

# A new relictual and highly troglomorphic species of Tomoceridae (Collembola) from a deep Croatian cave

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## Abstract

*Tritomurus veles* sp. n. (Tomoceridae) is described from a Croatian cave. It is characterized by troglomorphic features (absence of eyes, reduced pigmentation, slender claw, pointed tibiotarsal tenent hairs) that only compare, among Tomoceridae, to the microendemic species *T. falcifer* from the Pyrénées. *Tritomurus veles* also shares with *T. falcifer* the absence of macrochaetae on head, a presumably non-adaptive character that within Tomoceridae is unique to these two species. Both species have no known epigean relatives in their respective distribution areas and can be considered as relictual.

## Keywords

New taxon, *Tritomurus*, Croatia, cave hygropetric, troglomorphy

## Introduction

The family Tomoceridae includes 149 species in 16 genera, grouped in two subfamilies, Tomocerinae with 131 species and Lepidophorellinae with 18 species (Bellinger et al. 2010). Tomocerinae are distributed across the whole Holarctic region, extend-

ing locally as south as the mountains of Northern Sumatra. They are conspicuous by their large size and abundance in forest litter, but are also diversified and frequent in the caves of different regions of Europe, eastern Asia and North America, with about 30 troglobitic species. Many of these cave species have a reduced number of eyes and reduced pigment (Christiansen 1964). However, few species exhibit strong morphological adaptation to cave life. The most remarkable species in this respect is *Tritomurus falcifer* Cassagnau, 1958, which apparently is limited to a small karst of the central Pyrénées. In the present paper, we describe from a Croatian cave a second highly troglomorphic species, *Tritomurus veles* sp. n., already recorded as *Tomoceridae* gen. sp. in Lukić and Deharveng (2008). We also introduce several new morphological characters for the taxonomy of Tomoceridae, discuss the validity of the genus *Tritomurus* and comment the world distribution of reduced-eyed Tomoceridae.

## Materials and methods

The first specimen of *Tritomurus veles* sp. n. was collected in 2001 during a speleological exploration of the pit named Amfora jama conducted by the Croatian Natural History Museum, Speleological section PDS Velebit, Speleological club SAK Ekstrem and the Nature Park Biokovo (Lukić and Deharveng 2008). Type material was collected during a recent visit of Croatian Biospeleological Society to the same pit.

Specimens were mounted on slides in Marc-André II, and were studied with a Leica DMLB microscope. Photographs of Figs 1–3, 13 and 35 were taken with a Jenoptik ProgRes C10+ camera mounted on a Leica DMLB microscope. SEM micrographs were taken with a Cambridge 600 scanning electron microscope. SEM material was coated with gold and kept on stubs in MNHN collections.

## Abbreviations

**Abd.** abdominal segment, **Ant.** antennal segment, **Th.** thoracic segment, **Tita.** tibiotarsus.

The chaetotaxic formula of bothriotricha is given per half-tergite from Th.II to Abd.V.

According to Yosii (1967), the dens of Tomocerinae is subdivided in three parts: proximal, medial and distal. We use the “short and developed” dental spines formula, derived from Folsom (1913) and Ågren (1903); spines of the proximal part of the dens cannot be differentiated here into small and large, because individual variability in their size is too high. The “short formula” of dental spines is: total number of spines in the proximal part of the dens / (number of small spines), (number of large spines, underlined) of the medial part of the dens. The “developed formula” includes the successive numbers of large spines (underlined) and number of small spines (not underlined) of the medial part of the dens.

## Taxonomy

### Genus *Tritomurus* Frauenfeld, 1854

**Type species:** *Tritomurus scutellatus* Frauenfeld, 1854: p. 17

**Note:** *T. scutellatus* species was collected in “Grotte bei Treffen”; Treffen is the German name of Trebnje in Slovenia, where several caves are recorded in the literature.

#### *Tritomurus veles* sp. n.

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Figs 1–35

**Type locality.** Croatia, Biokovo Mt., Sveti Jure: Amfora jama. Coordinates: 43°20'48.5"N, 17°02'48.0"E (WGS84), elevation 1620 m.

**Type material.** Holotype male, 7 paratypes on slides (5 females, 2 with sexual plate not observable), 12 paratypes in 96% alcohol, 2 paratypes metalized for SEM, 17 July 2008, leg. M. Lukić; 1 paratype on slide (male), 14 July 2008, leg. B. Jalžić; 3 paratypes in 96% alcohol, 17 July 2008, leg. G. Rnjak; 4 paratypes in 96% alcohol, 03 November 2001, 16 July 2008, 18 July 2008, leg. J. Bedek. All material collected by hand.

**Type material deposition.** Holotype (CLL 969), 3 paratypes on slide (CLL 785, 794) and 17 paratypes in 96% alcohol (CLL 244, 785, 791, 792, 793) deposited in the collection of Croatian Biospeleological Society, Zagreb, Croatia.

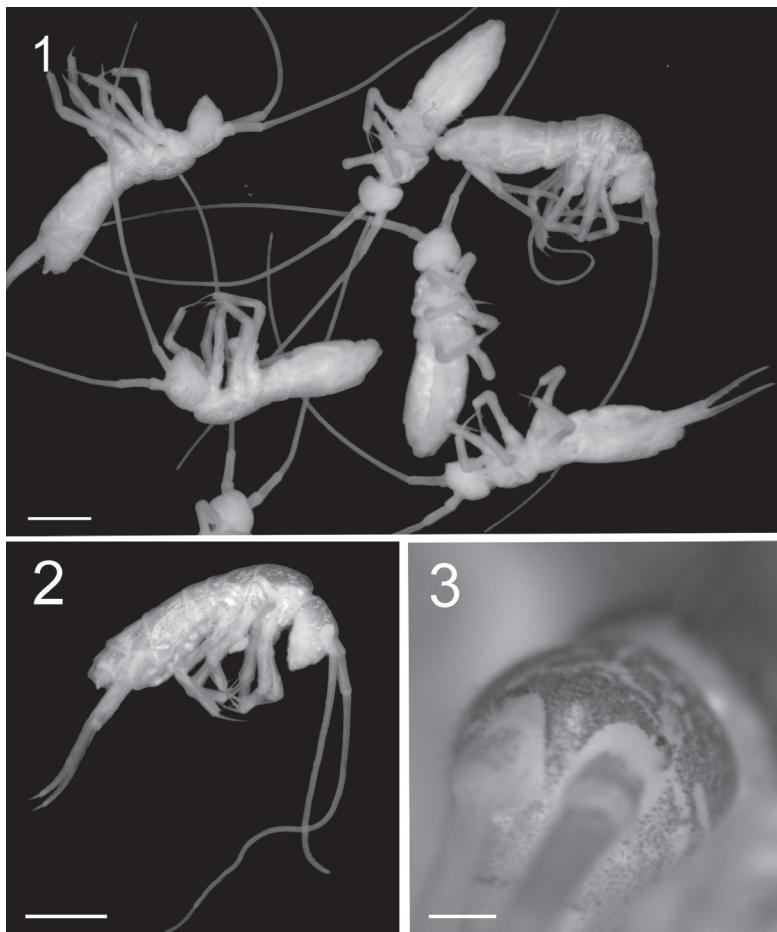
5 paratypes on slide, 2 paratypes in 96% alcohol, 2 paratypes metalized for SEM observation deposited in the collections of the Muséum National d’Histoire Naturelle de Paris.

**Derivatio nominis.** Named after Veles—a Slavic god of earth, water and the underworld.

**Description.** Body length 3.4 to 3.7 mm. Habitus slender, color pale grey in alcohol with scattered black pigment and white patches (Figs 1, 2). Region around the base of Ant.I without pigment (Fig. 3). Narrow white median line from Th.II to Abd.II. Primary granulation of integument fine and regular, mostly composed of hexagonal meshes (Figs 6, 25, 32); some areas with fusion of primary granules resulting in quadrangular or irregular meshes (Fig. 15). Eyes absent, ocular spot weak (Fig. 3) or absent.

Body and appendages with four types of chaetae: ordinary chaetae, S-chaetae, bothriotricha and scales (Fig. 8). Other specialized chaetae present on labrum, maxillary palp, labial palp and mucro (see description of these organs below).

Ordinary chaetae numerous on body and appendages, slightly rugose at optical microscope magnification and longitudinally rugose-striate at higher SEM magnification, distally tapering, with well-marked thin sub-basal ring, differentiated as medium mesochaetae and long to very long macrochaetae; macrochaetae thin, acuminate,

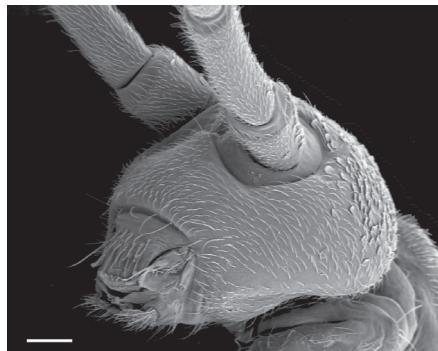


**Figures 1–3.** *Tritomurus veles* sp. n. (optical stereomicroscope). **1, 2** Habitus (scale 1 mm) **3** Head (scale 0.2 mm).

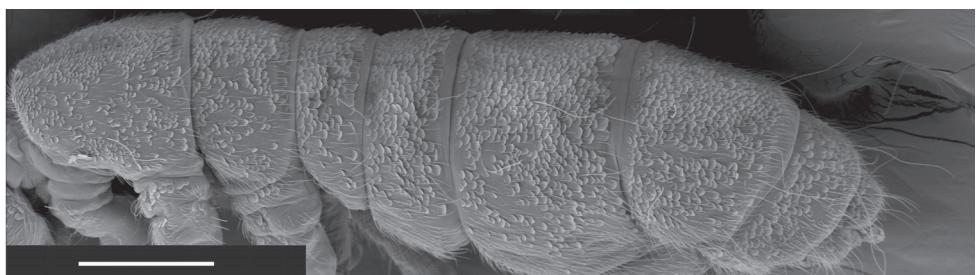
curved, not basally swollen, with socket ring markedly protruding above integument level (Fig. 7); mesochaetae basally swollen in specimens on slide but not in those examined with SEM; socket rings of mesochaetae strongly protruding on Ant.III-IV and dens (Figs 11–12, 31, 32), not protruding on tergites (Figs 6–8). Dense clothing of mesochaetae, particularly laterally (Figs 4, 5); macrochaetae few, frequently detached in microscopic preparations (Fig. 5); minute microchaetae present on anal valves and empodium.

S-chaetae smooth, subcylindrical, of variable length and thickness, not basally swollen, with socket border not or slightly protruding, located on antennae and tergites (Figs 8, 10–12); 1+1 very short (1/5 of surrounding mesochaetae), thin S-microchaetae ventro-laterally among antegenital mesochaetae (Fig. 34).

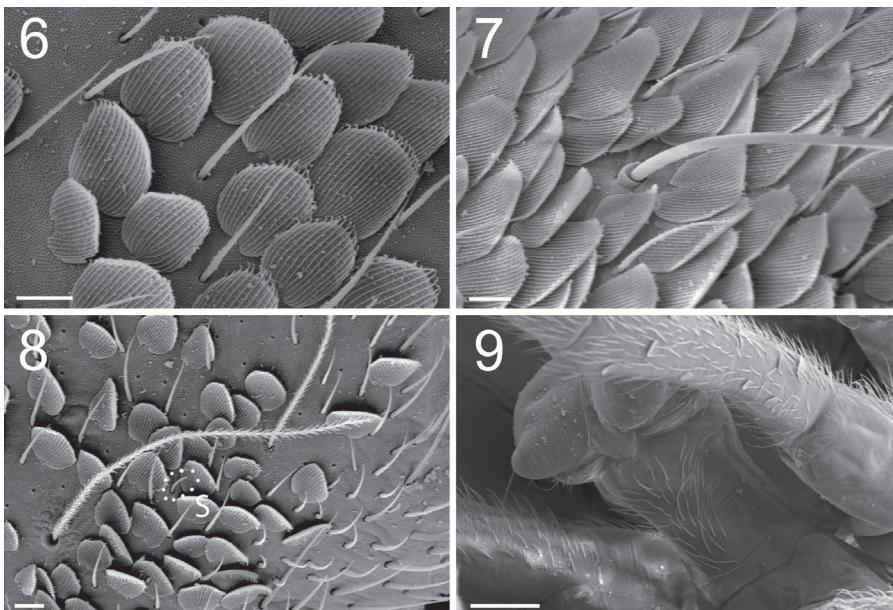
Bothriotricha thinner than macrochaetae, long, ciliated, present on Th.II, Th.III, Abd.III and Abd.IV, without marked protruding socket ring (Fig. 8).



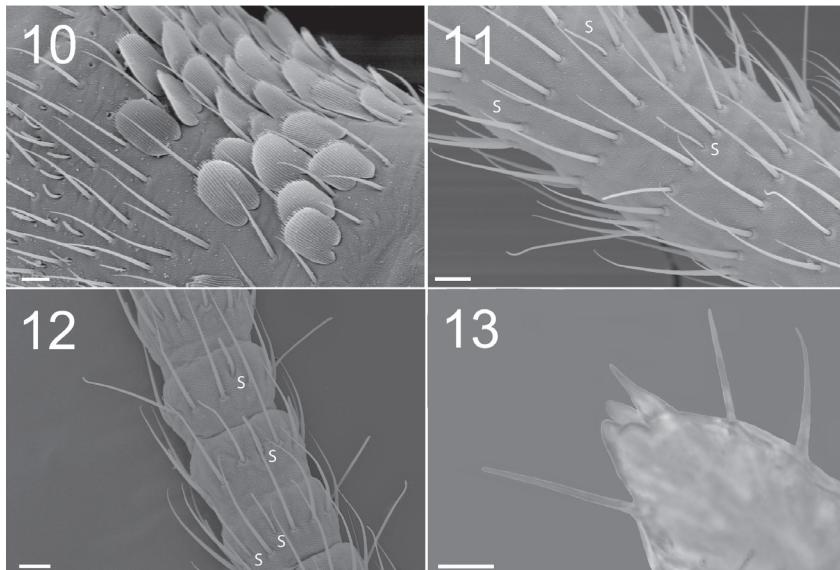
**Figure 4.** *Tritomurus veles* sp. n., head in lateral view (SEM, scale 100 µm).



**Figure 5.** *Tritomurus veles* sp. n., body (SEM, scale 400 µm).



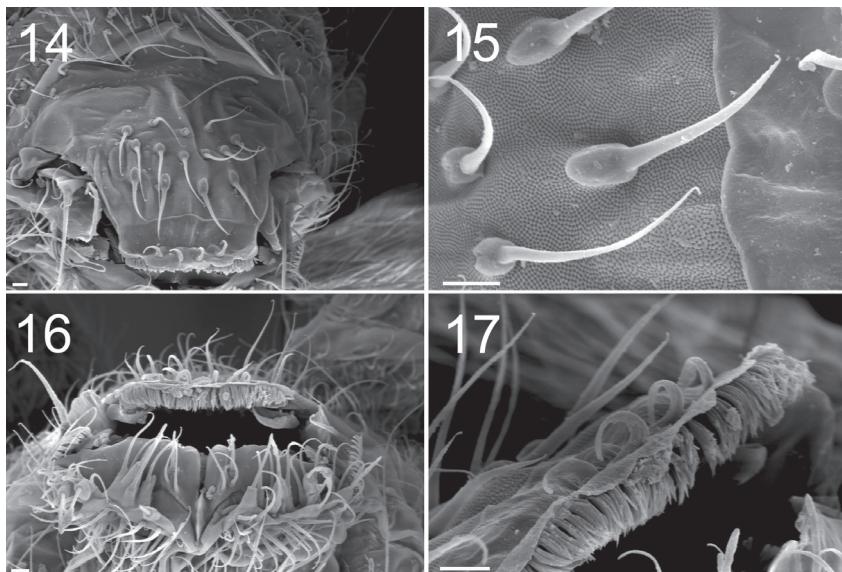
**Figures 6–9.** *Tritomurus veles* sp. n. (SEM). **6** Scales and ordinary mesochaetae on Th.II (scale 10 µm) **7** Scales, mesochaetae and macrochaetae on Abd.III (scale 10 µm) **8** Bothriotrichal area of Th.II, illustrating the presence of the four main chaetal types: bothriotricha, mesochaetae, S-chaetae (S) and scales (scale 10 µm) **9** Ventral tube in anterior view (scale 100 µm).



**Figures 10–13.** *Tritomurus veles* sp. n. (10–12, SEM; 13, optical microscope) **10** Lateral view of Ant.I, with scales, mesochaetae, and latero-distal short S-microchaetae at left (scale 10 µm) **11** Ant.III proximally (scale 10 µm) (S, S-chaetae) **12** Ant.IV (scale 10 µm) (S, S-chaetae) **13** Apical part of Ant.IV (scale 10 µm).

Scales overlapping, evenly arranged (Figs 4, 5, 6–8, 10, 29–30), transparent, rounded, small, morphologically uniform except on furca, with 20–25 longitudinal ribs (Figs 6, 8); scale ribs parallel, entire, ending as ciliate processes beyond the distal edge of the scale (Figs 6, 10, 30). Scales present dorsally from head to Abd.VI (Figs 4, 5), dorsally on Ant.I–II (Fig. 4), on most parts of legs, dorsally on manubrium and dens (Figs 29, 30). Scales absent from ventral side of head (Fig. 4), Ant. III–IV, sternites, all except the hind tibiotarsus, and ventral tube (Fig. 9). Manubrial scales larger than those of body, rounded except a distal group of elongate scales (Figs 29, 30); dental scales fusiform, narrower and much smaller than manubrial scales (Fig. 30).

Antennae 1.5–1.8 times length of body (Figs 1, 2). Antennal segment ratio as I:II:III:IV = 1:1.79:15:4.58. Microchaetae at bases of Ant.I and II not differentiated. Ant.I and II with a dense clothing of mesochaetae, and S-chaetae of two main types: (i) dark, thin, straight, long (usually longer than surrounding mesochaetae), evenly distributed in large number among mesochaetae; (ii) hyaline, variously but moderately thickened, shorter than surrounding mesochaetae, less evenly distributed (mostly ventrally and distally) (Fig. 10). Ant.III and IV annulated. Basal part of Ant.III (Fig. 11) with irregularly arranged chaetae, progressively organized in whorls for most of its length, as well as on Ant.IV. Each whorl composed of a single row of 17–28 chaetae, including ordinary mesochaetae and a smaller number of S-like chaetae, mostly long and thin, some shorter and thicker (Figs 11, 12). Serial pattern not evident in chaetal arrangement across successive whorls. Ant.III sense organ not clearly differentiated.

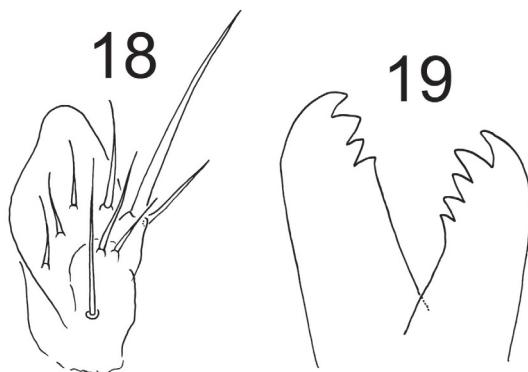


**Figures 14–17.** *Tritomurus veles* sp. n. (SEM) **14** Labrum (scale 10 µm) **15** Detail of labral chaetae with swollen socket (scale 10 µm) **16** Mouth (scale 10 µm) **17** ventro-distal brush of labrum (scale 10 µm).

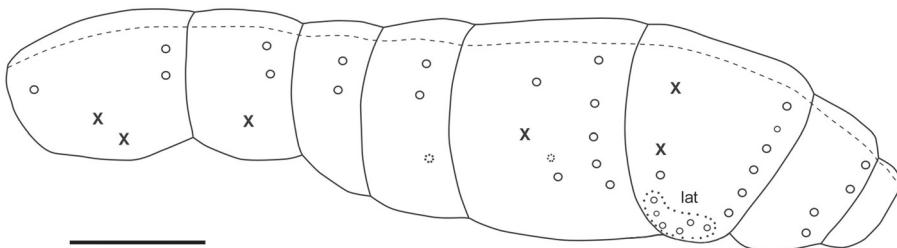
Two protruding papillae and a spiniform process (pin chaeta) simple, without lateral process apically on Ant.IV (Fig. 13); subapical organite not seen.

Labral formula 4/5,5,4. Prelabral chaetae smooth, curved, thinner and longer than the labral ones (Fig. 14); labral chaetae strong, smooth, acuminate, their socket with thickened appearance, fused to chaetal basis (Figs 14, 15); apical edge of labrum with four strong, recurved hooks (Figs 14, 17); distally, a large area devoid of primary granules well delimited by a transversal line at half distance between the apical edge of labrum and the distal row of chaetae. Ventro-distally, labrum with a thick brush (Figs 16, 17). Labium with about 30 baso-median chaetae and 5 baso-lateral chaetae; labial palp with numerous proximal chaetae (about 25), its distal part not examined in detail (Fig. 16). Outer maxillary lobe with one basal chaeta, a trifurcate palp with strong apical chaeta and 4 sublobal hairs (Fig. 18). Maxilla head stout, complex, similar to that of other Tomocerinae, with a strong external tridentate claw and without distinct maxillary beard-like extension on lamella 5; other lamellae not analyzed in detail. Mandibles asymmetrical, the left one with 4 teeth, the right one with 5 teeth (6 specimens observed, Fig. 19). Ordinary mesochaetae numerous on the clypeus (Fig. 4). Hypopharynx well developed with ciliate processes.

