TEXAS MEMORIAL MUSEUM
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STUDIES ON THE

CAVE AND ENDOGEAN FAUNA of North America IV

Edited by James C. Cokendolpher
& James R. Reddell

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Cover: *Chinquipellobunus madlae* (Goodnight and Goodnight) from Headquarters Cave, Bexar County, Texas
Photograph by James C. Cokendolpher

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This volume is dedicated to

GEORGE VENI

in recognition of his untiring support of

exploration, scientific study, and conservation of Texas caves

PREFACE

This is the fourth volume in a series devoted to the cavernicole and endogean fauna of North America, including Mexico and Central America. Most of the species described herein are from Texas, but new species are also included from Belize and Mexico.

A new species of troglophilic vaejovid scorpion is described from Mexico. Four additional localities are recorded for the rare troglobitic scorpion *Vaejovis gracilis* Gertsch from caves in Veracruz, Mexico. A second paper on the genus *Vaejovis* includes a description of the male and several new cave records for the Mexican scorpion *Vaejovis sprousei* Sissom. Two other papers are concerned in part with the cave fauna of Mexico. A revalidation of the harvestman genus *Chinquipellobunus* includes redescription of two previously described species (*C. osorioi* Goodnight and Goodnight and *Pellobunus mexicanus* Goodnight and Goodnight) from Nuevo León and description of a new species from Coahuila. A troglobitic species of the rare order Ricinulei is described from Belize and additional records provided for *Pseudocellus pearsei* (Chamberlin and Ivie) from caves of the Yucatán Peninsula.

One paper is devoted to the invertebrate fauna of two caves in the Guadalupe Mountains of New Mexico.

The petitioning and subsequent listing of cave invertebrates as endangered species by the U.S. Fish & Wildlife Service in 2000 inspired considerable fieldwork in Bexar and Comal counties, Texas. The resulting discoveries included many new records for the endangered species. Of equal importance was the discovery of additional records of rare species and the discovery of many new species, some of which have far more limited ranges than some of the listed endangered species. Four papers in this volume include the descriptions of some of these species, along with others from other parts of Texas. Special attention was directed to the cave fauna of Camp Bullis. This large military installation has taken a proactive approach to the preservation of not only the listed endangered species but also other rare species occurring on the military base. This approach, also taken by Fort Hood in Bell and Coryell counties, is intended to provide adequate protection for non-listed species so that they will not need consideration for endangered species status.

Eight papers have been devoted to groups that occur on Camp Bullis. One reviews the spider genus *Cicurina* in Bexar County, one describes a new species of the spider genus *Neoleptoneta* from Camp Bullis, one includes new records of the rare spider species *Eperigone albula* Zorsch and Crosby from throughout Central Texas, one reviews the cave spiders of Bexar and Comal counties, one updates an earlier revision of the harvestman genus *Texella* that includes new species from Bexar County, the paper revalidating the genus *Chinquipellobunus* includes two species endemic to Texas caves, one is devoted to the cave beetles of the genus *Rhadine* from Camp Bullis with descriptions of three new species, and a paper describing four new species of the millipede genus *Speodesmus* includes three species from Bexar County.

Papers on the cave fauna of Fort Hood, strongly emphasized in the third volume of this series, include the description of a new species of the spider genus *Cicurina* and the paper on *Speodesmus* includes the description of a new endemic troglobite.

The present volume would not have been possible without the tireless efforts of many cave explorers and collectors. George Veni has been instrumental in obtaining most of the material from Camp Bullis and other parts of Bexar County. William R. Elliott, the late Joe Ivy, Jean Krejca, and Peter Sprouse have conducted extensive monitoring studies on Camp Bullis that will provide the foundation for the conservation of this fauna for many years to come. Marcelino Reyes was a constant companion in the field on both Camp Bullis and Fort Hood.

We express our appreciation to the authors included herein for their contributions. These dedicated scientists have made possible the conservation of many caves and species through their taxonomic efforts.

Much of the funding for studies included in this volume was obtained from various contracts with the Texas Nature Conservancy, Texas Parks & Wildlife Department, U.S. Army, and the U.S. Fish & Wildlife Service. We thank all of these for their support.

Finally, we cannot state too strongly our appreciation to Jerry Thompson for his assistance on Camp Bullis.

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A NEW SPECIES AND NEW RECORDS FOR THE *VAEJOVIS NITIDULUS* GROUP, WITH A KEY TO THE MEXICAN SPECIES (SCORPIONES, VAEJOVIDAE)

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ABSTRACT

A new troglophilic species of the *nitidulus* group of the genus *Vaejovis* C. L. Koch is described from caves in the southern parts of Coahuila and Nuevo León, México. Numerous specimens of other *nitidulus* group species were examined, most of them representing new records or verification of old records. A key to all described Mexican species is provided.

INTRODUCTION

The *Vaejovis nitidulus* group was defined and revised in two previous papers (Sissom & Francke, 1985; Sissom, 1991). Members of this group are typically crevice dwellers, occurring on talus slopes, rocky outcrops, and vertical cliff faces. Species of the group are typically uncommon in collections. With the recent description of *Vaejovis mauryi* Capes (Capes, 2001), the group currently consists of sixteen species (Sissom, 2000). It is almost entirely Mexican in distribution, with only *Vaejovis intermedius* Borelli reaching northward into Trans-Pecos Texas.

In the course of studying collections at various institutions, a large number of new specimens representing species of the *Vaejovis nitidulus* group was identified. Among these specimens is a new species (the 17th member of the group), as well as significant new records for existing species that provide a better assessment of geographical distributions. The new species is recorded from caves in northern Mexico. It does not exhibit any significant troglobitic adaptations, such as eyelessness, loss of pigmentation, and appendage attenuation, and should be regarded as troglophilic. It is the purpose here to describe the new species and provide an updated assessment of the distributions of other species in the group. Finally, a key to the species constituting the *V. nitidulus* group in Mexico is provided for the first time.

Vaejovis norteno, new species
Figs. 1-5

Type data.—Adult male holotype collected from Cueva Oyamel, Mesa Colorada, Laguna de Sanchez, Nuevo León, México on 19 March 1999 by Jim Kennedy; deposited in the American Museum of Natural History, New York.

Etymology.—The specific epithet is a Spanish word, *norteño*, which means "belonging to the north," and is used as a noun in apposition (i.e., "northern one").

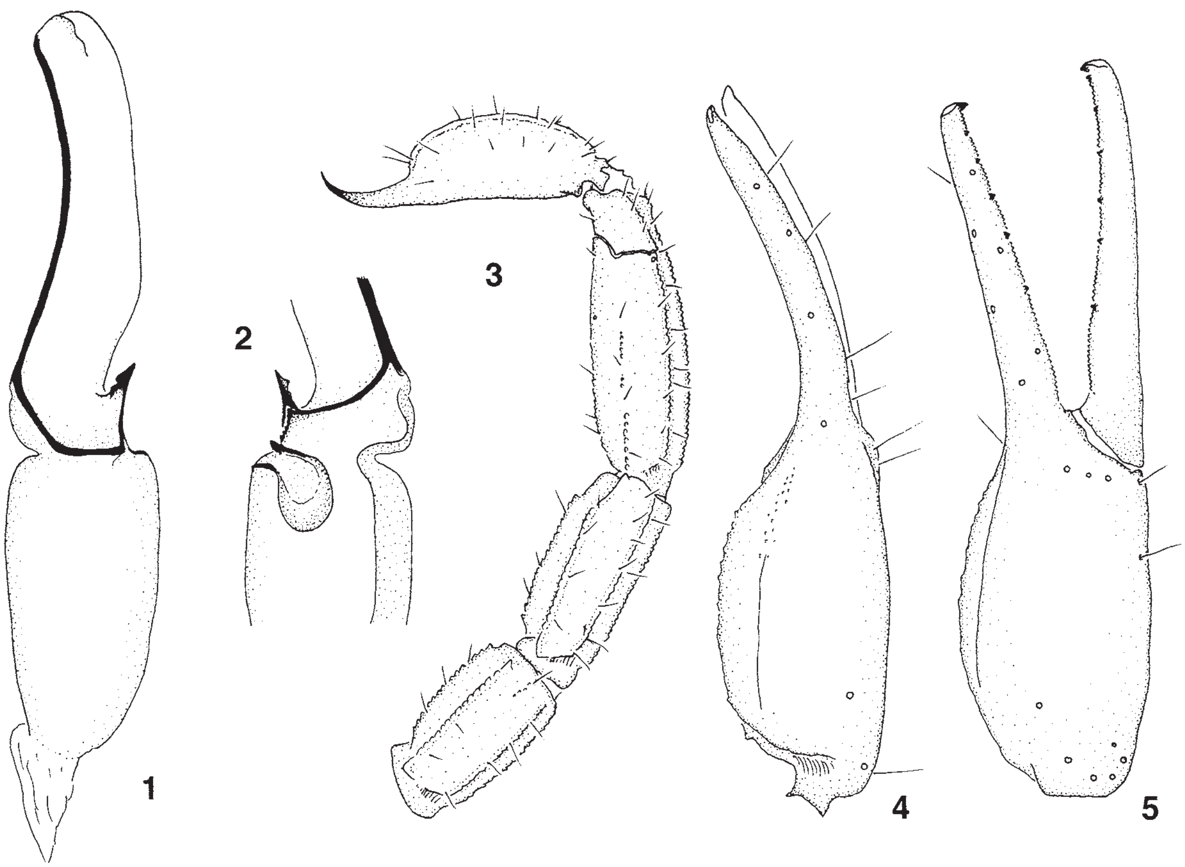
Diagnosis.—*Vaejovis norteno* appears to be most closely related to *Vaejovis rubrimanus*, *V. minckleyi*, and *V. decipiens*. It differs from all of these in the form of the male hemispermatophore, which has modified laminar hooks and no inner lobe (Figs. 1, 2), and its low pectinal tooth counts (13-17). It further differs from *V. minckleyi* in lacking denticles on the ventral margin of the cheliceral fixed finger, by having only two patellar *esb* trichobothria (instead of three), by having reduced carinal structure on the outer surface of the pedipalp chelae (rather than having granulose carinae). *Vaejovis minckleyi* is also a yellowish species, in contrast to the brownish *V. norteno*.

Vaejovis rubrimanus also has three patellar *esb* trichobothria and is a yellowish brown species with the pedipalps distinctly bicolored (yellowish femora and patellae and reddish chelae); *V. norteno* is more or less uniformly colored (brownish to orange brownish), even on the pedipalps.

Vaejovis decipiens is a form found in the Sierra Madre Occidental in the southern parts of Chihuahua and Sonora. It is dark brown to blackish, with pectinal tooth counts over 20 in both males and females. The telson of this species is slender, quite unlike that of *V. norteno*.

Comparisons with additional species are given in the identification key.

Description.—The following description is based on the holotype male; differences in females are noted in parentheses.



Figs. 1-5. Morphology of holotype male of *Vaejovis norteno*, new species. 1, Right hemispermatophore, dorsal aspect; 2, right hemispermatophore, ventral aspect; 3, left lateral aspect of metasomal segments III, IV, V, and telson; 4, pedipalp chela, dorsal aspect; 5, pedipalp chela, external aspect. Trichobothrial patterns are indicated on the drawings of the pedipalp chela.

Coloration. Carapace brown, tergites I-VI orange brown, tergite VII and first three metasomal segments brown, metasomal segments IV-V reddish brown. Telson orange brown, aculeus dark reddish brown. Cheliceral manus yellowish, teeth dark brown. Pedipalp femur, patella, and chela manus orange brown. Pedipalp chela fingers reddish basally, slightly yellowish at fingertips. Carinae of pedipalps and metasoma dark brown to reddish brown. Legs pale yellow brown.

Prosoma. Carapace length greater than posterior width; ratio of carapace length/metasomal segment V length 0.80 (0.81-0.89). Median ocular prominence slightly raised above carapacial surface. Anterior margin obtusely emarginate; median notch rounded. Carapace densely coarsely granular, less so in interocular area.

Mesosoma. Median carina obsolete on I; on II-VI represented by weak, low ridges covered with fine granules. Tergite VII with median carina present on anterior half as a moderate, rounded ridge covered with coarser granules; both pairs of lateral carinae strong, crenulate. Tergites densely finely granular, with post-tergites also bearing dense, coarse granulation. Pectinal teeth numbering 17-16 (13-17). Sternites III-VI sparsely setose; smooth, sublustrous medially; lateral areas finely granular. Sternite VI with coarser granulation laterally. Sternite VII with one pair of moderate, granulose lateral carinae; surface coarsely granular throughout, especially on lateral areas.

Hemispermatophore (Figs. 1-2). Distal lamina relatively slender, possessing short distal crest. Ectal margin of dorsal trough prolonged into pointed process bearing two denticles. Capsule with simple sperm duct area and lacking sperm plug structure.

Metasoma (Fig. 3). Segment I length/width 1.10 (0.92-0.95), III length/width 1.43 (1.17-1.28), V length/width 2.56 (2.35-2.54). Segments I-IV: Dorsolateral carinae strong, irregularly crenulate; distalmost denticle slightly enlarged, subspinoid. Lateral supramedian carinae strong, crenulate on I-III: moderate, granular on IV; distalmost denticle slightly enlarged, subspinoid on I-III, flared on IV. Lateral inframedian carinae on I strong, complete, granulose; on II present on posterior one-third, strong, granulose; on III present on posterior one-fifth, strong, granulose; on IV absent. Ventrolateral carinae strong, crenulate. Ventral submedian carinae moderate, granular. Intercarinal spaces shagreened; dorsal and lateral intercarinal spaces with scattered coarse granules. Segment V: Dorsolateral carinae moderate, granular. Lateromedian carinae moderate basally, weak distally; present on anterior two-thirds, granular. Ventrolateral carinae strong, feebly crenulate. Ventromedian carina moderate, feebly serrate.

Metasomal I-IV carinal setation (left side only): dorsolaterals, 1:3:3:3; lateral supramedians, 1:3:4:4; lateral inframedians, 2:2:1:1; ventrolaterals, 3 (+1 ventral seta):4 (+1 ventral seta):5 (+1 ventral seta):6 (+3 ventral setae); ventral submedians, 3:5:5:6; ventromedian intercarinal spaces of segments II-III with accessory seta by second carinal pair from base. Setation of metasomal segment V: dorsolaterals, 7; lateromedians, 4; ventrolaterals, 8; an accessory setal row laterally flanking ventrolateral carina, consisting of six setae on left and seven on right side.

Telson. Moderately globose. Dorsal surface of vesicle with small irregular punctations; 11 pairs larger setae.

Pedipalps. Femur length/width 3.93 (3.56-3.65). Tetracarinate: dorsointernal, dorsoexternal, and ventrointernal carinae strong, crenulate; ventroexternal carina strong, composed of large, irregularly spaced, sharp granules. Internal face with 7-9 larger, pointed granules; ventral face with coarse granulation on proximal portion; dorsal face with sparse fine and coarse granulation. Orthobothriotaxia C (Vachon 1974).

Patella length/width 3.82 (3.45-3.59). Tetracarinate. All carinae strong, granulose. Internal carina with 7-9 large and moderate tubercles arranged in oblique, longitudinal row. External, dorsal and ventral faces finely granular. Orthobothriotaxia C (Vachon 1974).

Chela (Figs. 4-5). Dorsal marginal carina moderate, granulose; dorsal secondary and digital carinae represented by low, smooth, rounded ridges; dorsointernal carina strong, with sharp granules; ventrointernal carina weak, irregularly granular; other carinae obsolete. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged denticles; six inner accessory denticles. Dentate margin of movable finger with primary row divided into six subrows by five enlarged denticles; apical subrow consisting of a single denticle; seven inner accessory denticles. Dentate margins of chela fingers without distinct scalloping. Chela length/width ratio 4.29 (4.36-4.50); fixed finger length/carapace length ratio 0.91 (0.85-0.89). Orthobothriotaxia C (Vachon 1974).

Legs. Ventromedian spinule row of telotarsus terminating between a single pair of enlarged spinules.

Measurements of Male Holotype (mm): Total L, 48.0; carapace L, 5.5; mesosoma L, 13.1 (0.9 + 1.0 + 1.4 + 1.8 + 1.9 + 2.4 + 3.7); metasoma L, 23.0; telson L, 6.4. Metasomal segments: I L/W, 3.2/2.9; II L/W, 3.8/2.9; III L/W, 4.0/2.8; IV L/W, 5.1/2.7; V L/W, 6.9/2.7. Telson: vesicle L/W/D,4.3/2.5/2.1; aculeus L, 2.1 Pedipalps: femur L/W, 5.9/1.5; patella L/W, 6.5/1.7; chela L/W/D, 10.3/2.4/2.8; fixed finger L, 5.0; movable finger L, 5.9; palm (underhand) L, 4.8.

Measurements of Female Paratype, Coahuila (mm): Total L, 62.5; carapace L, 7.2; mesosoma L, 18.5 (1.1 + 1.4 + 2.0 + 2.6 + 3.0 + 3.6 + 4.8); metasoma L, 28.3;

telson L, 8.5. Metasomal segments: I L/W, 4.0/4.2; II L/W, 4.5/3.9; III L/W, 4.8/3.8; IV L/W, 6.1/3.5; V L/W, 8.9/3.5. Telson: vesicle L/W/D, 5.7/3.4/2.9; aculeus L, 2.8. Pedipalps: femur L/W, 7.3/2.0; patella L/W, 7.9/2.2; chela L/W/D, 12.6/2.8/3.2; fixed finger L, 6.4; movable finger L, 7.5; palm (underhand) L, 5.7.

Variation.—Metasomal I-IV carinal setation (left side only) for the three adult females were as follows: dorsolaterals, 1-2:2-3:3:3-4; lateral supramedians, 1-2:3-4:3-4:3-4; lateral inframedians, 3:1-2:1:1; ventrolaterals, 1-3 (+1 ventral seta):2-4 (+1 ventral seta):4 (+1 ventral seta):5-6 (+1-2 ventral setae); ventral submedians, 3-4:5:5:5 (one specimen had two unpaired setae on the first segment in addition to the three pairs); ventromedian intercarinal spaces of segments II-III usually with one or two accessory setae. Setation of metasomal segment V: dorsolaterals, 6-10; lateromedians, 4; ventrolaterals, 7-10. The ventral accessory setal row laterally flanking ventrolateral carina consists of 3-6 setae.

The six female specimens exhibited pectinal tooth counts as follows: there were 1 comb with 13 teeth, 7 combs with 14 teeth, 1 comb with 15 teeth, 2 combs with 16 teeth, and 1 comb with 17 teeth. Juvenile specimens are light yellowish brown in coloration with diffuse dusky markings.

Juvenile specimens are light yellowish brown in coloration with diffuse dusky markings.

Paratypes. MÉXICO: *Coahuila*: Cueva de Los Llanitos, 1700 m N Los Llanitos (= 5 km NW Mesa de Las Tablas), Ejido el Potrero, 16-17 July 1993 (P. Sprouse), 1 female (AMNH). *Nuevo León*: Cueva San Francisco de Asis, Chipinque, 2 July 2000 (P. Sprouse), 1 female, 3 juv. females (AMNH); Hoya Aporrear, Mesa de la Colorado, Laguna de Sánchez, 1 Jan 1998 (J. Kennedy); 1 female, 1 2nd instar (TMM).

SPECIMENS EXAMINED OTHER *VAEJOVIS NITIDULUS* GROUP SPECIES

Vaejovis curvidigitus Sissom, 1991. MÉXICO: *Guerrero:* Acatempa (1675 m), 4 Feb 1989 (E. Barrera, A. Cadena, L. Cervantes), 1 female (UNAM); Huitzuco, Dec 1948, 1 male (UNAM); Iguala, 17 June 1961, 1 female (UNAM); Mpio. Tixtla, Atliaca, 16 July 1999 (Vásquez, Martinez, Moreno, Texta), 1 male (InDRE); Tlapa (date and collector unknown), 4 females (InDRE). *México:* Ixtapan de la Sal, 4 Nov 1977, 1 female (UNAM); Tonatico, 6 Mar 1948, 1 female (UNAM). *Morelos:* Cuautla, 23 Apr 1972 (M. García Peña), 1 male (UNAM); Cuautla, II-1936, 2 females (UNAM); Tlayacapan, Apr 1990 (Ibañez-Bernal), 1 female (InDRE, Sc 90018); Tlayacapan (in house), 13 Apr 1990 (Ibañez-Bernal), 1 male (InDRE, Sc 90019). *Oaxaca:* Huajapan de León, 21 Jan 1997 (J. Rivera Gomez), 1 male (InDRE); San Lorenzo Nuchila, 18 Nov 1996 (Jose Rivera), 1 female (InDRE); San Miguel Amatitlán, 25 Sept 2000 (E. Martin, M. A. Peregrina, V. Alcantara), 1 female (ENCB-IPN, no. 367); Silacayoapan (San Vicente, El Zapote?), 25 Nov 1996 (J. Rivera), 1 female (InDRE).

Vaejovis decipiens Hoffmann, 1931. MÉXICO: Chihuahua: Copper Canyon, 17 Mar 1997 (B. Pickering), 1 female (CAS); 5 mi SW Tejaban along Urique River, 4-10 May 1991 (R. E. Stecker), 1 male, 3 females, 3 juvs. (CAS); 10 mi SW Tejaban along Urique River, 11-15 May 1991 (R. E. Stecker), 3 females, 3 juvs. (CAS); 25 mi SW Tejaban along Urique River, 20-23 May 1991 (R. E. Stecker), 1 male, 2 females (CAS).

Vaejovis gracilis Gertsch & Soleglad, 1972. MÉXICO: *Veracruz:* Cueva del Cabrito, La Palma (728270 2106469 NAD27, 14Q) 2 Mar 2001 (P. Sprouse, T. Whitfield), 1 male (TMM); Gruta de Ojo de Agua, Paraje Nuevo, 1 Dec 1956, 1 female (UNAM); Gruta de Ojo de Agua, Paraje Nuevo, 2 May 1952, 1 female (UNAM).

Vaejovis intermedius Borelli, 1915. MÉXICO: *Chihuahua:* Nuevo León: Bustamante Canyon, Bustamante, 4 Sept 1999 (P. Sprouse), 4 males, 2 females (TMM).

Vaejovis kochi Sissom, 1991. MÉXICO: *Hidalgo:* Actopan (in house), Aug 1975 (Zerón), 1 male (UNAM); Actopan, 15 July 1990 (F. Zerón), 1 male, 2 juv males, 3 females (ENCB-IPN, No. 185); Barranca de Meztitlán (sobre al Poblado de Venados), 18 Aug 1962 (D. Pelaez, C. Bolivar), 2 males, 2 females, 1 sub female, 1 juv male, (ENCB-IPN, No. 116); Actopan, Aug 1991 (F. Zerón), 1 male, 1 sub female (ENCB-IPN, No. 184); Actopan, 21 Dec 1984 (F. Zerón), 2 females (ENCB-IPN, No. 6); Actopan, Nov 1979 (F. Zerón), 1 female (ENCB-IPN); Actopan, 4 Mar 1979 (F. Zerón), 1 female (ENCB-IPN); Guerrero, Mineral del Chico, 27 May 1986 (Rafael Aguilar), 1 female (ENCB-IPN, No. 172); Mpio. Huasca, San Sebastián, 11 June 2000 (collector unknown), 1 juv. male (InDRE); Mpio. Ixmiquilpan, Nicolas Flores (Cerro de la Cruz), 27 June 2000 (collector unknown), 1 sub female (InDRE); Metztitlán, Tlamaya (in house), 5 Aug 2000 (Vidal Angeles Pérez), 1 sub female, 1 juv female (InDRE); KM 76 de Pachuca a Ixtlahuaca (2000 m), 14 July 1962 (C. Bolivar, J. Alvarez), 1 sub male, 1 sub female (ENCB-IPN, no. 54); Pachuca, Colonia Vista Hermosa, 11 July 1999 (A. Franco), 1 female (UNAM); San Miguel Regla, Huayapan, 24 Feb 1990 (H. Brailovsky, E. Barrera), 1 female (UNAM); Santa María Lucana, Tula, 1953, 1 female (UNAM); Tulancingo (date and collector unknown); 1 female (ENCB-IPN, No. 155).

Vaejovis mitchelli Sissom, 1991. MÉXICO: *Queretaro:* Mpio. Arroyo Seco, Río Conca, 14 May 2000 (Ricardo Pérez), 1 female, 3 sub females, 1 juv female, 1 juv male (UNAM).

Vaejovis nigrescens Pocock, 1898. MÉXICO: *Guanajuato:* Mpio. Apaseo de Alto, 3 km S Huapango, 12/IX/98 (L. Ramirez), 1M (UAQ, LE0043); Mpio. Apaseo el Grande, El Tunal, 28 May 2000 (A. R. Arias), 1 female (InDRE); Mpio. Atarjea, El Pilar (El Pilón) (on wall of house), 12 May 2001 (Manual Suarez), 1 female (InDRE); Celaya, 23 June 1979 (Marisol Robledo), 2 males, 3 females, 1 sub female (ENCB-IPN, No. 49); León, 27 May 1965 (collector unknown), 1 male, 3 females (InDRE); Mpio. Irapuato, Rancho Cuchicuato (near Irapuato), 25 April 2001 (E. Martinez Zavala), 1 male (InDRE); Salamanca, 20 May 2001 (Veronica Jaime), 1 male, 1 female (ENCB-IPN); Mpio. Salvatierra, Emenguaro, Feb 1969 (collector unknown), 1 female (InDRE, Sc 88199); Mpio. Salvatierra, Cd. Salvatierra, 31-Oct 1999 (J. Callzontzin), 1 juv female (UAQ); Mpio. Salvatierra, San José del Carmen, Jan 1969 (collector unknown), 2 males, 1 female (InDRE, Sc 88195); Mcpio. Salvatierra, San Pedro de los Naranjos, Feb 1969 (collector unknown), 3 males, 12 females, 2 juv. females (InDRE); Mpio. Salvatierra, Santiago Maravatio, Feb 1969 (collector unknown), 1 female, 2 juv females (InDRE, Sc 88198); Mpio. Victoria, Agua Fría (in house), 10 May 2001 (Mayorico Rivera Diaz), 1 male, 1 juv (InDRE). *Jalisco:* Chamela, 4 Apr 1977, 1 female (UNAM). *México:* Ixtapan del Oro, 8 June 1941, (UNAM); San Juan de los Lagos, 31 Mar 1979 (Hector Plascencia), 1 male (ENCB-IPN, no. 189). *Michoacán:* Agua Blanca, Junganjeo (in house), 1 male (UNAM); Apatzingan, 30 July 1989 (Laura Rios), 2 males (UNAM); Cd. Hidalgo, 12 July 1987 (Irma Estreila), 1 male (UNAM); Hondacareo, 18 May 1989 (D. A. Fernandez), 1 male (UNAM); Hondacareo, 15 May 1989, 2 females (UNAM); La Piedad, 25 July 1987 (Mario Méndez), 1 female (UNAM); Morelia, 15 June 1987 (Angel Tinoco), 1juv male (UNAM); Morelia, 7 Sept 1986 (Jorge Fabela), 1 male (UNAM); Morelia, 30 June 1987 (Ma. de Jesus Nereyda), 1 male, 1 female (UNAM); Morelia, 28 May 1987 (Rosalba Maya), 2 males (UNAM); Morelia, 7 June 1987 (Irma Tinaco), 1 male (UNAM); Morelia, 12 May 1986, 2 females (UNAM); Morelia, 11/7/87 (Olga Barriga), 1 female (UNAM); Morelia, 8 Aug 1984 (J. Lopez), 1 male (UNAM); Morelia, El Reolito, date? (J. Ponce), 2 juvs. (UNAM); Pariwaro, 31 July 1988 (Baltazar Castro Zarco), 1 female (UNAM); Taretan, 12/07/96, 1 male (UNAM); Uruapan, 3 May 1988 (Manuel Moreno G.), 1 male (UNAM); Zamora, 2 June 1991 (A. Rosa Santos), 1 female (UNAM); Zitcuaro, 6 July 1985, 1 female (UNAM). *Querétaro:* Mcpo. Querétaro, 7/09/98 (R. Barron, Cid, Morales), 1 female (UAQ-LE0008). *Zacatecas:* Aguas Frías, July 1963 (collector unknown), 1 male (InDRE, Sc 88203).

Vaejovis nitidulus Koch, 1843. MÉXICO: *Hidalgo:* Mpio. Alfajayucan, Alfajayucan (found inside Health Center building), 22 Sept 2000 (Irene Hernandez), 1 female (InDRE); Mpio. Huichapan, Huichapan, 25 Mar 1970 (A. Luisa Lang), 1 male (UNAM); Mpio. Huichapan, Huichapan, 18 Aug 1969 (A. L. Amaya L.), 1 male (UNAM); Mpio. Huichapan, Huichapan, 13 Nov 1961 (Sergio Guerrero), 1 female (UNAM); Mpio. Huichapan, Maney (date and collector?), 1 juv female (InDRE); Mpio. San Jose Atlan, Barrio Guadalupe, 6 June 2000 (collector?), 1 male (InDRE). *México:* Mpio. Aculco, Poblado de Aculco, 31 Oct 1999 (V. Sanchez), 1 female (UNAM). *Querétaro:* Cadereyta Vizarron, 1977 (S. Zamudio), 1 male (ENCB-IPN, No. 191); Mcpo. Querétaro, 7/09/98 (R. Barron, Cid, Morales), 1 male, 1 female (UAQ-LE0044, LE0045); Tequisquiapan (Debajo de corteza de *Taxodium*), 17 Sept 1999 (R. Jones), 1 juv female (UAQ-LE0024); Vizarron (date and collector?), 2 males, 1 female (InDRE, Sc 88197).

Vaejovis pococki Sissom, 1991. MÉXICO: *Guanajuato:* Camino a Xichu, 30 May 1999 (Castelo), 1 male, 1 female + exuviae (UNAM); Rancho Corralillo, Victoria, 19 Feb 1985 (W. Lopez-Forment), 1 female (UNAM). *Querétaro:* Hacienda del Ahorcado, Pedro Escobedo, 3 June 1975 (J. Gpe. Pacheco), 1 female (UNAM); Mpio. El Marquez (700 m), 15 Nov 1997 (E. Rojo), 1 juv female (UAQ-LE0003); Mpio. Querétaro, 1 female (UAQ, LE0030); no specific locality (probably Mpio. Querétaro), 1 subadult female (UAQ-LE0022). *San Luis Potosí:* Camino a Santa María del Río, 12 Oct 1953 (F. Medellín), 1 male, 2 females (ENCB-IPN, No. 99).

Vaejovis rubrimanus Sissom, 1991. MÉXICO: *Nuevo León*: ca. 6 kms. W. Medreros, 21 December 1967 (F. García B., José Castillo T., J Puente F., A. Jiménez G.), 1 male, 3 females, 1 subadult female (UNAM); Cañon de el Diente, arriba de la Canica, Monterrey, 22 May 1959, 1 female, 1 juv male (UNAM).

Vaejovis solegladi Sissom, 1991. MÉXICO: *Oaxaca:* Cuicatlán, IX-1948, 4 males, 1 female (UNAM); Cuicatlán (collected in wall of a manger), 13 May 1954 (Jordi Julia), 1 female (UNAM); Cuicatlán Mpio., Cuicatlán, 23 March 1998 (J. L. Casto), 1 female (UNAM); Dominguillo, Mpio. Cuicatlán, 23-25/XI/1997 (J. Castelo), 1 female. *Puebla:* Izucar de Matamoros, 25 May 1943, 1 male (UNAM).

Key to the species of the *Vaejovis nitidulus* group in Mexico

1. Pedipalp chela fixed finger with primary row of denticles divided into seven subrows 2
   Pedipalp chela fixed finger with primary row of denticles divided into six subrows 4
2. Pedipalp patella with 3 *esb* trichobothria; base color of body yellow brown .... *V. nitidulus* Koch
   Pedipalp patella with 2 *esb* trichobothria; base color of body dark brown to reddish brown 3
3. Male pectinal tooth count greater than 24, female count greater than 23; movable
   finger of chela with eight subrows of denticles and eight inner accessory granules ... *V. mitchelli* Sissom
   Male pectinal tooth count less than 24, female count less than 23, movable finger
   of chela with seven subrows and seven inner accessory granules .... *V. pococki* Sissom
4. Pedipalp patella with 3 *esb* trichobothria 5
   Pedipalp patella with 2 *esb* trichobothria 9
5. Metasomal segments I-III in male distinctly longer than wide; at least II-III in
   female longer than wide; pectinal tooth counts greater than 25 in males,
   greater than 24 in females 6
   Metasomal segments I-II (and usually III) wider than long in both males and
   females; pectinal tooth counts less than 25 in males, less than 24 in females 7
6. Dorsal and external keels of pedipalp chela well developed, granulose; chela fixed
   finger with denticles ventrally at base; chela manus yellowish; ratio of chela
   length/width greater than 4.6 in males, 6.0 in females .... *V. minckleyi* Williams
   Dorsal and external keels of pedipalp chela moderately to weakly developed,
   smooth to finely granular; cheliceral fixed finger lacking denticles ventrally
   at base; chela manus reddish; ratio of chela length/width approximately
   3.8 in males, 4.6-4.7 in females .... *V. rubrimanus* Sissom
7. Metasoma with ventral submedian carinae obsolete 8
   Metasoma with ventral submedian carinae present (at least on segments II-IV) .... *V. peninsularis* Williams
8. Body size large, with adults 45 mm or more in length; pedipalp chela
   moderately swollen, with strong dorsointernal carina bearing enlarged sharp
   granules; pectinal tooth counts greater than 21 in males and 18 in females .... *V. kochi* Sissom
   Body size small, with adults less than 30 mm in length; pedipalp chela palm
   slender, with weak dorsointernal carina; pectinal tooth counts in male
   16-17, in females 14-15 .... *V. platnicki* Sissom
9. Metasoma with ventral submedian carinae obsolete on I-IV (except in
   V. curvidigitus, which may have vestiges of these keels on segment IV) 10
   Metasoma with ventral submedian carinae present, often variable on I-II,
   but distinct on III-IV 13
10. Pedipalp chela fingers lacking distinct scalloping; metasomal segments
    II-III with lateral inframedian carinae extending one-half to two-thirds
    length of segment; distalmost denticles on dorsolateral metasomal
    carinae not distinctly enlarged .... *V. solegladi* Sissom
    Pedipalp chela fingers of male with more or less distinct scalloping;
    metasomal segments II-III with lateral inframedian carinae limited to
    distal third to one-fifth of segment; distalmost denticles on dorsolateral
    carinae noticeably enlarged 11
11. Adult body size less than 40 mm; scalloping in male chela fingers pronounced;
    metasomal segments III-IV usually with faint vestiges of ventral
    submedian carinae; ventrolateral carinae finely crenulate .... *V. curvidigitus* Sissom
    Adult body size greater than 40 mm; scalloping in male chela fingers subtle
    to moderate; metasomal segment IV always with ventral submedian
    carinae obsolete; ventrolateral carinae smooth 12
12. Metasoma very hirsute, especially ventrally, with accessory setae between
    the carinae; chela length/depth 2.9-3.1 in males, 3.5-4.1 in females;
    femur length/carapace length 0.84-0.91; northern Mexico and
    southern Texas .... *V. intermedius* Borelli

Metasoma sparsely setose, with few setae restricted to the carinae; chela length/depth 3.47-4.5 in males, 3.7-4.6 in females; femur length/carapace length 0.94-1.05; central Mexico .... *V. nigrescens* Pocock

13. Pedipalps and metasoma greatly elongated; chela length/width ratio greater than 7.5; metasomal segment V length/width greater than 4.0; general coloration light yellow brown throughout .... *V. gracilis* Gertsch & Soleglad

Pedipalps and metasoma not drastically elongated; chela length/width ratio less than 5.5; metasomal segment V length/width less than 2.50; coloration variable 14

14. Ventral aspect of metasomal segments with an accessory row of setae along ventrolateral carinae; metasomal carinae more setose (e.g., segment V with 7-10 setae along dorsolateral carinae and 7-10 along ventrolateral carinae); metasomal segments more elongate (e.g., segment V 2.83-3.04 times longer than wide) .... *V. norteno*, new species

Ventral aspect of metasomal segments with no more than one or two accessory setae along ventrolateral carinae; metasomal carinae less setose (e.g., segment V typically with 5 setae along dorsolateral carinae and 5-6 on ventrolaterals) 15

15. Ventral submedian carinae on metasomal segments I-II obsolete; carinae of sternite VII weak, granular; pectinal tooth count 19 in males, 17 in females .... *V. mauryi* Capes

Ventral submedian carinae on metasomal segments I-II present; carinae of sternite VII strong, crenulate; pectinal tooth counts greater than 20 in males, 18 in females 16

16. Chela of male with distinct scallop; ventral submedian carinae on II-IV smooth with fine posterior crenulations; digital and external secondary carinae of chela smooth; pectinal tooth count of male 22-25, of female 21-22; SE Sonora, SW Chihuahua, México .... *V. decipiens* Hoffmann

Chela of male with subtle scallop; ventral submedian carinae on II-IV crenulate; digital and external secondary carinae of chela granular; pectinal tooth count of male 21-22, of female 18-21; Isla Socorro, México .... *V. janssi* Williams

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DESCRIPTION OF THE MALE OF *VAEJOVIS SPROUSEI* SISSOM, 1990 (SCORPIONES: VAEJOVIDAE)

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ABSTRACT

The male of *Vaejovis sprousei* Sissom, 1990 is described, based on a recently collected specimen from Cueva del Escorpion in Nuevo León, México. The hemispermatophore, which bears several distinctive features (a dorsal crest at the distal end of the distal lamina, a single blunt hook at the distal end of the dorsal trough margin, and a series of denticles associated with the sperm duct), is described and illustrated. This and a second record from Cueva del Mono near Dulces Nombres, Nuevo León, represent the first cave records for the species.

INTRODUCTION

Sissom (1990) redescribed *Vaejovis dugesi* Pocock, 1902 and described two related species from northeastern Mexico (*V. sprousei*) and the Chisos Mountains in Big Bend National Park, Texas (*V. chisos*). All three species, currently assigned to the *Vaejovis mexicanus* group (Sissom, 1990, 2000), are uncommon in museum collections. *Vaejovis dugesi* and *V. chisos* were represented only by females, but in the case of *V. sprousei* a subadult male was also available. A few new specimens of *V. sprousei* have accumulated since the original description, including the first adult male, which is herein described. Two of the new records are from caves, the first such records for this species.

Group assignment of these three species is becoming questionable. As new species have accumulated, it is increasingly apparent that the *mexicanus* group of *Vaejovis* is a heterogeneous assemblage that may be divisible into several subgroups. Interspecific variation in hemispermatophores is noteworthy (Sissom 1990, 1991) and is expected to contribute to a refinement of our knowledge of phylogenetic relationships within and between the groups currently assigned to the genus *Vaejovis*. Therefore, descriptions of males and hemispermatophores of all taxa are highly desirable.

Hemispermatophore terminology follows that of Lamoral (1979) and the identification of the sperm duct floor is from Stockwell (1989:130). The convex surface, which would be exposed on the outside when the two hemispermatophores are joined to form the spermatophore, is termed the dorsal side. The concave (medial) surface is referred to as the ventral side. Orthobothriotaxia designation follows Vachon (1974).

Vaejovis sprousei Sissom, 1990
Figs. 1-5

Vaejovis sprousei Sissom, 1990:48, 51-53, fig. 3A-G.
Vaejovis sprousei, Kovarik, 1998:148; Sissom, 2000: 543; Beutelspacher, 2000:22, 110, map 90.

Type Data.—Holotype female taken from Conrado Castillo, Tamaulipas, Mexico, on 19 April 1981 (Peter Sprouse); deposited in AMNH; examined.

Distribution.—Known from the southern portions of Nuevo León and adjacent Tamaulipas, Mexico.

Description of Male.—Coloration. Carapace and tergites orange brown with underlying dusky markings. Metasomal segment I-V orangish brown. Telson orange, aculeus dark reddish brown. Cheliceral manus and teeth yellow. Pedipalp femur orange, patella orange brown. Chela palm orange brown. Fingers orange brown basally, yellowish distally. Keels of pedipalps brownish. Metasoma dark brown. Legs yellowish with dusky markings.

Prosoma. Carapace length greater than posterior width. Median ocular prominence slightly raised above carapacial surface. Anterior margin obtusely emarginate; median notch rounded. Entire carapacial surface finely granular interspersed with larger granules.

Mesosoma. Median carina obsolete on I-III; weak, smooth on IV-VI. Tergite VII with median carinae present on anterior one-third, weak, smooth; lateral carinae strong, granulose. Pectinal teeth numbering 18-18. Sternites III-VI smooth, sparsely setose. Sternite VII with pair of moderate, granular lateral carinae.

Metasoma. Segment I 0.91 times as long as wide; III 1.30 times longer than wide; V 2.88 times longer than wide. Segments I-IV: Dorsolateral carinae on I-IV strong serrate; distalmost denticle enlarged, spinoid on I-IV. Lateral supramedian carinae on I-IV strong serrate; distalmost denticle enlarged spinoid on I-III and on IV flared. Lateral inframedian carinae on I strong, complete, serrate; on II present on posterior half, strong, serrate; on III present on posterior one-third, moderate, serrate; on IV absent. Ventrolateral carinae on I-IV strong, serrate. Ventral submedian carinae on I-IV strong, serrate. Dorsal and lateral intercarinal spaces with scattered coarse granules. Segment V: Dorsolateral carinae moderate, serrate to granulate. Lateromedian carinae moderate, present on anterior two-thirds, irregularly crenulate. Ventrolateral and ventromedian carinae strong, serrate. Dorsal and lateral surfaces with scattered coarse granules. Metasomal I-IV carinal setation: dorsolaterals, 0:1:1:2; lateral supramedians, 0:0:1:2; lateral inframedians, 1:1:1:1; ventrolaterals, 2:3:3:3; ventral submedians, 3:3:3:3; ventromedian intercarinal spaces of segments II-IV without accessory seta. Setation of metasomal segment V: dorsolaterals, 2; laterals 3; ventrolaterals, 6.

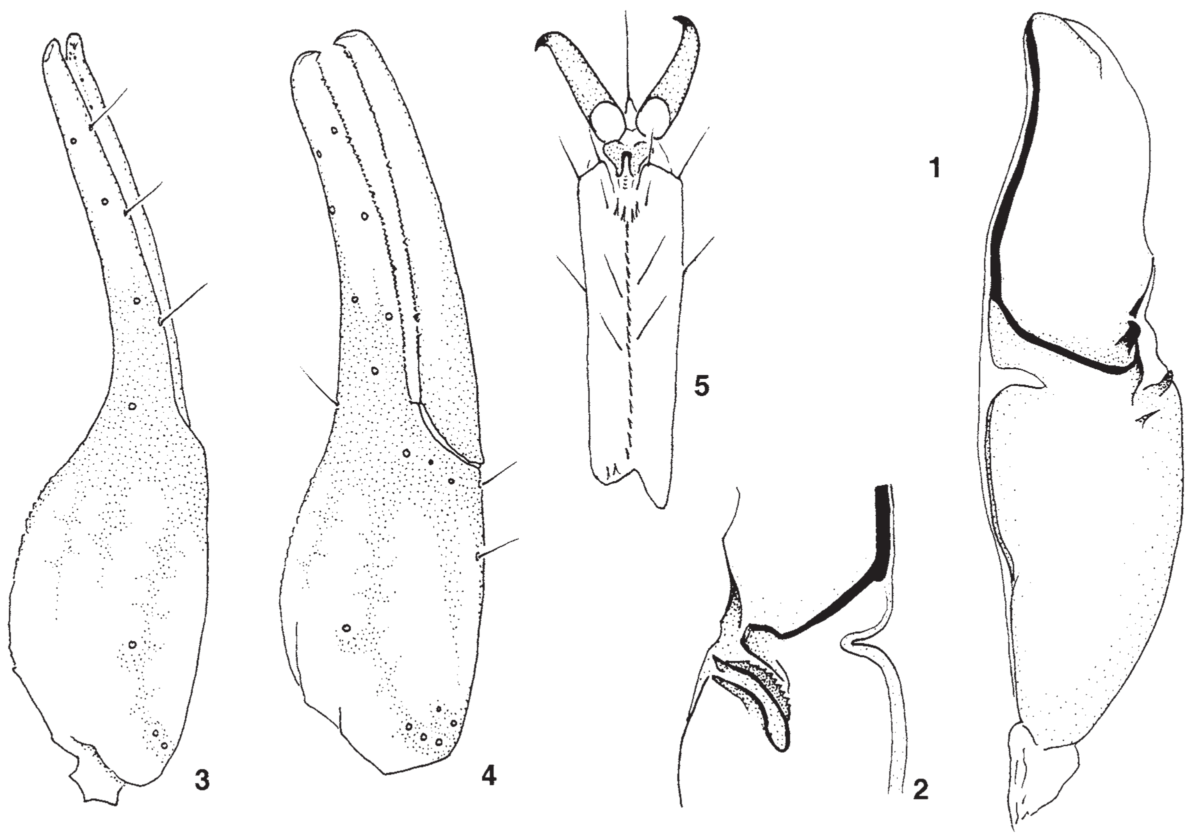
Telson. Dorsal surface of vesicle with a broad, elongate whitish patch (gland?); ventral surface with seven pairs very fine, long setae.

