

Two syntopic and remarkably similar new species of *Sinella* and *Coecobrya* from South China (Collembola, Entomobryidae)

**Feng ZHANG
Ji-Qiang QU**

School of Life Science, Nanjing University, Nanjing (P. R. China)
xtmtd.zf@gmail.com

Louis DEHARVENG

Muséum national d'Histoire naturelle,
UMR 7205 CNRS, Origine, Structure et Évolution de la Biodiversité,
case postale 50, 57 rue Cuvier, F-75231 Paris cedex 05 (France)
deharven@mnHN.fr

Zhang F., Qu J.-Q. & Deharveng L. 2010. — Two syntopic and remarkably similar new species of *Sinella* and *Coecobrya* from South China (Collembola, Entomobryidae). *Zoosystème* 32 (3): 469-477.

ABSTRACT

Sinella colorata n. sp. and *Coecobrya mulun* n. sp., both pigmented and 3+3-eyed, are described from Guangxi Province in southern China. *Coecobrya mulun* n. sp., is the first 3+3-eyed species in the large genus *Coecobrya* Yosii, 1956. The two species live in syntopy and are similar in many respects, but easily separated by their mucro, bidentate in *Sinella* Brook, 1882 and falcate in *Coecobrya*, the ratio between the length of the non-annulated distal part of the dens and the mucro (3 vs 1.5), and the position of the tooth on inner side of the claw (at 45 vs 65% from base).

RÉSUMÉ

Deux nouvelles espèces syntopiques et remarquablement similaires des genres Sinella et Coecobrya du sud de la Chine (Collembola, Entomobryidae).

Sinella colorata n. sp. et *Coecobrya mulun* n. sp., deux espèces d'Entomobryidae pigmentées et pourvues de 3+3 yeux, sont décrites de la province du Guangxi dans le sud de la Chine. *Coecobrya mulun* n. sp., est la première espèce à 3+3 yeux au sein du grand genre *Coecobrya* Yosii, 1956. Les deux espèces vivent en syntopie et sont similaires par de nombreux traits, mais peuvent être aisément séparées par la forme du mucron, bidenté chez *Sinella* Brook, 1882 et falciforme chez *Coecobrya*, le rapport entre la longueur de la partie distale non annelée de la dens et le mucron (3 versus 1.5) et par la position de la dent interne de la griffe (45 versus 65 % depuis la base).

KEY WORDS
Collembola,
Entomobryidae,
soil,
Guangxi,
China,
new species.

MOTS CLÉS
Collembola,
Entomobryidae,
sol,
Guangxi,
Chine,
espèces nouvelles.

INTRODUCTION

The genera *Coecobrya* Yosii, 1956 (see Zhang *et al.* 2009 for a justification of its taxonomic level as genus rather than subgenus of *Sinella*) and *Sinella* Brook, 1882 belong to the subfamily Entomobryinae Schäffer, 1896 characterized by the absence of body scales, a reduced eye number (0–6 on each side), antennal segments not subdivided and not annulated, and the presence of trochanteral organ on leg III. The two genera share several morphological features, though all of them are also found in various other genera of the subfamily: four smooth prelabral chaetae, absence of labral papillae, median U-shaped intrusion of labral margin, polymacrochaetotic chaetotaxy, thoracic chaetotaxy of the multiplet type, and absence of dental spines. The assignation of specimens to either genus only relies on mucronal structure, bidentate in *Sinella* and falcate in *Coecobrya*. The s-chaetotaxy and macrochaetaxy of tergites were studied in detail in the two genera (Zhang & Deharveng 2009; Zhang *et al.* 2009), but they did not result in additional generic characters.

In the course of work in the Guangxi Nature Reserves organized by the Guangxi Forestry Bureau and implemented by the World Bank for the Global Environment Facility, a rich material of various taxa, including several new Collembola, was collected, mainly in Mulun and Yachang nature reserves. The Entomobryidae genera *Coecobrya* and *Sinella* were particularly diverse in caves as well as in forest soils. We describe here two species of remarkably similar habitus (3+3 eyes and pigmented body), one in each genus, which occur in syntopy in this latter habitat of the Mulun Nature Reserve.

MATERIAL AND METHODS

Specimens, including both adult and young individuals, were mounted after clearing in lactic acid under a coverslip in Marc André II solution, and were studied using a Leica DMLB microscope. Photographs were taken with a Leica DMLB microscope using a mounted ProgRes microscope camera, and were enhanced with Photoshop CS2 (Adobe Inc.). The chaetae on both sides of head are described after Chen & Christiansen

(1993), and dorsal body chaetotaxy are designated using Szeptycki's system (1979).

