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Cave millipeds of the United States. IV.
A new genus and species from a high altitude cave
in Colorado (Diplopoda, Chordeumatida, Tingupidae)¹

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ABSTRACT

Blancosoma scaturgo, new genus, new species, is a minute, troglitic chordeumatid milliped assigned here to the Family Tingupidae. Its gonopod structure deviates strongly from that of most other members of the family; it is regarded as the sister taxon of *Buotus*. Some additional notes are provided on the gonopods of *Buotus carolinus* Chamberlin.

INTRODUCTION

The milliped Family Tingupidae, a member of the brannerioid assemblage of families, presently consists of only eleven species, distributed unequally in two genera. *Tingupa*, with ten species, is the most diverse in the Pacific Northwest, where six of the species may be found in wet, temperate forests along the Oregon coast; a seventh occurs in the northern Sierra Nevada of Eldorado County, California. Two additional species are known from scattered localities in Utah and Arizona. The species *Tingupa pallida* Loomis is a troglitic common in caves in Missouri, Illinois and Arkansas. *Buotus carolinus* Chamberlin, the only known representative of its genus, is a minute soil and litter inhabitant from West Virginia, Virginia and North Carolina (Shear 1981).

The closest relatives of the Tingupidae are to be found in the Japanese members of the Family Niponiosomatidae, an assemblage of three species in the genus *Niponiosoma* Verhoeff. In writing of this small family, Shear (1988) briefly discussed the present confusion concerning the composition of the Superfamily Brannerioidea; the reader is referred to that discussion, which, in the absence of any new information on the superfamily, remains.

¹ Part III: Shear (1984). *Myriapodologica* 1(14): 95-104

During August of 1996, the second author carried out biological explorations in caves in Colorado. Among the many animals collected were several species of millipeds, including the discovery of new populations of the polydesmid genus *Speodesmus* Loomis (Shear 1984). The most striking specimens, however, came from Spring Cave, located in Rio Blanco County on the White River Plateau, near Buford. The cave entrance is at an altitude of about 8,000 ft., and the cave itself is comparatively large and wet (Parris 1973). Upon first examination, the single male obtained could not be assigned to any previously known North American chordeumatid family; the gonopods appeared unique. However, temporarily mounting these minute appendages on a microscope slide and studying them at high magnification using Nomarski Differential Interference Contrast illumination revealed that they conform in general to the tingupid plan. Further, the somewhat rugose sculpture of the tergites also suggest a tingupid of branneriid assignment. The species cannot be placed in either *Tingupa* or *Buotus*, for reasons discussed below, and thus a new genus is described for it.

Subsequent collecting at this difficult-to-access cave has resulted in the discovery of only a single male at hand. An additional concern is for the protection of the species and its type and only locality; this is made more likely if a name is available.

We would like to thank Marti Elliott, Blanco Ranger District of the White River National Forest, for permission to collect in Spring Cave, and Mike and Kelsey Tate for additional collections. Information on Spring Cave was shared by Donald G. Davis, Elaine St. Martin, and Ed LaRock. Lynn Ferguson, Longwood College, determined the identity of a campodeid collected in the cave, Kenneth Christiansen, Grinnell College, examined a springtail, Janet W. Reid, Smithsonian Institution, identified a copepod, and John Holsinger, Old Dominion University, determined the identity of an amphipod. These additional components of the Spring Cave fauna are mentioned briefly below.

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The types of the new species are deposited in the Virginia Museum of Natural History (VMNH), Martinsville.

TAXONOMY AND DISCUSSION

Order Chordeumatida

Family Tingupidae Loomis

Tingupidae Loomis 1966:227. Shear, 1972:264; Hoffman 1979:135; Shear 1981:5.

Tingupid millipeds are recognized on the basis of a combination of characters, including small to minute size, sculptured tergites with prominent lateral swellings or paranota, clavate segmental setae, and coxal glands on legpairs 10 and 11 of

males. They differ from closely related families in details of the gonopods. Branneriids have a telopodite flagellum in the anterior gonopods that interlocks with processes from the coxites; this construction is absent in tingupids. Niponiosomatids are more difficult to distinguish from tingupids, and the two families may have to be combined at some time in the future, but the inner coxites of the anterior gonopods are completely fused in the former, generally separated in the latter; niponiosomatids have smooth, cylindrical pleuroterga with acute segmental setae.

