SIBIRACANTHELLA AND *SAHACANTHELLA* NEW GENERA OF ANUROPHORINAE (COLLEMBOLA, ISOTOMIDAE) WITH ANAL SPINES FROM CONTINENTAL ASIA

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Sibiracanthella *and* Sahacanthella *new genera of Anurophorinae (Collembola, Isotomidae) with anal spines from continental Asia.*– Two new genera and new species (*Sibiracanthella nuda*, *Sibiracanthella sohondo* and *Sahacanthella kele*) are described from the arid regions of continental Asia. *Sibiracanthella* is characterized by the presence of four anal spines, apical bulb on the fourth antennal segment and smooth integument. *Sahacanthella* differs from it by the presence of two anal spines, specific protuberance and reticulated integument. A key for identification of the holarctic genera of Anurophorinae with anal spines is given.

Key words: Collembola, Isotomidae, *Sibiracanthella*, *Sahacanthella*, Siberia, Kazakhstan.

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INTRODUCTION

Several genera of subfamily Anurophorinae with anal spines have been described from the continental parts of East Palaearctic. Eight of the so called "spined" genera are known from these regions, and only two of them (*Tetracanthella* Schott, 1891 and *Uzelia* Absolon, 1901) have been found in Western Europe. Analysis of diverse material from different areas of Siberia has revealed several other "spined" forms considered as being of generic rank; their description is presented in this paper. As these oriental genera are not closely related, one can suppose that the appearance of similar adaptations is influenced by certain conditions in dry and dense soils of continental Asia, since the strong anal spines can be used for active movement through such soils.

MATERIAL AND METHODS

The studied material was obtained by extracting soil and litter samples in Tullgren funnels.

Types are kept in: Moscow State Pedagogical University, Moscow (MSPU); Biological Institute, Novosibirsk (BI); and Jakutian Biological Institute, Jakutsk (JBI).

The abbreviations used in the descriptions, are as follows: PAO. Postantennal organ; Ant.I-IV. Antennal segments I-IV; Th.I-III. Thoracic segments I-III; Abd.I-VI. Abdominal tergites I-VI; GI,III. Length of claw of the first, third pair of legs; eI,III. Length of unguiculus of the first, third pair of legs; pl,3. The first, third chaeta of p-row; al,3. The first, third chaeta of a-row; pp. Chaeta of posterior row on head; Ml,Mdl. Lateral and dorsolateral macrochaeta; accp. Accessory p-row sensillum; s. Sensilla; ms. Microsensilla.

RESULTS

Sibiracanthella n. gen.

Description

With characters of Anurophorinae sensu str. Body is greatly elongated. Abd. V and VI fused. Reticulation and granulation absent, so integument looks smooth (even at the high - about 1500- magnification) that is the result of the fusion of all primary granules on body tergites probably. Fine primary granulation hardly recognized only on the intersegmental membranes and legs. Eight ommatidia on each side of the head. PAO present. Apical bulb on Ant.IV simple, of open type. In frontal part of head there is an organ of unknown function consisting of two oval plots of diameter as long as ommatidium.

Body chaetotaxy is distinctly oligochaetous. All microchaetae very small. Macrochaetae well differentiated. Sensorial chaetotaxy partly reduced: the number of sensilla on Th.II-Abd.V varies from 2+ms,2/1+ms,1,1,1,4 (*S. sohondo*) to 3+ms,3+ms/2+ms,2+ms,2+ms,2,4 (*S. nuda*). Microsensillum on Abd.III (if present) located in front of lateral sensillum, as on Abd.I-II. Medial sensilla of body tergites situated posterior to corresponded macrochaetae, the accp1 and accp2 sensilla on Abd.V are not on the papilla of anterior spines (as in genus *Tetracanthella*), but on more lateral part of tergite. There are no medial microchaetae between anterior macrochaetae on Abd.V. Unguiculus present. Tibiotarsus with dorsal clavate hairs. Furca present or absent. Abd.V+VI with four anal spines on papillae.

Type species

Sibiracanthella nuda n. sp.

Taxonomic remarks

Due to the presence of four anal spines on the high papillae, the new genus is formally closed to *Tetracanthella*, however it differs from last genus in the following features of above-species rank: smooth cuticle (as in *Uzelia*), the presence of apical bulb on Ant.IV, the specific organ in frontal part of head, unusual position of ms on Abd.III. (last feature is known only in *S. nuda* as other species lack ms). Genus *Tetracanthella* includes the species with reticulate integument, without apical bulb on Ant.IV as well as the specific organ on head, with typical position ms on Abd.III, namely between lateral and medial sensilla (DEHARVENG, 1987).

