

New or little-known species of springtails (Collembola: Hypogastruridae, Isotomidae) with uncommon chaetotaxy from India and Nepal

Новые или малоизвестные виды ногохвосток (Collembola: Hypogastruridae, Isotomidae) с необычной хетотаксией из Индии и Непала

Anatoly V. Babenko¹, Mikhail V. Potapov²
А.В. Бабенко¹, М.В. Потапов²

¹ Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky Prosp. 33, Moscow 119071 Russia.

² Moscow State Pedagogical University, Kibalchich Str., 6, build. 3, Moscow 129164 Russia.

¹ Институт проблем экологии и эволюции РАН им. А.Н. Северцова, Ленинский пр., 33, Москва 119071 Россия.

² Московский педагогический государственный университет, ул. Кибальчича, д. 6, корп. 3, Москва 129164 Россия.

Anatoly Babenko: lscd@mail.ru ORCID <https://orcid.org/0000-0002-6077-0619>

Mikhail Potapov: mpnk-abroad@yandex.ru ORCID <https://orcid.org/0000-0002-6111-3354>

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КЛЮЧЕВЫЕ СЛОВА: таксономия, *Hypogastrura*, *Ceratophysella*, *Xenylla*, *Anurophorus*, хетотаксия.

ABSTRACT. Three new species are described from India and Nepal. *Hypogastrura snesarevi* **sp.n.** differs from congeners by the combinations of characters that unites the diagnoses of the *monticola* and *nivicola* groups. *Ceratophysella redkini* **sp.n.** belongs to the *denticulata* group and shows a specifically differentiated chaetotaxy partly similar to that of the *armata* group. *Anurophorus septemvertex* **sp.n.** is well distinguished by the presence of eight particular erect setae at the end of the abdomen. In addition, *Xenylla yosii* Gama, 1971 is redescribed and illustrated.

РЕЗЮМЕ. Описаны три новых вида из Индии и Непала. *Hypogastrura snesarevi* **sp.n.** отличается от других видов рода сочетанием признаков, объединяющим диагнозы групп *monticola* и *nivicola*. *Ceratophysella redkini* **sp.n.** принадлежит к группе *denticulata* и демонстрирует специфическую хетотаксию, отчасти сходную с таковой у группы *armata*. *Anurophorus septemvertex* **sp.n.** хорошо отличается наличием восьми особых прямых щетинок на конце брюшка. Кроме того, переописан и проиллюстрирован *Xenylla yosii* Gama, 1971.

Introduction

The first work devoted to the faunas of springtails from the modern territories of India, Nepal and the adjacent territories of Southeast Asia appeared at the end of the 19th century [Parona, 1893]. In the first quarter of the 20th century, mainly Europeans contributed to those faunas [Rit-

ter, 1910; Imms, 1912; Carpenter, 1917, 1924; Handschin, 1925, 1929]. Subsequently, not only local researchers were active there [Baijal, 1955a, b, 1958; Baijal, Agarwal, 1972; Baijal, Kohli, 1972; Baijal, Verma, 1986; Paliwal, Baijal, 1985; Tyagi, Baijal, 1981, 1982; Mitra, 1966a, b, 1967; Prabhoo, 1970, 1971a, b, c; Prabhoo, Muraleedharan, 1980; Mandal, 2011, 2013, 2014, 2018a, b; Choudhuri, 1958, *et al.*], but also globally renowned specialists, such as J.T. Salmon [1956a, b, 1957a, b, 1958, 1963, 1965, 1969, 1970], R. Yosii [1966a, b, 1971, 1976], and P. Cassagnau [1984, 1993]. However, a complete inventory of the faunas of this highly interesting region is still obviously very far from complete. Thus, according to a recently published catalogue of springtails [Mandal, 2018], only 342 species from 113 genera have been registered throughout the vast territory of India. An online version of this catalogue [Mandal *et al.*, 2024] presently includes 377 species. This is about twice as low as, for example, a list from continental France, for which 745 species of springtails are currently known [Thibaud, 2017]. It seems noteworthy that the area of France is six times smaller than that of India. The recent annotated checklist of the Collembola of Nepal [Budha, Shrestha, 2021] encompasses 167 species, this estimate also being too low for the country so highly diverse in landscapes.

In the collection of the Department of Zoology of the Moscow State Pedagogical University, we have recently discovered several tubes with alcohol material taken by an unknown collector in northeastern India. This material is

quite fully labeled (albeit indicating neither the year nor name of the collector) and contains several new species of springtails of different families. All these species show rather uncommon patterns of chaetotaxy, these being discussed in associated descriptions given below.

Two taxa described herewith are named after outstanding researchers within the framework of the project "Their names in nature". The types of the described species are stored at the Department of Zoology of the Moscow State Pedagogical University, Russia.

ABBREVIATIONS: *a* — setae of anterior row on terga; A type — chaetotaxy of *denticulata* group; *a, b, c, d, e* — guards of labial palp; A, B, C, D, E — papillae of labial palp; A1, A7 — tibiotarsal tenent setae; Abd. I–VI — abdominal segments; Ant. I–IV — antennal segments; AO — antennal organ on Ant. III; B type — chaetotaxy of *armata* group; *i*-seta — seta of Ant. IV; L.1 — lamella 1 of maxillary head; *m* — setae of medial row on terga; *ms* — microsensillum; *p* — setae of posterior row on terga; *p'* — seta on Ant. I; PAO — postantennal organ; S1–S9 — sensilla of Ant. IV; Th. I–III — thoracic segments; *v* setae — setae of area verticalis; VT — ventral tube; *sd1, a0, p3, p4, q1, oc2, d2, d4, c1, L1, L3* — setae of different rows on head of *Xenylla* after notation of da Gama [1987]; *b, h1, h2, o, q, s, t, f* — code designations of chaetotaxy features of species of the genus *Xenylla* [Gama, 1987].

Family Hypogastruridae

Hypogastrura snesarevi sp.n.

Figs 1–10.

TYPE MATERIAL: Holotype, female, Northeast India, Arunachal Pradesh, 28.5087° N 94.4466° E, leaf litter and moss on rocks near a large waterfall, January (exact date and collector unknown).

DIAGNOSIS. A species of the *nivicola* group of the genus *Hypogastrura* Bourlet, 1839, characterized by the following set of features: Ant. IV with a simple apical bulb and (5)6 elongated sensilla; small PAO with four lobes, the presence of cornea-like cuticular convexities between eyes; poorly differentiated common setae on dorsal side and very long whip-shaped dorsal sensilla; Th. II–III with setae *m6* present; Abd. IV with a number of supplementary setae; VT with (4)5 distal setae on each side; setae A1 on tibiotarsi long and distinctly clavate; the presence of several spine-like granules dorso-apically on dens and a long, narrow mucro.

DESCRIPTION. Length of holotype 1.64 mm. Colour dark, brownish-gray, paler ventrally. Integument granulations fine and uniform all over the body, with 8–11 granules between setae p1 on Abd. V. Head with a pair of cornea-like convexity anterior to base of setae *sd1* (Fig. 4).

Antennae slightly longer than head. Ant. IV with a simple apical bulb and (5)6 elongated and curved sensilla (three dorsal, S1, S2 and S3) and three external, S7, S8 and S9), subapical organite (or), microsensillum (*ms*) and *i*-seta present as usual (Fig. 3). Ant. III organ typical of the genus, with all usual sensorial elements: two outer guards, two inner sensilla and a lateral microsensillum. Ant. I with *p'* seta present, i.e. 8 setae totally. Ant. II with 13 setae.

Head with 8+8 virtually equal ocelli. PAO slightly smaller than nearest ocelli, with four lobes, anterior pair longer, an accessory boss developed (Fig. 4). Distal edge of labrum with several roundish papillae, labral formula of setae as 4/554. Labium typical of the genus, with all common papillae (A–E), guards (including short *a1, b1, b2, d2* and *e2* set on low papillae) and 6 proximal

setae. Basomedial field of labium with four setae, basolateral field with 5 setae, as usual. Head ventrally with 3(4) postlabial setae on each side of ventral line. Maxillary head unmodified, of general generic type, L.1 hardly longer than maxillary teeth. Outer maxillary lobe simple, with two sublobal hairs.

