

Fauna of Thai Caves. III.
Two New Cavernicolous Species of *Arrhopalites*
from Thailand (Insecta: Collembola)¹

Pierre Nayrolles²

ABSTRACT

Two new species of *Arrhopalites* from Chiang Dao cave, northern Thailand, *A. chiangdaoensis* and *A. anulifer*, are described and illustrated.

INTRODUCTION

During the Thai 81 and Thai-Maros 85 expeditions, extensive faunal collections were carried out in Chiang Dao cave, a large underground system of the Chiang Mai Province. Symphypleona Collembolans were represented by 2 new species of *Arrhopalites*, which are described in this paper. They are the 1st species of this genus recorded from Thailand.

The following abbreviations are used: abd. = abdominal segment; ant. = antennal segment.

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

***Arrhopalites chiangdaoensis* Nayrolles, new species**

Figs. 1–7

Description. *Body length.* ♀: 0.6 mm; ♂: 0.5 mm. *Color.* White, or more or less reddish, particularly head (preserved in alcohol). *Antennae.* Relative lengths of antennal segments I:II:III:IV = 1:2:3.1:8. Ant. III with papilla in basal ½ (Fig. 6). Ant. III organ with usual 2 rods. Ant. IV distinctly subdivided into 5 subsegments, basal subsegment ca. 1.2 × longer than terminal one. *Head.* Eyes 1 + 1 unpigmented. Only thin ordinary setae present. *Legs* (Figs. 2–4). Tibiotarsal chaetotaxy as in table 1 (nomenclature follows Nayrolles 1988). Like *Arrhopalites terricola*, V ai and particularly V pi of 2nd and 3rd pairs of legs shifted toward base. Claws slender, without tunica, each with distinct inner tooth. Inner lamella of unguiculus more developed on hind legs than on 1st and 2nd legs. Unguiculus of all legs without tooth, with long apical needle, distinctly longer than tip of claw. *Tenaculum* (Fig. 5). With tridentate rami, small, club-shaped appendage at base of each ramus, 2 setae at tip of pars anterior. *Furca* (Fig. 1). Ratio dens/mucro 1.7; manubrium with 5 + 5 dorsal setae. Chaetotaxy of dentes as in table 4; same as *A. pygmaeus* (Wankel). Ventral setae of dentes: 3, 2, 1 . . . 1. Mucro serrated on both sides, without apical swelling. *Small abd.* Anal setae thin, smooth, median setae of upper anal

1. Publication costs supported by National Science Foundation Grant No. BSR-8515183.

2. UA 333 du CNRS, Laboratoire d'Ecologie des Invertébrés Terrestres, Université Paul Sabatier, 118 route de Narbonne, 31062 Toulouse Cedex, France.

flap (a0) not forked. Subanal appendage (Fig. 7) split into 2 more or less unequal serrated branches.

Type data. Holotype ♀ and 1 paratype ♀, THAILAND: Changwat Chiang Mai: Amphoe Chiang Dao, Tham Chiang Dao, "réseau actif," trap, 25.XII.1980 (Deharveng) (THA 104b). Other paratypes: 2 ♀, 1 ♂, 1 juv., same station, "réseau supérieur," 25.XII.1980, (Deharveng) (THA 110). 13, same station, VII.1985 (Deharveng): "réseau touriste," 2 ♀ (TC 19); "réseau guano," 1 ♀ (TC 32); "réseau supérieur," 6 ♀, 1 ♂, 3 juv. (TC 25, TC 26, TC 27, TC 84). Holotype in MNHN, Paris; 2 paratypes in BPBM; 2 paratypes in BDCM; 13 paratypes in LEITT.