The tingupid gonopod plan is characterized by anterior gonopods bearing inner and outer angiocoxites; the inner angiocoxites of both sides are appressed in the midline and in some species of *Tingupa* appear partially fused at the base. The lateral copocoxites are usually much broader than the inner ones. In *Tingupa*, the single colpocoxite² of each gonopod is complex, with an anteriolateral lobe-like process and a posteriomedial rod-like structure often divided into three branches. *Tingupa* legs, sometimes with a small, lamellate coxal process (illustrations in Shear 1981).

Buotus departs from this plan in having the angiocoxites sharply deflexed so that they parallel the long axis of the body. The colpocoxites have a single, curved, rod-like branch, and the single-articled posterior gonopods bear a long coxal process (illustrations in Shear 1981).

The anterior gonopods of the new genus *Blancosoma* resemble those of *Buotus* in general plan. However, the deflexion of the angiocoxites is even more pronounced, and the basal angle of the mesal coxites projects far anterior; these structures are so broad that they push the lateral coxites around to the lateral margins of the gonopod complex. Like *Buotus*, the angiocoxite is simple and rod-like. However, the tiny posterior gonopods, almost completely concealed by the anterior gonopods when undissected, bear no coxal armament.

KEY TO GENERA OF TINGUPIDAE

1. Males with 26 segments, females with 28; head with a single, deep-lying pigment spot in place of eyes; West Virginia, North Carolina and Virginia *Buotus* Chamberlin
 — Males and females with 28 or 30 segments 2.
2. Lacking ocelli; body completely depigmented; metatergites rugose but without regular pattern; Colorado *Blancosoma*, new genus.

² Until recently, I (WS) considered these structures to be the telopodites of the gonopods in all members of the Brannerioidea and Cleidogonoidea. New observations on the development of the gonopods and their musculature has now convinced me that the telopodites are entirely missing and what I formerly regarded as the telopodite is in reality the angiocoxite--thus returning to the classical interpretation of Brolemann (1935).

With 4-11 ocelli; body usually pigmented (*Tingupa pallida* may be white); metatergites with a regular pattern of short, acute ridges; Oregon, California, Arizona, Utah, Missouri, Illinois and Arkansas *Tingupa* Loomis.

Blancosoma, new genus

TYPE SPECIES: *Blancosoma scaturgo*, new species.

DIAGNOSIS: Differing from *Tingupa* in the extreme reduction of the posterior gonopods, in having the rod-like angiocoxal branch simple, and in lacking the characteristic microsculpture of the tergites. Differing from *Buotus* in lacking a long process on the coxa of the posterior gonopod and in the far greater complexity of the anterior gonopod colpocoxites. The only known species of the genus also shows trolobitic adaptation: elongated legs and antennae, weakly sclerotized transparent cuticle, and eyelessness.

DISTRIBUTION: Rio Blanco County, Colorado, in a high altitude cave.

NAME: "Blanco" refers not only to the county from which the type species comes but also means "white" in Spanish; "-soma" is a combining stem often used in forming chordeumatid millipede names and is derived from the Latin word for "body". Hence, "white body".

Blancosoma scaturgo, new species

Figs. 1-6

TYPES: Male holotype and female paratype from Spring Cave, near Buford (T2S, R90W), 0.75 miles west of Forest Service South Fork Campground, Rio Blanco County, Colorado, collected on logs, August 11, 1996 by David Hubbard. Deposited in VMNH.

NAME: The specific epithet is a Latin noun in apposition, a little-used word meaning "a spring of water".

MALE: 28 segments. Length, 5.4 mm, maximum width 0.4 mm. Antennal segment 3 0.3 mm long. Trunk segments with metaterga faintly rugose, prominent lateral swellings bear lateralmost segmental setae. Segmental setae long, acute on anterior metatergites, becoming shorter, subspatulate on more posterior ones. Ocelli absent. Antennae elongate, filiform, reaching backward to posterior margin of third trunk segment. Fourth and fifth pregonopodal legs with prefemora slightly enlarged, inner side with small swelling midlength. Pigment lacking.

