Cave millipedes of the United States. XIII. A new, troglobiotic species of *Austrotyla* from Colorado (Diplopoda, Chordeumatida, Conotylidae)

WILLIAM A. SHEAR¹ & DAVID B. STEINMANN²

¹Department of Biology, Hampden-Sydney College, Hampden-Sydney VA 23943 USA
²Department of Zoology, Denver Museum of Nature & Science, 2001 Colorado Boulevard, Denver, CO 80205 USA

Abstract

*Austrotyla stephensoni* n. sp., from Colorado, is described as the first troglobiotic species of its genus, and compared to sympatric *Austrotyla coloradensis* (Chamberlin 1910). A key to all *Austrotyla* species is provided.

Key words: Diplopoda, Chordeumatida, Conotylidae, *Austrotyla stephensoni*, new species

Introduction

The millipede genus *Austrotyla* was established by Causey in 1961, for the type species *Conotyla specus* Loomis 1939, a troglophile common in caves in southern Wisconsin, eastern Iowa, Illinois and Missouri, and occasionally found in surface forest litter. A little later in the same year, Hoffman (1961) set up the genus *Sonoratyla* for another Loomis species, *Conotyla montivaga* Loomis 1943, an epigean species from Pima Co., Arizona. The two species are clearly congeneric (Shear 1971) and Causey’s name, published earlier, takes precedence.

Causey (1961) recognized the relationship between the two species, but erred by sinking *montivaga* as a subspecies under *specus*, and placing pigmented, epigean specimens of *specus* from Illinois and Missouri as *A. specus montivaga*, though on biogeographic grounds it seems improbable that the same subspecies would occur in the mesic forests of the northern Mississippi Valley and on isolated mountains in southern Arizona. Causey also seemed to be laboring under the then common misapprehension that subspecies designation could be used for morphological variants, even if they were sympatric (and in this case virtually syntopic) with another “subspecies.” (For an excellent discussion of the subspecies problem in general and with particular application to millipedes, see Jorgensen *et al.* [2012]). In fact, *montivaga* proved to be a distinct species limited to Arizona, as Loomis (1943) originally thought; Causey’s (1961) contention that the gonopods of *montivaga* and *specus* were identical was incorrect (Shear 1971). Causey also included in *Austrotyla* Chamberlin’s *Conotyla coloradensis* 1910 (Chamberlin 1910), designating a neotype.

Ten years after the description of the genus, Shear added two additional species: *A. borealis* Shear 1971 and *A. chihuahua* Shear 1971, the former from Jasper National Park, Alberta, Canada, and the latter from Rio Urique, Chihuahua, México (Shear 1971). A further species, *Austrotyla montani* Loomis & Schmitt 1971 came from Missoula, Montana. Finally, in a reclassification of the family Conotylidae, Shear (1976) made *Austrotyla* the type genus of a subfamily Austrotylinae, which also includes the northern Rocky Mountain genus *Corypus* Loomis & Schmitt 1971 and *Achemenides* Shear 1971 from the upper Mississippi Valley.

*Austrotyla* as of 1976 therefore consisted of six species, distributed in the Rocky Mountains from southern Alberta, Canada, to Chihuahua, México, and in the Mississippi Valley from Wisconsin (possibly Minnesota) to Missouri. No additional work on the genus has appeared in the past 37 years.

*Austrotyla coloradensis* is the species best represented in collections and seems widespread in montane, forested habitats and canyon riparian zones in Colorado. *Austrotyla coloradensis* is sometimes taken as a troglophile in Colorado caves as well. However, one collection recently made by DS had a distinctive
appearance—the specimen (Fig. 2) was depigmented, narrow-bodied, with unusually long legs, and had a reduced number of ocelli. An examination of the gonopods showed that it was quite distinct from sympatric *coloradensis* (Fig. 1) and represented a new species with troglobiotic adaptations. The caves of the northern and central Rocky Mountains are gradually yielding to exploration by speleobiologists, and the appearance of a new, cave-adapted *Austrotyla* was perhaps to have been expected.