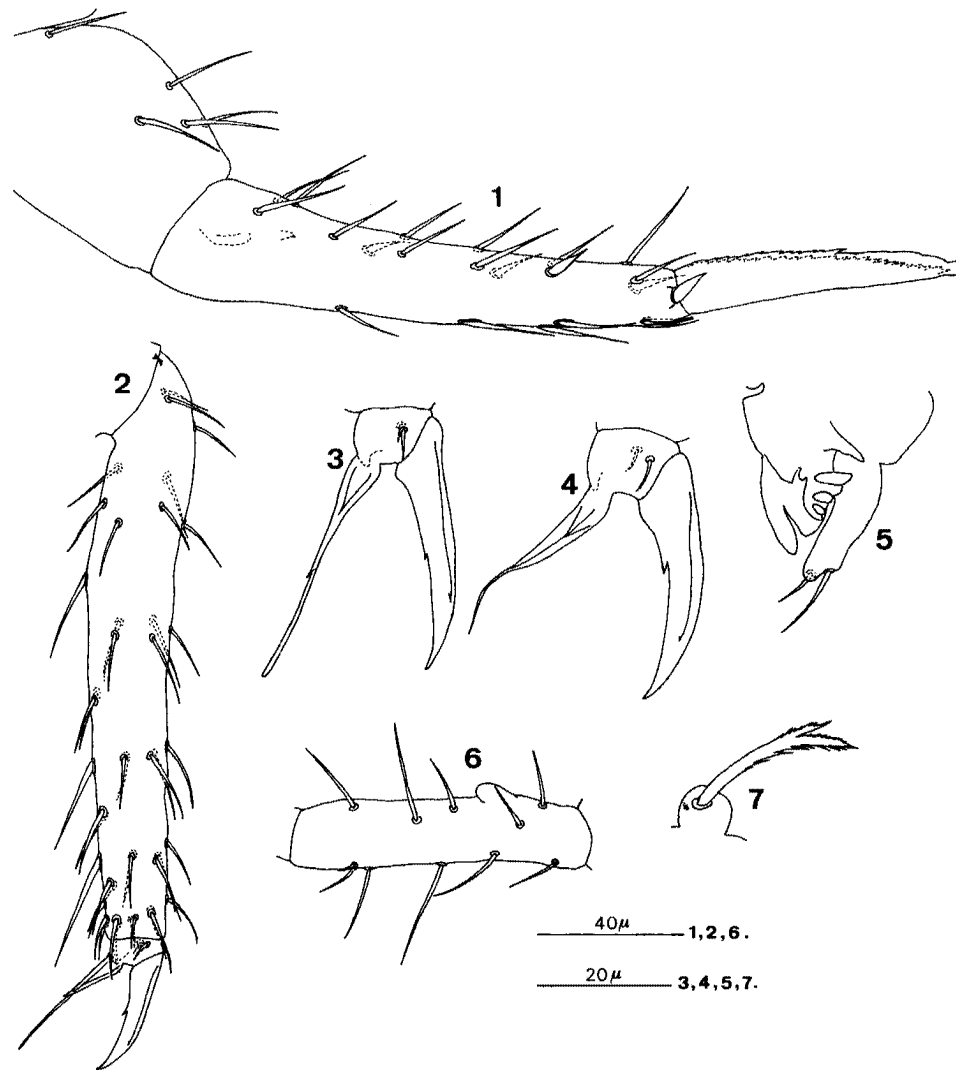
Remarks. On account of its characters (ant. III with a papilla on its basal half and a long apical needle on the empodial appendage of the hind legs), *Arrhopalites chiangdaoensis*, n. sp., seems close to the group of European species established by Cassagnau and Delamare Deboutteville (1953), which includes *furcatus* Stach, *ornatus* Stach, and *elegans* Cassagnau & Delamare. The differential characters of these species are given by Selga (1963). *Arrhopalites chiangdaoensis* and *elegans* differ from the other 2 species by their subanal appendage split into 2 serrated branches (subanal appendage with 2 smooth branches in *furcatus*, abundantly branched in *ornatus*). Differences between *elegans* and *chiangdaoensis* are weak: *elegans* has 1 inner tooth on the unguiculus of forelegs and the claws of hindlegs are thick, while *chiangdaoensis* has its unguiculus of the forelegs without a tooth and the claws of hindlegs are relatively slender; this last character can be considered as a troglomorphic one. A North American species: *hirtus* Christiansen has also ant. III with a papilla and all empodial appendages each with a long apical needle; nevertheless, seta e6 of the dens is absent and subanal appendage is deeply serrated in *hirtus*, while e6 is present and subanal appendage is simply split in 2 serrated branches in *chiangdaoensis*.