Dorsal setae poorly differentiated, bent, pointed and usually finely serrated, sensorial setae thin and more than two times longer than ordinary ones. Main peculiarities of dorsal chaetotaxy: head with all usual setae, including *a0* and 2+2 *v* setae on *area verticalis*, Th. I with only 2+2 setae [?], setae *m6* present on dorsolateral parts of both Th. II–III; Th. II with *m2* present, Th. III also with one additional *m*-seta (*m3*?) near *a3* (Fig. 1). Both Abd. IV–V with supplementary setae in *m* row (Fig. 2).

Chaetotaxy of legs 1–3 as follows: upper subcoxae – 1, 3, 3; lower subcoxae – 0, 3, 3; coxae – 3, 8, 7; trochanters – 7, 7, 7; femora – 14, 13, 11; tibiotarsi – 19, 19, 18 setae, respectively. Tenent tibiotarsal setae (A1) about as long as 1.3–1.5 inner claw edge, distinctly clavate (Fig. 9). Claw with a clear inner tooth in mid part of inner edge, two pairs of lateral teeth (apical and basal) also usually visible (Figs 9–10). Unguiculus broadly lamellate, reaching the middle of inner claw edge.

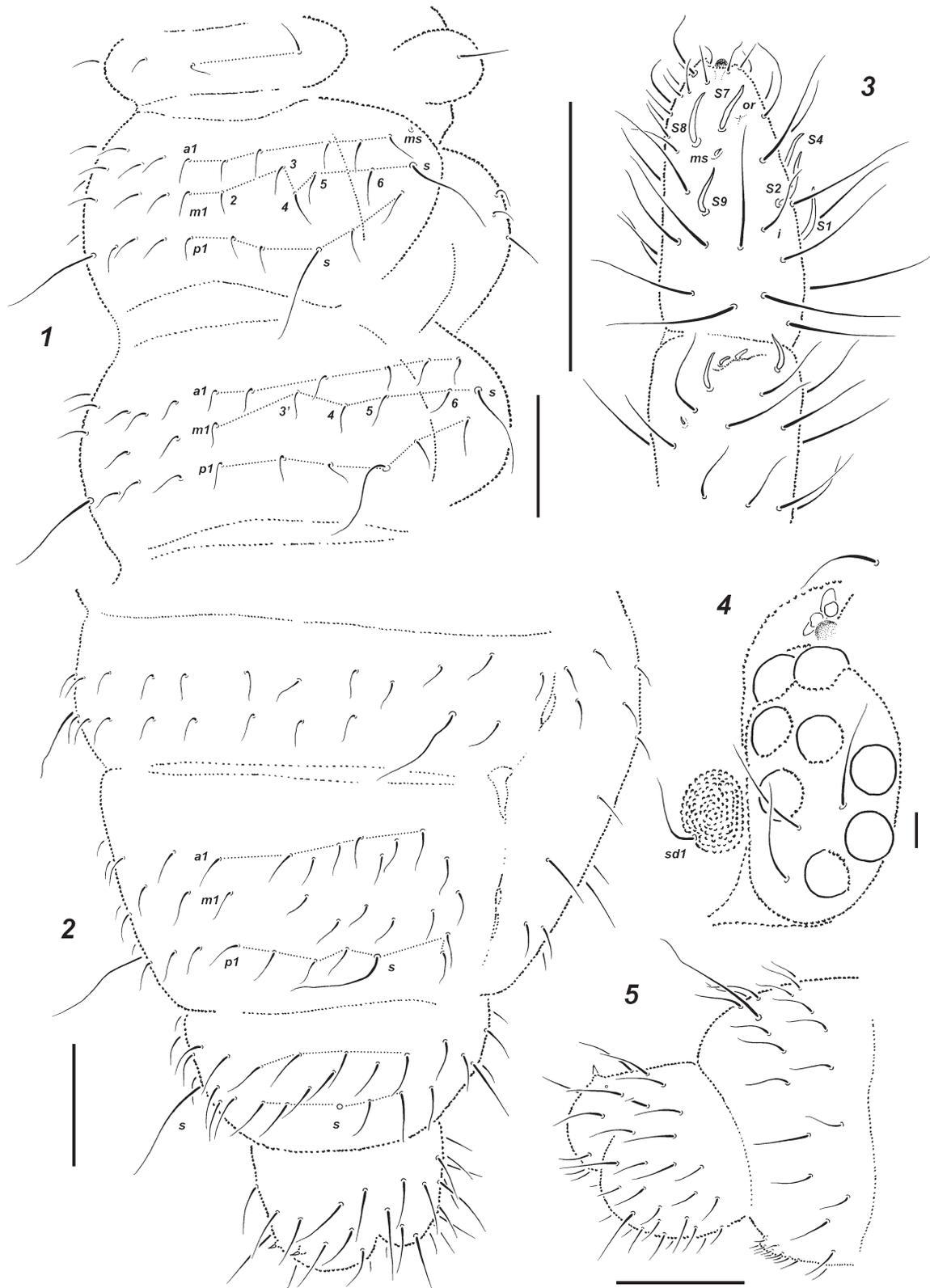
VT with (4)5+5 distal setae. Retinaculum with 4+4 teeth. Furca well developed (Figs 7–8). Manubrium with 18+18 ventral setae including four setae on each basolateral field. Posterior side of dens with several high and pointed granules apically, other part finely granulated (Fig. 6), apical field without visible granulation rather large (~0.4 of dens). Chaetotaxy of dens complete: seven posterior setae present as usual, basal macroseta longer than a half of dens (0.6 : 1) (Figs 7–8).

Mucro thin and long (mucro to dens ratio as 0.56 : 1.0), its tip closed, elongated and slightly upturned, lateral lamella long and thin, poorly visible, forming small tooth before mucro tip (Fig. 6). Anal spines small, set on subequal papillae (Fig. 5), their length together with papilla about 0.25 as long as claw inner edge.

ETYMOLOGY. The species is named after Andrei Evgenievich Snesev (1833–1915), a well-known Russian geographer and orientalist, for his contributions to the study of the political, geographic and ethnographic specifics of India during his expedition of 1899–1900.

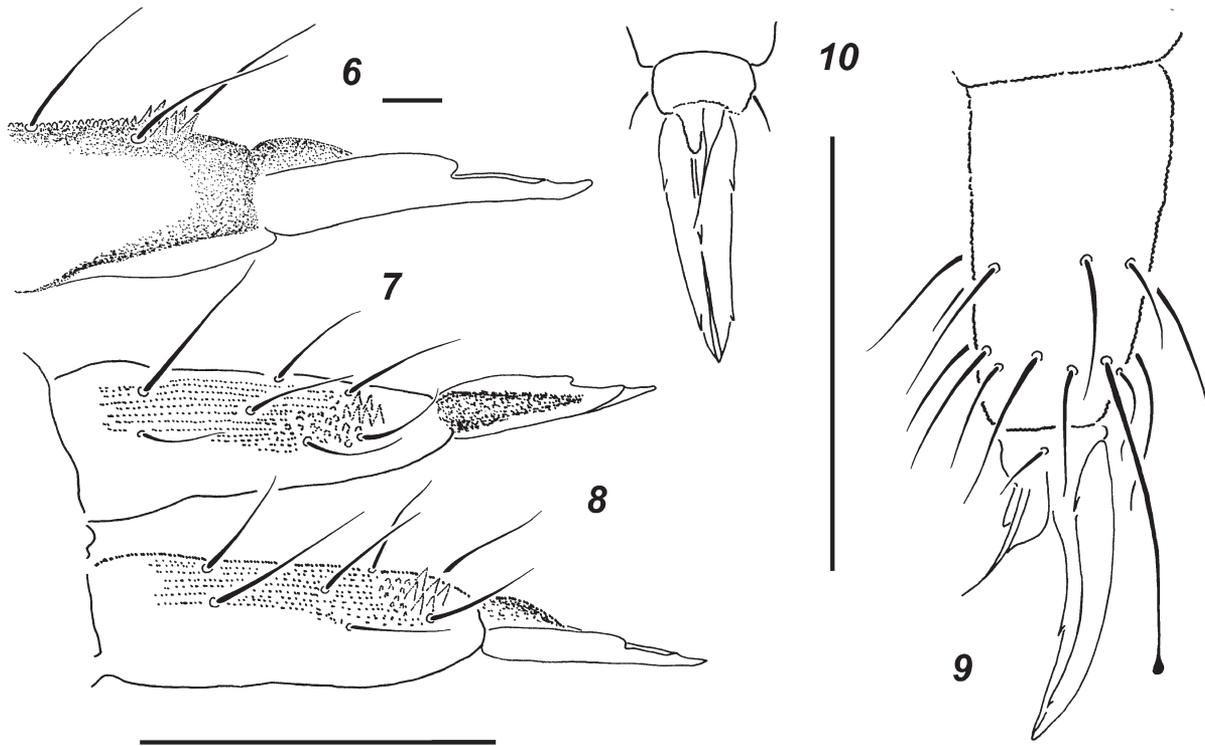
AFFINITIES. A position of the new species within the currently accepted division of the genus into species groups [Skarżyński, 2009] is not entirely clear. On the one hand, the new species shares some common characters with species of the *monticola* group, namely, poorly differentiated sensilla on the antennae and their relatively small number (6); chaetotaxy of the thoracic segments with the presence of setae *m6* and *m2/3* on Th. III; plurichaetosis of the last abdominal segments. On the other hand, small PAO, interocular cuticular convexities, spine-like granules and a large ventro-apical area devoid of granulations on the dens most likely indicate the *nivicola* group, the species of which are characterized by an increased number of short and strongly thickened sensilla on the antennae and a less rich chaetotaxy, as a rule. However, there are some exceptions and the latter group still includes species that have a small number (6–7) of elongated sensilla on the antennae, in particular, *H. simsi* Hart et Waltz, 1995, *H. tooliki* Fjellberg, 1985, and *H. ottawana* Cipola, 2020. The latter species is also characterized by a very rich chaetotaxy. In other words, we believe that the new species may be tentatively considered as representing the *nivicola* group.