ABBREVIATIONS

Abd.	abdominal segment;
Ant.	antennal segment;
Th.	thoracic segment;
MNHN	Muséum national d'Histoire naturelle, Paris;
NJU	Department of Biological Science and Technology, Nanjing University.

SYSTEMATICS

Family ENTOMOBRYIDAE Schäffer, 1896

Genus *Sinella* Brook, 1882

TYPE SPECIES. — *Sinella curviseta* Brook, 1882.

Sinella colorata n. sp.

(Figs 1A, B; 2; 3)

TYPE MATERIAL. — China. Guangxi, Huanjiang, Mulun National Reserve, Min Li forest, litter, Berlese extraction, sample no. CHIgx05-102, 14.III.2005, Deharveng L. & Bedos A. leg., ♂ holotype on slide (NJU). — Paratypes: same data as holotype, 1 ♂, 1 specimen with sex not visible (probably ♀) on slide (NJU); 1 ♂, 1 juvenile, 1 specimen with sex not visible (probably ♀) on slide (MNHN).

OTHER MATERIAL EXAMINED. — Same data as holotype, except Berlese extraction following sieving (CHIgx05-109), 1 ♀, 4 specimens with sex not visible on slide (NJU); 1 ♂, 4 specimens with sex not visible on slide (MNHN).

TYPE LOCALITY. — China, Guangxi, Huanjiang, Mulun National Reserve, Min Li forest.

ETYMOLOGY. — Named after its well-pigmented body.

ECOLOGY. — In leaf litter of broadleaf forest.

DESCRIPTION

Body length up to 1.25 mm.

Body colour stable, pale beige-violet to pale orange, antennae pale violet-bluish (Fig. 1A, B). Eyes black, subdivided into a large anterior patch (2 eyes) and a small posterior patch (1 eye).

Head: antenna about 2 times as long as cephalic diagonal. Ratio of antennal segment I : II : III : IV as 1 : 1.8–2.0 : 1.5–1.6 : 3.1–3.2. Ant. III organ with 2 slightly expanded rods. Ant. IV without apical bulb.

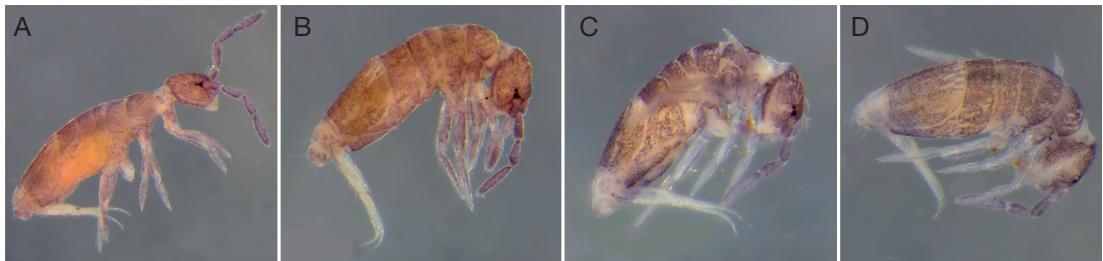


FIG. 1. — Habitus of Collembola from South China: **A, B**, two views of *Sinella colorata* n. sp. (1.2 mm); **C, D**, two views of *Coecobrya mulun* n. sp. (1.3 mm).

Eyes 3+3. Labral papillae absent. Prelabral and labral chaetae 4/5, 5, 4, all smooth. Lateral process of labial palp as thick as normal chaetae, with tip just reaching apex of labial papilla (Fig. 2A). Subapical chaeta of maxillary outer lobe large, slightly larger than apical one; 4 smooth sublobal hairs on maxillary outer lobe (Fig. 2B). Basal chaetae on labium as MREL₁L₂, all smooth; chaeta R 0.5 length of chaeta M. Ventral chaeta X behind labium smooth, X₄ ciliate, X₂ and X₃ absent (Fig. 2C). Dorsal cephalic chaetotaxy with 5 sutural macrochaetae (S) and 3 macrochaetae in Gr. II (Fig. 2D).