Hemispermatophore (Figs. 1-2). General appearance short and broad; distal lamina with a distal crest on dorsal surface and a single, blunt hook-like structure near the base. Capsular area with simple invaginated sperm duct floor, without conspicuous lobes or processes. Sperm duct flanked along distal edge by distinct denticle-like structures.

Pedipalps. Femur length/width ratio 3.43. Femur tetracarinate: Dorsointernal, dorsovexternal, and ventrointernal carinae strong, granulose; ventroexternal carina strong, composed of large, irregularly spaced, sharp granules. Internal face with 7-9 larger, pointed granules; ventral face with coarse granulation on proximal portion; dorsal face with sparse fine granulation. Orthobothriotaxia C.

Patella tetracarinate. All carinae strong, granulose. Internal face with moderate basal tubercle and 7-9 large, subconical granules arranged in longitudinal row. External, dorsal and ventral faces finely granular. Orthobothriotaxia C.

Chela (Figs. 3-4). Dorsal marginal, dorsal secondary, digital, external secondary, ventroexternal, ventromedian and ventrointernal carina weak and smooth. Dorsointernal carina slightly crenulate. Dentate margin



Figs. 1-5. 1, dorsal view of hemispermatophore; 2, ventral view of hemispermatophore; 3, dorsal aspect of pedipalp chela; 4, lateral aspect of pedipalp chela; 5, ventral aspect of left telotarsus III (for setal pattern, only pigmented macrochaetes shown).

of fixed finger with primary row divided into six subrows by five enlarged granules; six inner accessory granules. Dentate margin of movable finger with primary row divided into six subrows by five enlarged granules; apical subrow consisting of a single granule; seven inner accessory granules, of which all but the basalmost and distalmost are paired with a larger granule in the primary denticle row. Fingers without distinct scalloping. Chela length/width ratio 3.97; fixed finger length/carapace length ratio 0.77. Orthobothriotaxia C.

Legs. Ventromedian spinule row of telotarsus flanked distally by two pairs of larger spinules (Fig. 5).

Measurements (mm): Total L, 31.80; carapace L, 4.05; mesosoma L, 8.95; metasoma L, 14.45; telson L, 4.35. Metasomal segments: I L/W, 1.95/2.15; II L/W, 2.25/1.90; III L/W, 2.40/1.85; IV L/W, 3.10/1.75; V L/W, 4.75/1.65. Telson: vesicle L/W/D, 3.00/1.40/1.25; aculeus L, 1.35. Pedipalps: femur L/W, 3.60/1.05; patella L/W, 3.95/1.30; chela L/W/D, 6.15/1.55/1.80; fixed finger L, 3.10; movable finger L, 3.70; palm (underhand) L, 2.80.

Comments.—In general appearance, the hemispermatophore of *V. sprousei* is similar to those of certain other *mexicanus* group species for which the hemispermatophore is known (Sissom 1989). Like *Vaejovis monticola*, the hemispermatophore is robust. A distal crest on the distal lamina is also known in *V. rossmani* and *V. monticola*. As is typical of the group, the capsule of the ventral surface is simple, with the most conspicuous structure being the invaginated floor of the sperm duct. The denticle-like structures distal to the sperm duct invagination are thus far unique to *V. sprousei*. At the distal end of the dorsal trough margin is a hook-like structure, but in the case of *V. sprousei*, there is only a single, blunt hook (instead of a double hook, which is present in some species).

New Records.—*Nuevo León*: Cueva del Escorpión, Ejido Tinajas (UTM 446872 2647939 1515 NAD27), 1 January 1998 (J. Kreica), 1 male (AMNH); 7.8 mi N La Ascensión, 20 July 1979 (E. A. Liner), 1 juv. (FSCA); Cerro Potosí, 1.4 mi W 14 de Marzo, 25 July 1973 (Liner, Johnson), 1 female (FSCA); Cueva del Mono, 3 km E Garza, 8 km NW Dulces Nombres, 12 October 1987 (S. Lasko), 1 female (TMM). *Tamaulipas*: 24 km SW Ciudad Victoria, 26 July 2002 (Prendini, González Santillán, Francke), 1 female (UNAM, preserved in 95% ethanol).

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CICURINA SPIDERS FROM CAVES IN BEXAR COUNTY, TEXAS (ARANEAE: DICTYNIDAE)

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ABSTRACT

The placement of the genus *Cicurina* Menge in the Dictynidae is discussed and accepted. The subgenera of *Cicurina* are enumerated and *Cicurata* Chamberlin and Ivie is formally synonymized under *Cicurella* Chamberlin and Ivie. The synonymy of *Cicurella* under *Tetrilus* Simon is rejected; both subgenera are accepted as valid. The female genitalia of *C.* (*Tetrilus*) *japonica* (Simon) is reillustrated. *Cicurina elliotti* Gertsch is reillustrated and synonymized under *C. buwata* Chamberlin and Ivie (both from caves in Travis and Williamson Counties, Texas). *Cicurina gatita* Gertsch is synonymized under *Cicurina pampa* Chamberlin and Ivie. A taxonomic key and many new cave records to females of cicurinas known from Bexar County are provided. Females of the 12 species of *Cicurina* known from Bexar County (one species known only from epigean habitat) are redescribed and reillustrated. In addition, five new troglobitic species are described that are endemic to caves in the county. Variation and species definitions are evaluated with doubt being cast on the validity of *C. davisi* Exline. The possible evolution of cicurinas in Bexar County is briefly outlined. Notes on biology, endangerment, and captive culturing of cicurinas are provided.

INTRODUCTION

The central region of Texas is famous for its limestone caves. The complex geological history of this karst region has resulted in many isolated groups of caves in which endemic troglobitic faunas have developed. Spiders of the genus *Cicurina* Menge are very speciose in Texas (currently about 70 epigean and cavernicolous species). Gertsch (1992) recognized 51 species from caves in Texas, of which 46 were true eyeless troglobites. Four of the described troglobitic species of *Cicurina* from Bexar County are listed as endangered species (Stanford and Shull, 1993; Drewry, 1994; Rappaport Clark, 1998; Longacre, 2000). To better understand the current distributions of these species, a revision of recently collected materials was undertaken. Studies of the group immediately revealed that new material could not be identified by comparisons to the descriptions and illustrations in the most recent revision of the cicurinas of the subgenus *Cicurella* by Gertsch (1992). Part of the problem is the existence of several undescribed taxa, but more importantly, the illustrations of the female genitalia in the revision were not of sufficient detail to recognize some of the structures. Almost all of the species described from Bexar County were up to now known only from single specimens, with virtually nothing being known about variation in genital morphology. Therefore, the holotypes of all described species of *Cicurina* (both cavernicolous and epigean taxa) known from Bexar County have been reexamined and the female genitalia have been reillustrated. Cavernicolous *Cicurina* from nearby counties were also examined to verify that they were not the same species occurring in Bexar County. Additionally, five new troglobitic species are described herein. Because adult males are seldom encountered and only one male is known in Bexar County from a cave (Cross the Creek Cave) from which females are not known, they are not described in the present study. Furthermore, as noted by Gertsch (1992) the males of this genus do not exhibit as great differences in structures of the palps as can be seen in the genitalia of the females. This should be considered with caution though, as Gertsch's drawings lack sufficient detail and less than half of the species known from Bexar County are known from males. The collections of males are listed herein to establish dates and localities of their occurrences.

Only *Cicurina varians* Gertsch and Mulaik in Chamberlin and Ivie and *C. minorata* (Gertsch and Davis) are recorded (Chamberlin and Ivie, 1940; Vogel, 1970) outside of caves in Bexar County. As suggested later in this paper, *Cicurina pampa* Chamberlin and Ivie might also be found on the surface in the county. These three species will be found under large limestone rocks wherever they are encountered outside of caves, in mesocavernous (small, unenterable cracks and voids) spaces much like those that occur in caves. The few records of these spiders from the surface in central Texas are from the earlier parts of this century and they may not be easily found there today. Recent collecting efforts in the region revealed that the red imported fire ant (*Solenopsis invicta* Buren) has displaced many arthropods, which would normally be found under rocks in the region (Porter and Savignano, 1990). Collections from more northern counties revealed that *C. varians* just outside of cave entrances (within a few meters) under rocks do not differ significantly from specimens found within the caves. The fauna of cavernicolous *Cicurina* in Bexar County is very rich. Nine species are troglobites known exclusively from caves in Bexar County. Because of the rapid human development of Bexar County, the future of all the troglobitic species is uncertain.

MATERIALS AND METHODS

The synonymies are far more extensive than any normal taxonomic treatment. Because many of the species are endangered an effort has been made to include all references to the species, including unpublished reports. This should be helpful in the future for trying to associate data useful in legal, management, and conservation efforts. Complete addresses are provided for contracting agencies for reports, because some are not in the public domain.

Measurements and descriptions of the body are taken from the original descriptions of all previously described taxa. Additional data are provided on new collections. Female genitalia were removed from the abdomens and examined while they were in lactophenol.

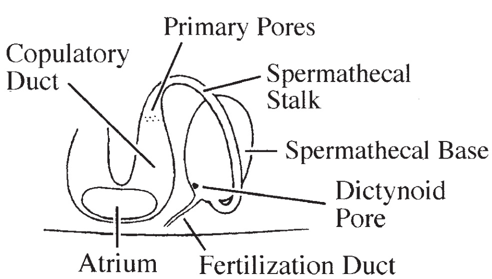
Terminology of the female genital structures generally follows Bennett (1992) (Figs. 1-4, 17, 18). The epigynum consists of the sclerotized external components and the atrium that is the opening leading to the vulva. The vulva or internal genitalia consist of paired spermathecae with a head (containing the primary pores), stalk (with one complex dictynoid pore), and base. The spermathecal head consists of the copulatory duct that terminates in a region with primary pores. The pores are located in some cicurinas in an enlarged area referred to as the bulb by Chamberlin and Ivie (1940). The pores open from microtubules that are generally not visible (Fig. 62, mt). In *Cicurella* species the head of the spermathecae containing the pores is located in a region generally in line with the axis of view of the microscope and therefore the pores are not easily detected. The spermathecal stalk starts just past the region of the primary pores and continues to the dictynoid pore. The connecting canal of Chamberlin and Ivie (1940) is equivalent to the stalk whereas the connecting canal of Gertsch (1992) is the copulatory duct. The index coil of Gertsch (1992) is the same as the spermathecal stalk used here. The spermathecal base as used by Bennett (1992) includes all the remaining internal spermathecal structures. This region was referred to as the spermathecum by Chamberlin and Ivie (1940). In cicurinas with a complex spermathecal base, those authors recognized a primary and secondary spermathecum. Gertsch (1992) referred to these regions as the spermathecum and sperm sac. For the discussions in this paper, the two regions of the spermathecal base are recognized as the anterior and posterior lobes.

The female genitalia are relatively thick in the larger species and if mounted under a cover glass the weight of the slip can distort the position of the canals. This was verified by remounting the same epigynum on different occasions. The cover slip should be elevated above the surface of the epigynum by the use of depression slides or by placing chips of cover glass next to the epigynum to support the top cover slip. The position and sizes of the anterior and posterior lobes of the spermathecal base have been found to be useful in distinguishing some species. In taxa with more of a rounded base, the distances between the two anterior lobes and posterior lobes are compared to imaginary lines drawn at right angles to the atrium (Figs. 5, 6) and expressed as a portion of the anterior lobe width. To describe the angle of insertion of the posterior lobe upon the anterior lobe of spermathecal base (in taxa with elongated spermathecae), an axis line is drawn through each structure (Figs. 7, 8) and the angle of incident expressed as less than, equal to, or greater than 90°. Determining the axis can be difficult in the species with a more rounded base. It is not necessarily the greatest width across the spermathecal base, but that which appears to be the center of the anterior lobe. I have drawn the axis line parallel to the flattest part of the posterior-most portion of the posterior lobe (Fig. 47).

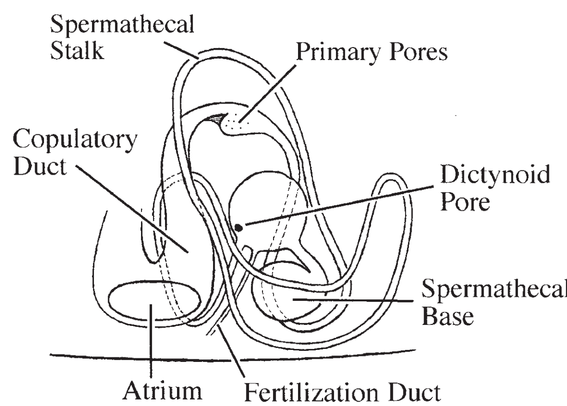
The descriptions of the body and legs are brief, as all but the genitalia appear to show considerable variation. Leg spine numbers are listed proximal to distal. From captive culturing of *Cicurina* spiders (see below), it is obvious cicurinas can mature at different sizes (possibly instars). *Cicurina varians* have been reared from a single egg sac that were about half the size of some of their sisters and mother. It appears that spiders fed little will mature into smaller spiders, thus suggesting that maturity may be time dependent as long as minimal food levels are reached.

Immatures are not described and cannot at this time be identified with certainty to species. To date, only one cave is known to harbor two different eyeless species in Bexar County and therefore, eyeless immatures from a single cave are assumed to belong to the same species known by adults in that cave. This could be an invalid assumption as few collections of multiple adults are known from single caves (see also comments under "Genus *Cicurina*," on the occurrence of two troglobitic species in other caves). No cave is known to be inhabited by more than a single species of 6-eyed or 8-eyed *Cicurina*, but as can be seen below (see Cave Faunas) many caves are known to have multiple *Cicurina* spp. (i.e., maximum of one each with 8-eyes, 6-eyes, and an eyeless species all from a single cave).

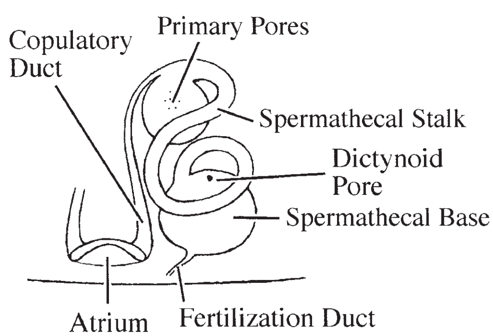
As can be seen from the lists of caves from which immatures alone are known (see end of article), most cave faunas are inadequately known. Many times collectors are only able to obtain immatures and some of these are near maturity. In an effort to resolve some of these identifications, captive culturing of these spiders was undertaken. Spiderlings destined for captive culturing were collected into plastic vials with tight fitting lids.



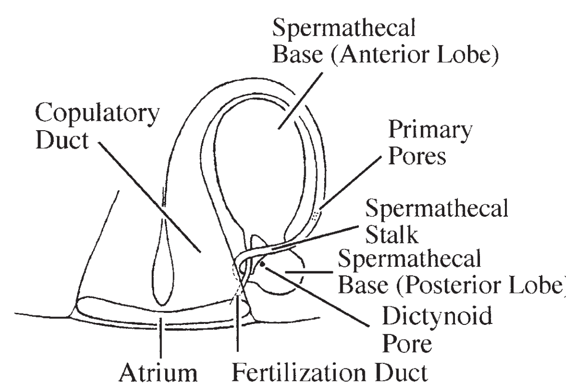
1 *Cicurina*



3 *Cicurusta*



2 *Cicurona*



4 *Cicurella* (=*Cicurata*)

Figs. 1-4.—Generalized female genital morphology of four subgenera of *Cicurina*. Only the right half (in ventral view) of the spermathecal structures is illustrated (redrawn from Chamberlin and Ivie, 1940: figs. 8-11). See Materials and Methods for discussion regarding the naming of the structures.

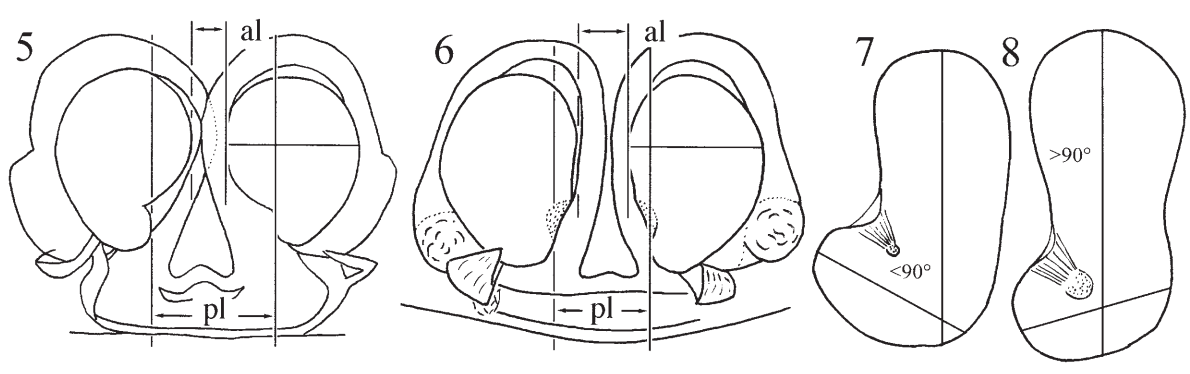
Upon exiting the cave, the vials containing spiders (one spider per vial) from a single cave were placed together in a ziplock bag, labeled, and placed in an ice chest (not directly on the ice). A small piece of moist, not wet, foam or paper toweling was added to each vial and a moist paper towel was added to each bag. Attempts to use too moist of toweling, soft tissue, or cave mud in the vials failed as this material would ball-up during transfer and roll around in the vial until it crushed the spider. Very small spiders can also be entrapped and drowned in small droplets of water which form in overly moist vials, especially when the outside temperature is lower than that inside of the vial. Once the spiders are safely placed in the moist vials they can survive at least a week sitting at room temperature and then either overnight express shipment or being hand-carried on an airplane for transfer to the rearing facility.

After six years of attempted culturing efforts, the best system found is as follows. A single spiderling (regardless of number of eyes) is kept in a jar in the dark until maturity. Jars [240 ml (8 ounces), about 9 cm tall] with tight fitting lids had about 2-3 cm of plaster of Paris on the floor. When the plaster was poured, small chunks of limestone were added to the container. The limestone was raised above the plaster at most by 3 cm, providing vertical surfaces for the spiders to attach their webs. Limestone was placed in the center of the jar; otherwise spiderlings would hide between the rock and the wall of the jar making it difficult to observe and remove molts.

The humid atmosphere in the jar is maintained by keeping the plaster moist. Small spiders can become entrapped and drown in water droplets on the glass or plaster; larger spiders are not so prone to drowning and can live (although not recommended) in webs over puddles of water on the plaster. As long as the air was very humid, temperature does not appear to be that important and could fluctuate considerably [up to 6 °C change in a single day, 10-32 °C (50-90 °F) over the year]. Temperature appears to be more important in the culture of more troglobitic forms (see below). Trying to match the cave environment, temperatures for the last few years were maintained close to 20.6 °C (69 °F). Monitoring temperature for three years in four caves at Camp Bullis revealed a mean range of 19.4-21.7 °C (67-71 °F) in areas distant from the cave entrances where troglobites predominantly occur, which approximates the county's 112-year mean temperature of 20.6 °C (69 °F) (Veni et al., 1998b).

Some experimentation is needed to establish the correct moisture level in a culture jar. The drier the jar the less fungal and mite problems are noted, but the humidity must remain high for the survival of the spiders (especially during molting). The cooler the environment the fewer mite and fungal problems were noted. Few problems were encountered when the temperature was maintained at about 20.6 °C (69 °F). The use of an environmental chamber and careful measurements and recording the temperature, humidity, and light levels was beyond the initial scope of this project. Only during the last three years was an environmental chamber used.

Larger spiderlings are fed fruit flies at least once a month, often once a week. The amount of food is determined by the spiders' activity and acceptance of food. Smaller spiderlings are fed collembolans. The collembolan used is a species [*Pseudosinella violenta* (Folsom)] common in caves of the region and can be reared on decaying organic material (leaves, dried cat food, etc.). In recent years some variety has been offered to the spiders diet. Occasionally live small whiteworms (*Enchytraeus albidus* Henle) and early instar domestic crickets are fed. Immature *Porcellio* isopods were also occasionally offered as food, but were



Figs. 5-8.—Positions and sizes of spermathecal bodies, dorsal views. 5, 6, lines drawn at right angle to atrium/posterior edge of genital plate to compare anterior lobe (al) and posterior lobe (pl) of spermathecal base interdistances; 5, *Cicurina loftini* n. sp. with anterior lobes much closer together than posterior lobes (about fourth diameter of anterior lobes apart); 6, *Cicurina bullis* n. sp. with anterior and posterior lobes about equally spaced (posteriors slightly further apart, anteriors about third anterior lobe apart). 7, 8, axis lines drawn down midlines of the anterior and posterior lobes of the spermathecal base with angle of incidence being greater or less than 90°; 7, *Cicurina madla* with body axis lines meeting at less than 90°; 8, *Cicurina madla* with body axis lines meeting at more than 90°.

refused by most of the smaller immature troglobitic *Cicurina*, but readily eaten by *C. varians*. Care should be used with feeding isopods. One *C. varians* did not feed and was consumed by the isopod. It is likely the spider was either caught during a molt or had died before the isopod ate it.

In earlier rearing attempts, an unidentified mite was used for food for smaller spiders. A small amount of commercial dyed (blue) fruit fly medium was kept in the jar as food for the mites. Although mites can serve as food, they can kill spiders when heavily infested and their use must be watched closely.

In one case, a subadult female was observed with a blue abdomen. Because she was so large, it is uncertain if she obtained the color from eating a large number of mites which had been reared on the blue dyed fruitfly medium or from direct ingestion of the medium. Peck and Whitcomb (1968) have recorded ingestion of artificial diets in other spiders.

It is important to open each culture jar and allow air exchange at least every three days at warmer temperatures [27-32 °C (80-90 °F)], less so if kept at about optimal of 20.6 °C (69 °F). On several occasions it was noted that the CO_2 level built up to the point that it killed fruit flies and mites in the jars. Possibly because some of the caves in Bexar County have high CO_2 levels, these *Cicurina* have developed an ability to "sleep" when the levels get high. Sometimes when opening the jar the spider would appear dead, but upon allowing the air to refresh, the animal would again start to move. In some cases it took several hours before the animals started to move and in the earlier culturing efforts it is likely that several animals were preserved because they were thought to be dead. Dropping them in alcohol did not "wake" them when under the apparent influence of CO_2.

A few spiders were accidentally killed by allowing fruit fly medium to decay in the jars. In these cases an odor of sulfur could be detected, another reason to air out the jars often when maintained at higher temperatures. More difficulties were encountered when jars with rubber seals were used. An airtight connection is not needed or desired, but it must be sealed enough to keep the humidity high and prevent the escape of the spider. Fewer problems with decay were observed once an environmental chamber was used and collembolans were provided as the main diet of very small spiderlings. Keeping the jars with minimal amounts of decaying material seems to be beneficial in controlling mites and unwanted high levels of toxic gases. Collembola also probably consume the fungi which develop in the container and serve as both janitor and food.

The above method works well for *Cicurina varians*. Success in rearing highly troglobitic *Cicurina* was less satisfactory. The majority of deaths were of animals that did not molt in captivity. Several individuals also died in the middle of molts or shortly after molting (body still white). Several things may be causing the reduced success in rearing troglobitic *Cicurina*. The environmental controls were not very stringent in earlier attempts and, although conducive to long-term maintenance, may not have been sufficient for the spiders to thrive. A variety of foods may also be important. The larger spiders were fed exclusively on fruit flies. In some epigean spiders it has been noted that they cannot reach adulthood on a strict one-food diet. Possibly crickets or some other source of nutrients should be added to the diet of the troglobitic *Cicurina*. It is also likely that highly troglobitic *Cicurina* simply take much longer to mature (see below under Biology). Relatively good success has been had using the above method to rear eyeless cicurinas from caves from more northern caves (in Coryell and Bell Counties, Texas). Most of the cicurinas reared to adulthood from these more northern counties were captured at only one or two molts from maturity. Either more spiders that were closer to maturity were collected in the second project or they are having a better survival and molting rate. It is possible that the better success is due to the cicurinas from the second project not being as highly cave-adapted as those from Bexar County.

Locality data generally are listed only as the name of the caves within the county and are roughly indicated on the maps. This is done to protect the precise location of the caves, many of which harbor endangered faunas. More detailed information on most of the caves can be found in Veni (1988, 1994) and the various reports listed in the literature cited by Veni et al. Anyone wishing to obtain precise locality data should contact the Texas Speleological Survey, Austin, Texas. Data relative to the formation and ages of the caves and bedrock are from Veni (1988, 1994). Acronyms for the collections from which specimens were examined/deposited are: American Museum of Natural History (AMNH), Cokendolpher collection (JCC), Texas Memorial Museum (TMM).

See below under "Genus *Cicurina*" for a discussion on species recognition that was used in preparing this manuscript.

Sex Ratios

Gertsch (1992) noted that only about one fifth (15 of about 70) of the species of the subgenus *Cicurella* were known from males. Of these males, eight are members of species with eyes and nine are eyeless taxa. This rarity of males suggests an uneven sex ratio. Although sexes cannot be externally distinguished in early instar immatures, antepenultimate and penultimate males can be determined by the presence of expanded pedipalpal tarsi. As Gertsch noted, and is confirmed here, many penultimate males are observed in recent cave collections, indicating that the sexes are not skewed towards females.

It is likely that adult males are relatively short lived. Because cicurinas live solitary lives, newly matured males must (like most other spiders) give up the safety of their retreats/webs and go in search of sexually mature females. Unlike many spiders, mature *C. varians* males (in captivity) will build new webs if the old webs are destroyed, thus suggesting that a mature male might be able to reestablish a retreat if no females are available in his region of the cave. This strategy would allow the male to move to new regions as well as wait until young females could mature. While searching for females, the males are exposed to predators in the cave, primarily other cicurinas and, rarely, larger centipedes. Twice immatures were observed in caves that were displaced from their retreats (because of rock turning activity) to be captured and killed by nearby and larger *Cicurina*.

Mating may also be hazardous. Females are generally larger than males, and an unreceptive female could certainly capture and eat an unwary male. Even after mating, males still can be eaten if they do not exit the female's retreat quickly enough. Two pairs of *C. varians* were successfully mated (resulted in fertile eggs) in captivity. One of the matings resulted in the male being killed and eaten. This may not be natural, though, as the spiders were kept together for mating in a small jar (same jars used for rearing, see "Materials and Methods" section) and the male had little space to run or hide. The second pair mated and remained together in the jar for over 24 hours, suggesting that the attack after mating in the first case may have been the result of hunger in the female. The amount of time between mating and egg laying was not recorded (it was several days), but it is possible that the male contributed sufficient nutrients to aid in the production of eggs. An attempted mating in an eyeless species from farther north in Texas (Coryell County) resulted in the death of the female. In this case, the male was almost twice as large as the female when they were placed in a jar together. The male was newly matured, and it is possible that he was not yet prepared to search out and mate with a female. Because no sperm webs have been observed with a Texas *Cicurina*, it is not certain when a mature male will be ready to mate.

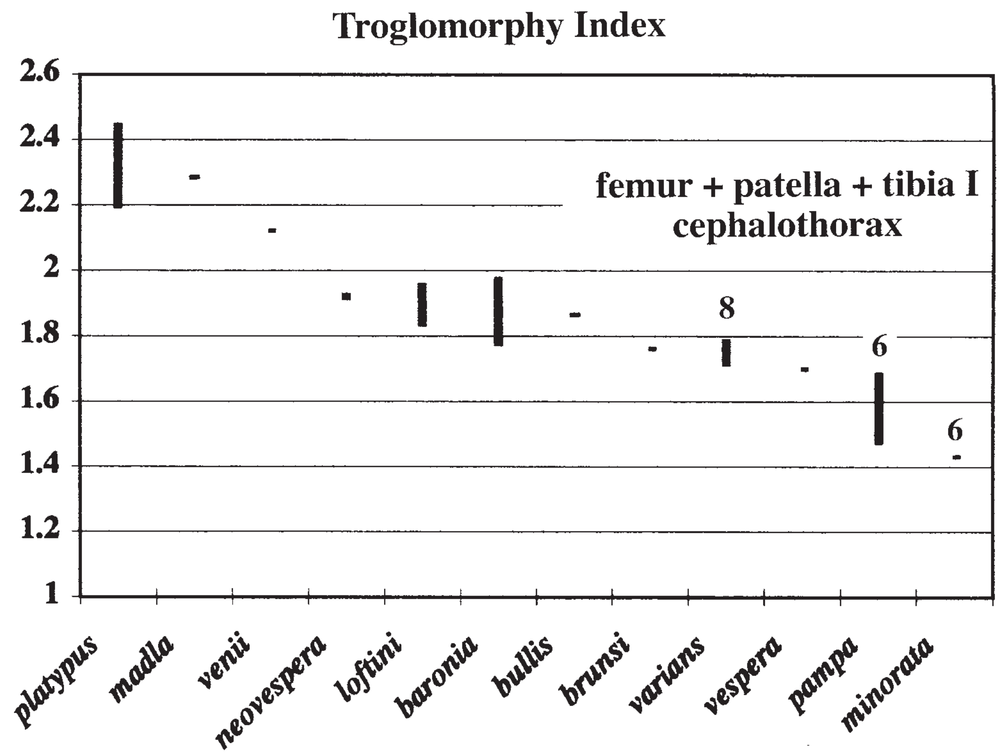
Cave Faunas

Troglophiles are species which reproduce in caves and are also known from the surface, or which do not exhibit morphological traits indicating that they are restricted to the cave habitat. Troglobites are species which exhibit morphological modifications (troglomorphy) indicating that they are restricted to caves (i.e., eyelessness, longer appendages, etc.). Among the cicurinas of Bexar County which have been taken from caves, the 6-eyed and 8-eyed species are considered to be troglophiles; the species lacking eyes are considered troglobites. In addition to the loss of eyes, troglobitic species also tend to have longer and more slender appendages, less heavily sclerotized cuticles, and lighter body coloration.

Using elongation of the legs versus cephalothorax length as a ratio (femur + patella + tibia I/cephalothorax lengths) to rank the degree of troglomorphy resulted in the data presented in Table 1 and Fig. 9. Because a larger number reveals relatively longer appendages the results are not surprising: eyed species have relatively shorter appendages and the surface form *C. minorata* had the shortest legs. Considering the eyeless taxa, larger body size was positively correlated with relatively longer appendages. Comparisons between ratios using the femur + patella + tibia lengths and those using only patella and tibia appear to represent similar degrees of elongation of the different appendage segments by species. It is clear from data presented in Fig. 9 that taking a few measurements and trying to relate this to length of evolutionary time or cave ages could result in errors. Nonetheless, these trends can be useful. The species with elongated spermathecae appear to be more troglomorphic than species with rounded spermathecae (excluding *C. platypus*). *Cicurina platypus* is interesting because the larger, even sized spermathecae are unlike those of other species grouped as "rounded" spermathecae and it is sympatric with a lesser troglomorphic *C. bullis*, which has the smaller "rounded spermathecae."

The extent to which *Cicurina* species worldwide have adapted to cave environments is remarkable. Almost half of the described species are known only from caves. Gertsch (1992) reported 50 species of eyeless troglobitic species of the subgenus *Cicurella* from Texas (46 species), Alabama (one species), and Mexico (three species). The 8-eyed *Cicurina* (*Cicurusta*) *varians*, although not a troglobite, is also abundant in caves of Texas (Reddell, 1965). *Cicurina* (*Cicurusta*) *mina* Gertsch (1991) is a troglobite and *Cicurina* (*Cicurusta*) *iviei* Gertsch (1991) is a troglophile from caves in Mexico. Gertsch (1992) also recorded the presence of two undescribed troglobitic species of *Cicurina* (*Cicurina*); one each from Georgia and Alabama. Yaginuma (1972, 1979) recorded three 8-eyed species of *Cicurina* (*Cicurina*) from caves in Japan. Presumably these three are troglophiles. Only one species of *Cicurina*, the type for the genus, is known from Europe and it is found both inside and outside of caves (Roberts, 1995)

Although it is not uncommon to find two or more *Cicurina* species living in a forested area in northern and eastern North America on the surface (pers. obs.), records of multiple cavernicolous forms are more lim-



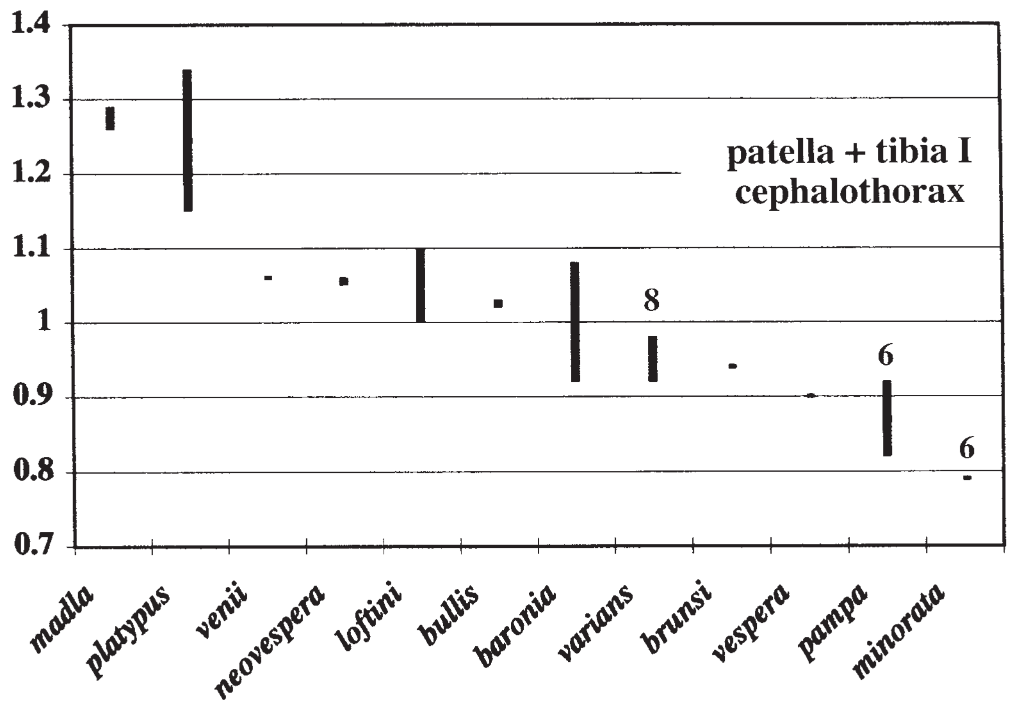


Fig. 9.—Measurements of troglomorphy in *Cicurina* spiders from Bexar County (larger number reveals longer appendages compared to body length). Indices are: femur + patella + tibia I lengths/cephalothorax length and patella + tibia I lengths/cephalothorax length. Eyed species are indicated by numbers above data bars (*C. varians* = 8 eyes, *C. minorata* and *C. pampa* = 6 eyes). Order within chart is based on median point of data ranges per species.

Table 1.—Troglomorphy and sizes of *Cicurina* from Bexar County, Texas [f+p+t/Ceph= femur + patella +tibia I lengths/cephalothorax length; larger number = more elongated appendages, BL = body length (excluding appendages)].

Species	Eyes	f+p+t/Ceph	p+t/Ceph	BL (mm)
varians	8	1.71-1.79	0.92-0.98	5.9-11.3
minorata	6	1.43	0.79	1.6
pampa	6	1.47-1.69	0.92-0.82	1.85-2.15
baronia	0	1.77-1.98	0.92-1.08	5.65-6
brunsi	0	1.76	0.94	4.05
bullis	0	1.86-1.87	1.03-1.02	3.9-5.75
loftini	0	1.83-1.96	1.00-1.10	3.25-5.6
madla	0	2.28-2.29	1.26-1.29	4.5-6.65
neovespera	0	1.91-1.93	1.05-1.06	3.6-4.9
platypus	0	2.19-2.45	1.15-1.34	6.2-6.25
venii	0	2.12	1.06	3.4
vespera	0	1.70	0.90	2.7

ited. Brignoli (1972) reported an eyed and a blind "form" of *Cicurina* in the same cave in Mexico. He was hesitant to accept that they were different species occurring together in the same cave. Gertsch (1992) and Cokendolpher and Reddell (2001b) each reported two different troglobitic species pairs to inhabit the same caves (*C. reddelli* Gertsch and *C. buwata* Chamberlin and Ivie in Cotterell Cave, Travis County, Texas; *C. caliga* Cokendolpher and Reddell and *C. hoodensis* Cokendolpher and Reddell from Buchanan and Triple J Caves, Bell County, Texas).

The present study revealed that an 8-eyed and an eyeless species of *Cicurina* both are commonly found together in caves in central Texas. In Bexar County, multiple groupings of *Cicurina* are also not uncommon. From B-52 Cave, Bunny Hole, Lone Gunman Pit and Ragin' Cajun Cave, the 8-eyed *C. varians* and eyeless immatures of *Cicurina* sp(p). are known. *Cicurina varians* and the 6-eyed *C. pampa* are known from Cross the Creek Cave, Up the Creek Cave, Stone Oak Parkway Pit, and Vera Cruz Shaft. Reddell (1993) reported a 6-eyed species from Mattke Cave where *C. varians* is known. *Cicurina varians* and eyeless species are known from Headquarters Cave (*C. madla*), Eagles Nest Cave, Isocow Cave, Hilger Hole (*C. bullis* n. sp.) and Platypus Pit (*C. bullis* n. sp. and *C. platypus* n. sp.). The eyeless *C. brunsi* n. sp. and 8-eyed immatures are known from Stahl Cave. Three species from the same cave appear to be the record: Platypus Pit with two blind species and *C. varians* and Up the Creek Cave with a blind species (either *C. bullis* or *C. platypus*), *C. pampa*, and *C. varians*. It is unusual to find a cave with eyeless cicurinas in which an 8-eyed species is not also collected. Unfortunately, most of the records of 8-eyed specimens are based on immatures which cannot currently be identified to species with certainty. It appears (Reddell, pers. comm.; pers. obs.) that when more than one species of *Cicurina* are present in the same cave, they will occupy different areas of the cave. The troglobites will be in the moister (but not dripping wet) and lower regions of the cave, whereas the eyed species will be nearer the entrance. This is not a hard-and-fast rule, though, as at least three eyeless specimens were collected from small areas of caves where *C. varians* were also present. In these cases, *C. varians* occupied both the twilight and upper dark zones of the cave. Troglobitic cicurinas apparently do not occur at or very near the twilight zones of caves. They either prefer to reside in the dark, moist, and less populated regions of the cave or they are absent because the greater number of larger predators (including *C. varians*) in the twilight zone eat them.

Biology

Little has been published on the biology of members of the genus *Cicurina*. Bennett (1985) reported on the biology of an epigean species from the eastern U.S.A., but it is atypical in that it builds a retreat tube without a web. More typical are the species known to live under and in rocks and wood on the surface and which spin a delicate and sparse, horizontal web without a retreat (citations within Bennett, 1985).

The webs of *C. varians* in captivity are a short tube which opens into a small sheet. The tube can be forked or multi-branched, depending on the substrate. This tube is unlike that reported by Bennett because it is not covered with debris and is rather delicate (the spider is easily seen through the web). Large specimens of *C. varians* in captivity will fill a jar with webbing. Both adult males and females will build new webs if their old webs are destroyed. The tube diameter is about the distance of the legs held partially extended, or about 3/4 the width of the body plus legs. In captivity, the diameter of the web changes as the animal grows; the web is altered to fit the individual. It is unknown if this happens in the cave or if the growing animal abandons its web and builds a new one. Abandoned webs are sometimes found in caves (possibly also due to predation). In captivity, the web can also be a simple tube around the base of the wall of the jar. In such cases the webbing will be attached to the floor and on the adjacent wall of the jar. The webbing is rounded above and the glass beneath the web will not be coated with silk. Several eyeless specimens from MARS Pit had well-developed webs, and in one web a distinct tube could also be detected. Generally, the troglobitic species have delicate webs of only a few strands or maybe a loose flat sheet. A few troglobitic individuals in captivity never constructed webs, but they were able to catch food and develop.

Cicurina varians generally hangs upside down in the tube area. Members of the Agelenidae (a family where *Cicurina* once resided) sit on top of the web. Unlike agelenids, *Cicurina* do not always sit at the edge of the tube facing out on the sheet. This may be because they have more than one "sheet" web (at least one on each end of the tube, more if a branched tube). The smaller troglobitic forms generally sit on the substrate under the "sheet" or the few strands of webbing. Larger spiders will often hang upside-down on the web. Although it would be interesting to speculate that the troglobitic species have reduced or given up web building because their prey are scarce and that they have to go in search of it, this could be entirely wrong. Because we do not know the ancestor(s) of the troglobitic forms, we cannot assume that they built webs like *C. varians*. Possibly the ancestor(s) of the troglobites also did not use webs as much. Otherwise, it might be advantageous in a rare food environment to sit and wait for such prey (less energy expended than making a web or walking around the cave searching for food).

The eggs of *Cicurina* spp. are laid in a small silken sac which is covered with bits of earth or attached to the inner wall of the retreat (Comstock, 1948; Bennett, 1985), where it remains with the female (Roberts, 1995). *Cicurina varians* egg sacs are placed within the web next to the substrate. An egg sac of a troglobitic species has not been observed.

From citations listed in Kaston (1948), it appears that some species of epigean *Cicurina* are myrmecophilous. No such association was noted with any of the cavernicolous species, but ants other than the red imported fire ant are relatively uncommon in caves from Central Texas (Reddell and Cokendolpher, 2001).

Cicurinas in caves live solitary lives in webs constructed under and among rocks. Areas of the cave occupied by the eyed taxa, generally near but not in the entrance of the cave, also are home to many types of other invertebrates. In some caves, larger spiders (lycosids and ctenids) and centipedes are present in the upper areas of these caves. Although immatures of these other species could serve as prey for eyed cicurinas, adults of these species could almost certainly eat even adult cicurinas. The numerous isopods, crickets, beetles, and harvestmen found near the entrances of caves could serve as prey for cicurinas and probably would not harm them except possibly if they were detected while molting. Reddell (pers. comm., 2000) found a dead *Rhadine* beetle in the web of a *Cicurina* (probably *varians*). Some *Ceuthophilus* crickets also occur in the depths of caves where troglobitic cicurinas occur. Here the cricket nymphs as well as a few other cavernicolous invertebrates (primarily *Brackenridgia* isopods, *Texoreddellia* silverfish, *Cambala* millipeds, and *Pseudosinella* springtails) probably occur in the diet of eyeless cicurinas. An eyeless *Cicurina* in Pussy Cat Cave, Williamson County, was observed carrying an immature *Speodesmus* milliped (Reddell, pers. comm., 2001). Larger predators, such as other spider species, are not present in the darker regions of the cave where troglobitic cicurinas occur. Very rarely the larger predatory *Pseudouroctonus* scorpions and *Theatops* centipedes have been collected in the same cave region as eyeless cicurinas.

An immature *Cicurina* sp. was found dead in Bunny Hole on 9 September 1998. It had been killed by what is probably a pathogenic fungus. Poinar (pers. comm., 1999) stated that the fungus was "a Deuteromycetales or one of the Fungi Imperfecti and probably the perfect stage is an Ascomycete." No other parasites or pathogens are recorded from troglobitic cicurinas.

Cicurinas bite their prey with the fangs and hold them tight with the chelicerae. They do not release the prey and allow the venom to act, as do some other spiders. The venom of cicurinas is very potent, as prey has not been observed to struggle but for a moment. Likewise, observations of larger cicurinas preying on smaller specimens of the same species reveal little struggle following the bite. These observations suggest the evolution of more potent venom because of food scarcity, but precise toxicological data are not available.