***Arrhopalites anulifer* Nayrolles, new species**

Figs. 8–14

Description. *Body length.* ♀: 0.6–0.7 mm. *Color.* White (preserved in alcohol). *Antennae.* Relative lengths of antennal segments I–IV = 1:1.9:3.6:7.1. Ant. III without prominent papilla, with circular area devoid of integumentary granulation in basal ½. Ant. III organ with usual 2 rods. Ant. IV (Fig. 10) more or less subdivided into 6 subsegments (sometimes 5 subsegments when 2 basal ones are fused). One or several rings more or less marked (generally 2) between subsegments. *Head.* Eyes 1 + 1 unpigmented. Vertical setae spiny except 3 setae of median row (like *Arrhopalites nivalis* Yosii). *Legs* (Figs. 11–13). Tibiotarsal chaetotaxy as in table 2. Claws of forelegs longer, more slender than those of 2nd and especially 3rd pair of legs; claws of leg III more curved. Fine tunica dorsally on the claws of median and hind legs; tunica absent on the claws of forelegs. Inner tooth on claws of all legs. All unguiculus with distinct tooth (smaller on 3rd pair of legs than on 1st and 2nd); apical needle longer than tip of claw. *Tenaculum.* Normal with 2 setae at tip of pars anterior. *Furca* (Figs. 8–9). Ratio dens/mucro 1.5; manubrium with 5 + 5 dorsal setae. Chaetotaxy of dentes as in table 4; ventral setae of dentes: 3,2,2,1,1; mucro serrated on both sides, rounded at tip. *Small abd.* (Fig. 14). Upper anal flap bears 7 (3–1–3) large, winged setae (a0, a1, a2, a3) alternating with 3 slender setae. Each lateral flap with 3 large winged setae (ai1, ai2, ai3) alternating with slender setae. Upper anal flap with 3 + 3 spinose processes: 1 + 1 small dorsal, 2 + 2 large lateral. One small female has only 2 + 2 spinose processes on upper anal flap, 1 of large spinose processes, most ventral one, wanting. Subanal appendage in side view straight, gradually narrowing toward tip; straight in dorsal view, equally thick throughout length, weakly denticulated at tip.