Dorsal chaetotaxy dense and regular on head and tergites, consisting of small rounded scales, mesochaetae and a few macrochaetae, but no microchaeta (Fig. 5). Chaetal row along the posterior part of antennal basis field made of mesochaetae identical to those of the head. A line of numerous (more than 30) short equal mesochaetae regularly and closely arranged at the posterior edge of head. Clothing of mesochaetae on tergites denser where scales are absent, i.e. laterally and behind posterior row of



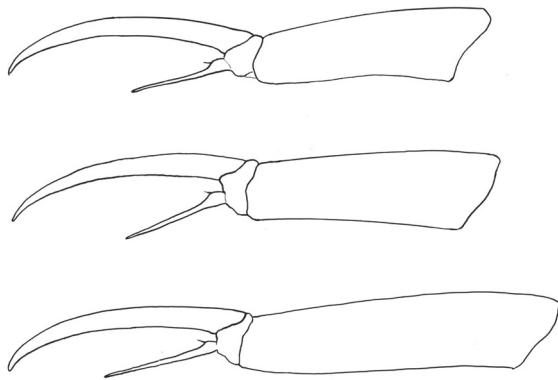
**Figures 18–19.** *Tritomurus veles* sp. n. **18** Outer maxillary lobe **19** Left and right mandibles.



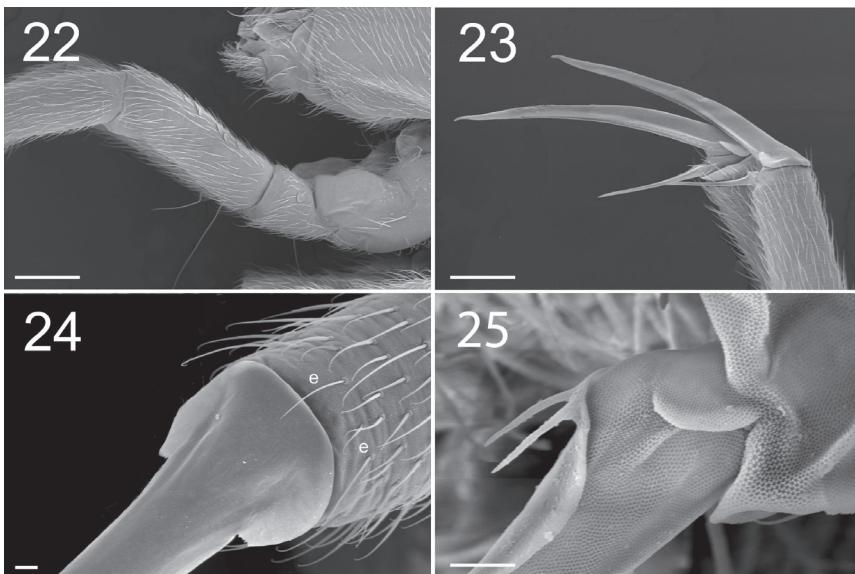
**Figure 20.** *Tritomurus veles* sp. n., macrochaetotaxic and bothriotrichal pattern; plain line circles, macrochaetae; dotted line circles, small macrochaetae or large mesochaetae; lat, lateral group of Abd.IV; X, bothriothricha (scale 400 µm).

macrochaetae, especially on Abd.IV and Abd.V (Fig. 5); mesochaetae more variable in size behind posterior macrochaetae than on the remaining of these tergites.

Macrochaetotaxy and bothriotrichal patterns of tergites illustrated in Fig. 20. Macrochaetae per half-tergite: none on head; 1 anterior and 2 posterior on Th.II; 2 posterior on Th.III; 2 posterior on Abd.I; 2 posterior on Abd.II (one lateral mesochaeta almost the length of the macrochaetae); 1 antero-median, 1–2 latero-median and 5 postero-lateral on Abd.III; 5–6 posterior, 1 antero-lateral and 5–6 lateral on Abd.IV; 4 posterior in two groups on Abd.V. Antero-median macrochaetae of Abd.III and postero-internal macrochaetae of Abd.IV and Abd.V very long, longer than Abd.V length; other macrochaetae shorter than Abd.V length. Long lateral mesochaetae present mostly on Th.III, Abd.I and Abd.II. S-chaetae thinner, shorter and much less numerous than mesochaetae, arrangement on tergites not clear. Bothriotrichal formula 0/2,1/0,0,1,2,0. Bothriothricha slightly shorter than long antero-median macrochaetae on Abd.III and than longest macrochaetae on Abd.IV; external bothriothrix about three-fourths as long as internal bothriothrix on Abd.IV. Macrochaetae without circlet of spine-like microchaetae near their bases. Scale arrangement and size not modified



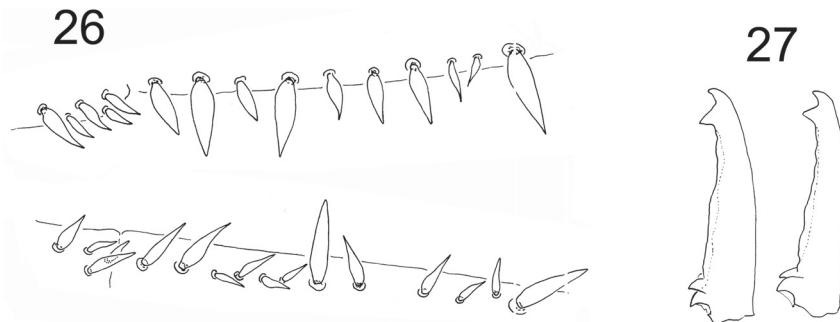
**Figure 21.** *Tritomurus veles* sp. n. Tibiotarsus and claw of legs I, II, III from upper to lower.



**Figures 22–25.** *Tritomurus veles* sp. n. (SEM). **22** Leg I, with ventro-basal macrochaetae of femur and ventral macrochaetae of trochanter (scale 100 µm); the second visible macrochaetae of femur belongs to other leg **23** Claws of legs I (scale 100 µm) **24** Claw of leg I, basal part in dorsal view (scale 10 µm); e, thin distal tenent hairs **25** Bifurcate empodial appendage of leg II (scale 10 µm).

around macrochaetae sockets; 6–7 scales smaller in size ahead each bothriotrix of Abd. III–IV, more densely arranged than on the remaining of the tergites. Abdominal segment ratio as I:II:III:IV:V:VI = 1:1.37:2.53:2.26:1.16:0.68.

Claw very slender, without inner tooth (Fig. 23), devoid of internal ridging characteristic of other Tomocerinae. Basal wings of claw wide and short (12–15% of claw length), blunt, with truncated and denticulate apical edges (Fig. 24). Empodial appendage (emp) straight, thicker basally, parallel distally until the tip, about half the



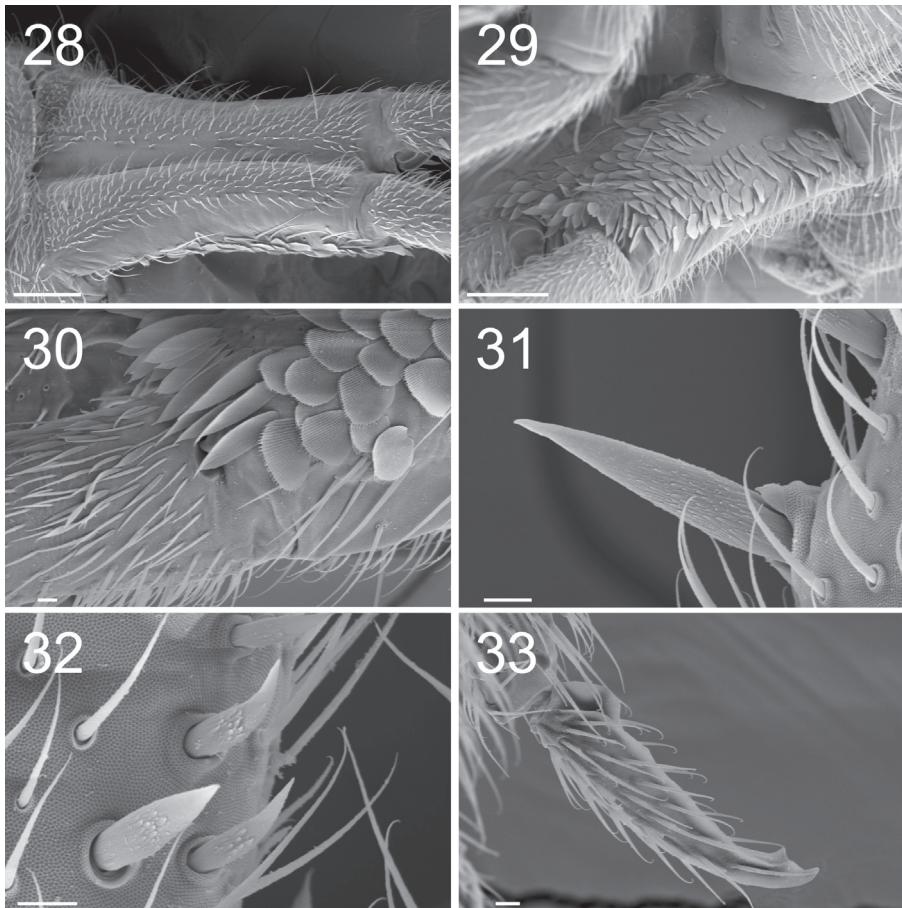
**Figures 26–27.** *Tritomurus veles* sp. n. **26** Dental spines formula in a female specimen: 4/2,4,1,4,1 (lower, right dens) and 5/1,1,1,1, 2,1,2,1 (upper, left dens) **27** Mucro in two different specimens.

length of inner edge (i.e.) of claw (emp/i.e.= 0.45 for legs I and II, 0.55 for leg III) (Fig. 21), with long, thin internal tooth, this tooth often bifurcated, occasionally trifurcated (Figs 23, 25). Pretarsus with 1+1 minute microchaetae. Tibiotarsi I and II slightly shorter than outer edge (o.e.) of claw, tibiotarsus III slightly longer (o.e./Tita=1.14 for leg I, 1.07 for leg II, 0.91 for leg III) (Fig. 21). Distal whorl of tibiotarsi I, II and III with 11 or 12 acuminate chaetae, not distinct from other tibiotarsal chaetae, including dorsally 2–3,3,3 thinner, straight, acuminate chaetae (Fig. 24), of which the most dorsal on each tibiotarsus probably corresponds to the tenent hair of other Tomocerinae. Clubbed tenent hairs absent. Tibiotarsi I, II and III with 0–1, 0–1 and 2–4 long, thin, dorsal macrochaetae, respectively; the proximal macrochaeta of tibiotarsus III nearly half the tibiotarsal length; other tibiotarsal chaetae as ordinary mesochaetae of variable length. Scales present dorsally from subcoxa to femur of legs II and III, on trochanter and femur of leg I (Figs 5, 9, 22), and dorso-basally on tibiotarsus III.

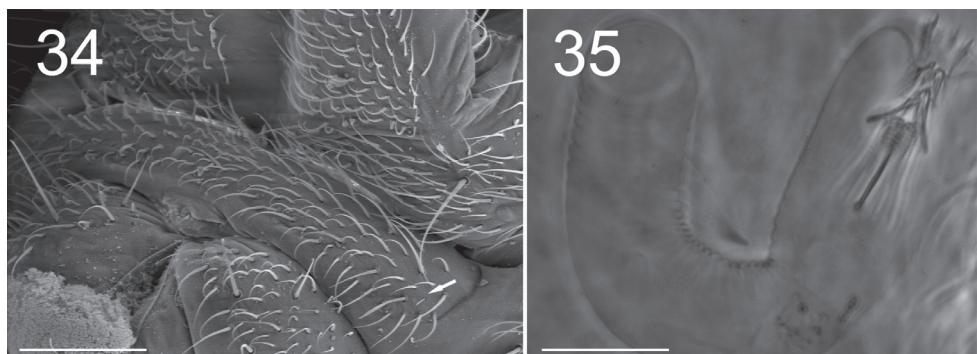
Each femur with very long, and thin ventro-basal macrochaeta, the two-thirds length of femur, inserted perpendicular to integument (Fig. 22); rest of femoral clothing mesochaetae. Each trochanter with one long, thin ventro-basal macrochaeta similar to that of femur (Fig. 22). Trochanteral-femoral organ not differentiated.

Ventral tube (Fig. 9) without scales, with about 60 mesochaetae, including 3 noticeably longer chaetae, on each latero-distal flap, anteriorly about 30–35+30–35 subequal, long mesochaetae, and posteriorly about 70 subequal mesochaetae.

Tenaculum with 1 or 2 chaetae and 4 teeth on each ramus. Manubrium dorsally with 2 longitudinal strips of mesochaetae and 2-3+2-3 erect macrochaetae, separated by a medial zone devoid of chaetae (Fig. 28); laterally with a row of chaetae on each side (Figs 28, 29); ventrally with large, rounded scales and a proximal group of ordinary chaetae (Fig. 29); ventro-distally, without chaetae but with a group of large, elongated scales (Figs 29, 30); ventro-distal sclerifications of manubrium with 1+1 internal triangular protrusions. Dens without outer basal spine-like chaetae or inner basal scale-like spine; ventro-basally with dense cover of small, narrow, fusiform scales (Fig. 30).



**Figures 28–33.** *Tritomurus veles* sp. n. (SEM). **28** Manubrium in dorsal view (scale 100 µm) **29** Manubrium in ventral view (scale 100 µm) **30** Manubrium ventro-distally and dens ventro-basally (scale 10 µm) **31, 32** Dental spines (scale 10 µm). **33**. Mucro (scale 10 µm).



**Figures 34–35.** *Tritomurus veles* sp. n. (34, SEM; 35, optical microscope). **34** Sternite of Abd.V with genital plate (scale 100µm); arrow points to minute lateral S-microchaeta **35** Internal parasite (Nematomorpha larva) (scale 20 µm).

turning to mesochaetae distally; externally with ordinary chaetae mixed with scales; dorsally, with dense clothing of subequal mesochaetae similar to those of manubrium; internally with basal rugose spine series (Figs 31, 32), the spines slightly inflated basally. Dental spines 4–5 in two irregular rows in the proximal part; 9–13 in one row in the distal part, variously arranged, usually asymmetrically (Fig. 26). Formula (and corresponding short formula) for 9 specimens:

5/1,1,1,1, 2,1,2,1 (short: 5/6, 4)  
 4/1,1,2,1,3,1 (short: 4/6, 3)  
 5/2,1,1,1,4,1 (short: 5/7, 3)  
 4/2,1,2,1,3,1 (short: 4/7, 3)  
 5/2,1,2,1,3,1 (short: 4/7, 3)  
 6/1,1,1,1,1,1,3,1 (short: 6/6, 5)  
 ?/1,1,1,4,1,3,1 (short: ?/8, 4)  
 5/1,3,1,4,1,2,1 (short: 5/9, 4)  
 4/2,4,1,4,1 (short: 4/8, 4)

Mucro with two irregular internal lamellae without intermediate tooth (Fig. 27), covered of ordinary chaetae with elongated, protruding sockets (Fig. 33). Basal teeth unequal, small, without toothlet. Ratio mucro : dens : manubrium = 1:8.08:5.33

Antegenital chaetae numerous, all of the ordinary type, except for one minute S-chaeta on each side (Fig. 34). Female genital slit with 1+1 anterior microchaetae. Two microchaetae on each anal valve. Male genital plate rounded, with many mesochaetae.

## Discussion

### Ecology

*Tritomurus veles* sp. n. was collected from -170 to -430 meters in the deep pit named Amfora jama. All specimens were found far away from entrance, in total darkness on or adjacent to the thin water-film flowing on vertical walls (hygropetric habitat). They walked on the water film with legs widely spread; if the water current or water drops detached them from the wall, they floated downstream and obtained purchase in another place. While walking on the wall with thin water-film, only the legs were immersed in water while body was held above the water surface. This species was not observed entering or on the surface of the pools. Water temperature at a depth of -350 meters was 4.7°C and air temperatures were 5.1–5.4°C.

The morphology and environment of the new species are similar to that of *Tritomurus falcifer*, which lives in the hygropetric habitat of caves on the Arbas massif of the French Pyrénées. Both species have the ventro-distal labral brush particularly well developed, apparently more than other epigean representatives of the family. This

mouthpart modification recalls similar filtering structures observed in other species of the cave hygropetric (Moldovan et al. 2004; Sket 2004), and suggests special feeding habits. The guts of the collected specimens were filled with very fine clay-like material, without the mycelium or spores typical of epigean Tomocerinae. The new species probably ingests clay as do many other troglobitic Collembola (unpublished observations).

Large parasitic worms (larva of Nematomorpha), were visible inside the body of several specimens (Fig. 35).

*Tritomurus veles* sp. n. was found with the beetle *Radziella styx* Casale & Jalzic, 1989 (Coleoptera, Leiodidae), another obligate inhabitant of the cave hygropetric. It supplements the already remarkable endemic fauna of Amfora jama, which includes *Dina* sp. (Hirudinea), *Zospeum* sp. (Gastropoda), *Protoneobisium biocovense* Müller, 1931 and *Neobisium peruni* Ćurčić, 1988 (Pseudoscorpiones), *Speoplanes giganteus biocovensis* Müller, 1934 (Leiodidae), *Biokovoaphaenopsis radici* Jalzic, 1993 (Coleoptera, Carabidae), *Alpioniscus* sp. (Oniscida), *Oncopodura* sp., *Pseudosinella* sp. and *Verhoeffiella* sp. (Collembola), and *Biokoviella mauriesi* Mršić, 1992 (Diplopoda).

## Relationships

*Tritomurus veles* sp. n. is strikingly similar at first sight to the rare cave species *T. falcifer* Cassagnau from Pyrénées by obvious troglomorphic traits: slender habitus, pigment reduction, anophthalmia, claw elongation, and reduction of tenent hairs to short, pointed chaetae. Such characters are assumed to be adaptive to cave life, and occur in most obligate subterranean species of Collembola (Thibaud and Deharveng 1994). But the two species also share several non-troglomorphic characters, including those listed as defining the genus *Tritomurus* by Bellinger et al. (2010): presence of scales on the body, absence of post-antennal organ and of eyes, trochanteral and femoral organs not differentiated, mucro elongate and setose with two basal teeth, the outer one devoid of toothlet, dens without large basal outer macrochaetae and without inner basal scale-like spine. Two other characters not considered as adaptive in the literature, the absence of macrochaetae on head and the absence of internal lobulations on claw, are also unique to *T. falcifer* and *T. veles* sp. n. among Tomocerinae.

Differences between *T. veles* sp. n. and *T. falcifer* include pigmentation (*T. veles* sp. n. has traces of pigment, *T. falcifer* is totally white), claw elongation (claw slightly more slender in *T. veles* sp. n.), claw structure (teeth absent on inner edge of claw in *T. veles* sp. n., present in *T. falcifer*), tooth on empodial appendage (present in *T. veles* sp. n., absent or inconspicuous in *T. falcifer*), and number of chaetae on tenaculum (*T. falcifer* has 5 chaetae, *T. veles* sp. n. has 1–2).

According to the most recent generic key for Tomoceridae (Bellinger et al. 2010), *T. veles* species is a member of *Tritomurus*. This genus is, however, poorly defined, as indicated by Cassagnau (1958), and the assignment of *T. falcifer* and *T. veles* sp. n.

to *Tritomurus* is unsatisfying. *Tritomurus scutellatus* Frauenfeld, 1854 from Slovenian caves, the type species of the genus, differs from *falcifer* and *veles* sp. n. in significant characters, including the presence of cephalic macrochaetae and a much different claw structure (claw not elongate and with very large basal wings in *T. scutellatus*). The features that separate *T. falcifer* and *T. veles* sp. n. from *T. scutellatus* and from all other Tomocerinae may well justify placing them in a separate genus. The placement of these species in *Tritomurus* is therefore provisional, pending redescriptions of *T. scutellatus* and *T. falcifer* based on fresh material.

## Troglobromorphy

All species of Tomocerinae living outside caves have 5+5 or 6+6 eyes. Those living in caves may have the complete 6+6 eye set for the family (e.g., *Tomocerus problematicus* Cassagnau, 1964 in the Pyrénées and *Plutomurus unidentatus* (Börner, 1901) in central and northern Europe), or a reduced number of eyes, but all species with reduced eye number are cave-restricted. Among reduced-eyed species, several also exhibit partial or total loss of pigment and have pointed tenent hairs, two characters often observed in subterranean Collembola. Claw elongation, considered another correlate to cave life in most troglomorphic Collembola (Christiansen 1961), is not observed in cave Tomoceridae, except *Tritomurus falcifer* and *T. veles* sp. n.