**Taxonomy**

**Family Conotylidae Cook 1896**

**Subfamily Austrotylinae Shear 1976**

**Genus *Austrotyla* Causey 1961**

In his 1971 revision, Shear described “capitate lobes” on either or both coxae 10 and 11 for some *Austrotyla* species, but we now realize that these “lobes” were in fact the usual extruded coxal glands, imperfectly observed. For this study we were able to check fresh specimens of *coloradensis*, *specus* and *montivaga* and are sure now that all *Austrotyla* have coxal glands only on coxae 10, as do all heterochordeumatoids.

**Key to species of *Austrotyla* (based on males)**

1a. Adult males 14–16 mm in length ................................................................. 2  
1b. Adult males 12 mm or less in length .......................................................... 4  
2a. Seventeen or fewer unpigmented ocelli; Colorado ..................................... stephensoni, *n. sp.*  
2b. Twenty-three to 25 pigmented ocelli .......................................................... 3  
3a. Posterior gonopod colpocoxites acutely triangular, basomesal branch lamellate; Chihuahua, México ... *chihuahua* Shear 1971.  
3b. Posterior gonopod colpocoxites evenly rounded, basal branch small, fimbriate; Colorado, ?New Mexico ............................................................ *coloradensis* (Chamberlin 1910).  
4a. Adult males 8–10 mm in length; northern Rocky Mountains ..................... 5  
4b. Adult males about 12 mm in length; Arizona or northern Mississippi Valley ............................................................ *specus* (Loomis 1939)  
5b. Twenty-three to 25 ocelli; Alberta, Canada ............................................... borealis Shear 1971.  
6a. Distal podomere of posterior gonopod slightly more than twice the length of the prefemur; Mississippi Valley from ?Minnesota to Missouri .......................................................... *coloradensis* (Chamberlin 1910).  
6b. Distal podomere of posterior gonopod at least three times the length of the prefemur; southern Arizona .............................................................. *montivaga* (Loomis 1943).

**Austrotyla coloradensis** (Chamberlin 1910)

Figs. 1, 3–6

Chamberlin (1910) gave the type locality of this species only as “Colorado” and the type had been lost by 1961. Causey (1961) designated a neotype male from Allen’s Park, Boulder County, Colorado (Museum of Comparative Zoology, Harvard University). Shear (1971) reported the species from Larimer, Jackson, Eagle, Pitkin, Chaffee, Gunnison, Hinsdale, Mineral and Conejos Counties, Colorado, and noted that most records were from coniferous forests above 7000’ (2134 m) asl. With increased exploration of the many limestone caves in Colorado, *coloradensis* has also emerged as a troglobile, with several records from caves in Eagle County. The following are new county records; all collections by David Steinmann and deposited in the Denver Museum of Nature & Science.

**COLORADO:** Jefferson Co.: Fault Cave, 6250’ (1905 m) asl, 15 February 2012, m; 12 January 2010, m, mff; Garfield Co.: Buffalo Cave, White River National Forest, 9200’ (2804 m) asl, juv.; Twenty-Pound Tick Cave, 7500’ (2286 m) asl, 14 October 2010, juv.

Chamberlin (1910) reported *coloradensis* from Ruidosa, New Mexico, and in 1971, Shear mentioned specimens from nearby Mescalero. Chamberlin’s specimens have disappeared along with the types of
coloradensis, and the present whereabouts of the Mescalero specimens are unknown. Geographically, it is not very likely either of these samples represent coloradensis or montivaga, and there may be an undescribed Austrotyla species in southern New Mexico.

Drawings of the male third (Fig. 3) and fourth legs (Fig. 4) and of the gonopods (Figs. 5, 6) of A. coloradensis from Fault Cave (see records above) are presented here for direct comparison with those of Austrotyla stephensoni n. sp. Figures 1 and 2 compare the field appearance of A. stephensoni with sympatric A. coloradensis.

Drawings of the male third (Fig. 3) and fourth legs (Fig. 4) and of the gonopods (Figs. 5, 6) of A. coloradensis from Fault Cave (see records above) are presented here for direct comparison with those of Austrotyla stephensoni n. sp. Figures 1 and 2 compare the field appearance of A. stephensoni with sympatric A. coloradensis.