The presence of four anal spines on the fused two last abdominal segments in both genera is the result of convergent evolution possibly, as indicated by the arrangement of setae and sensilla on Abd.V. According to DEHARVENG (1978) the anterior spines of *Tetracanthella* are the modified p2-setae of Abd.V surrounded by accp1-sensillum from medial side and accp2-sensillum from lateral one, a1 is meso- or microchaeta. The

corresponding spines of *Sibiracanthella* are the modified a1-setae, whereas as accp1 as accp2-sensilla are located laterally, around p2-seta not modified to spines. Posterior spines of both genera are the modified p1-setae and can be considered as homologs.

Tetracanthella rara Dunger, 1982, described from Mongolia, may undoubtedly be included to the new genus due to its smooth cuticle, the presence of apical bulb on Ant.IV and other characters. "The frontal organ" on the head was not mentioned in the description of the species (DUNGER, 1982).

Ecology

All members of the new genus are found in the steppes. Probably the most of the above mentioned morphological features are the result of the adaptations to dry dense steppe soil habitats.

Sibiracanthella nuda n. sp. (figs. 1 - 6, 12)

Studied material

Type material: holotipe, ♀, Kazakhstan, Pavlodarskaya region, 70 km from Pavlodar, nearby vil.Ermak, the left bank of the Irtysh River, the first above flood-land terrace, salty meadow, under *Artemisia nitrosa*, in soil (0-5 cm), 21 VII 1972, leg. S. Stebaeva; paratypes, 31 specimens. Holotype and five paratypes are kept in MSPU (Moscow), 25 paratypes in BI (Novosibirsk).

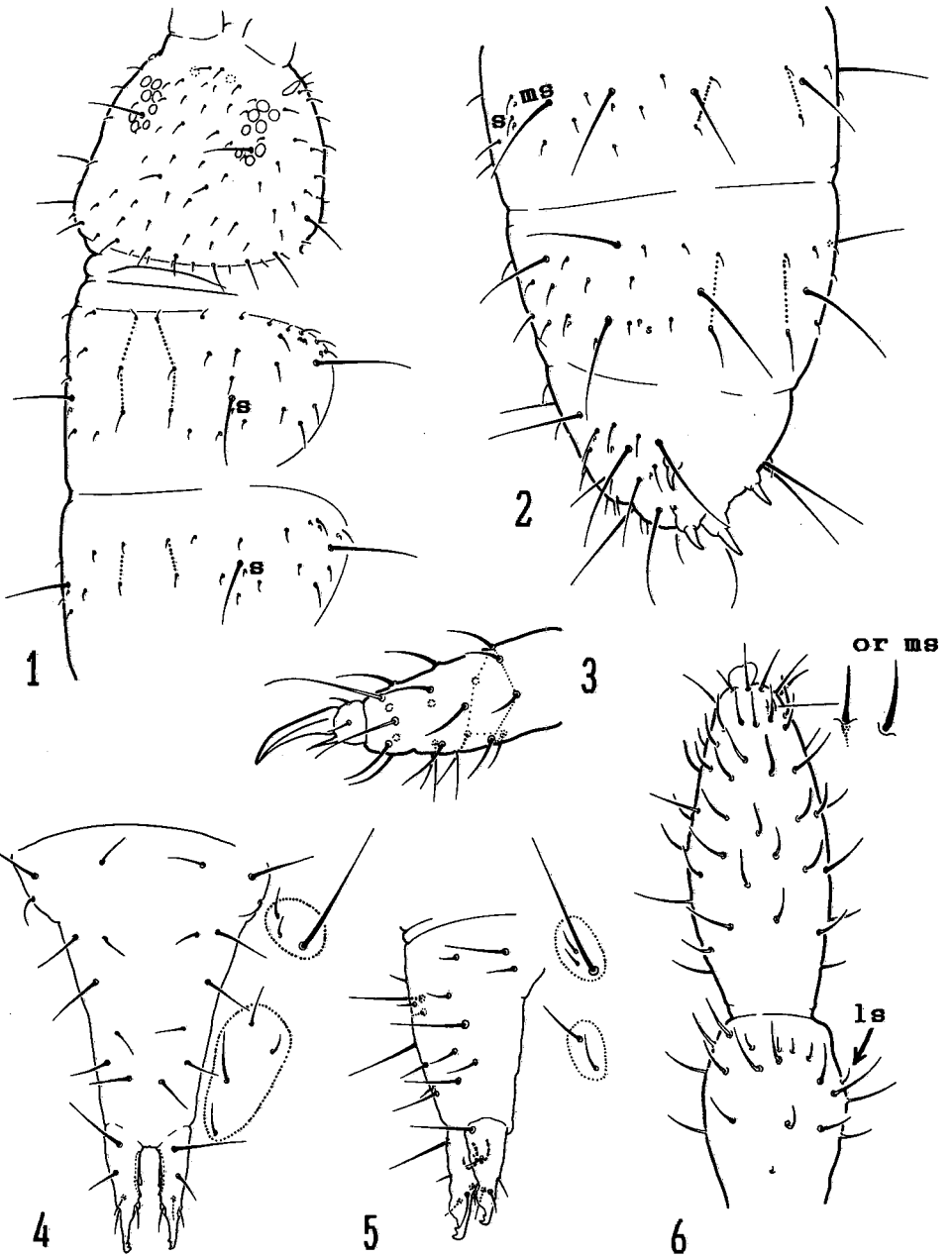
Other material: Kazakhstan, Kokchetavskaya region, nearby vil. Kuybishevsky, the left bank of Ishym River, rocky slope steppe, 30 V 1983, leg. S. Stebaeva.

