J. G. Palacios-Vargas and J. C. S. Benito – A new genus and three new species of Neanuridae (Collembola) from North America. *Journal of Cave and Karst Studies,* v. 69, no. 3, p. 318–325.

A NEW GENUS AND THREE NEW SPECIES OF NEANURIDAE (COLLEMBOLA) FROM NORTH AMERICA

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Abstract: *Speleonura* n. g. (Neanurinae) and the type species *S. kenchristianseni* n. sp., are described and illustrated from Porter's Cave, Bath County, Virginia. The new genus is characterized by the lack of eyes and the presence of well developed tubercles on the head and body, it is similar to *Paleonura* but the shape and disposition of the tubercles differentiate the new genus from others Neanurinae. The other two species described are *Paleonura petebellingeri* n. sp. (Neanurinae) from Skyline Caverns, Warren County, Virginia, similar to *Paleonura anops* (Christiansen & Bellinger, 1980) but they differ in the chaetotaxy on abdominal segments, and *Morulina stevehopkini* n. sp. (Morulininae) from litter of Mitchell County, North Carolina, which is easy to distinguish from other members of the genus because of its strong hypertrichosis.

Introduction

During our recent studies on the Neanuridae from Mexico and Central America (Palacios-Vargas and Simón Benito, in press; Simón Benito and Palacios-Vargas, in press) we received specimens from Virginia and North Carolina that were in the collection of Dr. Kenneth A. Christiansen. The specimens were remounted and study revealed the presence of a new genus and three new species that were not included in the work of Christiansen and Bellinger (1980). In this contribution, we describe these new American taxa. Used herein is the chaetotaxy system of Deharveng and Weiner (1984), as modified in Palacios-Vargas and Simón Benito (in press).

Genus and Species Descriptions

New genus

Speleonura

The genus is characterized by the lack of eyes and the presence of well developed tubercles on the head and body. The head antennal and ocular tubercles are well developed and subdivided. Abdominal segment V with dorso-internal tubercles coalesce. These characters differentiate the new genus from the others in the family. The structure of the antennae shows that the new genus is a member of the subfamily Neanurinae. The type species is *Speleonura kenchristianseni* new species.

Discussion

The new genus shares the lack of eyes with some species of several other genera, such as *Chirolavia* Deharveng, 1991, *Galanura* Smolis, 2000, *Coecoloba* Yosii, 1956, *Nepalanura* Yosii, 1966 and *Echinanura* Carpenter, 1935. It also seems very similar to *Paleonura* sharing the presence of eight sensilla of similar size on antennal segment IV. However, the shape and disposition of the tubercles on the body differentiate the new genus from other Neanuridae.

New species

Speleonura kenchristianseni

Length 550 µm. Color under slide white. Cuticular granulation strong. Tubercles well developed on head and body; on thoracic segment I dorso-internal and dorso-lateral undeveloped, on thoracic segment II and III dorso-lateral undeveloped. Each tubercle subdivided into 2 to 5 small bosses each with strong granulation. Body setae consisting of thick macrosetae with acuminate tip, thin microsetae, in addition to sensorial setae (Fig. 1e, 1f).

Antennal segment I with seven setae, antennal segment II with 11 setae. Antennal segment III sensorial organ with two globular sensilla in a cuticular fold, and two guard sensilla. Ventral sensilla of guard straight, one microsensillum ventro-external. Antennal segment IV with eight similar sensilla (Fig. 1b).

Eyes absent. Mandibles with three teeth (Fig. 1c), maxillae styliform (Fig. 1c). Antennofrontal tubercle subdivided into six subtubercles; setae C and E not on tubercle. Ocular tubercles well developed, each with about six subtubercles, and three setae. Tubercles dorso-internal and dorso-external well developed, dorso-internal with 1 seta and the dorso external 3 setae (Fig.1a).

Coxae I-III with 3, 5 and 6 setae on fore leg, middle leg and hind leg, respectively; trochanters with 6,6,5 setae; femora with 12,12,11 setae. Tibiotarsi I, II and III without tenent hairs; with 19, 19, and 18 setae, respectively. Unguis untoothed. No empodial appendage. Thoracic and abdominal chaetotaxy as in Figs. 1e and 1f. The total dorsal chaetotaxy is shown in Table 1.

