

SOME CAVERNICOLOUS MILLIPEDES FROM THE CUMBERLAND PLATEAU

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This paper is based upon part of the extensive collection of cavernicolous millipeds made by Dr. T. C. Barr, Jr., chiefly from the Tennessee part of the Cumberland Plateau. He visited more than 700 caves from 1954 through 1957 in his search for invertebrate animals; millipeds were found in more than 70 of them. I am greatly indebted to Dr. Barr for the opportunity of studying the millipeds in his collection.

I have omitted the numerous records of the genera *Scoterpes* and *Pseudotremia*, which will be the subject of subsequent reports. All other records are included.

All type specimens will be deposited in the American Museum of Natural History. Other specimens will be retained by the author.

The two most widespread genera of cavernicolous millipeds east of the Mississippi River, *Pseudotremia* and *Scoterpes*, were described by E. D. Cope (1869, 1872), who is remembered chiefly for his work in vertebrate paleontology. J. A. Ryder (1881) added *Zygonopus*, a genus with a relatively restricted range in Virginia and West Virginia. A. S. Packard included these three genera, which were then all monotypic, in his "Cave Fauna of North America" (1886), and O. F. Cook and G. N. Collins (1896) added three more species. The greatest contribution to this field was made by H. F. Loomis (1939, 1943), who studied the extensive collections made by Kenneth Dearolf and Leslie Hubricht, mostly from caves east of the Mississippi River. He extended the number of cavernicolous species of the area to approximately 22, representing 10 genera. R. V. Chamberlin (1916) added one subspecies from Georgia and R. L. Hoffman (1956) two genera and their respective type species from Alabama. From the Barr collection, exclusive of *Scoterpes* and *Pseudotremia*, I have added four species and one genus from Tennessee.

There are two marked differences between epigeal and cavernicolous millipeds from the Cumberland Plateau. Collections from caves tend to be poorer both as to number of specimens and number of species than epigeal collections. The collections from about 90 per cent of the caves contain only one species, which is almost always either a *Scoterpes* or a *Pseudotremia*; from only one cave, Cumberland Caverns, Warren

County, Tennessee, have as many as four species been collected. In contrast, almost any epigean site in the area will yield at least eight or nine species. In epigean collections the order Polydesmida usually outnumbers all others combined, both as to the number of specimens and the number of species; in cavernicolous collections the order Polydesmida is very poorly represented, about 98 per cent of the specimens are of the order Chordeumida, and there are fewer categories represented.

The species in this collection tend to fall into the usual three groups characteristic of animals collected in caves, viz., 1) epigean species that have entered the caves accidentally, *Aniulus niger*, *Cylindroiulus arborum*, *Cambala cristula*, *Choc-tella cumminsi*, and *Brachycybe petasata*; 2) epigean species that are somewhat tolerant of cave conditions and occur in caves more often than the species in the first group. *Nopoiulus venustus* and *Cambala minor*; and 3) troglodytes, *Tetracion tennes-sensis*, new species. The position of *Antriadesmus mollis*, new species, *A. debilis*, new species, and *Ameractis satis*, new genus and species, in this scheme is uncertain. When the epigean fauna of the Cumberland Plateau has been collected with as much diligence as the cave fauna has been, these three species will probably be found in deep litter as well as in caves.

Order Polydesmida

Family Vanhoeffeniidae

Antriadesmus Loomis

Antriadesmus Loomis, 1943, Bull. Mus. Comp. Zool Harvard, vol. 92, no. 7, p. 408.

All three species of this genus have been described from caves, but Dr. Barr (personal communication) has reported that at least one species, *A. fragilis*, is not strictly cavernicolous.

Key to the Species of *Antriadesmus* Based on the Male Gonopods

1. Setose nodules of metatergites in transverse series of 8 or 10. Tibiotarsus of gonopod entire, a solenomerite not branching from it; prefemoral branch two-pronged ----- *A. fragilis* Loomis

Setose nodules of metatergites in transverse series of 6 or fewer. Solenomerite branches from tibiotarsus; prefemoral branch entire or three-pronged ----- 2

2. Prefemoral branch of gonopod three-pronged --- *A. debilis*, new species
 Prefemoral branch of gonopod entire ----- *A. mollis*, new species

***Antriadesmus mollis*, new species**

Figure 1

Diagnosis: Distinguished by the undivided apical region of the prefemoral branch of the gonopod.

