

On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XXIII

О нескольких новых или плохоизученных ориентальных Paradoxosomatidae (Diplopoda: Polydesmida), XXIII

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KEY WORDS: Diplopoda, Polydesmida, Paradoxosomatidae, taxonomy, new records, new genus, new species, Vietnam, Thailand.

КЛЮЧЕВЫЕ СЛОВА: Diplopoda, Polydesmida, Paradoxosomatidae, таксономия, новые находки, новый род, новые виды, Вьетнам, Таиланд.

ABSTRACT. This contribution is devoted to new records of three known species from Thailand or Vietnam, as well as to descriptions of one new genus and five new species from Vietnam, as follows: *Piccola latiterga* sp.n., *Enghoffosoma extraspinosum* sp.n., *Jeekelomorpha bispinosa* gen.n., sp.n. (Sulciferini distinguished primarily by the unusually upright and fan-shaped gonopods), *Touranella moniliformis* sp.n. and *T. trichosa* sp.n.

How to cite this article: Golovatch S.I., Semenyuk I.I. 2018. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XXIII // Arthropoda Selecta. Vol.27. No.1. P.1–21. doi: 10.15298/arthsel. 27.1.01

РЕЗЮМЕ. Данное сообщение посвящено находкам трех известных видов из Таиланда и Вьетнама, а также описаниям следующих нового рода и пяти новых видов из Вьетнама: *Piccola latiterga* sp.n., *Enghoffosoma extraspinosum* sp.n., *Jeekelomorpha bispinosa* gen.n., sp.n. (Sulciferini, отличающиеся, прежде всего, необычными прямыми и похожими на веер гоноподами), *Touranella moniliformis* sp.n. и *T. trichosa* sp.n.

Introduction

This paper is devoted to new records of three known species from Thailand or Vietnam, as well as to descriptions of one new genus and five new species from Vietnam.

Material and methods

All material treated below is deposited in the collection of the Zoological Museum, Moscow State Uni-

versity, Russia. The colour pictures were taken with a Canon EOS 5D digital camera and stacked using Zerene Stacker software.

Taxonomic part

Anoplodesmus anthracinus Pocock, 1895

MATERIAL. 1 ♂, 1 ♀, Thailand, Phuket Island, Bangtao seashore, Sunwing Resort, N 7.9902°, E 98.2917°, 23.IV.2017, leg. I.V. Enushchenko.

REMARK. Characteristically, the ventral humps are increasingly strongly developed on ♂ femora 4–7 [Jeekel, 1965]. This species is new to the fauna of Thailand [Eng-hoff, 2005].

Anoplodesmus mirabilis Golovatch, VandenSpiegel et Semenyuk, 2016

Fig. 1.

MATERIAL. 2 ♂♂, 1 ♀, Vietnam, Gia Lai Prov., Kon Ka Kinh National Park, N 14°18'08", E 108°26'41", 600–700 m a.s.l., mixed tropical forest, steep slope (up to 45°), stream valley, on bush and forest floor, V.2017, leg. I.I. Semenyuk.

REMARK. As these samples come from a new locality in the Gia Lai Province, the *terra typica* [Golovatch et al., 2016], they can be regarded as near-topotypes. The species has also been recorded from another locality in the same province [Golovatch, 2017]. Live coloration appears to be blackish brown (Fig. 1), apparently strongly faded to light brown or even yellow in alcohol [Golovatch et al., 2016; Golovatch, 2017].

Desmoxytes grandis Golovatch, VandenSpiegel et Semenyuk, 2016

Fig. 2.

MATERIAL. 2 ♂♂, 1 ♀, Vietnam, Gia Lai Province, Kon Ka Kinh National Park, N 14°13'12", E 108°19'54", 1500 m a.s.l., mixed cloud forest on hill summit, on and under logs, in litter, V.2017, leg. I.I. Semenyuk.



Figs 1–2. Live coloration of *Anoplodesmus mirabilis* Golovatch, Semenyuk et VandenSpiegel, 2016 and *Desmoxytes grandis* Golovatch, Semenyuk et VandenSpiegel, 2016, ♂, respectively. Pictures by I. Semenyuk.

Рис. 1–2. Прижизненная окраска соответственно *Anoplodesmus mirabilis* Golovatch, Semenyuk et VandenSpiegel, 2016, ♂, и *Desmoxytes grandis* Golovatch, Semenyuk et VandenSpiegel, 2016, ♂. Фотографии И. Семенюк.

REMARK. As these samples come from a new locality in the Gia Lai Province, the *terra typica* [Golovatch et al., 2016], they can be regarded as near-topotypes. The species has also been recorded from the adjacent Kon Tum Province [Golovatch, 2017]. Live coloration appears to be red-brown (Fig. 2), apparently not faded and turning dark (blackish) brown in alcohol [Golovatch et al., 2016; Golovatch, 2017].

Piccola latiterga sp.n.

Figs 3, 6–13.

HOLOTYPE ♂, Vietnam, Gia Lai Prov., Kon Ka Kinh National Park, N 14°18'08", E 108°26'41", 600–700 m a.s.l., mixed tropical forest, steep slope (up to 45°), stream valley, on bush and forest floor, V.2017, leg. I.I. Semenyuk.

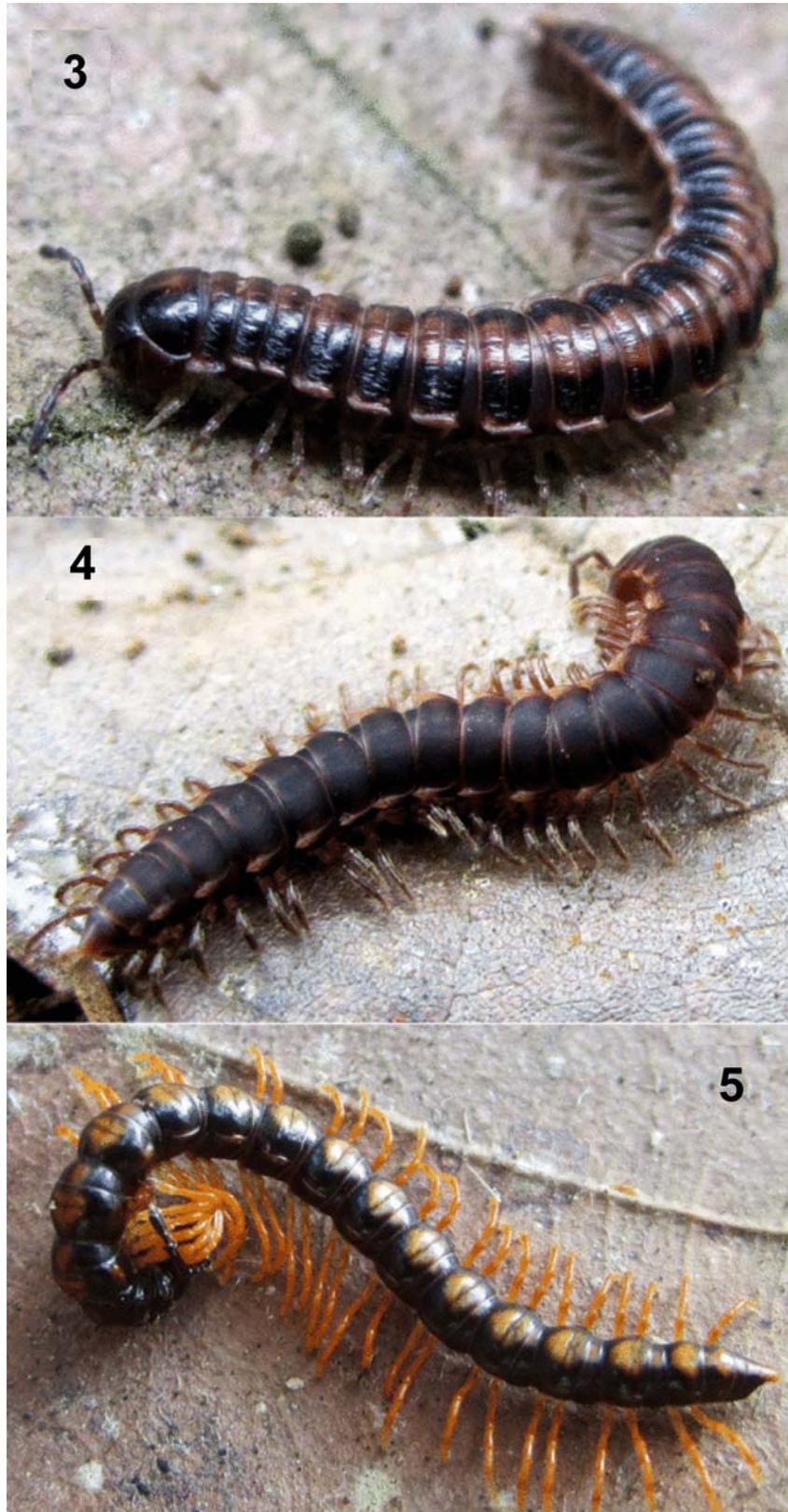
PARATYPES: 4 ♂♂, 1 ♀, same data, together with holotype.

DIAGNOSIS. Differs from other *Piccola* spp. in the presence of a distinct colour pattern and unusually broad

and even upturned paraterga, coupled with certain details of solenophore structure.

NAME. To emphasize the unusually broad paraterga; adjective.

DESCRIPTION. Holotype ca 16 mm long, width of midbody pro- and metazonae 1.1 and 2.0 mm, respectively. Paratype ♂♂ ca 18 mm long, width of midbody pro- and metazonae 1.3 and 2.3 mm, respectively. Paratype ♀ ca 17 mm long, width of midbody pro- and metazonae 1.5 and 2.0 mm, respectively. General coloration in alcohol apparently faded, uniformly chocolate brown (♂) or light brown (♀) with a characteristic pattern of more or less strongly contrasting light creamy to nearly pallid paraterga (except for their bases dorsally), vague, much darker creamy, paramedian, roundish spots on pro- and metaterga (divided transversally by dark brown bands near stricture and at metatergal sulci), and pallid tips of antennae (Figs 6–9). Live coloration considerably darker, pattern clear, but not too contrasting (Fig. 3).



Figs 3–5. Live coloration of *Piccola latiterna* sp.n., ♀ paratype, *Enghoffosoma extraspinosum* sp.n., ♂ holotype, and *Touranella moniliformis* sp.n., ♂ holotype, respectively. Pictures by I. Semenyuk.

Рис. 3–5. Прижизненная окраска соответственно *Piccola latiterna* sp.n. (паратип ♀), *Enghoffosoma extraspinosum* sp.n. (голотип ♂) и *Touranella moniliformis* sp.n. (голотип ♂). Фотографии И. Семенюк.