Anterior gonopods (figs. 1,2) large, prominent, sharply deflexed posteriorly so that coxosternal axis lies parallel to long axis of trunk. Median angiocoxites (**ma**) evidently fused along basal midline, greatly expanded distally, with acute, triangular tips; basal angle projects far forward, bearing pair of long, filamentous setae on each angiocoxal element. Lateral angiocoxites (**1a**) seeming to arise from posterior-dorsal surface of median angiocoxites, distally broadened, with arcuate tips. Colpocoxites with simple, lobe-like basal branches (**bc**) and sinuate distal branches (**db**) with internal channels.

Posterior gonopods (fig. 3) much reduced, *in situ* almost completely hidden under anterior gonopods. Coxosternum broad, laterally shortened; telopodite of two articles, basal of which is fused to coxosternum, distal article button-like, setose. Legpair 10 (fig. 4) with enlarged coxae bearing prominent eversible glands (accompanied in holotype by spermatophores); distal articles somewhat shorter than in legpairs 13 (fig. 6) and posteriad. Legpair 11 (fig. 5) with coxae only slightly enlarged, gland perhaps vestigial but opening for its eversion clearly present.

FEMALE: Much as described for male, but lacking primary and secondary sexual characters. Due to the small size and delicacy of the specimen, the cyphopods were not dissected. The cyphopods have not been studied or described for any tingupid species.

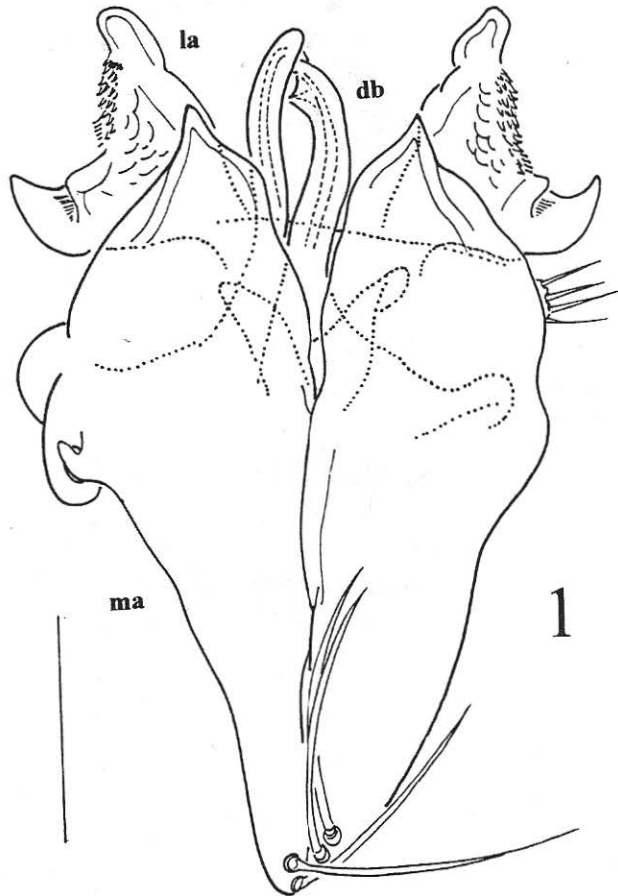
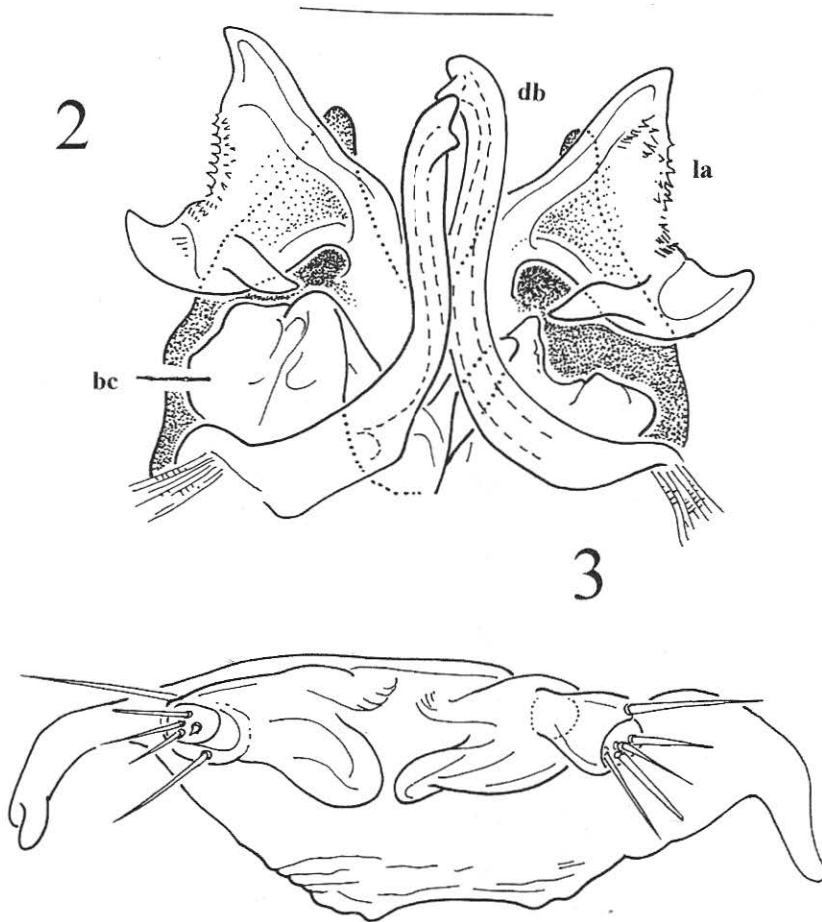


