Fauna of Thai Caves. II. New Entomobryoidea Collembola from Chiang Dao Cave, Thailand[1]

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ABSTRACT

Four new species of Entomobryoidea collected in Chiang Dao cave, northern Thailand, are described and illustrated: *Troglopedetes leclerci*, n.sp., *Pseudosinella chiangdaoensis*, n.sp., *Coecobrya guanophila*, n.sp., and *C. similis*, n.sp.

INTRODUCTION

Large collections of Collembola were made in Tham Chiang Dao (Tham = cave in Thai) during the speleo-scientific expeditions of the "Association Pyrénéenne de Spéléologie" in Thailand, particularly in 1985. Dr. Fred Stone also collected some collembological material from the same cave studied here.

Collembola are represented by at least 10 species in Tham Chiang Dao, of which only *Troglopedetes fredstonei* Deharveng has already been described. The present paper deals with 4 new species of Entomobryoidea *Troglopedetes leclerci*, n.sp., *Pseudosinella chiangdaoensis*, n.sp., *Coecobrya guanophila*, n.sp., and *Coecobrya similis*, n.sp. Two additional species (*Coecobrya* sp. and *Troglopedetes* sp.) were also found in one occasion in the cave, but the material is not sufficient for a full description.

The following abbreviations are used: abd. = abdominal segment; ant. = antennal segment; th. = thoracic segment. Numbering and morphology of labial basal setae follow Gisin (1967).

Holotypes are deposited in Museum National d'Histoire Naturelle, Paris, France (MNHN); paratypes are deposited in the following collections: Bishop Museum, Honolulu, Hawai'i (BPBM); Biology Department, Chiang Mai University, Chiang Mai, Thailand (BDCM) and Laboratoire d'Ecologie des Invertébrés Terrestres, Université Paul Sabatier, Toulouse, France (LEITT).

SYSTEMATICS

Troglopedetes leclerci Deharveng, **new species** Figs. 1–6

Length: 0.7–1mm. Color: white, with spot of blue pigment on each eye. Antenna 2–2.5 × as long as cephalic diagonal (Fig. 1). Ant. ratio in μm: 54:93:72:(84 + 84) (1 male), 75:138:120:(129 + 111) (1 female); ant. I, II with a few scales; ant.IV subdivided into 2 subsegments, without apical bulb. Eyes 3 + 3, small. Clypeolabral formula ?,4/5,5,4. Four prelabral setae ciliated. Outer maxillary ramus with 1 papillated seta, 1 basal seta, 2 sublobal hairs. Setae of labial basis as M1M2REL1l2; M1 to L1 subequal, ciliated; l2 reduced to smooth, short, large

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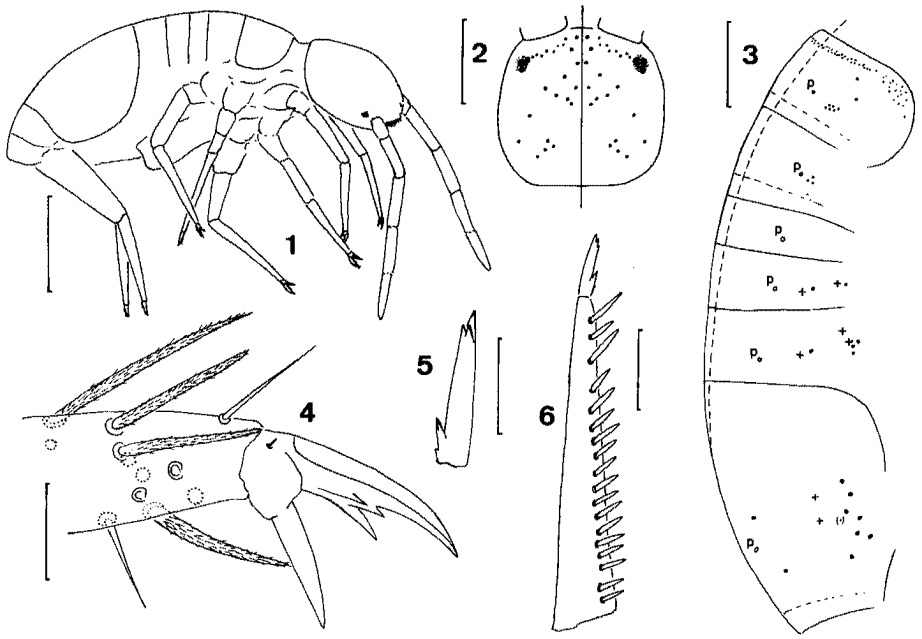