Bennett (1985) reported that epigean *Cicurina bryantae* Exline from the eastern U.S.A. probably has a life span of two or more years; the immatures take more than a year to mature. His studies suggested that some females could be able to produce offspring for two seasons, thus over-wintering as an adult to mate the third year as an adult. *Cicurina varians* can reach sexual maturity in one year in captivity, but the same is not true for troglobitic *Cicurina*. Larger immatures and adults can go many weeks without feeding in captivity. Several eyeless immatures have taken over seven months between molts and one of the paratypes of *C. bullis* n. sp. took 360 days between molts. Not all troglobitic cicurinas grow as slowly. An immature collected in MARS Pit on 9 Sept. 1998 molted on 24 Sept., 19 Dec., and 23 Jan. 1999. It died while apparently trying to molt again on 20 March 1999. Possibly rapid growth is not advantageous in troglobitic spiders, even when available food would support such activity. The longest an immature has been held in captivity is over four and half years. That individual is a troglobite from Low Priority Cave, and at the time of writing (Dec. 2003) it is still immature after six molts in captivity.

Threats to the Cave Fauna

Because of the restrictive distribution of the troglobitic species, any habitat alteration or competition from exotic species can be a serious problem. The U.S.

Fish and Wildlife Service recognized this potential problem when they listed four of the troglobitic cicurinas from Bexar County as endangered species (Longacre, 2000). Further taxonomic studies revealed that one of the species listed as endangered actually consists of two species. One being an up to now undescribed new species. The endangered status of this new species will have to be ruled upon by the U. S. Fish and Wildlife Service. The newly recognized species is described below as *C. neovespera* n. sp. The present study also revealed the presence of four additional troglobitic species which should be reviewed to see if their habitats require protection: *C. brunsi* from Stahl Cave; *C. bullis* in Eagles Nest Cave, Hilger Hole, Isocow Cave, Platypus Pit and Root Canal Cave, *C. loftini* n. sp. in Caracol Creek Coon Cave, and *C. platypus* in MARS Pit and Platypus Pit. All except, *C. loftini* occur in caves on Camp Bullis and are included in the Management Plan for that facility (Veni, Reddell, and Cokendolpher, 2002). As noted later in this paper (see also Fig. 67), there are numerous immature troglobitic cicurinas known from caves in Bexar County. Because these spiders cannot be identified to species, it is unknown if they represent one of the already known species or other undescribed taxa. Regardless of their status as named or not, they are true troglobites that are totally restricted to life in the caves that they inhabit, and destruction of those caves will result in the extinction of that population. Unfortunately for the spiders, human activities in the regions of the caves continue to flourish. Red imported fire ants also pose a threat to these cave faunas. Rappaport Clark (1998) and Longacre (2000) discussed the specific threats to cave faunas in Bexar County.

Field Identification

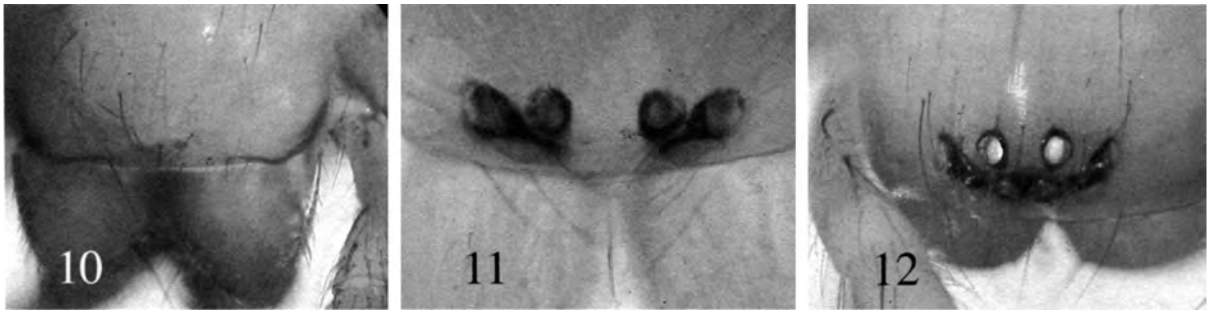
Because of the potential threat to many of the cicurinas in Bexar County, it will become necessary for future conservationists to be able to recognize members of this genus in a cave. Fortunately, the body style of cicurinas (Figs. 21, 28, 29, 40) is similar and unlike that of most other spiders in the caves. Near the entrances to the caves there are a few spiders that can occasionally be seen which vaguely resemble *Cicurina*. These include wandering spiders (*Falconina* and *Leptoctenus*) and various genera of wolf spiders (family Lycosidae). All of these spiders are darkly pigmented (often with patterns on the abdomen) and have eight well-developed eyes (see Sissom et al., 1999; figs. 1, 2). The only other spider found in caves from central Texas that looks like a *Cicurina* is a troglophilic gnaphosid spider: *Talanites captiosus* (Gertsch and Davis). Thus far, this gnaphosid is recorded only from Wren Cave (8.3 mi. NE Helotes) in Bexar County. Because it is also known from caves in Llano, Travis, and Williamson Counties it would not be surprising to find it in more caves in Bexar County. This species of *Talanites* looks very much like a *Cicurina varians* in size and shape. The *Talanites* is lighter in coloration and has reduced eyes (but still 8-eyed). Cave *Talanites* and *Cicurina varians* probably cannot be distinguished in the field by anyone but a spider specialist. Because gnaphosids generally do not sit in a web retreat like cicurinas, they will probably be more active. When observed in caves, cicurinas often appear to be roaming around in the cave. This is misleading because the cicurinas in such a circumstance are generally trying to escape from the individual that turned over the rock under which they were living. As observed in captivity and in the field, cicurinas (at least *C. varians*) actually spend most of their lives living on a web between, in, and/or under rocks. Mature males become more active, presumably while searching for mates.

The only eyeless (or almost eyeless) spiders currently known from Bexar County are members of *Cicurina*, *Eidmannella* (Nesticidae), and *Neoleptoneta* (Leptonetidae). The latter two differ from *Cicurina* in general body form, size, and type of web they inhabit. *Eidmannella* and *Neoleptoneta* have members that have small bodies (not over about 4 mm) with very long legs (see Cokendolpher and Reddell, 2001a: fig. 1; Cokendolpher, 2004a: fig. 1). They are found hanging upside-down in aerial webs, which fill holes, found in and around rocks; *Neoleptoneta* are minute sized spiders and their webs are generally overlooked. Only after the spider is disturbed and starts to run on a rock will it be detected. Cicurinas are often on the substrate under webs which are more sheet like and generally placed close to or attached to the rock surface.

Preliminary Remarks upon Evolution

Based on the morphology and apparent sister-group relationships of the cicurinas in Bexar County, there were several ancestral forms that invaded this karst region; not just one or two ancestors that gave rise to the species currently known in the county. The 8-eyed, 6-eyed, and eyeless species do not appear closely related and obviously did not all evolve in Bexar County from one ancestor. In Bexar County, there are no intermediate forms as regards the ocular condition, i.e., there are clearly eight, six, or no eyes (Figs. 10-12). Some specimens of the 6-eyed *C. pampa* have slightly reduced eyes but all eyes present are distinct. Cicurinas elsewhere are known with reduced eyes, being intermediate between 8 and 6-eyed and 6-eyed and eyeless (Gertsch, 1992). No 2 or 4-eyed cicurinas are known.

Because the 6-eyed troglophilic *Cicurina* of Bexar County do not have highly developed troglobitic adaptations (they have eyes, shorter appendages, small size), and some still occur on the surface, it is likely that they



Figs. 10-12.—Dorsal views of female *Cicurina*: 10, eyeless troglobite *C.* (*Cicurella*) *loftini* from SBC Cave. 11, 6-eyed troglophile *C.* (*Cicurella*) *pampa*. 12, the widespread 8-eyed troglophile *C.* (*Cicurusta*) *varians*.

invaded (and are still invading) the underground environments much later than the ancestors of the troglobitic species of Bexar County. The 6-eyed *Cicurina pampa* is known from caves and probably one surface collection and *C. minorata* is known only from a surface habitat (Fig. 14). Existing records only indicate that 6-eyed *Cicurina* successfully invaded three caves (Cross the Creek, Up the Creek, and Black Cat Caves) which were already homes to an eyeless *Cicurina* species. Unfortunately, the eyeless species cannot be identified with certainty (Cross the Creek and Black Cat Caves specimens are immature, Up the Creek Cave is a male). Both of the 6-eyed Bexar County species show close relationships with species from slightly further north in Kerr, McCulloch, and Travis Counties. It would not be surprising to find intervening populations with extensive collections. Because these are little brown spiders, they are probably overlooked or passed-over when collectors are searching under rocks on the surface. *Cicurina gatita* Gertsch from Black Cat Cave proved unremarkable and is synonymized with *C. pampa* elsewhere in this paper.

Another invasion into the caves of Bexar County was by *C. varians*. This is a relatively recent event (and is still happening) as this species is apparently still on the surface in favorable habitats throughout much of Texas and parts of New Mexico and Colorado. The cave forms show no morphological changes indicating troglobitic adaptations. *Cicurina varians* (and immatures which probably are this species) are known from caves in the northern half of the county (Fig. 15) and many of the other caves throughout Texas. Caves are essentially absent from the non-carbonate and Tertiary clastic sediments of southern Bexar County.

The modern eyeless troglobitic *Cicurina* species do not greatly resemble any epigean species. Unfortunately, the lack of eyes, large size, longer appendages, and lighter coloration are all troglobitic adaptations that are quite possibly the result of convergence, rather than shared ancestry. This does not mean that these species are not related, but simply that these characters should not be used to define this relationship. Genitalic features apparently do not change in a specified direction in underground habitats and are therefore useful characters in defining ancestral relationships.

The ancestors of the species which are now troglobitic (eyeless species) presumably arrived earlier than the eyed taxa, because a long period of isolation is needed for developing cave adaptations.

The immigration of ancestral cicurinas into the cave environment and subsequent isolation there could have occurred all at once or in steps. In either case, the cave inhabiting spiders must be isolated from their surface relatives to stop the exchange of genetic material. The most likely source of isolation would be the alteration of the surface abiotic environment which would either drive the surface form(s) into the underground environment or exterminate those remaining on the surface. If all the ancestral cicurinas were present on the surface at the same time and they invaded the caves and subsequently exited the surface habitats of Bexar County simultaneously the modern distributions should be overlapping with some species occurring together in the same caves throughout the range. This is not what happened. Or, if it did happen this way, the ancestors could have been patchily distributed throughout the county before the isolating event took place; which would result in the patchy present distributions (Fig. 13). This is also not likely because so few caves are known to house more than one species of blind *Cicurina*. More likely, a group of ancestors entered available caves, were isolated, and evolved in those caves. Later, different ancestors invaded these caves as well as any other caves which had more recently opened to the surface, were isolated, and evolved in those caves. This is much the same thing that is happening today with *C. varians* and *C. pampa*. Both troglophilic species are invading caves which are already inhabited by troglobitic *Cicurina* spp. In Cross the Creek and Up the Creek Caves, *C. pampa* and *C. varians* both occur with a blind *Cicurina* sp.

Based on similarities in genital morphology; the troglobitic *Cicurina* of Bexar County can be grouped together: (1a) *C. platypus* and a species from Hays County (rounded spermathecal lobes of equal size); (1b) *C. baronia, C. brunsi, C. bullis* (rounded spermathecal lobes of unequal size; spermathecal stalk transverse); (1c) *C. loftini, C. neovespera, C. vespera* (rounded spermathecal lobes of unequal size; spermathecal stalk oblique); (2) *C. madla, C. venii,* and species from Travis (*C. reddelli* Gertsch), Edwards (*C. rainesi* Gertsch, *C. gruta* Gertsch), Val Verde (*C. patei* Gertsch), and Terrell Counties (*C. venefica* Gertsch) (elongated spermathecae). Because no caves are known to harbor both a species with elongated and rounded spermathecae it can be assumed that ancestors of these two species did not coexist in the same caves or the second invading species was unable to successfully establish a population within those caves populated by the earlier arriving species.

Troglobitic species with rounded equal-sized spermathecal lobes (*C. platypus* and *C. russelli* Gertsch) are known only from MARS and Platypus Pits, Bexar County, and Boyett's Cave, Hays County, respectively. The area between these caves is crossed by streams that cut through much of the limestone, with the remaining limestone either near or below the water table and zones that do not provide suitable habitat for the spiders. Because of this barrier between these two caves it is not likely that one of these spiders was derived from the other. Instead, the ancestor entered both caves and then evolved to their present state. *Cicurina platypus* is quite rare (only known by two females) and could occur in other nearby caves, but just in densities so low that they are easily missed by collectors. The age of Platypus Pit is unknown, but Veni (1994) stated other area caves are middle to late Pleistocene in age.

The troglobitic species with rounded unequal-sized spermathecae in Bexar County are related to each other but not so closely to species outside of the county. The caves occupied by these species are: Caracol Creek Coon Cave (*C. loftini*), Eagles Nest Cave (*C. bullis*), Elm Springs Cave (*C. neovespera*), Government Canyon Bat Cave (*C. vespera*), Hilger Hole (*C. bullis*), Isocow Cave (*C. bullis*), Grubbs Cave # 23 (*C. neovespera*), Platypus Pit (*C. bullis*), Robber Baron Cave (*C. baronia*), Root Canal Cave (*C. bullis*), SBC Cave (*C. loftini*), and Stahl Cave (*C. brunsi*). From available data (Veni, 1994) it appears that these caves developed during the middle to late Pleistocene. Because all of these species appear more closely related to each other than those outside of the county, it seems likely that they all descended from a single ancestor. Wherever the ancestor was isolated underground without connection to other cave populations it evolved into new species. Because of the close proximity of some of the caves it also seems possible that

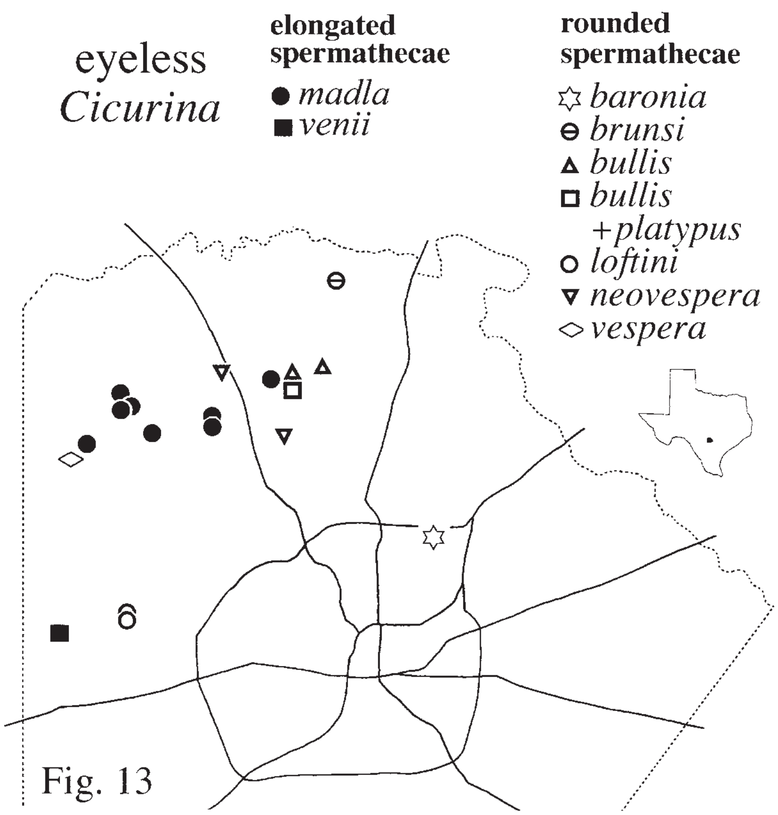


Fig. 13.—Distribution of adult troglobitic cicurinas in northern Bexar County: divided into groups which have females with elongated and rounded spermathecae.

more recent geologic/erosional events could have isolated already established populations which then further evolved in isolation. This could account for some of the small morphological variations observed in nearby populations herein accepted as single species (as in *C. bullis* and *C. loftini*).

Today, troglobitic species with elongate spermathecae having a relatively straight heavy spermathecal stalk (*C. madla* Gertsch, *C. venii* Gertsch) are found in caves in the northwestern portion of Bexar County. There are no non-troglobitic species known with similar spermathecae, suggesting that the ancestors sought refuge in the caves and avoided the extinction which occurred in all surface habitats. Species of this group are now found in Braken Bat Cave, Christmas Cave, Headquarters Cave, Helotes Blowhole, Hills and Dales Pit, Lost Pothole (= Lost Pot), Madla Cave, Madla's Drop Cave, and Robber's Cave. From available data (Veni, 1994) it appears that these caves developed during the late Pliocene and the middle to late Pleistocene.

Although the limestone of the caves of Bexar County dates from the middle to late Cretaceous, the caves themselves did not form until much later. The limestone is of marine origin and was not exposed for some time. During the very late Cretaceous and early Tertiary, the region was lifted above sea level. As newly formed streams cut into the terrain, they exposed the limestone, allowing water to flow through it to form caves and other subterranean voids. Even after the caves were formed, it is likely in some cases that the caves had no opening to the surface large enough to allow entry of arthropods. Because spiders are predatory, the ancestral *Cicurina* would have only been able to survive in the caves after a food supply was already established in the caves. Thus, the new caves had to have entrances from the surface large enough for organic matter (humus and other organic debris) to be washed into the voids. After the arrival of a continuous organic supply, the habitat was suitable for the immigration of primary converters (bacteria, fungi, and primitive arthropods). It is likely that the first foods consumed by cavernicolous *Cicurina* were collembolans and crickets whose descendants are still common in and around caves of the region. The oldest vertebrate fossils from Bexar County are only about 19,000 years old (Toomey, 1994), but it is likely that the smaller arthropods were able to enter the caves before vertebrates.

The date of the cave origin suggests that this is the earliest period in which colonization could occur; it does not necessarily mean that spiders entered the cave and started to evolve at that time. If the cave developed in isolation, the age of the cave would simply be the earliest possible date (maximal age) of the spider invasion and it could be hundreds or thousands of years before

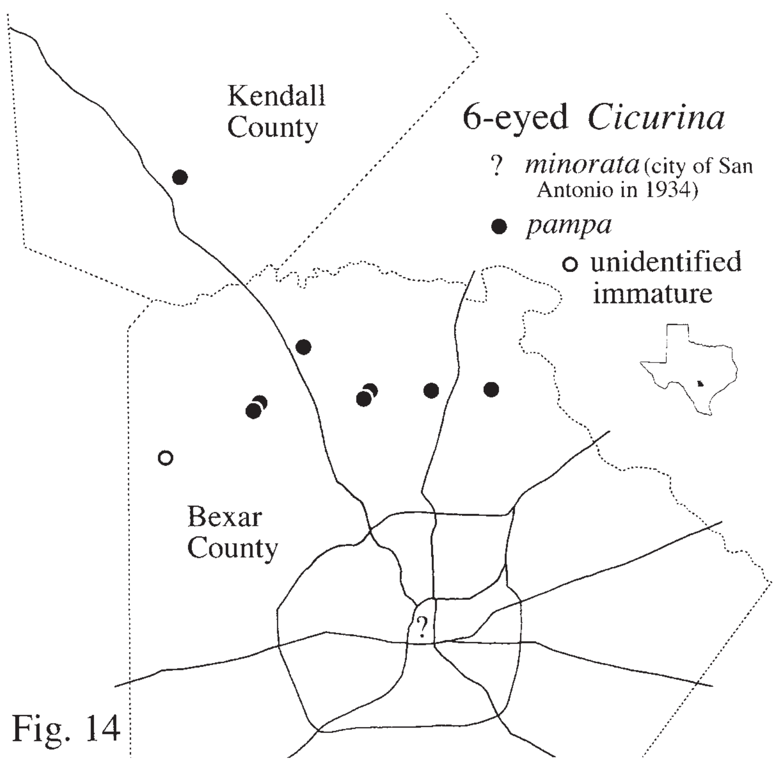


Fig. 14

Fig. 14.—Distribution of 6-eyed cicurinas in northern Bexar and southern Kendall Counties. *Cicurina minorata* is only known from an unspecified surface locality in San Antonio.

the actual isolating event took place. Not only did the spiders have to enter the new habitat, they had to be cut off (genetically) from the surface population by some later or simultaneous event (generally climatic change) which would either exterminate the spiders on the surface or drive them underground. Once isolated the spiders evolved into troglobites which could no longer live outside of caves.

Cave age may not be important if a troglobite evolved in caves preexisting the current landscape and migrated over geologic time through the subsurface into the modern caves as the older caves were eroded and the new ones formed.

Most karst in Bexar County can be roughly divided into four fauna/geologic regions: Stone Oak, Helotes, Alamo Heights, Culebra Anticline (based on Veni, 1994; Rappaport Clark, J., 1998). The latter two areas are geographically and geologically isolated (Fig. 16). The former two areas are now divided by Leon Creek. The larger Helotes Area is crossed by Los Reyes Creek and Helotes Creek with the three resulting subdivisions being called (from west to east) the Government Canyon, Helotes, and University of Texas San Antonio (UTSA) Karst Fauna Regions (Fig. 16). Veni, Reddell, and Cokendolpher (2002) further subdivided the Stone Oak Karst Fauna Area to include the Upper Glen Rose Biostrome Karst Fauna Area (north of the area previously included on maps), Edwards Outlier Karst Fauna Region, and the Cibolo Creek Karst fauna Region. The latter two are not discussed further here because caves in those regions have not yet yielded examples of eyeless *Cicurina*. Only the 8-eyed *C. varians* is recorded from the Edwards Outlier Karst Fauna Region (in Vera Cruz Shaft). Veni (1994) gives the approximate ages for some of the caves in these areas. From oldest to youngest they are: late Pliocene (Government Canyon and Helotes areas), middle to late Pleistocene (UTSA and Stone Oak areas), late Pleistocene (Culebra Anticline Area), and the entrance (but not necessarily the same as the cave proper) to Robber Baron Cave (Alamo Heights Area) is Pleistocene or Holocene in age.

Cicurina platypus is known only from MARS and Platypus Pits. This species is the most highly troglomorphic species (Fig. 9) in the region (although see caution under Cave Faunas, because this is based on measurements of only two specimens) indicating that it has been underground the longest. Neither Pit is the oldest cave in the region and therefore it seems possible that some other explanation is correct. Possibly, *C. platypus* has developed the more troglomorphic faces because it occurs in a cave with another more recent troglobite, *C. bullis,* and was forced to survive in areas of the cave not suitable for *C. bullis*. Another possibility is that the ancestors entered the void via separate [both geographical and temporal] entrances. First, an early invasion by a population through other nearby caves that eventually became isolated in Platypus Pit as the original entry via those caves/conduits became plugged and removed by erosion. Second, continued erosion created a new entrance (modern entrance) to the cave allowing the

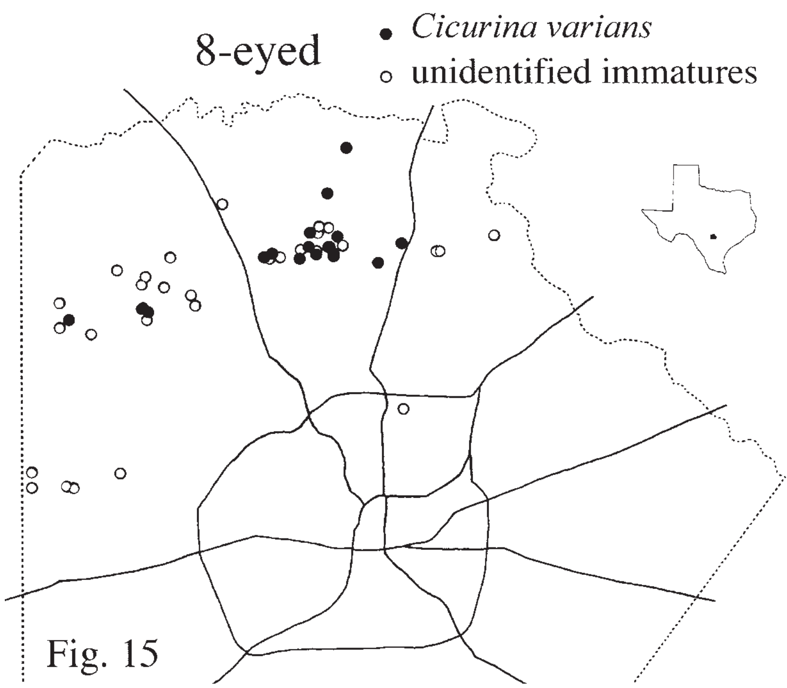


Fig. 15.—Distribution of 8-eyed cicurinas from northern Bexar County. The unidentified immatures are all probably *C. varians*. Note the size of the dots is relatively large and a single dot may cover several nearby caves.

reinvasion by a second ancestral species. In order for this option to work, the isolated fauna must have survived without significant nutrient input until the second cave entrance was formed.

Because species of *Cicurina* with rounded unequal-sized spermathecae are probably (no records to date from Helotes Karst Fauna Area) present in all karst areas, their ancestor possibly did not invade the caves any earlier than the development of the youngest isolated cave. This period could have coincided or followed the development of an entrance to Robber Baron Cave in the Alamo Heights Area (Pleistocene or Holocene). As noted earlier, it is possible that cicurinas migrated over geologic time through the subsurface into modern caves. If this happened, the arrival of the cicurinas could predate the formation of the youngest cave entrance.

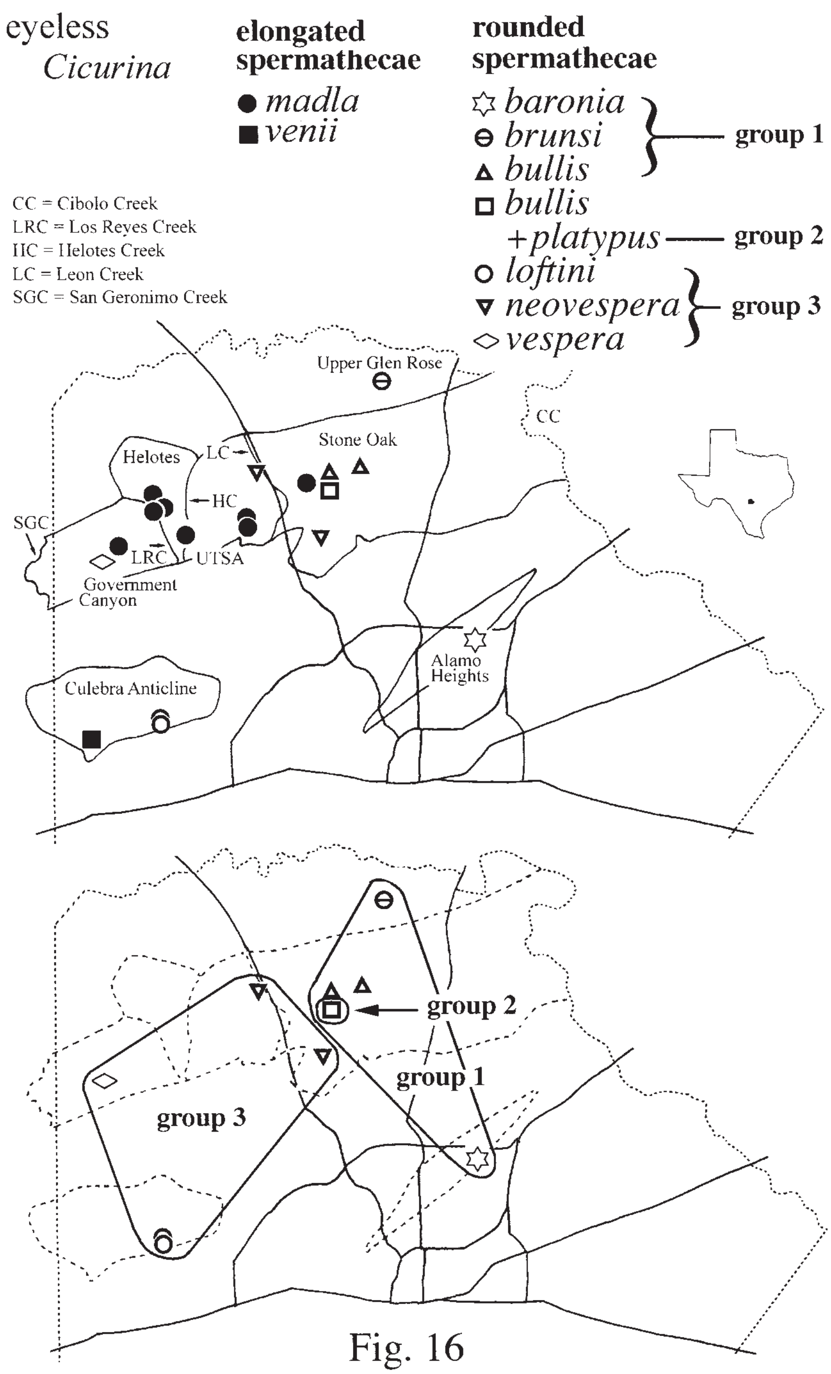


Fig. 16.—Distributions of adult troglobitic cicurinas in northern Bexar County: divided into groups which have females with elongated and rounded spermathecae. See section of article on Evolution for discussion on fauna/geologic regions shown by shading and groupings.

The two species with females having elongated spermathecae (*C. madla, C. venii*) occur in caves originating from the late Pliocene and the middle to late Pleistocene, respectively. They appear to be more troglomorphic than those with rounded unequal-sized spermathecae and presumably arrived in the region earlier. As discussed under the diagnoses of each species, they are probably not each other's nearest kin and arose from separate ancestors which were isolated in caves of Bexar County. They both are related to a series of species which today occur in caves in Edwards, Terrell, Travis, Uvalde, and Val Verde Counties of Texas. *Cicurina madla* can be split into two groups based on the morphology of the spermathecal base (see discussion of axes under that species). One group occurs east of Helotes Creek and the other west of the creek (Fig. 16, 47). The distinction is not clear and therefore they are not recognized taxonomically. Helotes Creek is recognized as being a major barrier to dispersal to cavernicole fauna and probably these populations are diverging. The population from Headquarters Cave exhibits a flattening of the lateral end of the spermathecal stalk. Possibly Leon Creek is serving as a barrier to stop gene flow between this most eastern population and those further west. Based on this same character, the spermathecal stalk of the populations in the extreme western part of the range [Lost Pothole (= Lost Pot), Christmas Cave, and Madla's Drop Cave] appears to be strongly bent laterally (Fig. 47). Unfortunately, the other known barrier of this area (Los Reyes Creek) dissects these populations and no other barrier is known that would keep this same form from exchanging genetic material with spiders in the nearby Madla's Cave. [Lost Pothole is separated from Madla's Cave by Los Reyes Creek, but Christmas Cave and Madla's Drop Cave are not and are fairly close to Madla's Cave.] More material and larger sample sizes are needed to help understand the emerging changes occurring in *C. madla*.

Hopefully, continued collecting and rearing of immature spiders will add new distributional records which can further test the above observations and provide new data for determining barriers which prevented the movement of these species into new caves.

SYSTEMATICS

Family Dictynidae

Until Lehtinen (1967), *Cicurina* was placed in the Agelenidae. Some authors (Pickard-Cambridge, 1893; Kishida, 1955) placed it in its own subfamily Cicurininae; whereas all others retained it in the Ageleninae. Lehtinen (1967) placed the genus in the Dictynidae: Cicurininae. This placement has not been well received by recent authors because Lehtinen did not provide a list of synapomorphic characters of the Dictynidae and Cicurininae which supported this transfer. But as noted by Griswold (1990), Lehtinen (1967:401) provided a synapomorphy for the Agelenidae: a typically paired colulus consisting of two, more or less protruding, obtusely triangular plates. Griswold stated that he had examined many genera of Agelenidae and found the character to be a conspicuous and consistent synapomorphy for the family. Although *Cicurina* lacks the typical agelenid type colulus (in troglobitic species it is only detectable by the presence of setae, but a slightly sclerotized plate is seen on epigean species examined), this condition does not assure placement in the Dictynidae. Roth and Brame (1972) listed another character (presence of plumose setae) which also excludes *Cicurina* from the Agelenidae. A third character excluding *Cicurina* from the restricted Agelenidae of Lehtinen is the presence of dictynoid pores in the female genitalia (Bennett, 1992). The presence of these pores is probably only an apomorphy for the Dictynoidea.

Among the New World Dictynoidea (Dictynidae of Lehtinen), the Cicurininae could be placed in the Dictynidae (where it currently resides), in the Cybaeidae, or be elevated to full family. Placement in the Hahniidae seems unlikely because of the lack of the specialized spinneret arrangement found in typical (Hahniinae) comb-tailed spiders. Elevating the subfamily would do little good as we still would not know the sister relationship, but this may be needed if the Cybaeidae (including Argyronetidae) are accepted. Bennett (1991) in his revision of the Cybaeidae stated that most members are united by the synapomorphies of a retrolateral patellar apophysis and one or more peg setae on its surface. He also stated that it appears reasonable to assume a sister relationship with the Dictynidae on the basis of their great morphological similarity, particularly in genitalic characters. The major differences in the two are the presence of the cribellum and calamistrum in the traditional Dictynidae. All members of the Cicurininae differ from the Cybaeidae in lacking the patellar apophysis, but *Cicurina*, *Blabomma* Chamberlin and Ivie, and *Yorima* Chamberlin and Ivie differ from other members of the Dictynidae (but not the Cybaeidae) by lacking a cribellum. Roth and Brame used the large flattened tibial process of the male palpus as a diagnostic character for *Cicurina*. If considering only genera that lack a cribellum, this indeed seems to represent an autapomorphy. However, the genitalia (both male and female) of members of the cribellate *Brommella* Tullgren (Chamberlin and Gertsch, 1958 as *Pagomys*; Wunderlich, 1994, as *Bromella*) are remarkably similar to *Cicurina*. The spermathecae of *Brommella* are simple, like members of the *Cicurina* subgenus *Cicurina*. The tibial process of European *Brommella* apparently differs from *Cicurina* and New World *Brommella* by the presence of a series of setae at the base of the tibiae (see Wunderlich, 1994: figs. 2, 6).

Lehtinen (1967) places *Cicurina* and *Brommella* within the Cicurininae of the Dictynidae; a position which is followed here. It seems more reasonable to accept that *Cicurina* lost a cribellum than to accept that both male and female genitalia of *Brommella* and *Cicurina* evolved convergently. Griswold et al. (1999) provided several characters of the spinnerets and cephalothorax which they use to place the Cicurininae in the Dictynidae and separate it from the amaurobioids (including the Agelenidae).

Genus *Cicurina*

The genus *Cicurina* is currently recognized by 125 species, of which one is from northern Europe, seven are from eastern Asia, and 117 are from North America (Brignoli, 1983; Roth and Brown, 1986; Platnick, 1989, 1993, 1997; Cokendolpher and Reddell, 2001b; Cokendolpher, 2004b). Chamberlin and Ivie (1940) placed the species known at that time (North America and Europe) into five subgenera, based primarily on the number of eyes, number of leg spines, and form of the female genitalia: *Cicurina* Menge, *Cicurona* Chamberlin and Ivie, *Cicurusta* Chamberlin and Ivie, *Cicurata* Chamberlin and Ivie, and *Cicurella* Chamberlin and Ivie. Later, Chamberlin and Ivie (1942) placed *Chorizomma* Simon as a subgenus of *Cicurina*. This action was upheld by Lehtinen (1967), but overturned by Brignoli (1983) who revalidated *Chorizomma* as an independent genus. *Cicurella* was synonymized under *Tetrilus* Simon 1886 and *Moguracicurina* Komatsu 1947 by Lehtinen (1967), but is not accepted here (see below).

The subgenus *Cicurata* included a single eyeless species (*Cicurina buwata* Chamberlin and Ivie) from a cave in Texas; this species was known only from a single immature. All of the 6-eyed species (as well as two 8-eyed species) were placed in the subgenus *Cicurella* Chamberlin and Ivie (1940). No publication can be located in which *Cicurata* has been formally synonymized with *Cicurella*, but it is clear that Gertsch felt the two were synonyms during the 1970s. In the diagnosis of a new species of *Cicurina* from Mexico, Gertsch (1971) stated: "Small, pale, species of subgenus *Cicurella*, without trace of eyes, related to *buwata* and various 6-eyed species of Texas ..." A similar statement was made in the diagnosis of another species he described from Mexico in 1977. Then in 1992, he placed all the 6-eyed and eyeless *Cicurina* in the subgenus *Cicurella*. In that same publication, Gertsch recorded *Cicurina buwata* as a *nomina inquirienda* of unknown status, and dropped the subgeneric name *Cicurata* which was created for that single species. The identity of *C. buwata* is now known (see below) and that species clearly fits in *Cicurella*. Although *Cicurata* has page-precedence over *Cicurella*, as first reviser, I place *Cicurata* as the junior synonym. This action will best serve stability as *Cicurata* has never been used for any species other than *buwata* and *Cicurella* has been used in combination with over 70 species in several publications.

Gertsch (1992) did not comment on the synonymy by Lehtinen (1967) of *Tetrilus* Simon with *Cicurella* and *Moguracicurina* Komatsu. This synonymy was also not listed by Brignoli (1983), although he did note the synonymy of *Tetrilus* and *Moguracicurina* with *Cicurina*. The type species of *Tetrilus* is *T. japonicus* Simon, 1886, from Japan and Korea. This species is a senior synonym of *Moguracicurina honesta* Komatsu (type and only species of *Moguracicurina*), according to Lehtinen (1967). In the description of the second species of *Cicurina* from Japan, Yaginuma (1979) stated that his *Cicurina maculifera* resembled *C. japonica* and that the genitalia are like that of *Cicurina cicur* (type species of the nominate genus and subgenus). None of the illustrations of *C. japonica* by Lehtinen (1967), Paik et al. (1969), and Yaginuma (1979, 1986) are of sufficient detail to resolve the issue of subgeneric placement. Therefore, I examined several females of *Cicurina japonica* from Yamaguchi Pref., Honshu [Kunugihara, Ube city, 1 Nov. 1990, Y. Ihara (JCC); Yamanoi, Sanyø-cho, Atsusa-gun, 30 Jan. 1991, Y. Ihara (JCC)]. It appears that they are not in the same subgenus as *Cicurella*, nor any of the other subgenera recognized by Chamberlin and Ivie. The widened atrium (Fig. 17) (reported to be longer than wide in *Cicurina maculifera* Yaginuma, 1979) opens into the copulatory ducts (Fig. 18- CD). These ducts are lightly sclerotized but relatively rigid and bifurcate anteriorly with one branch looping ventrally and feeding a large flexible sac-like structure (Fig. 18- FS; see also Paik et al., 1969: fig. 57 for dorsal view) and the other looping dorsally and tapering greatly to a flexible canal (Fig. 18- FC) which connects to the anterior-most end of what probably is the spermathecal stalk (Fig. 18- SS). No primary pores were observed anywhere in the internal genitalia (samples searched with oil immersion lens with spermathecae immersed in both lactophenol and clove oil). This design is unlike other cicurinas. The pores should have been present at or more basal to the area indicated with PP? in Fig. 18. Because the canal, stalk, and base all overlap in this region it is possible the pores are lateral to one of these structures and hidden from view. The dictynoid pores are easily seen and thus delimit the spermathecal stalk. The very minute size of the connection between the flexible canal and what I have labeled the spermathecal stalk is unique for this subgenus of cicurinas. The spermathecal base is oval and dorsally placed (Fig. 18- SB and possibly PL?; Paik et al., 1969: fig. 57). It appears in the specimens I examined that the heavy walled tube lying ventral to the rounded spermathecal base is closed on the posterolateral end forming a blind lobe which could be the posterior lobe of the spermathecal base. Just mesal to this closed end is a region where the dictynoid pore (Fig. 18-DP) is located and the apparent connection to the anterior lobe of the spermathecal base. A single tube (ventrad to the dictynoid pore) which is attached to the center of the spermathecal base via a spermathecae canal (Fig. 18- SC) goes to the fertilization duct (Fig. 18- FD). The posterior lobe is free from the spermathecal base at its lateral end, but is connected at the region near the dictynoid pore (Fig 18- C). More extensive microscopical techniques (staining or sectioning) will have to be used to resolve the presence of the primary pores. On the left side of the drawing of the genitalia, I have shown arrows to indicate the route of sperm entering the spermathecum. This route is clear up to the point of the dictynoid pore. At the region of the pore, the direction appears to go anterior through the enlargement indicated by a "C". The tube in the center of the spermathecal base appears to be an outlet to the fertilization duct. Regardless of the correct makeup of the region around the dictynoid pore, the morphology does not match other cicurinas illustrated by Chamberlin and Ivie.

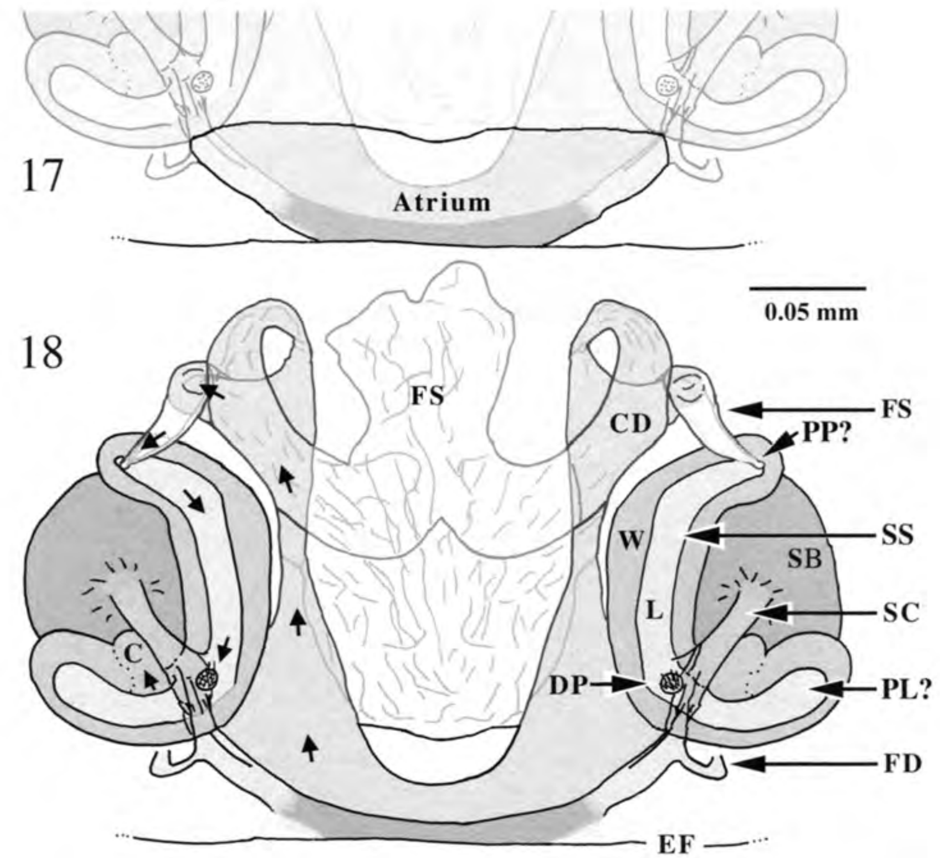
I believe *Tetrilus* should be retained as a separate subgenus for at least *japonica* and probably *maculifera*. In the illustration of this latter species, Yaginuma (1979: fig. 2) shows the copulatory duct leading to a spermathecal stalk which empties directly into the anterior side of the spermathecal base. Posteriorly, he shows another duct leading into (on left side) or near (right side) two connected bulbs or tubes. Specimens should be checked to determine if the stalk actually empties into the mesalmost end of the copulatory duct bulb or as illustrated into the spermathecal base. The genitalia of the other cicurinas from Asia (China, Japan, Korea) should also be checked closely. Also, the dictynoid pores are very distinct in some specimens of *C. japonica* and difficult or impossible to see in others; indicating their absence should be regarded with some skepticism when only viewing the genitalia immersed in lactophenol or clove oil.

The five now-recognized subgenera can be distinguished by the form of the female genitalia (Figs. 1-4, 17, 18). Those of the type subgenus, *Cicurina* (Fig. 1), have a single spermathecal base without a bulb at the junction of the copulatory duct and spermathecal stalk. *Cicurona* (Fig. 2) also has a single spermathecal base, but has a bulb at the distal end of the copulatory duct with primary pores. Two spermathecal base lobes are present in *Cicurusta* (Fig. 3) and *Cicurella* (Fig. 4). *Cicurusta* differs from *Cicurella* by having a distinct bulb at the distal end of the copulatory duct with primary pores. The posterior lobe of the spermathecal base of *Cicurella* is not the same as the bulb of *Cicurona* and *Cicurusta*, because the former contain primary pores.

