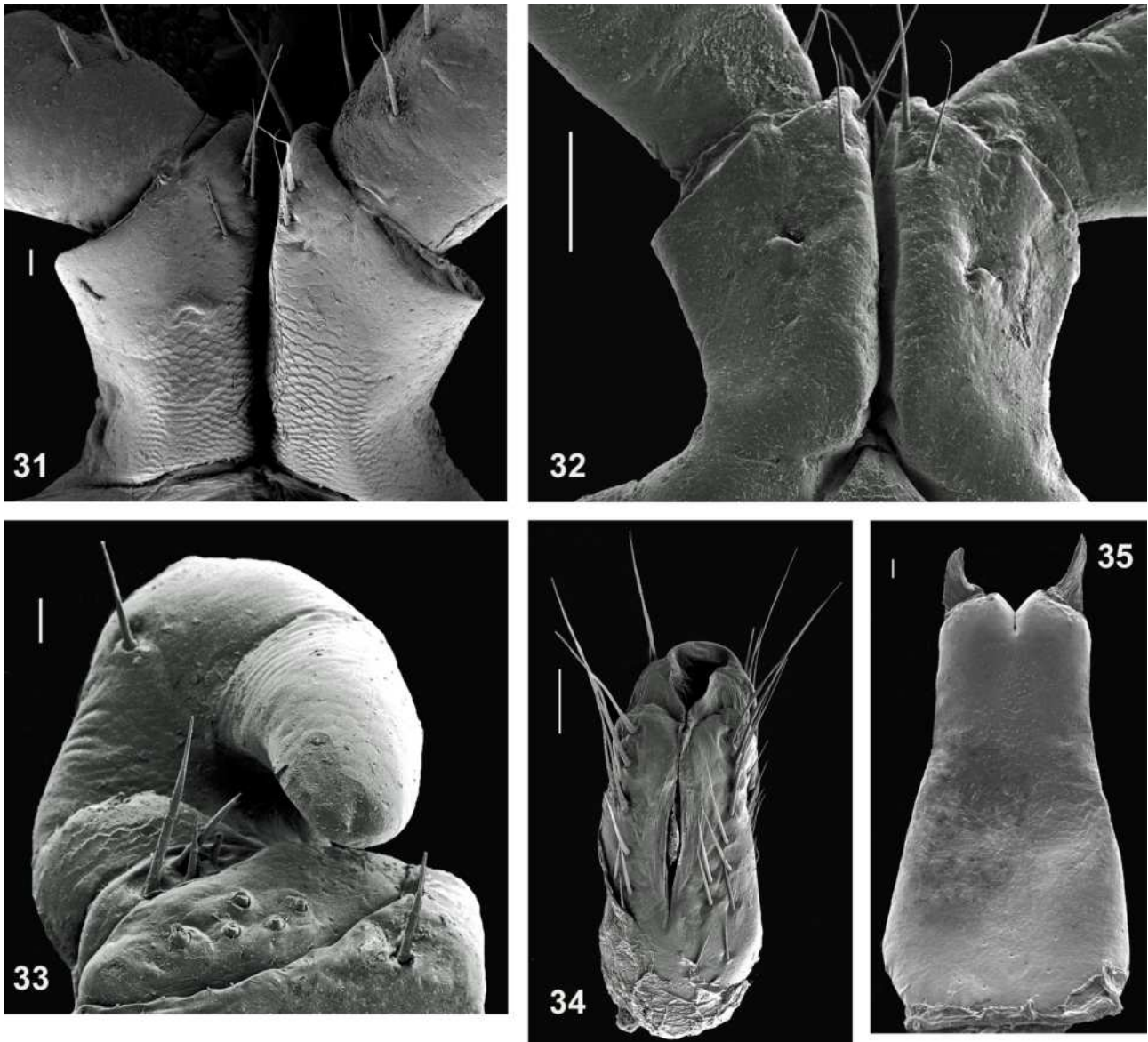
Figs 31–39

**Material examined.** Holotype: 1 male (ZMUM), China, Yunnan Province, Laojunshan, W Shigu, W Wujiangshui, 26°52'14" N, 99°41'43" E, H = 2740 m, 2.06. 2014, leg. I. Belousov, I. Kabak. Paratypes: 1 male, 1 female (ZMUM), same data as for holotype.