Description of male holotype: Length 6.5 mm., width 0.6 mm. Body colorless except for the gut contents. Head as in *A. fragilis*. Antennae clavate.

Body moniliform, with the prozonites well exposed. Collum semicircular, narrower than the head and the following metatergites, the anterior margin evenly rounded and the posterior margin slightly convex. Segments 2

through 19 with short horizontal keels, which on the segments of the posterior half of the body are usually produced in acute angles that extend behind the posterior margin of the metatergites. Pore distribution normal, the pores opening on the dorsal surface of the posterior angle of the keels. Lateral margin of keels of segment 2 and all poriferous segments each with 4 acute teeth, keels of the non-poriferous segments with 3 teeth each. Caudal angle of each keel and all teeth except the first on each keel have an apical seta, which is short and slightly clavate. Small nodules, each of which bears on its apex a similar seta, are arranged in three regular transverse series on all metatergites except the last; on the collum there are about 10 nodules on the anterior margin, 6 in the middle series, and about 8 in the series that is just in front of the posterior margin. On the metatergites of the following segments there are 6 nodules in each of the 3 series and a shallow transverse sulcus between the first and second series. The sulci are less distinct and the nodules are larger and less numerous than in *A. fragilis*. Metatergite of segment 7 larger than those of adjacent segments.

Gonopods the simplest in the genus, with the prefemoral branch, the solenomerite, and the tibiotarsus without prongs. In situ, ventral view, the broad blade of the tibiotarsus is C-shaped, opening cephalad and curving around the almost vertical solenomerite and the prefemoral branch. Figure 1 shows an anterior view of the left gonopod.

Female similar in appearance to the male except for the metatergite of the seventh segment, which is not larger than those of the adjacent segments.

Type locality: *Tennessee*: Warren Co., Cumberland Caverns, in vicinity of Historic and Onyx Curtain entrances, 6 males, 1 female, April 27, 1957.

Antriadesmus debilis, new species

Figure 2

Diagnosis: Distinguished by the three-pronged apex of the prefemoral branch of the gonopod.

Description of the male holotype: Length about 6.5 mm, width 0.6 mm. Somatic characters as described for *A. mollis* except the setose nodules, which on the posterior half of the body tend to be reduced to 2 or 4 in the first row and 4 in the second row.

Gonopods more complex than in the other species, with the apex of the prefemoral branch divided into three unequal prongs, and the solenomerite bearing two acute spines and the tibiotarsus three. Figure 2 shows an anterior view of the left gonopod.

Type locality: *Tennessee*: Wayne Co., Walker Spring Cave, 1 male, June 16, 1957.

Order Julida

Family Paraiulidae

Aniulus Chamberlin

Aniulus Chamberlain, 1940, Bull. Univ. Utah, biol. ser., vol. 5, no. 7, p. 3.

All species of this genus are epigean and seldom wander into caves.

Aniulus nigrans Chamberlin

Parajulus nigrans Chamberlin 1918, Psyche, vol. 25, no. 2, pp. 27-28; 1921, Canadian Nat., vol. 53, p. 233, fig. 3.

Record: *Tennessee*: Smith Co., New Piper Cave, Jan. 5, 1957, 4 males, 1 female, 6 late larvae.

Family Nemasomidae

Ameractis, new genus

Diagnosis: Resembles *Zosteractis* Loomis 1944 in that the sterna and pleura are fused and there are no eyes; differs in that the first legs of the male are of normal size and shape and without processes and in that the gonopods are minute, with the telopodites of the anterior pair as long as the coxites.

Description: Body slender, submoniliform, minute, about 40 segments, all segments except first three with sterna and pleura fused, depigmented in life.

Head hemispherical, four clypeal setae, no ocelli, vertex without medial furrow but with two setae. Antennae clavate, reaching to fourth segment. Promentum longer than wide. Mandibles each with four comb lamellae. No sexual dimorphism of mandibular cheeks.