Ventral tube with 3 + 3 setae subequal in size. Furcula vestigial with 5 setae and 6 microsetae (Fig. 1g). Female

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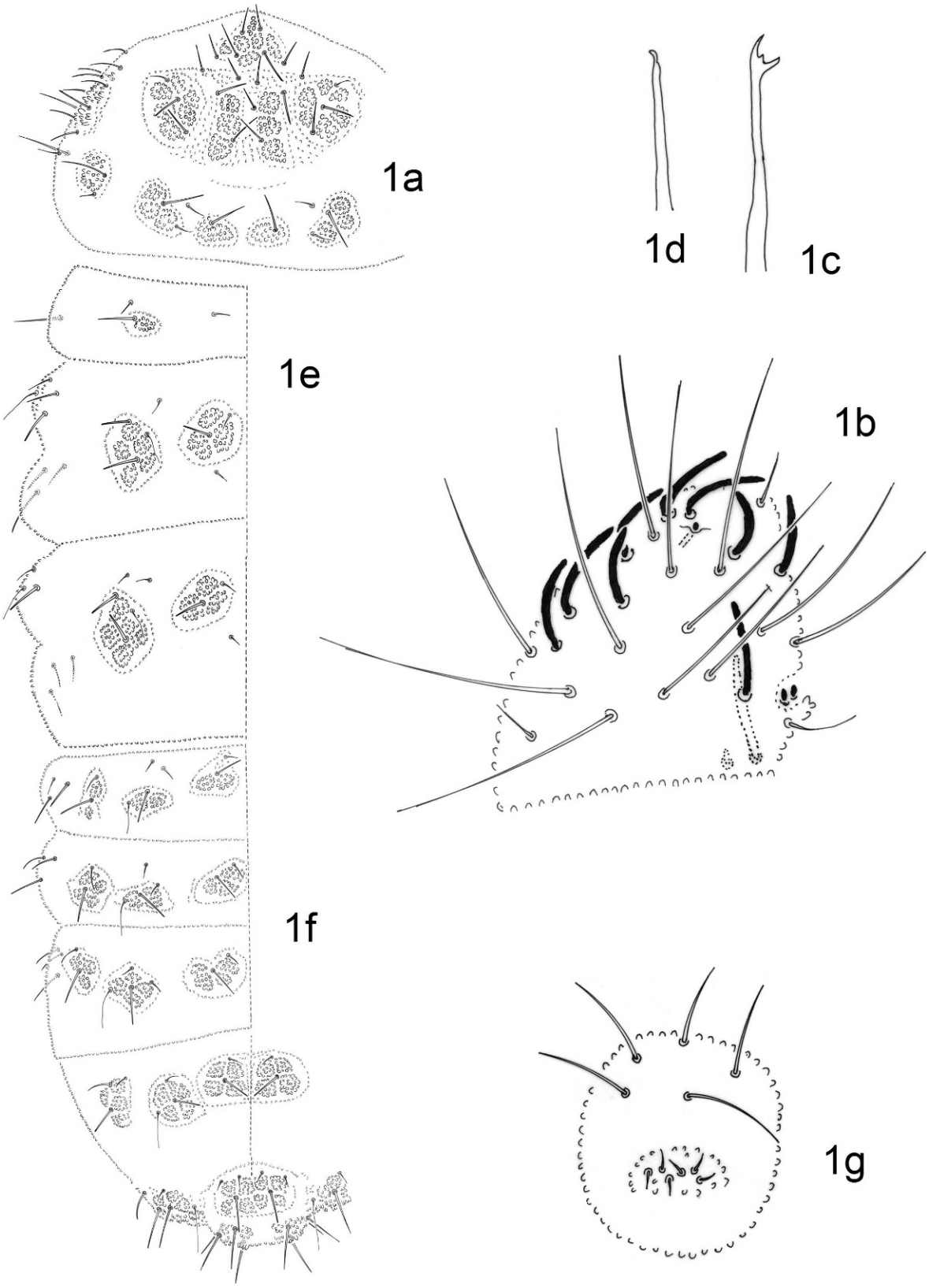

Figure 1. ***Speleonura kenchristianseni*** **n.sp. 1a, dorsal chaetotaxy of head; 1b, dorsal chaetotaxy of Ant. III and IV; 1c, mandible; 1d, maxilla; 1e, thoracic chaetotaxy; 1f, abdominal chaetotaxy; 1g, furcal vestige.**

Table 1. Total dorsal chaetotaxy of *Speleonura kenchristianseni* n. sp.