Description

Size: about 0.9 mm (subadult females). Color white, usually with scattered granules of dark pigment throughout the body. Eye-spots colored intensively. Body slightly elongated. Reticulation and granulation of integument absent. Antennae with two ms and two s on Ant.I, three ms and one s on Ant.II, one ms and four almost equal s (two inner and two outer ones) on Ant.III, in addition one lateral s present on Ant.III (only females investigated). Ant.IV without thickened sensilla, with slightly subdivided apical bulb, subapical organit elongated. 8+8 ommatidia, with G and H smaller than others. Eye-spot subdivided into two parts: the anterior part with five eyes and the posterior one with three. PAO small, 1.5 times as long as the nearest ommatidium. Frontal part of head with the "frontal organ" consisting of two oval plots of the diameter approximately as long as ommatidium. Maxillary outer lobe with three sublobal hairs. Two prelabral setae. Three pp-setae, ap-setae missing.

Body chaetotaxy distinctly oligochaetous. The number of axial setae on tergites of Th.II-III/Abd.I-IV is 6,4/2,2,2,4(6). Medial microchaetae on Abd.V absent. Microchaetae very small, general ratios for Abd.IV are following: p3:p1=0.4-0.5; p1:a1=2.6-4.0; p1:GIII=1.4-1.7. Dorsal macrochaetae large and acuminate (Abd.IV - Md:p1=2.1-2.7), their number is 2,2/3,3,3. Code of the sensorial chaetotaxy is: 3+ms,3+ms /2+ms,2+ms, 2+ms,2,4. Microsensillum on Abd.III is not between sensilla but in front of lateral one, as on Abd.I-II. Medial sensilla are posterior to the corresponded macrochaetae.

Coxa of the first pair of legs with seta. Unguiculus rather short, 2.2-3.3 times shorter than the inner side of claw. Dorsal tenent hairs weakly clavate. Their number is 1,2,1(2). The third pair of legs with one distinctly clavate tenent hair and short, slightly clavate one. Ventral tenent hairs



Figs. 1-6. *Sibiracanthella nuda* n. sp.: 1. Dorsal chaetotaxy of head and thorax; 2. Dorsal chaetotaxy of Abd.III-VI; 3. Tibiotarsus and claw of the third pair of legs (chaetae of C-row pointed); 4,5. Dorsal surface of furcal area of subadult (4) and juvenile (5) specimen; 6. Ant.III,IV (or. Organit; ls. Lateral sensilla; other abbreviations: see the text).

present. Their number is 2-3,2-3,0 for 1,2,3 pair of legs respectively. Tibiotarsus of the third pair of legs with 22 setae (the additional setae absent, sometimes D5 present). Th.III without ventral setae. Ventral tube with 3+3 laterodistal and four posterobasal chaetae. Tenaculum with 2+2 teeth and one seta. Furca present, manubrium with 9+9 (rarely 8+8) setae. Dens rather short, 1.0-1.5 times as long as GIII, with one ventral and four dorsal setae. Mucro with two teeth. Anterior furcal subcoxa with three or four (rarely two) setae, posterior one - with three setae. Anal spines rather small, their posterior pair is placed on short subdivided papillae.