Figs. 1–6. *Troglopedetes leclerci* Deharveng, n.sp. (p: = pseudopora; + = trichobothria): **1**, habitus; **2**, dorsal cephalic macrochaetotaxy; **3**, macrochaetotaxy of tergites; **4**, apex of tibiotarsus and praetarsus of leg III; **5**, mucro, ventral view; **6**, mucrodens, lateral view. Scales: 250 μm, Fig. 1; 100 μm, Figs. 2–3; 50 μm, Fig. 6; 25 μm, Fig. 5; 10 μm, Fig. 4.

spine. Legs devoid of scales. Unguis slightly elongated, rather strong unpaired tooth at basal ½ and pair of unequal teeth at basal ⅓ of inner side of claw (Fig. 4). Trochanteral organ of LIII with 5 to 9 smooth, straight, unequal setae. Tenent hair pointed or feebly capitate, slightly shorter than inner side of claw. Ventral tube with 6 + 6 setae on lateral flaps (4 + 4 smooth distal, 2 + 2 rough, more proximal), 3 + 3 large, rough, anterior setae, about 30 posterior, medium-sized setae, rough except 2 smooth, straight distal ones. Macrochaetae present on body with following pattern: 7,4/6 + 2,3/0,1,1,2 (Figs. 2, 3). Other dorsal setae: short to medium, smooth, thin, pointed (probably s-setae) and short, ordinary ciliated setae; body otherwise covered with rounded scales. Manubrium scaled ventrally, with many subequal ciliated setae dorsally, leaving median glabrous streak; 3–4 + 3–4 ciliated dorsodistal setae; no smooth setae on lateral border. Dens (Fig. 6) slightly tapering, ventrally scaled, with 2 dorsal rows of spines throughout, spines of external row larger, less sclerotized than those of internal row; short and long ciliated setae present only along dorsal side of dens. Mucro elongate, 4 main blunt teeth and additional minute tooth at base of basal tooth (Fig. 5).

Type data. Holotype ♂, THAILAND: Changwat Chiang Mai: Amphoe Chiang Dao, Tham Chiang Dao, "réseau guano," on walls, 10.VII.1985 (P. Leclerc) (TC45) (MNHN). Paratypes: THAILAND: 1 ♀, 1 juv., topotypic, "réseau guano," on walls, 10.VII.1985 (P. Leclerc) (TC45); 1 juv., topotypic, "réseau guano," G8 station, 10.VII.1985 (P. Leclerc) (TC46); 1 ♀, topotypic, "réseau supérieur," S5 station, 7.VII.1985 (L. Deharveng) (TC25); 1 ♀, topotypic, "réseau supérieur," 25.XII.1980 (L. Deharveng) (THA110). One paratype in BDCM; 4 paratypes in LEITT.

Etymology. We are pleased to name this species for Philippe Leclerc, who made large collections of Collembola with us in Tham Chiang Dao.

Relationships. *Troglopedetes leclerci* belongs to the same group as *T. fredstonei*, previously described from Tham Chiang Dao. It is easily distinguished from *fredstonei* by its smaller size, shorter antennae and legs, different macrochaetotaxic pattern, and presence of 3 + 3 pigmented eyes. These 2 species differ from all other described *Troglopedetes* by the following combination of characters: 4th antennal segment subdivided into 2 subsegments; 2 rows of spines on the dens; mucro devoid of basal denticulations.

Troglopedetes sp.

One young specimen of a 3rd species of this genus was collected in Tham Chiang Dao, near the entrance, in roots and soil. It differs from all known Thai species of the genus by its mucro being devoid of a basal tooth and by a larger number of macrochaetae on the tergites.