Thorax: dorsal macrochaetae shown in Figure 2E. Th. II with 3 (m₁, m₂, m_{2i}) medio-medial, 3 (m₄, m_{4p}, m_{4i}) medio-lateral, 14-16 posterior macrochaetae (with p₄ and p₅ as macrochaetae, p_{4i} often absent) and 3 lateral s-chaetae (the internal one smaller). Th. III with 20-22 macrochaetae and 2 s-chaetae; p₅, m_{6p} and a₇ as microchaetae. Trochanteral organ with 8-13 smooth spiny chaetae, 6-10 in arms and 2 or 3 between them (Fig. 2F). Inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis; inner outstanding macrochaeta ciliate and tapered at tip, located at about 0.33 distance from base. Unpaired tooth of claw at 45% from inner edge base. Ungual inner basal paired teeth unequal, outer one much larger. A pair of small outer basal teeth. Unguiculus lanceolate with outer edge smooth. Tenent hairs of all tibiotarsi thin and acuminate (Fig. 2G).

Abdomen: Abd. IV 2.8-3.8 times as long as Abd. III along dorsal midline. Abd. I with 5 (m_{2i}, m₂₋₄, m_{4p}) central macrochaetae and 2 s-chaetae. Abd. II with 3 (a₂, m₃, m_{3e}) central, 1 (m₅) lateral macrochaetae and 2 s-chaetae. Abd. III with 1 (m₃) central, 2 (p_{m6}, p₆) lateral macrochaetae and 3 s-chaetae; am₆

as microchaeta (Fig. 2H). Abd. IV with 3 (A₆, B₄₋₅) central, 6 (F₁, E₂₋₄, E_{2p}, D₃) lateral macrochaetae and about 13 s-chaetae (Fig. 2I). Abd. V with about 30 chaetae and 3 s-chaetae; m₂, m₃ and m₅ always much larger than others (Fig. 3A). Tenaculum with 4+4 teeth and one large, distally bent, apparently weakly striate chaeta. Ventral tube anteriorly with 4 ciliate chaetae on each side (Fig. 3B); posteriorly with 6-10 smooth chaetae, always 4 in distal row (Fig. 3C); each lateral flap with 5 smooth chaetae in adults (Fig. 3B) and often 4 in subadults. Manubrium without smooth chaetae. Manubrial plaque with 2+2 pseudopores and 2+2 ciliate chaetae. Distal smooth part of dens 3 times the length of mucro. Mucro bidentate and basal spine short with tip reaching apex of subapical tooth (Fig. 3D).

REMARKS

Sinella colorata n. sp. is characterized by the presence of 4 smooth sublobal hairs on maxillary outer lobe, 3+3 eyes, ciliate chaeta X₄ behind labium, macrochaetae p₄ and p₅ on Th. II, macrochaeta m_{5i} on Th. III, microchaeta am₆ on Abd. III, and long distal smooth part of dens. The 4 sublobal hairs on maxillary outer lobe are observed in *Sinella* for the first time, though the character is unknown in many species. Among *Sinella* with 3+3 eyes, *S. colorata* n. sp. is closest to the Vietnamese species *S. pseudostraminea* Stach, 1965 in number of eyes, absence of external tooth on unguiculus, and 1+1 central macrochaetae on Abd. III; it differs from the latter in shorter mucronal basal spine, presence of a₂ and absence of m_{3ep} on Abd. II, and fewer macrochaetae on Abd. IV (Table 1). The 3+3 eyed species of the genus *Sinella* may be separated by the following key.