## Distribution

The species is only known from the type locality. A number of caves were explored during the five-year project 2002–2006 “Inventory and Mapping of the Subterranean and Spring Fauna of Biokovo Nature Park,” but *T. veles* sp. n. was not collected in any other cave, perhaps because hygropetric zones in most of these caves were practically inaccessible. Tomoceridae with reduced numbers of eyes (less than 4+4) belong to four genera: *Lethemurus* Yosii with 2 blind species from Japan and North America; *Plutomurus* Yosii with 9 species and 3 subspecies with 3+3 or fewer eyes, from Eastern Asia and North America; *Tomolonus* Mills with one 3+3-eyed species from North America; and *Tritomurus* with 3 blind species, including *T. velles* sp. n. European cave species of *Plutomurus*, the most diverse of these genera, have the full complement of 6+6 eyes except *P. sorosi* Kniss & Thibaud, 1999 from Georgia with 4–5 eyes per side. Thus, *Tritomurus* is the only genus of Tomoceridae with blind and fully troglomorphic species in the Western Palaearctic region. Both *T. falcifer* and *T. veles* sp. n. have extremely narrow distribution and no close relatives is known in their respective regional fauna which are relatively well sampled, as well as among Tomocerinae, suggesting a relictual status.

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# A common terminology for the external anatomy of centipedes (Chilopoda)

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## Abstract

A common terminology for the external morphological characters of centipedes (Chilopoda) is proposed. Terms are selected from the alternatives used in the English literature, preferring those most frequently used or those that have been introduced explicitly. A total of 330 terms are defined and illustrated, and another ca. 500 alternatives are listed.

## Keywords

Chilopoda, morphology, terminology

## Introduction

This contribution is intended to propose a common terminology for the external morphological characters of centipedes (Chilopoda).

Students still use different terms to describe the same or similar structures in centipedes, even limiting our survey to papers in English. Consequently, the terminology is heterogeneous, redundant, and sometimes ambiguous. The lack of standardization

hinders comparative analysis and integration of information scattered through the literature, and discourages new students from undertaking taxonomic and morphological investigations on this arthropod group.

Efforts to revise the terminology have been rare and limited to either particular character sets or selected chilopod sub-groups, as exemplified by the terms for integumental projections discussed by Crabill (1960a) and those proposed for major taxonomic characters in Scolopendromorpha (Lewis et al. 2005). A common English terminology encompassing all external features and applicable to the Chilopoda as a whole has never been proposed.

## Methods

The terminology recommended here encompasses major structural features of the body and all external characters recognized under light microscopy. Internal characters are not addressed herein, because the terminology in use is more consistent and uniform. We also exclude fine structural details, including those of peristomatic structures (epipharynx and hypopharynx), because they have been documented only recently, by histology and scanning electron microscopy, so that a consistent terminology is available (Edgecombe and Giribet 2006; Koch and Edgecombe 2006, 2008). Our recommended terminology mainly focuses on adult morphology of extant chilopods, but is intended to be applicable to other post-embryonic stadia and to extinct taxa as well.

We considered all publications in English dealing with centipedes since Lewis' (1981) treatise on chilopod biology (the most recent, comprehensive synthesis on the morphology of this group in English) and a selection of older works also in English (listed in the additional file: Pre-1981 publications) that seemed most relevant for the morphological terminology. We omitted XIX century publications, because their terminologies were often based on erroneous or unwarranted homologies with other arthropods and have long been superseded. We retrieved all applicable terms and assessed counterparts.

To maximize future applicability, alternative criteria of selection have been discussed with authors who are either currently the most active centipede systematists publishing descriptions in English and/or have already addressed issues of terminology standardization. In order to identify and recommend a single term for each character, we applied the following criteria: (i) we selected a term already used in the literature, except when all alternatives are either ambiguous or inconsistent with other selected terms; (ii) among alternatives, we selected either the term used most frequently (by most authors and/or in most publications) or the one explicitly introduced and defined by an influential author; (iii) we applied minor emendations to selected terms (in endings, prefixes, hyphenations between elements of compound words) when necessary for consistency and uniformity. We refrained from revising the terminology based on homology hypotheses with other arthropods (Edgecombe 2008), because many relationships remain under debate.

Major anatomical differences exist between the six centipede orders, five extant - Scutigeromorpha, Lithobiomorpha, Craterostigmomorpha, Scolopendromorpha, and Geophilomorpha - and one extinct, Devonobiomorpha. Morphological and taxonomical investigations by different authors have sometimes been and still are limited to single orders, leading to different terminological traditions. While we propose a consistent terminology for the entire class, we specify the order(s) to which each term is applicable to facilitate usage by students interested in single orders; when no orders are specified, it is meant that the term is applicable to all orders; when an order is specified, it is meant that the term is applicable to at least some taxa in the order.

## Results

After reviewing the relevant literature as explained above, we retrieved roughly 830 terms that apply to 330 anatomical features. By applying the criteria described above, we obtained the recommended terminology presented herein.

Terms for surface depressions and projections are provided in Tables 1–2. Those indicating the arrangement of these and other features are given in Table 3. Terms recommended but not defined because of general use in Arthropoda include: appendage, arthrodial membrane, article, articulation, condyle, cuticle, head, pleurite, sclerite, segment, sternite, telopodite, tergite, and trunk. All other recommended terms are listed below. They are arranged first in anterior to posterior anatomical sequence and then in hierarchical-structural order (whole to part). The singular is in bold, and specifications that may be omitted are in parentheses. For each recommended term, we give the following: whenever suitable, the plural preceded by a slash; in the case of taxonomically restricted usage, the order(s) to which it applies (in brackets); a synthetic definition; reference to an illustration; whenever suitable, reference(s) to publication(s) where the term was defined; synonymous terms (introduced by “Syn.”; the plural form preceded

**Table 1.** Terms recommended for different kinds of impressions on the body surface.

recommended term/plural	features	source	alternative terms employed
<b>suture</b> /sutures	linear; sometimes corresponding to the seam between two immovable sclerites	Lewis et al. 2005: 3	hinge line/lines, sulcus/sulci
<b>sulcus</b> /sulci	shallow, elongated; in a sclerite	Lewis et al. 2005: 3	furrow/furrows, stria/striae
<b>depression</b> /depressions	shallow, large, not elongated; in a sclerite	Lewis et al. 2005: 2, 5	gutter/gutters
<b>fossa</b> /fossae	deep, large, elongated; in a sclerite or between two sclerites	Eason 1964: 278. Barber 2009: 204	pit/pits
<b>punctum</b> /puncta	point-like; in a sclerite	-	-
<b>setal socket</b> /sockets	deep, rounded; corresponding to a seta	-	setal alveolus/alveoli

**Table 2.** Terms recommended for different kinds of projections on the body surface.

recommended term/plural	features	source	alternative terms employed
<b>tubercle/</b> tubercles	non-articulated, stout, usually rounded	-	-
<b>spinous process/</b> processes	non-articulated, large, pointed	Lewis et al. 2005: 5	-
<b>spine/spines</b>	non-articulated, small, pointed	Crabill 1952: 204. Crabill 1962: 399. Würmli 1974: 93. Edgecombe and Giribet 2006: 509	spina/spinae
<b>spinula/</b> spinulae	non-articulated, very small, pointed	Würmli 1974: 93. Edgecombe and Giribet 2006: 509	spinule/spinules
<b>hair/hairs</b>	non-articulated, slender	Würmli 1974: 93	-
<b>spicula/</b> spiculae	non-articulated, spike-like	Würmli 1974: 93	hairlike spine/spines, spiculum/spicula
<b>seta/setae</b>	articulated at the base, slender	Crabill 1952: 204. Crabill 1960a: 14	bristle/bristles, hair/hairs, trichoid sensillum/sensilla
<b>spur/spurs</b>	articulated at the base, spine-like	Crabill 1952: 204. Crabill 1960a: 14. Crabill 1962: 399. Lewis et al. 2005: 5	-
<b>spine-bristle/</b> spine-bristles	articulated at the base, slender, large, covered with short spines proximally that elongate into a fluted ornament distally	Würmli 1974: 93	acicular seta/ setae, macroseta/ macrosetae, spinoseta/spinosetae
<b>sensillum/</b> sensilla	articulated at the base, shape various, sensorial function	-	sensory seta/setae

by a slash; listed alphabetically, without an implicit ranking). An alphabetical index of all recommended and synonymous terms is provided in the additional file: Analytical index. Abbreviations for orders are: Cra (Craterostigmomorpha), Dev (Devonobiomorpha), Geo (Geophilomorpha), Lit (Lithobiomorpha), Sco (Scolopendromorpha), and Scu (Scutigeromorpha).

### *cephalic capsule*

**cephalic capsule:** integument of the head to the exclusion of its appendages. Fig. 1.  
Syn.: head capsule

**cephalic plate:** [Cra, Dev, Geo, Lit, Sco] dorsal side of the cephalic capsule. Fig. 2.  
Syn.: cephalic shield, head plate, head shield

(cephalic) **median sulcus:** [Lit, Scu] mid-longitudinal sulcus on the anterior part of the cephalic capsule. Fig. 1. Syn.: (cephalic) median furrow

**Table 3.** Terms recommended for indicating the pattern of different elements.

recommended term	elements	alternative terms employed
<b>areolation</b>	scutes, on an area of the surface	reticulation
<b>setation</b>	setae, on an area of the surface	chaetotaxy, vestiture
(coxosternal)	teeth, on the anterior margin of the	-
<b>dentition</b>	forcipular coxosternite (Lithobiomorpha)	
<b>plectrotaxy</b>	spurs, on the legs (Lithobiomorpha)	armature, spinulation, spurulation

(cephalic) **transverse suture**: transverse suture on the anterior part of the dorsal side of the cephalic capsule. Figs 3–4. Syn.: cephalic suture, frontal line, frontal sulcus, frontal suture

**anterior projection/projections of the** (cephalic) **transverse suture**: [Scu] one of the paramedian sutures projecting anteriorly from the cephalic transverse suture. Fig. 3

**antennocellar suture/sutures**: [Cra, Lit, Scu] one of the paired sutures on the antero-lateral parts of the cephalic capsule. Fig. 3. Crabill 1961a: 131

**antennal branch/branches of antennocellar suture**: [Cra, Lit, Scu] part of the antennocellar suture, anterior to the cephalic transverse suture. Syn.: anterior portion/portions of antennocellar suture

**ocellar branch/branches of antennocellar suture**: [Cra, Lit, Scu] part of the antennocellar suture, posterior to the cephalic transverse suture. Syn.: posterior portion/portions of antennocellar suture, posterior limb/limbs of (cephalic) transverse suture

**frontal plate**: anterior part of the dorsal side of the cephalic capsule, delimited posteriorly by the cephalic transverse suture. Fig. 4. Syn.: frons

**ocellar area/areas**: [Lit, Scu] one of the paired antero-lateral parts of the cephalic capsule, bearing compound eyes or ocelli when present, and delimited mesally by the antennocellar suture. Fig. 3. Syn.: eye area/areas, ocellary area/areas, ocellary field/fields, ocular area/areas

**compound eye/eyes**: [Scu] faceted vision organ, composed of similar units known as ommatidia. Fig. 3

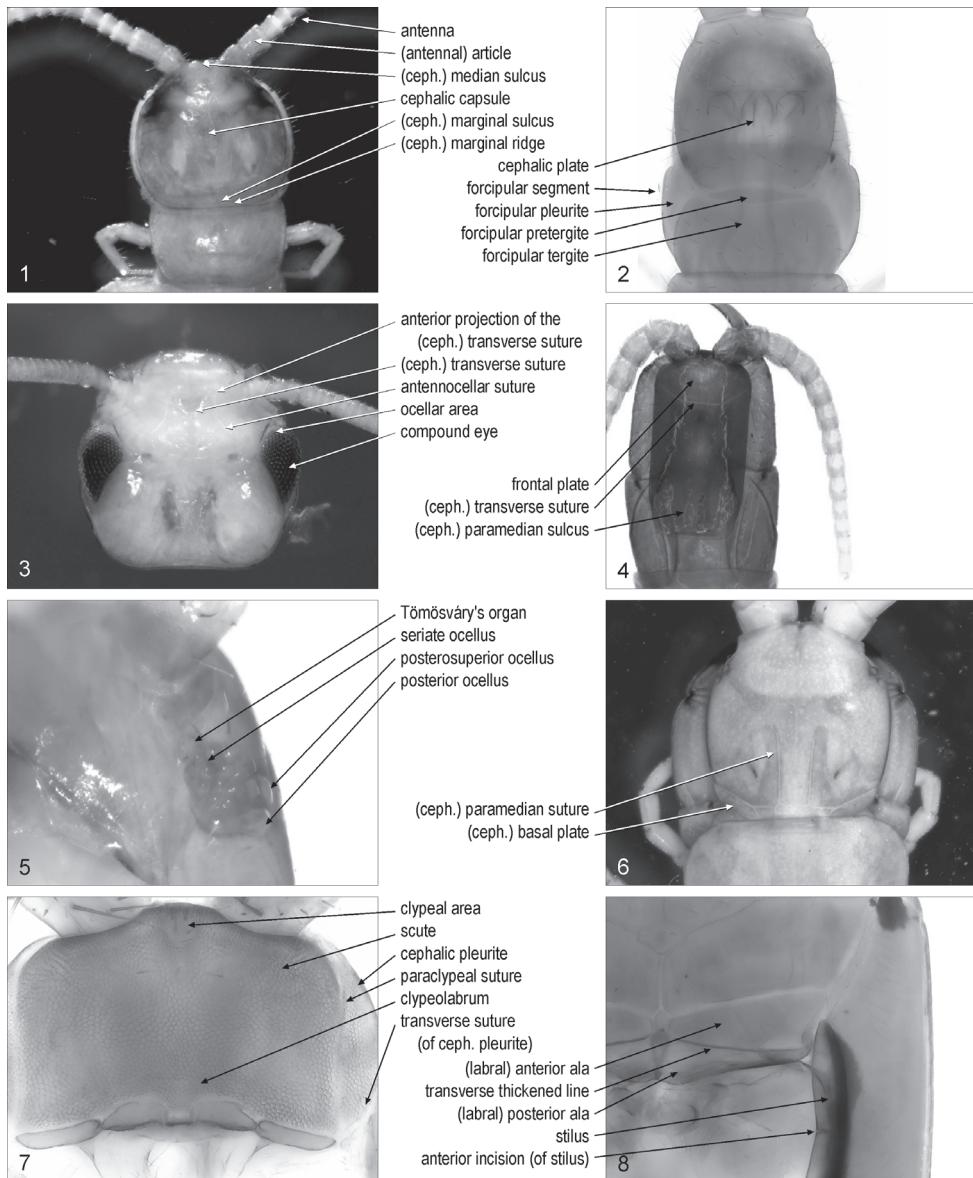
**ocellus/ocelli**: [Cra, Lit, Sco] simple vision organ, appearing as a single convex lens. Fig. 5

**posterior ocellus/ocelli**: [Lit] the most posterior ocellus on each side of the head. Fig. 5. Crabill 1961a: 132. Syn.: major ocellus/ocelli, principal ocellus/ocelli, terminal ocellus/ocelli

**seriate ocellus/ocelli**: [Lit] one of the ocelli other than the posterior ocellus. Fig. 5. Crabill 1961a: 132. Syn.: minor ocellus/ocelli

**ocellar series/series**: [Lit] one of the sub-horizontal rows in which the seriate ocelli can be arranged. Syn.: ocellar row/rows

**posterosuperior ocellus/ocelli**: [Lit] the most posterior ocellus of the most dorsal row of seriate ocelli. Fig. 5

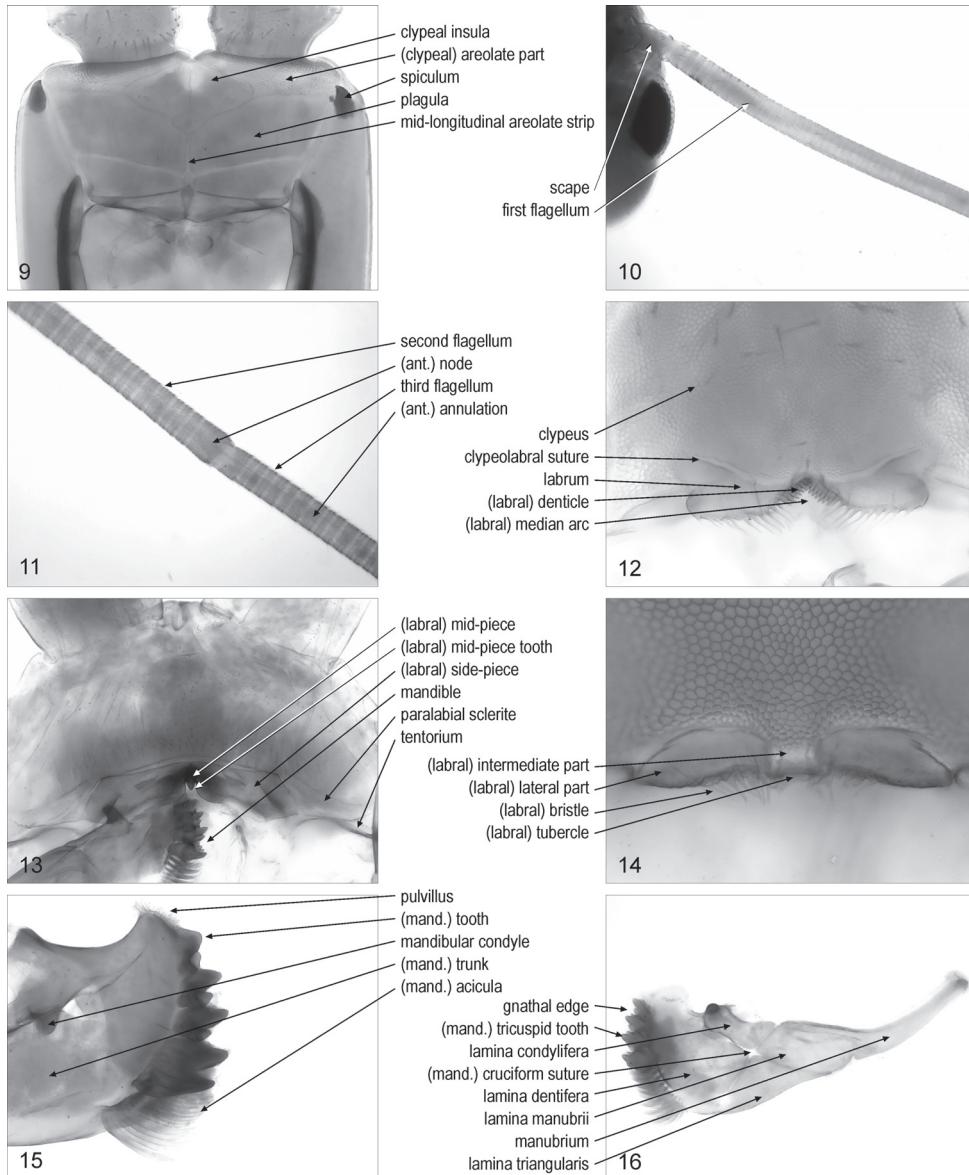


**Figures 1–8.** **1** anterior part of body, dorsal, *Lamyctes emarginatus* **2** anterior part of body, dorsal, *Geophilus carpophagus* **3** head, dorsal, *Scutigera coleoptrata* **4** anterior part of body, dorsal, *Mecistocephalus guildingii* **5** left part of cephalic capsule, ventro-lateral, *Lithobius dentatus* **6** anterior part of body, dorsal, *Cormocephalus gervaisianus* **7** anterior part of cephalic capsule, without maxillary complex and mandibles, ventral, *Ribautia centralis* **8** left part of cephalic capsule, without maxillary complex and mandibles, ventral, *Mecistocephalus togensis*. Abbreviations: ceph., cephalic.

- Tömösváry's organ/organs:** [Cra, Lit, Scu] hygroreceptor sensory organ at the side of the head. Fig. 5. Syn.: organ/organs of Tömösváry, postantennal organ/organs, Tömösváry organ/organs
- (cephalic) **paramedian suture/sutures:** [Sco] one of the paired paramedian sutures on the cephalic plate. Fig. 6
- (cephalic) **paramedian sulcus/sulci:** [Geo, Lit] one of the paired paramedian sulci on the posterior part of the cephalic plate. Fig. 4. Syn.: paired posterior depression/depressions.
- (cephalic) **marginal ridge:** [Lit, Sco] narrow ridge along the lateral and posterior margins of the dorsal side of the cephalic capsule. Fig. 1. Crabbill 1961a: 131; Lewis et al. 2005: 7. Syn.: limbus, marginal bulge, marginal rim
- (cephalic) **marginal sulcus/sulci:** [Lit, Sco] sulcus between the marginal ridge and the remaining part of the dorsal side of the cephalic capsule. Fig. 1
- lateral marginal interruption/interruptions (of cephalic plate):** [Lit] notch on the lateral margins of the cephalic plate. Eason 1964: 179. Syn.: disjuncture/disjunctions of limbus, lateral termination/terminations of marginal ridge
- (cephalic) **basal plate/plates:** [Sco] one of the paired sclerites at the posterior corners of the cephalic plate. Fig. 6
- cephalic pleurite/pleurites:** [Cra, Dev, Geo, Lit, Sco] one of the pleurites lateral to the clypeolabrum. Fig. 7. Syn.: bucca/buccae, cephalic pleura/pleurae, cephalic pleuron/pleura
- transverse suture/sutures (of cephalic pleurite):** [Geo] transverse suture on the cephalic pleurite. Fig. 7. Crabbill 1960b: 189. Syn.: buccal suture/sutures, transbuccal suture/sutures
- stilus/stili:** [Geo] sclerotised ridge on the mesal margin of the cephalic pleurite. Fig. 8. Crabbill 1959a: 192; 1964a: 168; 1970: 235. Syn.: buccal margin/margins
- anterior incision/incisions (of stilus):** [Geo] notch on the mesal side of the stilus. Fig. 8. Crabbill 1959a: 192
- spiculum/spicula:** [Geo] sclerotised, pointed projection on the anterior part of the cephalic pleurite. Fig. 9. Crabbill 1959a: 192; 1964a: 168; 1970: 236
- maxillary complex:** whole of first and second maxillae

### ***antenna***

- antenna/antennae:** one of the paired most anterior appendages on the head. Fig. 1
- (antennal) **article/articles:** one of the rigid sectors along the antenna. Fig. 1. Syn.:
- (antennal) annulus/annuli, (antennal) joint/joints, (antennal) segment/segments, antennomere/antennomeres
- scape/scapes:** [Scu] set of the two most basal antennal articles. Fig. 10
- (antennal) **annulation/annulations:** [Scu] short antennal article. Fig. 11. Syn.: (antennal) article/articles



**Figures 9–16.** **9** anterior part of cephalic capsule, without maxillary complex and mandibles, ventral, *Mecistocephalus togenis* **10** basal part of right antenna, dorsal, *Scutigera coleoptrata* **11** intermediate part of the right antenna, dorsal, *Scutigera coleoptrata* **12** anterior part of cephalic capsule, without maxillary complex and mandibles, ventral, *Pectiniunguis ducalis* **13** anterior part of the cephalic capsule, without maxillary complex and left mandible, ventral, *Scolopendra oraniensis* **14** labrum, ventral, *Ribautia centralis* **15** distal part of right mandible, antero-dorsal, *Lithobius dentatus* **16** left mandible, antero-dorsal, *Scolopendra oraniensis*. Abbreviations: ant., antennal; mand., mandibular.