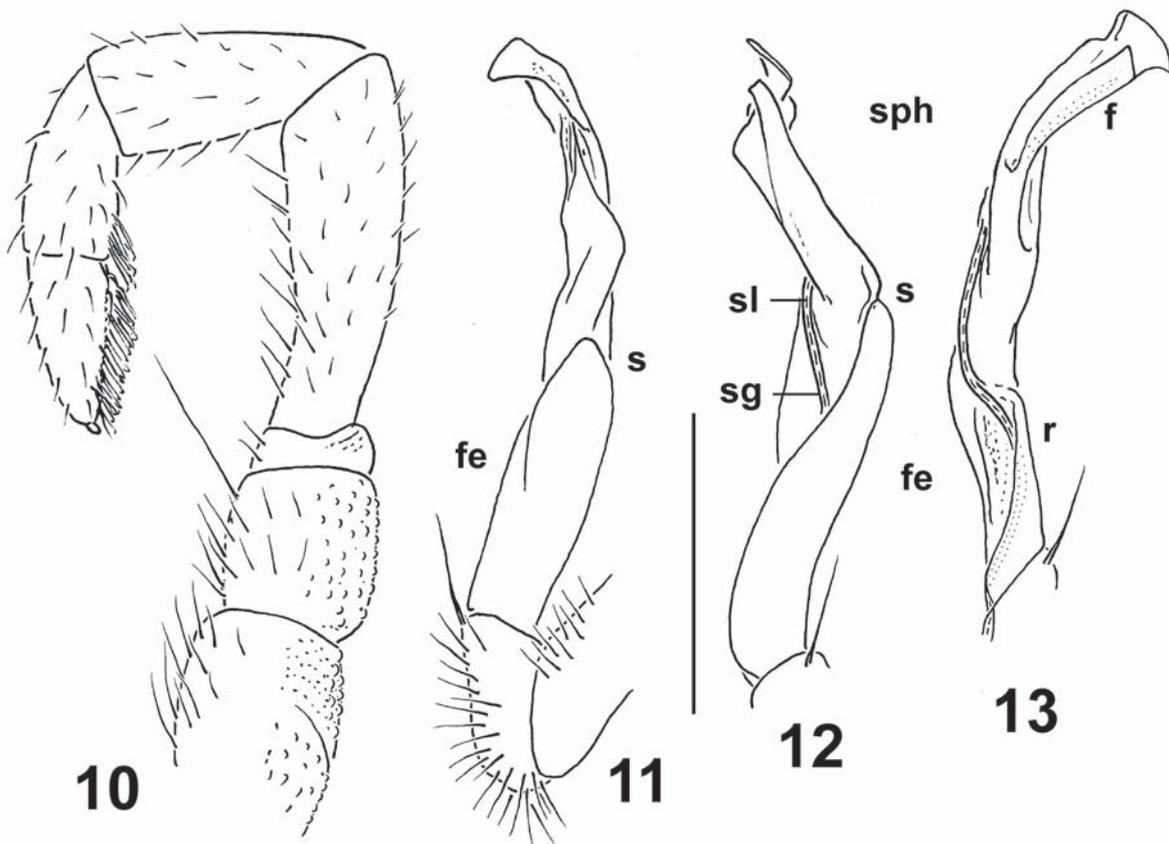
Figs 6–9. *Piccola latiterga* sp.n., ♂ paratype. 6 — habitus, lateral view; 7 — anterior part of body, ventral view; 8 — midbody segments, dorsal view; 9 — caudal part of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 6–9. *Piccola latiterga* sp.n., паратип ♂. 6 — общий вид, сбоку; 7 — передняя часть тела, снизу; 8 — среднетеловишние сегменты, сверху; 9 — задняя часть тела, сверху. Фотографии К. Макарова, сняты без масштаба.

Clypeolabral region densely setose, vertigial one bare; epicranial suture thin, but evident (Fig. 6). Antennae long and only slightly clavate, in situ extending until midlength of segment 3 when stretched dorsally (♂); antennomere 2 = 5 = 6 > 3 = 4 > 1 = 7; interantennal isthmus about 1.3 times as broad as diameter of antennal socket.

In width, head < collum < segment 2 = 3 < segment 4 < 5–16; thereafter body gradually tapering towards telson. Tegument mostly shining; prozonae finely shagreened; metaterga striolate (largely near bases of paraterga) and roughly longitudinally striate in rear halves; surface below paraterga almost dull and clearly granulate. Collum broadly rounded

laterally, with small, subhorizontal, rounded paraterga. Post-collum paraterga very strongly (♂) or only moderately (♀) developed, mostly set at about upper 1/4 (♂) or 1/3 (♀) of body height, broad, slightly, but obviously upturned (♂) (Figs 6–9) or faintly declined and lying well below a clearly convex dorsum (♀) (Fig. 3), delimited from callus by a complete distinct sulcus both dorsally and ventrally (Figs 6, 8, 9); anterolateral corner always very broadly and regularly rounded, caudolateral clearly rounded and acute-angled on segments 2–5, rounded and subrectangular until segment 11, increasingly acute-angled and sharpened thereafter, but especially sharp and drawn back behind rear tergal margin



Figs 10–13. *Piccola latiterga* sp.n., ♂ paratype. 10 — leg 7, lateral view; 11–13 — left gonopod, lateral, ventral and mesal views, respectively. Scale bar: 0.5 mm. Designations explained in text. Del. S. Golovatch.

Рис. 10–13. *Piccola latiterga* sp.n., паратип ♂. 10 — нога 7, сбоку; 11–13 — левый гонопод, соответственно сбоку, снизу и изнутри. Масштаб: 0,5 мм. Обозначения объяснены в тексте. Рисунки С. Головача.

only in segments 14–19 (♀) or 16–19 (♂). Poriferous calluses somewhat thicker than poreless ones, slightly, but clearly sinuate at about ozopore level; all calluses devoid of lateral incisions and extending dorsally into smaller ridges along both anterior and caudal margins of paraterga so that the latter slightly impressed; ozopores dorsolateral, partly visible from above, lying inside an ovoid groove at about 1/3 of metatergal length off caudolateral corner (Figs 8, 9). Transverse metatergal sulcus faint and incomplete on segments 4 and 19, deeper, finely beaded at bottom, complete and reaching the bases of paraterga on segments 5–18 (Figs 8, 9). Tergal setae mostly abraded, about 1/3–1/2 as long as metaterga, setation pattern untraceable, but setae arranged in two transverse rows. Stricture dividing pro- and metazonae thin and deep, clearly beaded at bottom down to level of paraterga where stricture growing striolate. Pleurosternal carinae evident, but low lobes only on segments 2 and 3, thereafter missing. Axial line mostly inconspicuous, traceable only on metaterga (Figs 8, 9). Epiproct (Figs 6, 9) long, conical, subtruncate at apex, subapical lateral papillae small, but evident; a pair of small, apical, ventrally directed claws placed at tip. Hypoproct roundly subtriangular, caudal 1+1 setae well-separated, borne on minute knobs.

Sterna sparsely setose, without modifications except for a pair of very small, rounded, independent, setose knobs between coxae 4 (♂); cross-impressions faint. Adenostyles missing. Legs long, slender, either slightly incrassate (♂) or

shorter and more slender (♀), >2.0 (♂) or 1.1–1.2 times (♀) as long as midbody height; in length, femora >> tibiae = tarsi > prefemora = postfemora = coxae; claw very small; coxae and prefemora often finely papillate laterally, the latter not swollen (Fig. 10). Tarsal brushes distinct, present on all legs, but largely covering only distal half to third (♂).

Gonopods (Figs 11–21) rather simple, in situ held parallel to each other; coxite short, slender, subcylindrical, setose distoventrally, about half as long as femorite (**fe**); telopodite slender, suberect; prefemoral (= densely setose) region ca 1/3 as long as acropodite; **fe** not twisted, clearly excavate on mesal face, bearing a distinct, oblique, ventromesal ridge (**r**) all along, set off from solenophore (**sph**) by a mainly lateral sulcus (**s**); **fe** about as long as **sph**, only slightly broadened apically, with a seminal groove (**sg**) running entirely on mesal face before almost level with **s**; distodorsally passing onto a free solenomere (**sl**), the latter almost as long as **sph**, flagelliform, its distal part lying inside a mesal fold (**f**) of an apically broadened and axe-shaped **sph**, leaving **sl** tip at most barely exposed.

REMARKS. At present, the rather small genus *Piccola* Attems, 1936, tribe Orthomorphi, encompasses only seven species, one each in Laos and southern China (the sole presumed troglobite), and the remaining five in Vietnam [Liu, Tian, 2015]. The new species is quite disjunct in showing unusually prominent, even slightly upturned paraterga. The diagnosis of this genus can now be somewhat emend-

ed in its main characteristics being typical orthomorphine, slender, more or less suberect gonopods, each femorite (**fe**) of which is mesally excavate, mostly shows a conspicuous, oblique, ventral ridge (**r**) and carries the seminal groove (**sg**) entirely on its mesal side, while the solenophore (**sph**) sometimes fails to have clear-cut lamellae, is more or less axe-shaped apically and demarcated basally from the femorite by only a single sulcus (**s**) (a postfemoral part/sulcus is thus missing), and the solenomere (**sl**) is flagelliform, about as long as the solenophore and sheathes it completely or nearly so.

Enghoffosoma extraspinosum sp.n.

Figs 4, 14–31.

HOLOTYPE ♂, Vietnam, Gia Lai Prov., Kon Ka Kinh National Park, N 14°12'43", E 108°18'57", 900 m a.s.l., mixed wet tropical forest at bottom of a river valley, on log, V.2017, leg. I.I. Semenyuk.

PARATYPES: 3 ♂♂, 1 ♀, same data, together with holotype.

DIAGNOSIS. Differs from other *Enghoffosoma* spp. primarily in the presence of an additional process (**a**) on the gonopod.

NAME. To emphasize the presence of an additional process (**a**) on the gonopod; adjective.

DESCRIPTION. Holotype and ♂ paratypes ca 21–22 mm long, width of midbody pro- and metazonae 2.6 and 3.0 mm, respectively. ♀ paratype ca 25 mm long, 3.0 and 3.4 mm wide on pro- and metazonae, respectively. General coloration in alcohol rather uniformly dark brown to brown, apparently somewhat faded, with a characteristic pattern of contrasting light creamy rear halves of paraterga and entire venter, legs light brown, tips of antennae pallid (Figs 22–25). Live coloration darker, but pattern clear, blackish orange (Fig. 4).

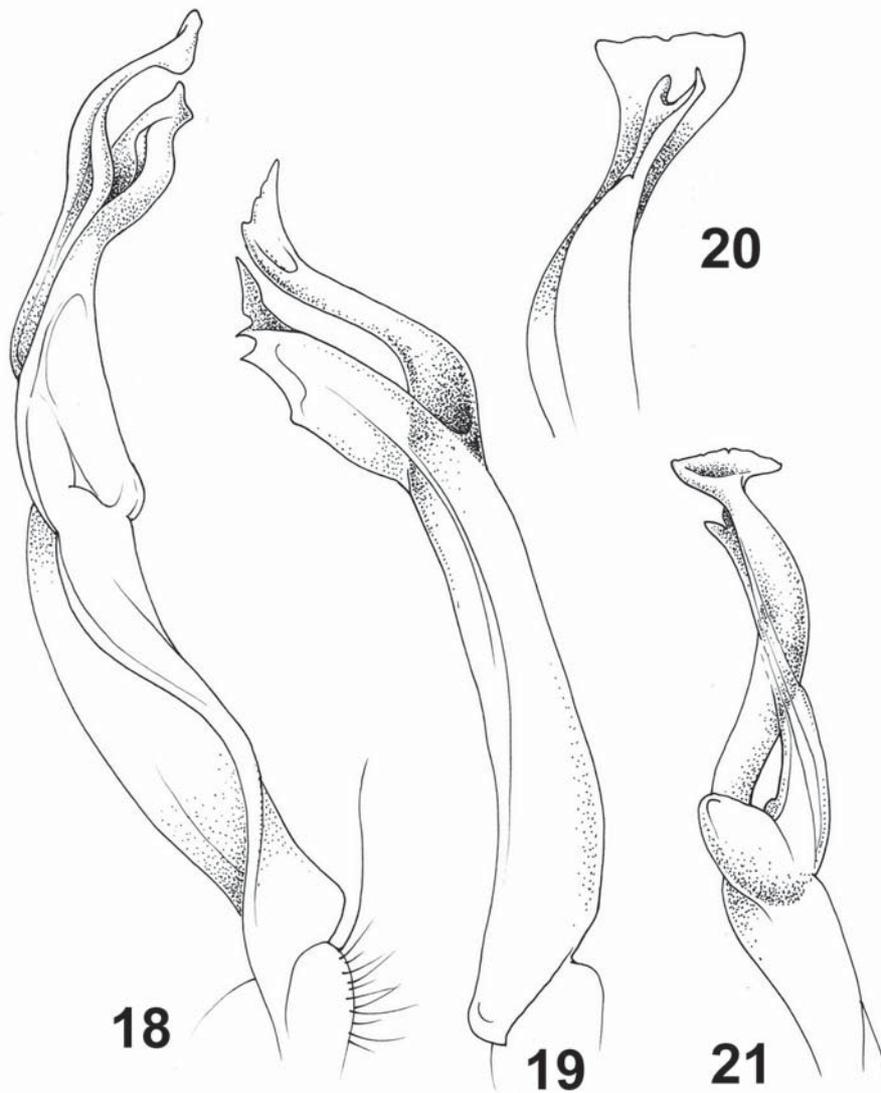
Clypeolabral region densely setose, abundant small and a few longer setae between and above antennae, respectively; occipital region bare; epicranial suture thin, superficial (Fig. 14). Antennae long and slender, only slightly clavate (Figs 22, 23), in situ extending back behind segment 2 (♂) when stretched dorsally; in length, antennomeres 2–6 \gg 1 = 7 (Fig. 22); interantennal isthmus about 1.1 times as broad as diameter of antennal socket (Fig. 22).