Head setae group	Tubercles	Number of setae	Kind of setae	Setae
Cl	1	3	M, M	FGD
Af	1	5	M	AB,OCE
Oc	2	3	m, M, M	Oca, Ocm, Ocp
Di	2	1	M	Di1
De	2	3	M, m, m	De1, De2, Di2
DL + L + Sc	2	13-14	M, m; 3M, 3m;2M, 3m	
Total amount	10	29		

Thorax	Di	De	DL	L
I	m	M, m	M	…
II	M, 2m	2M,m+s	2M,m+s+ms	M,2m
III	M, 2m	2M,2m+s	2M,2m+s ?	M,2m
Abdomen				
I	M,m	M,2m+s	M,m	2M,m
II	M,m	M,2m+s	M,m	M,2m
III	M,m	M,2m+s	M,m	2M,2m
IV	M,m	M,m+s	2M,m	7m
V	M, 2m	3M,m+s		
VI	5M, 2m			

Abbreviations: Af (antennofrontal), Cl (clypeal), De (dorso external), Di (dorso internal), DL (dorso lateral), L (lateral), M, macroseta; m, microseta; Oc (ocular), Sc (Subocular), Oca (Ocular seta anterior), Ocm (Ocular seta median), Ocp (Ocular seta posterior), s (sensorial seta).

genital opening with 2 + 2 pregenital, 20 circumgenital, and 2 eugenital setae.

Discussion

The new species has some similarities with species of the Nearctic *Paleonura*, in the general shape of the body, kinds of body setae, and number of setae on the vestigial furcul tubercle. However, the presence of well developed tubercles clearly separates it from *Paleonura* spp. This specimen was previously identified as a *Neanura* sp., but *Neanura* has three eyes per side and the dorso-internal tubercles are separate on abdominal segment IV.

Etymology. This species is named for Dr. Kenneth A. Christiansen, Grinnell College, Iowa, for his contribution to the study of Collembola.

Material. Porter's Cave, Bath County, Virginia, David Hubbard Col., holotype female. Slide 7874 in the Christiansen collection, at Grinnell College, Grinnell, Iowa.

New species

Paleonura petebellingeri

Length (n = 3) 825 μm (range 570 – 1050 μm). Color white under slide. Granulations very fine, except for small areas around some setae. Cuticular granulation stronger in dorso-internal region of abdominal segment V. Tubercles poorly developed, apparent only on posterior abdominal segments (Fig. 2f). Body setae consisting of thick macrosetae with thick tip, and thin microsetae, besides the sensorial setae (Fig. 2a).

Antennal segment I with seven setae, antennal segment II with 11 setae. Antennal segment III sensorial organ with two globular sensilla in a cuticular fold, and two guard sensilla. Ventral guard sensillum almost straight, one microsensillum ventro-external. Antennal segment IV with eight similar sensilla, except for S1, which is smaller than the others (Fig. 2b).

Eyes absent. Mandibles with three teeth (Fig. 2c), maxillae styliform (Fig. 2d). No head tubercles developed. Ocular area with three setae, one microseta and two macrosetae. Head chaetotaxy in Fig. 2e.

Coxae I-III with 3, 5 and 6 setae; trochanters with 5,5,5 setae; femora with 12,11,10 setae. Tibiotarsi I, II and III without tenent hairs, with 18, 18, and 17 setae respectively. No empodial appendage. Thoracic and abdominal chaetotaxy in Figures 2a and 2f. The total chaetotaxy is shown in Table 2.