Species recognition in the genus *Cicurina* has been a problem for taxa occurring in North America. Chamberlin and Ivie (1940) and Gertsch (1992) described almost every isolated collection of *Cicurina* as a new species. Brignoli (1979), on the other hand, suggested that many of the species names should be synonymized. In the case of epigean collections, I am in agreement with Brignoli that numerous indistinguishable forms have been given full species status, but possibly not to the extent that he suggested. Gertsch (1992) described numerous troglobitic *Cicurina* species from Texas and the diagnosis of each started with "Eyeless troglobite of Xxx Cave ..." Thus, almost every cave sampled yielded a new species. Fortunately, the collections examined by Gertsch were from scattered localities and in most cases represented geologically and geographically isolated populations. A similar, but not identical plan has been used here.

A population of eyeless troglobites which has been isolated in a particular karst region will be separate from populations which evolved into troglobites in another karst region. Because these animals are reproductively isolated by geography and geology their morphologies need not be greatly different. Evolving into a troglobite requires significant time and if populations from different caves cannot maintain some genetic exchange during this development they will be separate biological species. Veni and Reddell (1999) proposed that: "As web-spinners, troglobitic spiders of this genus do not travel far within their lifetimes, having to staying [sic] close to or within their webs. Additionally, they cannot use their webs as effectively in small interstitial areas that may extend between caves of adjacent karst fauna regions and subregions, forcing them to reside primarily in caves thus promoting speciation through minimal mixing of neighboring populations."

As noted earlier under biology, the ancestors of the present troglobitic cicurinas in Bexar County may not have used webs as much as modern surface members of *Cicurina* but they still would be limited in their movement through mesocavernous spaces because of a lack of food. Organic matter is rare in these mesocavernous spaces and therefore populations of small insects and mites are rare for cicurinas to feed upon; even if they are able to use webs. This does not mean that cicurinas cannot move underground to establish themselves in new nearby habitats. From observations of captive specimens if is clear that they can go long periods of time without feeding and they have a relatively long life span (at least



Figs. 17, 18.—Female genital morphology of *Cicurina* (*Tetrilus*) *japonica* from Kunugihara, Ube city, Yamaguchi Pref., Honshu, Japan. 17, Ventral view of atrial region. 18, Ventral view of internal genitalia. See text for discussion regarding arrows and labels: C = connection site to anterior lobe of spermathecal base, CD = copulatory duct, DP = dictynoid pore, EF = epigastric furrow, FC = flexible canal, FD = fertilization duct, FS = flexible sac-like structure, L = lumen, PL?= possible posterior lobe of the spermathecal base, PP? = possible location of primary pores, SB = spermathecal base (anterior lobe), SC = spermathecal canal, SS = spermathecal stalk, W = wall.

4 years in captivity for some species). Because females can store sperm [length of storage unknown in cicurinas, but length can be for up to half a year in other spiders (Cokendolpher and Reddell, 2001a)] a single mated female making her way to a new habitat can start a population of spiders. Once a species has become a troglobite it can no longer move above ground and any barrier (physical or biological) to its movement underground through mesocavernous spaces will keep it from establishing populations in nearby caves. It is because of this that nearby caves can host quite different species of cicurinas.

In several other arthropod groups, some species of troglobites are recorded in the literature from rather distant and geologically distinct areas. In these cases, the slight morphological differences detected between isolated populations are simply regarded as variation. This is what Gertsch (1984) and Cokendolpher and Reddell (2001a) have done with the spider *Eidmannella rostrata* Gertsch. Confronted with numerous collections from a large area with relatively uniform morphologies, these researchers accepted the differences as variation. Part of the problem is that this "species" still retains some of the characters of surface populations and probably is a recent troglobite. Future detailed study (possibly requiring studies of the genetics) should reveal that some of these isolated populations are actually full species. This is not the case with *Cicurina* because all the troglobites thus far found are highly cave adapted and show no eyes or features suggesting that they are recent additions to the cave fauna. Unfortunately for taxonomists, evolution underground leads to convergent troglomorphy, often with little differentiation of the sexual organs (which are important taxonomic structures). Importantly, troglobites are reproductively isolated from all surface populations. Taxonomists who do not have extensive experience with cavernicole faunas will have difficulty accepting that morphologically similar populations only a few km apart may be separate and distinct species. Complex geological activity in karst regions have fragmented and isolated many groups of organisms. In the case of *Cicurina*, the early extinction of surface relatives resulted in each isolated population evolving into a separate species. These taxa may be difficult to recognize by morphological characters alone, but they are surely valid species as they are physically and reproductively isolated from all other troglobitic relatives.

Gertsch (1992) described *Cicurina reddelli* and *Cicurina elliotti* (= *buwata*) from Cotterell Cave in Travis County, Texas. The drawings of the genitalia of the two species are similar suggesting that they are closely related. For two other troglobitic species in Travis County (*C. bandida* Gertsch and *C. cueva* Gertsch), Gertsch (1992) listed for each a single "aberrant" female. It is not clear why the females of either *C. reddelli* or *C. elliotti* were not listed as aberrant females of the other species. The occurrence of two troglobitic cicurinas from single caves in Texas are also reported by Cokendolpher and Reddell (2001b): *C. caliga* Cokendolpher and Reddell and *C. hoodensis* Cokendolpher and Reddell from Buchanan and Triple J Caves, Bell County, Texas. In each of these cases, the species pairs appear to be closely related, indicating that some event might have isolated an ancestral population which had already significantly diverged from the surface populations. Possibly, the ancestors of the species entered the caves via separate entrances. An early invasion by a population through other nearby caves became isolated in the new cave as the original entry via those caves/conduits became plugged and removed by erosion. A second invasion occurred as continued erosion created a new entrance to the cave. An alternate hypothesis would require two related ancestral species from the surface being isolated underground where both would evolve into separate troglobitic species. In the present paper, *C. platypus* and *C. bullis* are recorded from the same cave. Although these two species are similar (both have rounded spermathecae) they do not appear to be each other's nearest kin (see comments under each species).

I have accepted greater variation in genital morphology in the eyed taxa than I have in the eyeless species. I assume that troglobitic species arose from smaller founding populations and, because they live in a restricted habitat, they will be more uniform in their morphologies. As suggested by its name, *C. varians* has been a particularly vexing species to study. Although the original authors did not give the etymology of the name, it is assumed that they too noted the great variation observed in this species. Genetic studies will be interesting to see if this species indeed exhibits great morphological variation or if the existence of multiple genetically closely related species has confused our understanding of the limits of *C. varians* (and possibly *C. davisi*, see below under *C. varians*).

Cicurina buwata Chamberlin and Ivie
Figs. 19, 20

Cicurina buwata Chamberlin and Ivie, 1940:74, fig. 94; Gertsch, 1992:97; Platnick, 1997:643 *nomen dubium*.

Cicurina elliotti Gertsch, 1992:101, 103, figs. 73-74, NEW SYNONYMY.

Diagnosis.—Eyeless *Cicurella* troglobite from McNeil and Round Rock areas; spermathecae elongated, posterior lobe of spermathecal base bluntly rounded distal to junction with the anterior lobe, body axis lines meeting at less than 90°, axes of anterior lobes curved inward mesally, lobes almost touching distally, copulatory duct looped anterior to anterior lobe of spermathecal base, spermathecal stalk looped anteriorly to junction of the lobes of the spermathecal base.

The general morphology of the spermathecae resembles *C. travisae* Gertsch. Unfortunately, Gertsch (1992) illustrated what might be more than one species in his original description and does not indicate which illustration is of the holotype. The holotype of that species should be reexamined. The aberrant form of *C. travisae* illustrated by Gertsch (1992: figs. 69-70) appears most like *C. buwata* with the strongly forward looped spermathecal stalk.

Type-data.—Immature holotype (*C. buwata*) from "Cave near Austin, Texas. March 12-18, 1903. J. H. Comstock" (AMNH, not examined). Female holotype (*C. elliotti*) from Beck's Sewer Cave, 27 January 1965, J. Calvert, J. R. Reddell (AMNH, examined).

Barr (1960) and Barr and Lawrence (1960) listed the type locality of the carabid beetle *Agonum* (*Rhadine*) *subterraneum* [= *Rhadine subterranea subterranea* (Van Dyke)] as Sam Bass Cave, McNeil, Travis County. In those papers they also provided measurements of specimens which they considered conspecific from Beck's Ranch Cave (less than 8 km north of the type locality). Barr and Lawrence (1960) also thanked Dr. Henry Dietrich (Department of Entomology, Cornell University) for information on the type locality of this beetle. Later, Barr (1974) listed the type locality as "Sam Bass (= McNeil Quarry) Cave, near McNeil, Williamson County, Texas, March 12-18, 1903, J. H. Comstock." This beetle was collected by Comstock presumably in the same cave as *C. buwata* because the dates of collection are the same and the locality label reads "cave", not "caves" near Austin. The confusion of Travis and Williamson Counties by Barr and Lawrence (1960) is presumably because Austin is in Travis County and the cave is located near the two county lines.

Specimens examined.—TEXAS: Williamson County: Beck's Sewer Cave, 27 January 1965, J. Calvert, J. R. Reddell (female holotype, AMNH). Travis County: Fossil Garden Cave, 6 June 1990, J. R. Reddell, M. Reyes (1 female, JCC); 22 June 1990, J. R. Reddell, M. Reyes (1 female, TMM).

Description.—Gertsch (1992) described the adult female of this species as *C. elliotti*. Herein, the female genitalia are reillustrated (Figs. 19, 20). Male unknown.

Comments.—The vial containing the holotype of *C. elliotti* also includes an immature and abdomen of a second immature presumably of the same species.

Barr (1974) recorded the beetle *Rhadine subterranea subterranea* from three of the caves reported by Gertsch (1992) to be inhabited by *C. buwata* (= *C. elliotti*): Cotterell, McNeil Quarry, and Beck's Sewer Caves. This beetle has also been collected from one other cave reported by Gertsch (Reddell, pers. comm., 1998): Fossil Garden Cave. I am uncertain of all of the other records of "*C. elliotti*" listed by Gertsch (1992). Among the specimens listed by Gertsch (1992) are several from caves which are near the type locality of *C. buwata* and these are certainly that species. The other records, especially Cotterell Cave, will require confirmation. McNeil Quarry Cave is 3.2 km NE of Fossil Garden Cave. Beck's Sewer Cave is 3.7 km NNW of McNeil Quarry Cave. The entire area between all of these caves is contiguous karst with numerous other caves and sinks between the three caves.

Subgenus *Cicurusta*

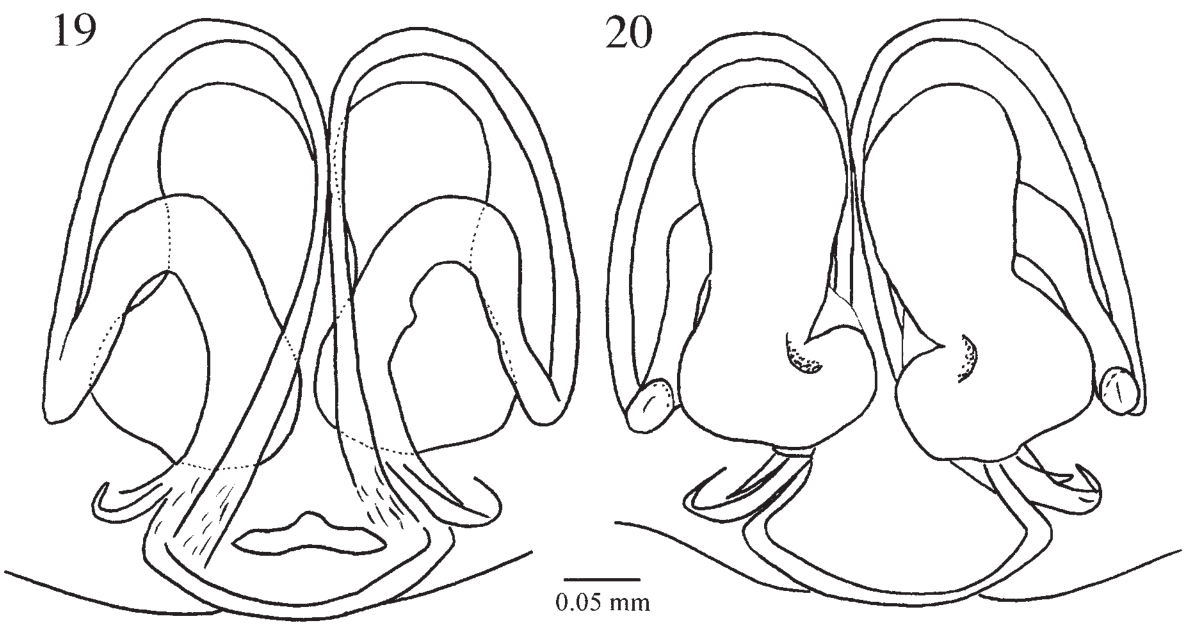
Cicurina varians Gertsch and Mulaik
Figs. 9, 12, 15, 21-27

Cicurina varians Gertsch and Mulaik *in* Chamberlin and Ivie 1940:57-58, figs. 42, 82, 93, 95; Roth and Brown 1986:8; Reddell, 1988:34; Gertsch, 1992: fig. 1; Jackman, 1997:162; Veni and Elliott, 1994:7; Veni and Reddell, 1999:6, 45, 46.

Cicurina (Cicurina) varians: Veni and Reddell, 2002b:12.

Cicurina (Cicurusta) varians: Reddell, 1993: 23, 46, 47, 54, 55, 58, 61, 64, 66, 68, 69, 71, 75. Veni et al., 1995:152, 180, 181, 189, 192, 207, 224, 234, 347. Veni et al., 1996:186. Veni et al., 1998a: 14, 83, 117, 123, 130, 210, 233-246. Veni et al., 1998b:17, 31, 32, 54, 62, 63, 76, 117, 118, 120, 121, 123, 124, 176, 186-201. Veni et al., 1999:33, 34, 37, 42, 61, 85, 95, 126, 173. Veni et al., 2000:13, 42, 115,146, 196; Veni, Glinn et al., 2002:12, 16, 42, 104, 107, 115, 117, 118, 134, 144, 145, 146, 163, 164, 166, 168, 237, 238, fig. 13; Veni, Hammond et al., 2002:95, 110, 112, 114, 128, 131, 133-135, 142, 143, 214; Veni, Reddell, and Cokendolpher, 2002:9, 50, 51.

Diagnosis.—8-eyed epigean and troglophilic *Cicurusta* from Texas and surrounding states;



Figs. 19, 20.—Female internal genitalia of *C. buwata* (holotype of *C. elliotti*); 19, ventral view; 20, dorsal view.

spermathecal base with equal-sized rounded anterior and posterior lobes, anterior lobes less than or about a radius apart, posterior lobes more than a diameter apart, copulatory duct looped anterior to anterior lobe of spermathecal base.

For comparisons to other described members of the subgenus see the revision by Chamberlin and Ivie (1940).

Type-data.—Raven Ranch, Kerr County, Texas, D. and S. Mulaik, Dec. 1939, female holotype, male and female paratypes (AMNH, not examined).

Specimens examined.—TEXAS: Bexar County: B-52 Cave, Camp Bullis, 6 Dec. 1994, W. R. Elliott, J. Ivy (2 females, 1 male, TMM); Banzai Mud Dauber Cave, Camp Bullis, 15 Nov. 2000, J. Krejca, P. Sprouse (molted 3 Feb., 17 March, 11 July 2001, 20 May, 2 Aug., 20 Sept., 20 Nov. 2002, 20 Jan. 2003; 1 male, TMM); (molted 3 Feb., 4 July, 20 Oct. 2001; 1 female, TMM); Boneyard Pit, Camp Bullis, 7 Sept. 1998 (molted 7 Oct., 8 Dec. 1998), J. Cokendolpher, J. Krejca (1 female, TMM); Breached Dam Cave, 8 Sept. 1998, J. R. Reddell, M. Reyes (1 female, TMM); Bunny Hole, Camp Bullis, 31 March 1995, J. R. Reddell, M. Reyes (1 female, TMM); 9 Sept. 1998 (molted 10 Oct., 18 Nov. 1998, 9 Jan., 21 March, 10 July, 4 Oct. 1999), J. C. Cokendolpher, J. Krejca, J. R. Reddell, M. Reyes (1 female, TMM); Cross the Creek Cave, Camp Bullis, 14 Nov. 1995 (molted to adulthood in captivity), J. C. Cokendolpher, J. R. Reddell, M. Reyes (1 male, 2 females, TMM); 31 Oct. 2000, J. R. Reddell, M. Reyes (molted 9 Nov. 2000, 17 March., 14 July 2001; 1 female, TMM); Dangerfield Cave, Camp Bullis, 21 April 1999, J. R. Reddell, M. Reyes (1 male, TMM); Dogleg Cave, Camp Bullis, 25 March 1998, M. Reyes (1 female, TMM); Eagles Nest Cave, Camp Bullis, 31 Oct. 2000, J. R. Reddell, M. Reyes (molted 3 Feb., 27 April 2001, 4 March, 20 May, 25 Nov. 2002; 1 female, TMM); Glinn's Gloat Hole, Camp Bullis, 18 Jan. 2000, J. R. Reddell, M. Reyes (1 female, TMM); Goat Cave, Government Canyon State Natural Area, 24 May 1998, J. R. Reddell, M. Reyes (1 female, TMM); Headquarters Cave, Camp Bullis, 29 Nov. 1993, M. Reyes (1 female, TMM); Hector's Hole, Camp Bullis, 11 April 2002, J. R. Reddell, M. Reyes, G. Veni (molted 20 Nov. 2002; 1 female, TMM); Hilger Hole, Camp Bullis, 7 Sept. 1998 (matured 27 Nov. 1998), J. R.

KEY TO THE FEMALES OF THE GENUS *CICURINA* FROM BEXAR COUNTY

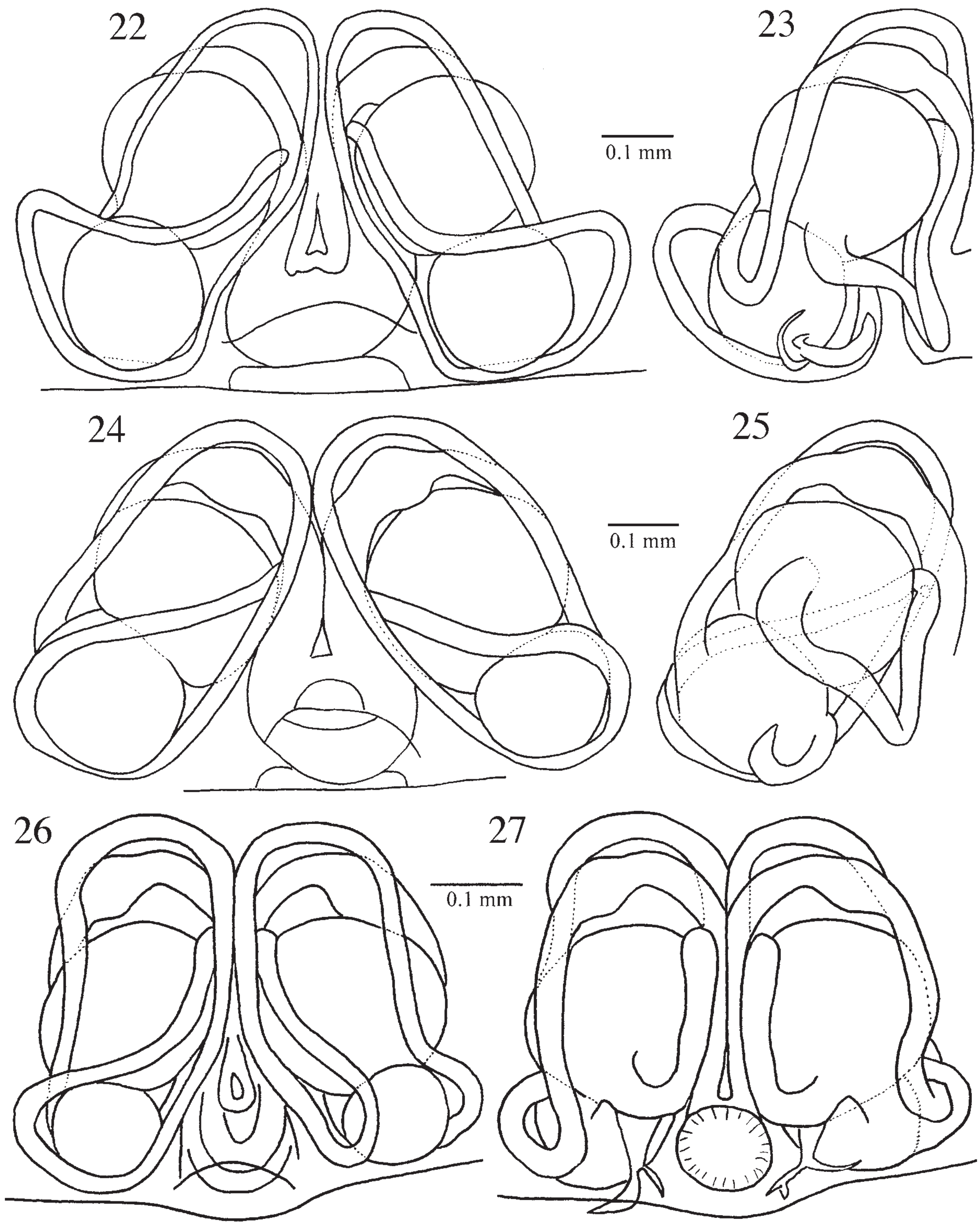
1. Eyes present 2
   Eyes absent (Fig. 10) (subgenus *Cicurella*, in part) 4
2. With eight eyes (Fig. 12); body length 5-10 mm (subgenus *Cicurusta*) .... *C. varians*
   With six eyes, anterior median eyes missing (Fig. 11); body length 1.5-2.5 mm (subgenus *Cicurella*, in part) 3
3. Spermathecal base lobes separated by strong constriction (Fig. 48-51) .... *C. minorata*
   Spermathecal base lobes broadly joined (Figs. 54-57) .... *C. pampa*
4. Spermathecae more than twice as long as wide; copulatory duct slender and loosely looped over spermathecal base (Figs. 41-44) 5
   Spermathecae oval with copulatory duct thicker and tightly looped around spermathecal base (Figs. 30-39) 6
5. Spermathecal stalk slightly to moderately curved and turned posterolaterally; anterior lobes of spermathecal bases are not strongly curved inward distally (Figs. 41-44) .... *C. madla*
   Spermathecal stalk straight and not turned; anterior lobes of the spermathecal bases strongly curved inward distally (Figs. 63, 64) .... *C. venii*
6. Posterior lobe of spermathecal base much smaller (less than half) than anterior lobe 7
   Posterior lobe of spermathecal base about as large as anterior lobe (Figs. 61, 62) .... *C. platypus*
7. Spermathecal stalk lying horizontal to atrium 8
   Spermathecal stalk curved around the posterior end of spermathecal base 10
8. Anterior lobes of the spermathecal bases widely separated (almost a diameter apart); mesal concavity small; large reddish-brown spiders (Figs. 30, 31) .... *C. baronia*
   Anterior lobes of the spermathecal bases separated by less than half a diameter; mesal concavity large; small, straw to cream colored spiders (Figs. 32-36) 9
9. Spermathecal stalk medially arched anteriorly (Fig. 32) .... *C. brunsi*
   Spermathecal stalk straight to sinuate, but not arched anteriorly medially (Figs. 34, 36) .... *C. bullis*
10. Spermathecal stalk widened on the middle-posterior section (Figs. 37, 38) .... *C. loftini*
    Spermathecal stalk evenly thickened throughout 11
11. Spermathecal stalk with single bend (Fig. 65) .... *C. vespera*
    Spermathecal stalk slightly sinuate (Fig. 52) .... *C. neovespera*

Reddell, M. Reyes (1 female, TMM); Hills and Dales Pit, 28 Oct. 2000, K. White, H. Bechtol (1 female, TMM); Hold Me Back Cave, Camp Bullis, 10 Nov. 2000, J. Krejca, P. Sprouse (molted 6 Jan., 17 March, 27 April, 29 Oct. 2001, 20 May, 20 Sept., 20 Nov. 2002; 1 female, TMM); Isocow Cave, Camp Bullis, 15 Dec. 1993, G. Veni (1 female, TMM); Kamikazi Cricket Cave, A. G. Grubbs, date unknown (2 female, TMM); Lone Gunman Pit, Camp Bullis, 1 Nov. 2001 J. R. Reddell, M. Reyes (1 male, TMM); 19 Nov. 2002, (molted 20 Jan. 2003, 1 female, TMM); Low Priority Cave, Camp Bullis, 8 Sept. 1998 (molted 29 Oct., 8 Dec. 1998), J. C. Cokendolpher, J. R. Reddell, M. Reyes (1 female, TMM); 22 April 1999 (molted 30 Oct. 1999, 7 March, 12 May, 11 June, 2 Sept. 2000), J. R. Reddell, M. Reyes (1 female, TMM); 1 Nov. 2000, J. R. Reddell, M. Reyes (molted 12 Dec. 2000, 17 March, 27 April 2001, 20 May, 25 Nov. 2002, 1 female, TMM); MARS Shaft, Camp Bullis, 9 Nov. 2000, J. Krejca, P. Sprouse (molted 3 Feb. 2001, 17 March, 13 July 2001, 5 March, 20 Sept., 25 Nov. 2002; 1 male, TMM); Mattke Cave, 10 June 1993, D. McKenzie, J. R. Reddell, M. Reyes (1 female, TMM); One Formation Cave, Government Canyon State Natural Area, 17 Jan. 1998, G. Veni (1 female, TMM); Platypus Pit, Camp Bullis, 30 March 1995, J. R. Reddell, M. Reyes (1 female, TMM); Rajin' Cajun Cave, 22 Jan. 1994, W. Elliott, G. Veni, J. Ivy, L. Palit (1 male, TMM); Root Canal Cave, Camp Bullis, 7 Sept. 1998 (molted 4 Oct., 5 Dec. 1998), J. R. Reddell, M. Reyes (1 female, TMM); Stone Oak Parkway Pit, 27 Jan, 6 Feb. 1993, A. G. Grubbs (2 females, TMM); Strange Little Cave, Camp Bullis, 29 Nov. 1993, J. R. Reddell, M. Reyes (1 female, TMM); Up the Creek Cave, Camp Bullis, 30 March 1995, J. R. Reddell, M. Reyes (2 females, TMM); 14 Nov. 1995 (reared to adulthood), J. C. Cokendolpher, J. R. Reddell, M. Reyes (1 female, TMM); Vera Cruz Shaft, Camp Bullis, 19 Nov. 2002, M. Reyes (1 male, TMM); 15 Oct. 2001, M. Reyes, (1 female, TMM), 15 Oct. 2001 (molted 20 May, 25 Nov. 2002, 20 Jan. 2003, 1 female, TMM); Well Done Cave, 15 April 2002, J. R. Reddell, M. Reyes, G. Veni (4 females, TMM); Winston's Cave, Camp Bullis, 13-14 Dec. 1993, J. Ivy, L. McNatt, G. Veni (1 female, TMM).

Other records (all TMM; not examined during this study).—TEXAS: Bexar County: Government Canyon Bat Cave, Government Canyon State Natural Area, 24 May 1993, J. R. Reddell, M. Reyes (1 female, det. D. Ubick, 1994); Han's Grotto, 16 Feb. 1984, S. Harden, D. Canny (1 female, det. W. J. Gertsch, 1985); Robber Baron Cave, 9, 11 Dec. 1983, S. Harden, R. Waters (1 male, det. W. J. Gertsch, 1985); 11 Dec. 1982, R. Waters (1 male, det. W. J. Gertsch, 1985); Robber's Cave, 22 June 1993, J. Loftin, J. R. Reddell, M. Reyes (1 female, det. D. Ubick, 1994); Some Monk Chanted Evening Cave, 15 Oct. 1985, G. Veni, L. Palit (1 female, det. W. J. Gertsch, 1985); Stevens Ranch Cave No. 1, 1 June 1993, J. Loftin, J. R. Reddell, M. Reyes, G. Veni (1 female, det. D. Ubick, 1994); Wurzbach Bat Cave, 4-5 Jan. 1984, S. Harden (1 female, det. W. J. Gertsch, 1985).

Description.—Females yellowish to brownish colored, body length 5.6-10.8 mm. Eight well-developed eyes. Cephalothorax 2.6-4.8 mm long, 2.05-3.4 mm wide.

Fig. 21.—Female *Cicurina varians*.



Figs. 22-27.—Female spermathecae of *Cicurina varians*. 22, 23, typical form from Tippit Cave, Coryell County: 22, ventral view; 23, dorsal view of left side. 24, 25, form with tightly coiled spermathecal stalk from B-52 Cave, Bexar County: 24, ventral view; 25, dorsal view of left side. 26, 27, aberrant specimen from One Formation Cave, Bexar County: 26, ventral view; 27, dorsal view.

Abdomen 3-6 mm long. Cheliceral retromargin with 3-6 teeth and 2 or 3 denticles. Leg lengths: first patella-tibia 2.65-4.5 mm, fourth patella-tibia 3.05-4.8 mm. Ventral leg spines: first and fourth tibiae 2-2-2. Internal genitalia: spermathecal base with equal-sized rounded anterior and posterior lobes, lobes less than or about a radius apart, posterior lobes more than a diameter apart, copulatory duct looped anterior to anterior lobe of spermathecal base.

Distribution.—Recorded from Texas, New Mexico, Colorado. Roth and Brown (1986) reported the distribution as "South central United States, northeastern New Mexico"; the "probable range" suggested by Chamberlin and Ivie (1940). This species is found in most caves in Bexar County (Fig. 15).

Comments.—This species has one of the larger distributions of southern cicurinas; occurring in at least three states. This is the only 8-eyed *Cicurina* recorded from caves in Texas (Gertsch identifications reported by Reddell, 1965). It exhibits considerable variation over its range, and earlier authors probably would have described a couple of new species from this material. I prefer instead to accept this as variation of a single species. Material from caves in central Texas was problematic. Gertsch felt (Reddell, pers. comm.) that a female from Tippit Cave, Coryell County, represented an undescribed species. This "new species" differed from *C. varians* by being slightly larger, darker colored, and by having a tight coil of the spermathecal stalk around the spermathecal base. Subsequently, I discovered females with this same tightly coiled spermathecal stalks from Bexar County in B-52 Cave, Up the Creek Cave, and Mattke Cave. Reexamination of all adult material from caves in central Texas (at TMM), as well as some surface collections (TMM, JCC, Midwestern State University), revealed that this material does not represent a new species. The variation accepted herein for *C. varians* includes spermathecal stalks which can be tightly coiled around the spermathecal base to samples which are loosely coiled and looped anteriorly.

This variation includes forms which are probably the same as that described as *C. davisi* Exline (see Chamberlin and Ivie, 1940: fig. 41). It appears that these two species are conspecific, but because I have not examined the type specimens I will not synonymize them here. Chamberlin and Ivie (1940) recorded only three localities for *C. davisi*: the type locality in Llano County, Raven Ranch in Kerr County, and a locality in Concho County.

Raven Ranch is the type locality of *C. varians* and based on the collection data presented by Chamberlin and Ivie (1940) the types of *C. varians* were collected with specimens of *C. davisi*. The differences noted by those authors (in their key to species) to distinguish the two species is size: body length over 6 mm = *C. varians*, under 6 mm = *C. davisi*. As already noted above, some specimens reared in captivity were half the size of their mother and sisters (apparently reaching adulthood with lesser amounts of food). I also examined two females from the same collection from Core Barrel Cave, Williamson Co., Texas on 4 June 1991 (TMM). One female was 9 mm long (cephalothorax 4.25 mm) and the other was 5.6 mm long (cephalothorax 2.6 mm). Apparently, the disparity in size noted in captive material is also found in nature. The spermathecae of the two females were almost identical from Core Barrel Cave and closely matched that illustrated by Chamberlin and Ivie (1940: fig. 42) for *C. varians* (although the body size of the smaller specimen matches that of *C. davisi*).

I have examined specimens with spermathecal stalks which are tightly coiled around the posterior lobe of spermathecal base (Fig. 24, 25) from Bell (Viper Den Cave, Moffatt Pit Cave), Bexar (B-52 Cave, Up the Creek Cave, Mattke Cave), and Coryell (Tippit Cave) Counties. Intermediate forms with slightly longer spermathecal stalks, like *C. davisi* illustrated by Chamberlin and Ivie (1940: fig. 41) were examined from Bell (Mixmaster Cave) and Coryell (Tippit Cave) Counties. "Typical" *C. varians* were seen from several caves (see specimens examined) and have the spermathecal stalks even longer and looped laterally (Chamberlin and Ivie, 1940: fig. 42; Figs. 22, 23). Note that the specimen illustrated is also from Tippit Cave (where Gertsch thought the new species occurred). Two females are known from Up the Creek Cave (Bexar County): one with spermathecae that have the spermathecal stalk looped lateral to the spermathecal base almost as long as those illustrated by Chamberlin and Ivie (1940: fig. 51) for *C. deserticola* Chamberlin and Ivie. The second female has dissimilar spermathecae: one side appears tightly coiled and the other side more loosely coiled like "normal" *C. varians*. Females with spermathecal stalks almost as long as those of *C. deserticola* were also seen from Figure 8 Cave (Bell County). One female from One Formation Cave, Bexar County, was atypical in that the spermathecal stalk was malformed on one side (Figs. 26, 27). More interestingly though is the fact that the posterior lobe of spermathecal base is much smaller than the anterior lobe. This disproportion in sizes is illustrated for the related species, *C. pacifica* Chamberlin and Ivie from California. The spermathecal stalk lacks the tight bend (which is found on more typical forms) just before entering the anterior lobe of spermathecal base from the dorsal side. Additional collections from One Formation Cave should reveal the normal form of *C. varians* in that cave.

The caves from which this species is recorded in Bexar County are predominantly in the Kainer Formation of the Edwards Limestone Group, but also in the

Edwards' Person Formation, the upper and lower members of the Glen Rose Formation, and the Austin Chalk.

Subgenus *Cicurella*

Cicurina baronia Gertsch
Figs. 9, 13, 16, 28-31

Cicurina n. sp. (in part): Reddell, 1988:34.
Cicurina baronia Gertsch, 1992:109, figs. 82, 89, 90, 155-156; Reddell, 1993: 5, 8-10, 22, 68; Stanford and Shull, 1993:63328, 63329; Drewy, 1994:59024; Veni, 1994:67; Johnson Linam, 1995:66, appendix I p. 83, 100; Jackman, 1997:162, 171; Platnick, 1997:644; Rappaport Clark, 1998:71855, 71856, 71858, 71860, 71866; Veni and Reddell, 1999:1, 7; Longacre, 2000:81419-81421, 81425, 81433; Anonymous, 2001:9; Pesquera, 2001:1; U.S. Fish and Wildlife Service, 2002:55064, 55066, 55067, 55075, 55086; Industrial Economics, Inc., 2002:3; Veni, 2002:1, 5-7; Veni, Glinn et al., 2002:164, 166, 169, 172, 173, fig. 13; Veni, Reddell, and Cokendolpher, 2002:4, 10; U.S. Fish and Wildlife Service. 2003:17156, 17158, 17176, 17191, 17203.

Diagnosis.—Eyeless *Cicurella* troglobite from Alamo Heights Karst Fauna Region; spermathecal base rounded; posterior lobe bluntly rounded, less than half size of anterior lobe, anterior and posterior lobes about equally spaced (about diameter of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across posterior lobe of spermathecal base, lying horizontal to atrium, about same width throughout.

The female genitalia of this species are most like *C. brunsi* n. sp. and *C. bullis* n. sp.; all have rounded spermathecal base lobes with spermathecal stalks lying horizontal to the atrium. They are separated by the interdistances between the copulatory ducts (much farther apart in *C. baronia*) and the shape of the spermathecal stalk (straighter in *C. baronia*).

Type-data.—Female holotype from Robber Baron Cave, San Antonio, Bexar County, Texas, April 1969, R. Bartholomew (AMNH, examined).

Specimens examined.—TEXAS: Bexar County: Robber Baron Cave, April 1969, R. Bartholomew (1 female holotype, AMNH); 3 April 1982, A. G. Grubbs (1 female, JCC); 9, 11 Dec. 1983, S. Harden, R. Waters (1 male, TMM).

Description [holotype (largest specimen) followed by smallest specimen (JCC specimen in parentheses)].—Female light reddish-brown colored, body length 6 (5.65) mm. Troglobite, eyeless. Cephalothorax 2.6 (2.45) mm long, 1.7 (1.5) mm wide. Abdomen 3.4 (3.2) mm long, 2.6 (2.25) mm wide. Cheliceral retromargin with 4 (3/4 large, 3/3 small) teeth. Leg lengths: first femur 2.2 (2.2) mm, fourth femur 2.25 (2.35) mm; first patella-tibia 2.4 (2.65) mm, fourth patella-tibia 2.6 (2.8) mm. Ventral leg spines: first tibia 2-2-1 (2-2-0), fourth tibia 2-2-2 (2-2-1). Internal genitalia: spermathecal base rounded; posterior lobe bluntly rounded, less than half size of anterior lobe, anterior and posterior lobes about equally spaced (about diameter of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across spermathecal base, lying horizontal to atrium, about same width throughout.

Distribution.—Known only from Robber Baron Cave (Fig. 13).

Comments.—Robber Baron Cave is by far the longest cave in Bexar County, with over 1500 m of interconnecting passages (Veni, 1997). It is formed in the Austin Chalk within the city of San Antonio in north-central Bexar County. Robber Baron Cave is the only cave in the Alamo Heights Karst Fauna Region known to be inhabited by a *Cicurina*. The entrance to the cave is now gated, but the cave has had extensive commercial and recreational use in the past (Veni 1988). The cave is owned by the Texas Cave Management Association (Veni in Longacre, 2000), which will likely be interested in protection and improvement of the cave habitat. However, this cave is relatively large, and the land over and around the cave is heavily urbanized. Cave crickets are virtually absent from the cave now probably due to the use of pesticides on lawns in the surrounding area (Reddell, 1993). The current gate on the cave is blocking organic material from entering and may be severely limiting food input and impacting the cave fauna (Veni and Reddell, pers. comm. 2001). This species is listed (Longacre, 2000) as federally endangered and shares Robber Baron Cave with another federally endangered arachnid (Opiliones: Phalangodidae: *Texella cokendolpheri* Ubick and Briggs, 1992).

Cicurina brunsi, new species
Figs. 9, 13, 16, 32, 33

Cicurina (*Cicurella*) sp. nr. *baronia*: Veni et al., 1995:207, 347.
Cicurina (*Cicurella*) new species 1: Veni et al., 1996:185. Veni et al., 1998a: 210. Veni et al., 1999:46, 51, 123, 173. Veni and Reddell, 1999: 1, 5-8, 24, 27, 33, 44, 67, fig. 1. Veni et al., 2000:196.
Cicurina (*Cicurella*) sp. (troglobite): Veni, Hammond et al., 2002:47.

Cicurina (*Cicurella*) new species 3: Veni, Reddell, and Cokendolpher, 2002:4, 11, 29, 32, 38, 49, 74, 103, fig. 1.

Diagnosis.—Eyeless *Cicurella* troglobite from Upper Glen Rose Biostrome Karst Fauna Region; spermathecal base rounded; posterior lobe bluntly rounded, much less than half size of anterior lobe, anterior lobes about third of anterior lobe apart, posterior lobes about anterior lobe diameter apart; copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across posterior lobe of spermathecal base, lying horizontal to atrium, about same width throughout.

The spermathecae of this species is most like *C. bullis* n. sp. They differ in the curvature of the spermathecal stalk; anteriorly arched medially in *C. brunsi*. The posterior lobes of the spermathecal bases are also further apart in *C. brunsi* than in *C. bullis*.

Type-data.—Female holotype from Stahl Cave, Camp Bullis, Bexar County, Texas, 1 Nov. 2001, J. R. Reddell and M. Reyes (AMNH) (molted 14 Dec. 2001, 2 Aug. 2002).

Etymology.—The specific name is honoring Dusty Bruns for his efforts in promoting cave research and sound cave management at Camp Bullis.

Description.—Female cream to straw colored, troglobite, eyeless. Body length 4.05 mm. Cephalothorax 1.7 mm long, 1.2 mm wide. Abdomen 2.35 mm long, 1.25 mm wide. Cheliceral retromargin with 3 large and 3 (2 on other side) small teeth. Leg lengths: first femur 1.4 mm, fourth femur 1.45 mm; first patella-tibia 1.6 mm, fourth patella-tibia 1.8 mm. Ventral leg spines: first tibia 2-2-1, fourth tibia 1-2-2. Internal genitalia: spermathecal base rounded; posterior lobe bluntly rounded, much less than half size of anterior lobe, anterior lobes about third of anterior lobe apart, posterior lobes about anterior lobe diameter apart; copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across posterior lobe of spermathecal base, lying horizontal to atrium, about same width throughout.

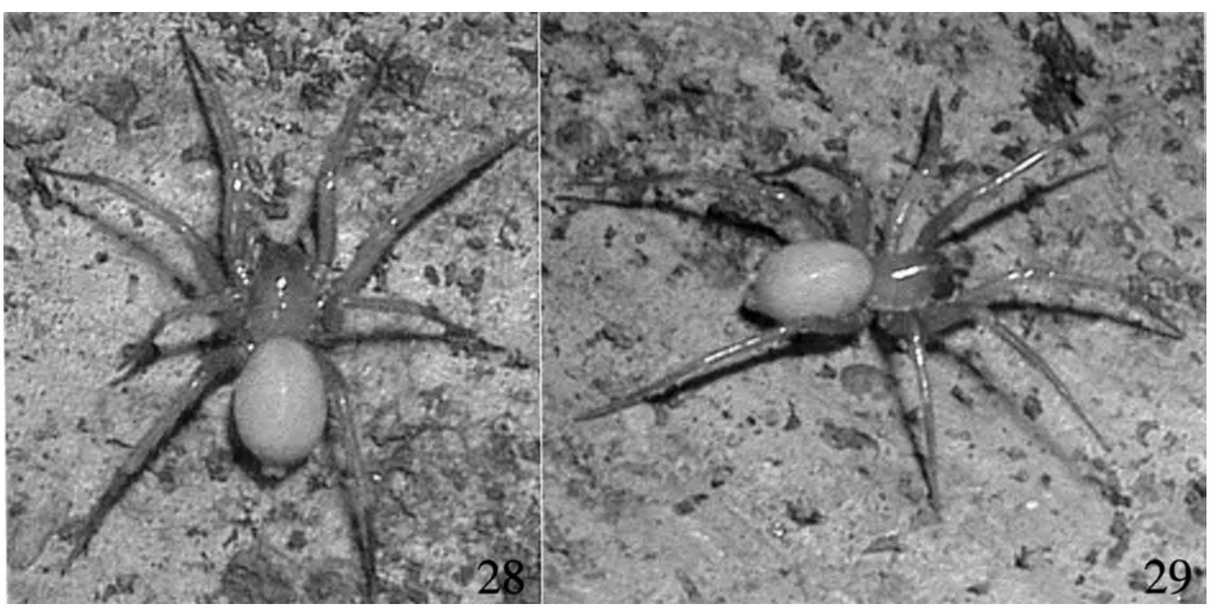
Distribution.—Known only from Stahl Cave of the Upper Glen Rose Biostrome Karst Fauna Region (Fig. 13).

Comments.—The Upper Glen Rose Biostrome Karst Fauna Region was subdivided from the Stone Oak Karst Fauna Region by Veni, Reddell, and Cokendolpher (2002). Red imported fire ants have been recorded from within Stahl Cave. Their significance was noted and efforts to eradicate or minimize the impact on the cave fauna were recommended (Veni, Reddell, and Cokendolpher, 2002).

Cicurina bullis, new species
Figs. 6, 9, 13, 16, 34-36

Cicurina (*Cicurella*) sp. nr. *baronia*: Veni et al., 1995:207, 347.

Cicurina (*Cicurella*) new species 1: Veni et al., 1996:185; Veni et al., 1998a: 210; Veni et al., 1999:46, 51, 123, 173; Veni and Reddell, 1999:1, 5-8, 24, 27,



Figs. 28, 29.—*Cicurina baronia* from Robber Baron Cave. Photos by Jean Krejca (U. S. Fish and Wildlife Service).