**Diagnosis.** Differs from Chinese congeners mainly by the male coxa 2 with two mesapical oral setae anteriorly and three ones posteriorly, in combination with a large body size and the coloration pattern, a small mesal projection of gonopod promere apex and a relatively long solenomere. Configuration of gonopod opisthomere in *N. shiguensis* **sp. nov.** similar to *Nepalmatoiulus angustus* Mikhaljova, 2023b, *N. tianbaoshanensis* Mikhaljova, 2020a and *N. davidiani* **sp. nov.** but differs from them by specific characters (see Remarks below).

**Description.** *Male.* Length in alcohol 34.0–36.0 mm, midbody vertical diameter about 2.6 mm, with 59(-1) (in holotype) and 58(-1) (in paratype) rings, excluding telson. The coloration in alcohol brown-gray with dark brown thin lateral stripes and adjacent longitudinal thin blurred beige stripes. Venter including basal parts of legs light beige. Distal parts of legs marbled brown. Antennae dark brown, eyes black.

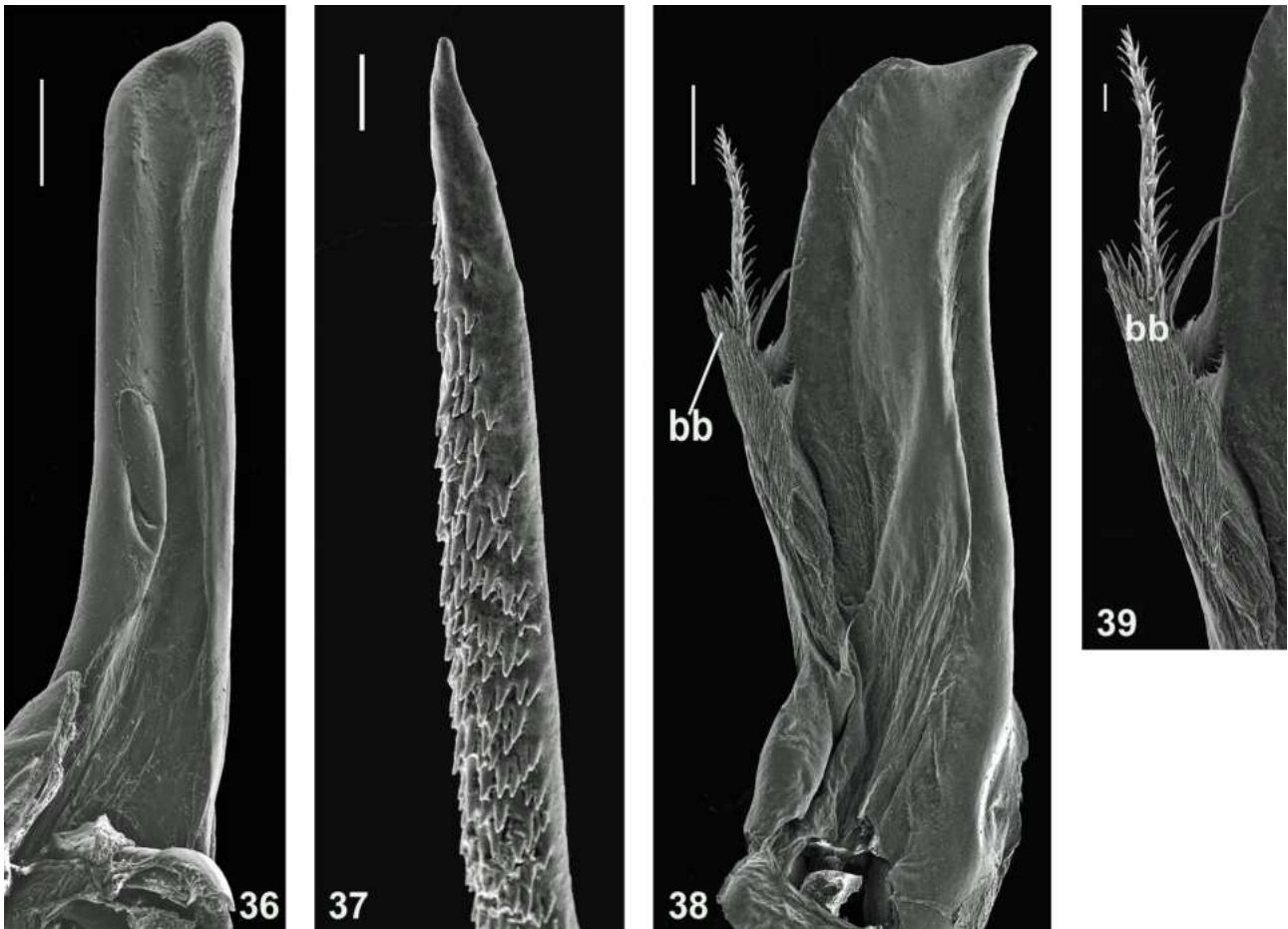
Head smooth, 2 epicranial setae, 4 supralabral setae; at least 30 labral setae. Eye patches almost oval, composed of at least 50 ommatidia. Antennae medium-sized, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica. Mandibular stipites with subtriangular smooth lobes; apical portion of lobe with well demarcated brown border. Gnathochilarium with 7–8 nonapical stipital setae; lamellae linguales each with 6–7 setae arranged longitudinally. Collum laterally with distinct striae at posterior margin nearly reaching to anterior margin, dorsally with distinct short striae at posterior margin. A transverse row of sparse thin setae at hind edge of collum.