Taxonomical remarks

This species differs from *T. rara* and *S. sohondo* by the presence of furca. Distinct oligochaetosis should be pointed. As a rule, juvenile specimens of the family Isotomidae have far less body setae than adult ones. On the contrary the juvenile specimens of *S. nuda* hardly differ from adults - only some microchaetae on the posterior margin of tergites are absent in juveniles.

Sibiracanthella sohondo n. sp. (figs. 7-11, 13, 15)

Studied material

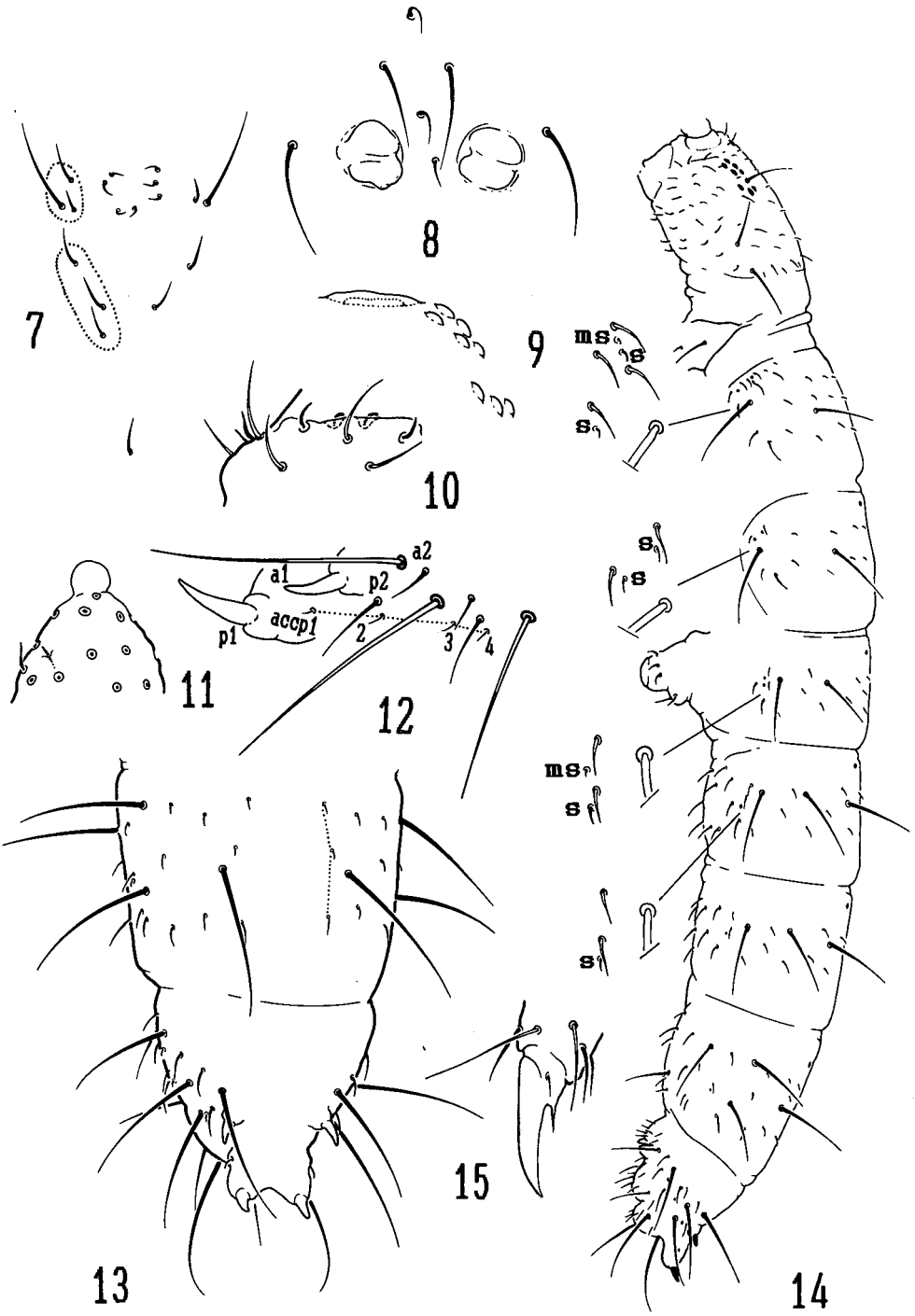
Type material: holotype, ♀, Russia, E. Siberia, Chitinskaya region, about 60 km SW from vil.Kyra, Sohondo reservation, West Sohondo Mt., slope steppe, in the litter, 8 VIII 1991, leg. N. Gladkevich; paratypes, three specimens. Holotype and one paratype are kept in MSPU (Moscow), two paratypes in BI (Novosibirsk).