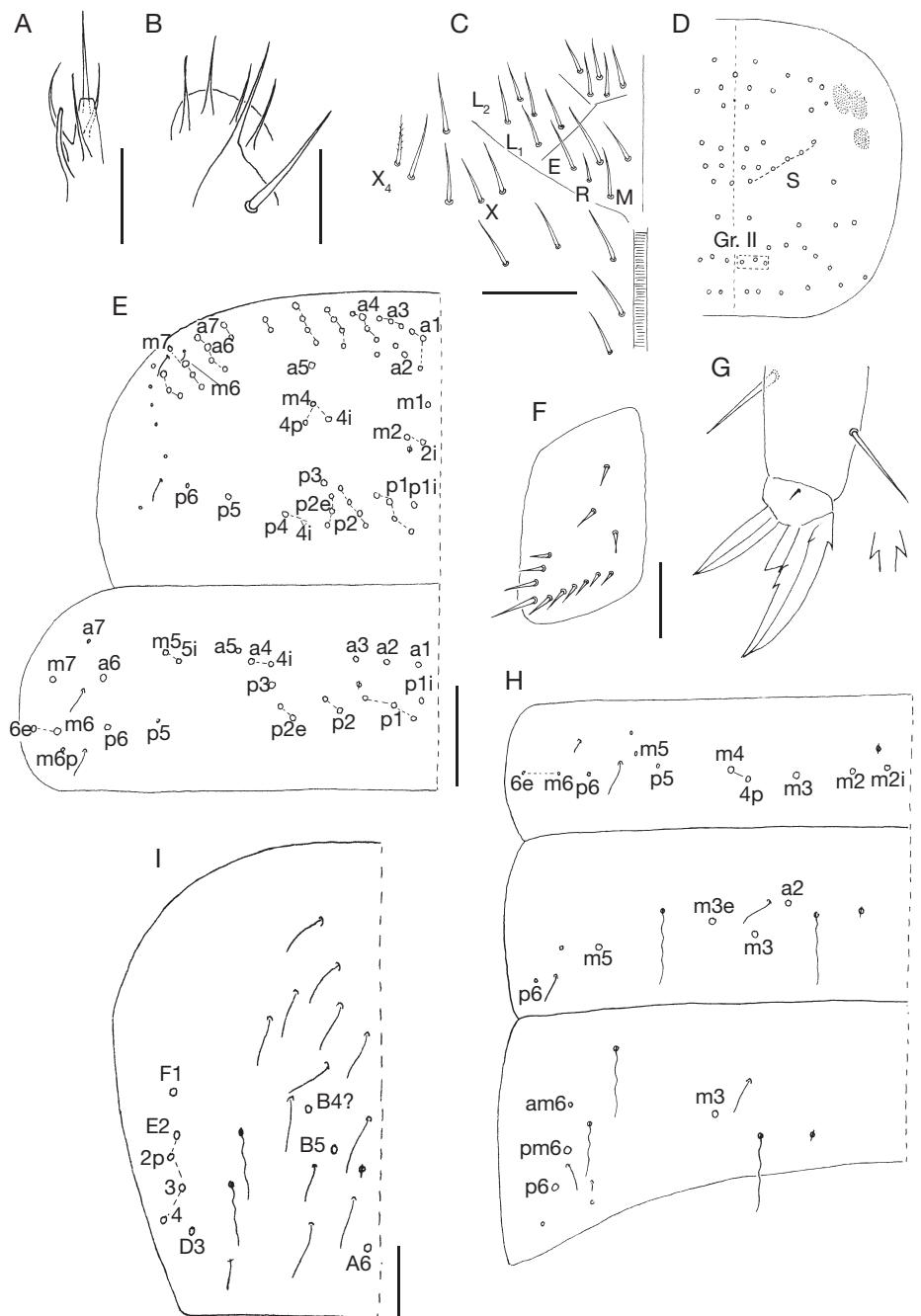


FIG. 2. — *Sinella colorata* n. sp.: A, lateral process of labial palp; B, maxillary outer lobe; C, chaetae on labium and ventral side of the head; D, dorsal cephalic chaetotaxy (eyes are represented by their pigment trace, which has migrated anteriorly during the clearing process); E, thoracic chaetotaxy; F, trochanteral organ; G, hind claw in lateral view, with detail of basal teeth in dorsal view; H, I, abdominal chaetotaxy; H, Abd. I-III; I, Abd. IV; D, E, H, I, macrochaetae and large ordinary chaetae represented by their sockets; s-chaetae represented in full. Scale bars: A, B, 10 µm; C, D, F, G, 25 µm; E, H, I, 50 µm.