Ventral tube with 4 + 4 setae. Furcula vestigial with 5 setae and 6 microsetae (Fig. 2g). Female genital opening with 3 + 3 or 4 + 4 pregenital setae, 13-10 circumgenital setae and 2 eugenital setae. Each anal tubercle with 12 macrosetae and 2 microsetae.

Discussion

We place this new species in the genus *Paleonura* because of the lack of blue pigment and eyes, the presence of dorso-internal setae on abdominal segment V, and the clear separation of dorso-internal and dorso-external

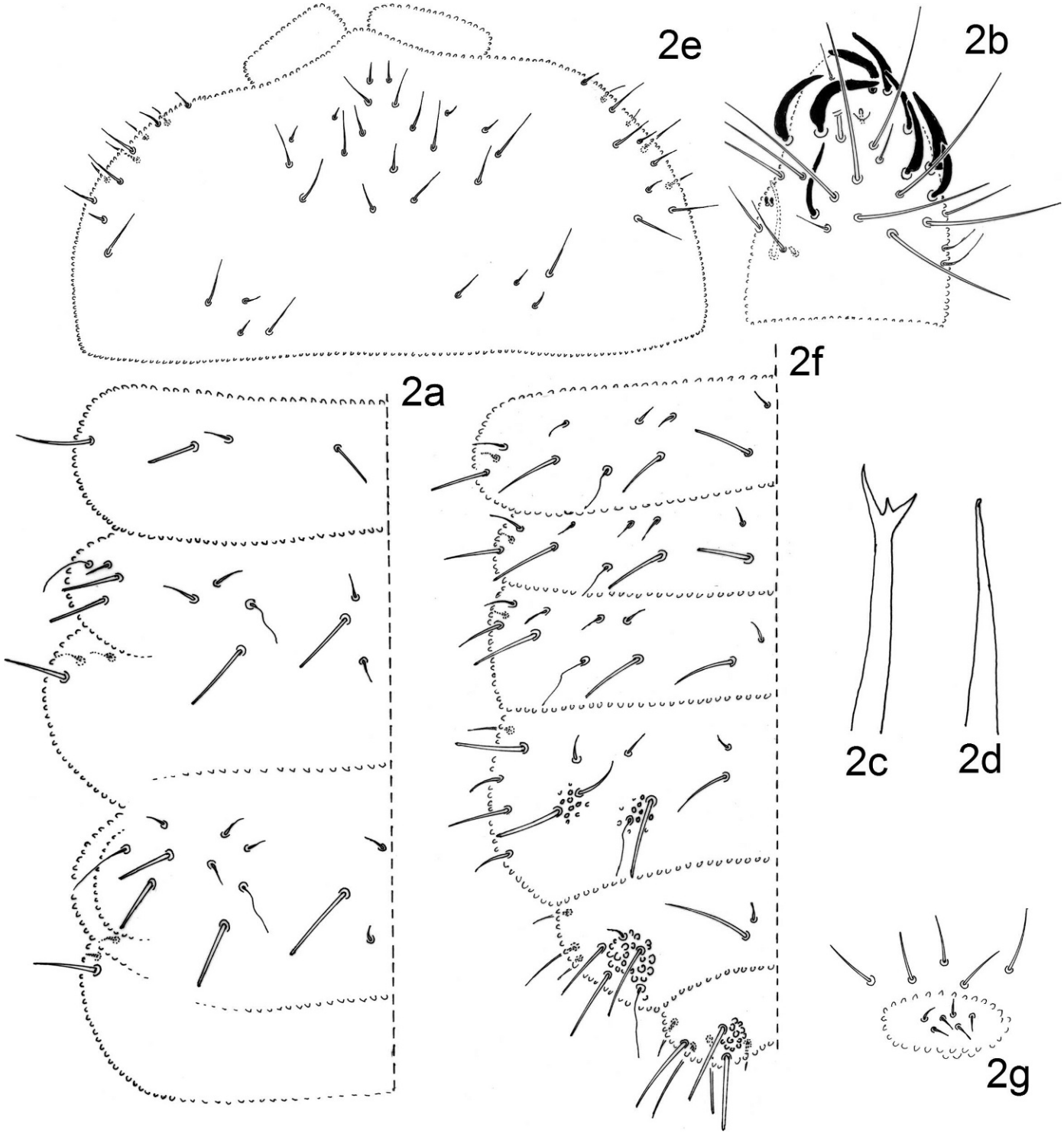

Figure 2. ***Paleonura petebellingeri*** **n. sp. 2a, thoracic chaetotaxy; 2b, dorsal chaetotaxy of Ant. III and IV; 2c, mandible; 2d, maxilla; 2e, head chaetotaxy; 2f, abdominal chaetotaxy; 2g, furcal vestige.**