**flagellum**/flagella: [Scu] one of the sections along the antenna composed of annulations. Figs 10–11. Syn.: duploflagellum/duploflagella

(antennal) **node**/nodes: [Scu] elongate antennal article between two flagella along the antenna. Fig. 11

**first flagellum**/flagella: [Scu] the most basal flagellum along the antenna. Fig. 10. Syn.: flagellum/flagella primum/prima, first division/divisions of antenna/antennae

**second flagellum**/flagella: [Scu] the second flagellum along the antenna. Fig. 11. Syn.: flagellum/flagella secundum/secunda, second division/divisions of antenna/antennae

**third flagellum**/flagella: [Scu] the third flagellum along the antenna. Fig. 11. Syn.: flagellum/flagella tertium/tertia, third division/divisions of antenna/antennae

**shaft organ**/organs: [Scu] sensory organ on the first antennal article

### *clypeus and labrum*

**clypeolabrum**: antero-ventral part of the cephalic capsule, posterior to the antennae and between the cephalic pleurites. Fig. 7

**clypeus**: sclerite on the antero-ventral part of the cephalic capsule, to the exclusion of the labrum. Fig. 12

**paraclypeal suture**/sutures: one of the lateral margins of the clypeus. Fig. 7. Crabbill 1959a: 192; 1959b: 173; 1960b: 189. Syn.: clypeal suture/sutures

**scute**/scutes: area on the cuticle, corresponding to the external face of a single epithelial cell. Fig. 7. Syn.: cuticular polygon/polymers

(clypeal) **areolate part**: [Geo] anterior part of the clypeus that is evidently areolate. Fig. 9. Syn.: areolate clypeus

**plagula**/plagulae: [Geo] one of the non-areolate areas on the posterior part of the clypeus. Fig. 9. Crabbill 1959a: 192; 1959b: 173; 1964a: 168; 1970: 235. Syn.: (clypeal or prelabral) consolidated area/areas, (clypeal or prelabral) non-areolate field/fields, (clypeal or prelabral) non-areolate part/parts, posterior clypeus

**mid-longitudinal areolate strip**: [Geo] mid-longitudinal areolate band separating two paired plagulae. Fig. 9. Syn.: mid-longitudinal areolate stripe

**clypeal insula**/insulae: [Geo] non-areolate area inside the areolate part of the clypeus. Fig. 9

**clypeal area**/areas: [Geo] small, subcircular, median area on the areolate part of the clypeus, with distinctly finer or indistinct areolation. Fig. 7. Syn.: anteroclypeal area/areas, clypeal spot/spots, (clypeal or anterocentral) fenestra/fenestrae

**clypeolabral suture**: suture between clypeus and labrum. Fig. 12

**labrum**: posterior part of the clypeolabrum, sometimes delimited from the clypeus by a suture. Fig. 12. Syn.: upper lip

(labral) **mid-piece**: median sclerite of the labrum. Fig. 13. Syn.: (labral) median piece, (labral) middle piece

(labral) **intermediate part**: [Geo] median part of the labrum, when not a sclerite distinct from the lateral parts. Fig. 14. Syn.: median labromere, (labral) median piece, (labral) middle piece, (labral) middle portion, (labral) mid-piece

(labral) **mid-piece tooth**: sclerotised tooth on the labral mid-piece. Fig. 13

(labral) **side-piece**/side-pieces: one of the paired lateral sclerites of the labrum. Fig. 13. Syn.: (labral) lateral piece/pieces, (labral) lateral portion/portions

(labral) **lateral part**/parts: [Geo] one of the paired lateral parts of the labrum, when not sclerites distinct from the intermediate part. Fig. 14. Syn.: (labral) lateral portion/portions, (labral) side-piece/side-pieces

(labral) **ala/alae**: [Geo] one of the two sclerites composing the labral side-piece. Fig. 8

(labral) **anterior ala/alae**: [Geo] the anterior of the two sclerites composing the labral side-piece. Fig. 8

(labral) **posterior ala/alae**: [Geo] the posterior of the two sclerites composing the labral side-piece. Fig. 8

(labral) **transverse thickened line**/lines: [Geo] sclerotised ridge between the anterior and posterior ala of the labral side-piece. Fig. 8

(labral) **median arc**: [Geo] concave posterior margin of the labral intermediate part. Fig. 12. Syn.: labral arch

(labral) **bristle**/bristles: hair-like, sometimes branching, projection along the posterior margin of the labrum. Fig. 14. Syn.: (labral) branching bristle/bristles, (labral) filament/filaments, (labral) (branched) fimbria/fimbriae, (labral) hair/hairs

(labral) **denticle**/denticles: [Geo] subtriangular, flat projection along the posterior margin of the labrum. Fig. 12. Syn.: (labral) tooth/teeth

(labral) **tubercle**/tubercles: [Geo] subconical, stout projection along the posterior margin of the labrum. Fig. 14. Syn.: (labral) tooth/teeth

**paralabial sclerite**/sclerites: [Lit, Sco] one of the paired sclerites posterior to the clypeus and lateral to the labral side-pieces. Fig. 13. Syn.: coclypeus/coclypei

**tentorium/tentoria**: Y-shaped sclerite whose three limbs are attached to the labral lateral parts, the cephalic pleurite, and the mandibular condyle, respectively. Fig. 13. Syn.: (labral or mandibular) fulcrum/fulcra, (labral or labial) fultura/fulturae, tentorial complex/complexes

### ***mandible***

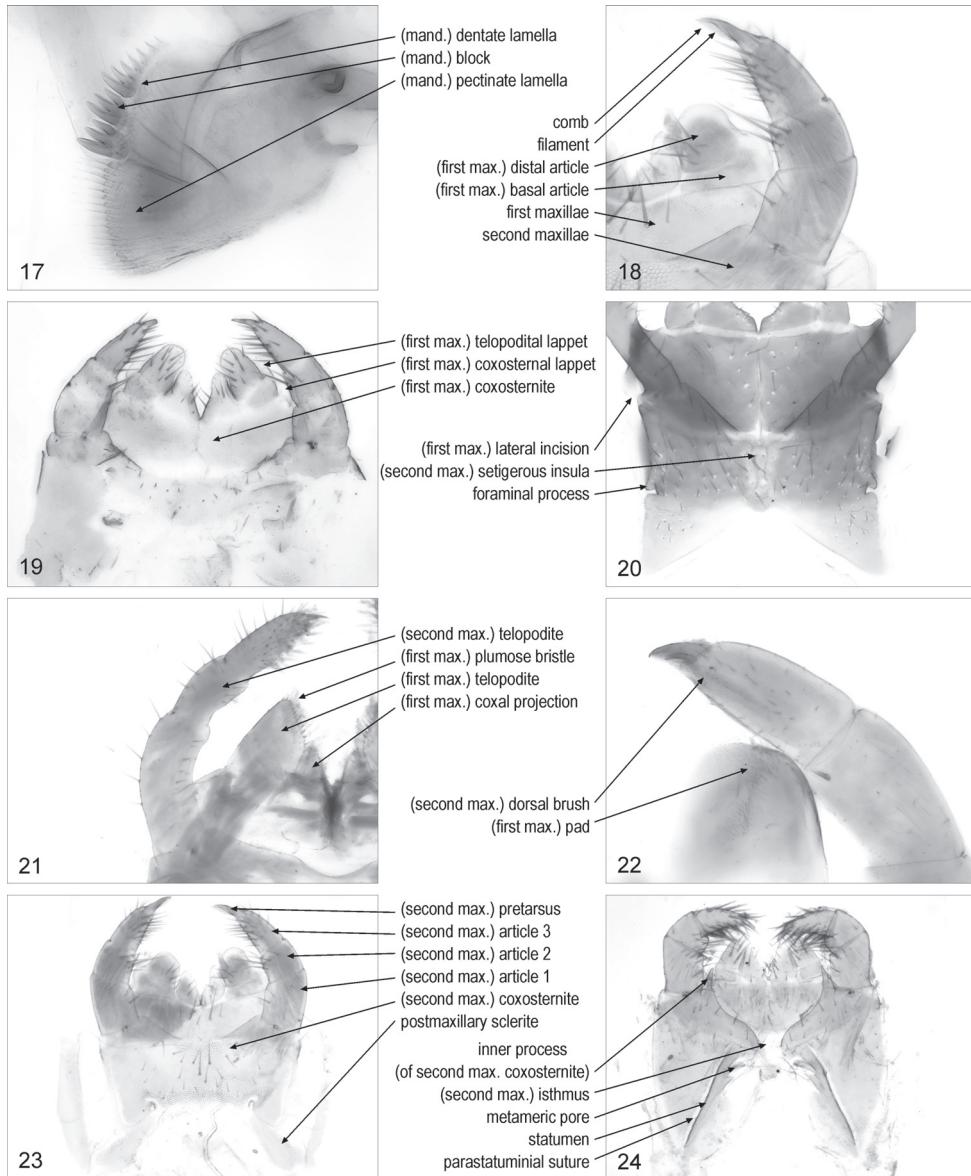
**mandible**/mandibles: one appendage of the first pair of the mouth-parts. Fig. 13

**mandibular condyle**/condyles: condyle of the mandible serving the articulation with the tentorium. Fig. 15

**gnathal edge**/edges: distal margin of the mandible. Fig. 16. Syn.: apical ridge/ridges, gnathal lobe/lobes, molar edge/edges

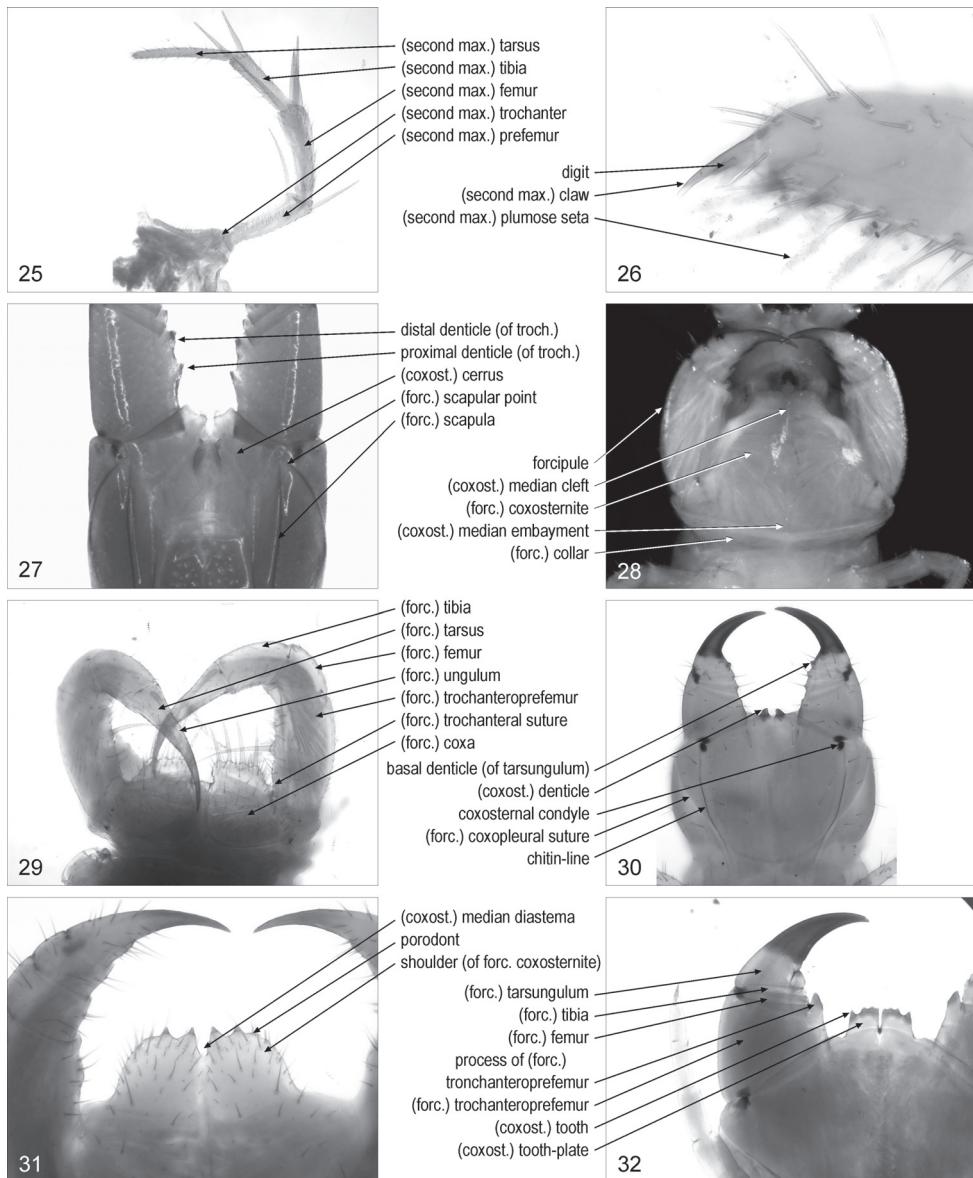
**manubrium**/manubria: slender projection of the mandible opposite to the gnathal edge with respect to the mandibular condyle. Fig. 16. Crabbill 1960a: 15. Syn.: shank/shanks

- (mandibular) **trunk/trunks**: main part of the mandible, to the exclusion of the manubrium and the gnathal edge. Fig. 15. Syn.: (mandibular) body/bodies, (mandibular) corpus/corpora, (mandibular) shaft/shafts
- (mandibular) **cruciform suture/sutures**: [Sco] pair of crossed sutures on the mandibular trunk. Fig. 16. Syn.: cruciform fissure/fissures
- lamina/laminae manubrii**: [Sco] part of the mandible between manubrium and cruciform suture. Fig. 16. Crabbill 1960a: 15
- lamina/laminae triangularis/triangulares**: [Sco] part of the mandible between the lamina manubrii and the lamina dentifera, opposite to the lamina condylifera with respect to the cruciform suture. Fig. 16. Crabbill 1960a: 15
- lamina/laminae dentifera/dentiferae**: [Sco] part of the mandible between apical ridge and cruciform suture. Fig. 16. Crabbill 1960a: 15
- lamina/laminae condylifera/condyliferae**: [Sco] part of the mandible between the lamina manubrii and the lamina dentifera, including the mandibular condyle and opposite to the lamina triangularis with respect to the cruciform suture. Fig. 16. Crabbill 1960a: 15
- molar plate/plates**: [Scu] sclerotised, flat area on the gnathal edge
- pulvillus/pulvilli**: array of dense short scales on the dorsal end of the mandibular gnathal edge. Fig. 15. Syn.: fury pad/pads, Haarpolster
- (mandibular) **acicula/aciculae**: one of the slender long projections on the ventral end of the mandibular gnathal edge. Fig. 15. Edgecombe 2001: 203. Syn.: sickle bristle/bristles, sickle-shaped bristle/bristles
- pinnule/pinnules (of acicula)**: one of the branches of a mandibular acicula
- (mandibular) **branching bristle/bristles**: [Lit] hair-like, branching projection fringing the mandibular teeth and aciculae
- (mandibular) **accessory denticle/denticles**: [Lit, Sco] one of the denticles arranged in rows on the mandibular teeth
- (mandibular) **lamella/lamellae**: one of the flat projections on the gnathal edge of the mandible. Fig. 17. Syn.: (mandibular) lamina/laminae
- (mandibular) **dentate lamella/lamellae**: mandibular lamella bearing teeth. Fig. 17. Syn.: dentate lamina/laminae, dentate plate/plates, lamella/lamellae dentata/dentatae
- (mandibular) **tooth/teeth**: sclerotised, large, subconical, projection on a mandibular dentate lamella. Fig. 15
- (mandibular) **tricuspid tooth/teeth**: tooth with three tips on a dentate lamella. Fig. 16
- (mandibular) **block/blocks**: one of the sclerotised distinct parts of a dentate lamella, each bearing one or more teeth. Fig. 17
- (mandibular) **pectinate lamella/lamellae**: [Geo, Sco] mandibular lamella bearing poorly sclerotised, subcylindrical, slender projections. Fig. 17. Syn.: pectinate lamina/laminae
- (mandibular) **basal tooth/teeth**: [Geo] subconical projection at the base of the first mandibular lamella



***first maxillae***

- first maxillae** {plural only}: pair of appendages and associated basal sclerites between the mandibles and the second maxillae. Fig. 18. Syn.: first maxilla {singular}, maxillae I {plural}
- (first maxillary) **sternite**: most basal part of the coxosternite, associated with the first maxillae
- (first maxillary) **coxa/coxae**: part of the coxosternite corresponding to a coxa, of the first maxillae
- (first maxillary) **coxosternite**: entire sclerite corresponding to sternite and coxae of the first maxillae. Fig. 19. Syn.: coxae {plural}, coxites {plural}, coxosterna {singular}, coxosternum, sternum, syncoxite, syncoxosternum
- (first maxillary) **lateral incision**: [Geo] notch on the lateral margin of the first maxillary coxosternite. Fig. 20. Crabil 1959a: 192
- (first maxillary) **coxal projection/projections**: one of the paired projections on the anterior margin of the first maxillary coxosternite, mesal to the telopodites. Fig. 21. Syn.: coxal process/processes, inner branch/branches, inner lobe/lobes, medial lobe/lobes, medial projection/projections
- (first maxillary) **telopodite/telopodites**: one of the paired projections, usually articulated at the base, on the anterior margin of the first maxillary coxosternite, lateral to the coxal projections. Fig. 21. Syn.: outer branch/branches, outer lobe/lobes, palp/palps, palpus/palpi
- (first maxillary) **basal article/articles**: the most basal article of the first maxillary telopodite. Fig. 18. Syn.: femoroid/femoroids
- (first maxillary) **distal article/articles**: the most distal article of the first maxillary telopodite. Fig. 18. Syn.: tibio-tarsus/tibio-tarsi
- (first maxillary) **plumose bristle/bristles**: [Lit] one of the feather-like projections on the distal article of the first maxillary telopodite. Fig. 21
- (first maxillary) **pad/pads**: [Sco] array of short, dense projections on the distal article of the first maxillary telopodite. Fig. 22
- (first maxillary) **lappet/lappets**: [Geo] projection on the lateral margin of the first maxillary coxosternite or telopodite. Fig. 19. Syn.: external sensory lappet/lappets, (lateral or maxillary) palp/palps, palpal process/processes, (lateral or maxillary) palpus/palpi
- (first maxillary) **coxosternal lappet/lappets**: [Geo] lappet on the first maxillary coxosternite. Fig. 19. Syn.: coxal palpus/palpi, syncoxal lobe/lobes, syncoxital lappet/lappets
- (first maxillary) **telopodal lappet/lappets**: [Geo] lappet on the basal article of the first maxillary telopodite. Fig. 19. Syn.: femural palpus/palpi



**Figures 25–32.** **25** left part of second maxillae, ventral, *Scutigera coleoptrata* **26** distal part of second maxillary right telopodite, dorsal, *Lithobius dentatus* **27** forcipular segment, dorsal, *Mecistocephalus togensis* **28** anterior part of body, ventral, *Lamyctes emarginatus* **29** forcipular segment, ventral, *Scutigera coleoptrata* **30** forcipular segment, ventral, *Clinopodes trebevicensis* **31** anterior part of forcipular segment, ventral, *Lithobius dentatus* **32** right part of forcipular segment, ventral, *Scolopendra oraniensis*. Abbreviations: coxost., coxosternal; forc., forcipular; max., maxillary; troch., trochanteroprefemur.