In width, head < segment 2 = 3 < collum = 4 < 5–16; thereafter body gradually tapering towards telson (Figs 22–25). Tegument nearly shining, almost dull; prozonae very finely shagreened; metaterga mostly smooth, longitudinally striolate in rear halves; surface below paraterga granulate and clearly striate longitudinally. Collum broadly rounded laterally, with small, subhorizontal, rounded, caudally subrectangular paraterga. Postcollum paraterga well-developed, mostly set low at about half of body height, oblique and clearly elevated caudally; caudal corner of paraterga 2 narrowly rounded, thereafter sharp, beak- or spine-shaped and drawn behind rear tergal margin (Figs 22, 24, 25), only paraterga 18 and 19 increasingly small (Fig. 25). Calluses delimited by a distinct sulcus only dorsally, particularly thin on poreless paraterga, somewhat thicker and slightly sinuate only in front of ozopore on pre-bearing paraterga. Ozopores small, lying inside short dorsolateral grooves, partly visible from above, located at about 1/4 off caudal corner (Figs 22, 24, 25). Transverse metatergal sulci absent, often with very faint impressions in their stead. Stricture between pro- and metazonae very thin and shallow, clearly beaded at bottom down to paraterga. Tergal setae largely abraded, short (about 1/4 of metatergal length, Fig. 24), setation pattern traceable as 2+2 in a transverse row in anterior 1/3 of metaterga. Axial line missing. Pleurosternal carinae small flaps on segment 2, square ridges on segment 3, thereafter with an increasingly



Figs 14–17. *Piccola latiterna* sp.n., ♂ paratype, left gonopod, mesal, dorsal, ventral and lateral views, respectively. Pictures by K. Makarov, not taken to scale.

Рис. 14–17. *Piccola latiterna* sp.n., паратип ♂, левый гонопод, соответственно изнутри, сверху, снизу и сбоку. Фотографии К. Макарова, сняты без масштаба.



Figs 18–21. *Piccola latiterra* sp.n., ♂ paratype, left gonopod, mesal, lateral, ventral and dorsal views, respectively. Drawn not to scale by I. Semenyuk.

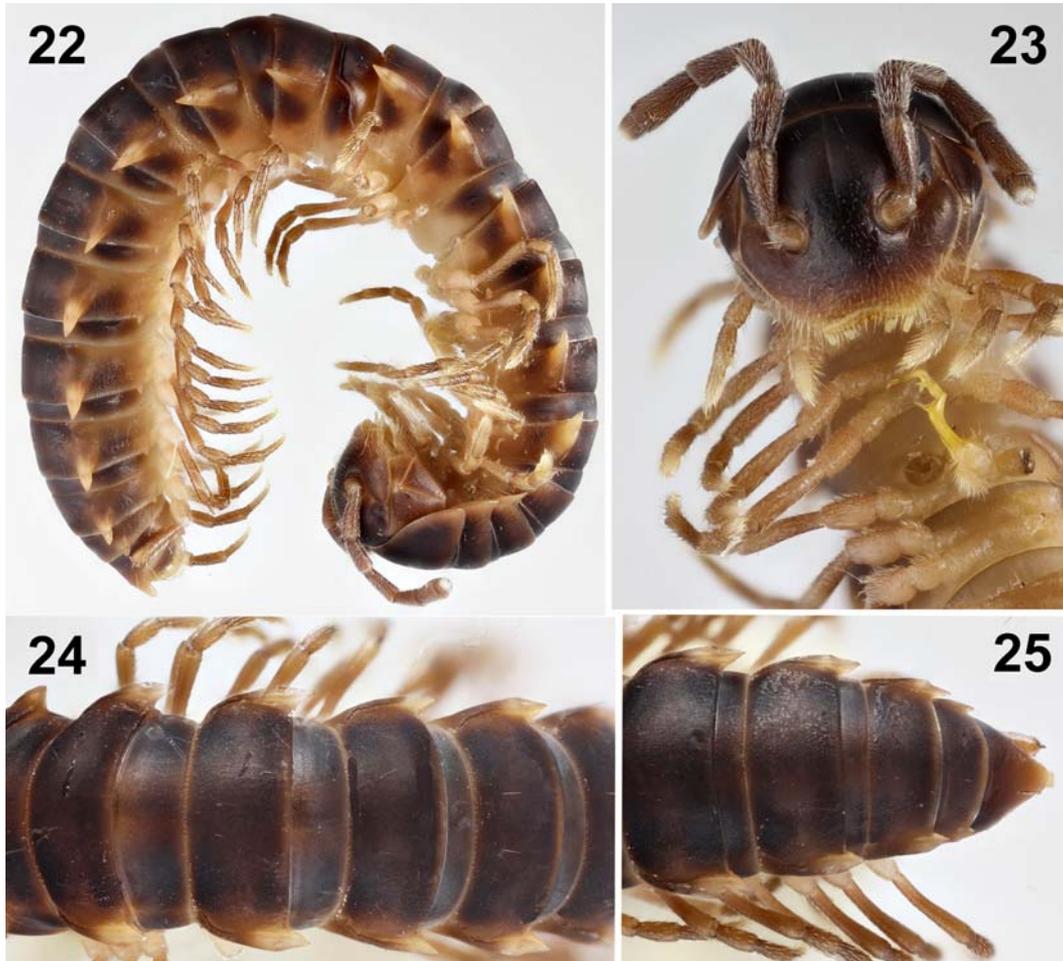
Рис. 18–21. *Piccola latiterra* sp.n., паратип ♂, левый гонопод, соответственно изнутри, сбоку, снизу и сверху. Нарисовала без масштаба И. Семенюк.

distinct caudal tooth until segment 7 (♂), then increasingly reduced on segments 8–16, traceable like small denticles even on segments 17–19 (♂) (Fig. 22) or 17–18 (♀). Epipect rather long, coniform, subapical lateral papillae small, tip subtruncate (Figs 22, 25). Hypoprect roundly subtriangular, 1+1 setae strongly separated from each other, borne on minute knobs, clearly removed from caudal margin.

Sterna very densely setose, cross-impressions faint, axial impression especially poor; a very small, sharp, vestigial tubercle or cone near each coxa (♂); a low, setose, roundly subtrapeziform lobe between ♂ coxae 4. Legs long and slender, very densely setose, somewhat incrassate as compared to ♀, ca 1.5–1.6 (♂) or 1.1–1.2 (♀) times as long as midbody height, devoid of adenostyles, ♂ prefemora clearly bulged laterally, tarsal brushes present only on ♂ legs 1–7, thereafter thinning out; in length, femora >> tarsi > tibiae = prefemora > postfemora = coxae (♂).

Gonopods (Figs 23, 28–31) rather complex, in situ slightly crossing each other distomedially; coxite about as long as femorite, subcylindrical, densely setose distolaterally; prefemoral (= densely setose) part of telopodite short, about 1/3 as long as acropodite; femorite (**fe**) long, slender, untwisted, slightly enlarged apically only due to a short, but bulky postfemoral region (**pf**); the latter set off basally from **fe** by an inconspicuous sulcus (**s**) on mesal face and distally by a prominent apical shelf/cingulum (**b**); **pf** with a single, distinct, dorsomesal, spine-shaped process (**p**); base of a long, twisted, gradually attenuating solenomere (**sl**) with two subequal membranous outgrowths, one (**e**) axe-shaped and dorsomesal in position, the other (**a**) spatuliform and ventromesal in location.

REMARKS. At the moment, the rather large Oriental genus *Enghoffosoma* Golovatch, 1993 encompasses 12 species described from Myanmar, Indochina and southern Chi-



Figs 22–25. *Enghoffosoma extraspinosum* sp.n., ♂ holotype. 22 — habitus, lateral view; 23 — anterior part of body, ventral view; 24 — midbody segments, dorsal view; 25 — caudal part of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 22–25. *Enghoffosoma extraspinosum* sp.n., голотип ♂. 22 — общий вид, сбоку; 23 — передняя часть тела, снизу; 24 — среднетелувищные сегменты, сверху; 25 — задняя часть тела, сверху. Фотографии К. Макарова, сняты без масштаба.

na [Likhitrakarn et al., 2014; Nguyen, Golovatch, 2016; Golovatch et al., 2016]. The vivid colour pattern in *E. extraspinosum* sp.n. strongly resembles that observed in *E. bispinum* Likhitrakarn, Golovatch et Panha, 2014, from Thailand, *E. contrastum* Golovatch, VandenSpiegel et Semenyuk, 2016 and *E. digitatum* Nguyen et Golovatch, 2016, both from Vietnam, *E. lanceolatum* Likhitrakarn, Golovatch et Panha, 2014, from both Thailand and Vietnam, and *E. anchoriforme* Likhitrakarn, Golovatch et Panha, 2014, from both Laos and Vietnam [Likhitrakarn et al., 2014; Nguyen, Golovatch, 2016; Golovatch et al., 2016], but they all are quite distinct in several somatic and, especially, gonopodal traits. Among congeners, the new species shows yet the maximum number (4) of clear-cut distal outgrowths on the gonopod.

Jeekelomorpha gen.n.

DIAGNOSIS. An aberrant genus of medium-sized Sulciferini Attems, 1898 with small paraterga, in which the gonopodal telopodite is suberect, the femorite untwisted, excavate and bearing two ridges mesally, a short postfemoral region demarcated by sulci only laterally, and the usual

two lamellae of a membranous, somewhat fan-shaped solenophore are upright and independent (vs. distinctly curved or coiled and intricately interlocked), with a few processes or outgrowths at the base, and a long and flagelliform solenomere running entirely on the mesal face between the lamellae to end up laterally on their top.

Type species: *Jeekelomorpha bispinosa* sp.n.