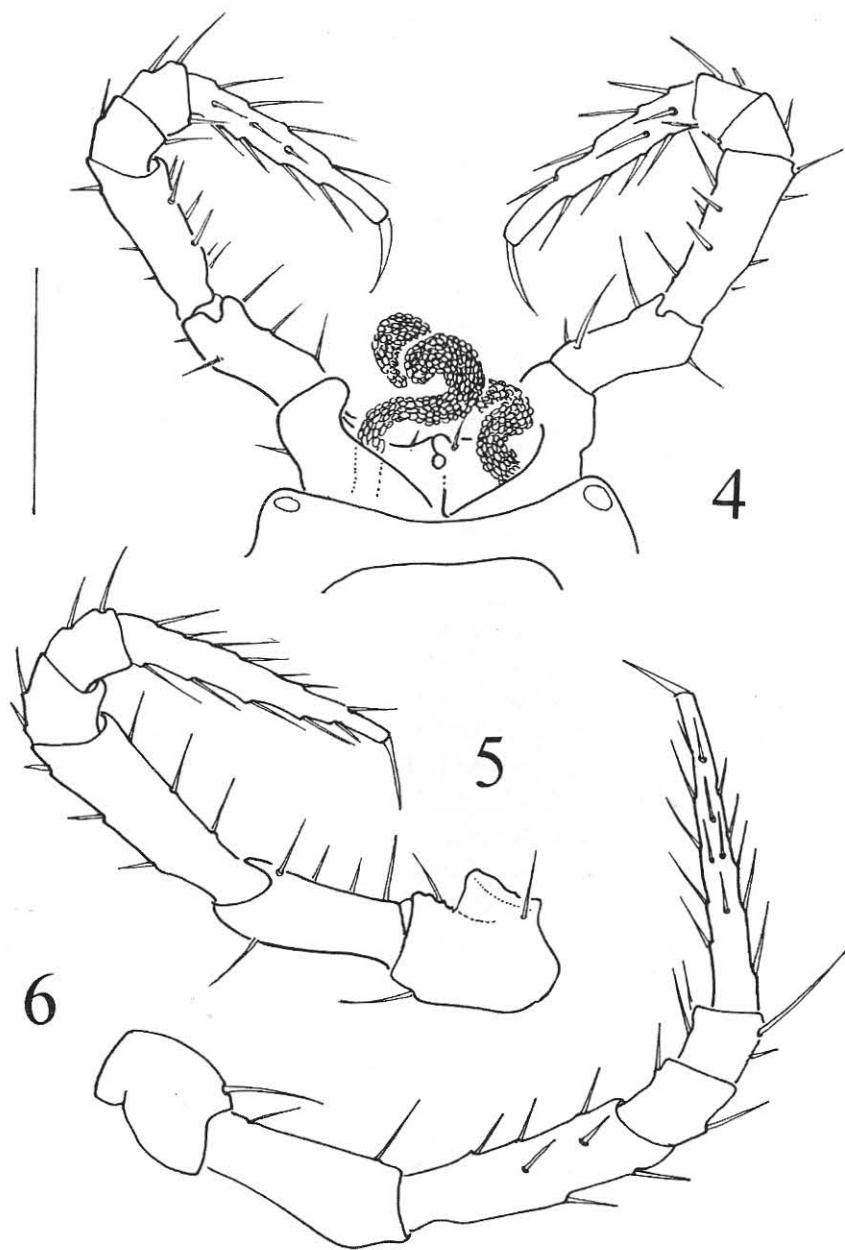
Fig. 1. Anterior gonopods of *Blancosoma scaturgo*, n. sp., ventral view. The small, setose structure on the right side is the right telopodite of the posterior gonopods, just visible *in situ*. Scale line for all figures = 0.1 mm.