According to the recently published checklist of Indian species of the genus *Hypogastrura* [Mandal, Arbea 2019], eleven congeners have so far been recorded from India, of which only two belong to the *nivicola* group, *H. nivicola* (Fitch, 1847) and *H. harveyi* (Folsom, 1902), both reported from the northwestern Himalayas (Ladakh region) [Bhagat, 2013], that is, much farther west and north of the place where our material was collected. The



Figs 1–5. *Hypogastrura snesarevi* sp.n.: 1 — thoracic chaetotaxy; 2 — dorsal chaetotaxy of Abd. III–VI; 3 — Ant. III–IV (lateral view); 4 — PAO and ocular field; 5 — abdominal tip (lateral view). Scales: 1–3, 5 — 0.1 mm, 4 — 0.01 mm.

Рис. 1–5. *Hypogastrura snesarevi* sp.n.: 1 — хетотаксия груди; 2 — дорсальная хетотаксия Abd. III–VI; 3 — Ant. III–IV (вид с наружной стороны); 4 — постантеннальный орган и поле с глазками; 5 — задний конец брюшка (вид с наружной стороны). Масштаб: 1–3, 5 — 0,1 мм, 4 — 0,01 мм.



Figs 6–10. *Hypogastrura snesarevi* sp.n.: 6 — apical part of dens and mucro; 7–8 — dens and mucro (different views); 9 — claw and tibiotarsus of leg 3; 10 — claw (anterior side). Scales: 7–10 — 0.1 mm, 6 — 0.01 mm.

Рис. 6–10. *Hypogastrura snesarevi* sp.n.: 6 — апикальная часть денс и мукро; 7–8 — денс и мукро (вид с разных сторон); 9 — коготок и голенелатка ноги 3; 10 — коготок (передняя сторона). Масштаб: 7–10 — 0,1 мм, 6 — 0,01 мм.

occurrence of these very species in Southeast Asia, both characterized by a sharp seasonal ecomorphosis and whose main range is limited to the Nearctic, seems unlikely. Both of these species are easily distinguished from *H. snesarevi* sp.n. in many characters, including the number of v-setae on the head (1+1 vs 2+2 in the new species), setae on the VT (6–11 and 10–14 vs 5, respectively) and a significantly shorter mucro of different shape, but both have a cornea-like convexity in the *area frontalis* on the head and spines on the dens in winter forms. As a result, these two names can be assumed to hide forms somewhat similar to *H. snesarevi* sp.n.

In addition to these two species, four further congeners have been recorded from East Asia, all of which on www.collembola.org [Bellinger *et al.*, 1996–2024] are considered members of the *nivicola* group, i.e. *H. nemoralis* Yosii, 1960, *H. bokusii* Yosii, 1961 (both Japan), *H. yongmunensis* Lee, 1974 (Korea) and *H. tsukubaensis* Tamura, 1997 (Japan). No interocular cornea-like convexities characteristic of *H. snesarevi* sp.n. have been mentioned in the original descriptions of these species. The only character that brings *H. nemoralis* close to all other species of the group is the presence of a large ventro-apical swelling without visible granulation on the dens. This species can be easily distinguished from *H. snesarevi* sp.n. by the poorly differentiated, short dorsal sensilla, by the absence of spine-like granules from the dens, and a short mucro of a different shape (dens : mucro = 3 : 1 vs 1.8 : 1 in *H. snesarevi* sp.n.).

Hypogastrura bokusii, described on materials collected on snow in the mountainous regions of central Japan, is more similar to *H. snesarevi* sp.n. Both these species are characterized by a small number of sensilla on Ant. IV, the presence of spine-like granules on the dens, a long mucro with a pointed tip, long dor-

sal sensilla and pronounced plurichaetosis on Abd. IV. Among the most significant differences, the presence of a large subapical tooth on the mucro (virtually not expressed in *H. snesarevi* sp.n.) and the presence on Abd. V of a *dorsal area* with *special stronger integumentary granules* (in *H. snesarevi* sp.n. granulation of the abdominal tip is not coarser than on other parts of the body) are worth mentioning.

Korean *H. yongmunensis* differs from *H. snesarevi* sp.n. in the larger number of sensilla on the antennae (10 vs (5)6 in *H. snesarevi* sp.n.), a fairly typical chaetotaxy of the genus with short, poorly differentiated sensilla and short mucro of a different shape (dens : mucro = 3 : 1 vs 1.8 : 1 for *H. snesarevi* sp.n.). The same set of characters, i.e. the number of sensilla on Ant. IV and the relative length of the mucro, can be used to distinguish *H. snesarevi* sp.n. from *H. tsukubaensis*, described from central Japan. According to the original [Tamura, 1997] and subsequent [Nakamori *et al.*, 2014] descriptions, the latter species is characterized by the presence of nine differentiated sensilla on Ant. IV (vs (5)6 in *H. snesarevi* sp.n.) and the dens/mucro ratio being 3/1 (1.8/1 in *H. snesarevi* sp.n.).

In addition to the interocular convexities, the rather peculiar dorsal chaetotaxy and the presence of spine-like granules in the dorso-apical part of the dens, a very characteristic feature of the new species is the long and narrow mucro. Of the species recorded from East Asia, based on this trait, *H. snesarevi* sp.n. can only be compared to *H. longimucrona* Lee et Choe, 1979, described from South Korea. Moreover, these two species have a number of other characters in common: antennae similarly equipped with 5–6 elongated sensilla, long and thin dorsal setae and even more elongated whip-shaped sensilla, and clearly coarser granulation in

the dorso-apical part of the dens (in *H. snesarevi* sp.n. the latter trait is, of course, more pronounced). The opinion of a close relationship between these species is hampered only by the peculiar dorsal chaetotaxy in *H. snesarevi* sp.n. (in particular, the presence of setae *m6* on the thoracic segments) and the absence of interocular convexities from *H. longimucrona*.

Ceratophysella redkini sp.n.

Figs 11–17.

TYPE MATERIAL: Holotype, preadult male, Northeast India, Arunachal Pradesh, 28.6284°N 94.0323°E, leaf litter from rocks around the waterfall, Sri Tapo Asthan, January (exact date and collector unknown). Paratype, 1 preadult male, same sample as holotype.

DIAGNOSIS. A middle-sized species of the genus characterized by the presence of a pair of cornea-like convexity laterally to setae *sd1* on a head, Abd. V with a distinct transversal belt with especially coarser granulation, narrow mucro with a low triangular outer lamella and an elongated closed tip, and also by a rather peculiar dorsal chaetotaxy of the *denticulata* type with few real macrosetae in the mid parts of the terga, and very long thoracic and abdominal sensilla.