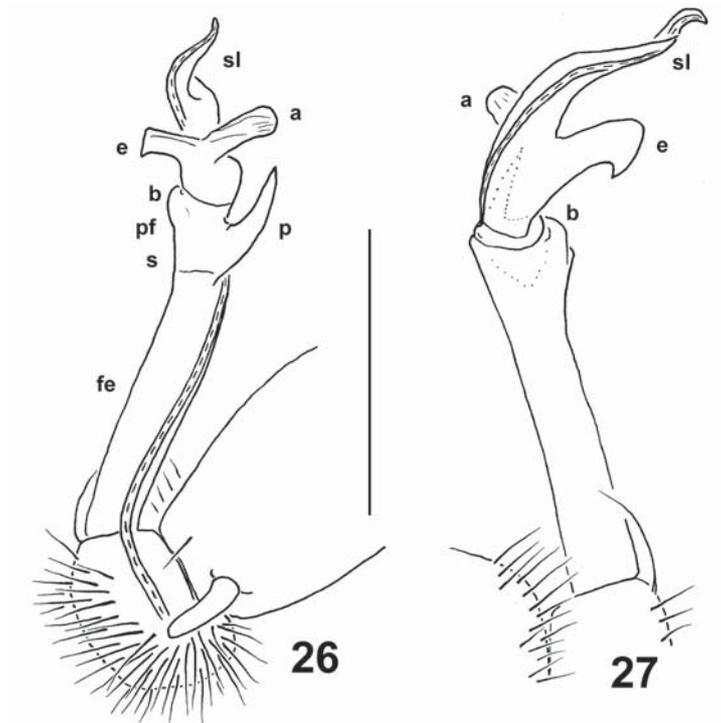
REMARKS. This new genus is gladly dedicated to the memory of the late Casimir Albrecht Willem Jeekel, an outstanding specialist in the taxonomy of Diplopoda.

The upright membranous and somewhat fan-shaped solenophore with a few distinct parbasal outgrowths, coupled with a double-ridged, but untwisted femorite and a flagelliform suberect solenomere seem to be apomorphic to and highly characteristic of this new genus. Feminine in gender.

Jeekelomorpha bispinosa sp.n.

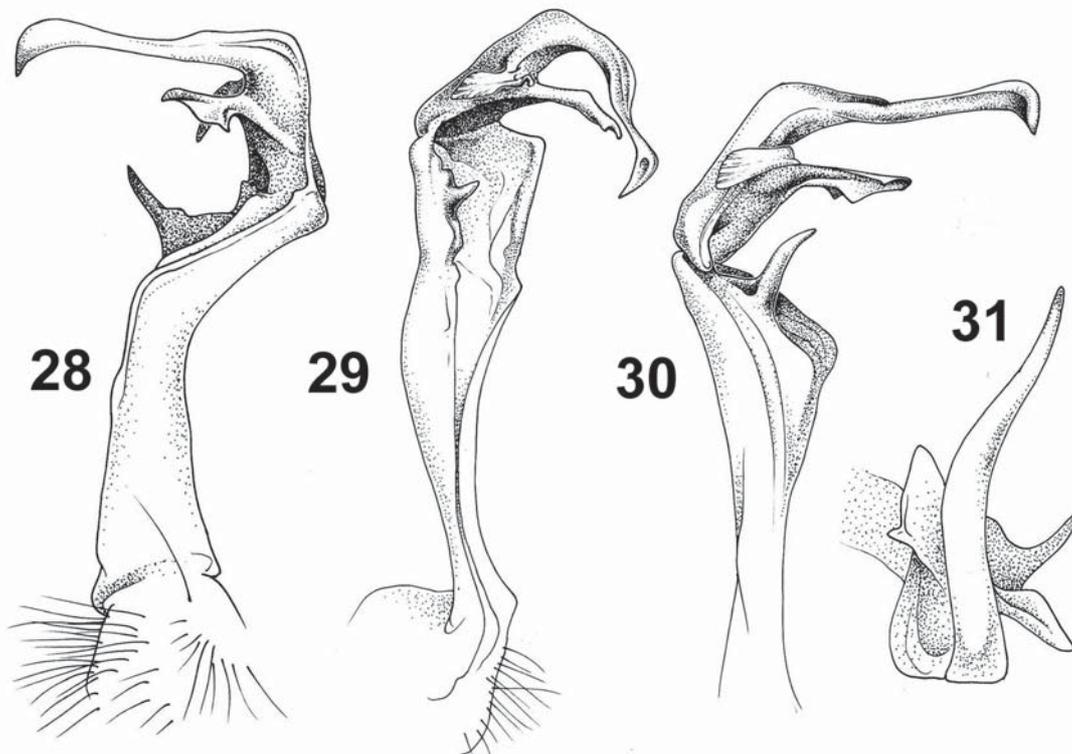
Figs 32–44.

HOLOTYPE ♂, Vietnam, Gia Lai Prov., Kon Ka Kinh National Park, N 14°18'08", E 108°26'41", 600–700 m a.s.l., mixed tropical forest, steep slope (up to 45°), stream valley, leaf litter, V.2017, leg. I.I. Semenyuk.



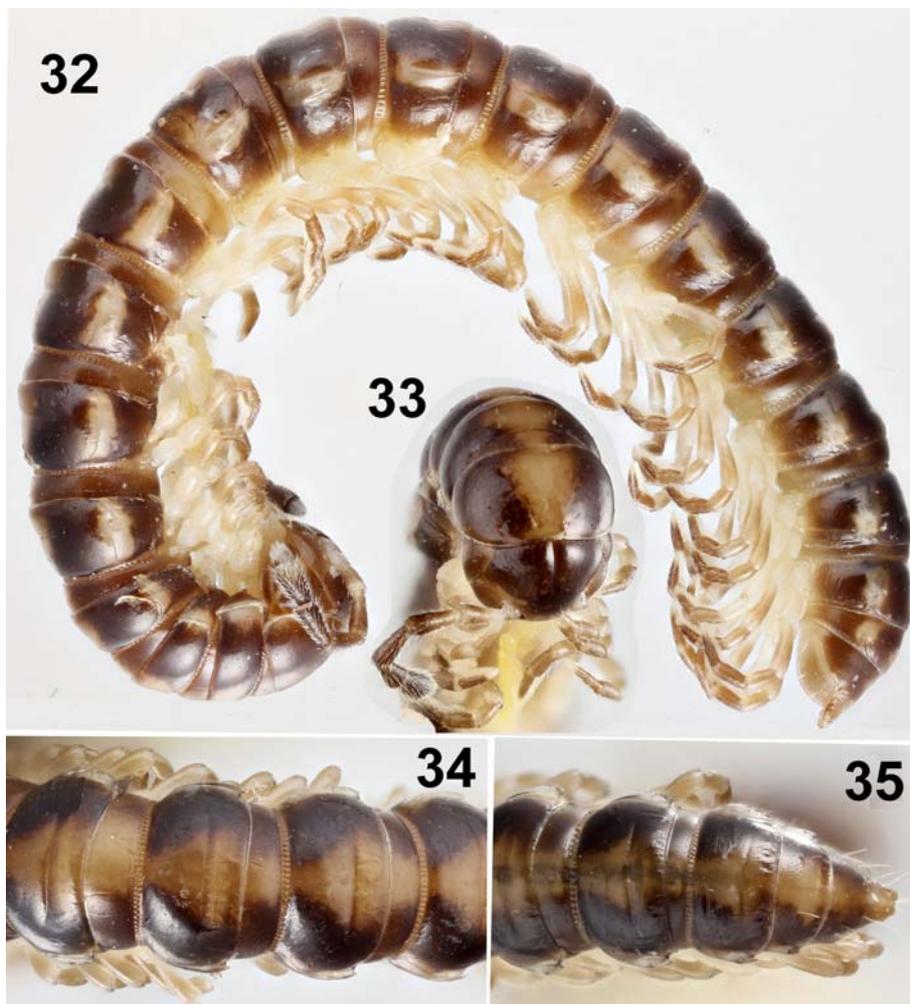
Figs 26–27. *Enghoffosoma extraspinosum* sp.n., ♂ holotype, right gonopod, mesal and lateral views, respectively. Scale bar: 0.5 mm. Designations explained in text. Del. S. Golovatch.

Рис. 26–27. *Enghoffosoma extraspinosum* sp.n., голотип ♂, правый гонопод, соответственно изнутри и сбоку. Масштаб: 0,5 мм. Обозначения объяснены в тексте. Рисунки С. Головача.



Figs 28–31. *Enghoffosoma extraspinosum* sp.n., ♂ paratype, left gonopod, ventral, mesal, dorsal and oral views, respectively. Drawn not to scale by I. Semenyuk.

Рис. 28–31. *Enghoffosoma extraspinosum* sp.n., паратип ♂, левый гонопод, соответственно снизу, изнутри, сверху и спереди. Нарисовала без масштаба И. Семенюк.



Figs 32–35. *Jeekelomorpha bispinosa* sp.n., ♂ holotype. 32 — habitus, lateral view; 33 — anterior part of body, oral view; 34 — midbody segments, dorsal view; 35 — caudal part of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 32–35. *Jeekelomorpha bispinosa* sp.n., голотип ♂. 32 — общий вид, сбоку; 33 — передняя часть тела, спереди; 34 — среднетелувищные сегменты, сверху; 35 — задняя часть тела, сверху. Фотографии К. Макарова, сняты без масштаба.

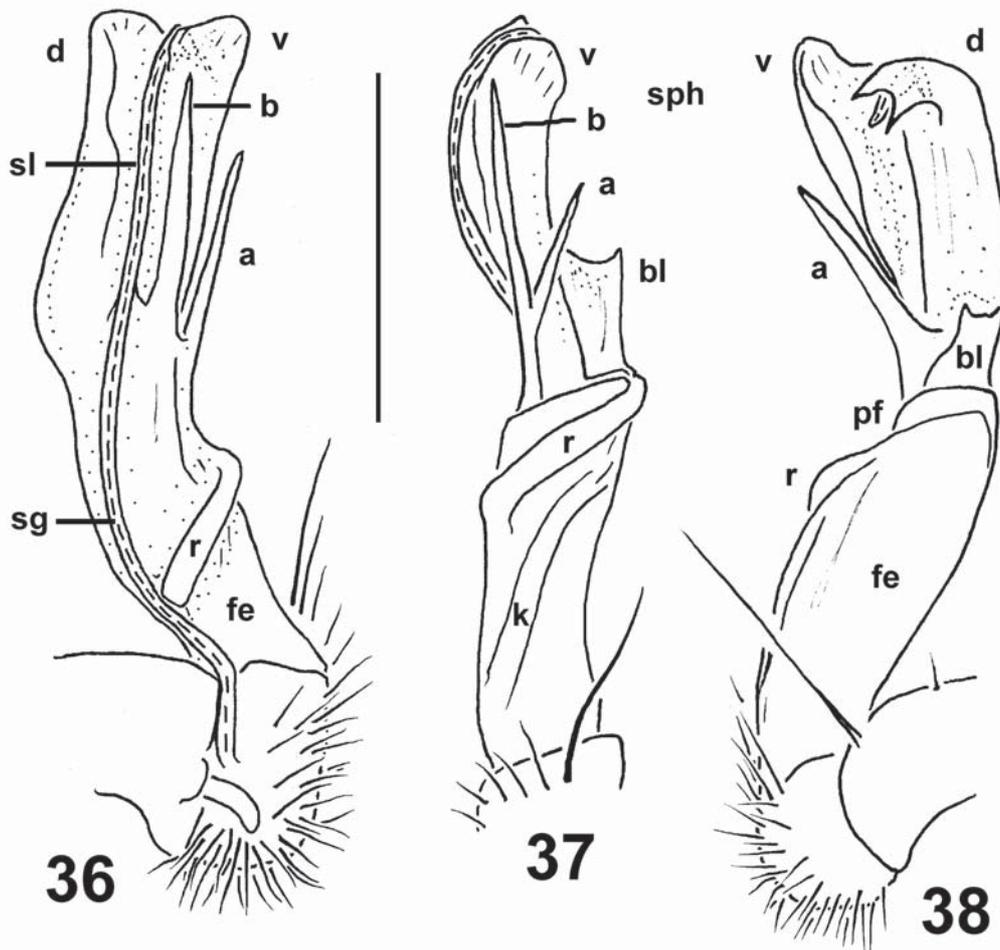
DIAGNOSIS. With the characters of the genus.