**FIGURES 31–35.** *Nepalmatoiulus shiguensis* sp. nov., male and female (Fig. 34) paratypes (ZMUM). **31.** Coxae 2, posterior view. **32.** Coxae 2, anterior view. **33.** Leg 1, anterior view. **34.** Vulva, posterior view. **35.** Penis, posterior view. Scales: 20  $\mu\text{m}$  (Figs 31, 33, 35), 100  $\mu\text{m}$  (Figs 32, 34).

Body rings circular. Metazona with dense, regular, longitudinal striae reaching hind margin (16–18 striae in an approximate square with sides equal to metazonital length of a dorsal side of a midbody ring). Limbus straight, smooth (of Type 1 in Enghoff 1987). A transverse row of sparse, thin setae at hind edge of metazonites, setae gradually growing denser and longer toward telson. Ozopores small, lying behind suture between pro- and metazona without touching it. Telson with caudal dorsal projection straight and long, covered with setae and carrying at tip a claw-shaped process curved dorsally. Preanal ring, anal valves, and subanal scale densely setose.

Legs relatively short and slender. Very delicately serrate ventral pads present on postfemur and tibia, starting from legs 2; pads decreasing in size towards telson, totally disappearing on postfemur and remaining only on the most extreme tibial apex of hind legs. Claw of all legs at base with a long setiform accessory claw ventrally. Leg pair 1 forming a hook, the distal podomere not coming into close contact with the basal podomeres (“open hook” type in Enghoff 1987); postfemur with inflated scaly-rugose ventral surface, tip indistinctly wrinkled, coxa with one seta, distal podomere with strong seta laterally (Fig. 33). Coxa 2 with two long mesapical oral setae anteriorly (Fig. 32) and three ones posteriorly (Fig. 31), gland opening positioned in apical and axial position *sensu* Enghoff (1987). Penis subtrapezoidal, about 1.7 times longer than wide (Fig. 35).



**FIGURES 36–39.** *Nepalmatoiulus shiguensis* sp. nov., male paratype (ZMUM). **36.** Right promere, posterior view. **37.** Apex of flagellum. **38.** Opisthomere, mesal view. **39.** Solenomere, mesal view. **Abbreviation:** **bb**, basal blade. Scales: 10  $\mu$ m (Fig. 37), 20  $\mu$ m (Fig. 39), 100  $\mu$ m (Figs 36, 38).

Gonopods slightly protruding. Promere flattened, with parallel margins, apically slightly obliquely rounded, in posterior view apically excavated for accommodation of mesomeral process, distal margins of the excavation papillate, rudimentary telopodite with seta (Fig. 36). Flagellum slender, of medium length, caudally covered with cuticular conical spikes (Fig. 37). Opisthomere slender (Fig. 38); mesomeral process slightly arched forward, its apex covered with papillae. Velum narrow, its margin smooth, arcuate, with a notch near the mesomeral process. Additional membrane with a serrate edge. Solenomere long, spinose throughout, basally with blade (**bb**) (Fig. 39).

*Female.* Length in alcohol about 35.0 mm, midbody vertical diameter about 2.5 mm, with 55(-1) rings, excluding telson. Dorsal projection of the preanal ring short, underdeveloped, deformed. Vulva as in Fig. 34.