Pseudosinella chiangdaoensis Deharveng, **new species** Figs. 7–14

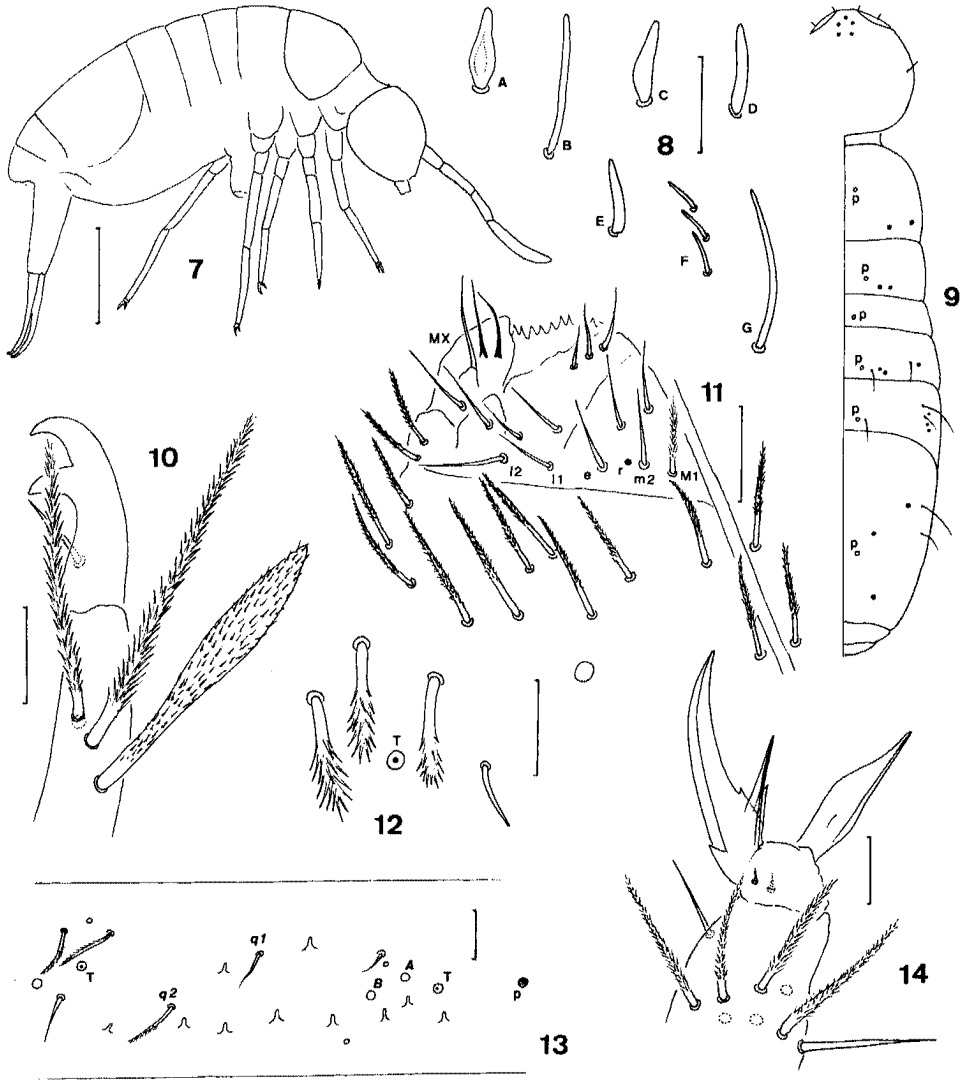
Length: 1–1.2 mm. Color: entirely white. No eyes. Antenna ca. 2× as long as cephalic diagonal; ant. ratios in μm: 62:100:99:195 (Fig. 7). Antennae devoid of scales, with 6 types of setae: 1) ordinary ciliated setae, medium to long, on all segments; some long and thin, perpendicular to integument on ant.II; 2) smooth, straight, thin ordinary setae, medium sized, perpendicular to integument on ant.IV, ventrally on ant.I; 3) short, smooth, thin microchaetae at bases of ant.I (4) and ant.II (4); 4) subcylindrical, medium sized s-setae, numerous on ant.II, III, and IV; some thicker and shorter (Figs. 8B, G), absent on ant.I; 5) short, thick s-setae, a few on ant.I (ventrally), II, III, and IV (Figs. 8A, C, D, E); 6) short, thin s-setae, ventrally on ant.I, a few on dorsodistal part of ant.II, on apical part of ant.III, some on ant.IV.