DESCRIPTION. Length, disregarding antennae of available preadults, 0.95–1.03 mm. Habitus typical of the genus. General body colour in alcohol brownish, dark blue pigment diffusely distributed on dorsal side, ventral side slightly paler. Integument granulations rather fine and uniform on anterior part of body, becoming notably coarser towards abdominal tip. Head with a pair of cornea-like convexity laterally to setae *sd1*. Abd. V with a distinct transversal belt with especially coarser granulation and 6–7 granules between bases of setae *p1*.

Antennae slightly longer than head. Ant. IV with a simple apical bulb, seven blunt sensilla (five dorsal, *S0*, *S1*–*S4* and two dorsolateral (external), *S7* and *S8*) cylindrical in shape, elongated and curved, well differentiated from common setae (Fig. 14); subapical organite (*or*) and microsensillum (*ms*) present as usual; ventral sensory file with few short sensorial elements (Fig. 15). Eversible sac between Ant. III and Ant. IV prominent. AO on Ant. III typical, composed of two inner sensilla, short and curved, two long guard sensilla and *ms* on outer side (Fig. 14). Ant. I–II with 7 and 13 smooth common setae, respectively.

Head with 8+8 large subequal eyes. PAO of typical shape with two long anterior and two more rounded posterior lobes, an accessory boss present; long axis of PAO 1.4–1.6 times longer than adjacent ocellus. Labrum with usual set of 4/5/4 setae, its distal edge without distinct papillae. Labial palp with a full set of papillae (A, B, D, E and C) and 5 proximal setae. Basomedial field of labium (submentum) with four setae, basolateral field (mentum) with five setae, as usual. Head with 3+3 postlabial setae along ventral line. Maxillary head with L.1 notably extending beyond tip of maxillary teeth and distinctly expanded at apex as in the *denticulata*-type, other maxillary lamellae not clearly seen. Outer maxillary lobe simple, with one sublobal hair.

All dorsal setae smooth, thin and rather long, macrosetae more or less straight and pointed, microsetae curved, sensorial setae blunt at tip and clearly longer than macrosetae on all segments. Dorsal chaetotaxy of the *denticulata* group, but rather peculiar. Head with all usual macrosetae: *p3*–*p4*, *q1*, *v2*, *oc2*, *d2* and *d4*. Th. II–III with only *p5* as rather short macrosetae (Fig. 11), all setae in mid parts of thoracic terga similar in length, sensilla *p4* and *m7* very long, *m6* absent from dorsolateral parts of terga (Fig. 13). Abd. I–III without *a2'*, i.e. only 3+3 medial setae present between macrosetae *p2*; setae *p4* similar in length to microsetae *p3*; sensilla *p5* long, lateral parts of these terga with few supplementary setae (Figs 11–12). Three pairs of axial setae (*a1*, *m1* and *p1*) on

Abd. IV strongly divergent, all setae of *a*-row as long microsetae, in *p*-row setae *p2* and *p4* as macrosetae, *p5* – sensilla as usual. Abd. V usually with *a2'* present, i.e. at least four *a*-setae present between bases of setae *p1* and *p5*, setae *p1* only slightly longer than *a1*.

Chaetotaxy of legs 1–3 as follows: upper subcoxae – 1, 3, 3 (among them, one macroseta on each subcoxa); lower subcoxae – 0, 2, 2; coxae – 3, 7, 7; trochanters – 6, 6, 5; femora – 13, 12, 11; tibiotarsi – 19, 19, 18 setae, respectively. Tibiotarsal tenent setae (A1) acuminate, about as long as inner claw edge. Claw with a tooth in mid part of inner edge, lateral teeth invisible. Unguiculus slightly exceeding the middle of claw inner edge, with a clear basal lamella.

VT with 4+4 distal setae. Retinaculum with 4+4 teeth. Furca well developed. Manubrium with (15)16+16 posterior setae, including 4+4 laterobasal and 2+2 proximal ones. Dens with usual number of setae (7); outer basal macroseta about 0.6 as long as dens, two distal inner setae clearly thickened and usually serrated in mid part (Fig. 16). Mucro narrow with a low triangular outer lamella and an elongated closed tip (Fig. 15), about half as long as dens.

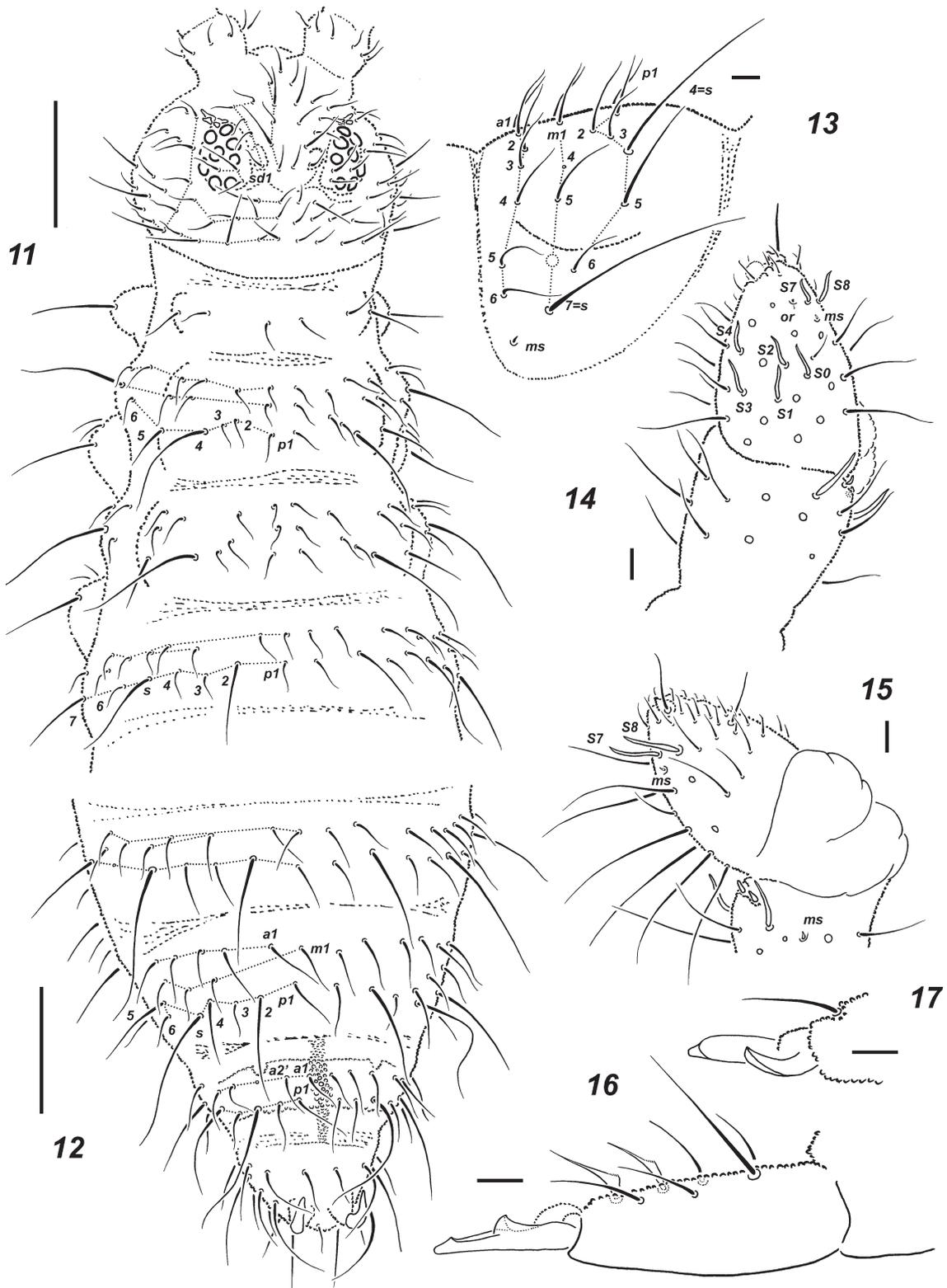
Anal spines long and curved, together with papilla about 1.5–1.7 as long as inner claw length.

ETYMOLOGY. The species is named after Yaroslav Andreevich Red'kin (born 1975), a Russian ornithologist and a specialist in the field of taxonomy and morphology of birds who is working at Zoological Museum of Lomonosov Moscow State University.