**Etymology.** The specific epithet refers to the type locality, Shigu. Adjective.

**Remarks.** *Nepalmatoiulus shiguensis* sp. nov. differs from *N. tianbaoshanensis* mainly by the male coxa 2 with two mesapical oral setae anteriorly and three ones posteriorly (vs. one mesapical oral seta anteriorly in *N. tianbaoshanensis*), by the subtrapezoidal penis (vs. nearly diamond-shaped penis in *N. tianbaoshanensis*), by the more slender opisthomere, by the mesomeral process located at about an angle 45° (vs. mesomeral process located almost vertically in *N. tianbaoshanensis*), by the less rounded apex of the promere as well as by a lower habitat above sea level.

*Nepalmatoiulus shiguensis* sp. nov. differs from *N. angustus* mainly by the male leg pair 1 with strong seta laterally on the distal podomere (vs. male leg pair 1 without seta laterally on the distal podomere in *N. angustus*), by the male coxa 2 with two mesapical oral setae anteriorly and three ones posteriorly (vs. two mesapical oral setae anteriorly only in *N. angustus*), by the less rounded apex of the promere, by the larger body.

*Nepalmatoiulus shiguensis* sp. nov. differs from *N. davidiani* sp. nov. mainly by the larger body length (34.0–

37.0 mm) and midbody vertical diameter (about 2.6 mm) (vs. length—about 18.0 mm, midbody vertical diameter—about 1.4 mm in *N. davidiani* sp. nov.), by the coloration of rings below ozopore level not of an usual julid type (after Enghoff 1982), by the male coxa 2 with two mesapical oral setae anteriorly and three ones posteriorly (vs. one mesapical oral seta anteriorly and two ones posteriorly in *N. davidiani* sp. nov.), by the less obliquely rounded apex of the promere, by a slightly more stronger apex of opisthomere.

### *Nepalmatoiulus tuoxiaensis* Mikhaljova, 2023

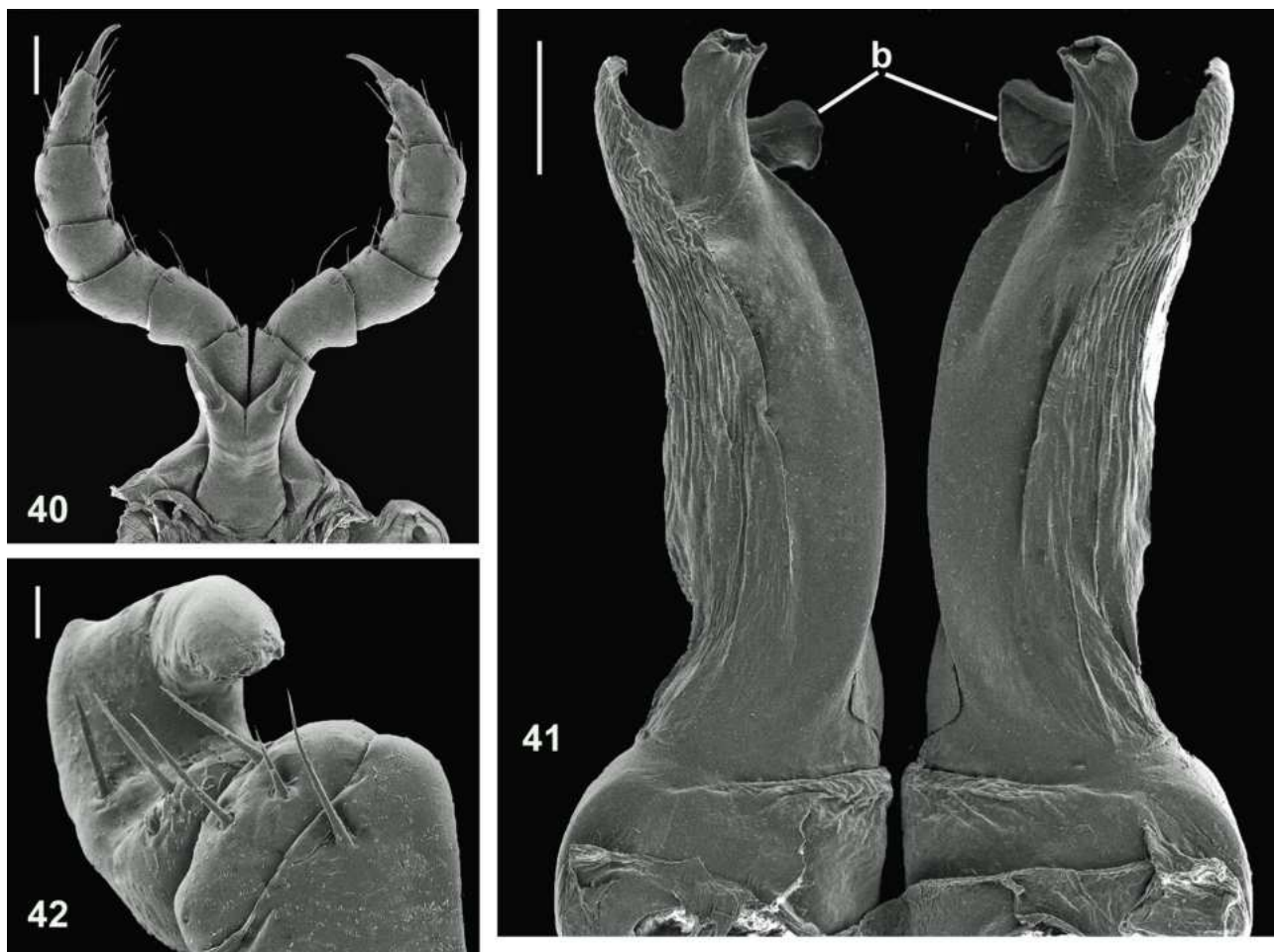
*Nepalmatoiulus tuoxiaensis* Mikhaljova 2023a: pp. 388–390, figs 27–38.