Ant.III organ with 2 internal s-setae of type 5, in small alveoli; guard setae mixed with type 4 and type 6 setae. One pseudopore at apex of ant.III. Prelabral setae ciliated. Labral formula ?,4/5,5,4. Labial formula M1m2rel1l2; m2, e, and l2 very slightly rough; r reduced to extremely minute seta with large base (Fig. 11). Outer maxillary ramus with 1 thin papillated seta, 1 basal seta, and 2 sublobal hairs as long and thin as papillated seta; venter head with scales and some ordinary ciliated setae (Fig. 11).

Legs without scales. Unguis elongated, small unpaired tooth at basal 37–40% and pair of pointed, long, unequal proximal teeth; 2 very small dorsobasal teeth also present; unguiculus rather thin, with 1 or 2 very small external teeth; pretarsal setae very short (Fig. 14). Tibiotarsal tenent hairs thin, pointed, 1 on each tibiotarsus; smooth ventrodistal seta of tibiotarsus III nearly as long as adjacent ciliated setae (Fig. 14). Trochanteral organ with 8 thin, smooth, straight setae (1 specimen examined). Ventral tube with 6 + 6 laterodistal setae (5 + 5 rough, 1 + 1 ciliated), 6 + 6 long ciliated anterior setae, 2 + 2 smooth medium posterior setae. Tenaculum with 4 + 4 teeth and 1 large ciliated seta. Manubrium with 2 + 2 ventrodistal ciliated setae and at least 5–6 + 5–6 dorsodistal ciliated setae; dorsum with numerous ciliated subequal setae, without smooth setae, each side with longitudinal row of smaller, thinner ciliated setae. Dens rather short, with ventral scales and rows of ciliated setae (1 internal row and 2 external rows; setae more numerous and rows not distinguishable at base). Distal nonannulated part of dens more than 2× mucro; mucro strong, bidentate, with large basal seta (Fig. 10). Macrochaetae on body with following pattern: R000/22/0201 + 2 (Fig. 9). Chaetotaxy of abd.II: -ABq1q2 (Fig. 13). On abd.IV seta "s" is absent (Fig. 12).

Type data. Holotype ♀, THAILAND: Changwat Chiang Mai: Amphoe Chiang Dao, Tham Chiang Dao "réseau supérieur"; 31.VII.1985 (P. Leclerc) (TC55) (MNHN). Paratypes: THAILAND: 2 ex., topotypic, "réseau supérieur"; 10.VII.1985 (L. Deharveng) (TC36) (LEITT).

Relationships. *Pseudosinella chiangdaoensis*, n.sp., is the first species of this genus described



Figs. 7–14. *Pseudosinella chiangdaoensis* Deharveng, n.sp. (p = pseudopora): **7,** habitus; **8,** different types of setae (see text) on ant.I (E,F), ant.II (A,D,G) and ant.III (B,C); **9,** schematic dorsal macrochaetotaxy; **10,** apex of mucrodens; **11,** labium base, outer maxillary ramus (MX) and part of ventral chaetotaxy of head; **12,** trichobothrial complex of abd.IV (left side); **13,** chaetotaxy of abd.II (left side; ∧ = scales; T = trichobothria); **14,** apex of tibiotarsus and praetarsus of leg III. Scales: 250 μm, Fig. 7; 25 μm, Fig. 11; 10 μm, Figs. 8,10,12–14.

from Thailand. Its macrochaetotaxic pattern is different from that of any of its congeners. In Thailand, *Pseudosinella* seem to be restricted mainly to cave environments, where they are not common. They may be relict species, but the reason for their limitation to caves, as well as their taxonomic relationships, are not clear.

Genus ***Coecobrya*** Yosii, **new status**

Sinella (Coecobrya) Yosii, 1956, Jap. J. Zool., 11(5): 622; type species *Sinella (Coecobrya) akiyoshiana* Yosii, 1956, l.c., by original designation.

Table 1. Characters of the *Sinella-Coecobrya* complex.