AFFINITIES. The most characteristic feature of the new species is undoubtedly its dorsal chaetotaxy: weak differentiation of setae on the mid parts of thoracic segments, the position of setae *p2* almost level to other *p*-setae and the absence of lateral setae *m6* from Th. I–II, as well as the absence of setae *a2'* from Abd. I–III. All this resembles the chaetotaxy of type B (the *armata* group), while that of the last abdominal segments (Abd. IV–VI) is not only quite common for species of the *denticulata* group, but is also rather complete.

Unfortunately, there is no real information concerning the chaetotaxy for any of the five species of the genus described from India [Mandal, Arbea 2014, 2019]. Of these, four species, namely *C. narkandae* (Baijal, 1955), *C. baltica* (Tyagi et Baijal, 1982), *C. katraensis* (Tyagi et Baijal, 1982) and *C. indovaria* Salmon, 1970, can easily be distinguished from the new species as all of them have the usual spoon-shaped mucro with a rounded apex and a high triangular outer lamella. The mucro shape of the fifth species, *C. indica* Salmon, 1956, described from the vicinity of Gangtok, Sikkim (about 600 km west of the place where our specimens were collected), appears to be similar to that of *C. redkini* sp.n. Salmon described it as *open, boat shaped and lamellate on basal two-thirds, closed and tapering on distal third; the outer lamella ... pass forward to rise to a point just beyond midway...* It is probably impossible to completely rule out the identity of these two species. However, this requires assuming that Salmon erroneously described a number of rather important structures: trilobed apical papilla on antennae (vs simple in the new species), PAO *about as large as a single ocellus* (much larger in the new species), chaetotaxy with *moderate, short straight or slightly curved setae with, posteriorly, some longer simple setae*, unguiculus *vestigial, being reduced to a small tubercle about one-eighth as long as the claw* (in the new species the empodial appendage is usual in length and shape), *a single faintly clavate tenent hair* (in the new species all tibiotarsal hairs are pointed) and *dens with three distinctly bent, stout, tapering setae* (only two such thickened setae are present on dens of the new species).

Besides these five conditionally endemic species, two widespread congeners, *C. communis* (Folsom, 1898) and *C. armata* (Nicolet, 1942), are also known from India [see Mandal *et al.*,



Figs 11–17. *Ceratophysella redkini* sp.n.: 11 — dorsal chaetotaxy of head, thorax and Abd. I; 12 — chaetotaxy of Abd. III–VI; 13 — Th. II (lateral view); 14 — Ant. III–IV (dorsal side); 15 — ibid. (lateral side); 16 — dens and mucro; 17 — mucro. Scales: 11–12 — 0.1 mm, 13–16 — 0.01 mm.
Рис. 11–17. *Ceratophysella redkini* sp.n.: 11 — дорсальная хетотаксия головы, груди и Abd. I; 12 — хетотаксия Abd. III–VI; 13 — Th. II (вид сбоку); 14 — Ant. III–IV (дорсальная сторона); 15 — то же (боковая сторона); 16 — денс и мукро; 17 — мукро. Масштаб: 11–12 — 0,1 мм, 13–16 — 0,01 мм.

2024]. The reliability of these records is somewhat doubtful, but, in any case, both species are characterized by a spoon-shaped mucro common to the genus.

In total, about 40 species of the genus are known from the contiguous territories of East and Southeast Asia (Nepal, Vietnam, Thailand, China, Japan and Korea). Six of them are characterized by pronounced plurichaetosis and/or spines on the head (species of the former "*Mitchellania*" genus), 19 species have chaetotaxy of the B type (the *armata* group), and 13 species belong to the *denticulata* group (A type of chaetotaxy). The vast majority of species of the latter group are characterized by spoon-shaped mucro and similar differentiation of dorsal setae, thus clearly differing from those of *C. redkini* sp.n. Among the known species of this group, the new species is probably the most similar in chaetotaxy to *C. proserpinae* (Yosii, 1956) from the Japanese cave. Thus, both species are characterized by very long dorsal sensilla on all segments, the absence of sharp differentiation of setae on the thoracic segments and the presence of a single macroseta *p2* on Abd. I–III. Nevertheless, the chaetotaxy of Abd. IV–V in these species is radically different, although *p1* is smaller than *p2* on Abd. IV in both species (cf. Fig. 12 and plate II, fig. 24 in Yosii, 1956). In addition, *C. proserpinae* has only 6 setae on the dens and the *Mucro kahnmformig, distal gerundet und mit einer schmalen, undeutlich lamellierten Aussenlappe* (mucro boat-shaped, rounded distally and with a narrow, indistinctly lamellar outer flap) [Yosii, 1956, p. 14].

There are also a few species whose chaetotaxy is difficult to interpret, such as *C. yakushimana* Yosii, 1965 from southern Japan, because all p-setae on Abd. IV are equal in length. Yosii (1965) believed that it probably belongs to the *denticulata* (= *communis*) group. Both *C. redkini* sp.n. and *C. yakushimana* have very long dorsal sensilla (much longer than ordinary setae) and only a few dorsal macrosetae, although the latter are differently arranged on the terga. The shape of the mucro in these two species also differs (with a triangular outer lamella and an elongated tip in *C. redkini* sp.n. vs *apically rounded* with a *very low outer lobe* in *C. yakushimana*).

Besides very specific chaetotaxy, *C. redkini* sp.n. possesses two quite striking features, neither of which is unique, of course, but both are only rarely observed in representatives of the genus. The first of them, i.e. the unusual shape of the mucro, has already been mentioned above. Besides *C. redkini* sp.n. and *C. indica* (see above), a similar shape of the mucro is known in a few other congeners, in particular, *C. mucronata* Deharveng et Bourgeois, 1991 (Thailand), which is clearly a not closely related form in having the chaetotaxy of B type. A similar but rather variable mucro is also characteristic of *C. meridionalis* (Steiner, 1955), an endemic to Spain, that has only recently been transferred to the genus *Ceratophysella* [Baquero, Jordana 2022]. Despite this, coupled with the presence of cuticular convexities between the eyes (the second diagnostic feature of the new species mentioned above), its affinity with *C. redkini* sp.n. is likely even more remote.

Among the species of the genus *Ceratophysella* found in East Asia, only *C. sinensis* Stach, 1964 and *C. beatifica* Nakamori, 2023, like *C. redkini* sp.n., have cuticular convexities between eyes. In addition, both *C. sinensis* and *C. redkini* sp.n. have a transverse belt of coarse granulations on the Abd. V. However, their dorsal chaetotaxy is fundamentally different — typical *armata* type in *C. sinensis* and a modified *armata* type in *C. beatifica*, vs the *denticulata* type in *C. redkini* sp.n. A form similar to *C. sinensis* has been found in the Himalayas, Nepal [Yosii, 1966b, as cf.]. This form is also characterized by the presence of cornea-like convexities between the eyes and a belt of coarser granulations on Abd. V but has an almost vestigial unguiculus. Such convexities on the head are found not only in the genus *Ceratophysella*, but are also known among some species groups of *Hypo-*

gastrura (see above). They seem to be good diagnostic characters at the species level, but hardly indicating really close relationships between species.

Xenylla yosii Gama, 1971
Figs 18–27.

MATERIAL STUDIED. 11 females, 4 males (slides) and 38 specimens (alcohol), Northeast India, Meghalaya, road to Cherapunji, sacred forest Durugry of *Baccuarea ramiflora*, 25.6195° N, 90.7666° E, on a water film on large dry leaves on ground, 01 January (a year and collector unknown).

DESCRIPTION. Length 1.2–1.6 mm. Colour rather dark, blue-violet, with numerous light patches, ocular field and antennal tip darker, ventral side and appendages paler. Tegumental granulations fine and almost uniform. Dorsal side of head with a clear reticulation (Fig. 18), this being invisible both on thorax and abdomen. Ant. IV with a simple apical vesicle and four blunt sensilla (1 dorsal [S4?] and 3 lateral [S7–S9]), relatively short and subequal in size, both a subapical microsensillum and an organite present (Fig. 19). AO typical of the genus, outer sensilla clearly shorter than sensilla on Ant. IV. Ant. I–II with 7 and usually 12 setae, respectively.