tubercles. It appears more closely related to *Paleonura anops* (Christiansen and Bellinger, 1980). Both species lack eyes and have a vestigial furcula represented only by 3 + 3 microsetae. However on *P. petebellingeri* the sensillum 1 on antennal segment IV is smaller than the others. Another difference between the species is the chaetotaxy on abdominal segments; in *P. petebellingeri* the dorso-internal tubercle of abdominal segment V, has one macroseta and one microseta, while *P. anops* has one macroseta and two microsetae. In *P. petebellingeri* tubercle dorso-external has three macrosetae and one microseta, but *P. anops* has two macrosetae and three microsetae.

Table 2. Total dorsal chaetotaxy of *Paleonura petebellingeri* n. sp.

Head setae group	Tubercles	Setae number	Kind of setae	Setae
Cl	…	2	M, m	FG
Af	…	4 + 1	3M, m	ABCD, 0
Oc	…	3	M, M, M	Oca, Ocm, Ocp
Di	…	1	M	Di1
De	…	3	M, m, m	De1, Dde2, Di2
DL + L + Sc	…	13	2M, 2m; 3M, 6m	
Total amount		27		

Thorax	Di	De	DL	L
I	M	M, m	M	…
II	M, 2m	M,2m+s	2M,m+s+ms	M,2m
III	M, 2m	M,3m+s	2M,m+s	M,2m
Abdomen				
I	M,m	M,2m+s	M,m	M,2m
II	M,m	M,2m+s	M,m	M,2m
III	M,m	M,2m+s	M,m	M,2m
IV	M,m	M,m+s	2M,m	2M, 2m
V	M, m	3M,m+s	M,2m	
VI	7 (5M, 2m)			

Abbreviations: Af (antennofrontal), Cl (clypeal), De (dorso external), Di (dorso internal), DL (dorso lateral), L (lateral), M, macroseta; m, microseta; Oc (ocular), Sc (Subocular), Oca (Ocular seta anterior), Ocm (Ocular seta median), Ocp (Ocular seta posterior), s (sensorial seta).

Variation. Some cases of asymmetries were observed on abdominal segment II: dorso-lateral with one seta present and one microseta missing, lateral with only one microseta instead of two. Abdominal segment I dorso-lateral of one specimen has one macroseta, instead of one macroseta and one microseta.

Etymology. This species is named in memory of Dr. Peter F. Bellinger, for his contributions on the Collembola.

Material. Skyline Caverns, Warren County, Virginia, January 22, 1995, David Hubbard Col., Holotype female (slide 7806) and two paratype females (slides 7806 and 7792) from the Christiansen collection at Grinnell College, Grinnell, Iowa. In cave soil. 7806 specimens collected on 3-16-1995; 7792 collected on 1-22-1995.

New species

Morulina stevehopkini

Length (n = 2) 2.2 mm. Color black, ventral side dark gray. Eyes very dark. Habitus convex, typical of the genus. Tubercles very well developed, forming rather semispherical structures with granulation and reticulations. Macrosetae with blunt tip and fine serrations, microsetae thin, smooth, and sensorial setae, difficult to distinguish (Fig. 3a).

Antennal segment I with 24 setae and few reticulations (Fig. 3b), antennal segment II with 26 setae. Antennal segment III with 24 setae; only two guard setae of the sensorial organ observed (Fig. 3c). Antennal segment IV with about 65 very small dorsal setae and poorly defined bilobulate apical bulb, without differentiated sensilla (Fig. 3b). Labrum with 4/4,5,4 smooth setae of different sizes (Fig. 3d). Mouth cone long, labium with10 pairs of setae (Fig. 3e), labial organ absent. Maxilla with four reduced lamellae (Fig. 3f), mandible with three subequal apical teeth and one basal paired tooth (Fig. 3g).