NAME. To emphasize the presence of two long spines (**a** and **b**) at the base of the solenophore; adjective.

DESCRIPTION. Holotype ca 15 mm long, width of midbody pro- and metazonae 1.1 and 1.4 mm, respectively (♂). General coloration in alcohol rather uniformly brown to chocolate brown with a characteristic bead-shaped pattern of contrasting light ochre dorsal markings (larger and rounded spots in rear halves turning into smaller and wide stripes in anterior halves of collum and following metaterga, spots extending onto proterga as well) and strictures; paraterga, entire venter, tip of epiproct and basal podomeres light beige; distal podomeres increasingly light grey-brown; antennae increasingly brown, but their tips pallid (Figs 32–35).

Clypeolabral region densely setose, only a few long setae between and above antennae; occipital region bare; epicranial suture thin, but evident (Fig. 33). Antennae long and slightly clavate (Figs 32, 33), in situ extending back behind segment 2 (♂) when stretched dorsally; in length, antennomeres 2–6 \gg 1 = 7; interantennal isthmus about as broad as diameter of antennal socket (Fig. 33).

In width, head < segment 2 < collum = 3 < 4 < 5–15; thereafter body gradually tapering towards telson (Figs 32–35). Tegument smooth and shining; prozonae very finely shagreened; rear 1/3 of metaterga and surface below paraterga often finely to very finely striolate longitudinally. Collum broadly and regularly rounded laterally. Postcollum paraterga well-developed, mostly set low at about half of body height, subhorizontal; anterior corner of paraterga 2 narrowly rounded, subrectangular, caudal one drawn behind into a short and small tooth, thereafter likewise produced into a small sharp tooth, but never drawn behind rear tergal margin (Figs 34, 35). Calluses delimited by two sulci, a complete and distinct one dorsally and, in posterior 2/3, a less distinct one ventrally; calluses neither incised nor sinuate, thin in dorsal view, thick in lateral view, especially so on pore-bearing paraterga. Ozopores small, lying inside a pit invisible from above, located at about 1/3 off caudal corner (Fig. 32). Transverse metatergal sulci present on segments 5–18, thin, shallow, slightly sinuate mid-dorsally, often very finely beaded at bottom, almost reaching the bases of paraterga. Stricture between pro- and metazonae thin and deep, clearly



Figs 36–38. *Jeekelomorpha bispinosa* sp.n., ♂ holotype, left gonopod, mesal, ventral and lateral views, respectively. Scale bar: 0.5 mm. Designations explained in text. Del. S. Golovatch.

Рис. 36–38. *Jeekelomorpha bispinosa* sp.n., голотип ♂, правый гонопод, соответственно изнутри, снизу и сбоку. Масштаб: 0,5 мм. Обозначения объяснены в тексте. Рисунки С. Головача.

beaded at bottom down to below paraterga (Figs 32, 34, 35). Tergal setae largely abraded, long (about half of metatergal length, Fig. 35), likely arranged in a single transverse row of 2+2 in about anterior 1/3 of metaterga. Axial line missing. Pleurosternal carinae roughly granulate, small flaps on segment 2, square ridges with small caudal teeth on segment 3, thereafter with increasingly distinct caudal teeth until segment 7 (♂), then suddenly fully reduced (Fig. 32). Epiproct long, subconiform, flattened dorsoventrally, subapical lateral papillae small, tip poorly concave (Figs 32, 35). Hypoproct roundly subtrapeziform, 1+1 setae strongly separated from each other, borne on minute knobs at caudal margin.

Sterna sparsely setose, cross-impressions moderately and equally deep, unmodified except for a high, subquadrate and setose lobe between coxae 4 (♂). Legs long and slender, densely setose, apparently somewhat incrassate as compared to ♀, ca 1.5–1.6 times as long as midbody height (♂), devoid of adenostyles, ♂ prefemora not bulged laterally; prefemoral, distotibial and tarsal brushes present ventrally on all ♂ legs; in length, femora >> prefemora = tarsi > tibiae > postfemora = coxae.

Gonopods (Figs 36–44) complex, somewhat fan-shaped; coxite about as long as femorite, subcylindrical, with a par-

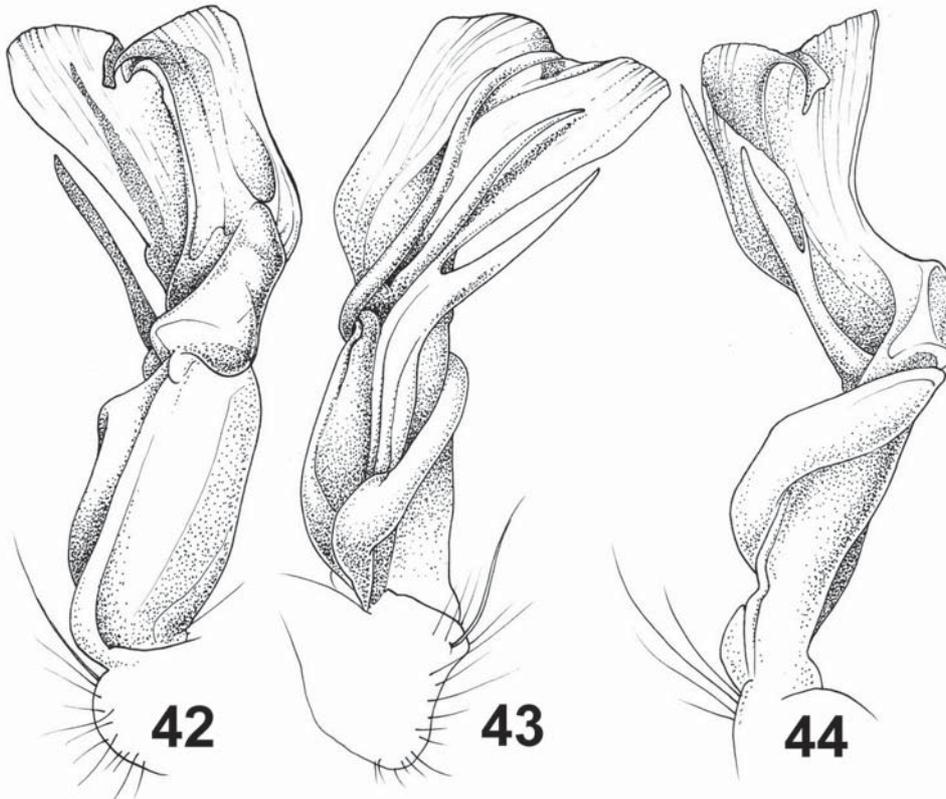
ticularly long seta distolaterally; prefemoral (= densely setose) part of telopodite short, about 1/4 as long as acropodite; femorite (fe) short, stout, untwisted, only slightly enlarged apically, distinctly excavate on mesal face and with two large, long, oblique, ventromesal ridges (r and k) all along, both set off by a lateral sulcus from a very short postfemoral region (pf); the latter set off apically by another lateral sulcus from a prominent and suberect solenophore (sph) consisting of a lateral blade (bl) with an apical denticle, two strong spines (a and b) fused parasally on ventral side, and two large, subequally high, independent, membranous lamellae, one ventral (v) and rounded, the other dorsal (d) and subapically bidentate; seminal groove (sg) running entirely on mesal side of fe before entering onto a long, flagelliform, similarly suberect solenomere (sl) starting about level with a, b and bl bases, located between lamellae v and d, but terminating on lateral side only near a bifid end of d.

REMARKS. The mostly Asian tribe Sulciferini Attems, 1898 is among the largest in the family Paradoxosomatidae, containing more than two dozen genera [Jeekel, 1988; Nguyen, Sierwald, 2013]. Their gonopodal conformation is typically complex, distinguished by an always untwisted, unarmed and often mesally excavate femorite that usually shows



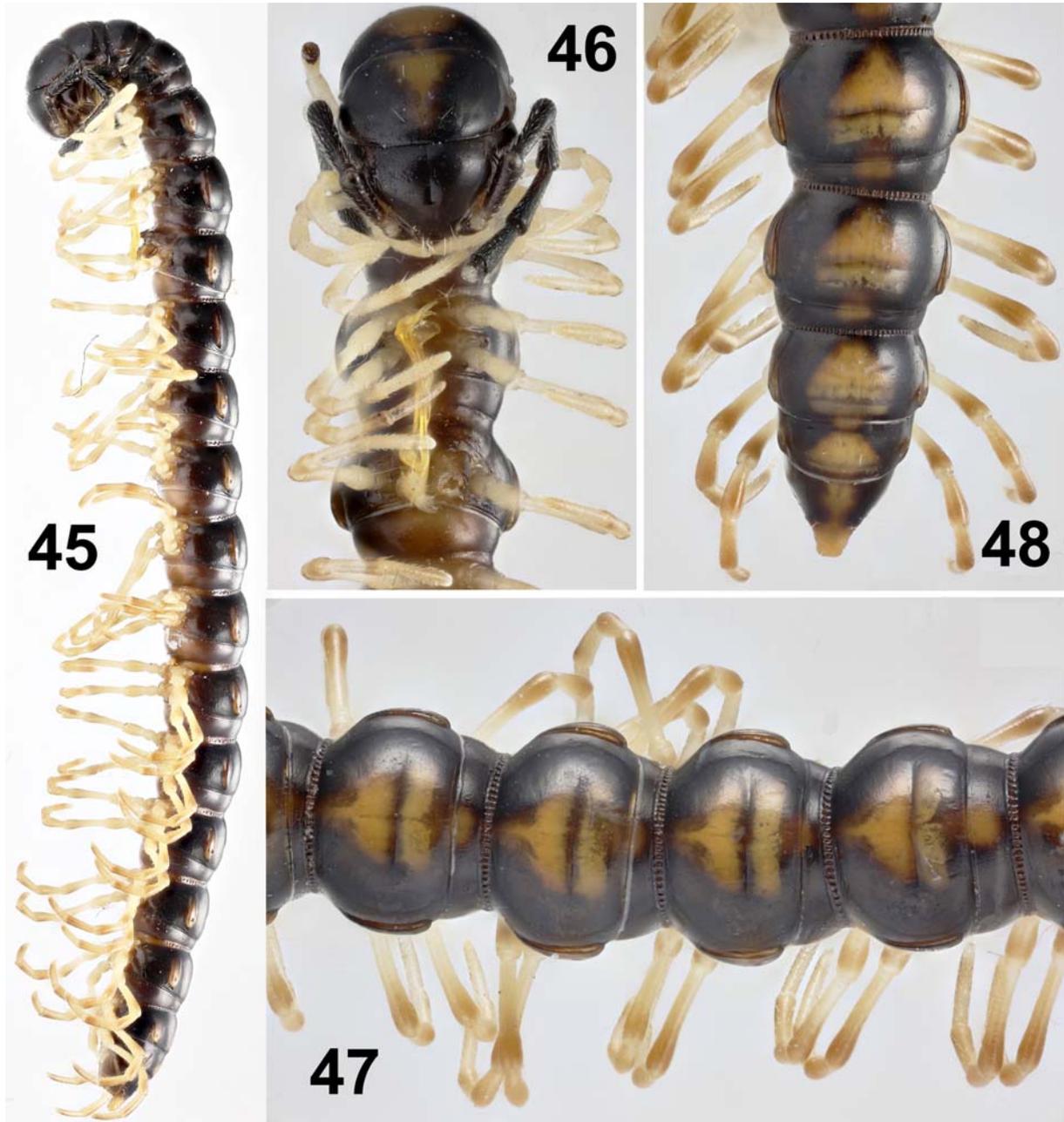
Figs 39–41. *Jeekelomorpha bispinosa* sp.n., ♂ holotype, left gonopod, mesal, lateral and ventral views, respectively. Pictures by K. Makarov, not taken to scale.