Segments with a constriction between prozonite and metazonite; metazonites slightly convex, shining, with a sparse row of setae on the posterior margin. Pores inconspicuous, opening a little in front of the middle of the metazonites. Keels of collum angular, each with 3 or 4 horizontal striae; first 8 or 9 segments behind the head each with several horizontal striae below the pores. Apex of last segment rounded, depressed, extending slightly beyond the anal valves, which are evenly inflated. Margins of preanal scale convex.

First legs of male normal size and without processes, composed of five segments beyond coxae, claw shorter than last segment. Other legs also slender, when extended reaching slightly beyond body, claw about two-thirds length of tarsal segment.

Penes wedge-shaped, closely appressed, about half as long as coxae of second legs. Vulvae a little longer than broad; vulvar invaginations short.

Gonopods minute, all except distal half of anterior pair concealed under pleurites. Telopodite and coxite of anterior gonopods slender, subequal in length, the coxite fused with its mate their entire length, the telopodite without apical setae, and the flagellum longer than the coxite. Posterior gonopods thin, unsegmented, triangular, with a flange near the apex along which the flagellum may slide, and shorter than the anterior gonopods.

Type species: *Ameractis satis*, new species.

Ameractis satis, new genus and new species

Figures 3-5

Description of male and female syntypes: Length of males 9.5 to 10.5 mm., length of females up to 11 mm., width about 0.5 mm. Number of segments 36 to 41; 6 adult specimens each with 3 legless segments, 3 with 2 legless, and 1 with 4 legless. Depigmented in life, pale brown in alcohol,

Explanation of Figures

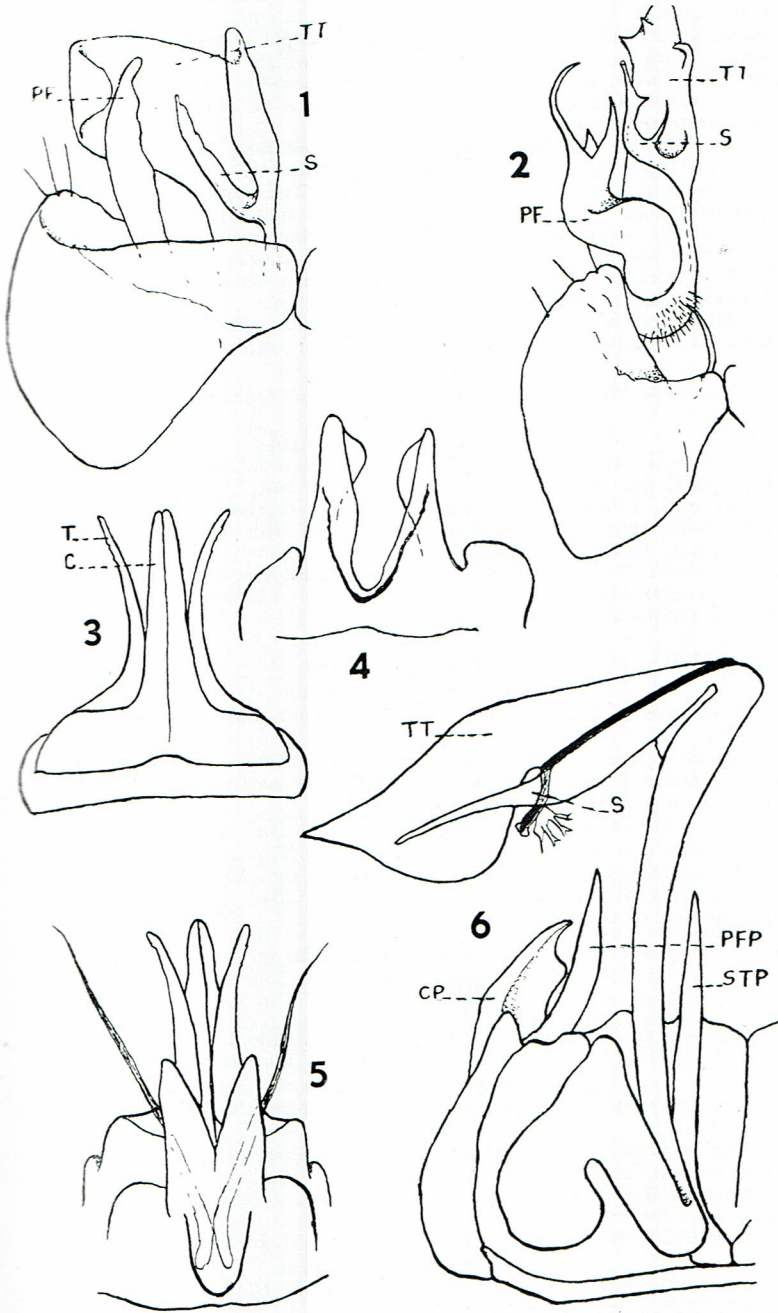
Fig. 1. *Antriadesmus mollis*, new species. Left gonopod, anterior view, male paratype.