Eyes 5 + 5 black (Fig. 3h), ocular tubercle with 6-7 ocular setae, three of them longer and thicker than the others. Postantenal organ moruliform with about 50 tubercles, slightly wider than the most proximal eye (Fig. 3h).

Coxae I-III with 2,9,? setae; trochanters with 6,8,8 setae; femora with 15, 15, 15 setae. Tibiotarsi I, II and III with 19, 19, and 18 setae respectively, two longest ventral setae longer hooked apically (Fig. 3i). Unguis with strong basal tooth. No empodial appendage.

Hypertrichosis strong dorsally and ventrally. Number of tubercles from thorax to abdomen IV are: 3,4,4/4,4,4,3. (Figs. 3a, 4a, 4b, 4c and Table 3).Tubercles with some microsetae. Ventral tube with 9 pairs of setae. Anal tubercle with about 35 setae (Fig. 4d). Vestigial furcula with 7 setae and 2 dens without mucro, each with one seta (Fig. 4e). Pregenital setae very abundant, about 75 (Fig. 4e). Female and male genital setae very small, more than 50.

Discussion

Morulina stevehopkini is easy to distinguish from other members of the genus because of the strong hypertrichosis it has. It shares with *M. gigantea* the presence of only one seta on each dens, but *M. stevehopkini* has a bigger postantenal organ, more ocular setae 6-7 (versus 3). The redescription of