	Sinella*	Coecobrya*	Sinella**	Coecobrya**
Subapical organ of ant. IV	absent***	present	absent*** or present	
Ant.II organ	absent	present	absent or present	
Ventral tube setae	numerous	fewer	variable	
Dens and manubrium smooth dorsal setae	absent	present	absent or present	
Mucro	bidentate or falcate		bidentate	falcate

* Sensu Yosii 1964.
** Sensu mihi.
*** Dubious statement.

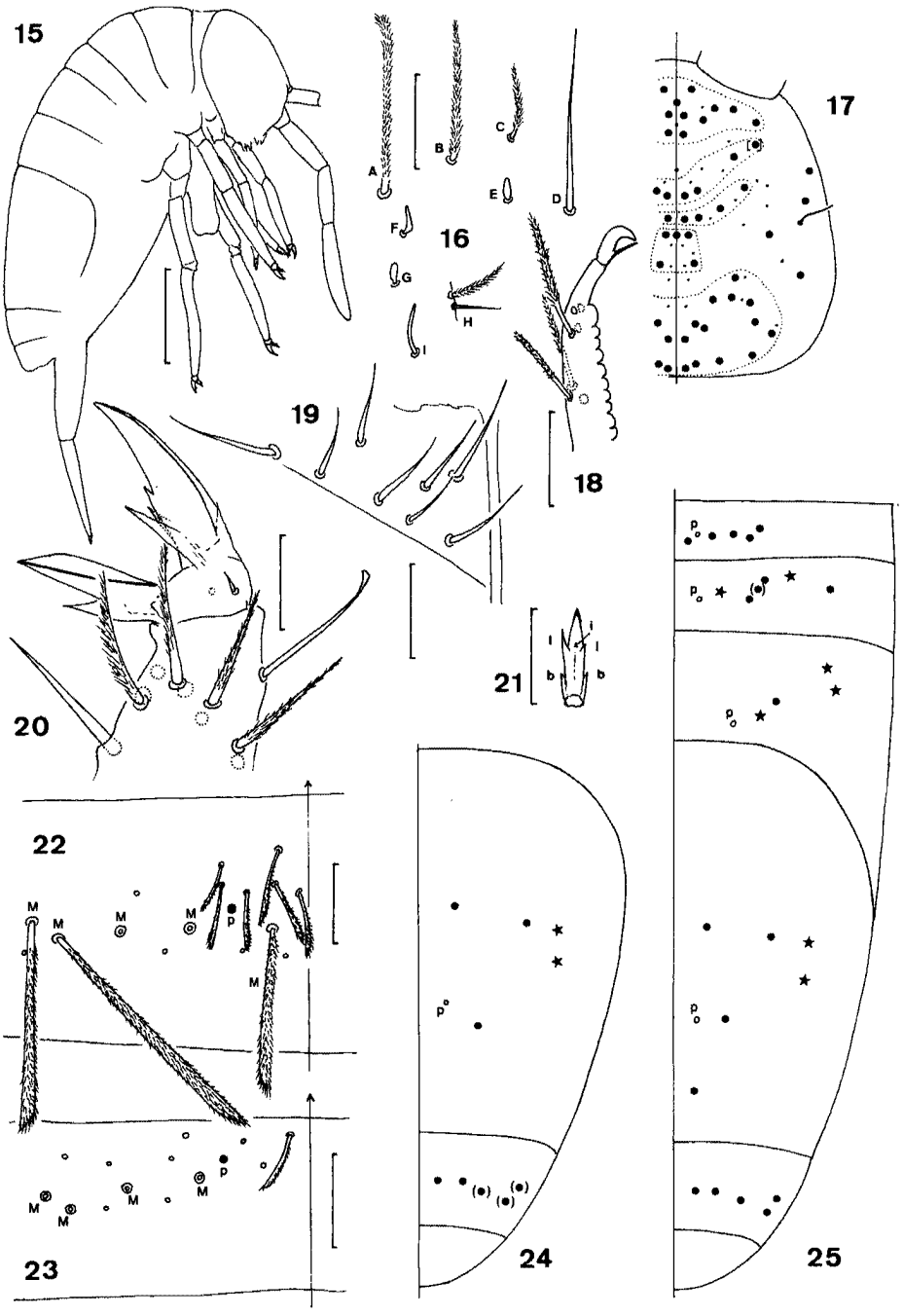
Yosii (1956) separates *Coecobrya* from *Sinella* by the presence in the former of only 1 smooth seta on tibiotarsus III and a falciform mucro. From the study of American species, Christiansen (1960) considered this difference only specific. Yosii (1964) follows Christiansen on this point; he proposed in the same paper a new set of sharp differential characters (Table 1), which I checked in all Thai species at hand. The 2 species described below would belong to *Coecobrya* sensu Yosii 1964, whereas several undescribed species of central and northern Thailand have characters both of *Sinella* sensu Yosii (dens and manubrium setae) and *Coecobrya* sensu Yosii (antennae and ventral tube). A better taxonomic and biogeographical consistency is obtained by considering the form of the mucro as the basic differential character between *Coecobrya* (falcate mucro) and *Sinella* (bidentate mucro): in this case, all Thai species come in *Coecobrya*, whereas all American except the probably introduced *C. caeca* (Christiansen and Bellinger, 1980) come in *Sinella*. On these grounds, I adopt here this new conception and, considering the number and diversity of species belonging to either 2 genera, I raise *Coecobrya* to generic status. Incidentally, the form of mucro has been described for all known species, which is not the case for the differential characters proposed by Yosii (1964). Many undescribed *Coecobrya* of different evolutionary lines are present in soils and in caves in Thailand. *Sinella* is absent in our samples.