**Material examined.** 1 male (ZMUM), China, Yunnan Province, Mekong valley, ENE Yezhixiang, 3 km NE Houqing, 27°43'00" N, 99°06'20" E, H = 3615 m, 29.05. 2017, leg. I. Belousov, I. Kabak.

**Distribution.** China.

**Remarks.** This species has hitherto been known only from China, Yunnan Province, Deqin, Tuoxia Highway Mt. Range between Xiaruolisuzuxiang & Yezhizhen, its *terra typica* (Mikhaljova 2023a).

A comparison of the description of *Nepalmatoiulus tuoxiaensis* by Mikhaljova (2023a) with the above sample shows a general morphological resemblance except for the following. 1) Body length is about 29 mm and midbody vertical diameter is about 3.0 mm in the above-mentioned male, but about 25.0 and about 2.0 mm in the holotype (see Mikhaljova 2023a). 2) The above male at hand has some longer outgrowth of the subapical excavation of the gonopod opisthomere mesomeral process. 3) Above male has a longer gonopod flagellum. Discrepancy in the male body size may be due to the difference in the habitat conditions or age. Perhaps, when more material on this species appears and intraspecific variability can be assessed, the taxonomy will have to be revised.



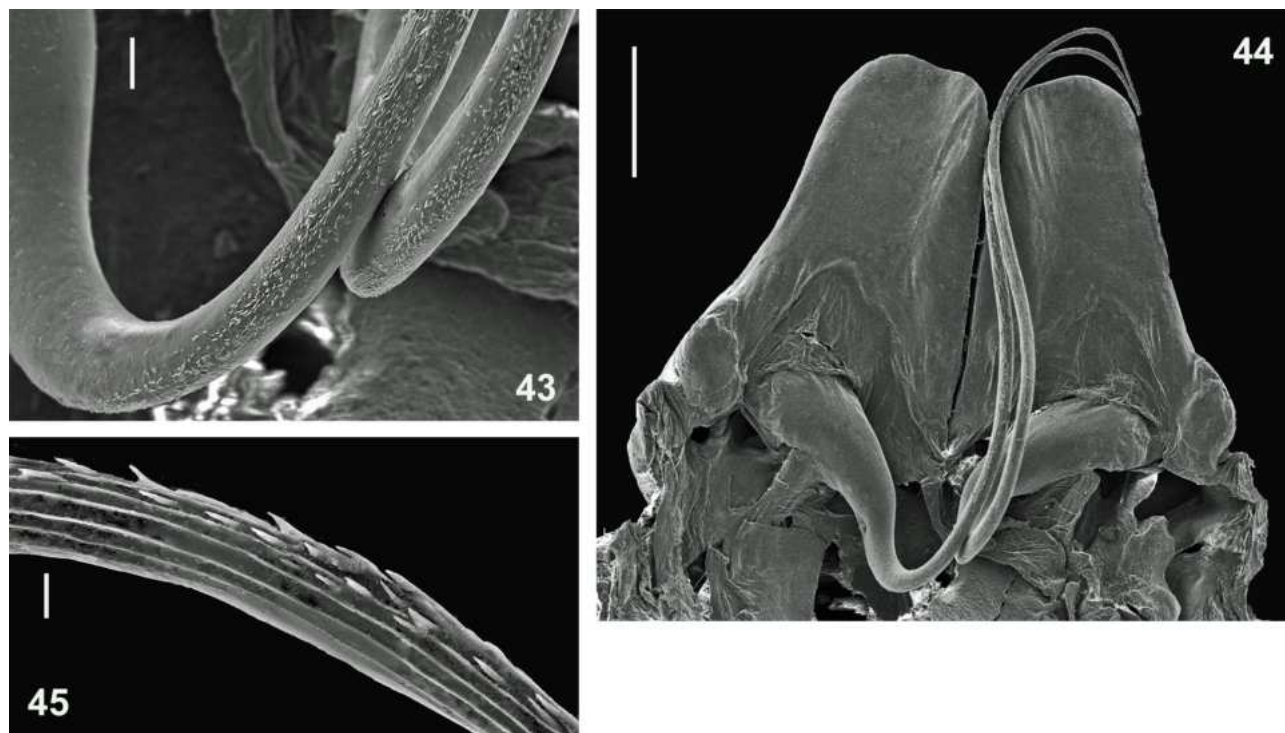
**FIGURES 40–42.** *Anaulaciulus shibaensis* sp. nov., male holotype (ZMUM). **40.** Leg pair 2 and penis, posterior view. **41.** Opisthomeres, anterior view. **42.** Leg 1, anterior view. **Abbreviation: b,** “beaklike” process. Scales: 20  $\mu$ m (Fig. 42), 100  $\mu$ m (Figs 40, 41).

*Anaulaciulus shibaensis* sp. nov.

Figs 40–49

**Material examined.** Holotype: 1 male (ZMUM), China, Yunnan Province, Mekong / Yangtze div. E Achidaga, 3.5 km ENE Shiba, 27°46'05" N, 99°08'10" E, H = 3965 m, 03.06. 2017, leg. I. Belousov, I. Kabak.

Nontypes: *Anaulaciulus inaequipus* Enghoff, 1986: Mikhaljova 2020a: 65 (pro parte), 1 male, 1 female (FSCB), China, NW Sichuan Province, 18.6 km SSW Ganzi, 31°27'40" N, 99°54'53" E, H = 4775 m asl., 13 July 2016, leg. I. Belousov, I. Kabak.



**FIGURES 43–45.** *Anaulaciulus shibaensis* sp. nov., male holotype (ZMUM). 43. Basal parts of flagella. 44. Promeres, posterior view. 45. Distal part of flagellum. Scales: 2  $\mu$ m (Fig. 45), 10  $\mu$ m (Fig. 43), 100  $\mu$ m (Fig. 44).