***second maxillae***

**second maxillae** {plural only}: pair of appendages and associated basal sclerite/s, posterior to the first maxillae. Fig. 18. Syn.: labium, maxillae II {plural}, second maxilla {singular}

(second maxillary) **coxosternite**: entire sclerite corresponding to sternite and coxae of the second maxillae. Fig. 23. Syn.: (second maxillary) coxosterna {singular}, (second maxillary) coxosternum

(second maxillary) **isthmus**: median part of the second maxillary coxosternite. Fig. 24

(second maxillary) **setigerous insula**/insulae: [Geo] one of the nonareolate areas, bearing setae, inside the areolate part of the second maxillary coxosternite. Fig. 20

**metameric pore**/pores: one of the paired pores of the maxillary glands on the second maxillary coxosternite. Fig. 24. Syn.: salivary pore/pores

**foraminal process**/processes: [Geo] marginal projection of the second maxillary coxosternite surrounding the metameric pore. Fig. 20

**statumen**/statuminia: [Geo] sclerotised elongated ridge mesal to the metameric pore. Fig. 24. Crabbill 1955: 222; 1960b: 194. Syn.: (second maxillary) pleurocoxal line/lines, (second maxillary) pleurosternal suture/sutures

**parastatuminal suture**/sutures: [Geo] suture along the statumen. Fig. 24. Crabbill 1964b: 39

**circumforaminal ring**/rings: [Geo] sclerotised ring partially surrounding the metameric pore

**inner process**/processes (of second maxillary coxosternite): [Geo] one of the paired projections on the anterior margin of the second maxillary coxosternite, mesal to the telopodites. Fig. 24. Syn.: (second maxillary) mesodistal process/processes

**postmaxillary sclerite**/sclerites: [Cra, Geo, Lit] one of the paired sclerites adjacent to the posterior corners of the second maxillary coxosternite. Fig. 23. Crabbill 1960b: 189.

(second maxillary) **telopodite**/telopodites: part of the appendage of the second maxillae, distal to the most basal articulation. Fig. 21. Syn.: palp/palps, palpus/palpi, telopod/telopods

(second maxillary) **trochanter**/trochanters: [Scu] first article of the second maxillary telopodite. Fig. 25

(second maxillary) **prefemur**/prefemora: [Scu] second article of the second maxillary telopodite. Fig. 25

(second maxillary) **femur**/femora: [Scu] third article of the second maxillary telopodite. Fig. 25

(second maxillary) **tibia**/tibiae: [Scu] fourth article of the second maxillary telopodite. Fig. 25

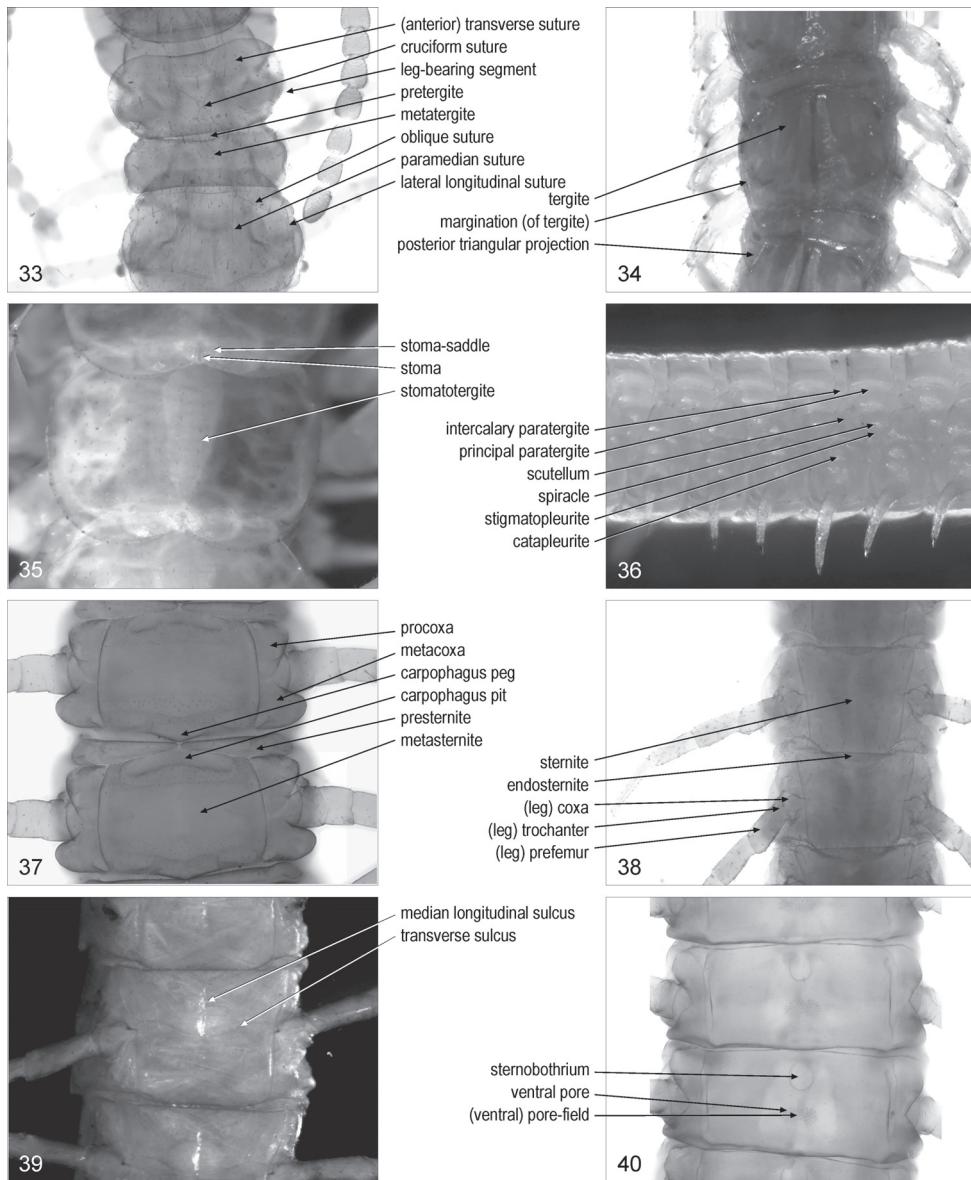
(second maxillary) **tarsus**/tarsi: [Scu] fifth article of the second maxillary telopodite. Fig. 25

- (second maxillary) **article/articles 1:** [Cra, Geo, Lit, Sco] first article of the second maxillary telopodite. Fig. 23. Lewis et al. 2005: 2, 3. Syn.: basal article/articles, femoroid/femoroids, first article/articles, telomere/telomeres 1
- (second maxillary) **article/articles 2:** [Cra, Geo, Lit, Sco] second article of the second maxillary telopodite. Fig. 23. Lewis et al. 2005: 2, 3. Syn.: second article/articles, second joint/joints, telomere/telomeres 2, tibia/tibiae
- (second maxillary) **article/articles 3:** [Cra, Geo, Lit, Sco] third article of the second maxillary telopodite. Fig. 23. Lewis et al. 2005: 2, 3. Syn.: apical article/articles, tarsus/tarsi, telomere/telomeres 3, terminal joint/joints, third article/articles, ultimate article/articles
- (second maxillary) **plumose seta/setae:** [Lit] one of the setae with apical branches, on article 3 of the second maxillary telopodite. Fig. 26
- (second maxillary) **dorsal brush/brushes:** [Cra, Sco] longitudinal row of hairs on article 3 of the second maxillary telopodite. Fig. 22. Lewis et al. 2005: 2, 3. Syn.: palisade/palisades of capitate hairs
- (second maxillary) **pretarsus/pretarsi:** [Cra, Geo, Lit, Sco] terminal element articulated to the most distal article of the second maxillary telopodite. Fig. 23. Syn.: praetarsus/praeptarsi
- (second maxillary) **claw/claws:** [Cra, Geo, Lit, Sco] second maxillary pretarsus in shape of a claw. Fig. 26. Syn.: apical claw/claws, pretarsal claw/claws, terminal claw/claws
- digit/digits (of second maxillary claw):** [Cra, Lit] one of the short projections on the second maxillary claw. Fig. 26
- comb/combs (of second maxillary claw):** [Geo, Sco] row of projections along the margin of the second maxillary claw. Fig. 18. Syn.: comb/combs of teeth
- filament/filaments (of second maxillary claw):** [Geo, Sco] one of the slender projections of the comb of the second maxillary claw. Fig. 18

### *forcipular segment*

- forcipular segment:** segment bearing the forcipules. Fig. 2. Syn.: maxilliped segment, prehensorial segment
- forcipular pretergite:** [Geo, Sco] short sclerite anterior to the forcipular tergite. Fig. 2. Syn.: lamina basalis, prebasal plate
- forcipular tergite:** main tergite of the forcipular segment. Fig. 2. Syn.: basal plate
- forcipular pleurite/pleurites:** lateral sclerite of the forcipular segment. Fig. 2. Syn.: (forcipular or maxilliped) pleuron/pleura, (forcipular or maxilliped) pleura/pleurae
- (forcipular) **scapula/scapulae:** [Geo] dorsal ridge of the forcipular pleurite. Fig. 27
- (forcipular) **scapular point/points:** [Geo] projecting anterior tip of the forcipular scapula. Fig. 27. Crabbill 1970: 237. Syn.: scapular projection/projections

- (forcipular) **collar**: [Lit] ventral transversal bridge connecting the forcipular pleurites. Fig. 28. Syn.: (maxillipede) (pleural) collar
- (forcipular) **coxa/coxae**: [Scu] one of the paired sclerites basal to the forcipules, bearing spine-bristles on the anterior margin. Fig. 29. Syn.: (forcipular) coxite/coxites
- (forcipular) **coxosternite**: [Cra, Dev, Geo, Lit, Sco] entire sclerite corresponding to sternite and coxae of the forcipular segment. Fig. 28. Syn.: (maxillipede) coxosternite, (forcipular or maxillipede) coxosternum, (prehensorial) pre-sternum, (prehensorial) prosternum
- (forcipular) **coxopleural suture/sutures**: suture between the forcipular pleurite and the forcipular coxae or coxosternite. Fig. 30. Syn.: pleuroprosternal suture/sutures
- coxosternal condyle/condyles**: condyle of the forcipular coxa or coxosternite serving the articulation with the trochanteroprefemur. Fig. 30. Syn.: (coxofemoral or prehensorial) condyle/condyles
- (coxosternal) **cerrus/cerri**: [Geo] one of the paired groups of setae on the dorsal side of the forcipular coxosternite. Fig. 27. Crabbill 1970: 236
- (coxosternal) **condylar process/processes**: [Geo] one of the paired projections of the forcipular coxosternite, close to the dorsal coxosternal condyles
- shoulder/shoulders** (of forcipular coxosternite): [Lit] one of the paired obtuse projections on the anterior margin of the forcipular coxosternite. Fig. 31. Syn.: coxal endite/endites, lateral prosternal prominence/prominences
- (coxosternal) **median diastema**: [Cra, Dev, Geo, Lit, Sco] median concavity on the anterior margin of the forcipular coxosternite. Fig. 31. Syn.: median interval, median notch, median sinus
- (coxosternal) **tooth/teeth**: [Cra, Dev, Lit, Sco] sclerotised, short, subconical projection on the anterior margin of the forcipular coxosternite. Fig. 32. Syn.: (coxosternal or prosternal) (anterior or anterocentral) denticle/denticles, (prosternal or forcipular) tooth/teeth, (marginal) tubercle/tubercles
- (coxosternal) **tooth-plate/tooth-plates**: [Cra, Sco] one of the paired sclerotised, flat, teeth-bearing projections on the anterior margin of the forcipular coxosternite. Fig. 32. Lewis et al. 2005: 2, 3. Syn.: dental plate/plates, (coxosternal or prosternal) plate/plates, (coxosternal or prosternal) toothed anterior process/processes
- (coxosternal) **denticle/denticles**: [Geo] one of the paired small, subconical projections on the anterior margin of the forcipular coxosternite. Fig. 30. Syn.: (coxosternal) tooth/teeth
- porodont/porodonts**: [Lit] one of the paired large setae usually placed lateral to the forcipular coxosternal teeth. Fig. 31. Crabbill 1953: 119. Syn.: accessory spine/spines, ectal spine/spines, ectodont/ectodonts, lateral (prosternal) spine/spines, parodontal spine/spines, pseudoporodont/pseudoporodents
- porodont node/nodes**: [Lit] basal structure from which the porodont arises
- (coxosternal) **median cleft**: [Lit] mid-longitudinal suture on the ventral side of the forcipular coxosternite. Fig. 28. Eason 1964: 165.
- chitin-line/chitin-lines**: [Geo] one of the paired paramedian sclerotised narrow stripes on the ventral side of the forcipular coxosternite. Fig. 30. Crabbill 1960a: 15.



**Figures 33–40.** **33** anterior part of trunk, dorsal, *Cryptops anomalans* **34** intermediate part of trunk, dorsal, *Lithobius dentatus* **35** intermediate part of trunk, dorsal, *Scutigera coleoptrata* **36** intermediate part of trunk, left, *Himantarium gabrielis* **37** intermediate part of trunk, ventral, *Clinopodes trebevicensis* **38** intermediate part of trunk, ventral, *Cryptops parisi* **39** intermediate part of trunk, ventral, *Cryptops punicus* **40** intermediate part of trunk, ventral, *Bothriogaster signata*.

- Syn.: chitinous line/lines, pleurogram/pleurograms, (prosternal) (subcondyllic) sclerotic line/lines
- (coxosternal) **median embayment**: [Lit, Sco] median notch at the posterior margin of the forcipular coxosternite. Fig. 28. Edgecombe and Koch 2008: 895
- forcipule**/forcipules: telopodite of the forcipular segment. Fig. 28. Lewis 1981: 11. Syn.: forcipula/forcipulae, forcipular telopodite/telopodites, maxilliped/maxillipeds, maxillipede/maxillipedes, poison claw/claws, prehensor/prehensors, prehensorial foot/feet, prehensorial telopodite/telopodites, toxicognath/toxicognaths
- (forcipular) **trochanteroprefemur**/trochanteroprefemora: first article of the forcipule. Figs 29, 32. Syn.: article/articles 1, basal article/articles, femoroid/femoroids, femuroid/femuroids, first article/articles
- (forcipular) **trochanteral suture**/sutures: trace of suture on the forcipular trochanteroprefemur. Fig. 29
- (forcipular) **intermediate article**/articles: one of the second and third articles of the forcipule. Syn.: intercalary article/articles, intermediate joint/joints
- (forcipular) **femur**/femora: second article of the forcipule. Figs 29, 32. Syn.: article/articles 2, femoroid/femoroids, femuroid/femuroids, second article/articles, second joint/joints, tibia/tibiae
- (forcipular) **tibia**/tibiae: third article of the forcipule. Figs 29, 32. Syn.: article/articles 3, tarsus/tarsi, third article/articles, third joint/joints, tiboid/tiboids
- (forcipular) **tarsus**/tarsi: [Scu] fourth article of the forcipule. Fig. 29
- (forcipular) **ungulum**/ungula: [Scu] terminal articulated element of the forcipule. Fig. 29. Syn.: pretarsus/pretarsi, ungula/ungulae
- (forcipular) **tarsungulum**/tarsungula: [Cra, Dev, Geo, Lit, Sco] ultimate article of the forcipule. Fig. 32. Lewis et al. 2005: 2. Syn.: article/articles 4, claw/claws, metatarsus/metatarsi, poison claw/claws, pretarsus/pretarsi, tarsungula/tarsungulae
- process/processes of** (forcipular) **tronchanteroprefemur**: [Cra, Sco] large projection on the mesal side of the forcipular trochanteroprefemur. Fig. 32. Lewis et al. 2005: 2, 3. Syn.: (tronchanteroprefemoral) (inner spinous) process/processes, process/processes of femoroid, (tronchanteroprefemoral) (inner or median) tooth/teeth
- (forcipular) **denticle**/denticles: [Geo] small subconical projection on the mesal side of the forcipule. Figs 27, 30. Syn.: node/nodes, nodule/nodules, tooth/teeth
- proximal denticle**/denticles (of trochanteroprefemur): [Geo] the most basal of two denticles along the mesal side of the forcipular trochanteroprefemur. Fig. 27. Syn.: basal denticle/denticles (of trochanteroprefemur)
- distal denticle**/denticles (of trochanteroprefemur): [Geo] the most distal of two denticles along the mesal side of the forcipular trochanteroprefemur. Fig. 27
- basal denticle**/denticles (of tarsungulum): [Geo] denticle at the base of the forcipular tarsungulum. Fig. 30. Syn.: basal tooth/teeth, (basal) node/nodes
- (forcipular) **spine comb**/combs: [Scu] row of spines on the forcipular tarsus

### ***leg-bearing segment***

**leg-bearing segment**/segments: segment of the trunk bearing paired walking appendages. Fig. 33. Syn.: pedal segment/segments, pedigerous (post-maxillipede) segment/segments, trunk-segment/trunk-segments

**tergite**/tergites (of leg-bearing segment): sclerite on the dorsal side of a leg-bearing segment. Fig. 34. Syn.: dorsal plate/plates, dorsal shield/shields, (dorsal) scutum/scuta, tergal plate/plates, tergum/terga {inappropriate use; see, e.g., Snodgrass 1935}

**stomatotergite**/stomatotergites: [Scu] tergite bearing a stoma. Fig. 35

**stoma**/stomata: [Scu] elongate opening of the respiratory organs on the posteromedian part of a stomatotergite. Fig. 35. Syn.: spiracle/spiracles, stigma/stigmata

**stoma-saddle**/stoma-saddles: [Scu] domed region of the stomatotergite surrounding the stoma. Fig. 35. Syn.: saddle/saddles

**margination**/marginations (of tergite): [Lit, Sco] marginal ridge on a tergite. Fig. 34. Lewis et al. 2005: 2. Syn.: border/borders, marginal ridge/ridges

**posterior triangular projection**/projections (of tergite): [Lit] angulated projection on each posterior corner of a tergite. Fig. 34. Syn.: angulation/angulations, posterior production/productions, posterior tergital projection/projections

**pretergite**/pretergites: [Geo, Sco] anterior sclerite of the two dorsal sclerites of a leg-bearing segment. Fig. 33. Syn.: intercalary tergite/tergites, intertergite/intertergites, prescutum/prescuta, pretergum/preterga, protergite/protergites

**metatergite**/metatergites: [Geo, Sco] posterior sclerite of the two dorsal sclerites of a leg-bearing segment. Fig. 33. Syn.: tergite/tergites

**paramedian sulcus**/sulci or suture/sutures (of tergite): [Geo, Sco] one of the paired paramedian longitudinal sutures or sulci on a tergite. Fig. 33. Lewis et al. 2005: 2, 3, 5. Syn.: paramedian groove/grooves, paramedian longitudinal sulcus/sulci or suture/sutures

(anterior) **transverse sulcus**/sulci or suture/sutures (of tergite): [Sco] transverse suture or sulcus on the first trunk tergite. Fig. 33. Lewis et al. 2005: 2, 3. Syn.: (procurred) cervical groove/grooves, (anterior) cervical sulcus/sulci or suture/sutures, semi-lunar sulcus/sulci, T1 ring suture/sutures, transversal suture/sutures, transverse collar sulcus/sulci, (procurred) transverse groove/grooves

**cruciform suture**/sutures (of tergite): [Sco] pair of crossed sutures on the first trunk tergite. Fig. 33

**oblique suture**/sutures (of tergite): [Sco] one of the paired oblique sutures on some anterior trunk tergites. Fig. 33. Lewis et al. 2005: 5. Syn.: arcuate suture/sutures, curved lateral sulcus/sulci

**lateral longitudinal suture**/sutures (of tergite): [Sco] one of the paired longitudinal sutures close to the lateral margins of a tergite. Fig. 33. Lewis et al. 2005: 5

**lateral crescentic sulcus**/sulci (of tergite): [Sco] one of the paired curved, sublongitudinal sulci on a tergite. Lewis et al. 2005: 5

**eupleurium**/eupleuria: the whole of pleurites on a side of a leg-bearing segment. Eason 1964: 277. Syn.: pleuron/pleura

**pleural membrane**/membranes: arthrodial membrane between pleurites

**paratergite**/paratergites: [Geo] pleurite contiguous or almost contiguous to a tergite.

Fig. 36

**intercalary paratergite**/paratergites: [Geo] paratergite lateral to a pretergite. Fig. 36.

Crabill 1960c: 93. Syn.: parapretergite/parapretergites, preparatergite/prepara-  
tergites, secondary paratergite/paratergites, suprascutellum/suprascutella

**primary intercalary paratergite**/paratergites: [Geo] the most mesal of two interca-  
lary paratergites. Fig. 36. Syn.: primary suprascutellum/suprascutella

**secondary intercalary paratergite**/paratergites: [Geo] the most distal of two inter-  
calary paratergites. Fig. 36. Syn.: secondary suprascutellum/suprascutella

**principal paratergite**/paratergites: [Geo] paratergite lateral to a metatergite. Fig. 36.

Crabill 1960c: 93. Syn.: major paratergite/paratergites, primary paratergite/pa-  
tergites

**scutellum**/scutella: [Geo, Sco] pleurite in antero-ventral position with respect to  
the stigmatopleurite. Fig. 36. Syn.: intercalary pleurite/pleurites, prescutellum/  
prescutella

**spiracle**/spiracles: [Cra, Dev, Geo, Lit, Sco] one of the paired openings of the tra-  
cheae on the lateral sides of a leg-bearing segment. Fig. 36. Syn.: stigma/stigmata