Figs. 2,3. *Blancosoma scaturgo*, n. sp. 2, anterior gonopods, posteriodorsal view. 3, posterior gonopods, ventral view.

DISTRIBUTION: Known only from the type locality.

NOTES: An immature female of this species was collected in Spring Cave by Mike and Kelsey Tate, October 4, 1996 (VMNH). The Tates also collected three immature individuals of an *Austrotyla* species, probably *A. coloradensis* (Chamberlin) (see Shear 1971). This species is a member of the Conotylidae and cannot be confused with *B. scaturgo*; the immature specimens had well formed eyes of 12-15 ocelli and were lightly pigmented. *Austrotyla coloradensis* is widely distributed in Colorado above 7000 ft. in elevation, and has been recorded before from caves. It should be considered a troglophile, while *Blancosoma scaturgo* is clearly a cave-limited troglobite.



Figs. 4-6. *Blancosoma scaturgo*, n. sp., male. 4, legpair 10, anterior view. 5, left leg 11, anterior view. 6, right leg 13, anterior view.

THE HABITAT OF *BLANCOSOMA SCATURGO*

The accessible entry to Spring Cave is located at about 8,000 ft. elevation. As the name suggests, the two entrances were former spring resurgences. The active stream level is now deeper in the cave, but one of the entrances has been known to resurge at least three times in the past 40 years. The cave probably receives recharge from about 12 square miles of the Cow Lake/Corral Lake karst (Donald G. Davis, pers. comm. to DAH). The wood on which the millipeds were collected may have been part of a ladder brought in to aid in the early exploration of the cave.

Spring Cave has a comparatively diverse fauna. In addition to *Blancosoma scaturgo* and *Austrotyla* sp., a new troglobitic dipluran of the genus *Haplocampa* has been collected, as well as a troglobitic springtail, *Tomocerus (Lethemurus) missus* Mills (Christiansen & Bellinger 1998). Aquatic fauna includes the cyclopoid copepod *Acanthocyclops carolinianus* (Yeatman), a widespread surface-dwelling species, and a new troglobitic amphipod in the genus *Stygobromus*.