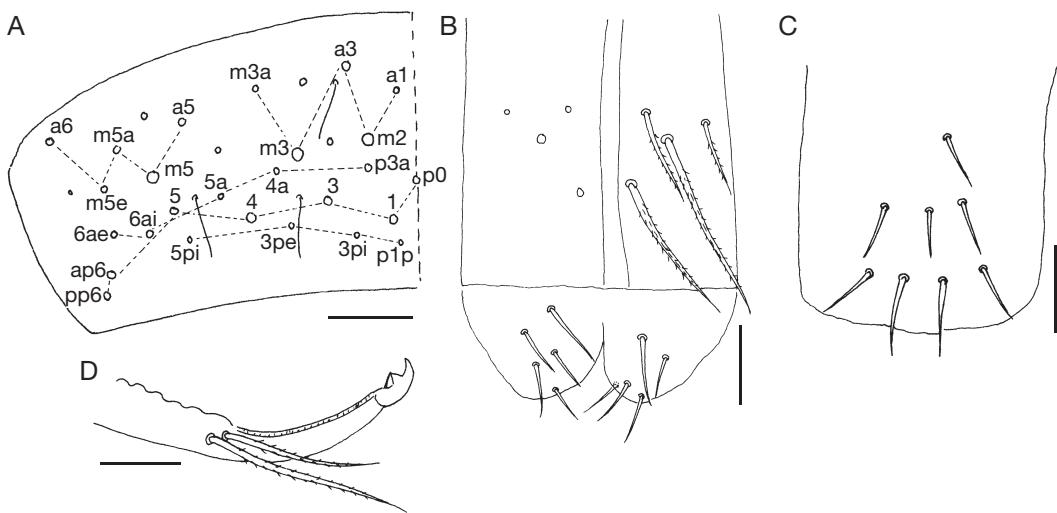


FIG. 3. — *Sinella colorata* n. sp.: A, chaetotaxy of Abd. V; B, anterior face and lateral flap of ventral tube; C, posterior face of ventral tube; D, distal part of dens and mucro; A, macrochaetae and large ordinary chaetae represented by their sockets; s-chaetae represented in full. Scale bars: A, D, 25 µm; B, C, 10 µm.

KEY TO THE 3+3-EYED SPECIES OF *SINELLA* BROOK, 1882

1. Unguiculus with a clear tooth on outer edge 2
- Unguiculus smooth or serrate or with a tiny tooth on outer edge 4
2. Mucronal basal spine long reaching at least half way from tip of subapical tooth to tip of apical tooth; Abd. III with 2+2 central macrochaetae; eyes equally distant *S. wui*, China
- Mucronal basal spine short, at most slightly exceeding tip of subapical tooth; eyes in two groups (2 anterior and 1 posterior) 3
3. Abd. III with 1+1 central macrochaetae *S. straminea* sensu Wang & Christiansen 2000, Japan
- Abd. III with 2+2 central macrochaetae *S. triocula*, China
4. Dental smooth part more than 5 times mucro in length 5
- Dental smooth part less than 4 times mucro in length 6
5. Inner basal paired teeth of unguis at 50% from inner edge base *S. hexophthalma*, Chile
- Inner basal paired teeth of unguis at 65% from inner edge base *S. recens*, USA
6. Abd. III with 3+3 central macrochaetae *S. sexoculata*, USA
- Abd. III with 1+1 central macrochaetae 7
7. Abd. IV with 3+3 central macrochaetae *S. colorata* n. sp., South China
- Abd. IV with 7+7 central macrochaetae *S. pseudostraminea*, Vietnam

Genus *Coecobrya* Yosii, 1956

TYPE SPECIES. — *Sinella (Coecobrya) akiyoshiana* Yosii, 1956.

Coecobrya mulun n. sp.
(Figs 1C, D; 4)

TYPE MATERIAL. — **China.** Guangxi, Huanjiang, Mulun National Reserve, Min Li Forest, sample no. CHIgx05-102, 14.III.2005, Deharveng L. & Bedos A. leg., ♀ holotype on slide. — Paratypes: same data as holotype, 1 ♀ on slide (NJU); 1 ♀ on slide (MNHN).

OTHER MATERIAL EXAMINED. — Same data as holotype, except Berlese extraction following sieving (CHIgx05-109), 1 ♀ (MNHN); 1 specimen with sex not visible on slide (NJU).

TYPE LOCALITY. — China, Guangxi, Huanjiang, Mulun National Reserve, Min Li Forest.

ETYMOLOGY. — Named after the type locality.

ECOLOGY. — In leaf litter of broadleaf forest.

DESCRIPTION

Body length up to 1.40 mm.

Body pale violet-bluish; antennae violet-bluish (Fig. 1C, D). Eyes black, subdivided into a large anterior patch (2 eyes) and a small posterior patch (1 eye).

Head: antenna 1.6–1.9 times as long as cephalic diagonal. Ratio of antennal segments I : II : III : IV as 1 : 1.5–1.8 : 1.3–1.5 : 2.3–2.5. Ant. III organ not clearly seen. Ant. IV without apical bulb. Eyes 3+3. Labral papillae absent. Prelabral and labral chaetae 4/5, 5, 4, all smooth. Lateral process of labial palp slightly thicker than normal chaetae, with tip reaching beyond apex of labial papilla (Fig. 4A). Subapical chaeta of maxillary outer lobe large, subequal to apical one; 3 smooth sublobal hairs on maxillary outer lobe (Fig. 4B). Basal chaetae on labium as MREL₁L₂, all smooth; R 0.4 length of chaeta M; ventral chaeta X behind labium smooth and 0.5 length of chaeta M; chaetae X₂ and X₄ ciliate; chaeta X₃ absent (Fig. 4C). Cephalic dorsal chaetotaxy with

5 sutural macrochaetae (S) and 4 macrochaetae in Gr. II (Fig. 4D).