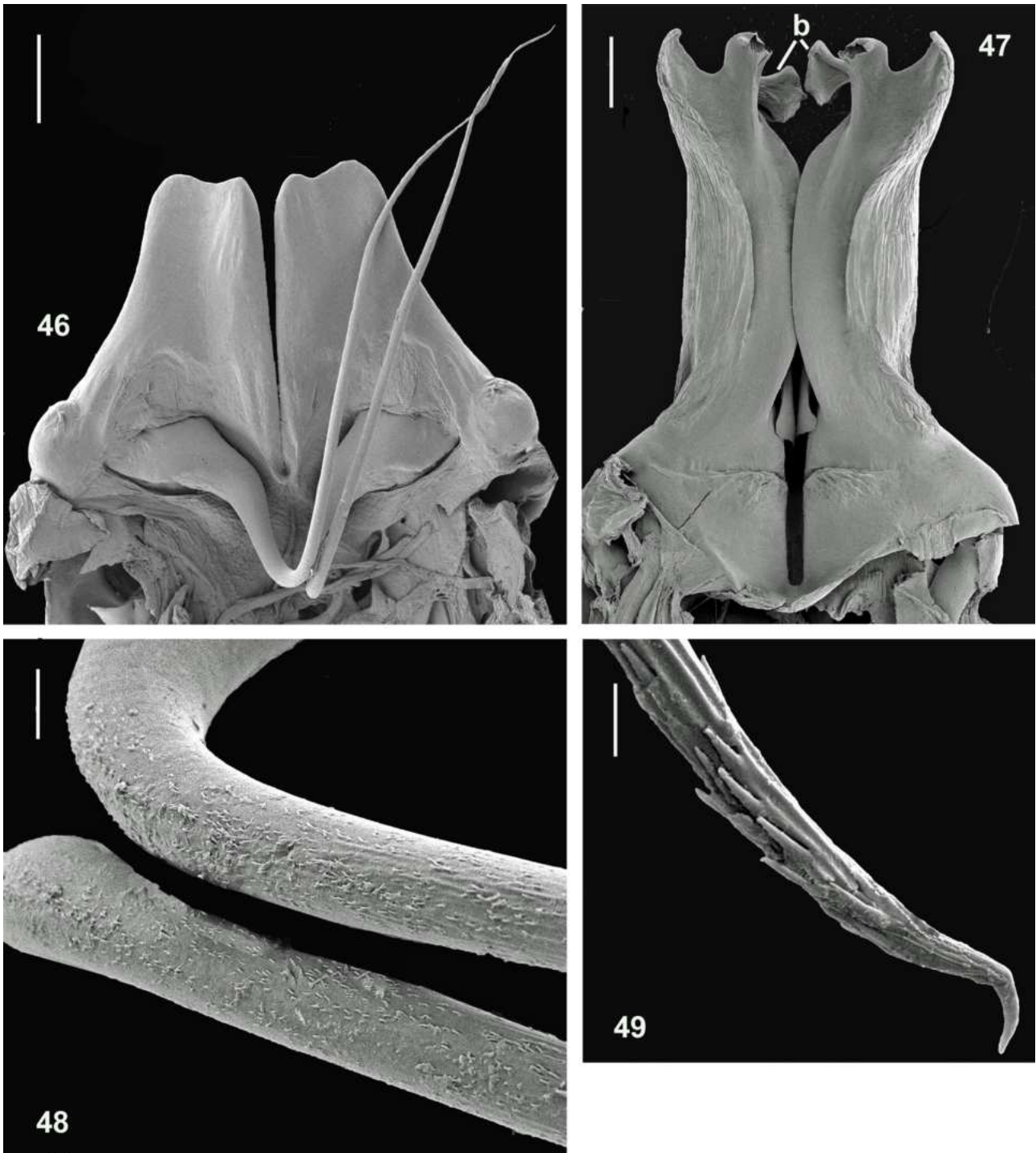
**Diagnosis.** Differs from congeners mainly by the opisthomere with a “beaklike” process similar to a leaf.

**Description.** *Male.* Length in alcohol about 15.0 mm in holotype and about 26.0 mm in nontype, midbody vertical diameter about 1.0 mm in holotype and about 1.9 mm in nontype, with 40(-2) (in holotype) and 48(-2) (in nontype) rings, excluding telson. The color in alcohol from brown (in holotype) to dark brown (in nontype). Legs from brown to dark brown (in holotype and nontype, respectively). Antennae dark brown, eyes black.

Head smooth, 2 epicranial setae, 4 supralabral setae; at least 20 labral setae in holotype and nontype. Eye patches almost oval, composed of at least 50 in nontype and almost rounded, composed of at least 30 ommatidia in holotype. Antennae short, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica.

Body slightly fusiform, rings circular. Ozopore location variable. In fore part of body, they lying almost on suture between pro- and metazona, moving gradually off the suture in rear body part. Metazona striate; 11–12 striae in an approximate square with sides equal to metazonal length of a dorsal side of a midbody ring. Limbus with straight margin. Preanal ring smooth; dorsal projection relatively short, blunted, somewhat flattened dorsoventrally; its margins covered with sparse setae. Anal valves and subanal plate covered with setae closer to the edges.

Midbody legs slightly longer than the front and hind legs. Starting from legs 2 postfemur with very small ventral pad or without pad, but tibia with very large pad (Fig. 40). Pads decreasing in size towards telson. Claw of all legs at base with an enough long setiform accessory claw ventrally (in Fig. 40 setiform accessory claw on the left are broken off). Leg pair 1 with strong setae lateroventrally, coxa with one seta, distal podomere with low seta tarsal remnant in holotype and nontype (Fig. 42). Penis deeply bifid, with strongly diverging branches (Fig. 40).