Рис. 39–41. *Jeekelomorpha bispinosa* sp.n., голотип ♂, левый гонопод, соответственно изнутри, сбоку и снизу. Фотографии К. Макарова, сняты без масштаба.



Figs 42–44. *Jeekelomorpha bispinosa* sp.n., ♂ holotype, left gonopod, lateral, mesal and subventral views, respectively. Drawn not to scale by I. Semenyuk.

Рис. 42–44. *Jeekelomorpha bispinosa* sp.n., голотип ♂, левый гонопод, соответственно сбоку, изнутри и почти снизу. Нарисовала без масштаба И. Семенюк.



Figs 45–48. *Touranella moniliformis* sp.n., ♂ paratype. 45 — habitus, lateral view; 46 — anterior part of body, ventral view; 47 — midbody segments, dorsal view; 48 — caudal part of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 45–48. *Touranella moniliformis* sp.n., паратип ♂. 45 — общий вид, сбоку; 46 — передняя часть тела, снизу; 47 — среднетеловишние сегменты, сверху; 48 — задняя часть тела, сверху. Фотографии К. Макарова, сняты без масштаба.

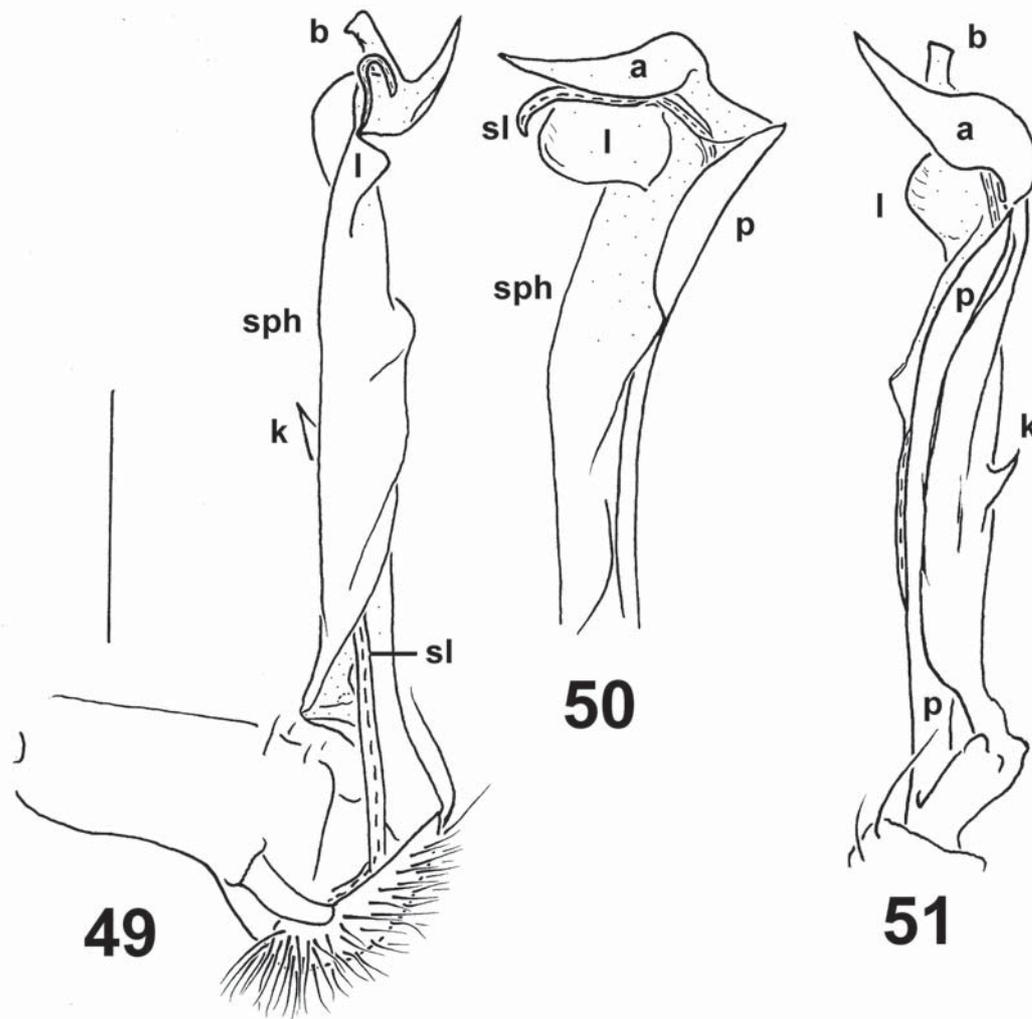
a delimited postfemoral region, a number (1–4) of outgrowths and/or processes at the base of a curved or coiled and always membranous solenophore, the latter normally consisting of two intricately folded laminae (a lamina lateralis and a lamina medialis) to support and largely or fully sheath a weak, flagelliform, mainly long solenomere. Despite the striking apomorphies observed in *Jeekelomorpha* gen.n., especially the somewhat fan-shaped, upright and bilamellate solenophore, its diagnosis seems best to fit in the scope of Sulciferini.

Touranella moniliformis sp.n.
Figs 5, 45–57.

HOLOTYPE ♂, Vietnam, Dong Nai Prov., Cat Tien National Park, N 11°26', E 107°21', 180 m a.s.l., monsoon broadleaved lowland tropical forest, on bush, IV.2017, leg. I.I. Semenyuk.

PARATYPE: 1 ♂, same data, together with holotype.

DIAGNOSIS. Differs from other species of the genus primarily by the large body, the special and contrasting colour pattern, the bare and smooth metaterga, the absence



Figs 49–51. *Touranella moniliformis* sp.n., ♂ holotype, left gonopod, mesal, ventral and sublateral views, respectively. Scale bar: 0.5 mm. Designations explained in text. Del. S. Golovatch.

Рис. 49–51. *Touranella moniliformis* sp.n., гомотип ♂, левый гонопод, соответственно изнутри, снизу и почти сбоку. Масштаб: 0,5 мм. Обозначения объяснены в тексте. Рисунки С. Головача.

of an additional gonoprefemoral outgrowth, the peculiar shape of the distal part of the solenophore, and the presence of a small, dorsal, midway peg on the latter. Using the latest available key [Golovatch, 2016], this new species keys out to the strictly sympatric *T. cattiensis* Golovatch et Semenyuk, 2010, but the latter species is much smaller (9–10 mm long), devoid of a contrasting colour pattern, the paraterga are more strongly developed and most are strongly incised laterally at the anterior 1/3 and drawn into a sharp tooth caudally, the dorsum is lightly, but clearly pilose, and the gonopods are much more simple, etc. [Golovatch, Semenyuk, 2010].

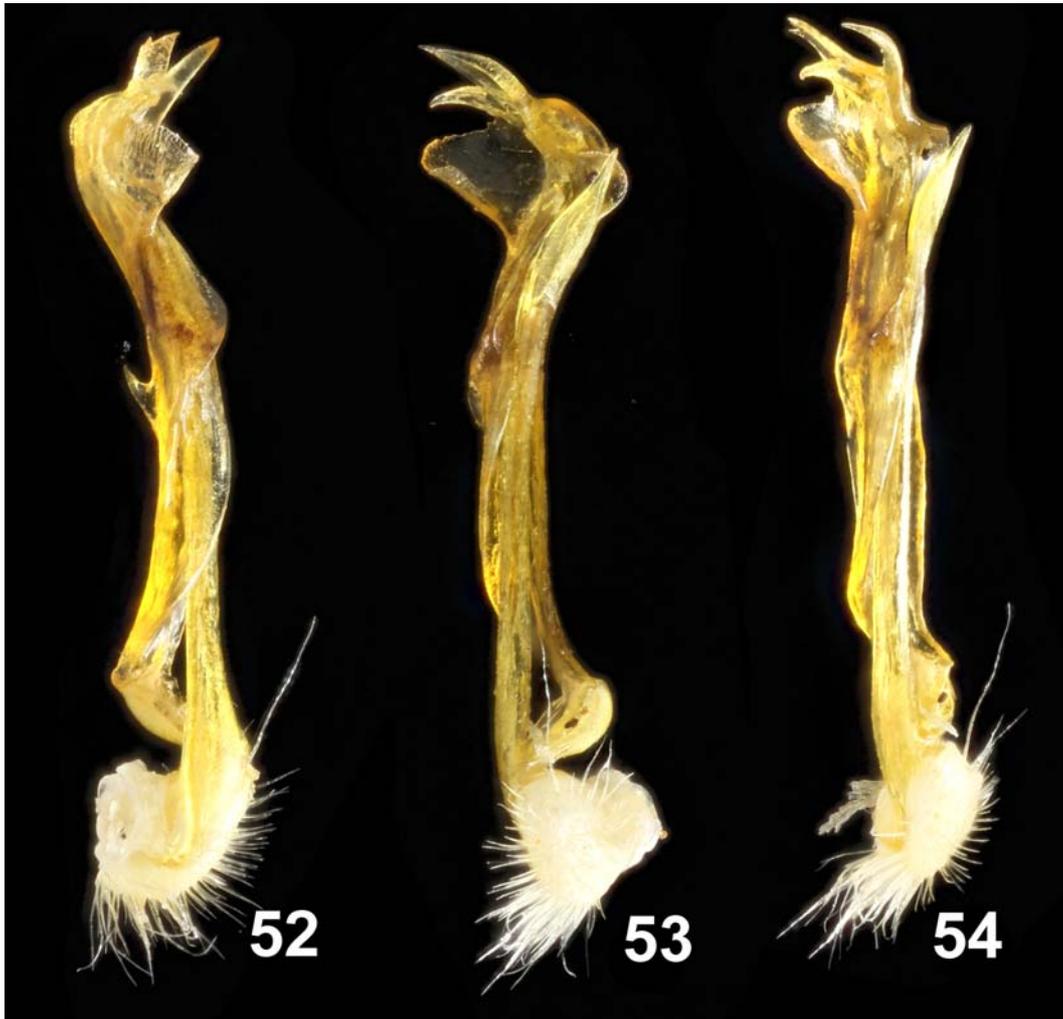
NAME. To emphasize the moniliform body; adjective.

DESCRIPTION. Both holo- and paratype ca 25 mm long, width of midbody pro- and metazonae 1.6 and 2.0 mm, respectively (♂). General coloration in alcohol blackish brown with a characteristic bead-shaped pattern of contrasting lighter, ochre to orche-orange, dorsal markings (large, more or less coniform, central spots on collum and following metaterga, most of these spots being divided into two by dark transverse sulci in rear 1/3; smaller spots in anterior

halves of proterga as well), similarly ochre to dark orche paraterga, an axial ochre stripe on telson extending onto entire epiproct; legs also contrasting nearly pallid to light brown; tips of antennae pallid (Figs 45–48). Live coloration very similar, but pattern somewhat brighter, legs clearly orange, dorsal spots from orange to yellow (Fig. 5).

Clypeolabral region sparsely setose, only a few long setae between and just above antennae; both vertigial and occipital regions bare; epicranial suture thin and superficial (Fig. 46). Antennae long and slightly clavate (Figs 45, 46), in situ extending back behind segment 3 (♂) when stretched dorsally; in length, antennomeres 2–6 >> 1 = 7; interantennal isthmus about as broad as diameter of antennal socket (Fig. 46).

Body clearly moniliform. In width, collum < head = segment 2 < 3 < 4–16; thereafter body gradually tapering towards telson (Figs 46–48). Tegument smooth and shining throughout; prozonae very finely shagreened; metaterga and surface below paraterga smooth, only in places very finely striolate longitudinally, but surface above paraterga 2 clear-



Figs 52–54. *Touranella moniliformis* sp.n., ♂ paratype, left gonopod, mesal, ventral and ventrolateral views, respectively. Pictures by K. Makarov, not taken to scale.