Head with 5+5 subequal ocelli, as usual. Buccal cone typical of the genus, not elongate. Setal formula of labrum, 4/554, setae of distal row clearly thickened. Labium with all common papillae (A–E), 12 guards (eight long and four short, rhabdoid and papillate) and six proximal setae. Basomedial field of labium (submentum) with four setae, basolateral field (mentum) with 5 setae, as usual. Maxillary outer lobe simple, with three sublobal setae (Fig. 20).

Dorsal setae rather strong, slightly serrated and barely differentiated (except for those on Abd. V–VI), tergal sensilla clearly longer than ordinary setae, lateral sensilla on Th. II–III more than twice as long as dorsal ones. Head with a basic set of setae (Fig. 21), only setae *c1* always absent [*b*], lateral setae L1 and L3 subequal. Th. II–III with all usual setae present, setae *a2* and *p2* only slightly shifted comparing to setae *a1* and *p1* [*h1* and *h2*?] (Fig. 21). Abdominal terga also with almost basic set of setae, but *p*-row on Abd. I–III usually without setae *p5*, Abd. IV without *m3* [*o*] and setae *a2* on Abd. V absent [*q*] (Fig. 22).

Ventral chaetotaxy: head with 3+3 setae along midline as a rule, but *p1* sometimes absent on one side; *m3* always absent [*s*] (Fig. 24), Th. II–III without axial setae on sternum [*t*]. Abdominal sternum as in Fig. 25: Abd. II with *p1*, but without *p2*, Abd. III without medial unpaired seta above retinaculum. Manubrium with all usual 9+9 setae in three rows present. General chaetotaxic code as *bh1h2oqst*.

VT with 4+4 setae. Retinaculum with 3+3 teeth. Furca complete, both dens and mucro thin, long and clearly separated ventrally. Mucrodens to claw III ratio as 3.1–3.3 : 1. Dens with 2 setae, its anterior side completely smooth, without primary granulations. Mucro long (approximately half as long as dens) and thin, with a low outer lamella not reaching tip (Fig. 27).

Chaetotaxy of legs 1–3 usually as follows: upper subcoxae — 1, 2, 2; lower subcoxae — 0, 2, 2; coxae — (2)3, 7, 7; trochanters — 5, 5, 4; femora — 12, 11, 10; tibiotarsi — 19, 19, 18 setae, respectively. Tibiotarsal setae A1 and A7 on all legs as long as 1.5–1.6 inner edge of claw, clearly clavate. Claw with a pair of lateral teeth and usually with a small tooth in upper third of inner edge (Fig. 26). Anal spines short, usually curved and set on tiny cuticular papillae.

REMARKS. Maria Manuela da Gama [1971] described this species in sufficient detail using materials from Nepal and it is easily recognizable due to the developed reticulation on the head (not described for any other species of the genus), the long fur-

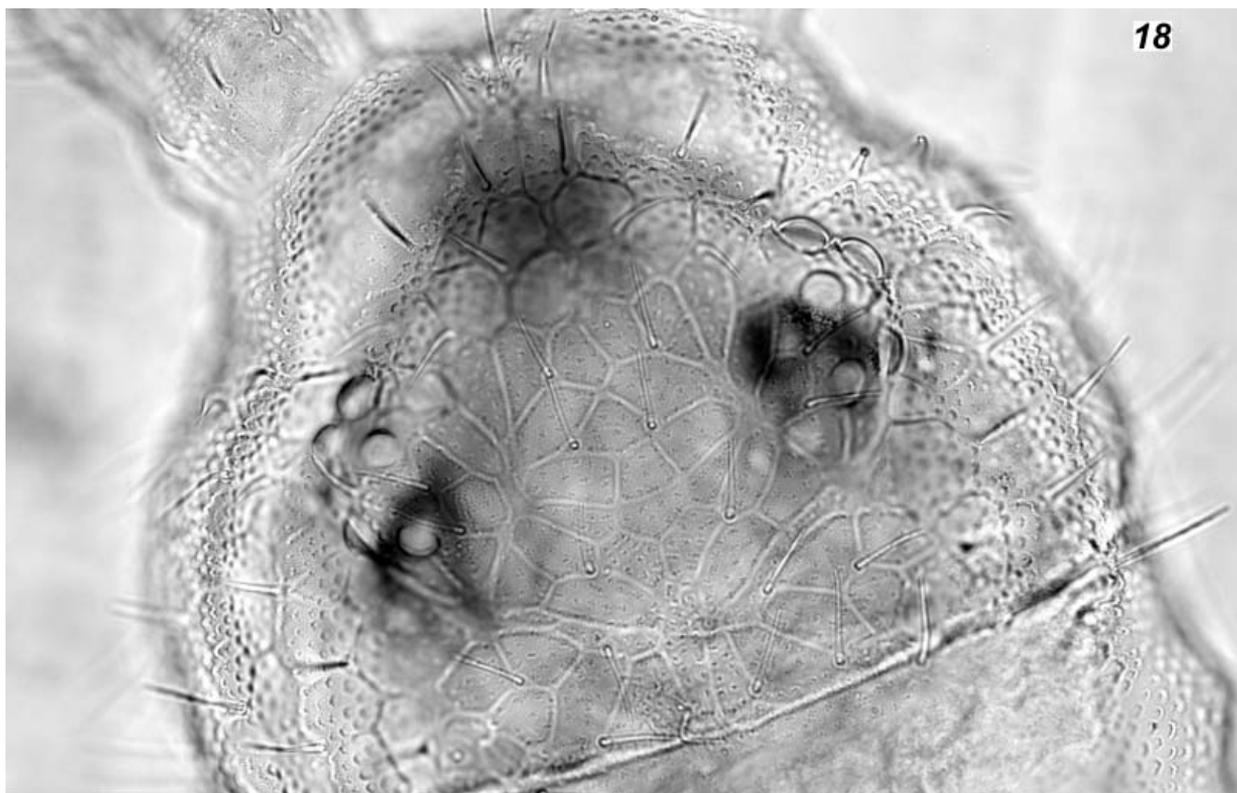


Fig. 18. Head reticulation in *Xenylla yossiana*.

Рис. 18. Кутикулярная сетчатость на голове у *Xenylla yossiana*.

ca and some peculiarities of dorsal and ventral chaetotaxy. Our desire to re-describe this species was caused not only by almost complete absence of illustrations in the original description, but also by some differences of the chaetotaxy of Indian individuals, which, however, cannot be considered as principal. In 1987, Gama gave the general chaetotaxic code as *bflh1h2oqst* for this species, which is fully consistent with the original description. The only apparent difference in the chaetotaxy of Indian specimens is the relative size of setae L1 and L3 on the head [f]. In other words, seta L1 in Nepalese specimens is longer than L3, while in Indian specimens the sizes of these setae are not strongly different. Codes such as *h1* and *h2* in Indian specimens also raise some doubts. The original description states that *les soies centrales se disposent en cinq rangées* [the central setae are arranged in five rows], which means that setae *a2* and *p2* are markedly displaced backward and anteriorly, respectively, relative to setae *a1* and *p1*. In the Indian specimens, this displacement is weakly pronounced. In addition, according to the original description, setae *p5* are present on Abd. I–III in *X. yossiana*, and therefore the sensilla are located at the position *p6*. In our Indian material, this seta (*p5*) was found in only a few specimens, and not on all segments and, as a rule, not symmetrically.

Family Isotomidae

Anurophorus septemvertex sp.n.

Figs 27–32.

TYPE MATERIAL: Holotype, adult female, Nepal, Solukhumbu, near Lukla, 27.696° N, 86.726° E, 2860 m alt., mixed forest with *Rhododendron* and *Pinus*, litter, May (exact date and

collector unknown). Paratypes, 4 (adults and subadults females and males), same sample as holotype.

DIAGNOSIS. A species of the *laricis* group characterized by the presence of four pairs of erect stick-like setae at the end of the abdomen and a rather small number of axial setae on terga.