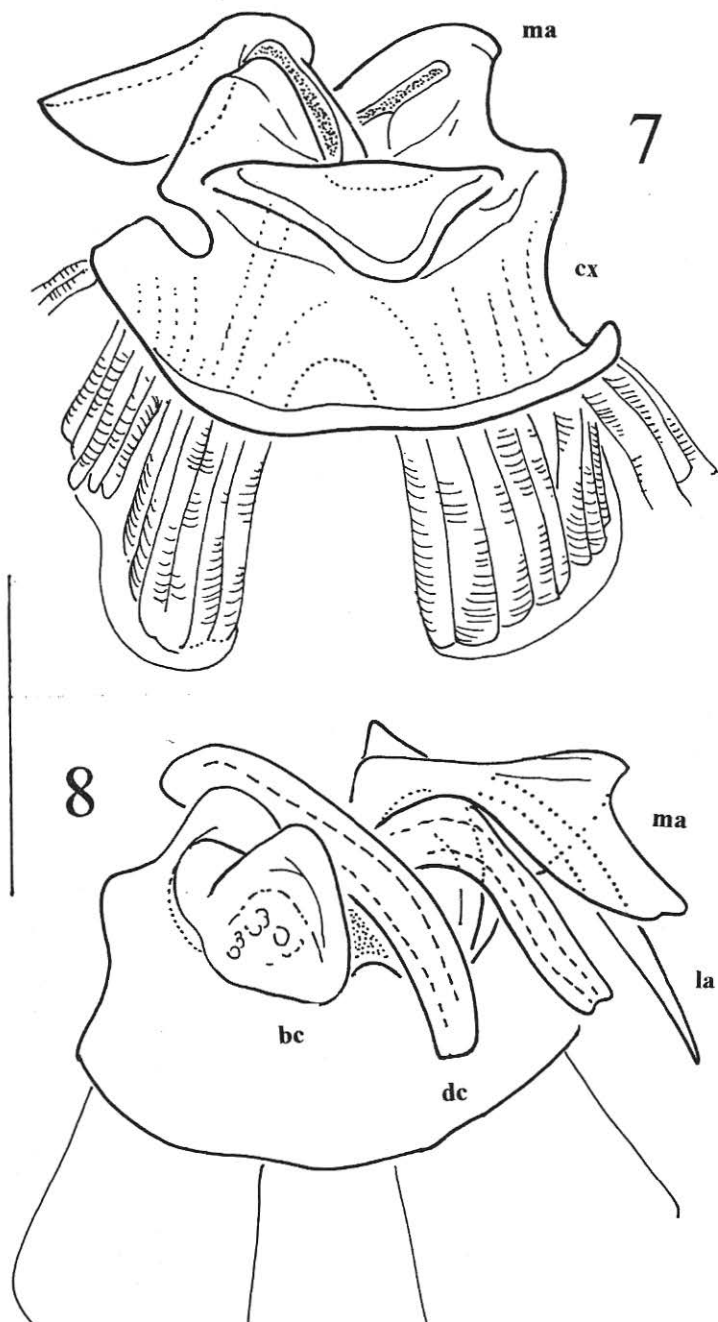
THE ANTERIOR GONOPODS OF *BUOTUS CAROLINUS*

When I (WS) studied the gonopods of the minute tingupid *Buotus carolinus* Chamberlin, I did not have available the optical equipment now present in my laboratory. This species is one of the tiniest of all millipeds, with a body length of only about 3 mm in mature males, and the gonopods are correspondingly small. The discovery of *Blancosoma scaturgo* caused me to re-examine the anterior gonopods of several tingupid species, *Buotus carolinus* included. Using high magnification and Nomarski contrast revealed crucial new details (figs. 7,8).

The gonopods are highly fused, with no clear articulation visible between the coxae, sternum (cx) and angiocoxites. As in *Blancosoma scaturgo*, the gonopods are sharply deflexed posteriorly. The median angiocoxites (ma) are broad, and the lateral angiocoxites (la) have been displaced to a posterior position; they are in the form of a simple, acute blade which I evidently mistook for the colpocoxites ("telopodites") in 1981. There are no setae of any kind on the angiocoxites. The real colpocoxites are larger, blunter, and consist of a basal lobe (bc) and a rod-like portion that is evidently tubular (dc). Given this new interpretation, the relationship between *Buotus* and *Blancosoma* seems clear.

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Figs. 7,8. *Buotus carolinus* Chamberlin, right colpocoxites removed. 7, anterior gonopods, oblique anterior view. 8, anterior gonopods, oblique posterior view.

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