Coecobrya guanophila Deharveng, **new species** Figs. 15–19, 21, 22, 25

Length: 0.9–1.2 mm. Color: entirely white. No eyes. Antennae about ½ as long as body. Ant. ratio in μm: 81:150:126:243 (Fig. 15). Antennal setae of 6 types: 1) Ciliated, medium to long setae; apically pointed (Figs. 16B, C, H), except sometimes 1–(2) large ones on dorsal side of ant.I and ant.II (Fig. 16A). 2) Smooth straight setae, inserted perpendicular to integument; either long (3 internal, 1 ventro-external on ant.I, 2 ventral, 3 internal on ant.II, 1 ventrodistal on ant.III, Fig. 16D), or rather short (numerous on ant.IV, Fig. 16H). 3) Smooth, short microchaetae at bases of antennal segments (at least 4 on ant.I, 4 on ant.II, ?0 on ant.III, none on ant.IV). 4) Subcylindrical, rather thin s-setae; numerous, mainly on dorsal side of ant.IV, also present on ant.II, III and ventrally on ant.IV (Fig. 16I). 5) Thick, short s-setae on ant.II (1 external, 1 internal, Fig. 16E) and ant.III (1 ventral, 3 external, 1 internal, Fig. 16F), apparently none on ant.I, IV. 6) Short, thin ordinary or s-setae inserted not perpendicular to integument, on ant.I, II (ventrally), and on ant.III, IV.

Ant.III organ with 2 very small, thick, internal sensillae (Fig. 16G), not hidden in integumental fold, guard-setae not different from other s-setae of segment. No apical bulb on ant.IV.

Clypeolabral formula ?,4/5,5,4. Four prelabral setae smooth. External differentiated seta of



Figs. 15–25. *Coecobrya guanophila* Deharveng, n.sp. (Figs. 15–19,21,22,25). *Coecobrya similis* Deharveng, n.sp. (Figs. 20,23,24) (p = pseudopora; M = macrochaeta; stars = trichobothria): **15**, habitus; **16**, different types of setae (see text) on ant.II (A, B, C, D, E), ant.III (F, G) and ant.IV (H, I); **17**, schematic dorsal macrochaetotaxy of head (small dots = short setae; groups of setae are surrounded by dotted lines); **18**, apex of mucrodens; **19**, labium base; **20**, apex of tibiotarsus and praetarsus of leg III; **21**, claw, ventral view (i = unpaired tooth; l = lateral unequal teeth; b = dorsobasal teeth); **22,23**, chaetotaxy of abd.I (left side); **24**, schematic macrochaetotaxy of abd. tergites IV-V; **25**, schematic macrochaetotaxy of abd. tergites I-V. Scales: 250 μm, Fig. 15; 25 μm, Figs. 18–19, 21–23; 10 μm, Figs. 16, 20.

labial palp well developed, curved. Setae of labial base smooth (Fig. 19). Outer maxillary ramus with 1 papillated seta, 1 basal seta, 3 sublobal hairs. Ventral side of head with numerous smooth setae and ciliated setae.