Thorax: dorsal macrochaetae shown in Figure 4E. Th. II with 3 (m₁, m₂, m_{2i}) medio-medial, 3 (m₄, m_{4i}, m_{4p}) medio-lateral, 17–20 posterior macrochaetae (with p₄, p₅ and p_{4i} as macrochaetae) and 3 lateral s-chaetae (the internal one smaller). Th. III with 23 macrochaetae and 2 s-chaetae; p₅ as microchaeta and m_{5i} as macrochaeta. Trochanteral organ with 10 or 11 smooth spiny chaetae, 7 or 8 in arms and 2–4 between them (Fig. 4F). Inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis; inner outstanding macrochaeta ciliate and tapered, located at about 0.33 distance from base. Unpaired tooth of claw at 65% from inner edge base. Ungual inner basal paired teeth unequal, outer one larger. A pair of small outer basal teeth. Unguiculus with outer edge smooth. Tenent hair on hind leg clavate and others thin and acuminate, subequal to unguiculus in length in the only specimen (holotype) where tenent hairs have been preserved (Fig. 4G).

Abdomen: Abd. IV 3–3.6 times as long as Abd. III along dorsal midline. Abd. I with 5 (m_{2–4}, a₃, m_{4p}) central macrochaetae and 2 s-chaetae. Abd. II with 3 (a₂, m₃, m_{3e}) central, 1 (m₅) lateral macrochaetae and 2 s-chaetae. Abd. III with 1 (m₃) central, 3 (am₆, pm₆, p₆) lateral macrochaetae and 3 s-chaetae (Fig. 4H). Abd. IV with 3 (A₆, B_{4–5}) central, 6 (D₃, F₁, E_{2–4}, E_{2p}) lateral macrochaetae and about 13 s-chaetae (Fig. 4I). Abd. V with 3 s-chaetae (Fig. 4J). Tenaculum with 4+4 teeth and one large, distally bent, apparently weakly striate chaeta. Ventral tube anteriorly with 5 ciliate chaetae on each side (Fig. 4K); posteriorly with 8 smooth chaetae (Fig. 4L); each lateral flap with 7 smooth chaetae. Manubrium without smooth chaetae. Manubrium plaque with 2+2 pseudopores and 3+3 ciliate chaetae. Distal smooth part of dens 1.5 times length of mucro. Mucro falcate and basal spine long with tip reaching apex of apical tooth (Fig. 4M).

REMARKS

All *Coecobrya* known so far had 0+0 or 1+1 eyes, except *C. tetraphthalma* (Denis, 1948)