33, 44, 67, fig. 1; Veni et al., 2000:196; Veni, Glinn et al., 2002:118, 166, 173, fig. 13; Veni, Hammond et al., 2002:114, 129, 213; Veni, Reddell, and Cokendolpher, 2002:4, 8, 10-12, 29, 36, 38, 49, 74, 113, 126, fig. 1.

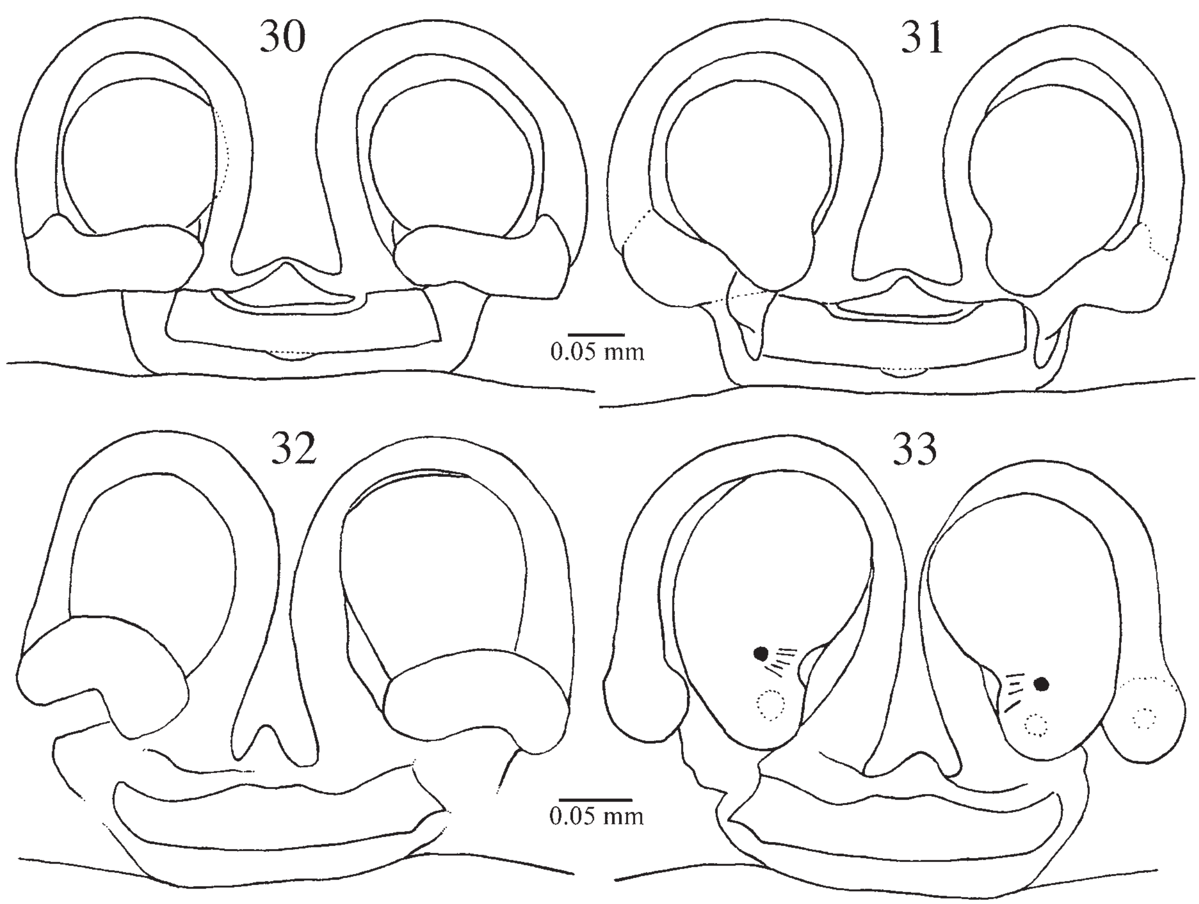
Diagnosis.—Eyeless *Cicurella* troglobite from Stone Oak Karst Fauna Region; spermathecal base rounded; posterior lobe bluntly rounded, much less than half size of anterior lobe, anterior lobes about equally spaced (about third of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy sinuate to straight bar across posterior lobe of spermathecal base, lying horizontal to atrium, about same width throughout.

The spermathecae of this species is most like *C. baronia* and *C. brunsi* (see diagnoses under those species for comparisons).

Type-data.—Female holotype from Isocow Cave, Zone 3 (top of 3.6 m drop to top of 4.6 m pit), Camp Bullis, Bexar County, Texas, 2 March 1994, W. Elliott, G. Veni (AMNH). Four female paratypes from Root Canal Cave, Camp Bullis, Bexar County, Texas, 20 April 1999, J. R. Reddell and M. Reyes (3 TMM, 1 JCC) (one mature at time of collection; one molted to maturity during the week following collection; one molted 16 July 1999, 10 July, 2 Sept. 2000; one molted 25 Aug. 1999, 9 April, 3 Dec. 2000). Two female paratypes from Hilger Hole, Camp Bullis, Bexar County, Texas, 20 April 1999, J. R. Reddell and M. Reyes (TMM), 15 Dec. 2000 (JCC). Female paratype from Platypus Pit, Bexar County, Texas 30 March 1995, J. R. Reddell, M. Reyes (TMM). Female paratype from Eagles Nest Cave, 1 Nov. 2001, J. R. Reddell, M. Reyes (TMM).

Etymology.—The specific name is a noun in apposition; taken from Camp Bullis.

Description [holotype followed by smallest (Root Canal Cave- matured 3 Dec.) and largest (Hilger Hole) paratypes in parentheses].—Female cream to straw colored, troglobite, eyeless. Body length 4.3 (3.9, 5.75) mm. Cephalothorax 2 (1.75, 2.65) mm long, 1.3 (1.2, 1.75) mm wide. Abdomen 2.3 (2.15, 3.1) mm long, 1.5 (1.4, 2.05) mm wide. Cheliceral retromargin with 4 large, 3



Figs. 30-33.—Female spermathecae of *Cicurina*. *Cicurina baronia*, holotype. 30, ventral view, 31, dorsal view. *Cicurina brunsi* n. sp. holotype 28, ventral view.; 29, dorsal view.

small (4 + 3, 3 + 3/4 + 3) teeth. Leg lengths: first femur 1.7 (1.45, 2.25) mm, fourth femur 1.8 (1.55, 2.35) mm; first patella-tibia 2.1 (1.8, 2.7) mm, fourth patella-tibia 2.15 (1.9, 2.9) mm. Ventral leg spines: first tibia 2-2-1 (2-2-1, 2-2-1/2-2-0), fourth tibia 1-2-2/2-2-2 (2-2-2, 2-2-0/1-1-1-2). Internal genitalia: spermathecal base rounded; posterior lobe bluntly rounded, much less than half size of anterior lobe, anterior lobes about equally spaced (about third of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy sinuate to straight bar across posterior lobe of spermathecal base, lying horizontal to atrium, about same width throughout.

Distribution.—Known only from five caves in the Stone Oak Karst Fauna Region (Fig. 13). Eagles Nest, Isocow Cave, and Root Canal Cave are located within 350 m of each other whereas Hilger Hole and Platypus Pit are located about 2-2.5 km to the southwest. All of these, except Platypus Pit, are in the Camp Bullis Eagles Nest Subregion (Veni, Reddell, and Cokendolpher, 2002). Platypus Pit belongs to the Camp Bullis Southeast Subregion.

Comments.—Measurements of the cephalothorax lengths revealed the following sizes: 2 mm (Isocow Cave, Platypus Pit, two specimens from Root Canal Cave), 1.75, 2.15 mm (Root Canal Cave), 2.4, 2.65 mm (Hilger Hole). The female collected in Platypus Pit is very similar in size to the holotype of *C. bullis*; both being about two-thirds the size of *C. platypus*. The Platypus Pit female: body length 4.35 mm. Cephalothorax 2.0 mm long, 1.25 mm wide. Abdomen 2.35 mm long, 1.8 mm wide. Cheliceral retromargin with 3 rounded, 3 thin teeth. Leg lengths: first femur 1.6 mm, fourth femur 2.0 mm; first patella-tibia 2.1 mm, fourth patella-tibia 2.15 mm. Ventral leg spines: first tibia 2-2-0/2-2-1 small, fourth tibia 1-2-2. The genitalia of the paratypes do not differ significantly from that of the holotype. In some specimens from Root Canal Cave the posterior lobe of spermathecal base is slightly more round and the spermathecal stalk is almost straight not curved (sine wave) as illustrated for the holotype. The interdistance of the lobes is similar in all specimens and much less than that seen in *C. baronia*. The female from Hilger Hole has the spermathecal stalk like those from Root Canal Cave, but the lobes are more like those from Isocow Cave, less rounded.

One of the females from Root Canal Cave took almost one year (lacking five days) to molt in captivity. Her last three instars lasted 16.5 months. The total number of instars from hatching to adulthood is unknown, but it clearly takes more than a year to mature in captivity.

Red imported fire ants have been observed within all of the known cave localities for this species. Their significance was noted and efforts to eradicate or minimize the impact on the cave faunas were recommended (Veni et al, 1999; Veni, Reddell, and Cokendolpher, 2002).

Isocow Cave is formed in the Kainer Formation (Edwards Limestone) and within the upper member of the Glen Rose Formation.

Cicurina loftini, new species
Figs. 5, 9, 10, 13, 16, 37-39

Cicurina (*Cicurella*) spp. (troglobite): Reddell, 1993:22, 47.
Cicurina new species #3: Veni, Glinn et al., 2002:165, 166, fig. 13.

Diagnosis.—Eyeless *Cicurella* troglobite from Culebra Anticline Karst Fauna Region; spermathecal base rounded; posterior lobe bluntly rounded, less than half size of anterior lobe; anterior lobes much closer together than posterior lobes (about fourth diameter of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across posterior lobe of spermathecal base, lying at almost 45° to atrium, wider at middle or distal end.

The female genitalia of this species are most like those of *C. neovespera* n. sp. and *C. vespera*. All have the spermathecal stalk directed at about 45° to the atrium. Unlike the other two species, *C. loftini* has the spermathecal stalk widened in the middle or at the distal end.

Type-data.—Female holotype (AMNH), 3 female (1 JCC, 2 TMM) paratypes from Caracol Creek Coon Cave, 15 June 1993, J. Loftin, J. R. Reddell, M. Reyes, G. Veni. Female paratype, SBC Cave, TxDOT Loop 1604 right of way 3-4 km south of Caracol Creek Coon Cave, 20 Feb. 2003, K. White, C. Collins (TMM).

Other material.—1 male (TMM) collected with the type series listed above.

Etymology.—The species is named after James Loftin of San Antonio, for his years of cave explorations.

Description [holotype followed by largest and smallest topotypical paratypes (TMM), SBC Cave paratype].—Female cream colored, body length 4.7 (4.15, 3.25, 5.6) mm. Troglobite, eyeless (with very faint indication of two eyes, Fig. 10). Cephalothorax 2.3 (2.05, 1.6, 2.5) mm long, 1.5 (1.35, 1.1, 1.8) mm wide. Abdomen 2.45 (2.1, 1.65, 3.1) mm long, 1.6 (1.4, 1.1, 2.0) mm wide. Cheliceral retromargin with 4 rounded and 3 thin (4 and 3, 3 and 3, 4 and 3) teeth. Leg lengths: first femur 1.9 (1.8, 1.35, 2.15) mm, fourth femur 2.15 (1.85, 1.4, 2.4) mm; first patella-tibia 2.3 (2.1, 1.6, 2.75) mm, fourth patella-tibia 2.25 (2.3, 1.75, 2.9) mm. Ventral leg spines: first tibia 2-2-0 (1-1-0, 1-1-0/2-2-0, 2-1-0), fourth tibia 1-2-2 (1-2-2, 1-2-2, 2-2-2). Internal genitalia: spermathecal base rounded; posterior lobe bluntly rounded, less than half size of anterior lobe; anterior lobes much closer together than posterior lobes (about fourth diameter of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across posterior lobe of spermathecal base, lying at almost 45° to atrium, wider at middle (topotypical specimens) or distal end (SBC Cave).

Distribution.—Known only from Caracol Creek Coon Cave and SBC Cave (Figs. 13).

Comments.—The specimen from SBC Cave was included as a member of this species with considerable hesitation. The specimen is larger than the few specimens recorded from the type locality and the spermatecae differ some. My decision to include the specimen is based upon the proximity of the caves, similarity in the genitalia, and presence of only one specimen from SBC Cave. Medio Creek is located between the two caves and it may have served to isolate the two populations. Both caves are located in the Austin Chalk of west central Bexar County.

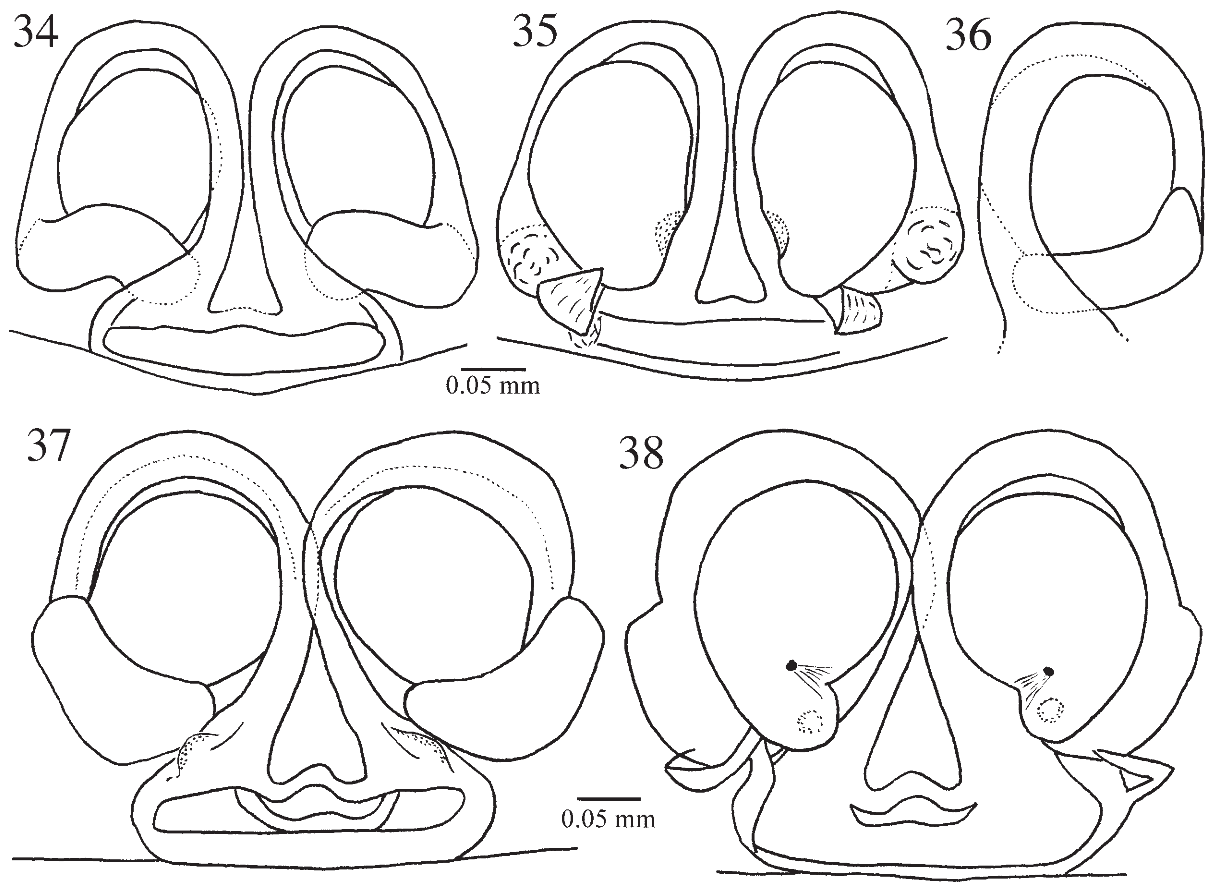
Caracol Creek Coon Cave has a heavy fire ant infestation. It is also in an area proposed for development (Reddell, 1993). SBC Cave was discovered while digging a utility trench located beside a highway.

Cicurina madla Gertsch
Figs. 7-9, 13, 16, 40-47

Cicurina n. sp. (in part): Reddell, 1988:34.

Cicurina (*Cicurella*) spp. (troglobite): Reddell, 1993:22, 50, 55, 64.

Cicurina madla Gertsch, 1992:109, figs. 91-92; Reddell, 1993:5, 8, 10, 22; Stanford and Shull, 1993:63328-63329; Drewy, 1994:59024; Veni, 1994:67; Johnson Linam, 1995:66, appendix I p. 85, 100; Veni et al., 1996:186; Jackman, 1997:162, 171; Platnick, 1997:646; Veni et al., 1998a:83, 210; Rappaport Clark, 1998:71855, 71856, 71858, 71860, 71866;



Figs. 34-38.—Female spermathecae of *Cicurina*. *Cicurina bullis* n. sp. 34, ventral view, holotype. 35, dorsal view, holotype. 36, ventral view of left half of paratype from Root Canal Cave. *Cicurina loftini* n. sp. holotype. 37, ventral view, 38, dorsal view.

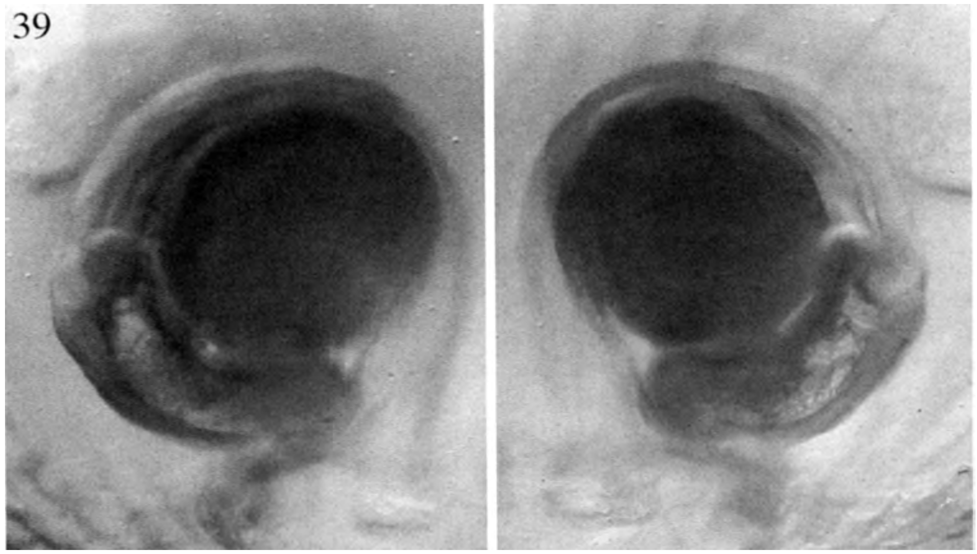


Fig. 39.—Female spermathecae of *Cicurina loftini* n. sp. from SBC Cave, ventral view.

Veni and Reddell, 1999:1, 33, 34, 44; Veni et al., 1999:123, 173; Longacre, 2000:81419-81421, 81425, 81433; Anonymous, 2001:9, unnumbered fig.; Pesquera, 2001:1, unnumbered fig.; Industrial Economics, Inc., 2002:3, 60; U.S. Fish and Wildlife Service, 2002:55064, 55066, 55067, 55074, 55075, 55086; Veni and Reddell, 2002a:1, 9, 10, 22, 24; 2002b:3; Veni, 2002: 1, 5-7, 13, 14, 17; Veni, Hammond et al., 2002:2, 213; Veni, Glinn et al., 2002:1, 165, 166, 170, 172, 173, 238, fig. 13; Veni, Reddell, and Cokendolpher, 2002:1, 4, 8, 10, 11, 29, 32, 37, 38, 49, 74, 132, fig. 1; U.S. Fish and Wildlife Service, 2003:17156, 17158, 17175, 17176, 17182, 17190, 17191, 17195.

Cicurina n. sp.: Veni and Elliott, 1994: 7.

Cicurina (Cicurella) n. sp. 1: Veni et al., 1995:152, 347.

Diagnosis.—Eyeless *Cicurella* troglobite from Government Canyon, Helotes, UTSA and Stone Oak Karst Fauna Regions; spermathecae elongated, posterior lobe of spermathecal base bluntly rounded distal to junction with anterior lobe, body axis lines meeting at 90° or more, axes of anterior lobes not curved inward mesally, anterior lobes about a radius apart distally, copulatory duct looped over or slightly anterior to anterior lobe of spermathecal base, spermathecal stalk not reaching beyond junction of spermathecal base lobes.

This species belongs to a series of species with elongate spermathecae that have relatively thin connecting coils looped anterior to the anterior lobe of spermathecal base and a thick spermathecal stalk that is not greatly arched anteriorly. The Bexar County *C. venii* (Figs. 63, 64) also belongs in this group as well as: *C. reddelli* Gertsch (1992: figs. 77, 78) from Travis County, *C. rainesi* Gertsch (1992: figs. 143, 144) and *C. gruta* Gertsch (1992: figs. 147, 148) from Edwards County, *C. patei* Gertsch (1992: figs. 117, 118) from Val Verde County, and *C. venefica* Gertsch (1992: figs. 129, 130) from Terrell County. The species are best told apart by examination of the shape and positions of the spermathecal base lobes and the spermathecal stalk. In addition to details that can be seen in the various illustrations listed above, *C. madla* differs from all of them by not having the axes of the anterior lobes of the spermathecal base noticeably curved inward mesally.

Type-data.—TEXAS: Bexar County: Madla's Cave, 4 Oct. 1963, J. R. Reddell, D. McKenzie (female holotype AMNH, examined).

Specimens examined.—TEXAS: Bexar County: Christmas Cave, 6 Sept. 1993, J. R. Reddell, M. Reyes (1 female, TMM); Headquarters Cave, Camp Bullis, 16 June 1993, S. Harden, J. R. Reddell, M. Reyes, G. Veni (1 female, TMM); 26 Oct. 1995, J. R. Reddell, M. Reyes (1 female, JCC); 14 Nov. 1995, J. C. Cokendolpher, J. R. Reddell, M. Reyes (1 male, TMM).; Helotes Blowhole, A. G. Grubbs, K. Kingsley, K. White, 18 Feb. 1999 (1 female, TMM); Hills and Dales Pit, 28 Oct. 2000, K. White, H. Bechtol (1 female, TMM); Lost Pothole (= Lost Pot), 4 Feb. 1995, A. G. Grubbs, G. Hoese, V. Vreeland (1 female, TMM); Madla's Cave, 4 Oct. 1963, J. R. Reddell, D. McKenzie (female holotype, AMNH); Madla's Drop Cave, 8 June 1993, J. Loftin, J. R. Reddell, M. Reyes, G. Veni (1 female, TMM); Robber's Cave, 14 July 1993, J. R. Reddell, M. Reyes (1 female, JCC).

Description [holotype (smallest specimen) followed by largest (Hills and Dales Pit)].—Female cream colored, body length 5.8 (4.85-6.65) mm. Troglobite, eyeless. Cephalothorax 2.4 (2.30-3.26) mm long, 1.7 (1.55-2.25) mm wide. Abdomen 3.4 (2.55-3.4) mm long, 2 (1.5-2.05) mm wide. Cheliceral retromargin with 4 (4+2

/ 4+1 - 4+2) teeth. Leg lengths: first femur 2.6 (2.36-3.28) mm, fourth femur 2.8 (2.55-3.4) mm; first patella-tibia 3 (2.9-4.2) mm, fourth patella-tibia 3.3 (3.16-4.45) mm. Ventral leg spines: first tibia 2-2-0 (1-1-2-2 to 2-2-1), fourth tibia 2-2-2 (1-2-2 to 2-2-2). Internal genitalia: spermathecae elongated, posterior lobe of spermathecal base bluntly rounded distal to junction with anterior lobe, body axis lines meeting at 90° or more, axes of anterior lobes not curved inward mesally, anterior lobes about a radius apart distally, copulatory duct looped over or slightly anterior to anterior lobe of spermathecal base, spermathecal stalk not reaching beyond junction of spermathecal base lobes, straight or slightly curved at midline and weakly to strongly turned posterolaterally.

Distribution.—Known from caves in Government Canyon, Helotes, UTSA, and Stone Oak Karst Fauna Regions (Figs. 13, 47).

Comments.—Measurements of all the specimens revealed the following variations in cephalothorax lengths: Christmas Cave 2.65 mm, Headquarters Cave 2.3-2.55 mm, Helotes Blowhole 2.35 mm, Hills and Dales Pit 3.26 mm, holotype 2.4 mm, Lost Pothole (= Lost Pot) 2.85 mm, Madla's Drop Cave 2.4 mm, and Robber's Cave 3.0 mm.

Cicurina madla can be split into two groups based on the morphology of the lobes of the spermathecal base (see discussion of axes under that species). One group occurs east of Helotes Creek and the other west of the creek (Fig. 16, 47). The distinction is not clear and therefore they are not recognized taxonomically. Helotes Creek is recognized as being a major barrier to dispersal to cavernicole fauna and probably these populations are diverging. Again based on a somewhat dubious character, the population from Headquarters Cave exhibits a flattening of the lateral end of the spermathecal stalk. Possibly Leon Creek is serving as a barrier to stop gene flow between this most eastern population and those further west closer to Helotes Creek. Based on this same character, the spermathecal stalk of the populations in the western part of the range [Lost Pothole (= Lost Pot), Christmas Cave, and Madla's Drop Cave] appears to be strongly bent laterally (Fig. 47). Unfortunately, the other known barrier of this area (Los Reyes Creek) dissects these populations and no other barrier is known that would keep this same form from exchanging genetic material with spiders in the nearby Madla's Cave. More material and larger sample sizes are needed to help understand the emerging changes occurring in *C. madla*. Christmas Cave and Madla's Drop Cave are near Madla's Cave and in the central part of the Helotes Region. Lost Pothole is in the western part, but there are no collections from the extreme western part of the karst region.

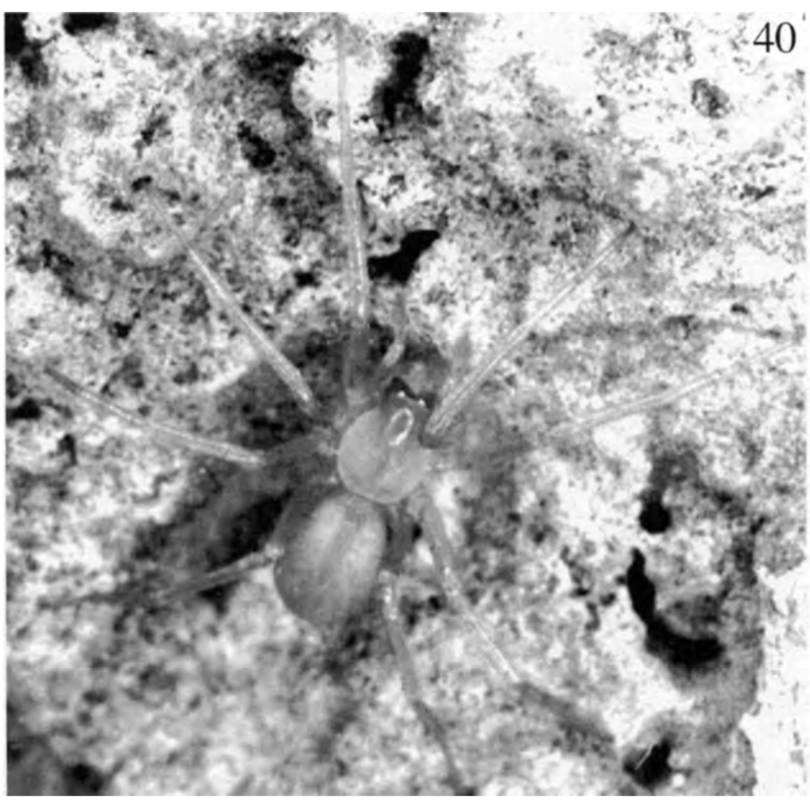
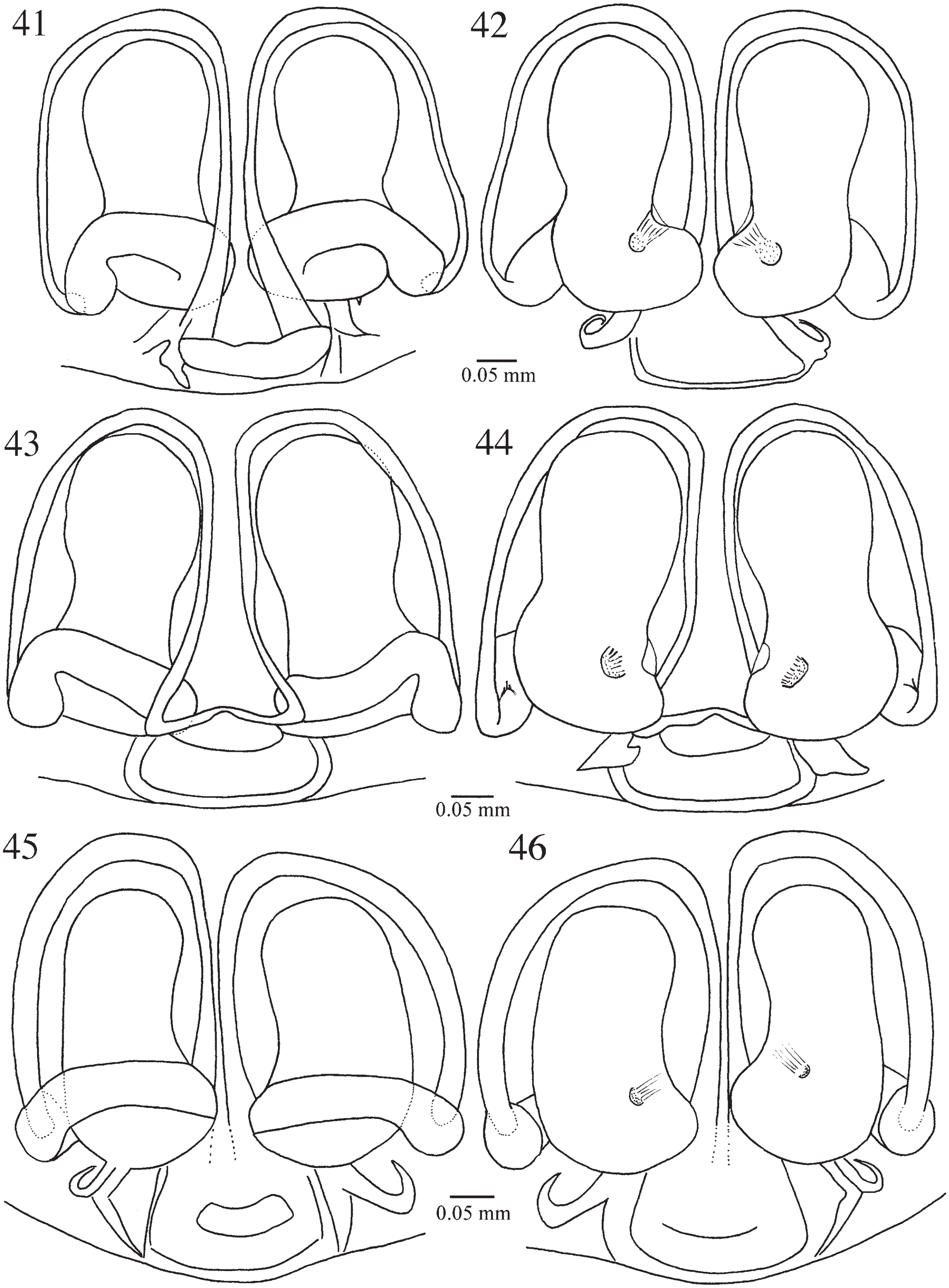


Fig. 40.—Female *Cicurina madla* from Headquarters Cave.



Figs. 41-46.—Spermathecae of female *Cicurina madla*: Madla's Cave, holotype, 41, ventral view, 42, dorsal view. Lost Pothole (= Lost Pot), 43, ventral view, 44, dorsal view. Headquarters Cave, 45, ventral view, 46, dorsal view.

Madla's Cave, Helotes Blowhole, and Christmas Cave were formed within the upper member of the Glen Rose Formation, which is overlain by Edwards Limestone. Madla's Drop Cave, Lost Pothole (= Lost Pot), Robber's Cave, and Hills and Dales Pit are in the Edwards Limestone. Headquarters Cave is primarily in Edwards Limestone, but extends into the Glen Rose Formation. Helotes Blowhole is located on a cliff about 4 meters above Helotes Creek. This creek is the eastern boundary of the Helotes Karst Fauna Region.

This species is now listed as an endangered species (Longacre, 2000). Madla's Drop Cave was reported to have a very heavy fire ant infestation (Reddell, 1993). Access to Headquarters Cave is now limited and the cave entrance is gated (Reddell, 1993). Other measures for conservation of Headquarters Cave are outlined in the Management Plan for Camp Bullis (Veni, Reddell, and Cokendolpher, 2002).

Cicurina minorata (Gertsch and Davis)
Figs. 9, 14, 48-51

Chorizomma minorata Gertsch and Davis, 1936:6, fig. 8.
Cicurina minorata: Chamberlin and Ivie, 1940:80-81, figs, 63, 96; Roth and Brown, 1986:7; Gertsch, 1992:92, fig. 15; Jackman, 1997:162; Platnick, 1997:646; Veni, Glinn et al., 2002:163, 165, 166, 170, 171, fig. 13.

Diagnosis.—6-eyed (anterior median eyes missing) epigean *Cicurella* from San Antonio; anterior and posterior lobes of spermathecal base separated by strong constriction; spermathecal stalk lacking in usual position; passing dorsally over posterior lobe of spermathecal base.

The genitalia are most like those of *C. armadillo* from near Austin, Travis County. Both of these species lack a spermathecal stalk between the lobes of the spermathecal base ventrally. Gertsch (1992) separated these two by the eye interdistances, but the distances between the anterior and posterior lobes of the spermathecal base (more distant in *C. minorata*) and the interdistances between the posterior lobes (much farther apart than anterior lobes in *C. minorata*) appear to be better characters.

Type-data.—Female holotype from San Antonio, Bexar County, Texas, December 1934, L. Irby Davis (body, part of abdomen, left legs I, II, and a damaged spermathecum in AMNH, examined).

Description.—Female holotype white to pale yellow colored, body length 1.6 mm. 6-eyed epigean.

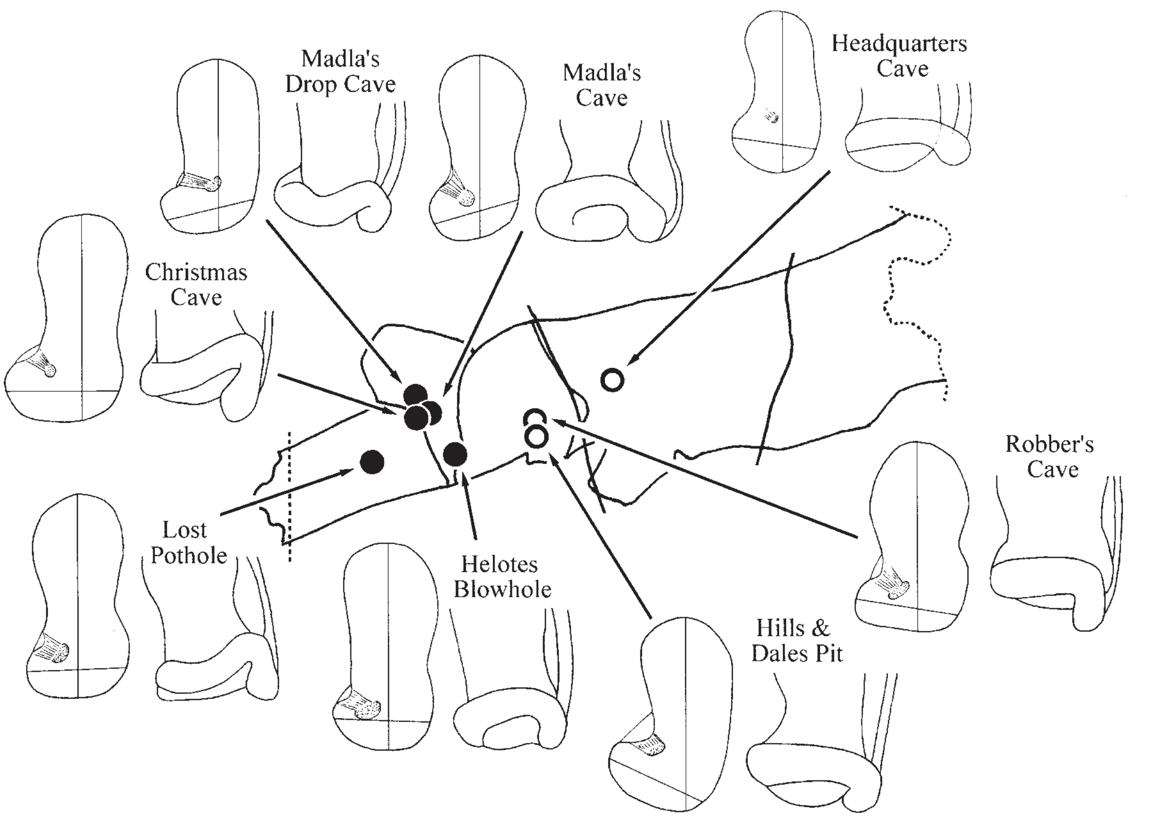


Fig. 47. Distributions of spermathecal morphology (ventral view of spermathecal stalk, dorsal view of spermathecal base) in female *C. madla* (west of Helotes Creek = solid circles) and *C. madla* (east of Helotes Creek = open circles).

Cephalothorax 0.7 mm long, 0.45 mm wide. Abdomen 0.9 mm long, 0.6 mm wide. Clypeal height about diameter of anterior eyes. Eyes subequal with narrow black rings around eyes. Anterior lateral eyes about a diameter apart; posterior eye row straight with median eyes 1.5 diameters apart, scarcely a radius from anterior and lateral eyes. Cheliceral retromargin with 5 small teeth. Leg lengths: first femur 0.45 mm; first patella-tibia 0.55 mm; fourth leg missing. Ventral leg spines: first tibia 2-2-0, fourth tibia missing. Internal genitalia: anterior and posterior lobes of spermathecal base separated by strong constriction; spermathecal stalk lacking in usual position; passing dorsally over posterior lobe of spermathecal base. According to Gertsch (1992), copulatory ducts closely appressed to spermathecum.

Distribution.—Only known from San Antonio.

Comments.—The single known specimen was collected on the surface from some unspecified locality within the city of San Antonio. The vial containing the holotype included the anterior and posterior lobes of a single spermathecal base. It does not include the other spermathecal base or any of the copulatory ducts or epigynal plate. This spermathecal base is illustrated in Fig. 51. Because this is so unlike that which is illustrated for the same specimen by other authors (Figs. 48-50) there was some question if this spermathecum actually belonged to the holotype. Because there is a distinct dictynoid pore it is likely from the holotype. Most likely the difference is because when unattached the spermathecum rotated some under the microscope slide cover so that it is more of a cross-sectional view rather than a straight ventral view. By mentally rotating a spermathecum in Fig. 50, it is easily visualized as that which is presented in Fig. 51. The small size of the spermathecal base (about 0.1 mm total length) make it difficult to detect the attachment points for the copulatory duct and fertilization duct needed for proper orientation. The spermathecum has now been placed in a microvial and placed within the larger vial containing the holotype. Also in the vial with the holotype (now moved to a separate labeled vial) was a single male pedipalp of an unidentifiable *Cicurina* sp. The male of *C. minorata* is unknown so it is uncertain if this might have been from a male that was collected (but not reported) with the holotype.

Cicurina neovespera, new species

Figs. 9, 13, 16, 52, 53

Cicurina vespera: Longacre, 2000:81419-81421, 81425, 81433 (in part).

Cicurina new species #4: Veni, Glinn et al., 2002:166, 171, fig. 13.

Diagnosis.—Eyeless *Cicurella* troglobite from UTSA Karst Fauna Region; spermathecae rounded; posterior lobe of spermathecal base bluntly rounded, less than half size of anterior lobe, posterior lobes slightly further apart than anterior lobes, anterior lobes about third diameter of anterior lobe apart; copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy terminally procurved bar across posterior lobe of spermathecal base, lying about horizontal to atrium but turned anterolaterally, about same width throughout.

The female genitalia of this species are most like those of *C. vespera* and *C. loftini*. All have the spermathecal stalk directed at about 45° to the atrium. *Cicurina loftini* has the spermathecal stalk widened in the middle and there is a uniform thickness in *C. vespera* and *C. neovespera*. *Cicurina neovespera* differs from *C. vespera* by the interdistances of the lobes of the spermathecal base (closer for both in *C. neovespera*), and the length and shape of the spermathecal stalk (straight and short in *C. vespera*; longer and curved in *C. neovespera*).

Type-data.—Two females from Elm Springs Cave (= Grubbs Cave ES), Bexar County, Texas, A. G. Grubbs, date? (holotype AMNH, paratype TMM); Grubbs Cave No. 23, 8 km NE Helotes, 2 Oct. 1995, A. G. Grubbs, 1 female paratype (JCC).

Etymology.—The specific name is from the Greek "*neo*", meaning new, and the species name *vespera*. This does not mean new in terms of evolutionary history, only that it is a newly recognized kin of *C. vespera*.

Description [holotype followed by smallest (TMM) and largest (JCC) paratypes in parentheses].—Female cream to light tan colored, body length 4.9 (3.95, 3.6) mm. Troglobite, eyeless. Cephalothorax 2.15 (1.75, 2) mm long, 1.5 (1.2, 1.45) mm wide. Abdomen 2.7 (2.2, 1.9) mm long, 1.7 (1.45, 1.2) mm wide. Cheliceral retromargin with 3+2/3+1 (3/3 large, 6/6 small) teeth. Leg lengths: first femur 1.9 (1.5, 1.75) mm, fourth femur 1.9 (1.6, 1.9) mm; first patella-tibia 2.25 (1.85, 2.1) mm, fourth patella-tibia 2.4 (1.9, 2.3) mm. Ventral leg spines: first tibiae 2-2-0/2-2-1 (2-2-0, 1-2-2), fourth tibiae 1-2-2 (2-2-2, 1-2-2). Internal genitalia: spermathecae rounded; posterior lobe of spermathecal base bluntly rounded, less than half size of anterior lobe, posterior lobes slightly further apart than anterior lobes (anterior lobes about third diameter of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy terminally procurved bar across posterior lobe of spermathecal base, lying about horizontal to atrium but turned anterolaterally, about same width throughout.

Distribution.—Known only from caves in the far eastern UTSA Karst Fauna Region and the western section of the Stone Oak Karst Fauna Region (Fig. 13).

Comments.—Longacre (2000) reported this species from a cave 8 km northeast of Helotes as *C. vespera*. I made the misidentification reported by Longacre prior to realizing that this species was distinct. I was hesitant in accepting this was a separate species because the differences were not great and there were questions regarding the accuracy of the collection data. My hesitancy to accept the locality data was partially satisfied when a second collection from a relatively nearby cave (Elm Springs Cave) was discovered in unidentified samples at the Texas Memorial Museum. Unfortunately, the data on that collection is also incomplete, but hopefully correct at least in connection to the locality because I have selected it as the type locality.