Description

Size: up to 1.2 mm (adult females). Color grey. The granules of dark pigment scattered throughout the body. Eye-spots colored more intensively. Body strongly elongated. Reticulation and granulation of integument absent. Antennae seems to be the same as in previous species except following details: inner sensilla on Ant.III curved, covered by fold, two times shorter than the outer ones; subapical organit short; with two lateral sensilla on Ant.III. 8+8 ommatidia, with G and H smaller than others. Eye-spot is subdivided into two parts: the anterior part with five eyes and the posterior one with three. PAO curved, about 2.5 times as long as the nearest ommatidium. Frontal part of head with the "frontal organ" consisting of sensillum-like structures in the holes. On anterior part of Th.III-Abd.IV near medial line there is the pair of specific small round fields corresponded to head "frontal organ". Maxillary outer lobe with three sublobal hairs. Two prelabral setae. Two pp-setae present, ap-seta missing.

Body chaetotaxy strongly oligochaetous. The number of axial setae on tergites of Th.II-III/Abd.I-IV is 6,4/2(4),2(4),2(4),6. Medial microchaetae on Abd.V absent. Microchaetae very small, general ratios for Abd.IV are following: p3:p1=1.3-1.8; p1:a1=1.6; p1:GIII=0.7-0.8. Dorsal macrochaetae large and acuminate (Abd.IV - Md:p1=7-10), their number is 2,2/2,3,3. Code of the sensorial chaetotaxy is: 2+ms,2/1+ms,1,1,1,4. Microsensilla present only on Th.II and Abd.I.

Coxa of the first pair of legs with seta. Unguiculus rather short, 3.4-4.0 times shorter than the inner side of claw. Dorsal tenent hairs weakly clavate. Their number is 1,2,1(2). The third pair of legs with one distinctly clavate tenent hair, the second tenent hair only weakly enlarged and acuminate. Ventral tenent hairs present. Their number is 2-3,2-3,1 for 1,2,3 pair of legs respectively. Tibiotarsus of the third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pair of legs with 22 setae (the additional setae absent, sometimes D5 present). Th.III without ventral setae. Ventral tube with 3+3 laterodistal and four posterobasal chaetae. Tenaculum and furca absent. Tenacular field with one chaeta, manubrial field with 3-4+3-4 setae. Anterior furcal subcoxa with from two to three setae, posterior one - with three (rarely two setae). Anal spines middle-sized, their posterior pair is on projected, weakly subdivided papillae.

Taxonomical remarks

New species is closely related to *Sibiracanthella rara* (Dunger, 1982). It differs distinctly in the small size of p1-chaetae on Abd.IV, those almost equal to other microchaetae on tergite. *S. rara* has very large p1-chaetae several times longer than the other dorsal microchaetae.

Sahacanthella n. gen.

Description

With characters of Anurophorinae sensu str. Body is strongly elongated. Abd.V and VI fused. Cuticular reticulation distinct as a result of partly fusion of primary granules. Eight ommatidia on each side of the head. PAO present. Apical bulb on Ant.IV absent, but apically there are two papillae.

Body chaetotaxy is polychaetous. Microchaetae middle-sized. Macrochaetae well differentiated. Sensorial chaetotaxy partly reduced: the number of sensilla on Th.II-Abd.V in the only known species is: 3+ms,3+ms/2+ms,2+ms,2+ms,2,4. Microsensillum on Abd.III located between lateral and medial sensilla. Medial sensilla on body tergites are posterior to corresponding macrochaetae. Tibiotarsi with unguiculus and dorsal clavate hairs. Furca present, manubrium without ventral chaeta. Abd.V with two anal spines on papillae (modificated p1-chaetae) on distinct papillae. There is the excellent medial conical protuberance on Abd.IV dorsally that seems to be hypertrophic cuticular fold.

Type species

Sahacanthella kele n. sp.