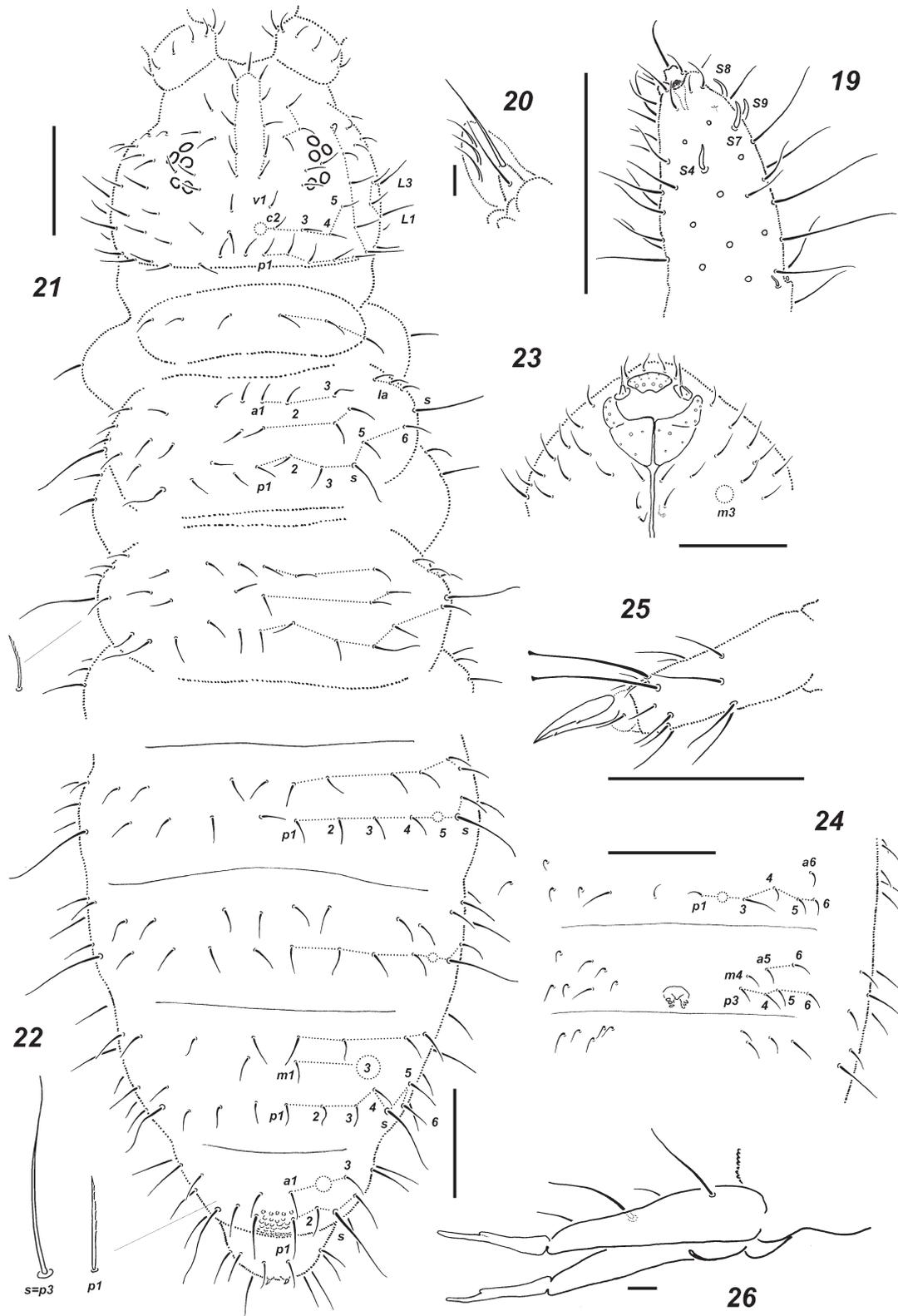
DESCRIPTION. Purple, including appendages. Length of female 0.9–1.2 mm. Integument with weak reticulation. Tape-shaped and elongated polygons absent.

Ant. IV with undivided apical bulb. Ant. III with 2 external, 2 internal and 2 lateral sensilla, additional sensilla absent. Ant. II with 1 sensillum. Ant. I with 2 ventrolateral sensilla. Ant. I, II and III with 2, 3 and 1 bms. 11 setae on Ant. I.

8+8(6+6) ommatidia, G and H small, hardly visible (Fig. 30). PAO of normal shape, *ca* 1.5 as long as diameter of nearest ommatidium. 3 prelabral setae, labral formula of setae as 3/554. Labial palp as A1B3C0D3E5 (B and D lost one guard each, E lost two guards). 3 proximal setae. Basomedial field of labium with four setae, basolateral field with five setae, as usual. 4+4 postlabial setae. Outer maxillary lobe with 3 sublobal hairs and simple maxillary palp.

Number of setae along dorsal medial line of Th. II–Abd. V: 6(7),4(5)/3,3,4,5(6),5. Common setae smooth. Macrochaetae well differentiated and pointed on all segments, their number on Th. II–Abd. V being 1,1/1,1,1,2,4. Medial macrosetae on Abd. V (Md), two p-setae of Abd. V and medial macrosetae on Abd. VI thickened, erect, stick-like. Md 0.6–0.8 as long as Ml. Sensilla on body well shorter than common setae. Number of sensilla of Th. II–Abd. V being 2,2/1,1,1,2,4. Microsensilla as 1,0/0,0,0. Th. I–III with 0+0, 0+0, 3+3 ventromedial setae, respectively.

Ventral chaetotaxy of abdomen as follows: VT with 3+3 laterodistal and 4 posterior setae, Abd. II with 2–3, Abd. III with



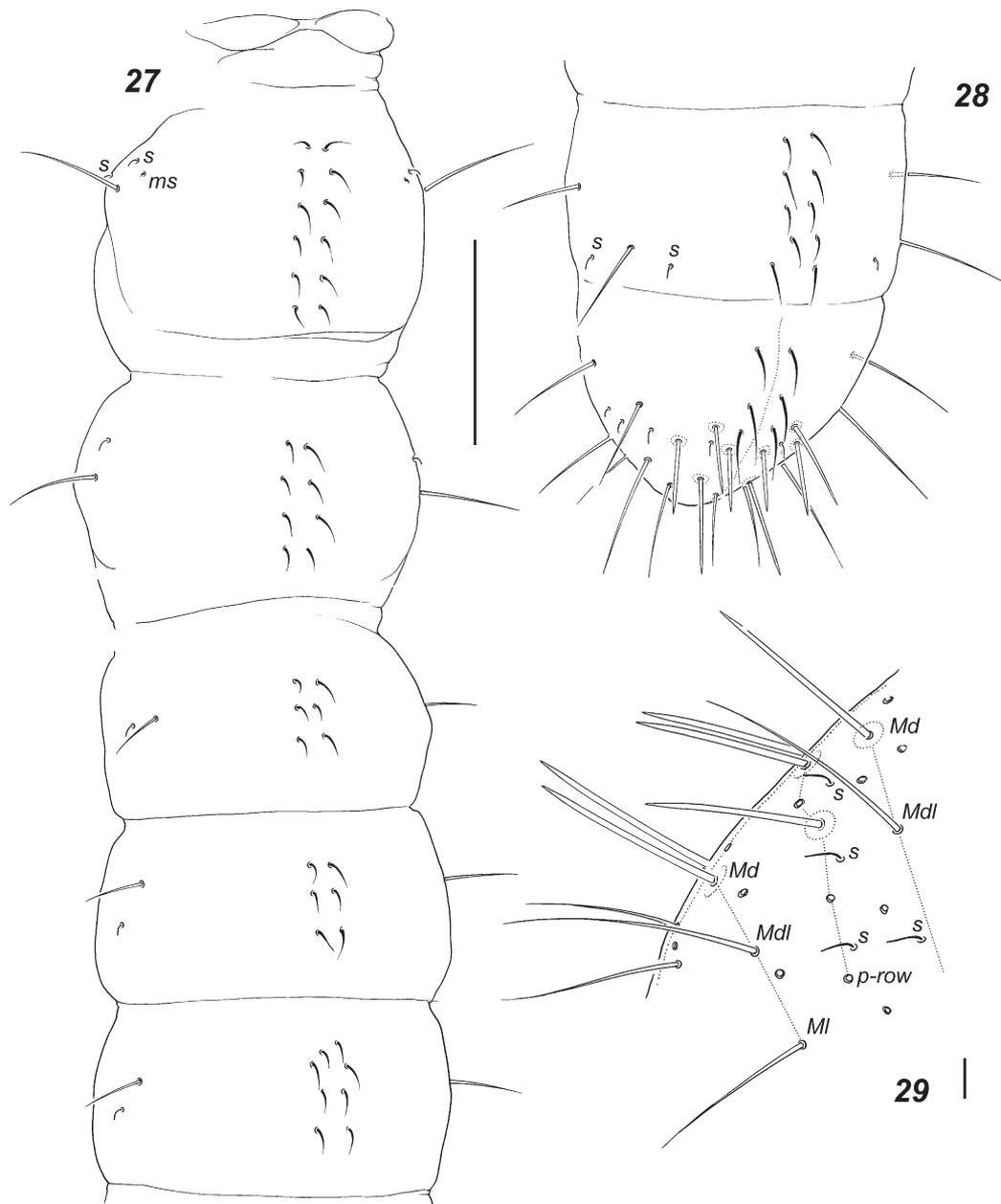
Figs 19–26. *Xenylla yossiana*: 19 — Ant. III–IV (dorsal side); 20 — maxillary outer lobe; 21 — dorsal chaetotaxy of head and thorax; 22 — dorsal chaetotaxy of Abd. II–VI; 23 — ventral chaetotaxy of head; 24 — ventral chaetotaxy of Abd. II–III; 25 — claw and tibiotarsus, leg 3; 26 — dens and mucro. Scales: 19, 21–25 — 0.1 mm, 20, 26 — 0.01 mm.