Cicurina pampa Chamberlin and Ivie
Figs. 9, 11, 14, 54-60

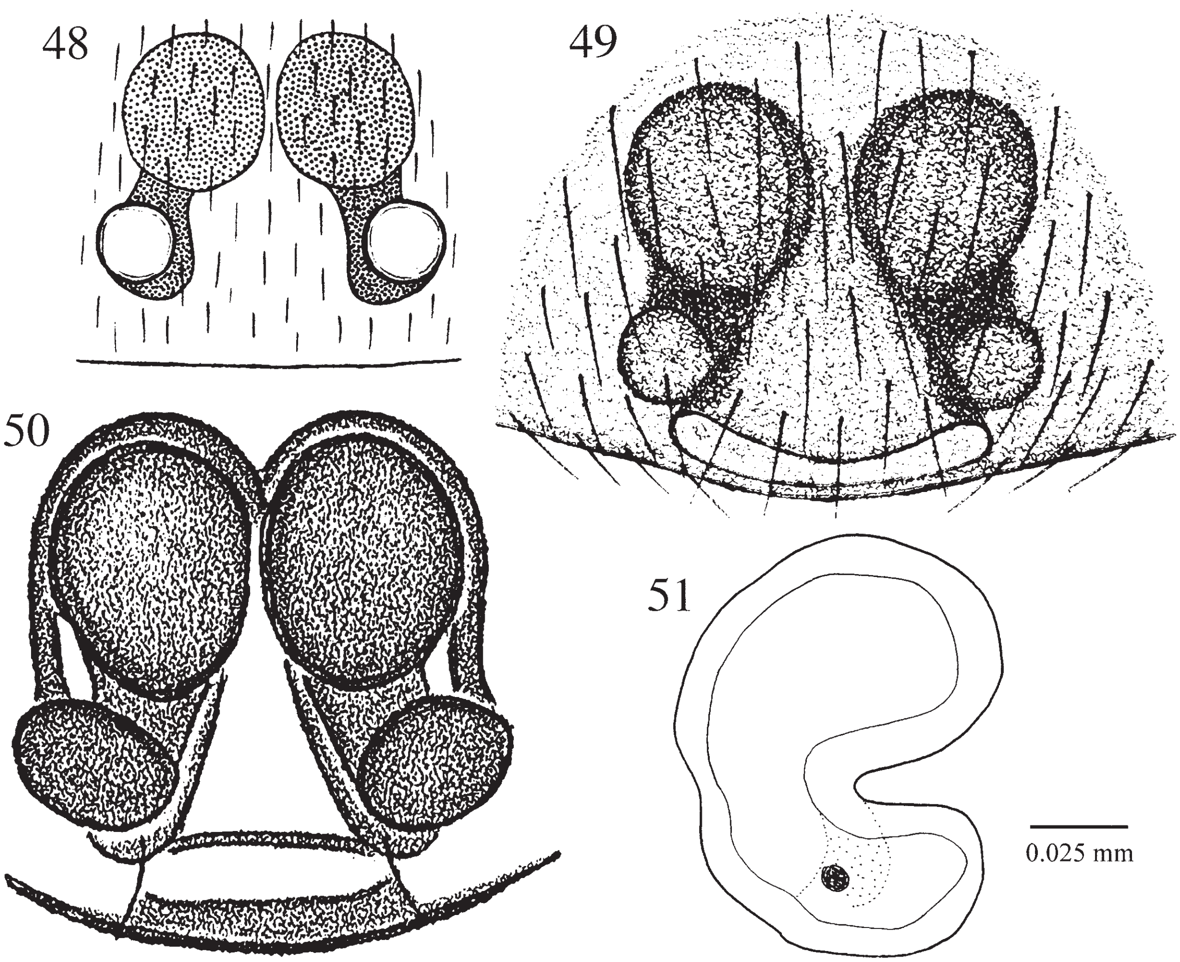
Cicurina pampa Chamberlin and Ivie 1940:79-80, fig. 60; Roth and Brown 1986:8; Gertsch, 1992:90, figs. 23-24; Jackman, 1997:162; Platnick, 1997:646.

Cicurina (*Cicurella*) *pampa*: Veni et al., 1998a:74, 210; Veni et al., 1999: 34, 95, 173; Veni et al., 2000:196; Veni, Glinn et al., 2002:107, 146, 163, 166, 171, 238, fig. 13; Veni, Hammond et al., 2002:135, 143, 214.

Cicurina (*Cicurella*) sp. cf. *pampa* (troglophile): Veni et al., 1995:192; Veni et al., 1996:185.

Cicurina (*Cicurella*) sp. (?troglophile): Reddell, 1993:22, 46.

Cicurina gatita Gertsch, 1992:91, 92, 94, figs. 27-28. NEW SYNONYMY



Figs. 48-51.—Spermathecae of *Cicurina minorata*, female holotype. 48, ventral view from Gertsch and Davis, 1936: fig. 8. 49, ventral view from Chamberlin and Ivie, 1940: fig. 63. 50, ventral view from Gertsch, 1992: fig. 15. 51, mesoventral view of spermathecal base probably from holotype (see text). Scale only for Fig. 51.

Diagnosis.—6-eyed (anterior median eyes missing) epigean and troglophilic *Cicurella* from Kendall and Bexar Counties; anterior and posterior lobes of spermathecal base broadly joined; spermathecal stalk of relatively thin tube crossing in normal position ventral to junction of lobes of spermathecal base.

This species appears to be closely related to *C. microps* Chamberlin and Ivie from Kerr and McCulloch Counties. Chamberlin and Ivie (1940) separated them on the basis of the eyes (very small and white, without black borders in *C. microps*). In their illustrations (1940: figs. 60, 61), it also appears that *C. microps* differs by having a more elongated anterior lobe of spermathecal base.

Type-data.—Female holotype of *C. pampa* from Kendall County, 98°45'W: 29°50'N, Texas, December 1939, D. and S. Mulaik. Epigynum preserved in AMNH, body apparently lost (Platnick, pers. comm., 1996), examined. Female holotype of *C. gatita* from Black Cat Cave, Bexar County, Texas, 27 January 1987, J. R. Reddell, M. Reyes (AMNH, examined).

New Records.—Texas: Bexar County: Cherry Hollow (20b) (= Cave No. 19), 6.9 km NE Helotes, 11 Oct. 1995, A. G. Grubbs, G. Wade (1 female JCC, 1 female TMM); Grubbs Cave No. 189, 6.1 km NE Helotes, 12 Jan. 1995, A. G. Grubbs, N. Lake, G. Wade (2 females JCC); Up the Creek Cave, Camp Bullis, 30 March 1995, J. R. Reddell, M. Reyes (1 female, TMM); 14 Nov. 1995, J. C. Cokendolpher, J. R. Reddell, M. Reyes (2 females, 1 male, JCC); 22 April 1999, J. R. Reddell, M. Reyes (1 female, TMM), 21 Nov. 2001, J. R. Reddell, M. Reyes (1 female, TMM); Cross the Creek Cave, Camp Bullis, 6 Oct. 1995, J. R. Reddell, M. Reyes (1 male, TMM); 11 Oct. 2000, J. R. Reddell, M. Reyes (1 female, TMM); Vera Cruz Shaft, Camp Bullis, 23 March 1998, M. Reyes (1 female TMM); Stone Oak Parkway Pit, 27 Jan., 6 Feb. 1993, A. G. Grubbs (3 females, TMM).

Description (based primarily on Gertsch, 1992: female holotype *C. pampa* followed by female holotype *C. gatita* in parentheses, ? = data unknown) small, cream-colored troglophile: Length 2.1 (1.85) mm. Cephalothorax 0.95 (0.65) mm long, 0.7 (0.5) mm wide. Abdomen 1.15 (1.2) mm long, 0.7 (0.8) mm wide. Clypeal height about half diameter of anterior lateral eye; anterior lateral eyes about a diameter apart; posterior eye row straight with median eyes 1.5 diameters apart, scarcely radius (about half) from posterior lateral eyes. Cheliceral retromargin with 5 (6) teeth. Leg lengths: first femur ? (0.5) mm; fourth femur ? (0.5) mm; first patella-tibia 0.75 (0.6) mm, fourth patella-tibia 0.8 (0.7) mm. Ventral leg spines: first tibia 2-2-0 (2-2-0), fourth tibia 2-2-1 (2-2-2). Internal genitalia: anterior and posterior lobes of spermathecal base broadly joined; spermathecal stalk of relatively thin tube crossing in normal position ventral to junction of lobes of spermathecal base; spermathecal stalk more heavily pigmented/sclerotized and slightly greater in diameter than copulatory duct. There is little variation in body sizes and genital morphology among the other females observed from the county.

Distribution.—This species is known with certainty only from southern Kendall and northwestern Bexar Counties. The map coordinates provided in the original description of the species, places the type locality at about 4.8 km NNW of Boerne.

Comments.—No habitat data were recorded for the holotype and it is possible that it was collected from a cave. Stanley and Dorthea Mulaik were active and diligent collectors in the 1930-40s and one would assume that they would have recorded "collected in a cave" if that was the case. But, all that Stanley Mulaik recorded on the first collection of one of the most highly troglobitic Opiliones known from Texas was from Hays County, 15 Apr. 1939. No specific location or habitat was recorded

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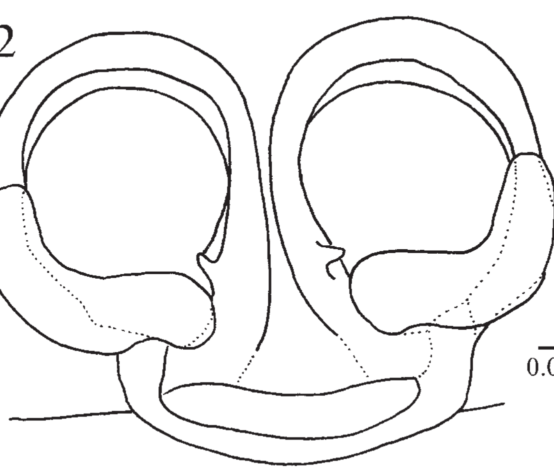

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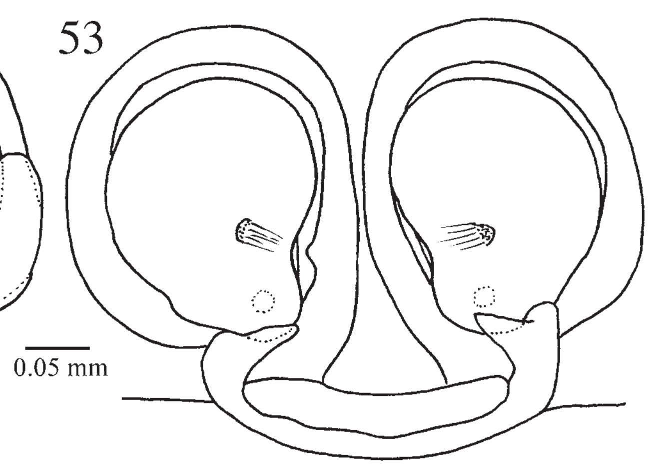
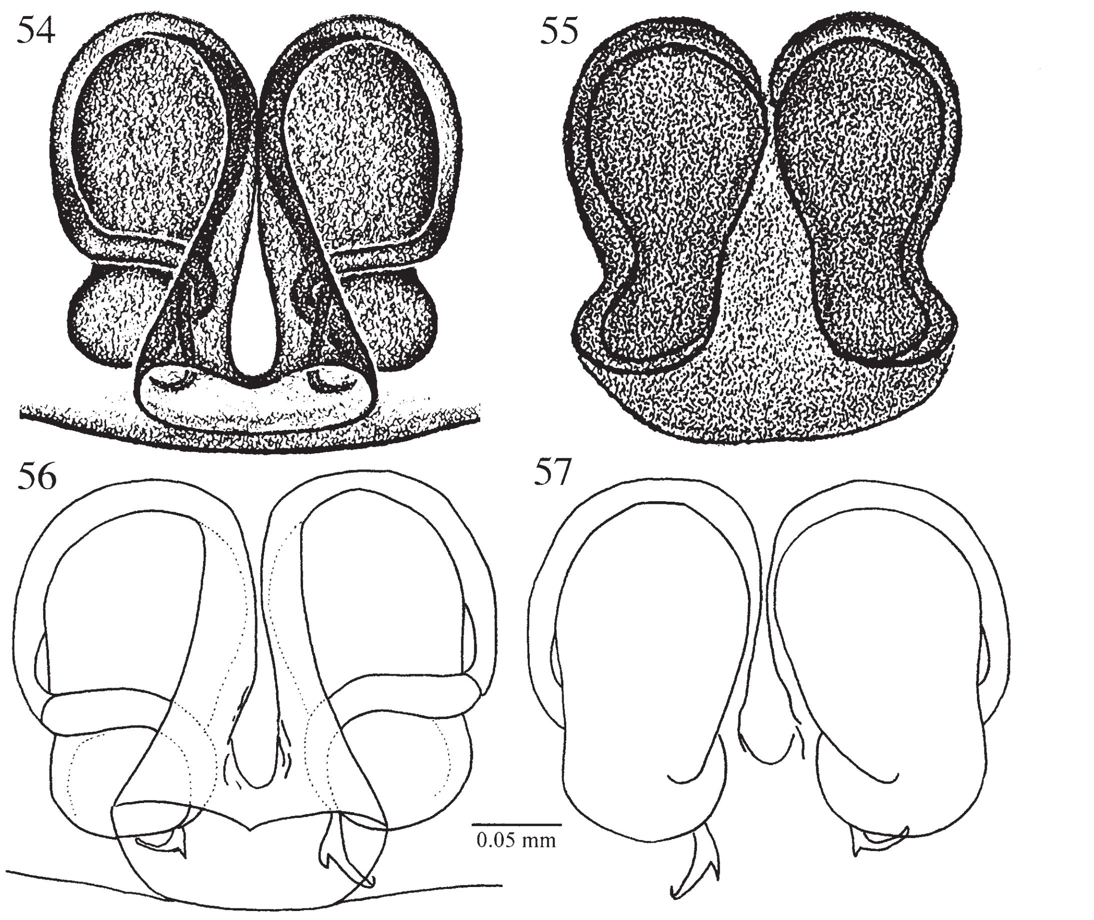


Figs. 52, 53.—Spermathecae of *Cicurina neovespera*, female holotype. 52, ventral view; 53, dorsal view.

(Ubick and Briggs, 1992). West and northwest of Boerne are hilltops and a large ridge that are capped with the Kainer Formation of the Edwards Group. There are reports of a couple of small caves in this area. The upper Glen Rose that underlies those caves is noncavernous in that region. This region is geologically isolated from the other sites in Bexar County. All other known specimens are from caves in the Edwards Limestone and Glen Rose Formation. Up the Creek Cave, Cross the Creek Cave, and Stone Oak Parkway Pit are within the Edwards Aquifer recharge zone in the Kainer Formation. Vera Cruz Shaft is within the upper member of the Glen Rose, a relatively short distance below the contact with the Edwards. The geology of Grubbs Cave No. 189 and Cherry Hollow (20b) (6.4 and 6.9 km NE Helotes, respectively) have not been examined, but the region has exposed areas of Edwards Limestone and Glen Rose Formation. Black Cat Cave is formed in the Edwards Limestone and has a heavy fire ant infestation and the entrance to the cave is in a cleared area for widening of Bulverde Road (Reddell, 1993).

Chamberlin and Ivie (1940: fig. 60; herein as Fig. 52) illustrated the spermathecae with the spermathecal stalk being about the same diameter as the copulatory duct. Although Gertsch (1992: fig. 28; herein as Fig. 58) provided a dorsal view of the spermathecae, he copied the ventral view of Chamberlin and Ivie's. Both illustrations are somewhat misleading. The spermathecal stalk is more heavily pigmented/sclerotized and slightly thicker in diameter than the copulatory duct. Although the illustrations provided in this report (Figs. 56, 57) are of a specimen from Bexar County, it is very similar to that of the holotype. The differences noted between the holotype and the specimen illustrated here are: the lateral region between the anterior and posterior lobes of the spermathecal base is not constricted as much as illustrated earlier (Figs. 54, 55), the anteromedian wall of the atrium is more pointed in the new collection (Fig. 56). The base of the spermathecal stalk arises more medially on the dorsal side (Fig. 57) than previously illustrated (Fig. 55). Examination of the remaining females from Bexar County, revealed that these few differences



Figs. 54-57.—Spermathecae of *Cicurina pampa*. Female holotype from Kendall County, Texas. 54, ventral view from Chamberlin and Ivie, 1940: fig. 60. 55, dorsal view from Gertsch, 1992: fig. 24. Female from Up the Creek Cave, Bexar County, Texas. 56, ventral view, 57, dorsal view. Scale only for Fig. 56, 57.

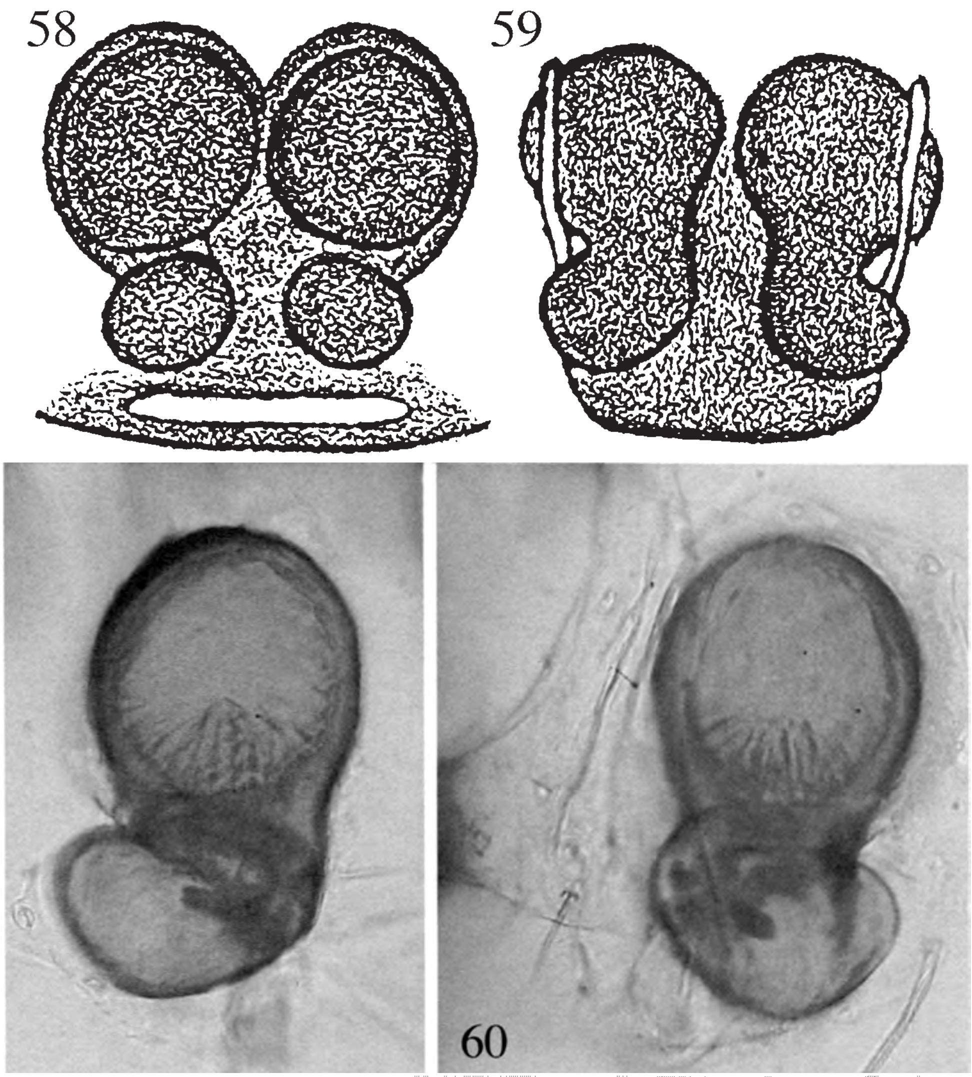
as well as the variation in the separation distance between the anterior eyes was non-significant and within the variation of this species. The differences in eye interdistances are probably related to the fact that some individuals had reduced eye sizes.

Troglophila: Although the holotype was possibly taken from the surface, this species is considered a troglophile. All specimens for which habitat data are recorded are from caves and they show reduction of eyes in some individuals. Future collections from the surface under rocks or in rock outcroppings may confirm the presence of this species outside of caves proper.

Cicurina platypus, new species
Figs. 9, 13, 16, 61, 62

Cicurina (*Cicurella*) n. sp. 2: Veni et al., 1995: 189, 347.
Cicurina (*Cicurella*) new species 2: Veni et al., 1996:185; Veni et al., 1998a:123, 210; Veni and Reddell, 1999:1, 7, 8, 24, 27, 32, 33, 44, 67, fig. 1; Veni et al., 1999:64, 123, 173; Veni et al., 2000:196; Veni, Glinn et al., 2002:165, 166, 172, 173, 238, fig. 13; Veni, Hammond et al., 2002:134, 135, 213; Veni, Reddell, and Cokendolpher, 2002:4, 9, 10, 29, 32, 36, 38, 49, 74, 124, 125, 128, 129, fig. 1.

Diagnosis.—Eyeless *Cicurella* troglobite from Stone Oak Karst Fauna Region; anterior lobe of spermathecal base rounded, posterior lobe of spermathecal base oblong, more than half size of anterior lobe, anterior lobes much closer together than posterior lobes (about third diameter of anterior lobes apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across



Figs. 58-60.—Spermathecae of *Cicurina pampa* (female holotype of *Cicurina gatita*). 58, ventral view from Gertsch, 1992: fig. 28; 59, dorsal view from Gertsch, 1992: fig. 27. 60, ventral view.

anterior/posterior lobe junction of spermathecal base, lying almost 90° to atrium, slightly wider at base.

The morphology of the spermathecae are most like that of *Cicurina russelli* Gertsch from Boyett's Cave, Hays County. These two are the only species described with rounded spermathecae that have the lobes of the spermathecal base of similar sizes (Figs. 61, 62; Gertsch, 1992: figs. 83, 84). The copulatory ducts of *C. platypus* are thicker and more tightly coiled around the spermathecal base. The spermathecal stalk of *C. russelli* extends quite a ways lateral of the anterior lobes of the spermathecal base.

Type-data.—Female holotype from Platypus Pit, Bexar County, Texas, 30 March 1995, J. R. Reddell, M. Reyes (AMNH). Female paratype MARS Pit, 29 Oct. 2001, J. Krejca, P. Sprouse (TMM).

Etymology.—The specific name is a noun in apposition; taken from the type locality Platypus Pit.

Description (holotype followed by paratype).—Female cream colored, body length 6.25 (6.2) mm. Troglobite, eyeless. Cephalothorax 2.8 (2.6) mm long, 1.95 (1.8) mm wide. Abdomen 3.45 (3.6) mm long, 2.55 (2.0) mm wide. Cheliceral retromargin with 4 (4) rounded, 3 (3) thin teeth. Leg lengths: first femur 3.1 (2.7) mm, fourth femur 2.8 (2.9) mm; first patella-tibia 3.75 (3.0) mm, fourth patella-tibia 4.0 (3.7) mm. Ventral leg spines: first tibia 2-2-0 (2-2-0), fourth tibia 0-2-1/1-2-1 (1-2-1). Internal genitalia: anterior lobe of spermathecal base rounded, posterior lobe of spermathecal base oblong, more than half size of anterior lobe, anterior lobes much closer together than posterior lobes (about third diameter of anterior lobes apart); copulatory duct looped at or slightly anterior to anterior lobe of spermathecal base; spermathecal stalk heavy procurved bar across anterior/posterior lobe junction of spermathecal base, lying almost 90° to atrium, slightly wider at base.

Distribution.—Known only from two caves on Camp Bullis (Fig. 13).

Comments.—This spider is known only from Platypus and MARS Pits located in the Camp Bullis Southeast Subregion of the Stone Oak Karst Fauna Region (Veni and Reddell, 1999; Veni, Reddell, and Cokendolpher, 2002). Platypus Pit is developed in the Kainer Formation (Edwards Limestone) within the recharge zone of the Edwards Aquifer.

The original vial containing the holotype also contained a noticeably smaller female (total length 4.35 mm) which is now part of the type series of *C. bullis*. Platypus Pit is the only cave in Bexar County known to be inhabited by two troglobitic species of *Cicurina*.

Red imported fire ants have been recorded from both known localities. Their significance was noted and efforts to eradicate or minimize the impact on the cave fauna were recommended. This and other recommendations are located in the Management Plan for Camp Bullis (Veni, Reddell, and Cokendolpher, 2002).

Cicurina venii Gertsch
Figs. 9, 13, 16, 63, 64

Cicurina n. sp. (in part): Reddell, 1988:34.

Cicurina venii Gertsch, 1992:111, figs. 95, 96; Reddell, 1993: 5, 10, 22, 46; Stanford and Shull, 1993:63328-63329; Drewy, 1994:59025; Veni, 1994:67; Johnson Linam, 1995:66, appendix I p. 86, 100; Jackman, 1997:162, 171; Platnick, 1997:648; Rappaport Clark, 1998:71855, 71856, 71858, 71860, 71866; Veni and Reddell, 1999:1; Longacre, 2000:81419-81421, 81425, 81433; Anonymous, 2001:9; Pesquera, 2001:1; Industrial Economics, Inc., 2002:3; U.S. Fish and Wildlife Service, 2002:55064, 55067, 55075, 55086; Veni, 2002: 1, 5-7, 12; Veni, Glinn et al., 2002:165, 166, 170, 172, fig. 13; Veni, Reddell, and Cokendolpher, 2002:4; U.S. Fish and Wildlife Service. 2003:17156-17158, 17175, 17176, 17190, 17191, 17193.

Diagnosis.—Eyeless *Cicurella* troglobite from Culebra Anticline Karst Fauna Region; spermathecae elongated, posterior lobe of spermathecal base much smaller in diameter distal to junction with anterior lobe, body axis lines meeting at less than 90°, axes of anterior lobes strongly curved outward mesally, anterior lobes about a radius apart distally and more than a diameter apart basally, copulatory duct looped anterior to anterior lobe of spermathecal base, spermathecal stalk not reaching beyond junction of anterior/posterior lobes of spermathecal base, straight and not turned posterolaterally.

This species belongs to a series of species with elongate spermathecae that have relatively thin connecting coils looped anterior to the anterior lobe of spermathecal base and a thick spermathecal stalk that is not greatly arched anteriorly. The Bexar County *C. madla* (Figs. 41-46) also belongs in this group as well as: *C. reddelli* Gertsch (1992: figs. 77, 78) from Travis County, *C. rainesi* Gertsch (1992: figs. 143, 144) and *C. gruta* Gertsch (1992: figs. 147, 148) from Edwards County, *C. patei* Gertsch (1992: figs. 117, 118) from Val Verde County, and *C. venefica* Gertsch (1992: figs. 129, 130) from Terrell County. The species are best told apart by examination of the shape and positions of the lobes of spermathecal base and the spermathecal stalk. In addition to details that can be seen in the various illustrations listed above, *C. venii* differs from all of these by having the spermathecal base gradually decreasing in diameter from the distal end of the anterior lobe to the distal end of the posterior lobe, without a distinct constriction in the middle. The tapering spermathecal bodies and the almost horizontal spermathecal stalk are most like those of *C. patei*.

Type-data.—Female holotype from Braken Bat Cave, Bexar County, Texas, 22 Nov. 1980, G. Veni (AMNH). Gertsch (1992) stated the specimen was to be deposited in the AMNH; where it cannot be found (Platnick, pers. comm., 1995, 1996).

Description.—Female holotype body length 3.4 mm. Troglobite, eyeless. Cephalothorax 1.7 mm long, 1.3 mm wide. Abdomen 1.7 mm long, 1 mm wide. Cheliceral retromargin with 4 or 5 teeth. Leg lengths: first femur 1.8 mm; fourth femur 2 mm; first patella-tibia 1.8 mm, fourth patella-tibia 2 mm. Ventral leg spines: first tibia 2-2-0, fourth tibia 2-2-2. Internal genitalia: spermathecae elongated, posterior lobe of spermathecal base much smaller in diameter distal to junction with anterior lobe, body axis lines meeting at less than 90°, axes of anterior lobes strongly curved outward mesally, anterior lobes about a radius apart distally and more than a diameter apart basally, copulatory duct looped anterior to anterior lobe of spermathecal base, spermathecal stalk not reaching beyond junction of anterior/posterior lobes of spermathecal base, straight and not turned posterolaterally.

Distribution.—Known only from the type locality (Fig. 12).

Comments.—The single known specimen is apparently misplaced or lost. The entrance of Braken Bat Cave was filled with rocks during construction of a home in about 1990 (Reddell, 1993) and remains so today (Veni, 1997) so new material cannot be immediately obtained. The cave is located on private property in the Culebra Anticline Karst Fauna Region. It is formed within the Austin Chalk. This species is listed as an endangered species (Longacre, 2000).

Cicurina vespera Gertsch
Figs. 9, 13, 16, 65, 66

Cicurina n. sp. (in part): Reddell, 1988:34.

Cicurina vespera Gertsch, 1992:111, figs. 93, 94; Reddell, 1993:5, 8, 10, 23, 54; Stanford and Shull, 1993:63328-63329; Drewy, 1994:59025; Veni, 1994:67; Johnson Linam, 1995:66, appendix I p. 87, 100; Jackman, 1997:162; Platnick, 1997:648; Rappaport Clark, 1998:71855, 71856, 71858, 71860, 71866; Veni and Reddell, 1999:1. Longacre, 2000:81419-81421, 81425, 81433; Anonymous, 2001:9; Pesquera, 2001:1; Industrial Economics, Inc., 2002:3; U.S. Fish and Wildlife Service, 2002:55064, 55067, 55074, 55086; Veni, 2002: 1, 5-7, 13, 14; Veni, Glinn et al., 2002:165, 166, 172, fig. 13; Veni, Reddell, and Cokendolpher, 2002:4; U.S. Fish and Wildlife Service. 2003:17157, 17158, 17176, 17190.

Diagnosis.—Eyeless *Cicurella* troglobite from Government Canyon Karst Fauna Region; spermathecae rounded; posterior lobe of spermathecal base bluntly rounded, less than half size of anterior lobe, anterior lobes much closer together than posterior lobes (about radius of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe spermathecal base; spermathecal stalk heavy straight to procurved bar across posterior lobe of spermathecal base, lying at 45° to atrium, about same width throughout.

The female genitalia are most like *C. neovespera* (see diagnosis under that species).

Type-data.—Female holotype from Government Canyon Bat Cave, Government Canyon State Natural Area, Bexar County, Texas, 11 August 1965, J. R. Reddell, J. Fish (AMNH, examined).

Description.—Female cream to light tan colored, body length 2.7 mm. Troglobite, eyeless. Cephalothorax 1 mm long, 0.45 mm wide. Abdomen 1.7 mm long, 1.2 mm wide. Cheliceral retromargin with 4 teeth. Leg lengths: first femur 0.8 mm, fourth femur 0.9 mm; first patella-tibia 0.9 mm, fourth patella-tibia 1 mm. Ventral leg spines: first and fourth tibiae 2-2-1. Internal genitalia: spermathecae rounded; posterior lobe of spermathecal base bluntly rounded, less than half size of anterior lobe, anterior lobes much closer together than posterior lobes (about radius of anterior lobe apart); copulatory duct looped at or slightly anterior to anterior lobe spermathecal base; spermathecal stalk heavy straight to procurved bar across posterior lobe of spermathecal base, lying at 45° to atrium, about same width throughout.

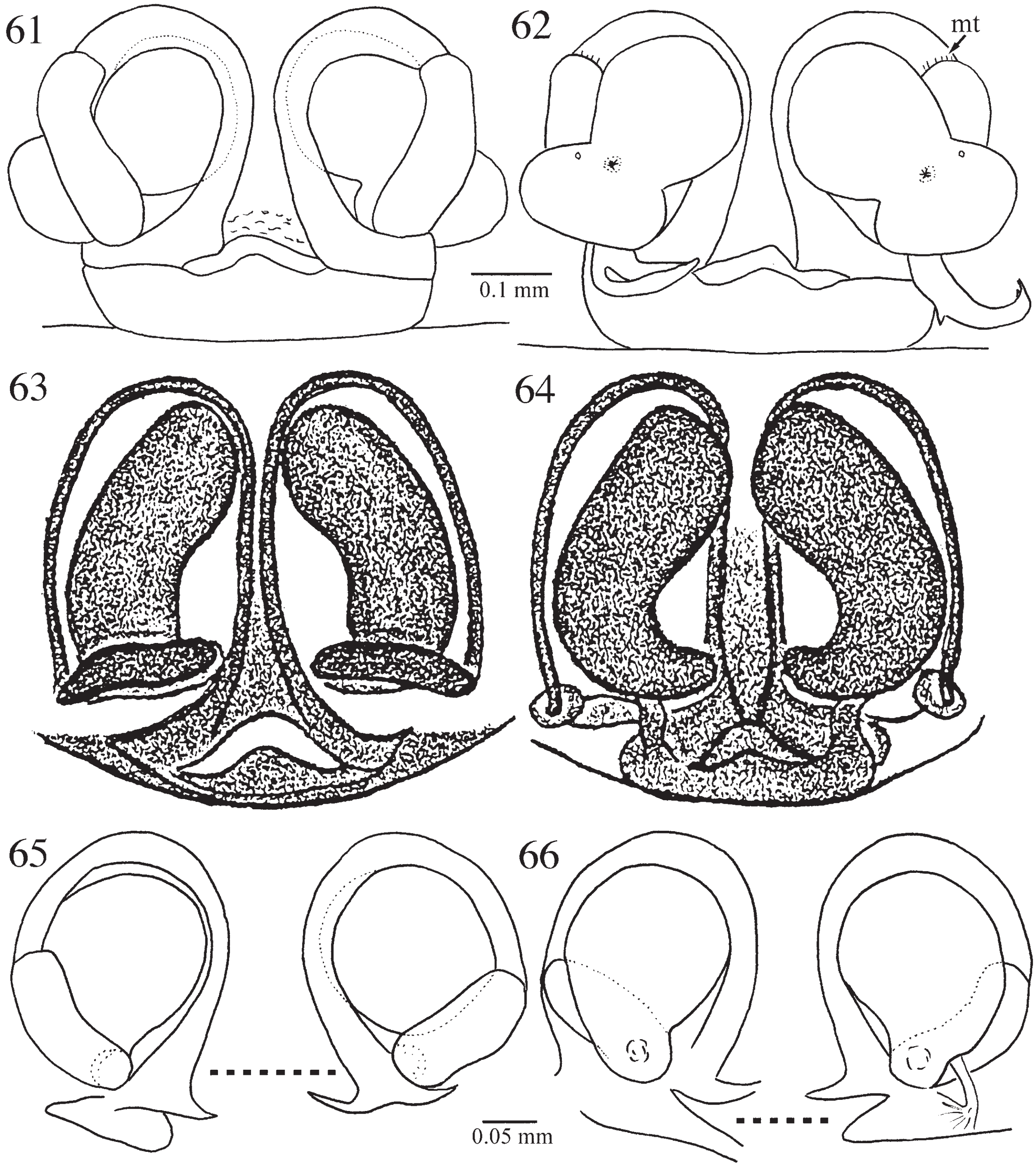
Distribution.—Known only from the type locality (Fig. 12)

Comments.—Government Canyon Bat Cave is formed within the Edwards Limestone of Government Canyon Karst Fauna Region. The type locality is located within a state natural area, but fire ants have been observed in the cave entrance (Reddell, 1993). This species is listed as an endangered species (Longacre, 2000).

Longacre (2000) reported this species from a cave 8 km northeast of Helotes. I made the misidentification reported by Longacre prior to realizing that the second specimen represented another closely related species described herein as *C. neovespera*.

Cicurina sp. maybe *bullis* or *platypus*

Comments.—A single eyeless penultimate male was collected 10 Sept. 1998 in Up the Creek Cave. It molted to maturity on 18 Nov. 1998, while lying upside-



Figs. 61-66.—Spermathecae of female *Cicurina*: *Cicurina platypus* n. sp. holotype. 61, ventral view; 62, dorsal view; mt = microtubules (see text). *Cicurina venii*, holotype. 63, ventral view, 64, dorsal view (from Gertsch, 1992: figs. 95, 96). *Cicurina vespera*, holotype (sides broken apart, orientation based on Gertsch, 1992: figs. 93, 94). 65, ventral view, 66, dorsal view.

down in its web. Because no females of eyeless taxa are known from this cave and males are not known of the other nearby species (*C. platypus*, *C. bullis*), this specimen cannot currently be identified with certainty. Comparisons to males known of troglobitic species in the region (*C. madla* and *C. baronia*) reveal the Up the Creek Cave male most closely resembles that of *C. baronia*. Because the females of *C. baronia* have rounded spermathecae (they are elongated in *C. madla*), the female of the Up the Creek Cave species probably also has rounded spermathecae. Up the Creek Cave is only about 1.2 km from Platypus Pit, where both *C. platypus* and *C. bullis* are recorded.

Cicurina spp.

Immature specimens of *Cicurina* were examined from numerous caves (Fig. 67). Because adults of

Cicurina have not yet been obtained from many of these caves the identifications of these immatures are uncertain. Even when adults are known, the identifications of immatures cannot be certain because two different eyeless species have been recorded from central Texas caves (see section on Cave Faunas). Collections from caves from which adults are known are listed below as "probably" whatever species is recorded as an adult from that cave. Further collecting and possibly rearing studies will be needed to ascertain the identity of the species. A few additional records of eyeless taxa are recorded by Gertsch (1992) and are included in the following lists.

Caves from which unidentified 8-eyed *Cicurina* sp. have been collected (all are presumably *C. varians*): 40mm Cave, Backhole, Banzai Mud Dauber Cave, Bob Wire Cave, Boneyard Pit, Bone Pile Cave, Breached Dam Cave, Bunny Hole, Canyon Ranch Shelf Cave, Caracol Creek Coon Cave, Cave With A View, Christmas Cave, Crownridge Canyon Cave, Dangerfield Cave, Dogleg Cave, Dos Viboras Cave, Eagles Nest Cave, Firing Lane 11 Cave, Government Canyon Bat Cave, Hanging Rock Cave, Haz Mat Pit, Hector's Hole, Hairy Tooth Cave, Here Today Gone Tomorrow Cave, Hold Me Back Cave, HPD Cave, Isopit Cave, John Wagner Ranch Cave No. 3, Kamikazi Cricket Cave, Karst Feature 10-75, Karst Feature 11B-1, Karst Feature 11B-57, Larsen's Pit, Lithic Ridge Cave, Logan's Cave, Low Priority Cave, Madla's Cave, MARS Pit, MARS Shaft, Pain in the Glass Cave, Peanut Sink, Ponytail Pit, Poor Boy Baculum Cave, Porcupine Squeeze Cave, Robber Baron Cave, Robber's Cave, Root Canal Cave, Root Toupee Cave, Scorpion Cave, Sink Hole, Sewer Line Karst Feature F-3, Stahl Cave, Springtail Crevice, Stien Cave, Stevens Ranch Cave No. 1, Surprise Sink, Three-Fingers Cave, Two Hit Cave, Two Raccoon Cave, World News Cave, Vera Cruz Shaft, Wurzbach Bat Cave, Young Cave No. 1.

Caves from which 6-eyed *Cicurina* sp. (presumably *C. pampa*) have been collected: Bob Wire Cave, Cross the Creek Cave, Goat Cave, Up the Creek Cave.

Cave from which long-legged 6-eyed species with evanescent eyes was reported by Reddell (1993); not examined: Mattke Cave.

Caves from which blind, eyeless *Cicurina* spp. have been collected: B-52 Cave, Backhole, Black Cat Cave, Breached Dam Cave, Bunny Hole, Cannonball Cave, Caracol Creek Coon Cave (probably *C. loftini*), Crownridge Canyon Cave, Dancing Rattler Cave, Cross the Creek Cave, Eagles Nest Cave (probably *C. bullis*), Elm Springs Cave (probably *C. neovespera*), Firing Lane 11 Cave, Genesis Cave, Government Canyon Bat Cave (probably *C. vespera*), Hackberry Sink in Government Canyon State Natural Area, Hairy Tooth Cave, Headquarters Cave (probably *C. madla*), Helotes Blowhole, Hills and Dales Pit (probably *C. madla*), Isocow Cave (probably *C. bullis*), John Wagner Ranch Cave No. 3, Kamikazi Cricket Cave, Karst Feature 8A-12 = 8A-12 Sink Dig, Lithic Ridge Cave, Logan's Cave, Lone Gunman Pit, Lost Pothole (= Lost Pot) (probably *C. madla*), Low Priority Cave, MARS Pit (probably *C. platypus*), Mattke Cave, Pain in the Glass Cave, Platypus Pit (probably *C. platypus* or *C. bullis*), Ragin' Cajun Cave,

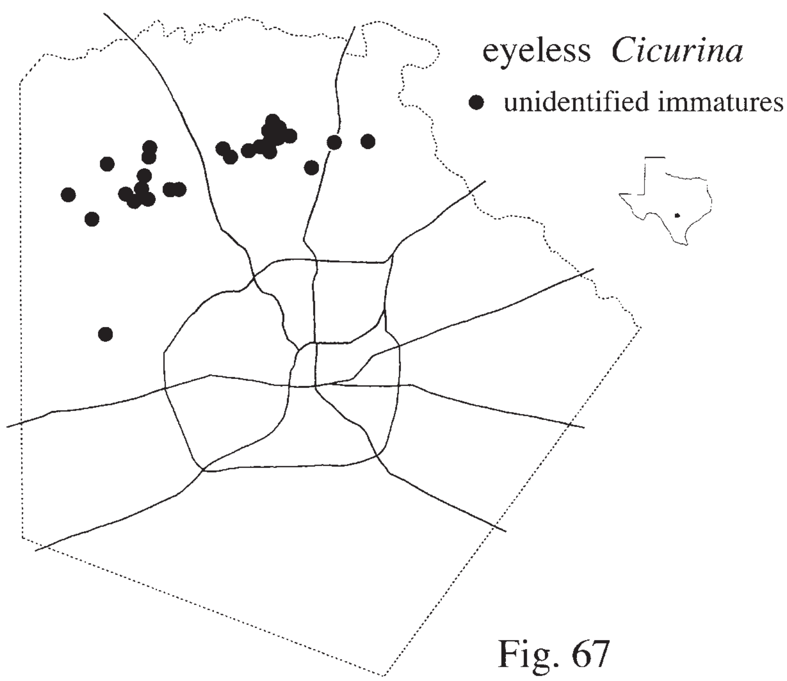


Fig. 67.—Distribution of unidentifiable immature troglobitic (eyeless) cicurinas in Bexar County.

Robber's Cave (probably *C. madla*), Root Canal Cave (probably *C. bullis*), Scorpion Cave, Surprise Sink (probably *C. vespera*), SWCA Cave sites #1 and #3, Three Fingers Cave, Up the Creek Cave (maybe *C. platypus* or *C. bullis*), Young Cave No. 1.

Comments.—The eyeless specimen from Bunny Hole (was collected immature on 10 Sept. 1998, molted on 21 Nov. 1998, and died on 25 April 1999) was unusual in that it had a dark brown to black abdomen. The animal was very small and several molts from adulthood. It is not known if the pigmentation was normal or due to some infection or other agent which caused the mortality. The pigmentation was not like the blue coloring which appears in spiders that eat the dyed fruit fly medium.

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NOTES ON TROGLOBITIC *CICURINA* (ARANEAE: DICTYNIDAE) FROM FORT HOOD, TEXAS, WITH DESCRIPTION OF ANOTHER NEW SPECIES

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ABSTRACT

Cicurina (*Cicurella*) *troglobia*, new species, is described from Seven Mile Mountain Cave on the Fort Hood Military Reservation. This is the fifth troglobitic member of the genus from this Reservation. New collection records are presented for *C. coryelli* and *C. hoodensis*.

INTRODUCTION

Cokendolpher and Reddell (2001) remarked "The immatures from Seven Mile Mountain Cave probably represent an undescribed species because this cave is geologically and geographically isolated from all other populations of eyeless *Cicurina*." Adult female specimens from that cave have now been examined and indeed represent a new species described below. New records of the troglobitic species *Cicurina coryelli* Gertsch and *Cicurina hoodensis* Cokendolpher and Reddell from Fort Hood are also provided.

Five species of troglobitic *Cicurina* (*Cicurella*) are now known from Fort Hood (Cokendolpher and Reddell, 2001; herein). It is not unusual for this subgenus to have many troglobitic species from a relatively small region. Gertsch (1992) recognized 51 *Cicurina* species from caves in central Texas; of which 46 are true eyeless troglobites. Additional undescribed species have been discovered since 1992 and the total number is expected to increase as new cavernous areas of the state are studied. Gertsch (1992) recorded one species from Fort Hood; we (Cokendolpher and Reddell, 2001 and herein) described four new species from that area. Likewise, my descriptions (Cokendolpher, 2004) of five new species from Bexar County caves more than doubled the number of troglobitic *Cicurina* reported there by Gertsch (1992).