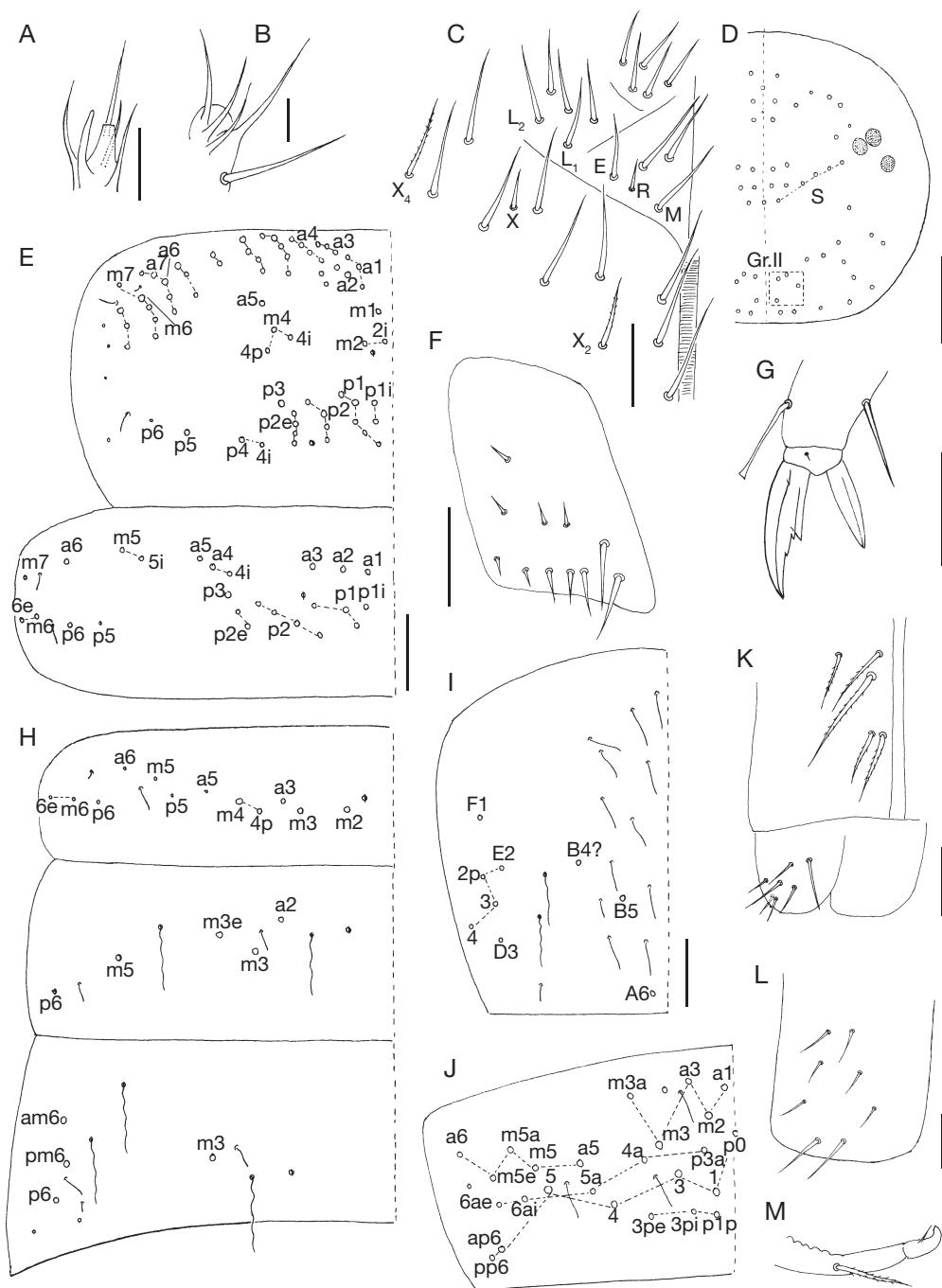


FIG. 4. — *Coecobrya mulun* n. sp.: **A**, lateral process of labial palp; **B**, maxillary outer lobe; **C**, chaetae on labium and ventral side of the head; **D**, dorsal cephalic chaetotaxy; **E**, thoracic chaetotaxy; **F**, trochanteral organ; **G**, hind claw; **H-J**, abdominal chaetotaxy; **H**, Abd. I-III; **I**, Abd. IV; **J**, Abd. V; **K**, anterior face and lateral flap of ventral tube; **L**, posterior face of ventral tube; **M**, distal part of dens and mucro; **D**, **E**, **H-J**, macrochaetae and large ordinary chaetae represented by their sockets; **s**-chaetae represented in full. Scale bars: A-C, 10 µm; D, F, G, J-M, 25 µm; E, H, I, 50 µm.

TABLE 1. — Differences between *Sinella colorata* n. sp., *Coecobrya mulun* n. sp. and their closest relatives, *S. pseudostraminea* Stach, 1965 (original description) and *C. tetrophthalmalma* (Denis, 1948) (from specimens of Dalat, Vietnam). —, information not available.

	<i>S. colorata</i> n. sp.	<i>S. pseudostraminea</i>	<i>C. mulun</i> n. sp.	<i>C. tetrophthalmalma</i>
Distribution	South China	Vietnam	South China	Vietnam
Pigment on body	present	absent	present	absent
Eyes	3+3	3+3	3+3	2+2
Sublobal hairs on maxillary outer lobe	4	—	3	3
Chaeta X ₂ on ventral side of head	absent	—	ciliate	smooth
Dorsal cephalic chaetae				
sutural chaetae	5	—	5	3
Gr. II	3	—	4	4
Th. II				
macrochaeta m4i	present	—	present	absent
macrochaeta p4	present	—	present	absent
Macrochaeta m5i on Th. III	present	—	present	absent
Spines on trochanteral organ	8-13	23	10-11	7-8
Tenent hair of tibiotarsus III	pointed	pointed	clavate	pointed
Abd. I				
macrochaeta m2i	present	absent	absent	absent
macrochaeta a3	absent	present	present	absent
macrochaeta m4p	present	present	present	absent
Abd. II				
macrochaeta a2	present	absent	present	present
macrochaeta m3ep	absent	present	absent	absent
Macrochaeta am6 on Abd. III	absent	present	present	absent
Abd. IV				
central macrochaetae	3	7	3	3
macrochaeta F1	present	—	present	absent
Chaetae of ventral tube				
anterior face	4	—	5	5-6
posterior face	6-10	—	8	8
lateral flap	5	—	7	6
Mucro	bidentate	bidentate	falcate	falcate
Ratio of smooth part of dens to mucro	3	1	1.5	2-3
Mucronal basal spine	short	long	long	long
Ciliate chaetae on manubrial plaque	2	—	3	2