Type data. Holotype ♀ and 1 paratype ♀, THAILAND: Changwat Chiang Mai: Amphoe

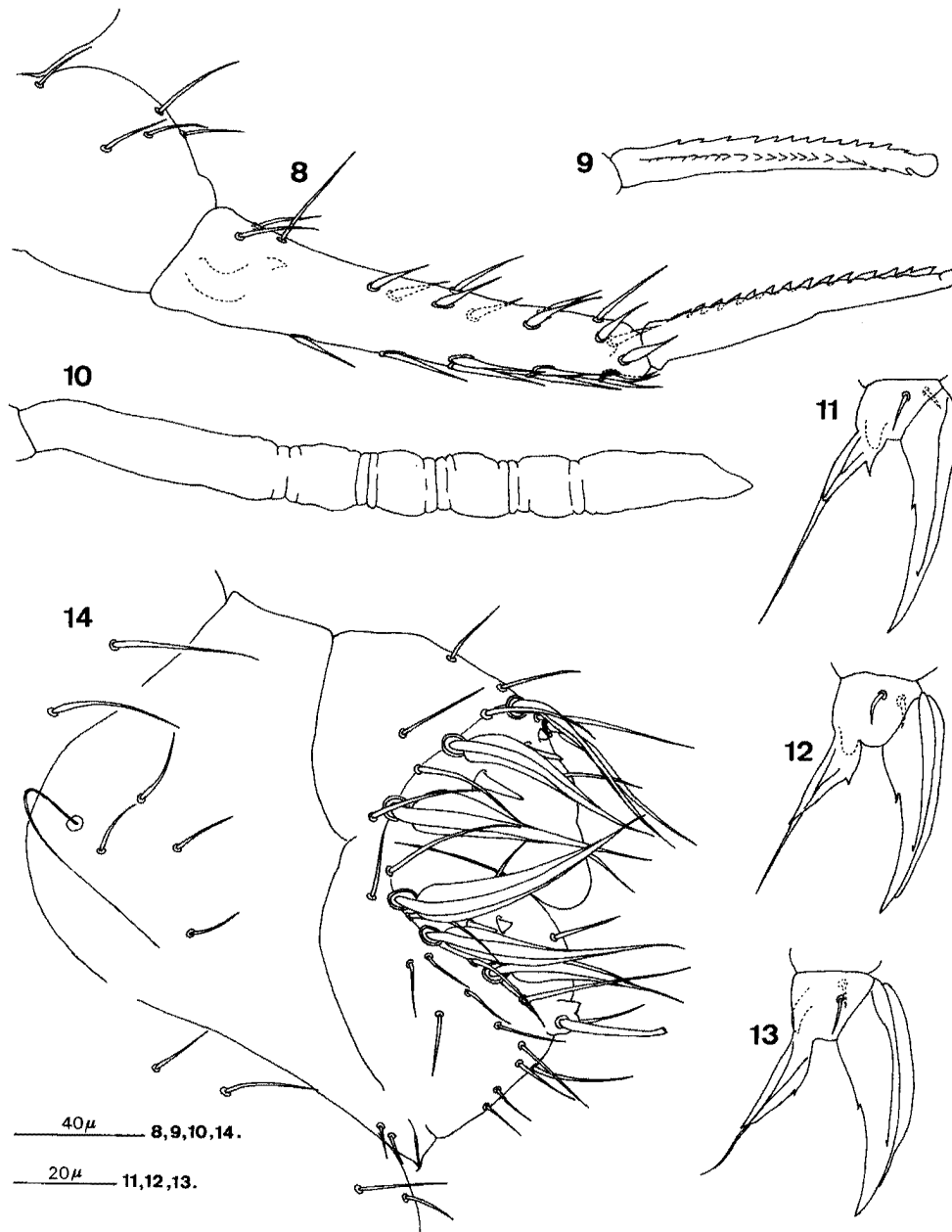


Figs. 1–7. *Arrhopalites chiangdaoensis*, n. sp.: 1, furca, external view; 2, tibiotarsus of leg II, anterior view; 3, praetarsus of leg I, anterior view; 4, praetarsus of leg III, anterior view; 5, tenaculum, right side view; 6, right ant. III; 7, subanal appendage.

Chiang Dao, Doi Chiang Dao, 1,720 m, shaft P1, –22 m, 12.VII.1985 (J.P. Besson) (DC 14). Holotype in MNHN, Paris; paratype in LEITT.

Other material examined. THAILAND: Changwat Chiang Mai: 1 juv., Amphoe Chiang Dao, Tham Chiang Dao, 25.XII.1980, “réseau supérieur,” (L.Deharveng) (THA 110); 1 ♀, same station, 6.VII.1985, “réseau touriste,” (Deharveng) (TC 19); 2 ♀, same station, 7.VII.1985, “réseau supérieur,” (Deharveng) (TC 27); 9 ♀, 11 juv., forest near Ban Tham Chiang Dao, decaying wood, 17.XII.1980, (Deharveng) (THA 5). Three ex. in BPBM; 3 ex. in collection of BDCM; 18 ex. in LEITT.

Etymology. The specific epithet, *anulifer* is from the Latin *anulus* = ring, with reference to the rings between subsegments of ant. IV.



Figs. 8–14. *Arrhopalites anulifer*, n. sp.: 8, furca, external view; 9, mucro, dorsal view; 10, left ant. IV; 11, praetarsus of leg I, anterior view; 12, praetarsus of leg II, anterior view; 13, praetarsus of leg III, anterior view; 14, small abd., left side view.

Discussion. The presence of spinose processes on the anal flaps links *Arrhopalites anulifer*, n. sp., to the *coecus* group. On account of its ant. IV subdivided with rings between the subsegments, its lack of a ventral spine at the tip of the dens, and particularly its 3 + 3 spinose processes on the upper anal flap, *anulifer*, n. sp., seems very close to *antrobius* *Yosii* (redescribed by Yosii 1967). They can be separated by the characters in table 3.

**Ecology and Feeding of
Arrhopalites chiangdaoensis and *A. anulifer***

Arrhopalites chiangdaoensis was found only in the cave whereas *anulifer* has been met also in a shaft 22 m deep and in decaying wood in the forest.