Fig. 2 *Antriadesmus debilis*, new species. Left gonopod, anterior view, male holotype.

Figs. 3-5. *Ameractis satis*, new genus and species. 3. Anterior gonopod, anterior view. 4. Posterior gonopod, subcaudal view. 5. Gonopods, caudal view, male syntype.

Fig. 6. *Tetracion tennesseensis*, new species. Right gonopod, caudal view, Rucker Cave specimen.

Abbreviations: C — coxite. CP — lateral lobe. PFP — outer spinous process. PF — prefemur. S — solenomerite. STP — inner spinous process. T — telopodite. TT — tibiotarsus.



repugnatorial pores not conspicuously darker. Pleural lobes of third segment overlap. Marginal setae number from about 12 on the collum to about 24 on most of the other segments. Caudal segment with 5 pairs of setae on the caudal margin of the tergite, which is rounded, 2 pairs on the anal valves, and 1 pair on the preanal scale.

Labral teeth 5 or 3. Clypeus with a medial vertical row of nine pairs of minute refringent dots.

The slender anterior gonopods project obliquely through the narrow V-shaped opening between the margins of the seventh pleurites. Figure 5 shows a posterior view of the gonopods. The sternum of the anterior gonopods (fig. 3) is a broad U-shaped band that is reflected around the sides of the posterior gonopods, while the sternum of the posterior pair (fig. 4) is smaller, with the ends reflected forward.

Type locality: *Tennessee*: White Co., Indian Cave, 5 males, 5 females, 1 larva, Dec. 24, 1956.

Other record: Overton Co., Mill Cave, near Okalona, Mar. 16, 1957, numerous specimens collected on rotten wood with *Nopoiulus venustus*.

Nopoiulus Menge

Nopoiulus Menge, 1851, *Neustre Schrift. Naturf. Ges. Danzig*, vol 4, no. 4, p. 6.

Nopoiulus venustus Menge

Nopoiulus venustus, Schubart, 1934, *Die Tierwelt Deutschlands*, 28 Teil, Diplopoda, pp. 189-191, *cum synom.*, figs. 302-304.

Records: *Tennessee*: Overton Co., Mill Cave, near Okalona, Mar. 16, 1957, several females collected on rotten wood with *Ameractis satis*, which this species closely resembles.

Hamilton Co., Ruby Falls Cave, Sept. 3, 1957, several females.

Kentucky: Fayette Co., Picadome Cave in Lexington, May 25, 1957, several specimens of both sexes.

Family Julidae

Cylindroiulus Verhoeff

Cylindroiulus Verhoeff, 1894, *Verh. Zool. Bot. Ges. Wien*, vol. 44, p. 155.

Several species of this large genus have been introduced into the United States, where they often outnumber our native species of millipeds in parks and gardens.

Cylindroiulus (Aneuloboiulus) arborum Verhoeff

Cylindroiulus (A.) arborum, Schubart, 1934, *Die Tierwelt Deutschlands*, 28 Teil, Diplopoda, pp. 224-225, *cum synom.*, figs. 356, 357.

Record: *Indiana*: Crawford Co., Marengo Cave, July 14, 1957, several specimens of both sexes.

Order Cambalida

Family Cambalidae

Cambala Gray

Cambala Gray, 1832, in Griffith, *Animal Kingdom*, vol. 2, pl. 135, fig. 2. Loomis, 1938, *Proc. U. S. Nat. Mus.*, vol. 86 (no. 3043), p. 36.

Cambala cristula Loomis

Cambala cristula Loomis, 1938, *Proc. U. S. Nat. Mus.*, vol. 86 (no. 3043) p. 39, fig. 12.

The two specimens of this big dark epigeal millipede represent the most western records of its distribution.