Рис. 19–26. *Xenylla yossiana*: 19 — Ant. III–IV (дорсальная сторона); 20 — наружная доля максиллы; 21 — дорсальная хетотаксия головы и груди; 22 — дорсальная хетотаксия Abd. II–VI; 23 — вентральная хетотаксия головы; 24 — вентральная хетотаксия Abd. II–III; 25 — коготок и тибиятарзус, нога 3; 26 — денс и мукуро. Масштаб: 19, 21–25 — 0,1 мм, 20, 26 — 0,01 мм.

2–3 anterior and 1–2 posterior setae. “Manubrial field” with 38–40 setae, furcal subcoxa with 19–21 setae. Claw without inner tooth. Empodial appendage reduced (<1/4 of inner edge of claw) on all legs. Tibiotarsi with 2, 3, 3 dorsal and 1, 1, 0 ventral clavate tenent hairs. Tenent hairs slightly longer than inner edge of claw 3 (ca 1.1–1.2). Upper and lower subcoxae 1, 2 and 3 with 0/1, 1/5–6 and 3/6(5) setae, respectively. Tibiotarsi 1 and 2 with 21, 3 – with 22 setae (additional setae absent). Shape of male spurs unknown (adult males absent among type specimens). Subadult males present, also armed with a group of erect macrosetae mentioned above.

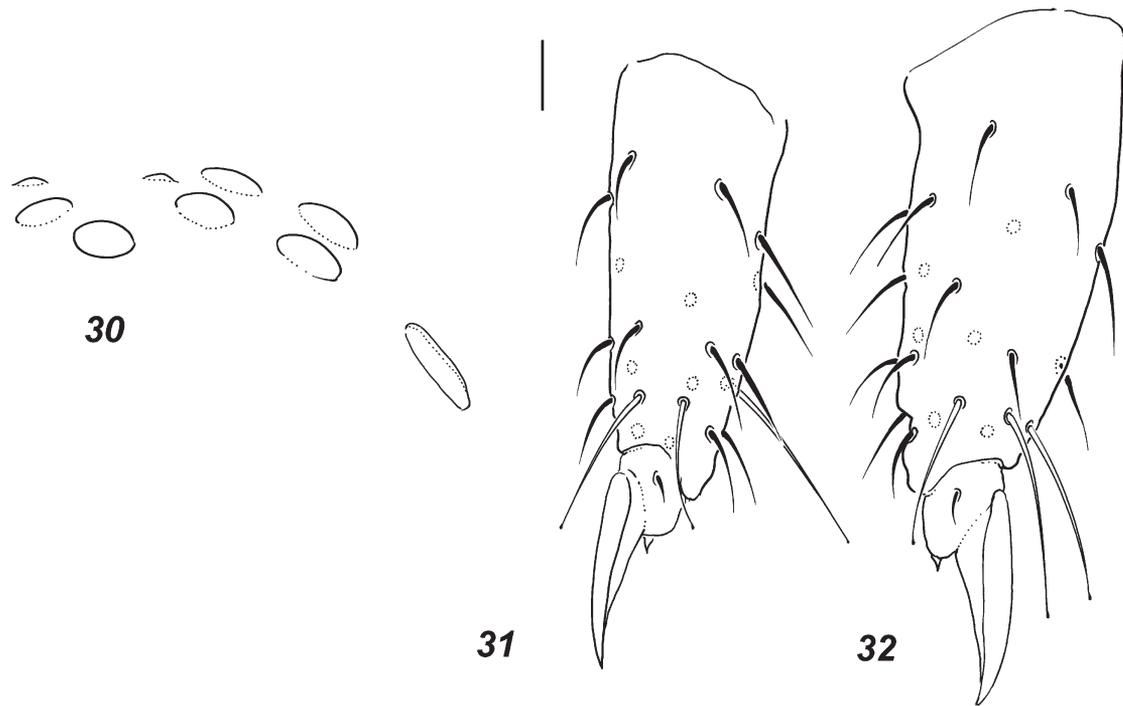
ETYMOLOGY. The species is named after the “7 Summits” Club, founded in 1994, which has been making the mountains more accessible to climbers and scientists for more than 30 years.

AFFINITIES. The new species is well distinguished due to 8 specific erect setae at the end of the abdomen, clearly visible even at low magnification. Such setae were so far been unknown in the genus *Anurophorus*. The new species belongs to the *laricus* group because of the short empodium and the absence of ventro-medial setae from Th. I and II. Other characters of *A. septemvertex* **sp.n.** are rather general and bring it closer to *A. stepposus* Pota-



Figs 27–29. *Anurophorus septemvertex* **sp.n.**: 27 — dorsal chaetotaxy of thorax and anterior half of abdomen; 28 — dorsal chaetotaxy of Abd. IV–VI; 29 — posterior part of Abd.V and Abd.VI (lateral view). Stick-like setae encircled. Scales: 27, 28 — 0.1 mm, 29 — 0.01 mm.

Figs 27–29. *Anurophorus septemvertex* **sp.n.**: 27 — дорсальная хетотаксия груди и передней части брюшка; 28 — дорсальная хетотаксия Abd. IV–VI; 29 — задняя часть Abd.V и Abd.VI (вид сбоку). Палочковидные хеты обведены. Масштаб: 27, 28 — 0,1 мм, 29 — 0,01 мм.



Figs 30–32. *Anurophorus septemvertex* sp.n.: 30 — PAO and ommatidia; 31–32 — claw and tibiotarsus, leg 1 (31) and leg 3 (32). Scale: 0.01 mm.
Figs 30–32. *Anurophorus septemvertex* sp.n.: 30 — Постантенный орган и глазки; 31–32 — коготок и тибиятарзус, нога 1 (31) и нога 3 (32). Масштаб: 0,01 мм.

pov et Stebaeva, 1990 (Asia) and *A. elongatus* Fjellberg, 1984 (N America). These two latter species have normal macrosetae and p-setae at the abdominal end and a much larger number of setae in the axial formula of terga.

In the genus *Anurophorus*, a modified end of the abdomen concerned so far only the cuticle, this being expressed either in two conical papillae on Abd. VI or in changes of primary granulation (wrinkles, fusion of granules). Two papillae are known in *A. rarus* (Yosii, 1939) and *A. spinosus* Dallai, 1971 vs wrinkles in several species. We hypothesize that the stick-shaped setae in *A. septemvertex* sp.n. play the same strengthening role as spines or wrinkles. For the family Isotomidae, a group of erect stiff setae at the end of the abdomen is well known in the genus *Isotomodes* inhabiting deep soil layers, where the setae probably play the same role in the process of active movement along soil passages.

The only species of the genus recorded so far from Nepal is *A. cuspidatus* Stach, 1919 [see Yosii, 1966, 1971]. The redescription of this species given by Yosii [1971] has nothing in common with either European *A. cuspidatus* or *A. septemvertex* sp.n., and the fauna of this region evidently includes at least one more undescribed species.

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