**stigmatopleurite**/stigmatopleurites: [Cra, Dev, Geo, Lit, Sco] pleurite bearing a  
spiracle. Fig. 36. Syn.: spiracle-bearing pleurite/pleurites, spiraculiferous plate/  
plates, stigma-bearing pleurite/pleurites, stigmopleurite/stigmopleurites

**catapleurite**/catapleurites: pleurite between the scutellum and the coxa. Fig. 36.  
Syn.: catopleure/catopleures, katopleure/katopleures

**eucoxa**/eucoxae **superior**/superiores: [Lit] pleurite dorsal to the coxa

**eucoxa**/eucoxae **inferior**/inferiores: [Lit] pleurite ventral to the coxa

**pleurocoxa**/pleurocoxae: [Geo] pleurite between coxa and metacoxa

**subcoxa**/subcoxae: [Cra, Dev, Geo, Lit, Sco] pleurite anterior or posterior to the  
coxa. Syn.: subcoxal pleurite/pleurites

**procoxa**/procoxae: [Cra, Dev, Geo, Lit, Sco] subcoxa anterior to the coxa. Fig. 37.

Syn.: anterior subcoxal plate/plates, precoxa/precoxae, procoxal pleurite/pleuri-  
tes, prosubcoxa/prosubcoxae

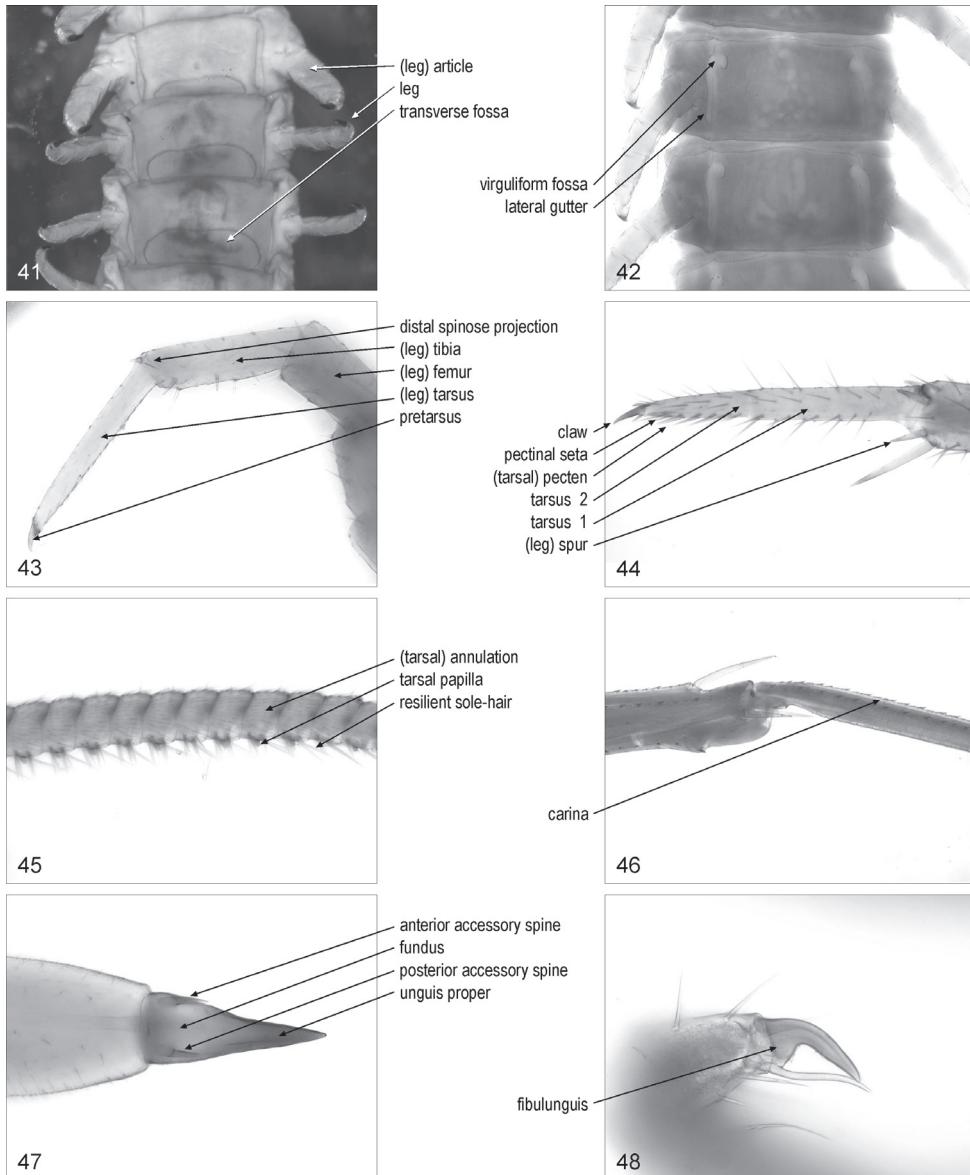
**metacoxa**/metacoxae: [Cra, Dev, Geo, Lit, Sco] subcoxa posterior to the coxa.

Fig. 37. Syn.: metacoxal pleurite/pleurites, metasubcoxa/metasubcoxae

**sternite**/sternites (of leg-bearing segment): sclerite on the ventral side of a leg-bearing  
segment. Fig. 38. Syn.: sternum/sterna {inappropriate use; see, e.g., Snodgrass,  
1935}, ventral plate/plates, ventral shield/shields

**presternite**/presternites: [Cra, Dev, Geo, Sco] anterior region of the single sternite  
of a leg-bearing segment, or anterior sclerite of the two ventral sclerites of a  
leg-bearing segment. Fig. 37. Syn.: intercalary sternite/sternites, intersternite/  
intersternites, prosternite/prosternites

**metasternite**/metasternites: [Cra, Dev, Geo, Sco] posterior region of the single ster-  
nite of a leg-bearing segment, or posterior sclerite of the two ventral sclerites of  
a leg-bearing segment. Fig. 37. Syn.: sternite/sternites



**Figures 41–48.** **41** intermediate part of trunk, ventral, *Haplophilus souletinus* **42** intermediate part of trunk, ventral, *Stigmatogaster gracilis* **43** right leg, anterior, *Lamyctes emarginatus* **44** distal part of right leg, antero-ventral, *Lithobius dentatus* **45** tarsus of left leg, anterior, *Scutigera coleoptrata* **46** intermediate part of left leg, anterior, *Scutigera coleoptrata* **47** distal part of left leg, ventral, *Scolopendra oraniensis* **48** distal part of left leg, anterior, *Diphyonyx conjungens*

- transverse sulcus/sulci** (of sternite): [Sco] transverse sulcus on a sternite. Fig. 39. Lewis et al. 2005: 5
- median longitudinal sulcus/sulci** (of sternite): [Sco] mid-longitudinal sulcus on a sternite. Fig. 39. Lewis et al. 2005: 5. Syn.: median sulcus/sulci, mid-longitudinal sulcus/sulci
- cruciform suture/sutures** (of sternite): [Sco] the pair of transverse and median longitudinal sulci on a sternite. Fig. 39. Syn.: cross furrow/furrows, cross sulcus/sulci, cruciform impression/impressions, cruciform sulcus/sulci
- trigonal suture/sutures** (of sternite): [Sco] pair of crossed sutures on the posterior part of the sternite. Lewis et al. 2005: 5
- endosternite/endosternites**: [Geo, Sco] posterior projection of a sternite, covered by the sternite of the following segment. Fig. 37. Syn.: metasternite/metasternites
- carpophagus peg/pegs**: [Geo] median projection on the posterior margin of a sternite, in the carpophagus-structure. Fig. 37. Crabbill 1954: 174. Syn.: paxillus/paxilli
- carpophagus pit/pits**: [Geo] median socket on the anterior margin of a sternite, in the carpophagus-structure. Fig. 37. Crabbill 1954: 174. Syn.: carpophagus fossa/fossae, sacculus/sacculi, sternal pit/pits
- carpophagus-structure/carpophagus-structures**: [Geo] whole of a carpophagus peg and the associated carpophagus pit. Fig. 37
- ventral pore/pores**: [Geo] glandular pore on the ventral side of a leg-bearing segment. Fig. 40. Syn.: sternal pore/pores, sternital pore/pores
- (ventral) **pore-field/pore-fields**: [Geo] an area of clustered pores on the ventral side of a leg-bearing segment. Fig. 40. Syn.: pore area/areas, pore-group/pore-groups, poriferous area/areas, porigerous area/areas
- sternobothrium/sternobothria**: [Geo] median horseshoe-like pit on the metasternite. Fig. 40
- transverse fossa/fossae** (of sternite): [Geo] transverse, ellipical depression on some trunk sternites. Fig. 41. Eason 1964: 54
- fungiform fovea/foveae**: [Geo] median T-like pit on the metasternite
- virguliform fossa/fossa**: [Geo] comma-like pit at each of the anterior corners of a sternite. Fig. 42. Eason 1964: 284. Syn.: sternal pouch/pouches
- lateral gutter/gutters** (of sternite): [Geo] longitudinal groove along the lateral margin of a sternite. Fig. 42. Eason 1964: 48. Syn.: parasternal cleft/clefts, parasternal fossa/fossae, parasternal pit/pits

## leg

- leg/legs**: one of the paired appendages of the trunk to the exclusion of the forcipules and the gonopods. Fig. 41. Syn.: (ambulatory or locomotory or walking) leg/legs
- cursiped/cursipeds**: [Lit] a leg of the pairs 1–13. Crabbill 1961a: 132
- tenaciped/tenaciped**: [Lit] a leg of the pairs 14–15. Crabbill 1961a: 132

- (leg) **article/articles**: one of the articulated elements of a leg. Fig. 41. Syn.: podomere/podomeres, (leg) segment/segments
- (leg) **coxa/coxae**: the most basal article of a leg. Fig. 38
- (leg) **trochanter/trochanters**: small, basalmost article of a telopodite. Fig. 38
- (leg) **prefemur/prefemora**: second article of a telopodite. Fig. 38. Syn.: praefemur/praefermora
- (leg) **femur/femora**: third article of a telopodite. Fig. 43
- (leg) **tibia/tibiae**: fourth article of a telopodite. Fig. 43. Syn.: patellotibia/patellotibiae
- (leg) **tarsus/tarsi**: fifth article of a telopodite, when ultimate. Fig. 43
- tarsal article/articles**: one of the articles of a biarticulated region of the leg corresponding to the tarsus. Syn.: tarsalium/tarsalia, tarsomere/tarsomeres
- tarsus/tarsi 1**: the basal article of two tarsal articles. Fig. 44. Lewis et al. 2005: 2. Syn.: basitarsus/basitarsi, first division/divisions of tarsus/tarsi, first tarsal article/articles, first tarsal joint/joints, first tarsal segment/segments, first tarsus/tarsi, I tarsus/tarsi, protarsus/protarsi, proximotarsus/proximotarsi, tarsomere/tarsomeres 1, tarsus/tarsi, tarsus/tarsi I
- tarsus/tarsi 2**: the distal article of two tarsal articles. Fig. 44. Lewis et al. 2005: 2. Syn.: distitarsus/distitarsi, distotarsus/distotarsi, II tarsus/tarsi, metatarsus/metatarsi, pretarsus/pretarsi, second division/divisions of tarsus/tarsi, second tarsal article/articles, second tarsal joint/joints, second tarsal segment/segments, second tarsus/tarsi, tarsomere/tarsomeres 2, tarsus/tarsi II, telotarsus/telotarsi
- (tarsal) **annulation/annulations**: [Lit, Sco, Scu] each part of a tarsal article, between two contiguous constrictions. Fig. 45. Syn.: annulus/annuli, pseudosegment/pseudosegments, secondary article/articles, tarsale/tarsalia, tarsomere/tarsomeres
- carina/carinae**: [Scu] longitudinal ridge on a leg article. Fig. 46. Edgecombe and Giribet 2006: 509
- tarsal papilla/papillae**: [Scu] relatively short, stout projection with a rounded tip, on the ventral side of tarsus 2. Fig. 45. Edgecombe and Giribet 2006: 509
- resilient sole-hair/sole-hairs**: [Scu] one of the paired hairs thickened at the base, on the ventral side of the leg, originating near the posteromedian margin of each tarsal papilla. Fig. 45. Würmler 1974: 95; Edgecombe and Giribet 2006: 512
- (leg) **spur/spurs**: [Lit, Sco] spur on legs. Fig. 44. Syn.: calcar/calcars, (leg or pedal) spine/spines, spiniform seta/setae
- distal spinose projection/projections (of tibia)**: [Lit] spinous process at the distal end of the tibia of a leg. Fig. 43. Syn.: tibial spur/spurs
- pectinal seta/setae**: [Lit] one of the decumbent setae arranged in rows along the tarsal articles of legs. Fig. 44. Crabill 1958: 262
- (tarsal) **pecten/pectines**: [Lit] row of pectinal setae. Fig. 44. Crabill 1958: 262
- pretarsus/pretarsi**: apical element articulated at the tip of a leg. Fig. 43. Lewis et al. 2005: 2. Syn.: praetarsus/praeftarsi, posttarsus/posttarsi, posttarsus/posttarsi
- claw/claws**: pretarsus in shape of a claw. Fig. 44. Lewis et al. 2005: 2. Syn.: apical claw/claws, end claw/claws, tarsal claw/claws

**fundus/fundi** (of claw): basal, swollen part of a claw. Fig. 47. Crabbill 1961b: 501

**unguis/ungues proper:** distal, slender part of a claw. Fig. 47. Syn.: claw/claws proper, main claw/claws, principal claw/claws, unguis/ungues

**accessory spine/spines:** slender, pointed projection at the base of the claw. Fig. 47. Lewis et al. 2005: 2, 3. Syn.: accessory claw/claws, accessory seta/ setae, accessory spur/spurs, basal bristle/bristles, basal spine/spines, basal spur/ spurs, claw spine/spines, parunguis/parungues, sensory spine/spines, sensory spur/spurs

**anterior accessory spine/spines:** the anterior accessory spine of two of a claw. Fig. 47. Syn.: anterior accessory claw/claws, anterior accessory spur/spurs, anterior parunguis/parungues

**posterior accessory spine/spines:** the posterior accessory spine of two of a claw. Fig. 47. Syn.: posterior accessory claw/claws, posterior accessory spur/spurs, posterior parunguis/parungues

(pretarsal) **posteroventral spine/spines:** [Lit] the largest of a pair of spines emerging on the ventro-posterior side at the base of a claw, close to the posterior accessory spine. Edgecombe 2004: 31; Koch and Edgecombe 2008: 168

(pretarsal) **subsidiary spine/spines:** [Lit] the smallest of a pair of spines emerging on the ventro-posterior side at the base of a claw, close to the posterior accessory spine. Edgecombe 2004: 31

**fibulunguis/fibulungues:** [Geo] pretarsus with a large projection flanking the unguis proper. Fig. 48. Crabbill 1969: 38

**penultimate leg/legs:** leg of the penultimate pair. Fig. 49. Syn.: penult leg/legs

### ***ultimate leg-bearing segment***

**ultimate leg-bearing segment:** leg-bearing segment bearing the ultimate pair of legs. Fig. 49. Syn.: last leg-bearing segment, last pediferous segment, last trunk- segment, ultimate pedal segment, ultimate pedigerous segment

**ultimate pretergite:** [Geo] pretergite of the ultimate leg-bearing segment. Fig. 50

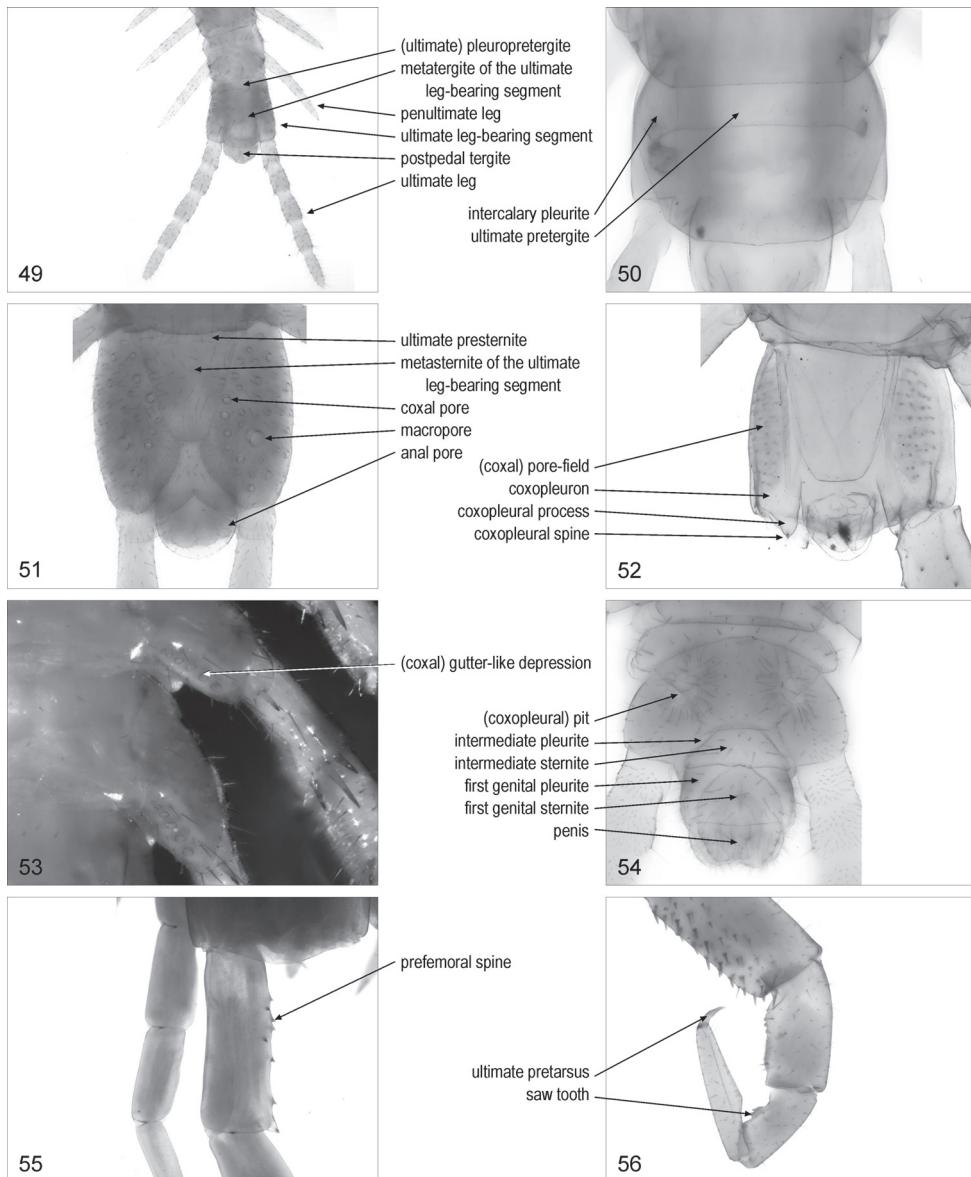
**intercalary pleurite/pleurites:** [Geo] pleurite contiguous to the ultimate pretergite. Fig. 50. Syn.: prepleurite/prepleurites

(ultimate) **pleuropretergite:** [Geo] entire sclerite corresponding to the ultimate pretergite and the two intercalary pleurites. Fig. 49

**tergite (or metatergite) of the ultimate leg-bearing segment:** main tergite of the ultimate leg-bearing segment. Fig. 49. Syn.: last dorsal plate, last tergite, ultimate tergite

**ultimate presternite:** [Geo] presternite of the ultimate leg-bearing segment. Fig. 51

**sternite (or metasternite) of the ultimate leg-bearing segment:** main sternite of the ultimate leg-bearing segment. Fig. 51. Syn.: last sternite, last sternum, last ventral plate, sternite (or metasternite) of the last trunk segment, sternite (or metasternite) of the last leg-bearing segment, ultimate (pedal) sternite



**Figures 49–56.** **49** terminal part of trunk, dorsal, *Gnathoribautia bonensis* **50** ultimate leg-bearing segment, dorsal, *Bothriogaster signata* **51** terminal part of trunk, ventral, female *Dicellophilus carniolensis* **52** terminal part of trunk, ventral, *Cormocephalus gervaisianus* **53** basal part of posterior left legs, ventral, *Lithobius dentatus* **54** terminal part of trunk, ventral, male *Tuoba sydneyensis* **55** basal part of ultimate left legs, dorsal, *Scolopendra oraniensis* **56** ultimate pretarsus, saw tooth

**ultimate leg/legs:** one of the legs of the ultimate pair. Fig. 49. Syn.: anal leg/legs, caudal leg/legs, end leg/legs, last leg/legs, posterior leg/legs, terminal leg/legs

**coxopleuron/coxopleura:** [Geo, Sco] basal element of the ultimate leg, corresponding to coxa and pleurites. Fig. 52. Lewis et al. 2005: 2. Syn.: (anal or last) coxa/ coxae, coxopleura/coxopleurae, coxopleurite/coxopleurites, (last) pleura/pleurae, pleurocoxa/pleurocoxae

**coxopleural process/processes:** [Sco] posterior process of the coxopleuron. Fig. 52. Lewis et al. 2005: 2. Syn.: coxal process/processes, process/processes of last coxa/ coxae

(coxopleural) **spine/spines:** [Sco] spine on the coxopleuron. Fig. 52. Lewis et al. 2005: 2, 5. Syn.: (coxopleural) spur/spurs