MATERIALS AND METHODS

The description format and methods essentially follow that of Cokendolpher and Reddell (2001). The female epigynum and associated spermathecal structures were removed and examined on both covered and uncovered depression slides in lactophenol with a Nikon-SL3D microscope. The use of a 3D microscope with uncompressed samples has proved helpful in understanding the complex structures of the spermathecae. The term 'index coil' of the internal genitalia was used by Gertsch (1992) and Cokendolpher and Reddell (2001); it corresponds to the start of the 'spermathecal stalk' with primary pores demarking the end of the copulatory duct proper and position of the 'spermathecal head' as used by Bennett (1992). Bennett's terminology is followed here. Depositories are: AMNH= American Museum of Natural History, TMM= Texas Memorial Museum, Austin, TTU = Museum of Texas Tech University. The studies on the DNA of several of the specimens is unpublished. The collection/rearing data for those samples are presented here.

ACKNOWLEDGMENTS

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Cicurina (*Cicurella*) *troglobia*, new species
Figs. 1-3

Cicurina (*Cicurella*) spp., Cokendolpher and Reddell, 2001:37.

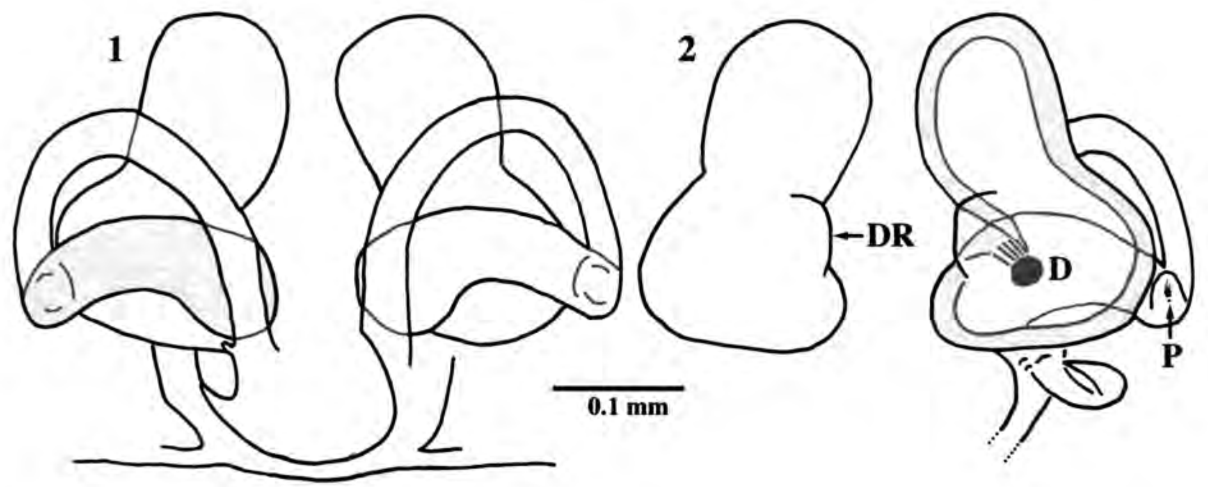
Diagnosis.—Eyeless troglobite from Seven Mile Mountain Cave. Internal genitalia with spermathecal stalk (index coil) lying at or posterior to the midline of spermathecal base; stalk narrowed at base, gradually widening distally; anterior-most arch of copulatory duct placed slightly anterior to midpoint of anterior lobe of the spermathecal base; distal end of copulatory duct (at junction with spermathecal stalk) extended ventrally as short lobe with 4-6 primary pores; spermathecal base in dorsal view with diaphanous ridge at mesal junction of spermathecal bodies.

In the key to Fort Hood *Cicurina* (Cokendolpher and Reddell, 2001), the new species keys to *C. coryelli* because of the short copulatory duct that crosses over the midline of the spermathecal base. The short lobe at the junction of the copulatory duct and spermathecal stalk is present in the new species and absent in *C. coryelli*. In this latter species, the copulatory duct loops more dorsal and bends ventrally to attach to the dorsal surface of the spermathecal stalk. The two species also differ in the shapes of the spermathecae (broader connection between spermathecal bodies in *C. troglobia*, more slender connection in *C. coryelli*).

Etymology.—The specific name is taken from the Greek *trogl-* meaning cave, and *bios* meaning life.

Type-data.—Texas: Bell County: Seven Mile Mountain Cave, 28 June 2000 (J. Reddell, M. Reyes), molted in captivity 2 Oct. 2000, molted to maturity 14 July 2001, female holotype (AMNH), right legs removed for DNA studies. 28 June 2000 (J. Reddell, M. Reyes), molted in captivity 20 Nov. 2000, 17 March 2001, 25 Nov. 2002, matured 25 Aug. 2003), female paratype epigynum in 70% ethanol, body frozen at -80°C (TTU), 4 legs preserved for DNA.

Other records.— Seven Mile Mountain Cave, 11 April 1999 (R. Price, M. Warton), 1 immature (TMM); 28 June 2000 (J. Reddell, M. Reyes), 1 ?immature (abdomen missing) (TMM), 1 immature (died 3 Sept. 2000, not preserved), 1 immature (molted in captivity 2 Sept. 2000, 3 Feb. 2001, 20 Sept. 2002, died 26 March 2003, preserved



Figs. 1-2.—Cleared genitalia of female holotype of *Cicurina troglobia*, new species, from Seven Mile Mountain Cave: 1, ventral view; 2, dorsal view. Shading on dorsal view showing thick walls of spermathecal bodies, shading on ventral view showing right spermathecal stalk; D = 'dictynoid' pore, DR = diaphanous ridge, P = primary pores.

for DNA studies); 30 Nov. 2002 (M. Reyes, M. Warton), 2 immatures (TMM).

Description.—Female holotype straw-colored, troglobite, eyeless. Cephalothorax 2.15 mm long, 1.5 mm wide. Abdomen 2.85 mm long, 1.6 mm wide. Cheliceral retromargin with 7/7 teeth. Legs: F I - 1.9 mm, F IV - 2.15 mm; P-T I - 2.4 mm, P-T IV - 2.65 mm. Ventral leg macrosetae: T I - 2-2-2, T IV - 2-2-2. Epigynum (Fig. 3): thinly sclerotized without distinct borders except at posterior edge; atrium thin and pointed anteriorly; chitin around atrium thickened posteriorly; internally genitalia visible through chitin. Vulva (Figs. 1-2): spermathecae with spermathecal stalk lying across midline of spermathecal base, arched anteriorly, narrowed at base, gradually widening distally; anterior-most arch of each copulatory duct placed slightly anterior to midpoint of spermathecal base; basal end of spermathecal stalk strongly bent dorsally with copulatory ducts looping dorsally lateral to spermathecae, then ventrally below spermathecae; distal end of copulatory duct (at junction with spermathecal stalk) extended ventrally as short lobe with 4-6 primary pores (each with a small microduct); spermathecae in dorsal view with diaphanous ridge at mesal junction of spermathecal bodies (Fig. 2).

Variation: Female paratype cephalothorax 2.5 mm long, 1.7 mm wide. Abdomen 2.8 mm long, 1.95 mm wide. Legs: F I - 1.9 mm, F IV - 2.2 mm; T I - 1.7 mm, T IV - 1.9 mm. Like holotype, except spermathecal stalk flipped over so that it is arched posteriorly in the midline.

Distribution.—Known only from the type locality.

Comments.—The posteriorly arching spermathecal stalk of the paratype looks like that of *C. coryelli*. It is uncertain if this is natural or possibly a result of extracting the genitalia from a living animal and then placing it in alcohol (all other genitalia were fixed *in situ*). Because the lobe with primary pores was present and also rotated some laterally, it suggest that this might not be the natural condition. Sequencing of the DNA of this animal should be informative.

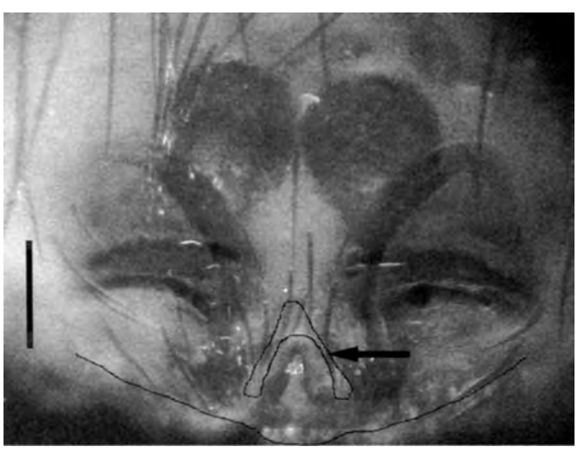


Fig. 3.— Epigynum of female holotype of *Cicurina troglobia*, new species, from Seven Mile Mountain Cave: Ventral view. Arrow indicates placement of atrium, scale = 0.1 mm.

These spiders may go for many months between molts. The time from egg to adult is unknown but may be greater than three years in captivity. Immatures have been held in captivity for three years before maturing after 4 molts. In captivity, these spiders readily capture and eat living fruitflies, immature domestic crickets, small moths, and small whiteworms (*Enchytraeus albidus* Henle). When the spiders are smaller they eat mites and collembolans but appear to prefer larger prey when older.

Cicurina (*Cicurella*) *coryelli* Gertsch

Comments.—The second known female (first being recorded by Cokendolpher and Reddell, 2001) from Egypt Cave was collected 7 April 1999 (molted 30 Oct. 1999, 3 Sept. 2000, 15 April 2001, 20 Sept. 2002, 25 Nov. 2002), J. Reddell, M. Reyes (deposited TTU, 4 legs removed for DNA studies).

The external features and spermathecae do not differ significantly from that described for the species. The anterior-most arch of copulatory duct is higher than that illustrated by Cokendolpher and Reddell (2001), but does not reach the top of the spermathecae like *C. caliga*. The anterior-most point of the duct reaches almost 3/4 the length of the spermathecae.

Cicurina (*Cicurella*) *hoodensis*
Cokendolpher and Reddell

Comments.—Three females from the type locality (Buchanan Cave, Ft. Hood, Bell County, Texas): collected on 13 June 2000 (J. Reddell and M. Reyes) and 4 legs from each removed for DNA studies: specimen 1, deposited TTU, molted to adulthood in captivity on 29 Oct. 2001; specimen 2, deposited TMM, molted 18 Sept. 2000, no molts in 2001, molted 20 Sept. 2002, matured 25 Nov 2002; specimen 3, deposited TTU, collected 4 Nov. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes) molted 28 Jan. 1999, 10 May 2000, 22 Feb. 2001, 20 Sept. 2002, matured 20 Jan. 2003.

The external features of these specimens do not differ significantly from the published description/illustration (Cokendolpher and Reddell, 2001). The internal genitalia of specimens 1 and 3 also are very similar. Spermathecal stalk of specimen 2 is not as strongly arched, but still is not straight as in *C. caliga*. Specimen 2 was collected in the upper level of the cave (similar information not recorded for specimens 1 and 3). Specimen 3 reached maturity after molting five times in a period of over four years in captivity. As observed with the eight previous females reared to maturity in captivity (Cokendolpher and Reddell, 2001), these three specimens matured during later summer to winter.

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A NEW *NEOLEPTONETA* SPIDER FROM A CAVE AT CAMP BULLIS, BEXAR COUNTY, TEXAS (ARANEAE: LEPTONETIDAE)

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ABSTRACT

A new species of *Neoleptoneta* is described and illustrated from caves in Bexar County, Texas, U.S.A. Some notes on its biology are presented with photographs of the egg sacs.

INTRODUCTION

Leptonetids are minute, web-building spiders restricted to subterranean and litter habitats around the world. Most species are known from caves. Two of these troglobitic species are currently listed as U.S.A. federally protected endangered species (Longacre, 2000). Members of this family are restricted to the northern Hemisphere in three disjunct areas: U.S.A. to Panama, Mediterranean region, and southeast Asia. Two subfamilies are recognized with about 150 species. The Nearctic fauna is currently recognized as consisting of four genera and 45 species. *Neoleptoneta* Brignoli is recorded (Gertsch, 1974; Brignoli, 1983; Cokendolpher and Reddell, 2001) from scattered localities from Georgia to Arizona in the U.S.A. and from Nuevo León and Tamaulipas to Oaxaca in Mexico. Almost half of the described 28 species of *Neoleptoneta* are known from Texas. Because of their minute size and uniform general morphology, characters for separating species are difficult to detect and examine. Looking at the variation in general morphology of larger series from single caves in Texas has convinced me that some of the "diagnostic" characters used by Gertsch (1974) in his revision are not valid. This does not mean that his species are invalid, but rather that these characters upon which he placed "weight" are not that useable. Also, as noted by Brignoli (1977) and myself, this problem is compounded by the fact that Gertsch's illustrations are not sufficiently detailed. Females are proving to be quite difficult to distinguish by traditional methods and Gertsch based several of his species solely on females. As noted by Joel Ledford (in press), information is there but it must be gathered using specialized techniques, i.e., trypsin digestion, Coddington style slide mounts, 3-D imaging, etc.

The purpose of this contribution is to describe a new species of *Neoleptoneta* from caves at Camp Bullis, which is known by both males and females. Some notes on biology are also provided as well as the first description of the egg-sac for this genus.

MATERIALS AND METHODS

The depositories for the specimens are: American Museum of Natural History (AMNH); California Academy of Sciences (CAS); Jeffrey Shultz Collection, University of Maryland (JSC); Texas Memorial Museum (TMM); Museum of Texas Tech University (TTU).

Examination of *Neoleptoneta* proved a challenge. The specimens are small, delicate and easily damaged. It is very important to correctly position the pedipalp when viewing it. A slight rotation can make it appear to be quite different. It is best to rotate the pedipalps from side to side while looking for the diagnostic details. The male pedipalps were generally removed and placed in glycerin on a depression slide for viewing. The female genitalia were examined while they were immersed in lactophenol. In some cases the entire animal was soaked in lactophenol to reveal the orientation of the undisturbed spermathecae. On other specimens the genitalia were removed and examined on slides. In such cases, the coverslips over the genitalia are supported so that it would not distort the natural morphology of the genitalia, especially the position of the spermathecae in respect to each other. Care should be used in exposing the entire animals to clearing solutions like lactophenol because the pigment in/around the eyes (a diagnostic character) is quickly destroyed.

RESULTS AND DISCUSSION

Gertsch (1974) used number and sizes of eyes as an important taxonomic character. But, he was inconsistent in his descriptions and illustrations of Texas *Neoleptoneta*. The eyes of *N. coeca* were described as small, those of *N. concinna* as medium, and *N. uvaldea* as average. Yet all appear the same in his drawings. Checking fresh material of the former two also revealed that they are essentially the same "average size." In an examination of *Neoleptoneta* specimens from various localities in Bexar and adjoining Comal Counties, most specimens have "average sized" eyes. Like *N. concinna*, *N. coeca*, and *N. valverde*, the front row of eyes (posterior lateral eyes + anterior lateral eyes; anterior median eyes missing) is strongly recurved, eyes subequal and contiguous; posterior median eyes contiguous, slightly smaller than eyes in front row, separated from posterior lateral eyes by about 1-1.5 diameters of lateral eye (see Gertsch, 1974: figs. 50, 52, 57). In all of the Bexar and Comal counties specimens examined, except those from Government Canyon Bat Cave (type locality for *N. microps*) and one from the nearby Surprise Sink, the eyes are lightly pigmented and opalescent/reflective with the eyes being narrowly ringed with black. A single female from Surprise Sink has no pigment in or around the eyes. Possibly the female was damaged during examinations. I drew the female genitalia a few years before I realized that lactophenol could destroy the eye pigment and I did not note whether the entire animal was soaked in this solution. Long term storage in ethanol also removes pigment. Joel Ledford (pers. comm., 2003) also found a lot of intraspecific variation with this character in his study of *Calileptoneta*. Two subsequent expeditions to this cave resulted only in the capture of five adults with pigmented eyes. The four known specimens from Government Canyon Bat Cave all have the eyes slightly reduced in size and the eyes and surrounding areas are unpigmented. One female of the new species described below was missing the right posterior eye, but the left was present and normally pigmented. Preliminary studies do not reveal any differences besides the eyes of *N. microps* and congeneric individuals from other nearby caves. The only known male from Surprise Sink is one with pigment around the eyes and no males are known from Government Canyon Bat Cave. Until a male can be collected from Government Canyon Bat Cave (*N. microps*), it is not possible to determine for certain if this species is the same as the pigmented populations in Surprise Sink and caves further east in Bexar County. As noted above the female genitalia do not differ significantly. These specimens from central and western Bexar County have eyes similar to the species described below but differ noticeably in the morphology of the male pedipalp and cheliceral dentition.

Thus far, the only species of *Neoleptoneta* from Texas with the pedipalp illustrated in any detail is that of *N. paraconcinna* Cokendolpher and Reddell (2001). So many details were not mentioned by Gertsch (1974) that it is difficult to recognize described Texas species without examination of topotypes. A new revision of this genus is needed, especially in the central Texas area where two species are currently listed as federally protected endangered species (Longacre, 2000). The new species is very restricted in distribution, but as long as the conservation efforts at Camp Bullis continue it should remain safe from extinction.

Neoleptoneta Brignoli

Diagnosis.—Eyeless or 6-eyed (lacking anterior median eyes). With retrodorsal spur-bearing apophysis on the male palpal tibia; without prolateral lobe on the male palpal tarsus. Legs with patellar, without tibal, integumentary glands; glands elongated to triangular without a longitudinal median ridge, gland pores small and located near edge of gland. From Arizona east to Georgia, U.S.A., and south to Oaxaca, Mexico.

Neoleptoneta spp.

Comments.—Members of *Neoleptoneta* are known from three caves on Camp Bullis. Those from Up the Creek Cave (south-central Camp Bullis) are described herein as a new species. The single female known from Cross the Creek Cave, (31 March 1995, J. Reddell, M. Reyes, TMM) differs from the new species in the number of cheliceral teeth (seven promarginal teeth) but otherwise appears similar. Up the Creek and Cross the Creek Caves are only slightly over 1.5 miles apart. More material is needed, especially a male, to properly place the Cross the Creek Cave population. The setae on the cephalothorax next to the eyes are broken off so it is not possible to determine if they are straight or curved. A single male known from western Camp Bullis (Constant Sorrow Cave, 6 March 2001, G. Veni, TMM) differs from the new species by having seven promarginal teeth, having the setae next to the posterior median eyes straight (at least the seta on right side was before it was accidentally detached while examining the pedipalps), and by differences in the pedipalps. The male from Constant Sorrow Cave has the tibial spur on an elongated tubercle and the tarsus lacks a retrolateral enlargement or lobe.

Neoleptoneta bullis, new species
Figs. 1-9

Diagnosis.—Pale cavernicole from northeastern Bexar County caves; eyes present, relatively large, subcontiguous to touching in front row; posterior median eyes separated from anterior lateral eyes by 1-1.5 diameters of eyes; some surrounding cuticle with dark pigment; promargin of chelicerae with eight teeth, retromargin with three teeth; tibia of male pedipalp with retrolateral apophysis bearing a spur and five overlapping flattened setae that are finely pointed; pedipalpal bulb with single retrolateral apophysis ventrally and bluntly rounded embolus; tarsus not curved, with retrolateral enlargement distally; bulb of seminal receptacle medium sized without loop in copulatory duct; first leg of male 5.2 times, of female 4.8 times as long as cephalothorax.

In Gertsch's key (1974) to the species of *Neoleptoneta* from Texas, the new species will almost key to *N. coeca* for males and will not work for females [couplet 5: has legs eight times longer than cephalothorax, but femur I is only 1.4 (should be at least 1.8 to match couplet) times as long as cephalothorax]. *Neoleptoneta bullis* shares with *N. myopica* the presence of 8 promarginal teeth on the chelicerae. These two also share the fact that they are the longest-legged species with pigmented eyes, but this seems to be more of a convergence due to habitat than to close phylogenetic relationship. The male pedipalps are quite dissimilar and suggest that these are not each other's nearest relative. The male pedipalp is most like that of *N. coeca*, but that species differs from *N. bullis* by having the spur somewhat shorter and only slightly enlarged at the base, the seven setae overlapping the spur are little if any different from the other setae on the tibiae (not noticeably flattened or widened).

Etymology.—The specific name is a noun in apposition taken from the type locality, Camp Bullis.

Type Specimens.—Texas: Bexar County: Camp Bullis: Up the Creek Cave, 30 March 1995, J. Reddell, M. Reyes, 4 female paratypes (TMM); 5 Oct. 1995, J. Reddell, M. Reyes, 1 male, 1 female paratypes (CAS), 1 male, 3 female paratypes (eye pigment of one female cleared with lactophenol; TMM); 1 male, 1 female paratypes (AMNH); 14 Nov. 1995, J. C. Cokendolpher, J. R. Reddell, M. Reyes, 1 female allotype (AMNH), 1 male paratype (TTU); 10 Sept. 1998, J. C. Cokendolpher,

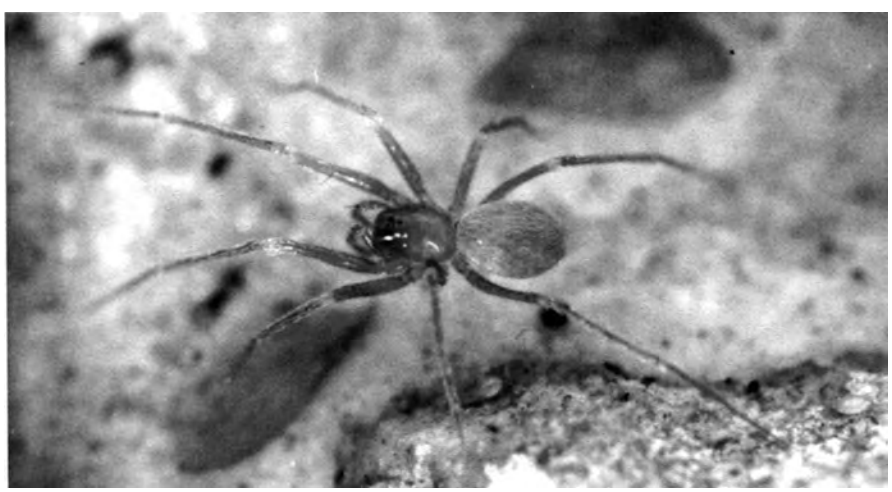


Fig. 1.—Dorsal aspect of female *Neoleptoneta bullis*, new species, from Up the Creek Cave.

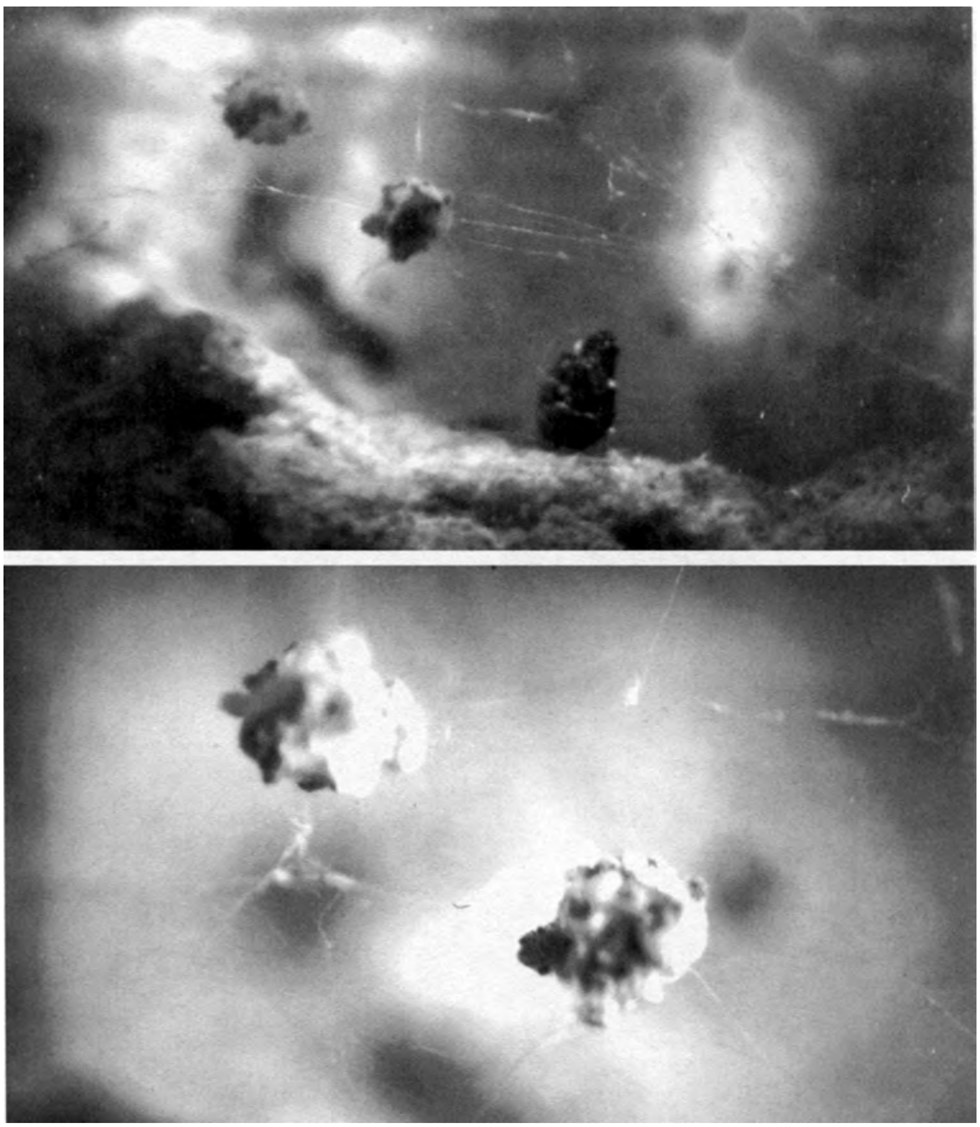
Figs. 2-7.—Male holotype of *Neoleptoneta bullis*, new species, from Up the Creek Cave: 2, eyes and front of cephalothorax; 3, retrolateral view of pedipalp; 4, enlarged retrolateral view of retrolateral spur; 5, enlarged retrolateral view of flattened spines which overlap the retrolateral spur; 6, dorsal view of pedipalpal tibia and tarsus; 7, enlarged retrolateral view of pedipalpal embolus.

J. Krejca, J. R. Reddell, M. Reyes, 1 female paratype (laid 3 egg sacs on or near 24 Sept., preserved 4 Oct. 1998, TTU), 1 male holotype (preserved 4 Oct. 1998, AMNH), 1 male paratype (preserved 4 Oct. 1998, TMM), 1 male paratype (molted in captivity 26 Sept., preserved 4 Oct. 1998, TMM); 16 Jan. 2002, J. Krejca, T. Engelhard, T. Schumann, 1 female paratype (TMM).

Additional material.—TEXAS: Bexar Co., Camp Bullis, Up the Creek Cave, 14 Nov. 1995 J. C. Cokendolpher, J. R. Reddell, M. Reyes (preserved in 100% ethanol for DNA study 1996, JSC); 30 March 1995, J. Reddell, M. Reyes, 1 immature (TMM); 5 Oct. 1995, J. Reddell, M. Reyes, 4 immatures (TMM).

Distribution.—This species is known with certainty only from a single cave on Camp Bullis. A single female known from a nearby cave possibly belongs to this species but cannot be verified until further material is collected (see under "*Neoleptoneta* spp." above.

Description.—Cephalothorax and appendages dusky yellow to creamy brown, abdomen creamy yellow without markings (Fig. 1). In life, coxae to tibae of all legs (male and female) and all segments of female pedipalp iridescent. Promargin of chelicerae with 8 teeth, retromargin with three teeth. Four to six (males), 12-16 (females) short setae on anterior edge of cephalothorax; pair of setae lateral to posterior eyes distinctly curved



Figs. 8-9.—Egg sacs of *Neoleptoneta bullis*, new species, from Up the Creek Cave: 8, two egg sacs suspended from center of web; 9, enlarged view of egg sacs showing covering of debris.

distally (more so on males); row of four (males), three (females; 2nd from anterior end missing) setae behind eyes (Fig. 2). Eyes relatively large; anterior row (posterior lateral eyes + anterior lateral eyes: anterior median eyes missing) strongly recurved, subequal in size; posterior median eyes slightly smaller than anterior row eyes, contiguous; anterior lateral eyes separated by less than half diameter of eye, posterior eyes contiguous, separated from posterior laterals by about 1.5 diameter of lateral eye; dark pigment between eyes; some individuals with more or less pigment between posterior eyes than illustrated (Fig. 2). One female missing the right posterior median eye, left eye present, normally pigmented. Series of small semicircular raised areas behind anterior row of eyes (Fig. 2; appearing similar to those illustrated by Platnick, 1994: fig. 1 for *Archoleptoneta*). Leg formula 1423.

Male (holotype): Cephalothorax 0.74 mm long, 0.58 mm wide; abdomen 0.96 mm long, 0.66 mm wide. Femora I-IV lengths (in mm): 1.12, 0.92, 0.76, 1.02; patella + tibia I, II: 1.36, 1.08. Legs relatively long, thin; femur I 7.47 times longer than maximum width; leg I (excluding coxa + trochanter) 3.84 mm long, leg IV 3.44 mm long.

Pedipalp with lyriform sensilla on both lateral and retrolateral sides of femur and patella (Fig. 3); tibia with retrolateral spur on small tibial apophysis; spur about 1/2 length of tarsus; with ridges running most of length of spur, not twisted (Fig. 4); spur overlain by series of five, smooth, sharply pointed, flattened, only slightly twisted setae (Fig. 5); tibia dorsally with three trichobothria (Figs. 3, 6); tarsus with relatively deep transverse groove in apical part, retrolateral side with group of short stout setae distal to groove and very thin, short setae starting at groove and extending basally (Fig. 3), setae of tarsus finely serrated; tarsus with retrolateral enlargement distally; bulb with single smooth apophysis on retrolateral side near ventral border (Fig. 3); embolus wide, bluntly rounded at tip (Fig. 7).

Female (allotype): Cephalothorax 0.68 mm long, 0.52 mm wide; abdomen 0.92 mm long, 0.66 mm wide). Femora I-IV lengths (in mm): 0.96, 0.80, 0.64, 0.94; patella + tibia I, II: 1.16, 0.95. Legs relatively long and thin; femur I 8.0 times longer than maximum width; leg I (excluding coxa + trochanter) 3.26 mm long; leg IV 3.24 mm long.

Genitalia: Seminal receptacles relatively large; bulb directed slightly to strongly posteriorly, covered with many minute pores; spermathecal duct without coil; long thin sclerotized plate (or flattened duct?) attached at junction of the copulatory and spermathecal ducts, posterior edge covered with minute pores.

Comments.—From incidental laboratory studies of two females from Up the Creek Cave, it was revealed that animals which were collected as adults of unknown age could remain alive beyond one year and to carry sperm for an extended period (detailed records not kept, but many months). Unlike other Texas cave spiders (and spiders in general), *N. bullis* lay a single egg per sac. The first female kept captive only produced two eggs on or near 13 May 1996. Another female laid three egg sacs on or near 24 Sept. 1998. The egg sacs are about 0.8-1 mm in diameter and are covered with debris (Figs. 8, 9). The sacs are suspended from near the center of the small web. Unfortunately, data were not obtained on the time intervals and numbers of molts of the immatures but the time in culture from egg to adult female is about a year. A male, female and their young can all live peacefully together in a small container (plastic box 10.5 X10.5 X 4 cm filled about half full of moist plaster of Paris) in the laboratory. Their webs can be touching but each tends to stay in its own area. The container also housed a few mites, collembola and some fungi growing on small pieces of organic matter. The spiders were never observed to feed, so it is uncertain what they were eating.

Fage (1913) remarked, about European species, that the number of eggs contained in each sac is always very small (2-6 eggs), but that it seemed to decrease with an increase in the degree of troglomorphy of the species. He also noted that as egg numbers decreased the mass of each egg increased, resulting in more robust young leaving the egg. Machado and Ribera (1986) reported observations on captive egg laying in three specimens of a leptonetid species native to caves in Portugal. One female laid a single egg in a finely woven egg sac that was transparent. The other two females covered the sac with sand grains; one female laid two eggs, one laid three eggs per sac. Machado and Ribera (1986) also reported that a female lived in a moist tube without food for nine months.

The 3rd leg metatarsus of both sexes has a transverse row of approximately 8-10 fine setae basoventrally. I am unable to locate mention of this preening comb in the older literature. It is also present on other *Neoleptoneta* from Bexar County as well as *Appaleptoneta* spp. I have seen. Ledford (in press) also reported it from *Calileptoneta* spp. It might be a unique character for the family.

ACKNOWLEDGMENTS

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REDISCOVERY OF *EPERIGONE ALBULA* IN CENTRAL TEXAS CAVES (ARACHNIDA: ARANEAE: LINYPHIIDAE)

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ABSTRACT

The tiny *Eperigone albula* spider has been rediscovered in leaf and other organic litter from caves. The many new records are from seven counties in central Texas. The female internal genitalia are illustrated for the first time.

INTRODUCTION

Zorsch and Crosby (1934) described *Eperigone albula* from one male and five females that were obtained by Berlese funnel extraction from Tallulah, Madison Parish, Louisiana, in 1933. No subsequent records have been attributed to this species until now. Because Tallulah is in the far northeastern section of Louisiana, it is surprising but not impossible to have rediscovered the species in caves of central Texas. This spider appears to be abundant in the leaf litter which collects in the entrances of central Texas caves. Because of its small size (about 1 mm), it is likely that collectors have overlooked this species in the past. New collections by Berlese funnel extractions of leaf litter from ravines and rock crevices from eastern Texas and northern Louisiana should be interesting, to see if this tiny species is also present in the regions between the known records.

TAXONOMY

Eperigone albula Zorsch and Crosby

Eperigone albula Zorsch and Crosby, 1934:245-246, fig. 1A-D; Millidge, 1987: 2-3; Buckle et al., 2001:113.
Eperigone new species: Cokendolpher and Reddell, 2001:50.

Description.—The description by Zorsch and Crosby is adequate for recognition of this species. The drawings (Zorsch and Crosby, 1934:fig, 1A-D) are detailed and agree with the new material. Because the internal genitalia of the female has not previously been illustrated, it is shown in Fig. 1. These internal parts are much more darkly pigmented than illustrated by Zorsch and Crosby (1934:Fig. 1D) and are easily seen on uncleared specimens.

Comments.—Millidge (1987) excluded this species from *Eperigone* based on the genitalia. He did not provide details, just that it was different. We propose that *E. albula* belongs to the group of species currently placed in *Eperigone* that includes females with broad, posteriorly truncated epigynal plates that are not split [e.g., *E. index* (Emerton) and *E. entomologica* (Emerton)]. Whether this group actually belongs in *Eperigone* or *Erigone* is uncertain at this time. "*Eulaira*" *suspecta* Gertsch and Mulaik (1936: fig. 3) has a similar epigynal plate, but the internal structures differ as do the male palps. Chamberlin & Ivie (1935) considered the placement of *suspecta* in *Eulaira* dubious, but did not offer another combination. Cokendolpher and Reddell (2001) stated that "This is an undescribed species known from many caves in Central Texas. It is related to "*Eulaira*" *suspecta* Gertsch and Mulaik, which is known from a cave in Val Verde County" [Texas].

Records.—TEXAS: *Bell County*: Big Crevice, Fort Hood, 13 May 1999 (J. Reddell, M. Reyes), 5 females; 14 June 2000 (J. Reddell, M. Reyes), 1 female; Figure 8 Cave, Fort Hood, 20 April 1998 (L. J. Graves, J. Reddell, M. Reyes), 1 male; Fools Cave, Fort Hood, 1 April 1999 (J. Reddell, M. Reyes), 1 female; Hidden Pit Cave, Fort Hood, 18 Aug. 2003 (C. Pekins, J. Reddell, M. Reyes), 1 female; Keilman Cave, Fort Hood, 26 Sept. 1997 (J. Reddell), 1 female, 9 immatures; 23 April 1998 (J. Reddell, M. Reyes), 2 males, 5 females, 1 immature; Peep in the Deep Cave, Fort Hood, 8 May 1998 (J. Reddell, M. Reyes), 1 female, 1 immature; Poison Ivy Pit, Fort Hood, 2 Dec. 2002 (M. Reyes), 2 males, 1 female, 1 immature; Price Pit, Fort Hood, 6 May 1999 (J. Reddell, M. Reyes), 2 females, 3 immatures; Soldiers Cave, Fort Hood, 25 March 1999 (J. Reddell, M. Reyes), 1 male, 2 immatures; Viper Den Cave, Tumble Down Entrance, Fort Hood, 13 Jan. 1995 (M. Warton), 1 male.

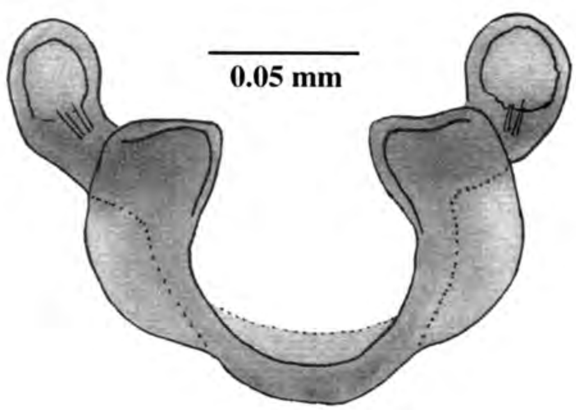

Fig. 1. Ventral view of internal genitalia: female *Eperigone albula* from 3-Holer Cave, Travis County, Texas.

Bexar County: Bob Wire Cave, 8.4 miles NW Helotes, 5 Aug. 1994 (A. G. Grubbs), 1 male, 1 immature; Cave No. 194, 4.5 miles NE Helotes, 14 Oct. 1995 (A. G. Grubbs), 1 male (in Cokendolpher collection); Eagles Nest Cave, Camp Bullis, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 female; 20 April 1999 (J. Reddell, M. Reyes), 1 male, 21 females, 21 immatures (1 male, 3 females in Cokendolpher collection); Elm Water Hole Cave, 10-11 May 2000 (M. Reyes), 2 females; Leon Hill Cave, Camp Bullis, 24 May 2003 (J. Reddell, M. Reyes), 1 female; Record Fire 1 Pit, Camp Bullis, 18 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 female; Toad Cave, no date (A. G. Grubbs), 1 male; Up the Creek Cave, Camp Bullis, 22 April 1999 (J. Reddell, M. Reyes), 1 male.

Comal County: Washington Cave, Camp Bullis, 21 Nov. 1996 (J. Reddell, M. Reyes), 1 female.

Coryell County: B. R.'s Secret Cave, Fort Hood, 9 Feb. 1992 (J. Reddell, M. Reyes), 1 female; Copperhead Sink No. 2, Fort Hood, 20 Feb. 1999 (J. Reddell, M. Reyes), 1 female; Porter Cave, Fort Hood, 8 April 1999 (J. Reddell, M. Reyes), 2 females.

Hays County: Wimberly Bat Cave, 8 Feb. 1987 (W. R. Elliott), 1 female.

Travis County: 3-Holer Cave, 1 May 1992 (J. Reddell, M. Reyes), 2 females, 6 immatures; District Park Cave, 19 Jan. 1991 (J. Reddell, M. Reyes), 1 female, 1 immature; Moss Pit, 5 March 1991 (J. Reddell, M. Reyes), 1 male; No Rent Cave, 11 June 1990 (J. Reddell, M. Reyes), 1 male, 3 females; Wade Sink, 7 Feb. 1991 (J. Reddell, M. Reyes), 1 female.

Williamson County: Avery Ranch Cave, March 1994 (M. Warton), 1 female; Beck Crevice Cave, 3 June 1996 (J. Reddell, M. Reyes), 1 female; Beck Horse Cave, 15 May 1996 (J. Reddell, M. Reyes), 1 female; 29 May 1996 (J. Reddell, M. Reyes), 1 male, 4 females, 3 immatures; Core Barrel Cave, 4 June 1991 (J. Reddell, M. Reyes), 2 females; Lobo's Lair, 1 Sept 1991 (W. Elliott, J. Reddell, M. Reyes, M. Warton), 2 males, 7 females, several immatures (in Buckle collection); 13 Sept. 1991 (J. Reddell, M. Reyes), 2 males, 5 females, 16 immatures; Susana Cave, 7 March 1991 (J. Reddell, M. Reyes), 1 male; Testudo Cave, 29 May 1991 (J. Reddell, M. Reyes), 3 males, 2 females, 21 immatures; Texella Cave Karst Park, 5 mi. NNE Georgetown, 14 Sept. 1995 (A. G. Grubbs), 1 female; Venturi Cave, March 1994 (M. Warton), 1 male.

Notes.—All of the new records, except possibly that from Texella Cave Karst Park, are from caves. Because a specific cave is not listed on the label from the Karst Park, it is likely that it was collected on the surface relatively close to a cave entrance. Litter was listed for all of the collections for which habitat or collection methods were recorded. Almost all of the collections were obtained by Berlese funnel extractions.

Eperigone albula is easily recognized when found in samples from caves because it is the smallest spider with eight eyes and short legs from Texas caves. The female genitalia are very darkly pigmented and easily seen with lower magnification of a dissecting microscope, making identifications certain.

ACKNOWLEDGMENTS

We thank James Reddell, Texas Memorial Museum, for providing the rich collections which resulted in so many new records of *Eperigone albula* and for allowing us to retain a few specimens in each of our reference collections. Unless indicated otherwise, all specimens are housed in the Texas Memorial Museum. Norman Horner, Midwestern State University, and Allen Dean, Texas A&M University, are thanked for their helpful comments on the manuscript.

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THE CAVE SPIDERS (ARANEAE) OF BEXAR AND COMAL COUNTIES, TEXAS

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ABSTRACT

All records are included for all spiders known from caves and sinks in Bexar and Comal counties, Texas. The fauna includes at least 64 species, including 17 possible troglobites: *Cicurina baronia, C. brunsi, C. bullis, C. joya, C. loftini, C. madla, C. neovespera, C. platypus, C. puentecilla, C. reclusa, C. venii, C. vespera* [Dictynidae]; *Neoleptoneta bullis, N. coeca, N. microps* [Leptonetidae]; *Erigone* n. sp. [Linyphiidae]; *Eidmannella rostrata* [Nesticidae].

INTRODUCTION

The cave fauna of Bexar and Comal counties is of considerable interest because of the numerous species of cave-restricted species (troglobites) that have been recorded. Many of these have extremely limited distributions, with some species known only from one or a few nearby caves. The geologic and topographic complexity of the region has led to the evolution of many closely related species in the area. Cokendolpher (2004a) has discussed the zoogeography and evolution of the species of blind *Cicurina* from caves in Bexar County.

The cave spider fauna includes a minimum of 64 species, including at least 17 suspected troglobites in four families (Dictynidae, Linyphiidae, Nesticidae, and Leptonetidae). The highly restricted distributions of some of these species and rapid development of Bexar County led to the U. S. Fish and Wildlife Service listing *Cicurina baronia* Gertsch, *C. madla* Gertsch, *C. venii* Gertsch, *C. vespera* Gertsch, and *Neoleptoneta microps* (Gertsch) as endangered in 2000. Other species of troglobite in these two counties, some described elsewhere in this volume, have equally restricted distributions and should probably be considered for listing.

With the exception of a few specimens collected prior to 1961, most of the fauna has been obtained by members of the Texas Speleological Survey. The fauna of Bexar County is far better known than that of Comal County because of studies conducted in the 1990s as a result of the petition to list species as endangered. Studies have continued since the listing in 2000, and it is anticipated that considerable information will be obtained in the next few years. Monitoring of the fauna of endangered species caves on Camp Bullis has begun and should provide considerable information on population sizes and biology of species inhabiting those caves.

MATERIALS

Unless indicated otherwise, all specimens are deposited in the collection of the Texas Memorial Museum. Other collections are: AMNH (American Museum of Natural History) and JCC (J. Cokendolpher Collection). With the exception of specimens studied earlier by Dr. W. J. Gertsch, Cokendolpher has identified all material. Full collection data for some species have appeared elsewhere in the context of revisions and descriptions. In those cases we only repeat the cave name here. Those wishing further collection details should consult the earlier publication.

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We are especially grateful to Dusty Bruns and Jerry Thompson at Camp Bullis for their support throughout the process of studies on Camp Bullis. We particularly thank George Veni for his unflagging efforts to study and protect the caves of Texas in general and Bexar County in particular. Special thanks are due to Marcelino Reyes for his help both in the field and in the laboratory. The following individuals have contributed greatly to this study through their collections and field assistance: Allan Cobb, William R. Elliott, Andy Grubbs, Scott Harden, Bruce Johnson, Jean Krejca, James Loftin, Gary McDaniel, David McKenzie, Logan McNatt, Marvin Miller, Linda Palit, Charley Savvas, Peter Sprouse, Randy Waters. Hub Bechtol and Kemble White provided many specimens obtained during investigations for SWCA Environmental Consultants.