Records: *Tennessee*: Perry Co., Bethel Cave, Feb. 14, 1957, on raccoon dung near the entrance.

Wayne Co., Walker Spring Cave, June 5, 1955, in humus on cave floor.

Cambala minor Bollman

Cambala annulata minor Bollman, 1889, *Proc. U. S. Nat. Mus.*, vol. 11, p. 405; 1893, *Myr. N. Amer.*, p. 105.

Cambala minor, Loomis, 1938, *Proc. U. S. Nat. Mus.*, vol. 86 (no. 3043), p. 40.

This is the most numerous epigean milliped in the collection. Almost all specimens are sexually mature.

Records: *Tennessee*: Bedford Co., Reese Cave, Dec. 22, 1956, abundant on bat dung; Jan. 20, 1957, on bat and raccoon dung in wet places.

DeKalb Co., Avant Cave, Dec. 23, 1956, abundant on cave rat and raccoon dung. Jim Cave, Dec. 23, 1956, on raccoon dung.

Davidson Co., Scottsboro, Bull Run Cave, on wet gravel, rare.

Hickman Co., Walker Spring Cave, Jan. 18, 1957.

Perry Co., Bethel Cave, Feb. 14, 1957, on raccoon dung near entrance. Hurricane Creek, Inman Cave, Feb. 14, 1957, on cave rat dung. Walker Spring Cave, June 5, 1955, in humus on cave floor.

Order Spirostreptida

Family Choctellidae

Choctella Chamberlin

Choctella Chamberlin, 1918, *Psyche*, vol. 25, no. 2, p. 25.

Choctella Chamberlin, 1918

Choctella cumminsi Chamberlin

Choctella cumminsi Chamberlin, 1918, *ibid.*, pp. 25-27. Loomis, 1943, *Bull. Mus. Comp. Zool. Harvard*, vol. 92, no. 7, p. 39, fig. 9.

This rare epigean milliped was collected in one cave. Two new surface records are included.

Records: *Tennessee*: Grundy Co., Crystal Cave, 300 yards west of Wonder Cave, 1 female, May 18, 1957.

Warren Co., Cardwell Mts., several specimens of both sexes, April 27, 1957.

Alabama: Limestone Co., Belle Mina, "tens of thousands injuring tobacco", June 1, 1932, (C. D. Carter).

Order Chordeumida

Family Conotylidae

Conotyla Cook and Collins

Conotyla Cook and Collins, 1896, *Ann. New York Acad. Sci.*, vol. 9, nos. 1-3, pp. 70-71.

Conotyla bollmani (McNeill)

Conotyla bollmani, Cook and Collins, 1896, *Ann. New York Acad. Sci.*, vol. 9, nos. 1-3, pp. 76-77, *cum synonym.*, pl. 5, figs. 79-94.

The specimens in this collection correspond to Cook and Collins' description of the species in all except two characters, viz., the body surface and details of the gonopods. The dorsal surface of the body is not "minutely hispid with microscopic point-like bristles," as they reported, but it is smooth, shining, and entirely free of any other than the usual six segmental setae on each metazonite. It is possible that minute crystals that often form on long preserved specimens were mistaken for setae. The gonopods do not consist of a single, medial structure, as drawn by Cook and Collins, but of a pair of narrow, slightly curved, acute blades almost as long as the coxal processes of the ninth legs.

Records: *Indiana*: Lawrence Co., Shiloh Church Cave, 1 male, 1 female, Aug. 3, 1957. Sullivan Cave, 1 male, Jan. 7, 1956.

Orange Co., Elrod Cave, 2 miles east of Orangeville, 2 males, Aug. 3, 1957.

Family Lysiopetalidae

Tetracion Hoffman

Tetracion Hoffman, 1956, *Geol. Sur. Alabama*, mus. paper no. 35, p. 5.

The two species of this genus are known only from caves in Alabama and Tennessee. They have fewer ocelli, longer antennae and legs, and much less body pigment than species of the closely related epigean genus *Abacion*.

Tetracion tennesseensis, new species

Figure 6

Diagnosis: A slightly smaller species than the genotype, *T. jonesi* Hoffman, with the gonopods of the male very similar, but differing in the unbranched solenomerite.