Taxonomic remarks

This new genus is formally closed to *Uzelia* by the presence of two anal spines on the high papillae. It can be easily distinguished by the presence of cuticular reticulation and of unguiculus and specific protuberance on Abd.IV. All members of *Uzelia* are characterized by smooth cuticle (i.e. without visible primary granulation) and by the absence of unguiculus and protuberance on Abd.IV. *Sahacanthella* is rather related to primitive species of genus *Tetracanthella* according to distinct polychaetous, developed furca, tibiotarsi, reticulated cuticle. However the latter genus has four anal spines and no protuberance on Abd.IV. *Pentapleotoma dahli* Borner, 1903, which was described based on a single specimen from Sudet (Poland), has also two anal spines and granulated cuticle. This species was placed to genus *Uzelia*, although the taxonomical position of *P. dahli* remains unclear as no other records of this species exist. The above mentioned specimen is most probably an aberration of some

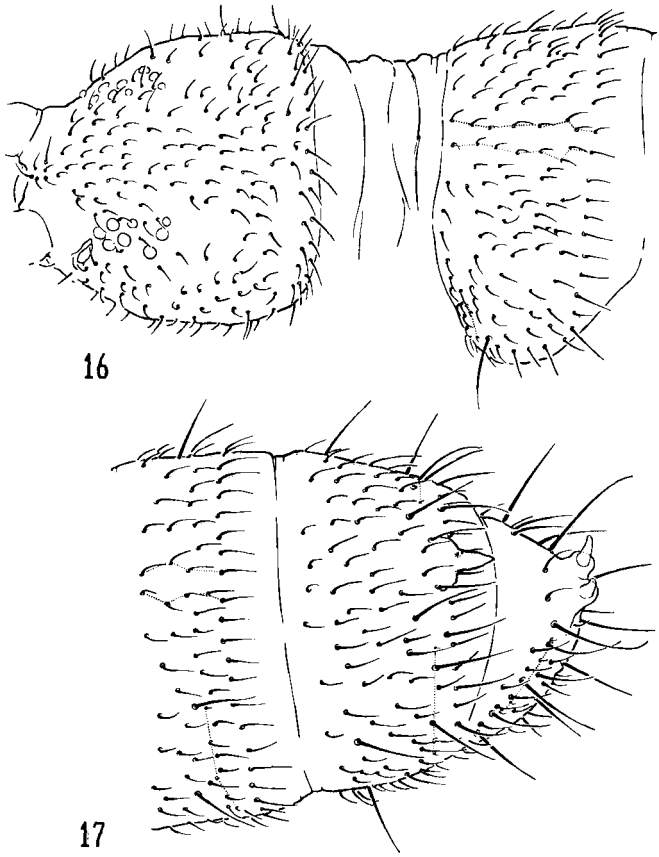
Figs. 7-15. *Sibiracanthella sohondo* n. sp. (figs. 7-11, 13-15) and *S. nuda* n. sp. (fig. 12): 7. Furcal area; 8. "Frontal organ"; 9. Ocular area and PAO; 10. Antennal organ on Ant.III; 11. Apical part of Ant.IV; 12. Anal spines (lateral position); 13. Dorsal chaetotaxy of Abd.IV-VI; 14. Dorsal chaetotaxy of body (side-view); 15. Apical part of the third pair of legs. (For abbreviations see the text).

Tetracanthella. Genus *Anurophorouzelia* Stach, 1947 (type species: *Uzelia rara* Yosii, 1936, Japan) has granulated cuticle and two conical granulated papillae (those are not real spines) on last abdominal segment (Yosii, 1992) so it can be also compared with *Sahacanthella*. Examination of some Korean material of *A. rara* has shown that it belongs evidently to *Anurophorus* Nicolet, 1841 as it has all its typical features. As shown by Dallai (1971) on *Anurophorus spinosus* Dallai, 1971, the spines of certain species are hardly important in generic taxonomy, so they are not analyzed in the present paper. *Anurophorouzelia* should be considered as syn. nov. to *Anurophorus*. *Sahacanthella kele* strongly differs from *Anurophorus rarus* comb. nov. in the presence of furca and peculiarity of anal spines.