Dorsal macrochaetotaxic pattern: 15, 6–8, 8, 5, 20–26/ numerous on th.II-III/5, 2–3, 1, 1 + 3; on abd.II some specimens have 2 + 2, others have 3 + 3 macrochaetae; on abd.V, generally 5 + 5 macrochaetae, with some variability (Figs. 17, 22, 25). Pseudopora of abd.IV rather variable in position.

Unguis not elongate, with unpaired tooth at basal 50–60 % of inner side, 2 proximal unequal inner teeth and 1 pair dorsobasal subequal teeth (Fig. 21). Unguiculus with strong external tooth. One tenent hair on each tibiotarsus, smooth, thin, not capitate on TI and TII, capitate on TIII. Tibiotarsus III with only 1 smooth ventral seta distally. Each tibiotarsus has strong ciliated ventrobasal macrochaeta. Trochanteral organ with 12 smooth setae, some relatively long, others very short. Tenaculum with 4 + 4 teeth and 1 strong rough seta. Ventral tube with 7 + 7 smooth setae, little swelling on lateral flaps, 1 + 1 smooth posterior setae and 6 + 6 ciliated anterior setae. Manubrium with numerous, medium sized, ciliated setae on dorsal and ventral sides, containing 6–7 + 6–7 smooth dorsal setae, rather long, inserted perpendicular to integument. Dorsodistal setae 2 + 2, with 2 + 2 pseudopora nearby. Dens with numerous, rather long, ciliated setae, 1 dorsobasal smooth, rather long, seta. Mucro falciform, strongly curved, with 1 straight basal seta; distal nonannulated part of dens subequal to length of mucro (Fig. 18).

Type data. Holotype ♀, THAILAND: Changwat Chiang Mai: Amphoe Chiang Dao, Tham Chiang Dao, "réseau guano," 16.VII.1985 (P.Leclerc) (TC47) (MNHN). Paratypes: THAILAND: 9 ex., topotypic, "réseau guano," 16.VII.1985 (P. Leclerc) (TC47); 1 ex., topotypic, 25.XII.1980 (Deharveng) (THA110); 13 ex., topotypic, VIII.1981 (F. Stone) (5253, 5254); numerous ex., topotypic, 2.VII.1985 to 31.VII.1985 (L.Deharveng) (TC18, 21, 22, 25, 26, 27, 29, 32, 38, 40); numerous ex., same data (P. Leclerc) (TC44, 45, 57); 1 ex., topotypic, 5.VII.1986 (F.Stone) (TCD 102C). Five paratypes in MNHN; 10 paratypes in BPBM; 4 paratypes in BDCM; numerous paratypes in LEITT.

Etymology. The name of the species refers to its abundance in humid guano deposits in caves.

Relationships. *Coecobrya guanophila* comes near *C. caeca* (Schött) as redescribed by Christiansen and Bellinger (1980). The macrochaetotaxic pattern of abd.I-III is the same. The main difference is the number of smooth or very finely striate ventral setae on tibiotarsus III, which is only 1 in *C. guanophila*; they are several in *C. caeca*.

According to Yosii (1956), the Japanese cave species *C. dubiosa* Yosii and *C. guanophila* have similar macrochaetotaxic patterns, except in the presence of 2 + 2 posterior macrochaetae on abd.IV in the former instead of 1 + 1 in *C. guanophila*. *Coecobrya dubiosa* should also be devoid of smooth ventral seta on tibiotarsus III, a character which has yet to be checked. At least the distal smooth seta seems to be a constant feature in *Coecobrya*.