Description: Width of male holotype 2.2 mm., length about 34 mm., 52 segments; other specimens from 1.9 to 2.5 mm wide, with the females tending to be a little larger than the males, 50 to 54 segments. Depigmented in life, in alcohol pale, brownish yellow, with the posterior one-third of most metatergites light brown. Ocelli usually without pigment, from 25 to 29 in 5 or 6 irregular rows that form a triangular patch. Collum with 14 longitudinal ridges between the two outermost setae, of which there are 10. Leg pairs 3 through 13 with coxal sacks. Leg pairs 1, 2, and 3 of the male and 1 and 3 of the female with tarsal combs. Leg pairs 4 through 18 of the male with tarsal pads. Female with second leg pair degenerate and the vulvae much extruded. Other somatic characters as described for *T. jonesi*.

Male gonopods large, the tibiotarsal blades carried outside the gonopodal cavity, but not very conspicuous because they tend to be about the same color as the body. Proximal half of tibiotarsal blade and adjacent part of femur light brown, seminal canal and margins of some parts of the basal region dark brown. Shape of membrane on the anterior surface of the angle made by the tibiotarsal blade and the femur is as drawn by Hoffman for *T. j. jonesi*. The free solenomerite bears a minute, transparent, divided piece.

Figure 6 shows a posterior view of the right gonopod; the outer and inner spinous processes are subequal and slightly longer than the lateral lobe; the minute, transparent, divided piece at the end of the solenomerite can be seen in situ.

Type locality: *Tennessee*: Warren Co., Cumberland Caverns (also known as Higgenbotham and Henshaw Caves), 1 male, Nov. 1, 1954; 1 female June 1, 1955, 3 males, 6 females, larvae, Oct. 20, 1956; 1 male, 2 females, Apr. 27, 1957; all from vicinity of Henshaw and Onyx curtain entrances and in Little Higgenbotham Cave.

Other records: Grundy Co., Saltpeter Cave, 3 miles south of Viola, common but not abundant, June 22, 1956.

Warren Co., Little Bat Cave, 3 miles southeast of Irving College, common but not abundant on plant debris brought in by cave rats, April 9, 1956. Rucker Cave, 0.6 mile south of Rock Island on the left bank of Rocky River, abundant on bat dung, April 29, 1956. Blowing Cave, near Irving College, crawling on ledges covered with wet mud, Nov. 11, 1956. Knowles Ridge Cave, near Irving College, on bat dung, Nov. 11, 1956. Little Bat Cave, near Irving College, on wet walls near cave entrance, April 9, 1956.

Tetracion jonesi antraeum Hoffman

Tetracion jonesi antraeum Hoffman, 1956, *ibid.*, pp. 8-9, figs. 6-8.

Record: *Alabama*: Jackson Co., Talley Ditch Cave, on the east side of the valley of Crow Creek, 1 male, larvae of the last larval stadium, Aug. 28, 1957.

Tetracion sp.

Records: *Alabama*: Jackson Co., Jessie Elliot Cave, Nov. 12, 1955, 1 female, width 3 mm., ocelli about 34. Sauta Cave, July 7, 1956, larvae. Tumbling Rock Cave, Mary 27, 1956, 1 female, width 2.6 mm., ocelli 24.

Tennessee: White Co., Indian Cave, 2 miles south of Quebeck, June 19, 1954, larvae; Dec. 24, 1956.

Abacion Rafinesque

Abacion, Hoffman and Crabill, 1953, *Florida Ent.*, vol. 36, no. 2, pp 81-82.

Not any species of this genus is known to be cavernicolous.

Abacion sp.

Record: Kentucky: Fayette Co., Picodome Cave, Lexington, May 25, 1957, 1 female.

Order Colobognatha

Family Andrognathidae

Brachycybe Wood

Brachycybe, Loomis, 1936, *Proc. U. S. Nat. Mus.*, vol. 83, no. 2989, pp. 364-365.

Brachycybe petasata Loomis

Brachycybe petasata Loomis, 1936, *ibid.*, pp. 365-366, fig. 32, d.

Record: Tennessee: Blount Co., Great Smoky Mountains National Park, Cades Cove, Gregory's Cave, several specimens of both sexes, adult and larval, April 2, 1958 (Arthur Stupka and Vernon C. Gilbert, Jr.).

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