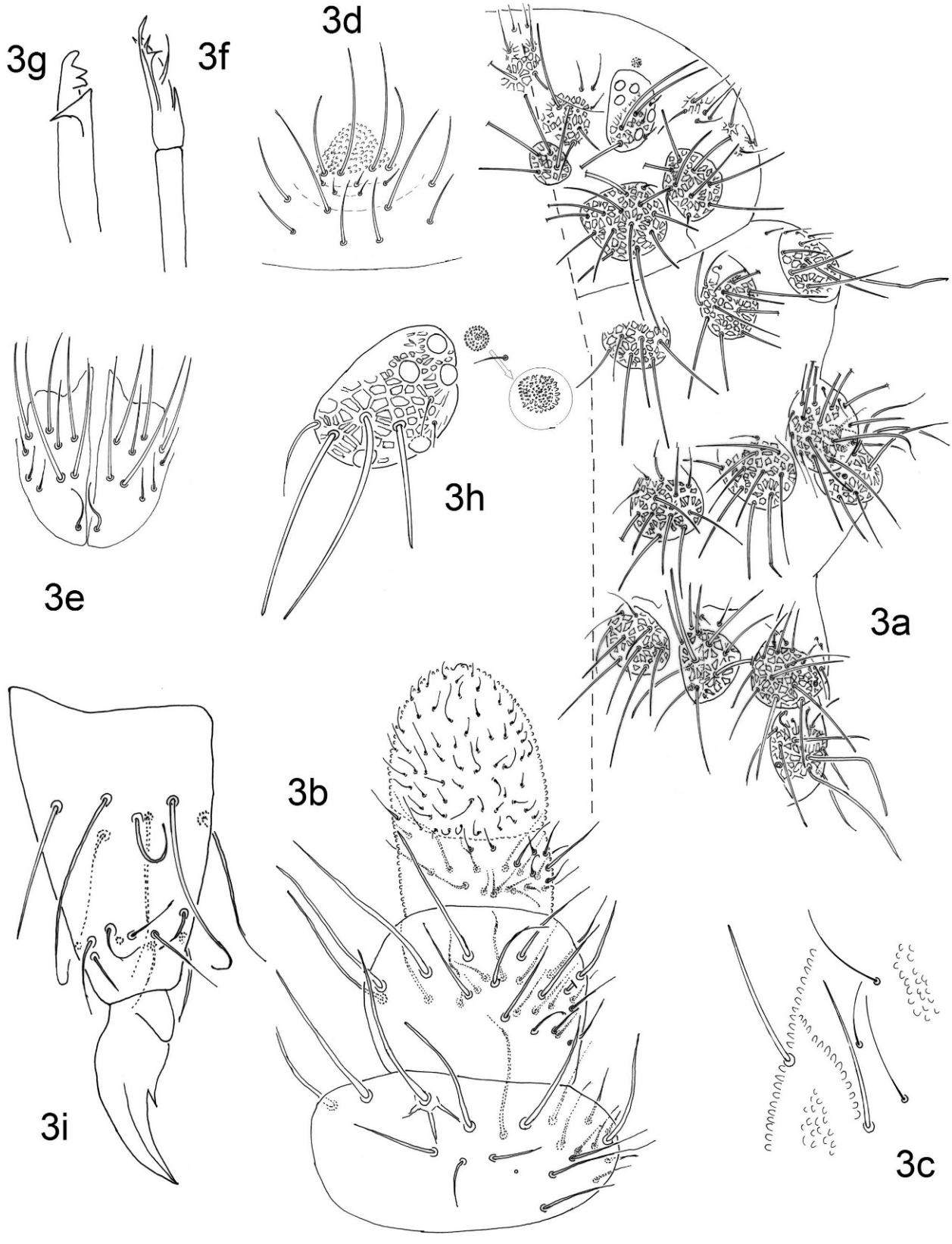

Figure 3. ***Morulina stevehopkini*** **n. sp. 3a, cephalic and thoracic chaetotaxy; 3b, Ant. from I to IV, dorsal view; 3c, sensorial organ of Ant. III; 3d, labrum; 3e, labium; 3f, maxillae; 3g, mandible; 3h, ocular tubercle with magnification of postantenal organ; 3i, tibiotarsus III.**