**FIGURES 46–49.** *Anaulaciulus shibaensis* **sp. nov.**, male nontype (FSCB). **46.** Promeres, posterior view. **47.** Opisthomeres, anterior view. **48.** Basal parts of flagella. **49.** Apex of flagellum. **Abbreviation: b,** “beaklike” process. Scales: 2  $\mu\text{m}$  (Fig. 49), 10  $\mu\text{m}$  (Fig. 48), 100  $\mu\text{m}$  (Figs 46, 47).

Gonopods. Apex of promere from rounded (in Fig. 44 on the right) to emarginate to varying degrees (in Fig. 44 on the left; Fig. 46). Flagellum relatively long, caudally covered with cuticular conical spikes (Figs 43, 45, 48, 49). Opisthomere (Figs 41, 47) with a long anterior lamella equal to or a little longer than opisthomere. Opisthomere “beaklike” process (**b**) broad and flat, like a leaf (Figs 41, 47).

*Female-nontype.* Length in alcohol about 17.0 mm, midbody vertical diameter 1.0 mm, with 45(-1) rings, excluding telson. Coloration in alcohol brown, legs brown. The increase in the length of the midbody legs is imperceptible.

**Etymology:** The specific epithet refers to the type locality, Shiba. Adjective.

**Remarks.** Taking into account the great morphological similarity of the gonopods and other diagnostic structures of above-mentioned male of *Anaulaciulus inaequipipes* from China, stored in the FSCB, with the ones of *Anaulaciulus shibaensis* **sp. nov.** as well as the ratio of the body size of the female of the first species and of the male of second species, above-mentioned specimens of *Anaulaciulus inaequipipes* should be reclassified as *A. shibaensis* **sp. nov.** (see Discussion below).

## Discussion

During the comparative study of the specimens of *Anaulaciulus inaequipipes* from China, stored in the FSCB [see above Material examined: *Anaulaciulus shibaensis* **sp. nov.** male and female nontypes: *Anaulaciulus inaequipipes* Enghoff, 1986: Mikhaljova 2020a: 65 (pro parte)] with the above male holotype of *Anaulaciulus shibaensis* **sp. nov.** the general morphological resemblance were identified (especially in the gonopods) except for some features (see below). As a result, the former specimens have been assigned to the new species described here. The main distinguishing character that allows above-mentioned specimens of *A. inaequipipes* from China to be classified as *A. shibaensis* **sp. nov.** is the leaf-shaped form of the opisthomere “beaklike” process. However, the following differences were found in the holotype and nontypes: 1) body length is about 26.0 mm in male nontype but only about 15.0 mm in holotype; 2) midbody vertical diameter about 1.0 mm in holotype but about 1.9 mm in male nontype; 3) apex of promere from rounded (Fig. 44, promere on the right) to emarginated (Fig. 44, promere on the left) in holotype, but emarginated in nontype (Fig. 46); 4) the body color brown in holotype but dark brown in male nontype; 5) eye patches almost oval in nontypes and almost rounded in holotype. The difference in the shape of the apex of the promere seems to have no specific value (Mikhaljova 1982; Korsós 2001), especially since the apical edge of promere shows some variation even within a holotype (Fig. 44: apex of promere emarginated on the left but rounded on the right). Discrepancies in male body length and midbody vertical diameter may be due to the difference in the habitat conditions (different altitudes) or ages. Some color difference and the shape of the eye patches are probably correlated to their body size. However, the ratio of the body size of the female nontype and of the male holotype is standard. In addition, the body color of the female nontype does not differ from that of the male holotype.

Thus, the occurrence of *A. inaequipipes* in China according to Mikhaljova (2020a) requires verification. Also it is necessary to check the species affiliation of other Chinese specimens of *A. inaequipipes* stored in the ZMUM.

## Acknowledgements

I am most grateful to all persons who collected material for the present study. Dr. S.I. Golovatch and Dr. Ark. A. Schileyko (both Moscow, Russia) have kindly provided access to the materials housed at the ZMUM. I am very grateful to Mr. V.M. Kazarin (FSCB, Vladivostok, Russia) for the help in preparation of scanning electron micrographs. Special thanks go to Dr. H. Enghoff (Denmark) and an anonymous reviewer for reviewing the manuscript and valuable comments.

The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme No. 124012400285-7).

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