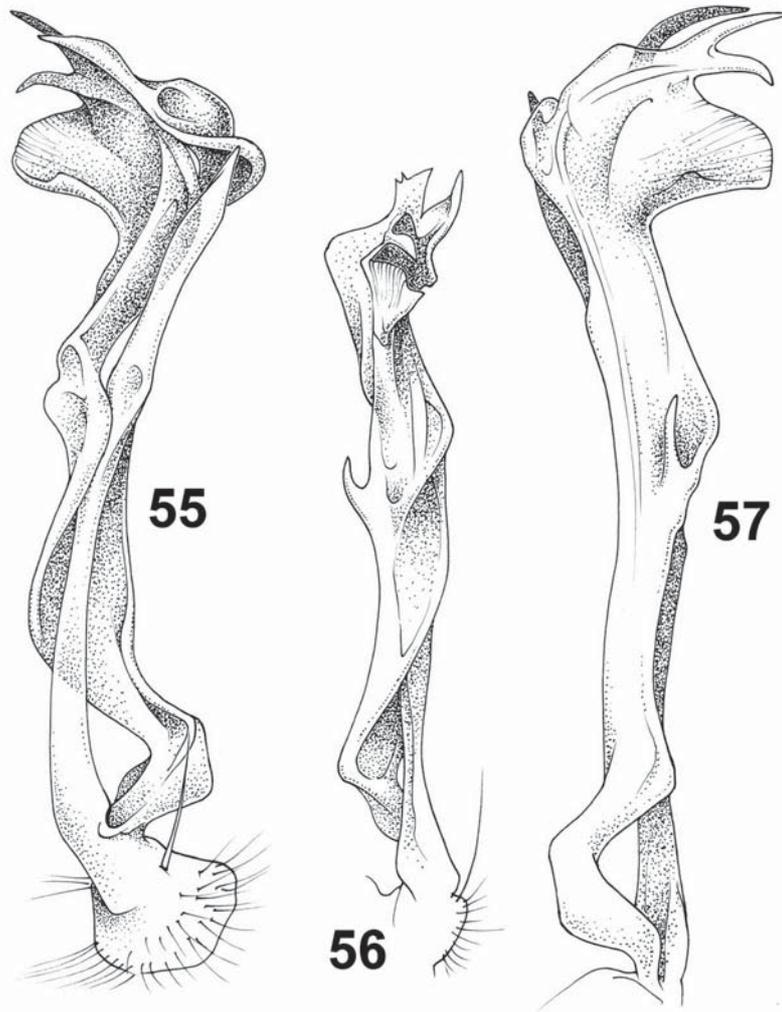
Рис. 52–54. *Touranella moniliformis* sp.n., паратип ♂, левый гонопод, соответственно изнутри, снизу и одновременно снизу и сбоку. Фотографии К. Макарова, сняты без масштаба.

ly striolate. Collum broadly and regularly rounded laterally, its paraterga very small. Postcollum paraterga very modest, set low at about half of body height; paraterga 2 exceptional in being declivous squarish flaps slightly acute-angled and drawn into a nearly sharp tooth anteriorly and into a narrowly rounded, subrectangular tooth caudally; following paraterga gentle and regularly rounded bulges/calluses devoid of any extensions even caudally, always lying within posterior margin of metaterga, slightly thicker in pore-bearing segments than in poreless ones both in dorsal and lateral views (Figs 45–48). Calluses delimited by clear-cut and complete sulci both dorsally and ventrally. Ozopores small, completely lateral, barely traceable in dorsal view due to a very slight sinuosity, lying inside a short longitudinal groove, placed at about 1/3 off caudal corner (Fig. 45, 47, 48). Transverse metatergal sulci present on segments 5–17, thin, shallow, faintly sinuate mid-dorsally, not reaching the bases of paraterga, also traceable as a darker band in a very faint impression on segment 4. Stricture between pro- and metazonae thin and deep, clearly ribbed at bottom down to below paraterga (Figs 45, 47, 48). Tergal setae nearly fully abraded, retained

only in a single transverse row on metatergum 19 (Fig. 48), short, setation pattern untraceable. Axial line missing. Pleurosternal carinae small flaps on segment 2, small ridges on segments 3 and 4, thereafter wanting. Epiproct long, subconiform, flattened dorsoventrally, subapical lateral papillae nearly missing, tip subtruncate (Fig. 48). Hypoproct roundly subtriangular, 1+1 setae strongly separated from each other, borne on minute knobs at caudal margin.

Sterna sparsely setose, cross-impressions moderately and equally deep, unmodified except for a paramedian pair of small setose cones between coxae 4 (♂). Legs very long and slender, apparently somewhat incrassate and longer compared to ♀, >2 times as long as midbody height (♂) (Fig. 45), devoid of adenostyles, ♂ prefemora not bulged laterally; tarsal brushes present ventrally on all ♂ legs except last two pairs; in length, femora >> tibiae = tarsi > prefemora = postfemora > coxae.

Gonopods (Figs 46, 49–57) complex, tripartite; coxite about 1/3 as long as telopodite, subcylindrical, with only a few short setae distolaterally; prefemoral (= densely setose) part of telopodite short, about 1/4 as long as acropodite;



Figs 55–57. *Touranella moniliformis* sp.n., ♂ paratype, left gonopod, ventral, dorsal and lateral views, respectively. Drawn not to scale by I. Semenyuk.

Рис. 55–57. *Touranella moniliformis* sp.n., паратип ♂, левый гонопод, соответственно снизу, сверху и сбоку. Нарисовала без масштаба И. Семенюк.

femorite rudimentary, immediately distal to prefemoral sulcus giving rise to a very long, strong, flat, distally lanceolate and acuminate femoral process (**p**) with an even longer, flagelliform solenomere (**sl**) neatly attached to and running along its mesal side; remaining part of solenophore (**sph**) longitudinally folded, protecting/sheathing both **sl** and **p** nearly all along and leaving only their tips exposed; **sph** membranous, suberect, somewhat geniculate dorsally near base, with a small, but conspicuous, dorsolateral peg (**k**) near midlength; distal end of **sph** with a large, rounded, mesal, hyaline lobe (**l**), a small, bifid, subtruncate, lateral branchlet (**b**) and a prominent apicomeral beak (**a**).

REMARKS. The genus *Touranella* Attems, 1937 has hitherto been known to comprise six species, all keyed [Golovatch, 2016], as follows: *T. gracilis* Attems, 1937, the type-species from Vietnam, *T. himalayaensis* Golovatch, 1994 and *T. pilosa* Golovatch, 2016, from Nepal, as well as *T. peculiaris* Golovatch, 2009, *T. hirsuta* Golovatch, 2009 and *T. cattiensis* Golovatch et Semenyuk, 2010, all three again from Vietnam. Hardly surprisingly, two new species can now be added to the Vietnamese list.

PHENOLOGY. Based on longterm field observations, *T. moniliformis* sp.n. fails to show a peak of abundance every year, but in the years it does, like in 2017, the peak is restricted to April, the latest and harshest part of the dry season. During the other seasons, these millipedes are nearly absent. They appear in considerable abundance, up to 20 specimens per sq. m, and colonize only bushes above 1 meter high, mostly *Acacia*. The activity covers both daytime and night. This species, unlike most other millipedes, is capable of climbing up smooth vertical glass or plastic surfaces when kept in captivity.

Touranella trichosa sp.n.

Figs 58–73.

HOLOTYPE ♂, Vietnam, Gia Lai Prov., Kon Ka Kinh National Park, N 14°18'08", E 108°26'41", 600–700 m a.s.l., mixed tropical forest, steep slope (up to 45°), stream valley, leaf litter, V.2017, leg. I.I. Semenyuk.

PARATYPE: 3 ♂♂, 4 ♀♀, same data, together with holotype.



Figs 58–61. *Touranella trichosa* sp.n., ♂ holotype. 58 — habitus, lateral view; 59 — anterior half of body, ventral view; 60 — midbody segments, dorsal view; 61 — caudal part of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 58–61. *Touranella trichosa* sp.n., голотип ♂. 58 — общий вид, сбоку; 59 — передняя половина тела, снизу; 60 — среднетуловищные сегменты, сверху; 61 — задняя часть тела, сверху. Фотографии К. Макарова, сняты без масштаба.

DIAGNOSIS. Using the latest available key [Golovatch, 2016], this new species keys out to couplet 2 which encompasses several species with densely hirsute collum and following metaterga. However, unlike all of them, *T. trichosa* sp.n. is totally devoid of a distinct gonofemoral process (at most with a small to vestigial parabasal lobule, **j**), coupled with a peculiar shape of the solenophore which carries a distinct, acuminate, apical uncus (**u**) and a couple of characteristic subapical outgrowths (**h** and **n**) (Figs 66–76).

NAME. To emphasize the hairy collum and metaterga; adjective.

DESCRIPTION. Both holotype and ♂ paratypes ca 11 mm long, width of midbody pro- and metazonae 0.7 and 0.9 mm, respectively. ♀ paratypes ca 13 mm long, width of midbody pro- and metazonae 1.0–1.1 and 1.3–1.4 mm, re-

spectively. General coloration in alcohol dark brown to brown with venter, legs, tergal hairs and epiproct tip contrasting light greyish or brownish to nearly pallid; tip of antenna pallid (Figs 58–64).

Nearly entire cephalic capsule sparsely setose, setae long, but slightly shorter than tergal hairs (Figs 59, 63). Antennae rather long and clavate (Figs 58, 59, 62, 63), in situ extending back behind segment 3 (♂) or 2 (♀) when stretched dorsally; in length, antennomere 3 > 2 = 4–6 > 1 = 7; interantennal isthmus about as broad as diameter of antennal socket (Figs 59, 63).

Body clearly moniliform. In width, collum < segments 2–4 < 3 < 5–17 < head; starting with segment 18, body gradually tapering towards telson (Figs 59–61, 63, 64). Tegument shining throughout; prozonae very finely shagreened;

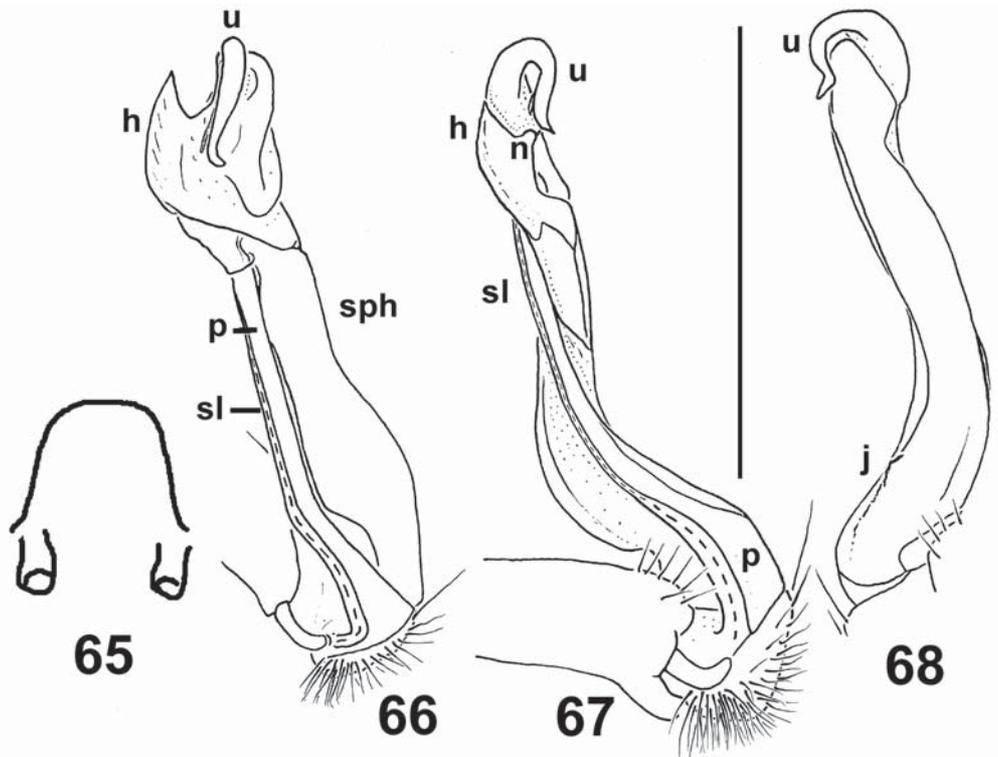


Figs 62–64. *Touranella trichosa* sp.n., ♂ paratype. 62 — habitus, lateral view; 63 — anterior part of body, ventral view; 64 — caudal half of body, dorsal view. Pictures by K. Makarov, not taken to scale.