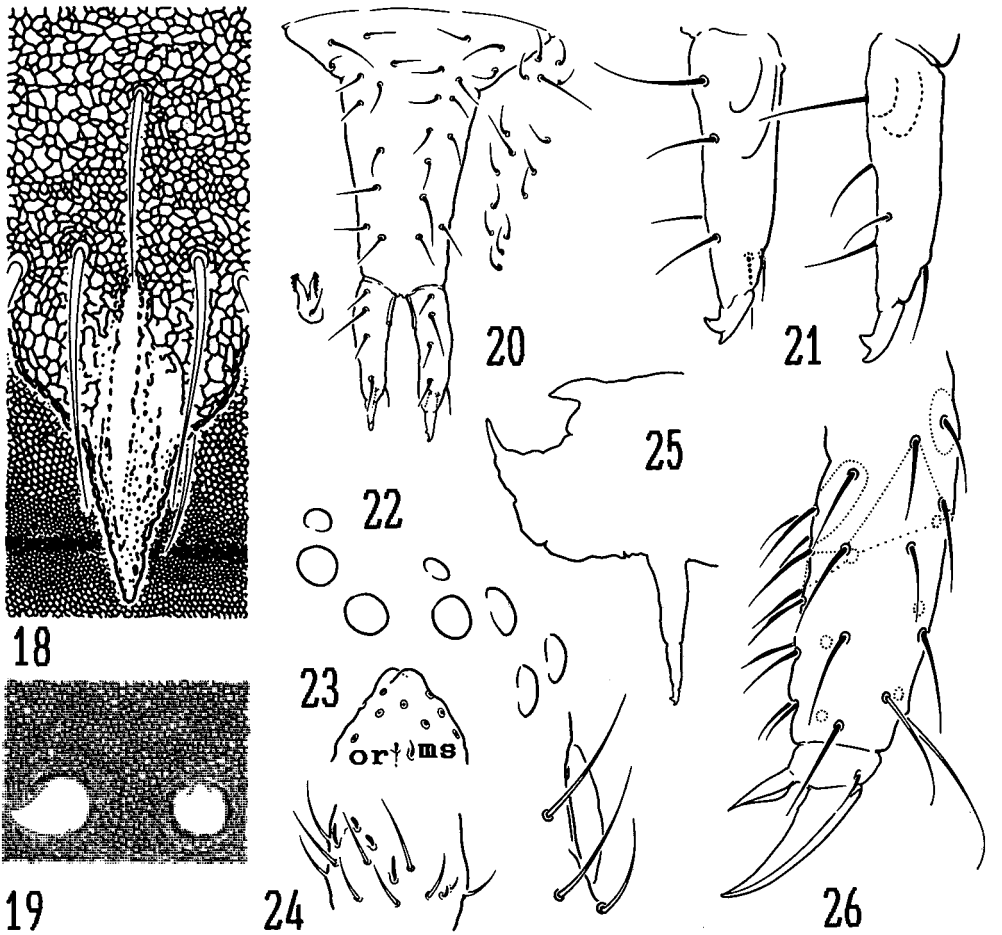
Sahacanthella kele n. sp. (figs. 16 - 26)

Studied material

Type material: holotype, ♀, Sakha Republic (Jakutia), south part of Verkhoyanskiy Ridge, upper flow of Kele river, alpine tundra with *Cobresia*, in litter, 3 VII 1989: leg. N. Vinokurov, coll. G. Okhlopkov;



Figs. 16, 17. *Sahacanthella kele* n. sp.: 16. Dorsal chaetotaxy of head and Th.I-II; 17. Dorsal chaetotaxy of Abd.III-VI.



Figs. 18-26. *Sahacanthella kele* n. sp.: 18. Reticulation of Abd.IV and protuberance; 19. Reticulation around anal spines; 20. Furcal area; 21. Variants of dens; 22. Ocular area; 23. Apical part of Ant.IV; 24. Antennal organ on Ant.III; 25. Profile of Abd.IV-VI; 26. Tibiotarsus and claw of the third pair of legs (chaetae of C-row and additional chaetae marked).

paratypes, eight specimens. Holotype and three paratypes are kept in MSPU (Moscow), two paratypes in BI (Novosibirsk), and two paratypes in JBI (Jakutsk).

Description

Size: up to 1.3 mm (adult females). Color greyish-blue. Body moderately elongated. Cuticular polygons are rather large (approximately as long as diameter of basis of microchaeta on Abd.I-II and as one-two on Abd.IV). Smooth fields on body tergites absent. Sensorial chaetotaxy of antennae is the same as in major part of Anurophorinae: with two ms and two s on Ant.I, three ms and one s on Ant.II, one ms and six s (two inner, two outer and two lateral ones) on

Ant.III. Ant.IV without thickened sensilla, without bulb, subapical organit and microsensilla of normal form. Apically there are two papillae on Ant.IV. 8+8 ommatidia, with G and H smaller than others. PAO approximately 3.5 times as long as the nearest ommatidium. Maxillary outer lobe with four sublobal hairs. Two prelabral setae. Formula of labrum is: 5,5,4. From five to six pp-setae. Besides 3+3 large p-setae there are 1-2 small additional ones in p-row. Macrochaetae on head indistinct.