Coecobrya similis Deharveng, **new species** Figs. 20, 23, 24

Length: 0.55–0.95 mm. Color: entirely white. No eyes. Antennae about ½ as long as body. Ant. ratio in μm: 39:60:60:114. Antennal setae of 6 types as in *C. guanophila*: type 1 apically pointed except sometimes 1–2 large setae on dorsal side of ant.II, rarely of ant.I; type 2 either long (some on ant.I, ant.II and ant.III), or rather short (numerous on ant.IV); type 3 with at least 4 on ant.I, 3 on ant.II, ?0 on ant.III, none on ant.IV; type 4 as in *guanophila*; type 5 on ant.II (at least 1) and ant.III (several), apparently none on ant.I and ant.IV; type 6 as in *guanophila*.

Ant.III organ with 2 very small thick internal sensillae, similar to type 5, not hidden in

integumental fold, guard setae not different from other type 4 s-setae of segment. No apical bulb on ant.IV.

Clypeolabral formula ?,4/5,5,4. Four prelabral setae smooth. External differentiated seta of labial palp well developed. Setae of the labial base smooth. Outer maxillary ramus with 1 papillated seta, 1 basal seta, 3 sublobal hairs. Ventral side of head with numerous smooth, ciliated setae.

Dorsal macrochaetotaxic pattern illustrated in Figs. 23, 24: 15,6–8,8,5,20–26/numerous on th.II-III/4,2–3,1,1 + 2; macrochaetae on abd.V variable in number, feebly differentiated from large mesochaetae. Pseudopora on abd.IV variable in position.

Unguis not elongate, with unpaired tooth at basal 50–60% of inner side, 2 proximal unequal inner teeth, 1 pair dorsobasal subequal teeth; unguiculus with strong external tooth; 1 tenent hair on each tibiotarsus, smooth, thin, pointed on TI and TII, capitate on TIII; tibiotarsus III with only 1 smooth ventral seta distally (Fig. 20). All tibiotarsi have 1 or 2 broad ciliated ventrobasal macrochaeta. Trochanteral organ with 9–12 smooth setae, some relatively long, others very short. Ventral tube with 6 + 6 smooth setae, slight swelling on lateral flaps, 1 + 1 smooth posterior setae, 5–6 + 5–6 ciliated anterior setae. Tenaculum with 4 + 4 teeth and 1 strong ciliated seta. Manubrium with numerous, medium-sized ciliated setae on dorsal and ventral side containing 6–7 + 6–7 smooth dorsal setae, rather long, inserted perpendicular to integument. Dorsodistal setae 2 + 2, with 2 + 2 pseudopora nearby. Dens with numerous, rather long, ciliated setae, 2 dorsobasal smooth, rather long, setae. Mucro falciform, with straight basal seta. Distal nonannulated part of dens subequal to length of mucro.

Type data. Holotype ♀, THAILAND: Changwat Chiang Mai: Amphoe Chiang Dao, Ban Tham, 500 m, forest soil, 17.XII.1980, berlese extractor (L. Deharveng) (THA13) (MNHN). Paratypes: THAILAND: numerous ex., topotypic, 500m, forest litter and soil, 17.XII.1980, berlese extractor (L. Deharveng) (THA10,11,12,13). Three paratypes in MNHN; 8 paratypes in BPBM; 8 paratypes in BDCM; numerous paratypes in LEITT.

Other material examined. THAILAND: 3 ex., Changwat Chiang Mai, Amphoe Chiang Dao, Tham Chiang Dao, roots and soil near entrance, dark zone, 25.XII.1980 (L.Deharveng) (THA 108) (LEITT).

Observations. *Coecobrya similis* is frequent in the forest litter outside Tham Chiang Dao; the few specimens found in the cave were just at the entrance and should be considered trogloxenes.

Relationships. Morphological differences between *C.guanophila* and *C. similis*, which are otherwise very similar, are summarized below:

	guanophila	*similis*
Body size in mm	0.9–1.2	0.55–0.95
Macrochaetae on abd.I	5 + 5	4 + 4
Macrochaetae on abd.IV	4 + 4	3 + 3
Smooth dorsobasal setae on dens	1	2

Coecobrya sp.

One specimen of a 3rd species of *Coecobrya* was collected in Tham Sia Dao, a small fossil cave, which develops only a few meters from the "réseau Touristes" of Tham Chiang Dao. This new species is not closely related to *C. guanophila* or *C. similis*. In particular, its macrochaetotaxic pattern is rather different on abdominal tergites (5,3,1,1 + 5).

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