(coxopleural) **side spine/spines:** [Sco] spine on the posterior margin of the coxopleuron mesal to the coxopleural process. Lewis et al. 2005: 5

**coxal pore/pores:** [Cra, Dev, Geo, Lit, Sco] one of the pores of the coxal organs on posterior legs. Fig. 51. Syn.: coxopleural pore/pores, pleural pore/pores

**macropore/macropores:** [Geo] coxal pore that is distinctly larger than the other pores. Fig. 51

(coxal) **gutter-like depression/depressions:** [Lit] depressed area on the coxopleuron containing the openings of the coxal organs. Fig. 53

(coxopleural) **pit/pits:** [Geo] pit on the coxopleuron, containing the openings of the coxal organs. Fig. 54. Crabill 1961a: 133. Syn.: (coxal or coxopleural) crypt/ crypts, gland pit/pits, subsurface gland-pit/gland-pits, subsurface pocket/pockets

(coxopleural) **fossa/fossae:** [Geo] longitudinal pouch close to the mesal margin of the coxopleuron, containing the openings of the coxal organs. Syn.: (coxopleural or porigerous) cavity/cavities, (coxopleural or porigerous) fossula/fossulæ

(coxal) **pore-field/pore-fields:** [Cra, Dev, Geo, Lit, Sco] part of the surface of the coxa or coxopleuron of the ultimate legs containing the coxal pores. Fig. 52. Syn.: (coxal) cribriform area/areas, (coxal) porose area/areas

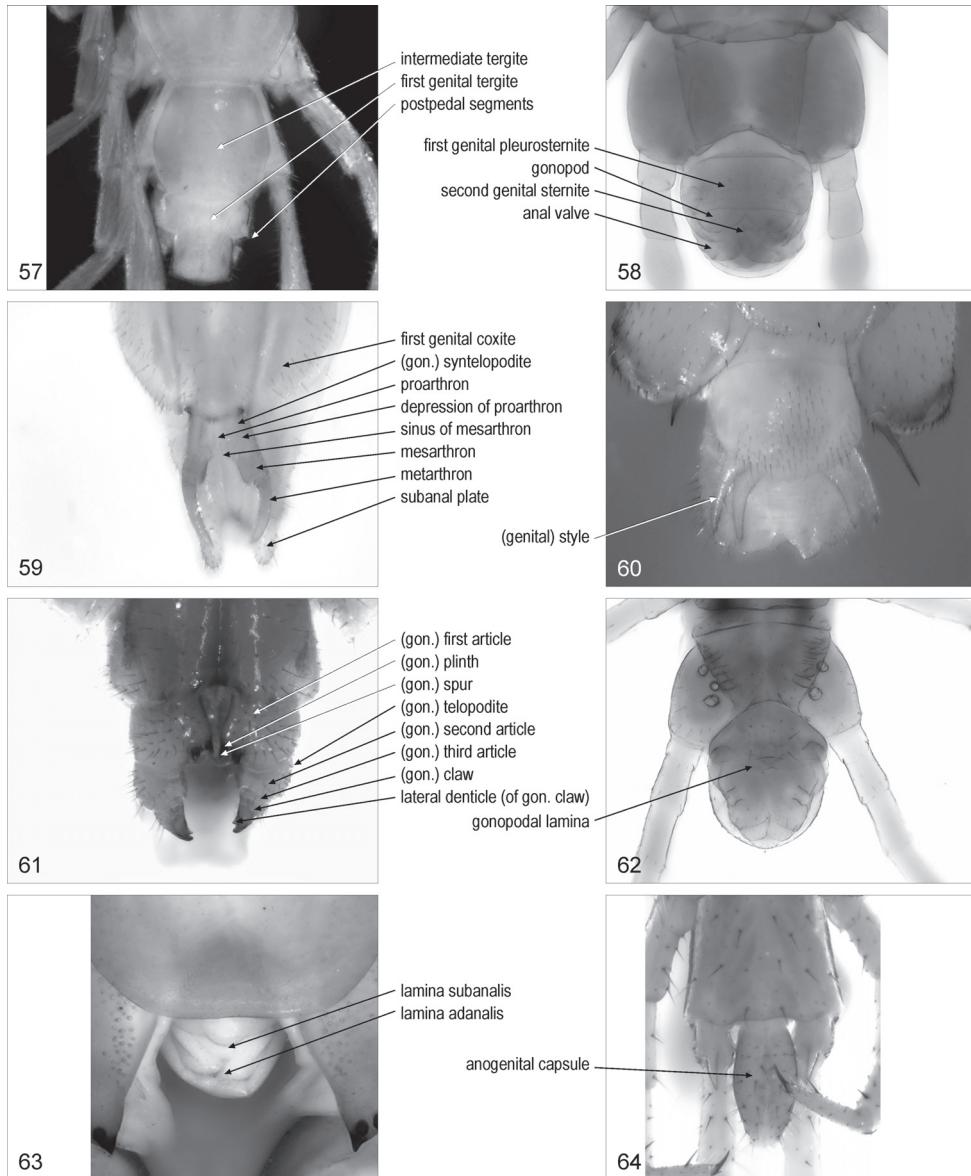
**prefemoral spine/spines:** [Sco] spine on the prefemur of ultimate and/or penultimate legs. Fig. 55. Lewis et al. 2005: 3, 5. Syn.: prefemoral dorsal spur/spurs, prefemoral tooth/teeth

**prefemoral (spinous) process/processes:** [Sco] process, usually bearing spines, on the prefemur of the ultimate legs. Lewis et al. 2005: 3, 5, 7. Syn.: distomedial prefemoral tubercle/tubercles

(prefemoral) **corner spine/spines:** [Sco] spine on the distal end, on the mesal side, of the prefemur of ultimate legs. Lewis et al. 2005: 3, 5. Syn.: (prefemoral) distomedial spine/spines

**saw tooth/teeth:** [Sco] one of the bluntly pointed projections arranged in rows on the tibia and tarsus 1 of ultimate legs. Fig. 56. Lewis et al. 2005: 7. Syn.: (tibial and tarsal) (serrate) comb/combs, mucro/mucrones, saw-like tooth/teeth

**ultimate pretarsus/pretarsi:** pretarsus of the ultimate leg. Fig. 56



**Figures 57–64.** **57** terminal part of trunk, dorsal, *Lamyctes emarginatus* **58** terminal part of trunk, ventral, female *Bothriogaster signata* **59** postpedal segments, ventral, female *Scutigera coleoptrata* **60** postpedal segments, ventral, male *Scutigera coleoptrata* **61** postpedal segments, ventral, female *Lithobius dentatus* **62** posterior part of trunk, ventral, female *Geophilus carpophagus* **63** postpedal segments, ventral, *Scolopendra cingulata* **64** terminal part of trunk, ventral, *Craterostigmus tasmanianus*. Abbreviations: gon., gonopodal.

***terminal part of the body***

**postpedal segments** {plural only}: part of the trunk posterior to the ultimate leg-bearing segment. Fig. 57. Syn.: terminal segments

**intermediate tergite**: [Lit] tergite posterior to the tergite of the ultimate leg-bearing segment, corresponding to the intermediate sternite. Fig. 57. Eason 1964: 167

**intermediate sternite**: sternite between the sternite or metasternite of the ultimate leg-bearing segment and the first genital sternite. Fig. 54

**intermediate pleurite/pleurites**: [Geo] one of the two pleurites flanking the intermediate sternite. Fig. 54

**first genital tergite**: [Lit] tergite posterior to the intermediate tergite, corresponding to the first genital sternite. Fig. 57

**first genital sternite**: sternite between the intermediate sternite and the second genital sternite, usually associated with gonopods. Fig. 54. Syn.: pregenital sternite, sternite of first genital segment

**first genital pleurite/pleurites**: one of the two pleurites flanking the first genital sternite. Fig. 54. Syn.: pleurite of first genital segment

**first genital pleurosternite**: entire sclerite corresponding to the first genital sternite and the relevant pleurites. Fig. 58

**first genital coxite/coxites**: [Scu] one of the paired sclerites lateral to the first genital sternite. Fig. 59

**second genital sternite**: sternite posterior to the first genital sternite. Fig. 58. Syn.: genital sternite, sternite of second genital segment

**gonopod/gonopods**: one of the paired appendages usually associated with the first or the second genital sternite. Fig. 58. Syn.: genital appendage/appendages

(genital) **style/styles**: [Scu] styliform male gonopod. Fig. 60

**proarthron**: [Scu] basal part of the complex of the paired female gonopods, composed of the basal contiguous parts of the basal articles of the gonopods. Fig. 59

**depression/depressions of proarthron**: [Scu] one of the paired depressions on the proarthron. Fig. 59

**mesarthron**: [Scu] median part of the complex of the paired female gonopods, composed of the distal separated parts of the basal articles of the gonopods. Fig. 59

**sinus of mesarthron**: [Scu] concave median posterior margin of the mesarthron. Fig. 59

**metarthron**: [Scu] terminal part of the complex of the paired female gonopods. Fig. 59

(gonopodal) **syntelopodite**: [Scu] coalescent pair of female gonopod telopodites. Fig. 59

(gonopodal) **first article/articles**: [Cra, Dev, Geo, Lit] basal article of the gonopod. Fig. 61. Syn.: (gonopodal) basal article/articles, (gonopodal) coxa/coxae, (gonopodal) coxite/coxites, (gonopodal) segment/segments 1

(gonopodal) **telopodite/telopodites**: [Lit] articles of the gonopod other than the first article. Fig. 61

- (gonopodal) **second article/articles**: [Cra, Dev, Geo, Lit] second article of the gonopod. Fig. 61. Syn.: (gonopodal) segment/segments 2
- (gonopodal) **third article/articles**: [Lit] third article of the gonopod. Fig. 61. Syn.: (gonopodal) segment/segments 3
- (gonopodal) **claw/claws**: [Lit] apical claw of the female gonopod. Fig. 61
- (gonopodal) **spur/spurs**: [Lit] spur on the female gonopod. Fig. 61. Syn.: (gonopodal) basal spine/spines, (gonopodal) (accessory) denticle/denticles, macroseta/macrosetae
- (gonopodal) **plinth/plinths**: [Lit] swollen projection bearing a gonopodal spur. Fig. 61
- (gonopodal) **papilla/papillae**: [Lit] relatively short, stout projection with a rounded tip, on the gonopod
- (gonopodal) **supplementary spur/spurs**: [Lit] spur on the female gonopod other than those invariantly present
- lateral denticle/denticles (of gonopodal claw/s)**: [Lit] one of the denticles on one or both sides of a gonopodal claw. Fig. 61. Syn.: (gonopodal) lateral claw/claws
- gonopodal lamina**: [Geo] entire median projection, corresponding to the paired female gonopods. Fig. 62. Syn.: genital appendage
- penis**: median projection bearing the male genital pore. Fig. 54. Syn.: aedeagus, intromittent apparatus, median lobe, spinneret
- postpedal tergite**: the most posterior tergite of the trunk. Fig. 49. Syn.: anal tergite, tergite of telson, tergum of postpedal segments
- lamina adanalis**: [Sco] median dorsal flat projection on the posterior tip of the female body. Fig. 63. Syn.: adanal lamina
- lamina subanalis**: [Sco] median ventral flat projection on the posterior tip of the female body. Fig. 63
- subanal plate/plates**: [Scu] one of the paired ventrolateral sclerites in the telson. Fig. 59
- anogenital capsule**: [Cra] terminal, capsule-like part of the trunk. Fig. 64. Syn.: anal capsule
- anal pore/pores**: [Cra, Geo, Lit] one of the pores of the anal organs, on the ventrolateral sides of the telson. Fig. 51. Syn.: terminal pore/pores
- anal valve/values**: one of the paired rounded flat projections on the ventral side of the telson. Fig. 58

### *Abbreviations and formulae*

Conventional abbreviations recommended for describing particular elements and patterns of elements are described below.

**Antennal articles in Geophilomorpha.** Each article is indicated by a Roman number, from the most basal article (I) to the most distal one (XIV).

**Arrangement of ocelli in Lithobiomorpha.** The number of ocelli in different rows are indicated from the most dorsal row to the most ventral row, separated by commas [1+ n<sub>1</sub>, n<sub>2</sub>, ... where 1 is the posterior ocellus and n<sub>1</sub>, n<sub>2</sub>, ...are the numbers of seriate ocelli in the rows].

**Pattern of teeth on the anterior margin of the forcipular coxosternite in Lithobiomorpha and on the tooth-plates in Scolopendromorpha.** The number of teeth is indicated for the right and the left side, separated by a plus [n<sub>right</sub> + n<sub>left</sub>].

**Leg-bearing segments and pairs of legs.** Each leg-bearing segment, or the corresponding pair of legs, is indicated by an Arabic number, from the most anterior one (1) to the most posterior one.

**Tergites and sternites of the leg-bearing segments.** Each tergite and sternite is indicated by T and S respectively (TT and SS for multiple tergites and sternites, respectively), followed by an Arabic number, from the most anterior ones (T1 and S1) to the most posterior ones.

**Arrangement of spurs on the legs in Lithobiomorpha** (plectrotaxy; Table 3). The position of the spurs on each article of the legs is indicated in a tabular form (Table 4). Spurs on the ventral side are indicated on the left part of the table, those on the dorsal side on the right part. The pairs of legs are indicated by Arabic numbers, from the most anterior one (1) to the most posterior one (15), as described above. The articles are indicated by the following abbreviations: C = coxa, t = trochanter, P = prefemur, F = femur, T = tibia (upper case letter, except for trochanter). The position of each spur relative to the antero-posterior axis is indicated by the following abbreviations: a = anterior, m = median, p = posterior (lower case letter). Leg articles without

**Table 4.** Example of conventional table describing the plectrotaxy of *Lithobius forficatus*. See text for abbreviations.

	ventral					dorsal				
	C	t	P	F	T	C	t	P	F	T
1	-	-	mp	amp	am	-	-	mp	ap	a
2	-	-	mp	amp	am	-	-	amp	ap	ap
3	-	-	mp	amp	am	-	-	amp	ap	ap
4	-	-	mp	amp	am	-	-	amp	ap	ap
5	-	-	mp	amp	am	-	-	amp	ap	ap
6	-	-	mp	amp	am	-	-	amp	ap	ap
7	-	-	mp	amp	am	-	-	amp	ap	ap
8	-	-	mp	amp	am	-	-	amp	ap	ap
9	-	-	mp	amp	am	-	-	amp	ap	ap
10	-	-	mp	amp	am	-	-	amp	ap	ap
11	-	-	mp	amp	am	-	-	amp	ap	ap
12	-	-	amp	amp	am	a	-	amp	p	ap
13	-	m	amp	amp	am	a	-	amp	p	p
14	-	m	amp	amp	am	a	-	amp	p	p
15	-	m	amp	amp	am	a	-	amp	p	-

spurs are indicated by a dash. Spurs that could be absent (variation) are indicated in parentheses. Spurs that could be present on one side only are marked by an asterisk. Additional spurs are indicated by the abbreviation of their position (a, m, p) typed as a superscript to the corresponding spur (e.g., a<sup>a</sup>). Legs with the same plectrotaxy in both ventral and dorsal side can be indicated in distinct rows or in a single, common line. This convention was first proposed by Ribaut (1921) and introduced in the English literature by E.H. Eason and R.E. Crabbill (Eason 1951, 1964; Crabbill 1953, 1962; Crabbill and Lorenzo 1957). Each individual spur is indicated in a text with a formula comprising the following abbreviations: the pair of legs (1–15), the side of the leg (V = ventral, D = dorsal), the position relative to the antero-posterior axis (a, m, p), the leg article (C, t, P, F, T) (e.g., 15VaC).

**Pattern of coxal pores on the legs in Lithobiomorpha.** The number of coxal pores is indicated from anterior to posterior legs, without separation between the numbers [...n<sub>13</sub>n<sub>14</sub>n<sub>15</sub>].

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## **Appendix I.**

**Pre-1981 publications.** Selected publications published before 1981 from which morphological terms have been retrieved. File format: PDF. doi: 10.3897/zookeys.69.737-app.I

## **Appendix II.**

**Analytical index.** Alphabetic index of morphological terms used for Chilopoda in the English literature. File format: PDF. doi: 10.3897/zookeys.69.737-app.II



# Araneibatrus gracilipes gen. et sp. n., a remarkable Batrisitae (Coleoptera, Staphylinidae, Pselaphinae) from P. R. China

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## Abstract

*Araneibatrus gracilipes* gen. n. and sp. n. from South China is described and illustrated. The systematic position of the genus is discussed.

## Keywords

Coleoptera, Staphylinidae, Pselaphinae, *Araneibatrus gracilipes*, new genus, new species, key, China, taxonomy

## Introduction

A remarkable species with extremely elongate antenna and legs was discovered among the pselaphines collected from Nan'ling National Nature Reserve, Guangdong Province, South China, by use of a Tullgren Funnel. Based on a combination of following characters, this species was recognized as new and representing a unit for which a new genus belonging to *Tribasodes* genus-group of subtribe Batrisina

Reitter, 1882 is erected: 1) extremely elongate antenna with three-segmented club; 2) pronotum with a pair of minute lateral denticles, and with discal and antebasal spines; 3) elytron with three basal foveae; 4) tergite IV with paratergites reduced to a pair of lateral triangular plates.

## Material and methods

The material examined was extracted from soil samples by use of a Tullgren Funnel. Dissections were made in 75% ethanol, dissected parts were mounted in Euparal on plastic slides. Photo of habitus taken with a Canon EOS 40D Camera mounted with MP-E 65 mm Macro Photo Lens. Line drawings made with Adobe Illustrator CS2.

Type material deposited in the Insect Collections of Shanghai Normal University, China (SNUC)

The terminology of foveal system mainly follows Chandler (2001).

## Taxonomy

### *Araneibatrus* Yin & Li, gen. n.

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**Type species.** *Araneibatrus gracilipes* Yin et Li, sp. n.

**Diagnosis.** Head slightly elongate, sides round. Eyes situated at anterior half of head. Antenna conspicuously elongate, club loosely three-segmented, terminal segment large. Pronotum with pairs of tubercles, a pair of lateral antebasal foveae, a pair of outer basolateral foveae and a pair of inner basolateral foveae. Each elytron with three basal foveae, discal stria present. Subhumeral elytral fovea present, indistinct. Legs conspicuously elongate. Abdominal segments successively narrower posteriad, with round apex. Segment IV large. Tergite IV with paratergites forming a pair of triangular plates. Aedeagus elongate, basal bulb large, with flattened membrane and hook-like sclerite, median lobe elongate and well sclerotized, with elongate dorsal apophysis.

**Description.** Head with vertexal sulcus absent. Vertexal foveae small. Eyes relatively small, convex. Antennae 11-segmented, conspicuously elongate, with thick scape and loosely three-segmented club, terminal antennomere large. Pronotum nearly hexagonal, with pair of lateral antebasal foveae, pair of outer basolateral foveae, and pair of inner basolateral foveae. Elytron with three basal foveae, subhumeral elytral fovea present. Sutural stria absent, discal stria faint, marginal stria present. Venter with pair of lateral mesoventral foveae, pair of lateral mesocoxal foveae, and pair of lateral metaventral foveae. Abdomen moderately narrow and round apically. Tergite IV large. Paratergites IV present as pair of triangular plates.

**Remarks.** Members of *Araneibatus* can be distinguished from other Asian genera of *Tribasodes* genus-group in their conspicuously elongate antennae and legs; metatrochanter without protuberance and the structure of aedeagus. Though the new genus is tentatively placed in *Tribasodes* group, we recognize that the metacrochanter without protuberance and form of aedeagus is like in the other members of *Batrisocenus* group.

**Bionomics.** Only one male specimen was collected during a long-term investigation on the soil beetles of Nan'ling National Nature Reserve, indicating that this is a rare species or that we have not found a method of finding individuals.

**Distribution.** Guangdong Province (South China)

**Etymology.** The generic name is derived from the Latin word “*araneosus*”, meaning “spider-like”, and combined with an arbitrary rearrangement of *Batrisus* Aubé, 1833, the type genus of Batrisitae. Gender masculine.

### *Araneibatus gracilipes* sp. n.

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Figures 1–20

**Type material.** HOLOTYPE male, China: Guangdong Province, Nan'ling N. R., No. 6 Forest-Road, 24°56'34" N, 113°01'26" E, alt. 1,388 m, Oct. 2009, Lei GAO leg.