Body chaetotaxy distinctly polychaetous. The number of axial setae on tergites of Th.II-III/Abd.I-IV is 14-15,10-12/8-9,8,8,10-11. Medial microchaetae on Abd.V anterior to nearest macrochaetae. Microchaetae of normal size, general ratios for Th.II are following: Ml:p1=2.2-2.7; p1:GIII=0.9-1.1. Dorsal macrochaetae are rather short and acuminate (as in some species of *Tetracanthella pilosa* gr.): Mdl of Abd.I only about 1.2 length of p1-chaeta. Number of macrochaetae is 1(2),1(2)/1(2),2,2. Some lateral p-chaetae of Th.II,III enlarged, but their length varies within population. Sensilla very short and hardly visible. Code of the sensorial chaetotaxy is: 3+ms, 3+ms/2+ms, 2+ms, 2+ms, 2, 4. Microsensillum on Abd.III between medial and lateral sensilla. Medial sensilla are posterior to the corresponded macrochaetae.

Coxa of the first pair of legs with seta. Claw simple, toothless, unguiculus of normal length, 1.6-1.9 times shorter than the inner side of claw. Dorsal tenent hairs clavate and short (only 1.1-1.3 times longer than the inner side of claw of third pair of leg). Their number is 1,2,2. Usually the second clavate hair on the third leg hardly developed. Ventral tenent hairs absent. As a rule tibiotarsus of he third pair of legs with 26 setae (the additional setae D1/2,D3,D4 and D5 present, sometimes the additional seta present in the third or fourth row). Th.III without ventral setae. Ventral tube with 4+4 (rarely 4+5) laterodistal and from six to eight posterobasal chaetae. Tenaculum with 4+4 (rarely 4+3) teeth and one seta. Furca present, manubrium with 14(12-15)+14(12-15) setae. Dens rather long, 1.6-1.9 times longer than GIII, chaetotaxy is variable - from one to two ventral and four (rarely three or five dorsal ones). Mucro with two teeth. Anterior furcal subcoxa with 8-11 setae, posterior one - with five (rarely six) setae. Anal spines rather large (1.5-1.8 times longer than GIII) on distinct reticulated papillae. On tergite of Abd.IV medial conical protuberance present.

A KEY TO IDENTIFICATION OF THE HOLARCTIC GENERA OF ANUROPHORINAE S. L. WITH ANAL SPINES

1. Abd.IV and V fused ..... *Pseudofolsomia* Martynova, 1967
– Abd.IV and V separated 2
2. Eyes and pigment absent 3
– Eyes and pigment present 4
3. Furca present ..... *Isotomodes* Linnaniemi, 1907 (part)
– Furca absent .... *Martynovella* Deharveng, 1978
4. Ventral chaetae on manubrium present 5
– Ventral chaetae on manubrium absent 6
5. Integument smooth. 2+2 or more ventral chaetae on manubrium ..... *Appendisotoma* Stach, 1947 (part)
– Integument reticulate. 1+1 ventral chaetae on manubrium.... *Weberacantha* Christiansen, 1951
6. Two anal spines on abdomen 7
– Four or more anal spines on abdomen 8
7. Unguiculus absent. Cuticle smooth ..... *Uzelia* Absolon, 1901
– Unguiculus present. Cuticle reticulate ..... *Sahacanthella* n.gen.
8. Eight anal spines on abdomen 9
– From four to five anal spines on abdomen 10
9. Furca absent ..... *Tiancanthella* Rusek, 1979

- Furca present ..... *Octodontophora* Tshelnokov, 1990
10. Four anal spines on Abd.V-VI 11
- Five anal spines on Abd.V-VI 13
11. Ant.IV with apical bulb. Microchaetae between anteriomedial macrochaetae on Abd.V absent .. .. *Sibiracanthella* n. gen.
- Ant.IV without apical bulb. Microchaetae between anteriomedial macrochaetae on Abd.V present 12
12. Cuticle more or less reticulate .... *Tetracanthella* Schott, 1891
- Cuticle seems to be smooth, excluding rare points scattered all over the surface of the body . ..... *Blissia* Rusek, 1985
13. Four anal spines on Abd.V and one on Abd.VI .. .. *Pentacanthella* Deharveng, 1978
- Two anal spines on Abd.V and three on Abd.VI.. ..... *Tuvia* Grinbergs, 1962

The key was compiled on the basis of a key of DEHARVENG (1978) and KEYS OF COLLEMBOLA OF USSR FAUNA (1988).

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