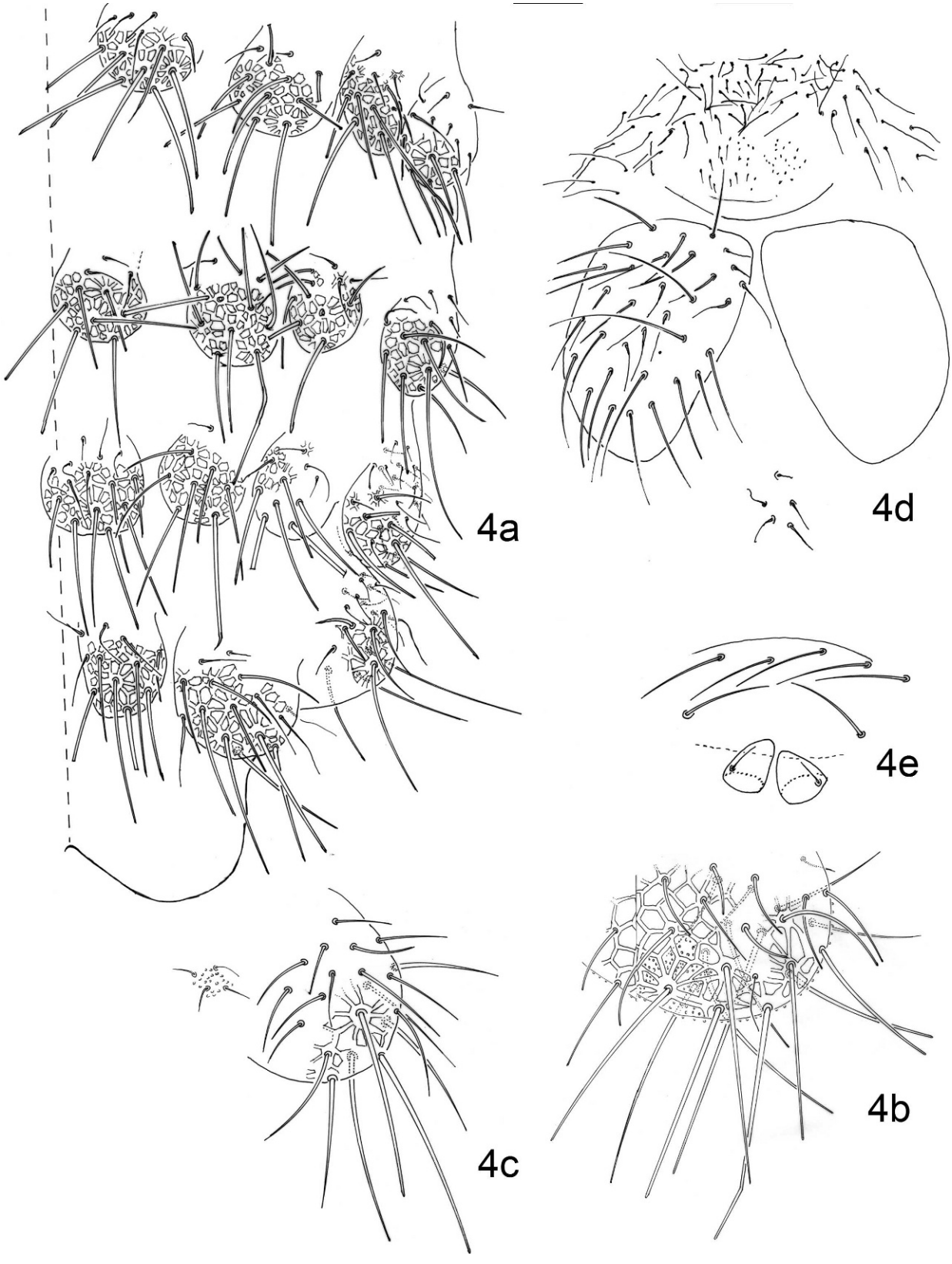

Figure 4. ***Morulina stevehopkini*** **n. sp. 4a, chaetotaxy of Abd. I to IV; 4b, tubercle of Abd. V; 4c, tubercle of Abd. VI, ventral view; 4d, anal tubercle and genital region; 4e, furcal vestige.**

Table 3. Total dorsal chaetotaxy of *Morulina stevehopkini* n. sp.

Head setae group	Tubercles	Setae number	Kind of setae	Setae
Cl	1	5	M	CDEFG
Af	3	4	M	AB
Oc	1	6	M, m	Oca, Ocm, Ocp
Di	1	13-15	M	
De	1	8-9	M	
DL + L + Sc	···	3 + 6	M, m	
Total amount		45 – 48		

Thorax	Di	De	DL	L
I	6-9	11-12	9-11	-
II	11-12	10-12	17-18	5-6
III	9-12	11-13	17-19	11-12
Abdomen				
I	12	9-12	9-11	9-12
II	10-14	11-13	8-11	13-14
III	14-15	8-11	10	13-21
IV	9-11	13-15	18	
V	23-27			
VI	15-20			

Abbreviations: Af (antennofrontal), Cl (clypeal), De (dorso external), Di (dorso internal), DL (dorso lateral), L (lateral), M, macroseta; m, microseta; Oc (ocular), Sc (Subocular), Oca (Ocular seta anterior), Ocm (Ocular seta median), Ocp (Ocular seta posterior).

M. gigantea by Fjellberg (1985) and *M. callowayia* by Yosii (1958) allows comparison with the new species *M. stevehopkini*. Most important differences are chaetotaxy of dorso-internal tubercle on the thoracic segment I (3-5, 12, 6-9 setae respectively) and the chaetotaxy of fused tubercles dorso-internal + dorso-external of abdominal segment V (13-16, 14, 23-27 setae respectively).

Etymology. Species named in memory of Dr. Stephen P. Hopkin, recently deceased, for his contribution to the biology of springtails (Collembola).

Material. Leaf litter, Bakersville, Mitchell County, North Carolina, August 24, 1981. K A. Christiansen Col., Holotype male (slide 7613), paratypes, one male (7613) and three females (7623) North Carolina Slide 7623 from Christiansen's collection at Grinnell College, Iowa, USA.

Acknowledgements

The authors are grateful to Kenneth A. Christiansen (Grinnell College, Iowa, USA) for the loan of the specimens for study, and for reviewing the manuscript, and to Frans Janssens, University of Antwerp, Belgium, for reviewing the manuscript. Dirección General de Asuntos del Personal Académico, Universidad Nacional Autónoma de México supported Dr. José G. Palacios Vargas at Madrid, Spain.

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