**Description.** Body (Fig. 1) length 2.73 mm, width 1.22 mm. Reddish-brown, appendages slightly lighter in color.

Head (Fig. 2) slightly elongate, sides round, smooth, covered with short setae; clypeus short, with rounded anterior margin, densely covered with short setae; frons narrower, moderately depressed in median part, convex at antennal tubercles, sparsely covered with short setae; center of vertex slightly raised, sparsely covered with short setae, with pair of small vertexal foveae; postgena rounded laterally, covered with long setae on both sides; gular area smooth, gular foveae merged into a single pit, gular carina faint. Eyes relatively small, semispherical, each composed of about 35–40 facets; mouthparts normal in structure; labrum (Fig. 4) nearly trapezoidal, narrower posteriad, anterior margin with four specialized setae; mandible (Fig. 7) large, outer margin arcuate, with several blunt denticles near its middle, cutting edge with three to four big teeth and about ten smaller teeth; labium (Fig. 5) slightly wider than long, with anterior margin concavely emarginate, sides round, constrict at basal 1/3. Maxillary palpi (Fig. 6) large and elongate, with palpomere I tiny, indistinct, II pedunculate, thickened distally, III short, nearly triangular, IV largest, covered with short setae, about as long as combined length of palpomeres I to III, nearly fusiform, about three times as long as wide, widest near its basal 2/5. Antenna (Fig. 3) conspicuously elongate and slender, antennomeres elongate; scape cylindrical, large and thickened, about 2.5 times as long as wide, with swollen apex; pedicel about twice as long as wide, gradually thickened anteriad; III to V successively narrower and more elongate; VI narrower than V, short, 3/4 times as long as V; VII slightly longer than VI, but narrower; VIII the smallest, about 3/4 times as long as VII; IX to XI loosely clubbed, successively wider; IX about

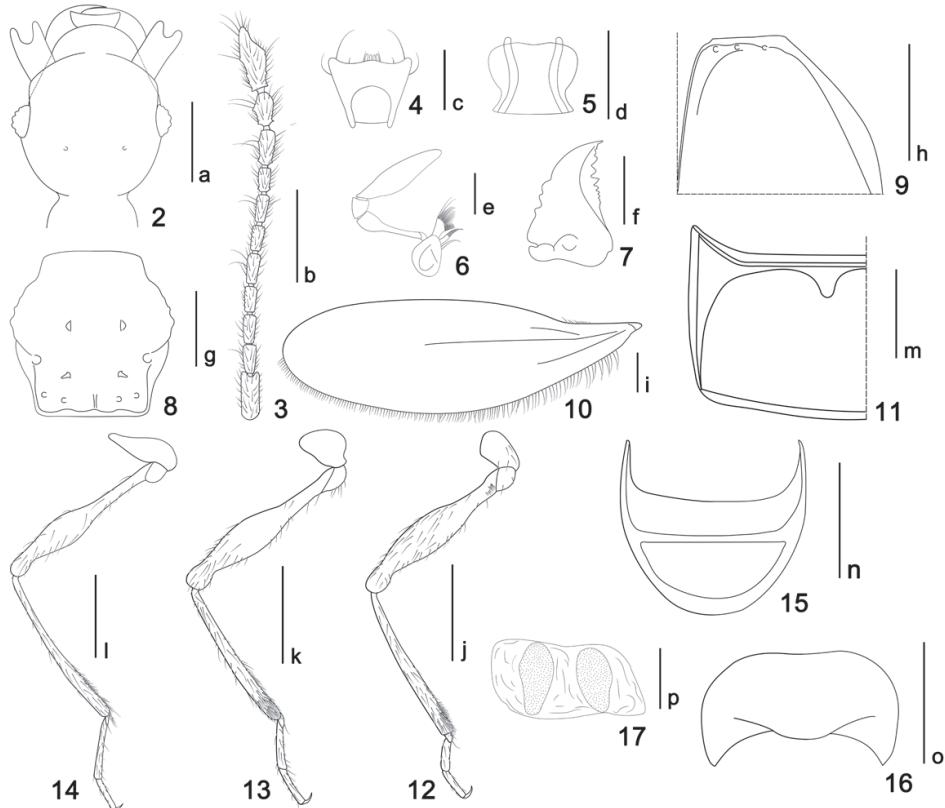


**Figure 1.** Habitus of *Araneibatrus gracilipes* gen. et sp. n.

1.25 times as long as VIII, slightly asymmetrical, widest near its middle; X slightly shorter but wider than IX, thickened, inner margin with distinct process; XI largest, about 1.8 times as long as X, narrowest at base, gradually widened toward its middle, then narrowed toward apex, lateral margin irregular with several small processes. Basolateral margins of antennomere II, VIII, IX, X and XI protuberant, forming tiny spine-like process (this character may only occur in males).

Pronotum (Fig. 8) nearly hexagonal, slightly wider than head and about as long as wide, widest at middle; sides strongly sclerotized, shallowly and roughly dentate, disc with two pairs of tubercles. Elytrae (Fig. 9) convex dorsally, both together slightly wider than long, sparsely covered with hairs. Hind wing (Fig. 10) large and elongate, widest at middle, with round apex. Venter strongly convex in apicomedian part, widest at apex. Legs normal in structure, conspicuously elongate and slender; foreleg (Fig. 12) with femor widest near middle, with tuft of short setae near base, tibia densely covered with short setae at base; midlegs (Fig. 13) similar to forelegs, but slenderer; hindlegs (Fig. 14) even more slender than midlegs, with femora widest near basal 1/3.

Abdomen with tergite IV (Fig. 11) large, with deep basal excavation, discal carinae absent. Paratergites IV reduced to a pair of triangular plates; following segments

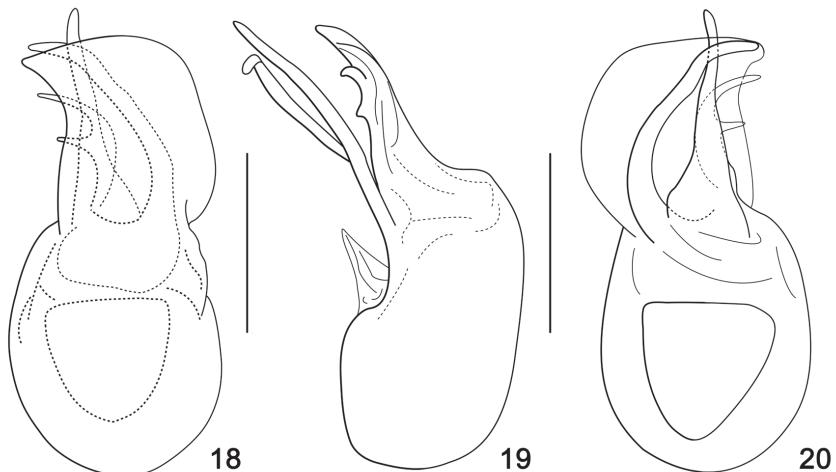


**Figures 2–17.** *Araneibatus gracilipes* gen. et sp. n. **2** Head, in dorsal view **3** Right antenna **4** Labrum **5** Labium **6** Left maxilla **7** Left mandible **8** Pronotum **9** Anterior half of right elytron **10** Left hind wing **11** Left half of tergite IV **12** Foreleg **13** Midleg **14** Hindleg **15** Tergite VIII **16** Sternite VIII **17** Sternite IX. Scales: c, d, e, f, p = 0.1 mm; a, g, h, m, n, o = 0.2 mm; i = 0.3 mm; b, k, l, m = 0.4 mm.

successively shorter and narrower, setose; tergite VIII (Fig. 15) concavely excavate on posterior margin, with round apex; sternite VIII (Fig. 16) transverse, with strongly emarginate anterior margin, posterior margin slightly concave. Sternite IX (Fig. 17) semi-membranous, transverse, with two weakly sclerotized plates.

Aedeagus (Figs. 18–20) well-sclerotized, ventral stalk elongate and slender, broadened basally, slightly curled to the right; dorsal apophysis elongate and slender, connected with ventral stalk at base, strongly curled to the left in ventral view; hook-like sclerite erect just behind ventral stalk and curled to the left in ventral view; the strongly expanded semi-sclerotized membrane derived from the end of basal bulb widest near its middle and then gradually narrowed and ending to left in ventral view; basal bulb large, with round base.

**Remarks.** The new species is distinct by its conspicuously elongate and slender antennae and legs. A number of external characters of the new genus, such like the roughly dentate sides of the pronotum, each elytron with three basal foveae, tergite IV with a pair of triangular paratergites, provide evidence for placement of *Araneibatus*



**Figures 18–20.** Aedeagus of *Araneibatrus gracilipes* gen. et sp. n. **18** Aedeagus in dorsal view **19** Same, lateral view **20** Same, ventral view. Scales = 0.2 mm.

*gracilipes* gen. et sp. n. in the *Tribasodes* genus-group. The presence of the movable dorsal apophysis of the aedeagus suggests a relationship to the *Batriscenoides*-group. Thus, according to S. Nomura (pers. comm.), the new taxon appears intermediate between these two closely related groups.

**Etymology.** The name is derived from the Latin words, “*gracilis*”, meaning “slender” and “*ipes*”, meaning “leg, limb”.

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# A new species of *Megischus* Brullé (Hymenoptera, Stephanidae) from China, with a key to the Chinese species

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## Abstract

A new species of *Megischus* Brullé from China, *M. aplicatus* sp. n., is described and illustrated. A key to the Chinese species of *Megischus* is added. The holotype is deposited in the Parasitic Hymenoptera Collection of Zhejiang University, Hangzhou.

## Keywords

Hymenoptera, Stephanidae, *Megischus*, new species, China

## Introduction

The genus *Megischus* Brullé, 1846 (Hymenoptera: Stephanidae) is cosmopolitan, but most species are known from the Indo-Australian region (van Achterberg 2002). In total, 82 species of the genus *Megischus* were previously known worldwide (Aguiar 2004,

2006; van Achterberg and Yang 2004; van Achterberg and Quicke 2006). For the Chinese fauna, only two species were recognized: *M. ptosimae* Chao, 1964 and *M. chaoi* van Achterberg, 2004. *Megischus ptosimae* was reared from *Ptosima chinensis* Marseul, 1867 (Coleoptera: Buprestidae) on peach trees (Chao, 1964) and from Buprestidae on other *Prunus* species (van Achterberg and Yang 2004).

The genus *Megischus* is characterized mainly as follows: body medium sized to large; temple without conspicuous ivory stripe along outer orbit; forewing with four or more closed cells; first subdiscal cell of fore wing comparatively slender and vein 2-1A completely pigmented; vein 1-M of fore wing 2.2–8.0 times as long as vein 1-SR; hind femur with two large ventral teeth; hind tarsus of female 3-segmented and of male 5-segmented; ovipositor sheath with an ivory subapical band (van Achterberg 2002).

## Material and methods

The specimen was collected in Hubei Province, China, and is deposited in the Parasitic Hymenoptera Collection of Zhejiang University, Hangzhou (ZJUH).

Morphological terminology, including the wing venation system, follows van Achterberg (2002). Descriptions were made under an Olympus SZ61 stereoscope, in combination with a 40W LED lamp. Photographic images were processed with both Image-Pro Plus and AnalySIS Extended Focal Imaging software, and figures were finished with ACDSee10.0 and Photoshop CS 8.0.1, mostly to adjust the size and background.

## Results

### Genus *Megischus* Brullé, 1846

*Megischus* Brullé 1846: 537. Type species: *Megischus annulator* Brullé 1846 (designated by Viereck 1914) [= *Stephanus furcatus* (Lepeletier & Serville, 1825)].

*Megischus* Brullé 1846: van Achterberg 2002: 53–168; Aguiar and Johnson 2003: 469–482.

*Bothriocerus* Sichel 1860: 759. Type species: *Bothriocerus europaeus* Sichel, 1860 (by monotypy) (= *Stephanus anomalipes* Foerster, 1855, according to Madl 1991).

### Key to species of the genus *Megischus* Brullé from China

- 1 Gena narrowly rounded medially behind eye in dorsal view (Fig. 18 in van Achterberg and Yang 2004); neck postero-dorsally at about same level as middle part of pronotum (Fig. 23, l.c.); vein cu-a of fore wing strongly reclivous (Fig. 24, l.c.); hind basitarsus about 4 times as long as wide; [without distinct pronotal fold and without a cavity; vein 1-M of fore wing about 5 times as

- long as vein 1-SR and 1.2 times vein m-cu; widened part of hind tibia of female nearly straight or weakly concave ventrally (Fig. 20, l.c.); ivory part of ovipositor sheath about twice as long as dark apical part] .....  
 ..... ***M. chaoi* van Achterberg, 2004**
- Temple medially roundly convex behind eye in dorsal view (Fig. 25 in Van Achterberg and Yang 2004); neck at lower level than middle part of pronotum postero-dorsally (Fig. 29, l.c.); vein cu-a of fore wing weakly reclivous or subvertical (Fig. 26, l.c.; 7); hind basitarsus 3.0–3.5 times as long as wide ..  
**2** 2 Temple slightly convex behind eye (Fig. 25 in Van Achterberg and Yang 2004); pronotal fold distinct and with a cavity below it (Figs 27–29, l.c.); vein 1-M of fore wing 4.2–5.5 times as long as vein 1-SR and 1.1–1.3 times vein m-cu; first tergite largely transversely striate or striate-rugose; head largely blackish or dark brown; widened part of hind tibia of female distinctly concave ventrally (Figs 30, 31, l.c.), but straight in male; [whitish or ivory part of ovipositor sheath 0.7–2.0 times as long as dark apical part] .... ***M. ptoisimae* Chao, 1964**
- Temple distinctly convex behind eye (Fig. 3); pronotal fold absent (Fig. 4–5); vein 1-M of fore wing about 2.2 times as long as vein 1-SR and 0.9 times vein m-cu (Fig. 8); first tergite largely smooth and shiny dorsally (Fig. 9); head largely orange brown; widened part of hind tibia of male nearly straight ventrally (Fig. 10) ..... ***M. aplicatus* sp. n. (male)**

***Megischus aplicatus* Hong, van Achterberg & Xu, sp. n.**

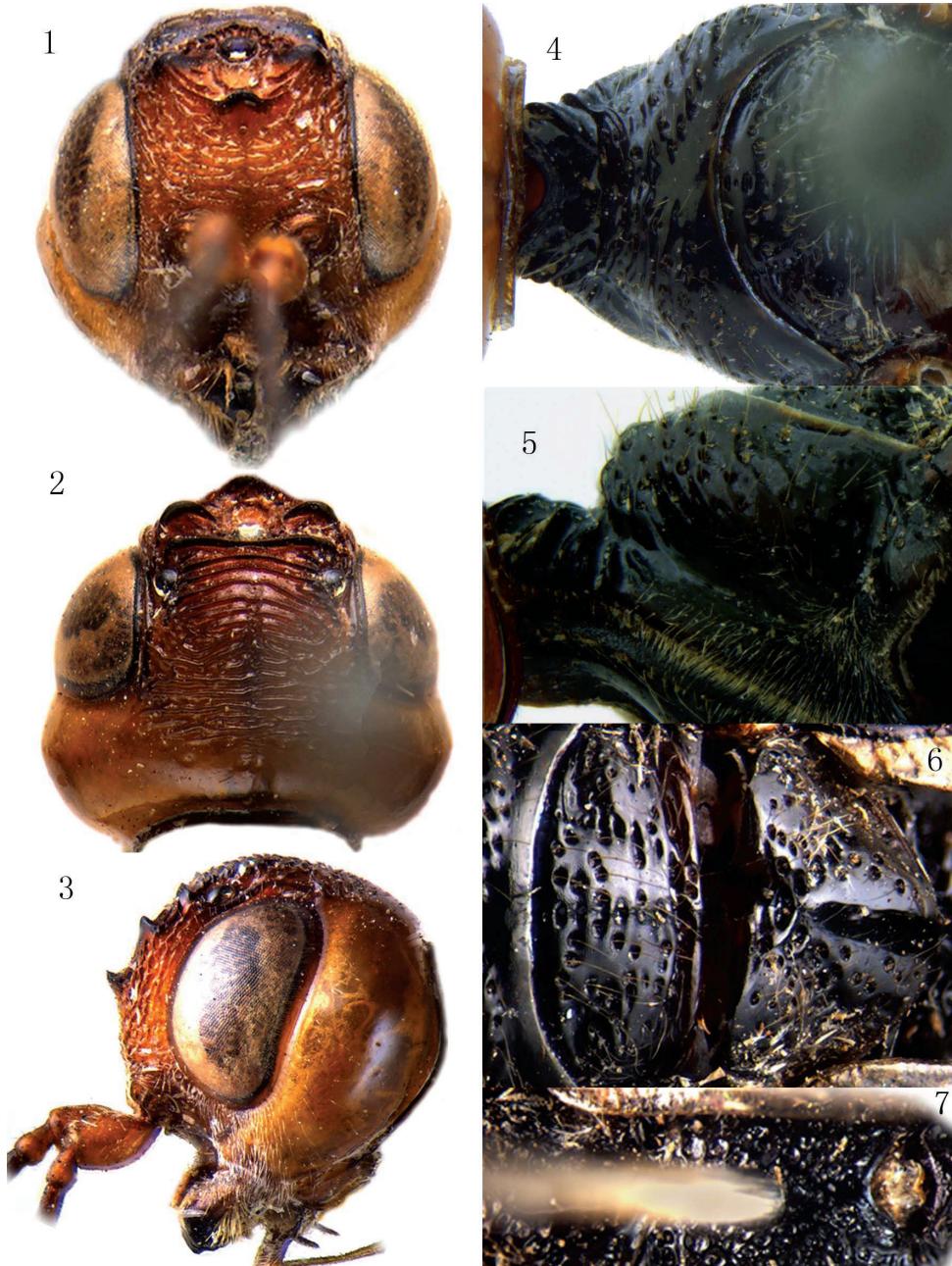
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Figs 1–12

**Male.** Length of body 25.7 mm, and of fore wing 13.9 mm.

**Head.** Antenna with 41 segments; first antennal segment 1.6 times as long as wide and twice as long as second segment, third segment 2.4 times as long as wide and 0.8 times as fourth segment; frons (Fig. 1) strongly rugose, rugae laterally curved upwards; three anterior coronal teeth large, two posterior ones connected and somewhat sinuate; vertex (Fig. 2) with 4 strongly curved carinae, followed by irregularly transversely striate area, striae coarser laterally and largely interrupted medio-dorsally, resulting in a more or less longitudinal impression, sculpture disappearing near occipital carina, leaving a narrow smooth area; area along inner orbit with one distinct longitudinal carina on each side; temple (Fig. 3) largely smooth and shiny, roundly convex occipital carina strongly developed.

**Mesosoma.** Neck (Fig. 4) rather short and robust, medio-dorsally rather shallowly concave, laterally with pairs of strong carinae, neck at much lower level than middle part of pronotum; pronotal fold absent (Fig. 4–5); middle and posterior part of pronotum strongly punctate dorsally and laterally, punctures bearing setae and with smooth interspaces; lateral oblique groove of pronotum smooth and shallowly impressed (Fig. 5), ventral area below it punctate and setose; propleuron coriaceous and densely setose;



**Figures 1–7.** *Megischus aplicatus* sp. n. ♂. 1 head, anterior view 2 head, dorsal view 3 head, lateral view 4 pronotum, dorsal view 5 pronotum, lateral view 6 mesoscutum and scutellum 7 propodeum.

prosternum irregularly punctate, punctures posteriorly more dense and with setae; mesoscutum (Figs 6) shiny, foveolate and with smooth interspaces, laterally foveolate, largely coalescent, areolate; notauli and median groove indistinct and formed by some



**Figures 8–12.** *Megischus aplicatus* sp. n. ♂. 8 fore wing 9 first tergite 10 hind femur and tibia 11 hind tarsus 12 pygidial process.

small foveolae; axillae foveolate and setose; scutellum (Fig. 6) medially largely smooth and laterally sparsely foveolate; mesopleuron robust, dorsal part finely setose, convex part evenly punctate and with smooth interspaces, each puncture bearing a whitish seta, metapleuron medially distinctly convex and densely foveolate-rugose, with fine setosity, ventral part largely smooth and with both dorsal anterior depression and ventral one rather deep; propodeum (Fig. 7) densely reticulate-foveolate.

**Wings.** Fore wing (Fig. 8): vein 1-M distinctly curved, 2.2 times as long as vein 1-SR and 0.9 times vein m-cu; vein 2-SR 1.1 times as long as vein r; vein r ends 0.5 times length of pterostigma behind level of apex of pterostigma; vein 1-SR 0.95 times as long as parastigmal vein; vein cu-a postfurcal and subvertical; vein 3-CU1 largely nebulous.

**Legs.** Hind coxa rather strong, annular, coarsely punctate and setose; hind femur (Fig. 10) sparsely punctate and with whitish setae, area in between smooth and shiny, ventrally with two large teeth and some denticles in between; hind tibia robust, ventrally mostly straight and 1.3 times as long as hind femur, basal narrow part about 0.6 times as long as widened part, outer side obliquely carinate, inner side apically densely setose; hind basitarsus (Fig. 11) subparallel-sided, 3.5 times as long as its apical width and 4.7 times as long as second tarsus.

**Metasoma.** First tergite largely smooth and shiny (Fig. 9), 5.2 times as long as its maximum width, 1.4 times as long as second tergite and 0.5 times as long as remainder of tergites; remainder of tergites smooth; pygidial process (Fig. 12) distinct and tubular apically.

**Colour.** Head orange brown; pronotum, mesosoma, first tergite and hind legs largely dark brown or black; metasoma except first tergite brown to blackish; wing membrane light brownish, wing venation and pterostigma dark brown.

**Material examined:** Holotype male, China: Hubei, Shennongjia National Nature Reserve, viii.1982, Coll. Shi Shang-bo, No. 870112 (ZJUH).

**Female.** Unknown.

**Host.** Unknown.

**Distribution:** China (Hubei).

**Comments:** The new species runs in the key by van Achterberg (2002) combined with the revision by van Achterberg and Yang (2004) to *M. ptosimae* Chao. It differs as indicated in the included key to Chinese species.

**Etymology:** The name of this species derives from the Latin “a-” and “plicatus” which means without fold, because this species has no pronotal fold on the pronotum.

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