from Vietnam with 2+2 eyes. With 3+3 eyes, *C. mulun* n. sp. has the highest number of eyes recorded in *Coecobrya*. Many morphological and chaetotaxic features are shared by *C. mulun* n. sp. and *C. tetrophthalmalma*, but all are also found in various other species of the genus: 3 sublobal hairs on the maxillary outer lobe, 4 dorsal cephalic macrochaetae in Gr. II, similar claw structure (but see below), chaetotaxy of Abd. II, 1+1 central macrochaetae on Abd. III, and 3+3 central macrochaetae on Abd. IV. The two species differ by the number of eyes, pigmented versus unpigmented body, 5 versus 3 sutural chaetae on head and several chaetotaxic characters summarized in Table 1.

DISCUSSION

Coecobrya mulun n. sp. and *Sinella colorata* n. sp. belong to closely related, but well-defined genera. They have pigmented body and 3+3 eyes, a feature not rare in *Sinella*, but recorded for the first time in the genus *Coecobrya*. Their habitus extremely similar and their occurrence in the same litter samples of the Mulun forests raise problems at first sight regarding the status of the genera to which they belong. Aside habitus (the two species are hardly distinguishable in alcohol under low magnification, see Figure 1), they share several morphological features, such as ocular pattern, antenna length, absence of external tooth on unguiculus, labial and tergite chaetotaxy

(particularly on Th. II-III., Abd. II and IV, and s-chaetotaxy). However, these characters are also found in many other species of both genera, where eye number is different and pigment sometimes absent. Beside the obvious difference in mucronal morphology that separates the genera *Coecobrya* and *Sinella*, *C. mulun* n. sp. and *S. colorata* n. sp. also differ in important characters, such as the number of sublobal hairs (3 vs 4), the ratio of smooth part of dens to mucro, the position of the unpaired tooth on inner side of unguis (65 vs 45% from inner edge base), and several chaetotaxic details. The similarity in habitus, eyes and coloration between the two species might simply reflect the close relationships between *Coecobrya* and *Sinella*, combined to a plesiomorphic state of eye (in *Coecobrya*) and of pigment development. This similarity is not stronger than observed between blind species of both genera. The validity of the two genera *Coecobrya* and *Sinella* is therefore not questioned by our finding, as far as the character states used to discriminate them (falcate versus bidentate mucro) are unambiguous in all species known so far.

Acknowledgements

The present study was supported by the Ministry of Science and Technology of the People's Republic of China (2006FY120100).

REFERENCES

- CHEN J.-X. & CHRISTIANSEN K. A. 1993. — The genus *Sinella* with special reference to *Sinella* s.s. (Collembola: Entomobryidae) of China. *Oriental Insects* 27: 1-54.
- SZEPTYCKI A. 1979. — *Morpho-Systematic Studies on Collembola. IV. Chaetotaxy of the Entomobryidae and its Phylogenetical Significance*. Polska Akademia Nauk, Kraków, Poland, 216 p.
- WANG F. & CHRISTIANSEN K. 2000. — A new species of *Sinella* from China (Collembola: Entomobryidae). *Entomological News* 111 (6): 332-336.
- ZHANG F. & DEHARVENG L. 2009. — A new cave *Sinella* species from South China (Collembola: Entomobryidae). *Zootaxa* 2009: 35-40.
- ZHANG F., DEHARVENG L. & CHEN J.-X. 2009. — New species and rediagnosis of *Coecobrya* (Collembola: Entomobryidae), with a key to the species of the genus. *Journal of Natural History* 43: 2597-2615.

*Submitted on 26 October 2009;
accepted on 4 May 2010.*