Austrotyla stephensoni, n. sp.

Figs. 2, 7–10


Diagnosis. Austrotyla stephensoni differs from every other species of Austrotyla in the notched, or bifid, coxites of the posterior gonopods (Fig. 10). From A. coloradensis it further differs in the markedly reduced posterior lobe of the anterior gonopods (cf. Figs. 5, 6) and the form of the fimbriate branches, which are larger and more strongly curved, and in having fewer ocelli, proportionally longer legs and antennae, and being depigmented (troglobiotic syndrome). In addition, the femoral knobs of the male third and fourth legs of coloradensis are distal, while in stephensoni they are mesal (cf. Figs. 3, 4, 7, 8).

Etymology. The species epithet honors Jeff Stephenson, who has helped with hundreds of cave life specimens including many new species, and who is very supportive of cave life research as Collections Manager for the Zoology Department at the Denver Museum of Nature & Science.

Description. Male holotype: Length, 14.0 mm, greatest width 0.9 mm; head and anterior end lightly mottled purplish tan, otherwise unpigmented (Fig. 2). About 17 ocelli in triangular eyepatch, ocelli unpigmented, irregularly shaped, dorsal row lacking clearly formed lenses. Antennae elongate, extending back to fourth diplosegment if fully extended. Legpairs 3, 4 (Fig. 7, 8) crassate, femora and prefemora swollen and mesally...
curved; both with prominent ventral apophysis slightly distal of midlength on femora. Anterior gonopods (Fig. 9) with distinct sternum bearing curved, mesally directed fimbriate branches. Basal angiocoxite branches narrow, distally toothed; coxal plates large, deeply cupped, basolaterally with translucent oval “window” bordered laterally by sternal process. Posterior gonopods (Fig. 10) with coxites strongly curved, cupped anteriorly, with deep mesal notch in each coxite producing bifid appearance in ventral view; basal fimbriate area reduced; pre femora with deep lateral notches, distal articles short, slightly longer than prefemora.

Notes. The type locality, Bonnie’s Hall, is a cave located at the bottom of a moss-covered sinkhole formed in Leadville Limestone. The total surveyed length of Bonnie’s Hall is 273' (83.2 m) (Reames, 2011). The temperature inside the cave is 1° C, just above freezing, with humidity at 94%. Numerous other macroinvertebrate species live in the cave including springtails, harvestmen, diplurans, spiders, flies, beetles and mites. Bats were observed on the cave ceiling. There are other limestone caves near Bonnie’s Hall which may also harbor populations of *A. stephensonii*.

**FIGURES 3–10.** Structures of male *Austrotyla* millipedes. Figs. 3–6. *Austrotyla coloradensis*. Fig. 3. Right third leg, posterior view. Fig. 4. Right fourth leg, posterior view. Fig. 5. Anterior gonopods, posterior view. Fig. 6. Posterior gonopods, anterior view. Figs. 7–10. *Austrotyla stephensonii*. Fig. 7. Right third leg, posterior view. Fig 8. Right fourth leg, posterior view. Fig. 9. Anterior gonopods, posterior view. Fig. 10. Posterior gonopods, anterior view.
Acknowledgments

We would like to thank Kay Hopkins, Rich Doak, Richard Haskins, Bill Kight, Phil Nyland and Scott Fitzsimmons with the White River National Forest, United States Forest Service, for helping with the Special Use Permit under which the specimens were collected. WS is grateful to Jeff Stephenson and Frank Krell of the Denver Museum of Nature & Science for loaning the specimens. The cavers involved in the discovery and mapping of Bonnie’s Hall are thanked for their contributions, including Ed Crawford, Bob Ayre, Richard Klatt, Gene Dover, Paul Burger and Mark McVay. Debbie and Nathan Steinmann assisted with invertebrate collecting in the cave. The publication of this research was made possible under a grant (NSF DEB-1256139) to WS, Jason Bond, Petra Sierwald and Paul Marek, and with assistance from the Professional Development Committee of Hampden-Sydney College.

Literature cited