The observation of the digestive tube of *chiangdaoensis* shows that this species ingests clay; only 1 female had myceliae mixed with clay. The digestive tubes of some individuals had unusual contents. One female had fragments of Collembola (2 mandibules, 1 claw, labium); 3 females and 1 juvenile had pieces of scales, probably from Tineoidea (Lepidoptera), which are abundant in the cave; 1 female had 1 piece of scale and some setae of *Sinella* (Collembola present in the same sample). Thus, *chiangdaoensis* seems to be polyphagous; the scales of Tineoidea in the digestive tube might be connected with eating moth cadavers.

One individual of *A. anulifer* had clay in its digestive tube; 1 female had myceliae and a labium of an unidentified Collembola. All others had myceliae or nothing (lacking of digestive contents connected with the molt).

REFERENCES

- Cassagnau, P. & C. Delamare Deboutteville.** 1953. Les *Arrhopalites* et *Pararrhopalites* d'Europe (Collemboles Symphypléones cavernicoles). Not. Biospéol. 8:133-47.
- Christiansen, K.** 1966. The genus *Arrhopalites* (Collembola: Sminthuridae) in the United States and Canada. Int. J. Speleol. 2:43-73.
- Christiansen, K. & P. Bellinger.** 1981. The Collembola of North America, north of the Rio Grande. Grinnell College, Grinnell, Iowa. 1,322 p.
- Nayrolles, P.** 1988. Chétotaxie tibiotarsale des Collemboles Symphypléones. Trav. Lab. Ecobiol. Arthropod. Edaph. Toulouse 5(4):1-19.
- Selga, D.** 1963. Contribución al conocimiento de los *Arrhopalites* de España. Eos 39:449-79.
- Yosii, R.** 1954. Höhlencollembolen Japans I. Kontyû 20:62-70.
- . 1966. Collembola of Himalaya. J. Coll. Arts Sci. Chiba Univ. 4:461-531.
- . 1967. Some cave Collembola of Japan. Bull. Akiyoshi-dai Sci. Mus. 4:61-66.

Table 1. Tibiotarsal chaetotaxy of *Arrhopalites chiangdaoensis*, n.sp.

	P1	P2	P3
Primary setae			
Wanting setae of whorls	0	Vp	Vp
Setae K	-	-	-
Setae FP	+	+	+
Secondary setae			
Fundamental setae			
(Vai & Vpi)	+	+	+
Setae FS	-	-	FSa
Present setae of interwhorls	-	-	-
Oval organs	-	-	-
Specially shaped setae	-	-	-
Variable setae	Vai frequently wanting (1 case for 2)	Sometimes Vai wanting	-

Table 2. Tibiotarsal chaetotaxy of *Arrhopalites anulifer*, n.sp.

	P1	P2	P3
Primary setae			
Wanting setae of whorls	0	Vp	Vp
Setae K	-	-	-
Setae FP	+	+	+
Secondary setae			
Fundamental setae			
(Vai & Vpi)	+	+	+
Setae FS	-	-	FSa
Present setae of interwhorls			
Oval organs	-	-	-
Specially shaped setae	-	-	-
Variable setae	-	-	-

Table 3. Differences between *Arrhopalites antrobius* and *Arrhopalites anulifer*, n.sp.

<i>A. antrobius</i>	<i>A. anulifer</i> , n. sp.
Most ventral spinose process of upper anal flap small	Most ventral spinose process of upper anal flap large
Ventral setae of dentes: 3,2,1,1,1	Ventral setae of dentes: 3,2,2,1,1
Dorsal setae of dentes: 1 basal + 4	Dorsal setae of dentes: 1 basal + 3
Mucro not rounded at tip	Mucro rounded at tip
1 setae on pars anterior of tenaculum	2 setae on pars anterior of tenaculum

Table 4. Dental chaetotaxy of *Arrhopalites chiangdaoensis*, n. sp., and *Arrhopalites anulifer*, n. sp. (nomenclature follows Christiansen & Bellinger 1981).

	e2	e3	e4-5	e6	e7	e8-9	id3	l1	l2-3	14	ve1	ve2-4	ve5
<i>A. chiangdaoensis</i>	+	s	+	+	+	-	+	s	s	-	+	+	-
<i>A. anulifer</i>	s	s	s	-	+	-	-	s	s	(s)	+	+	+