Рис. 62–64. *Touranella trichosa* sp.n., паратип ♂. 62 — общий вид, сбоку; 63 — передняя часть тела, снизу; 64 — задняя половина тела, сверху. Фотографии К. Макарова, сняты без масштаба.

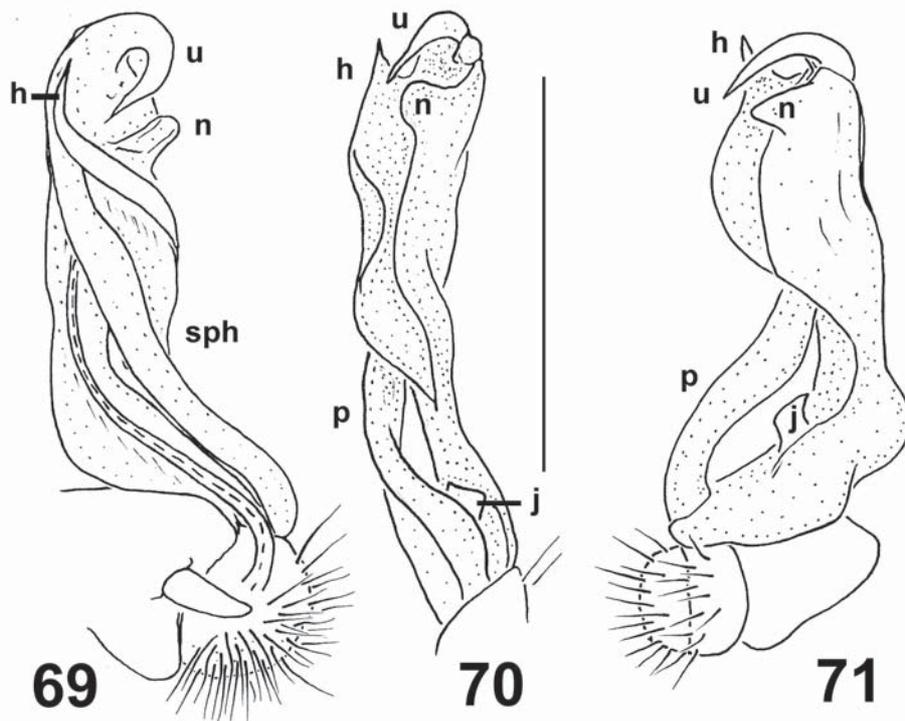
metaterga and surface below paraterga smooth, only in places very finely striolate longitudinally. Collum and all metaterga beset with long hairs, each hair placed inside a minute pore or on a minute knob (Figs 58–64). Collum broadly and regularly rounded laterally, its paraterga very thin and bordered calluses with a few lateral hairs on minute knobs. Postcollum paraterga very small, set low at about half of body height; paraterga 2 exceptional in being small, declivous, squarish flaps slightly acute-angled and drawn into a nearly sharp tooth anteriorly and into a rounded subrectangular tooth caudally; following paraterga regularly rounded and laterally faintly incised (again due to 3–4 trichome-bearing knobs) bulges/calluses typically drawn caudally into

a sharp denticle, the latter always far from reaching the posterior margin of metaterga; paraterga slightly thicker in pore-bearing segments than in poreless ones in lateral view (Figs 58–64). Calluses delimited by clear-cut and complete sulci only dorsally, by shorter and less distinct sulci in posterior 1/3–1/2 ventrally. Ozopores small, completely lateral, invisible in dorsal view, lying inside a short longitudinal groove, placed at about 1/3 off caudal corner (Figs 58, 62). Transverse metatergal sulci complete on segments 5–17, rather thin, deep, clearly sinuate mid-dorsally, finely beaded at bottom, not reaching the bases of paraterga, but incomplete, abbreviated and traceable as a faint impression on segment 18. Stricture between pro- and metazonae thin



Figs 65–68. *Touranella trichosa* sp.n., ♂ holotype. 65 — sternal lobe between coxae 4, ventrocaudal view; 66–68 — left gonopod, ventromesal, mesal and lateral views, respectively. Drawn not to scale (65) or scale bar: 0.5 mm (66–68). Designations explained in text. Del. S. Golovatch.

Рис. 65–68. *Touranella trichosa* sp.n., голотип ♂. 65 — стерральная пластинка между тазиками 5, одновременно снизу и сзади; 66–68 — левый гонопод, соответственно одновременно снизу и изнутри, изнутри и сбоку. Без масштаба (65) и масштаб 0,5 мм (66–68). Обозначения объяснены в тексте. Рисунки С. Головача.



Figs 69–71. *Touranella trichosa* sp.n., ♂ paratype, left gonopod, mesal, ventral and sublateral views, respectively. Scale bar: 0.5 mm. Designations explained in text. Del. S. Golovatch.

Рис. 69–71. *Touranella trichosa* sp.n., паратип ♂, левый гонопод, соответственно изнутри, снизу и почти сбоку. Масштаб 0,5 мм. Обозначения объяснены в тексте. Рисунки С. Головача.



Figs 72–73. *Touranella trichosa* sp.n., ♂ holotype, left gonopod, mesal and lateral views, respectively. Pictures by K. Makarov, not taken to scale.

Рис. 72–73. *Touranella trichosa* sp.n., голотип ♂, левый гонопод, соответственно изнутри и сбоку. Фотографии К. Макарова, сняты без масштаба.

and deep, very distinctly ribbed or beaded at bottom down to well below paraterga (Figs 58, 60–64). Axial line evident only in posterior (= postsulcus) halves of postcollum metaterga. Pleurosternal carinae small flaps only in segment 2, thereafter wanting. Epiproct relatively short, subconiform, flattened dorsoventrally, subapical lateral papillae very small, tip faintly concave (Figs 61, 64). Hypoproct triangular, 1+1 setae strongly separated from each other, borne on minute knobs at caudal margin.

Sterna sparsely setose, cross-impressions faint, axial ones especially so, unmodified except for a high, setose, subtrapeziform lobe between coxae 4 (♂), the lobe supplied with a paramedian pair of remarkably prominent, well separated and caudoventrally directed tubes behind (Fig. 65). Legs long (♂) or short (♀), slender, slightly incrassate and longer in ♂ compared to ♀, ca 1.6–1.7 (♂) or 1.1–1.2 (♀) times as long as midbody height (Figs 58, 59, 62, 64), devoid of adenostyles, ♂ prefemora not bulged laterally; tarsal brushes missing; in length, femora = tarsi > tibiae > coxae = prefemora = postfemora.

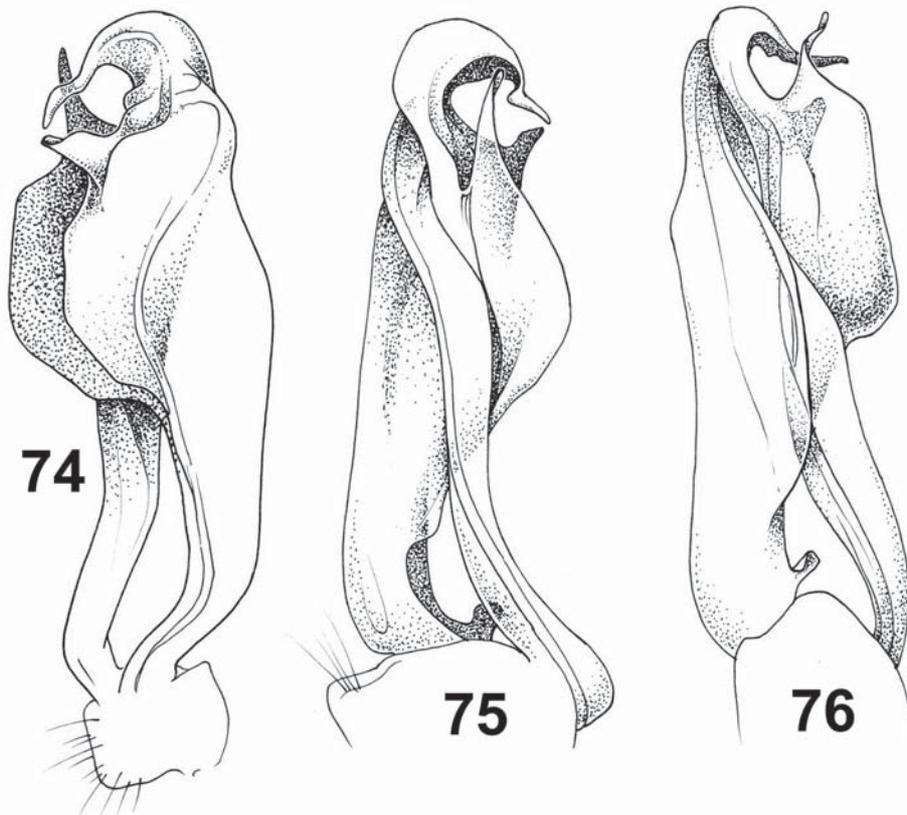
Gonopods (Figs 59, 63, 66–76) complex, tripartite as usual; coxite about 1/3 as long as telopodite, subcylindrical, with only a few short setae distolaterally; prefemoral (= densely setose) part of telopodite short, about 1/4 as long as acropodite; femorite rudimentary, immediately distal to prefemoral suclus giving rise to a very long, strong, flat, distally invisible, femoral process (**p**) with an even longer, flagelliform solenomere (**sl**) neatly attached to and running

along its mesal side; remaining part of solenophore (**sph**) suberect, longitudinally folded, protecting/sheathing both **sl** and **p** nearly all along and leaving only **sl** tip exposed near a peculiar apical uncus (**u**) of **sph**; parabasal part of **sph** slightly curved dorsad and with a small, sometimes vestigial (broken off?) flap (**j**); distal 1/3 of **sph** membranous, **u** directed mesally, bearing at base a prominent, hyaline, dorsal, apically acuminate lobe (**h**) and a small, mesal, spatuliform outgrowth (**n**).

ACKNOWLEDGEMENTS. Field-work of IS, including material collection, was conducted in accordance with Agreement 37/HD for the scientific cooperation between the Cat Tien National Park and the Joint Russian–Vietnamese Tropical Centre; that in the Kon Ka Kinh National Park, according to Agreements 432/TCLN-BTTN and 142/SNgV-VP.

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Figs 74–76. *Touranella trichosa* sp.n., ♂ paratype, left gonopod, ventral, dorsal and lateral views, respectively. Drawn not to scale by I. Semenyuk.

Рис. 74–76. *Touranella trichosa* sp.n., паратип ♂, левый гонопод, соответственно снизу, сверху и сбоку. Нарисовала без масштаба И. Семенюк.

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Responsible editor K.G. Mikhailov