U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department provided funding through Section 6 grants for general study of Bexar County cave fauna. The U.S. Army supplied funds for study of the fauna of Camp Bullis.

Family Agelenidae

Agelenopsis sp.

Record.—*Bexar County*: King Toad Cave, 1 June 1993 (J. Loftin, M. Reyes), 1 immature.

Agelenopsis aperta (Gertsch)

Agelenopsis aperta: Reddell, 1988:34; Veni, 1988:83.

Records.—*Bexar County*: Cave of the Half-Snake, April 1982 (G. Veni), 1 immature (det. W. J. Gertsch) (AMNH); Logan's Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female.

Tegenaria domestica (Clerck)

Record.—*Bexar County*: Cave With A View, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; 7 immatures.

Family Amphinectidae

Metaltella simoni (Keyserling)

Metaltella simoni: Reddell, 1988:34; Veni, 1988:211.

Record.—*Bexar County*: Robber Baron Cave (Reddell, 1988).

Comment.—This species is native to Brazil, Uruguay, Argentina and introduced to the USA (Platnick, 2004).

Family Anyphaenidae

Undetermined genus and species

Record.—*Bexar County*: Lone Gunman Pit, 23 Oct. 1997 (P. Sprouse, G. Veni), 1 immature.

Comment.—This specimen is too immature to allow further identification.

Anyphaena sp.

Record.—*Bexar County*: Porcupine Squeeze Cave (=Grubbs Cave No. 189), 6.1 km NE Helotes, 12 Jan. 1995 (A. Grubbs, N. Lake, G. Wade), 1 immature.

Comment.—This is an accidental.

Wulfila tantillus (Chickering)

Record.—*Bexar County*: Kick Start Cave, 30 May 2002 (G. McDaniel, C. Savvas), 1 female.

Comment.—This is an accidental.

Family Araneidae
Undetermined genus and species

Record.—*Bexar County*: Mattke Cave, 10 June 1993 (D. McKenzie, J. Reddell, M. Reyes), 1 male.

Family Caponiidae
Orthonops sp.

Record.—*Bexar County*: Cave in the Woods (=Grubbs Cave #21), 5.3 mi. NE Helotes, 2 Oct. 1995 (A. Grubbs), 1 immature.
Comment.—This is an accidental.

Family Clubionidae
Clubiona sp.

Records.—*Bexar County*: 8A-12 Sink, 15 Dec. 1994 (R. Corbell, B. Larsen), 1 immature; Cave With A View, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 immature.

Family Corinnidae
Undetermined genus and species

Record.—*Bexar County*: Crownridge Canyon Cave, 13 Nov. 2002 (G. Veni), 2 immatures.
Comment.—These specimens are too immature for further identification.

Falconina (?) sp.

Records.—*Bexar County*: Madla's Drop Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 2 immatures; Robbers Cave, 22 June 1993 (J. Loftin, J. Reddell, M. Reyes), 2 immatures; Scorpion Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Surprise Sink, 5 Feb. 1995 (A. Grubbs), 2 immatures; Wurzbach Bat Cave, 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 3 immatures.
Comment.—These specimens are too immature for further identification.

Falconina sp.

Records.—*Bexar County*: Cave, site #305, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 immature; Flying Buzzworm Cave, 9 Jan. 1995 (J. Reddell, M. Reyes), 1 immature; 4 Oct. 1995 (J. Reddell, M. Reyes), 3 immatures; Vera Cruz Shaft, 9 Sept. 1998 (J. Krejca, M. Reyes), 1 immature.

Falconina gracilis (Keyserling)

Record.—*Bexar County*: Crownridge Canyon Cave, 19 Nov. 2002 (J. Reddell, M. Reyes), 1 female.
Comments.—This is an accidental. It is recorded from Brazil, Paraguay, Argentina, and introduced in USA (Platnick, 2004).

Trachelas sp.

Trachelas sp.: Reddell, 1988:34; Veni, 1988:81.

Record.—*Bexar County*: Cave of the Bearded Tree, April 1982 (G. Veni), 1 immature (det. W. J. Gertsch) (AMNH).
Comment.—This is an accidental.

Trachelas volutus Gertsch

Record.—*Bexar County*: Surprise Sink, 7 Oct. 1995 (A. Hill, G. Veni), 1 male.
Comment.—This is an accidental.

Family Ctenidae
Leptoctenus byrrhus Simon

Leptoctenus byrrhus: Sissom, Peck, and Cokendolpher, 1999:261, figs. 1-2.

Records.—*Bexar County*: Up the Creek Cave (Sissom, Peck, and Cokendolpher, 1999); 22 April 1999 (J. Reddell, M. Reyes), 1 immature; Get a Rope Cave, 23 Sept. 2000 (G. Veni), 1 immature.
Comments.— Although the new records are based upon immatures, they are probably correct because this species is the only member of the family known from the region. The species is apparently a troglophile in Up the Creek Cave. It has been found crawling on the floor in both twilight and dark zones.

Family Dictynidae
Cicurina (*Cicurella*) sp. (eyeless)

Cicurina spp.: Reddell, 1965:168 [part—Adam Wilson's Cave, Jr. (=John Wagner Ranch Cave No. 3) record only].
Cicurina n. sp. (blind): Reddell, 1988:34 [part—Genesis Cave, John Wagner Ranch Cave No. 3, Kamikazi Cricket Cave, and Young Cave No. 1 records only]; Veni, 1988:137, 150, 170, 173, 267.
Cicurina sp.: Gertsch, 1992:120-121.
Cicurina spp.: Cokendolpher, 2004a:54-56.

Records.—*Bexar County*: Cave, site #301, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 immature; Cave, site #305, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 immature; Cave, site #820, west of Helotes, Nov. 1999 (K. White), 1 immature; 8A-12 Sink, 15 Dec. 1994 (R. Corbell, B. Larsen), 1 immature; B-52 Cave, 31 March 1995 (J. Reddell, M. Reyes), 3 immatures; 10 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 3 immatures; 29 Oct. 2001 (J. Krejca, P. Sprouse), 1 immature; Backhole, 7 June 1994 (J. Ivy, G. Veni), 1 immature; Black Cat Cave, 27 Jan. 1987 (J. Reddell, M. Reyes), 1 immature (det. W. J. Gertsch) (AMNH); 8 March 1987 (J. Reddell, M. Reyes), 2 immatures (det. W. J. Gertsch) (AMNH); Bunny Hole, 24 Oct. 1994 (J. Reddell, M. Reyes), 3 immatures; 31 March 1995 (J. Reddell, M. Reyes), 5 immatures; 9 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 1 immature; 2 Nov. 2001 (J. Reddell, M. Reyes), 1 immature; Cannonball Cave, 6-7 Nov. 2001 (P. Sprouse), 1 immature; 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 12 immatures; Cave in the Woods (=Grubbs Cave #21), 5.3 mi. NE Helotes, 2 Oct. 1995 (A. Grubbs), 14 immatures; Crownridge Canyon Cave, 13 Nov. 2002 (G. Veni), 1 immature; Dancing Rattler Cave, 21 April 2002 (K. Scanlon), 1 immature; 21 April 2002 (R. Hill, K. Walker), 1 immature; Firing Lane 11 Cave, 9 Jan. 1995 (J. Reddell, M. Reyes), 1 immature; Genesis Cave, June 1985 (A. Cobb, R. Waters), 1 immature (det. W. J. Gertsch) (AMNH); Hackberry Sink Cave, 3 June 2002 (M. Miller, K. Scanlon, K. Walker, 1 immature; Hairy Tooth Cave, 21 Jan. 1994 (W. Elliott, J. Ivy, G. Veni), 7 immatures; Helotes Blowhole, 25 Dec. 1982 (R. Waters), 4 immatures (det. W. J. Gertsch) (AMNH); 20 Nov. 2000 (K. White), 2 immatures; Helotes Hilltop Cave, 29 Nov. 2000 (H. Bechtol, K. White), 1 penultimate male, 1 immature; Here Today, Gone Tomorrow Cave, 1 July 1994 (J. Loftin), 2 immatures; Hilger Hole, 1 April 1998 (B. Johnson, J. Reddell, M. Reyes), 2 immatures; 20 April 1999 (J. Reddell, M. Reyes), 1 immature; Isocow Cave, 15 Dec. 1993 (G. Veni), 1 immature; John Wagner Ranch Cave No. 3, 4 Oct. 1963 (D. McKenzie, J. Reddell), 2 immatures (det. W. J. Gertsch) (AMNH); 23 Dec. 1963 (C. Huebner, O. Knox, 1 immature (det. W. J. Gertsch) (AMNH); 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 2 immatures; Kamikazi Cricket Cave, no date (A. Grubbs), 7 immatures; 19 Jan. 1986 (S. J. Harden), 1 immature (det. W. J. Gertsch) (AMNH); 10 June 1993 (J. Reddell, M. Reyes), 4 immatures; La Cantera Cave No. 1 (=Cave #2001), UTSA Region, 23 May 2000 (S. Carothers, K. White), 20 immatures; Lithic Ridge Cave, 1 Oct. 1994 (G. Atkinson, L. Palit), 1 immature; 4 June 1995 (G. Veni), 8 immatures; 12 Sept. 2001 (G. Veni), 1 immature; Logan's Cave, April 1987 (A. Grubbs, B. Harrison, C. Thibideaux), 2 immatures; 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 9 immatures; Lone Gunman Pit, 8 Sept. 1998 (J. Cokendolpher, M. Reyes), 1 immature; Low Priority Cave, 14 Dec. 1994 (C. Savvas), 2 immatures; 9 June 1995 (J. Reddell, M. Reyes), 8 immatures; 29 March 1995 (J. Reddell, M. Reyes), 4 immatures; 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 5 immatures; 1 Nov. 2000 (J. Reddell, M. Reyes), 5 immatures; 2 Nov. 2001 (J. Reddell, M. Reyes), 1 immature; Madla's Cave, 24 May 1993 (J. Reddell, M. Reyes), 5 immatures; Madla's Drop Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 7 immatures; MARS Pit, 9 Oct. 1995 (M. Reyes), Lower Level, 1 immature; 23 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; 4 April 1996 (W. Elliott), Zone 3, 1 immature; 10 Sept. 1998 (J. Cokendolpher, J. Krejca), 7 immatures; 29 Oct. 2001 (J. Krejca, P. Sprouse), 1 immature; Pain in the Glass Cave, 20 Sept. 1995 (J. Ivy, B. Johnson, L. McNatt), entrance rubble fill, 1 immature; 9 Oct. 1995 (J. Reddell, M. Reyes), main pit, 1 immature; Platypus Pit, 24 Oct. 1995 (J. Reddell, M. Reyes), 2 immatures; 11 March 1998 (W. Elliott), Zone 2, 1 immature; Porcupine Squeeze Cave (=Grubbs Cave No. 189), 6.1 km NE Helotes, 12 Jan. 1995 (A. Grubbs, N. Lake, G. Wade), 8 immatures; Robber's Cave, no date (A. Grubbs), 1 immature; 3 Sept. 1987 (A. Cobb, G. Veni), 3 immatures (det. W. J. Gertsch) (AMNH); 22 June 1993 (J. Loftin, J. Reddell, M. Reyes), 10 immatures; 14 July 1993 (J. Reddell, M. Reyes), 3 immatures; Root Canal Cave, 26 Oct. 1995 (J. Reddell, M. Reyes), 4 immatures; 20 April 1999 (J. Reddell, M. Reyes), 1 immature; Scenic Overlook Cave (=Cave site #2101), Government Canyon Karst Fauna Region, 11 May 2001 (H. Bechtol, K. White), 9 immatures; Scorpion Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 7 immatures; Sharron Spring, 6 Nov. 2000 (J. Krejca, P. Sprouse), ex mophead placed in spring mouth, 1 penultimate male; Stahl Cave, 14 Dec. 2000 (J. Reddell, M. Reyes), 1 immature; Surprise Sink, 5 Feb. 1995 (A. Grubbs), 1 immature; 21 April 1996 (J. Kennedy, G. Veni, K. Veni), 1 immature; SWCA Cave No. 1, June 2000 (K. White), 3 immatures; 9 Nov. 2000 (K. White), 1 immature; SWCA Cave No. 3, 20 Sept. 2000 (K. White), 4 immatures; Three Fingers Cave, 22 June 1993 (J. Loftin, J. Reddell, M. Reyes), 5 immatures; 2008 = La Cantera Cave No. 3 (=UTSA cave site no. 2008), 17 Nov. 2000 (K. White), 1 immature; Young Cave No. 1, 6 Aug. 1983 (J. Ivy, G. Veni), 1 immature (det. W. J. Gertsch) (AMNH); 6 Sept. 1993 (J. Reddell, M. Reyes), 8 immatures.

Comal County: Coreth Bat Cave, 28 Oct. 1995 (J. Reddell, M. Reyes), 5 immatures; Double Decker Cave, 5 Feb. 1978 (G. Darilek, T. Mills, D. Montgomery), 1 immature (det. W. J. Gertsch) (AMNH); Lewis Cave, 8 March 1968 (J. Fish, S. Fowler, J. Reddell), 1 immature (det. W. J. Gertsch) (AMNH); Startzville Bat Cave, 1988 (A.G. Grubbs), 1 immature (det. W. J. Gertsch) (AMNH).

Cicurina (*Cicurella*) sp. (6-eyed)

Cicurina spp. (long-legged 6-eyed species): Cokendolpher, 2004a:55.

Record.—*Bexar County*: Mattke Cave, 10 June 1993 (D. McKenzie, J. Reddell, M. Reyes), 3 immatures.

Comment.—This long-legged species does not appear to be the same as *C. pampa*, but was not examined for the study by Cokendolpher (2004a).

Cicurina (*Cicurella*) sp. maybe *C. bullis* Cokendolpher or *C. platypus* Cokendolpher

Cicurina sp. maybe *bullis* or *platypus*: Cokendolpher, 2004a:53-54.

Record.—*Bexar County*: Up the Creek Cave (Cokendolpher, 2004a).

Cicurina (*Cicurella*) sp. prob. *baronia* Gertsch

Record.—*Bexar County*: Robber Baron Cave, 22 May 1993 (J. Reddell, M. Reyes), 2 immatures.

Cicurina (*Cicurella*) sp. prob. *bullis* Cokendolpher

Cicurina spp., probably *C. bullis*: Cokendolpher, 2004a:55.

Record.—*Bexar County*: Eagles Nest Cave, 5 April 1996 (W. Elliott), Zone 1, 1 immature.

Cicurina (*Cicurella*) sp. prob. *loftini* Cokendolpher

Cicurina spp. probably *C. loftini*: Cokendolpher, 2004a:55.

Record.—*Bexar County*: Caracol Creek Coon Cave, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 5 immatures.

Cicurina (*Cicurella*) sp. prob. *madla* Gertsch

Records.—*Bexar County*: Headquarters Cave, 16 June 1993 (S. Harden, J. Reddell, M. Reyes, G. Veni), 14 immatures; 5 April 1996 (W. Elliott), Zone 3, 1 immature; 26 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; 12 March 1998 (J. Ivy, W. Elliott), Zone 2, 1 immature; 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 7 immatures; Helotes Blowhole, no date (A.G. Grubbs, K. Kinsley, K. White), 4 immatures; Hills and Dales Pit, 28 Oct. 2000 (H. Bechtol, K. White), 1 immature; Nov. 2000 (K. White), 3 immatures; Lost Pothole, 4 Feb. 1995 (A.G. Grubbs, G. Hoese, C. Vreeland), 4 immatures

Cicurina (*Cicurella*) sp. prob. *neovespera* Cokendolpher

Cicurina spp., probably *C. neovespera*: Cokendolpher, 2004a:55.

Record.—*Bexar County*: Elm Springs Cave, no date (A. Grubbs), 1 immature.

Cicurina (*Cicurella*) sp. prob. *pampa* Chamberlin and Ivie

Record.—*Bexar County*: Bob Wire Cave, 5 Aug. 1984 (A. Grubbs), 1 immature.

Cicurina (*Cicurella*) sp. prob. *vespera* Gertsch

Cicurina spp., probably *C. vespera*: Cokendolpher, 2004a:55.

Records.—*Bexar County*: Government Canyon Bat Cave, 24 May 1993 (J. Reddell, M. Reyes), 1 immature; 24 May 1998 (J. Reddell, M. Reyes), 2 immatures.

Cicurina (*Cicurella*) *baronia* Gertsch

Cicurina n. sp. (blind): Reddell, 1988:34 [part—Robber Baron Cave record only]; Veni, 1988:211.

Cicurina baronia Gertsch, 1992:106, 109, 118, figs. 89-90, 155-156; Cokendolpher, 2004a:38, figs. 9, 13, 16, 28-31.

Record.—*Bexar County*: Robber Baron Cave (Cokendolpher, 2004a).

Comment.—This troglobite is known only from this cave.

Cicurina (*Cicurella*) *brunsi* Cokendolpher

Cicurina brunsi Cokendolpher, 2004a:38-39, figs. 9, 13, 16, 32, 33.

Record.—*Bexar County*: Stahl Cave (Cokendolpher, 2004a).

Comment.—This troglobite is known only from this cave on Camp Bullis.

Cicurina (*Cicurella*) *bullis* Cokendolpher

Cicurina bullis Cokendolpher, 2004a:39-41, figs. 6, 9, 13, 16, 34-36.

Records.—*Bexar County*: Eagles Nest Cave; Hilger Hole; Isocow Cave; Platypus Pit; Root Canal Cave (Cokendolpher, 2004a).

Comment.—This species is known only from these four caves on Camp Bullis.

Cicurina (*Cicurella*) *joya* Gertsch

Cicurina joya Gertsch, 1992:81, 89, 97, chart 1, figs. 13-14.

Record.—*Comal County*: Brehmmer Cave (=Heidrich's Cave) (Gertsch, 1992).

Comment.—This 6-eyed species is known only from this cave.

Cicurina (*Cicurella*) *loftini* Cokendolpher

Cicurina loftini Cokendolpher, 2004a:41-42, figs. 5, 9, 10, 13, 16, 37-39.
Cicurina (*Cicurella*) spp. (troglobite), Reddell, 1993:22, 47.

Records.—*Bexar County*: Caracol Creek Coon Cave; SBC Cave, TxDOT Loop 1604 right of way 3-4 km south of Caracol Creek Coon Cave (Cokendolpher, 2004a)

Comment.—This species is known only from these two caves.

Cicurina (*Cicurella*) *madla* Gertsch

Cicurina n. sp. (in part): Reddell, 1988:34.
Cicurina (*Cicurella*) spp. (troglobite), Reddell, 1993:22, 50, 55, 64.
Cicurina madla Gertsch, 1992:109, figs. 91-92; Cokendolpher, 2004a:42-46, figs. 7-9, 13, 16, 40-47.
Cicurina n. sp.: Veni and Elliott, 1994: 7.

Records.—*Bexar County*: Christmas Cave; Headquarters Cave, Camp Bullis; Helotes Blowhole; Hills and Dales Pit; Lost Pothole (= Lost Pot); Madla's Cave; Madla's Drop Cave; Robber's Cave (Gertsch, 1992; Cokendolpher, 2004a).

Cicurina (*Cicurella*) *neovespera* Cokendolpher

Cicurina vespera Gertsch: Longacre, 2000:81419-81421, 81425, 81433 (in part).
Cicurina neovespera Cokendolpher, 2004a:9, 13, 16, 52, 53.

Records.—*Bexar County*: Elm Springs Cave (= Grubbs Cave ES); La Cantera Sink (=Grubbs Cave No. 23), 8 km NE Helotes (Cokendolpher, 2004a).

Cicurina (*Cicurella*) sp. prob. *pampa* Chamberlin and Ivie

Records.—*Bexar County*: Bob Wire Cave; Goat Cave (Cokendolpher, 2004a); Mattke Cave (Reddell, 1993).

Comment.— These specimens are immature and cannot be identified for certain.

Cicurina (*Cicurella*) *pampa* Chamberlin and Ivie

Cicurina sp. (eyed): Reddell, 1988:34.
Cicurina sp.: Veni, 1988:69.
Cicurina (*Cicurella*) sp. (?troglophile), Reddell, 1993:22, 46.
Cicurina gatita Gertsch, 1992:91, 92, 94, figs. 27-28.
Cicurina pampa: Cokendolpher, 2004a:48-51, figs. 9, 11, 14, 54-60.

Records.—*Bexar County*: Black Cat Cave (Gertsch, 1991); Cherry Hollow Cave (20b) (=Cave No. 19), 6.9 km NE Helotes (Cokendolpher, 2004a); Cross the Creek Cave, Camp Bullis (Cokendolpher, 2004a); Karst Feature 471-4, 17 Jan. 2002 (L J. Graves), 2 females; Porcupine Squeeze Cave (=Grubbs Cave No. 189), 6.1 km NE Helotes (Cokendolpher, 2004a); Stone Oak Parkway Pit (Cokendolpher, 2004a); Up the Creek Cave, Camp Bullis (Cokendolpher, 2004a); Vera Cruz Shaft, Camp Bullis (Cokendolpher, 2004a).

Comment.—This six-eyed species is a troglophile.

Cicurina (*Cicurella*) *platypus* Cokendolpher

Cicurina platypus Cokendolpher, 2004a:51-52, figs. 9, 13, 16, 61, 62.

Records.—*Bexar County*: Platypus Pit; MARS Pit (Cokendolpher, 2004a).

Comment.—This species is known only from these two caves on Camp Bullis.

Cicurina (*Cicurella*) *puentecilla* Gertsch

Cicurina sp.: Reddell, 1964:41.
Cicurina spp.: Reddell, 1965:168 [part—Natural Bridge Caverns record only].
Cicurina puentecilla Gertsch, 1992:106, 111, figs. 99-100.

Record.—*Comal County*: Natural Bridge Caverns (Gertsch, 1992).
Comment.—This species is known only from this cave.

Cicurina (*Cicurella*) *reclusa* Gertsch

Cicurina, blind: Reddell, 1964:34.
Cicurina spp.: Reddell, 1965:168 [part—Kappelman Salamander Cave record only].
Cicurina reclusa Gertsch, 1992:106, 111, figs. 97-98.

Records.—*Comal County*: Kappelman Cave (Gertsch, 1992); Kappelman Salamander Cave (Gertsch, 1992).
Comment.—This species is known only from these two nearby caves.

Cicurina (*Cicurella*) *venii* Gertsch

Cicurina n. sp. (blind): Reddell, 1988:34 [part—Braken Bat Cave record only]; Veni, 1988:74.
Cicurina venii Gertsch, 1992:106, 111, figs. 95-96; Cokendolpher, 2004a:52-53, figs. 9, 13, 16, 63, 64.

Record.—*Bexar County*: Braken Bat Cave (Gertsch, 1992; Cokendolpher, 2004a).
Comments.—This troglobite is known only from this cave. The only known specimen has apparently been lost and the cave entrance is now sealed.

Cicurina (*Cicurella*) *vespera* Gertsch

Cicurina spp.: Reddell, 1970:404 [part—Government Canyon Bat Cave record only].
Cicurina n. sp. (blind): Reddell, 1988:34 [part—Government Canyon Bat Cave record only]; Veni, 1988:141.
Cicurina vespera Gertsch, 1992:106, 111, figs. 93-94; Cokendolpher, 2004a:53, figs. 9, 13, 16, 65, 66.

Record.—*Bexar County*: Government Canyon Bat Cave, Government Canyon State Natural Area (Gertsch, 1992; Cokendolpher, 2004a).
Comment.—This endangered troglobite is known only from this cave.

Cicurina (*Cicurusta*) sp. prob. *varians* Gertsch and Mulaik

Cicurina varians: Reddell, 1964:7; 1965:169-170 [part—Friesenhahn Cave, Madla's Cave, Bear Creek Cave, and Brehmmer Cave records only]; 1988:44; Veni, 1988:110, 129, 177, 181, 249.
Cicurina spp., presumably *C. varians*: Cokendolpher, 2004a:55 [in part].

Records.—*Bexar County*: Cave, site #301, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 2 immatures; Cave, site #801, west of Helotes, Nov. 1999 (K. White), 1 immature; Cave, site #802, west of Helotes, Nov. 1999 (K. White), 1 immature; 40 mm Cave, 5 Nov. 1993 (J. Reddell, M. Reyes), 6 immatures; 29 Nov. 1993 (J. Reddell, M. Reyes), 7 immatures; Backhole, 9 Sept. 1998 (J. Cokendolpher, J. Krejca), 1 immature; Bear Cave, 3 July 1968 (J. Reddell, A. R. Smith), 3 immatures (det. W. J. Gertsch) (AMNH); Bob Wire Cave, 5 Aug. 1984 (A. Grubbs), 2 immatures; Bone Pile Cave, 24 May 1998 (J. Reddell, M. Reyes), 1 immature; 12 Sept. 2001 (G. Veni), 1 immature; Canyon Ranch Shelf Cave, 9 Aug. 2002 (C. Collins, K. White), 1 immature; Caracol Creek Coon Cave, 26 Aug. 1987 (A. Cobb, S. Harden), 1 immature; Cave With A View, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 immature; Cherry Hollow Cave (20b) (= Grubbs Cave #19), 4.3 mi. NE Helotes, 11 Oct. 1995 (A. Grubbs, G. Wade), 3 immatures; Chimney Cricket Cave, 14 June 2001 (J. Cokendolpher), 3 immatures; Christmas Cave, 6 Sept. 1993 (J. Reddell, M. Reyes), 1 immature; Crownridge Canyon Cave, 19 Nov. 2002 (J. Reddell, M. Reyes), 1 immature; Dirtwater Cave, 2 Aug. 1983 (J. Ivy, G. Veni), 2 immatures; Dos Viboras Cave, 14 Dec. 1994 (W. Elliott, G. McDaniel, Zone 1, 1 immature; Zone 3, 1 immature; 6 Oct. 1995 (J. Reddell, M. Reyes), 3 immatures; Firing Lane 11 Cave, 5 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Friesenhahn Cave, Oct. 1964 (T. Raines), 1 penultimate male (det. W. J. Gertsch) (AMNH); Hairy Tooth Cave, 21 Jan. 1994 (W. Elliott, J. Ivy, G. Veni), 1 immature; Hanging Rock Cave, 18 Nov. 1997 (G. Veni), 2 immatures; Haz Mat Pit, 8 Sept. 1998 (J. Reddell), 1 immature; 19 Nov. 2002 (J. Reddell, M. Reyes), 1 immature; Here Today, Gone Tomorrow Cave (Cokendolpher, 2004a); Holy Smoke Cave, 20 Feb. 2000 (G. Veni), 1 immature; 27 Sept. 2000 (C. Savvas), 1 immature; Isopit, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Javalina Cave (=HPD Cave), 2 Nov. 2001 (H. Bechtol, K. White), 3 immatures; John Wagner Ranch Cave No. 3, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 3 immatures; Karst Feature 10-75 (Cokendolpher, 2004a); Karst Feature 11B-57 (Cokendolpher, 2004a); Karst Feature 6A-41, 18 April 2001 (J. Reddell, M. Reyes), 1 immature; Karst Feature 11B-1, 23 March 1995 (B. Johnson), 1 immature; Karst Feature 471-4, 17 Jan. 2002 (L. J. Graves), 1 immature; La Cantera Cave No. 1 (=Cave #2001), UTSA Region, 23 May 2000 (S. Carothers, K. White), 1 immature; La Cantera Sink (=Grubbs Cave No. 23), 5 mi. NE Helotes, 2 Oct. 1995 (A. Grubbs), 3 immatures; Larsen's Pit, 26 Sept. 1995 (A. Grubbs), 1 immature; Lithic Ridge Cave, 1 Oct. 1994 (G. Atkinson, L. Palit), 1 immature; 4 June 1995 (G. Veni), 1 immature; 12 Sept. 2001 (G. Veni), 1 immature; Logan's Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 immature; Lost Mine Trail Cave, 2 May 2002 (C. Collins), 1 immature; Madla's Cave, 4 Oct. 1963 (D. McKenzie, J. Reddell), 4 immatures (det. W. J. Gertsch) (AMNH); 24 May 1993 (J. Reddell, M. Reyes), 1 immature; MARS Pit, 9 Oct. 1995 (J. Reddell, M. Reyes), Upper Level, 4 immatures; 10 Sept. 1998 (J. Cokendolpher, J. Krejca), lower level, 2 immatures; 10 Sept. 1998 (J. Reddell, M. Reyes), upper level, 2 immatures; Niche Cave, 31 July 1983 (G. Veni), 1 immature; Pain in the Glass Cave, 9 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Peanut Sink, 12 May 2001 (M. Warton), 3 immatures; Phil's Friggin Line Cave (Cave, site #803), west of Helotes, Nov. 1999 (K. White), 1 immature; Ponytail Pit, 4 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Poor Boy Baculum Cave, 15 Dec. 1994 (W. Elliott, B. Johnson), Zone 1, 3 immatures; Porcupine Squeeze Cave, 13 Oct. 1995 (A. Grubbs), 1 immature; Rattlesnake Cave, 19 July 1989 (A. Cobb), 1 immature; Root Toupee Cave, 1 Nov. 2000 (J. Reddell, M. Reyes), 1 immature; Scorpion Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 6 immatures; Sewer Line Karst Feature F-3, 16 Jan. 2002 (L. J. Graves), 1 immature; Sink Hole, 17 June 1993 (S. Harden, G. Veni), 5 immatures; Springtail Crevice, 9 June 2002 (J. Reddell, M. Reyes), 3 immatures; Stahl Cave, 21 April 1999 (J. Reddell, M. Reyes), 1 immature; Surprise Sink, 7 Oct. 1995 (A. Hill, G. Veni), 1 immature; 21 April 1996 (J. Kennedy, G. Veni, K. Veni), 1 immature; 24 May 1998 (J. Reddell, M. Reyes), 13 immatures; Stein Cave, 10 May 2001 (M. Warton), 1 immature; Sunray Cave (Grubbs Cave #18), 4 mi. NE Helotes, 13 Jan. 1995 (A. Grubbs), 2 immatures; Surprise Sink (Cokendolpher, 2004a); Three Fingers Cave, 22 June 1993 (J. Loftin, J. Reddell, M. Reyes), 9 immatures; Tin Pot, 6 March 2001 (G. Veni), 1 immature; 18 April 2001 (J. Reddell, M. Reyes), 3 immatures; Twin Pits, 13 Oct. 1985 (A. Cobb), 1 immature (det. W. J. Gertsch) (AMNH); Two Hit Cave, 30 March 1995 (J. Reddell, M. Reyes), 1 immature; Two Raccoon Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 3 immatures; Voges Cave, 6 March 2001 (G. Veni), 1 immature; 17 April 2001 (J. Reddell, M. Reyes), 4 immatures; World News Cave, 14 July 1993 (J. Reddell, M. Reyes), 1 immature; Young Cave No. 1, 6 Sept. 1993 (J. Reddell, M. Reyes), 5 immatures.

Comal County: Bear Creek Cave, 24 Feb. 1963 (B. Russell), 2 immatures (det. W. J. Gertsch) (AMNH); Brehmmer's Cave, 13 July 1988 (A. Cobb), 1 immature (det. W. J. Gertsch) (AMNH); Calmbach Cave, 21 Aug. 1988 (A. Cobb, G. Veni), 1 immature (det. W. J. Gertsch) (AMNH); Camp Bullis Bad Air Cave, 23 Oct. 1996 (P. Sprouse, G. Veni), 1 immature; 23 Oct. 1996 (B. Johnson, J. Reddell, M. Reyes), Zone 1, 1 immature; Zone 2, 1 immature; Camp Bullis Bat Cave, 19 Nov. 1996 (W. Elliott), Zone 1, 1 immature; 21 Nov. 1996 (J. Ivy, A. Scott, G. Veni), 1 immature; Camp Bullis Cave No. 1, 22 Oct. 1996 (G. Veni), 2 immatures; 21 Nov. 1996 (B. Johnson, J. Reddell, M. Reyes), 1 immature; 21 Nov. 1996 (B. Johnson, J Reddell, M. Reyes), Zone 2, 1 immature; Fischer Cave, 9 Oct. 1965 (D. McKenzie), 5 immatures (det. W. J. Gertsch) (AMNH); Lewis Cave, 7 July 1975 (W. Elliott), 2 immatures (det. W. J. Gertsch) (AMNH); Little Gem Cave, 19 Oct. 1963 (J. Porter, J. Reddell), 2 immatures (det. W. J. Gertsch) (AMNH).

Comments.—The only 8-eyed species of *Cicurina* recorded from Texas caves is *C. varians* and it is likely that all of these immatures belong to that species. Immatures collected in caves that also contain adult *C. varians* are listed below under that species.

Cicurina (*Cicurusta*) *varians*
Gertsch and Mulaik *in* Chamberlin and Ivie

Cicurina sp.: Kohls and Jellison, 1948:117.
Cicurina varians: Reddell, 1964:11, 16, 33, 34, 38, 41; 1965:169-170 [part—Bracken Bat Cave, Hitzfelder's Cave (=Hitzfelder's Bone Hole), Kappelman Salamander Cave, Klar's Cave, Little Gem Cave, and Natural Bridge Caverns records only]; 1970:404; 1988:34; Veni, 1988:55, 62, 141, 145, 146, 159, 169, 173, 211, 234, 263.
Cicurina spp., presumably *C. varians*: Cokendolpher, 2004a:55 [in part].

Records.—*Bexar County*: Assassin Cave, 18 Aug. 1985 (A. Cobb), 1 female, 1 immature (det. W. J. Gertsch) (AMNH); B-52 Cave, 6 Dec. 1994 (W. Elliott, J. Ivy), 4 immatures; 6 Dec. 1994 (W. Elliott, J. Ivy), Zone 1, 1 male, 1 female, 3 immatures; Zone 3, 1 female; 31 March 1995 (J. Reddell, M. Reyes), 1 female, 9 immatures; 10 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 3 immatures; Banzai Mud Dauber Cave, 5 Dec. 1994 (C. Savvas, P. Sprouse), Zone 1, 3 immatures; 5

Oct. 1995 (J. Reddell, M. Reyes), Zones 1-2, 2 immatures; 10 Nov. 2000 (J. Krejca, P. Sprouse), 1 immature; 15 Nov. 2000 (J. Krejca, P. Sprouse), 1 male [matured 20 Jan. 2003], 1 female [matured 29 Oct. 2001], 2 immatures; Black Cat Cave, 28 Nov. 1982 (S. Harden, R. Waters), 4 immatures; 27 Jan. 1987 (J. Reddell, M. Reyes), 1 female (det. W. J. Gertsch) (AMNH); 2 Dec. 1984 (S. Harden, J. Ivy), 2 immatures; Boneyard Pit, 5 Dec. 1994 (R. Corbell, W. Elliott), Zone 2, 1 immature; 7 Sept. 1998 (J. Cokendolpher, J. Krejca), 1 female [matured 8 Dec. 1998]; Breached Dam Cave, 29 March 1995 (J. Reddell, M. Reyes), 6 immatures; 4 Oct. 1995 (J. Reddell, M. Reyes), 4 immatures; 8 Sept. 1998 (J. Reddell, M. Reyes), 1 female; 1 Nov. 2000 (J. Reddell, M. Reyes), 4 immatures; 11 July 2001 (J. Reddell, M. Reyes), 1 immature; Bunny Hole, 24 Oct. 1994 (J. Reddell, M. Reyes), 2 immatures; 31 March 1995 (J. Reddell, M. Reyes), 1 female, 1 immature; 9 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 1 female [matured 4 Oct. 1999], 6 immatures; 2 Nov. 2001 (J. Reddell, M. Reyes), 5 immatures; Constant Sorrow Cave, 8 Feb. 2001 (L. J. Graves), 1 female; 6 March 2001 (G. Veni), 1 immature; Cross the Creek Cave, 22 March 1995 (B. Johnson), 1 immature; 31 March 1995 (J. Reddell, M. Reyes), 1 immature; 14 Nov. 1995 (J. Cokendolpher, J. Reddell, M. Reyes), 2 immatures, 3 females, 3 egg sacs; 6 Oct. 1995 (J. Reddell, M. Reyes), 9 immatures; 10 Sept. 1998 (J. Reddell, M. Reyes), 2 immatures; 21 April 1999 (J. Reddell, M. Reyes), 3 immatures; 31 Oct. 2000 (J. Reddell, M. Reyes), 1 female [matured 14 July 2001], 1 female [matured 3 Feb. 2001]; Dangerfield Cave, 23 March 1998 (J. Reddell), 4 immatures; 21 April 1999 (J. Reddell, M. Reyes), 1 male; 31 Oct. 2000 (J. Reddell, M. Reyes), 1 immature; Dogleg Cave, 22 March 1995 (B. Johnson), 1 female; 12 Nov. 1997 (P. Sprouse, G. Veni), 1 immature; 25 March 1998 (M. Reyes), 1 female, 1 immature; Eagles Nest Cave, 23 Oct. 1995 (J. Reddell, M. Reyes), 2 immatures; 6 Sept. 1998 (J. Reddell, M. Reyes), 2 immatures; 25 April 2000 (J. Reddell, M. Reyes), 2 immatures; 31 Oct. 2000 (J. Reddell, M. Reyes), 1 female [matured 25 Nov. 2002]; Glinn's Gloat Hole, 18 Jan. 2000 (J. Reddell, M. Reyes), 1 female; Goat Cave, 24 May 1998 (J. Reddell, M. Reyes), 1 female, 3 immatures; Berlese of leaf litter and bird nest, 24 May 1998 (J. Reddell, M. Reyes), 1 immature; Government Canyon Bat Cave, 11 Aug. 1965 (J. Fish, J. Reddell), 18 immatures (det. W. J. Gertsch) (AMNH); 24 May 1993 (J. Reddell, M. Reyes), 1 female, 13 immatures; 24 May 1998 (J. Reddell, M. Reyes), 4 immatures; Han's Grotto, 16 Feb. 1984 (D. Canny, S. Harden), 1 female; Headquarters Cave, 24 April 1966 (D. McKenzie, B. Russell), 1 female, 6 immatures (det. W. J. Gertsch) (AMNH); 16 June 1993 (S. Harden, J. Reddell, M. Reyes, G. Veni), 10 immatures; 29 Nov. 1993 (M. Reyes), 1 female, 3 immatures; Hector Hole, 11 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 female [matured 20 Nov. 2002]; 15 April 2002 (J. Reddell, M. Reyes), 3 immatures; Hilger Hole, 15 Dec. 2000 (J. Reddell, M. Reyes), 1 female; 11 Nov. 1997 (G. Veni), 2 immatures; 7 Sept. 1998 (J. Reddell, M. Reyes), 1 female [matured 27 Nov. 1998], 5 immatures; 20 April 1999 (J. Reddell, M. Reyes), 3 immatures; Hills and Dales Pit, no date (H. Bechtol), 1 immature; 28 Oct. 2000 (H. Bechtol, K. White), 1 female [matured 29 Oct. 2001]; 17 Nov. 2000 (K. White), 1 immature; Hitzfelder's Bone Hole [=Hitzfelder's Cave], March 1965 (B. Russell), 1 female (det. W. J. Gertsch) (AMNH); Hold Me Back Cave, 1 Dec. 1993 (C. Savvas, G. Veni), 1 immature; 10 Nov. 2000 (J. Krejca, P. Sprouse), 1 male, 1 female [matured 20 Nov. 2002]; Hornet's Last Laugh Pit, 25 March 2002 (G. Veni), 1 female; Isocow Cave, 15 Dec. 1993 (G. Veni), 1 female, 2 immatures; 19 Sept. 1994 (W. Elliott), Zone 1, 1 immature; Kamikazi Cricket Cave, no date (A. Grubbs), 2 males, 1 immature; 3 Oct. 1984 (J. Ivy, G. Veni), 3 immatures; 19 Jan. 1986 (A. Cobb), 1 female (det. W. J. Gertsch) (AMNH); 10 June 1993 (J. Reddell, M. Reyes), 1 female, 6 immatures; Lone Gunman Pit, 23 Oct. 1997 (P. Sprouse, G. Veni), 2 immatures; 24 March 1998 (J. Reddell, M. Reyes), 1 immature; 14 Dec. 2000 (M. Reyes), 1 female; 1 Nov. 2001 (M. Reyes), 1 male; 19 Nov. 2002 (M. Reyes), 1 female [matured 20 Jan. 2003]; Low Priority Cave, 14 Dec. 1994 (C. Savvas), 2 immatures; 29 March 1995 (J. Reddell, M. Reyes), 1 immature; 4 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 1 female [matured 8 Dec. 1998]; 22 April 1999 (J. Reddell, M. Reyes), 1 female [matured 2 Oct. 2000]; 1 Nov. 2000 (J. Reddell, M. Reyes), 1 female [matured 25 Nov. 2002], 2 immatures; MARS Shaft, 9 Nov. 2000 (J. Krejca, P. Sprouse), 1 male [matured 25 Nov. 2002]; 25 Oct. 2001 (J. Krejca, P. Sprouse), 1 immature; Mattke Cave, 10 June 1993 (D. McKenzie, J. Reddell, M. Reyes), 2 females, 14 immatures; Max and Roberts Cave (SWCA cave site no. 3006, 3010), Culebra Anticline, 28 Sept. 2000 (H. Bechtol, K. White), 1 male, 1 female, 5 immature; One Formation Cave, 17 Jan. 1998 (G. Veni), 1 female; Peace Pipe Cave, 7 March 2001 (G. Veni), 1 female, 3 immatures; 17 April 2001 (J. Reddell, M. Reyes), 1 immature; Platypus Pit, 30 March 1995 (J. Reddell, M. Reyes), 1 female, 1 immature; 4 April 1996 (W. Elliott), Zone 1, 1 immature; Porcupine Parlor Cave, 29 March 2001 (G. Veni), 1 female, 1 immature; 18 April 2001 (J. Reddell, M. Reyes), 2 females, 5 immatures; Raging Cajun Cave, 22 Jan. 1994 (W. Elliott, J. Ivy, L. Palit, G. Veni), 1 male, 4 immatures; Robber Baron Cave, 26 Dec. 1980 (G. Veni), 1 male, 3 immatures (det. W. J. Gertsch) (AMNH); 11 Dec. 1982 (R. Waters), 1 male, 3 immatures; 6 April 1983 (R. Waters), 1 immature (det. W.

J. Gertsch) (AMNH); 9, 11 Dec. 1983 (S. Harden, R. Waters), 1 male, 1 immature; 21 Feb. 1986 (S. J. Harden), 1 female, 5 immatures (det. W. J. Gertsch) (AMNH); 14 Sept. 1986 (R. Waters), 1 female, 2 immatures (det. W. J. Gertsch) (AMNH); 8 March 1987 (J. Reddell, M. Reyes), 3 immatures (det. W. J. Gertsch) (AMNH); 22 May 1993 (J. Reddell, M. Reyes), 1 immature; 25 June 1993 (A. Grubbs, J. Reddell, M. Reyes), 1 immature; Robbers Cave, no date (A. Grubbs), 3 immatures; 22 June 1993 (J. Loftin, Jvera. Reddell, M. Reyes), 1 female, 6 immatures; Root Canal Cave, 26 Oct. 1995 (J. Reddell, M. Reyes), 4 immatures; 7 Sept. 1998 (J. Reddell, M. Reyes), 1 male [matured 5 Dec. 1998], 2 immatures; 20 April 1999 (J. Reddell, M. Reyes), 1 immature; 26 Oct. 2001 (J. Krejca, P. Sprouse), 1 immature; Some Monk Chanted Evening Cave, 15 Oct. 1983 (L. Palit, G. Veni), 1 female; Stevens Ranch Cave No. 1, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female, 3 immatures; Stone Oak Parkway Pit, 27 Jan., 6 Feb. 1993 (A. Grubbs), 2 females; Strange Little Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 female, 3 immatures; 5 Oct. 1995 (J. Reddell, M. Reyes), 7 immatures; Tall Tales Cave, 13 Oct. 1999 (G. Veni), 1 immature; 12 Jan. 2000 (P. Sprouse), 2 females, 1 immature; Vera Cruz Shaft, 15 Oct. 2001 (M. Reyes), 1 female [matured 20 Jan. 2003], 1 immature; 19 Nov. 2002 (M. Reyes), 1 male, 1 female, 1 immature; Up the Creek Cave, 30 March 1995 (J. Reddell, M. Reyes), 2 females, 5 immatures; 5 Oct. 1995 (J. Reddell, M. Reyes), 7 immatures; 14 Nov. 1995 (J. Cokendolpher, J. Reddell, M. Reyes), 1 male; 10 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 13 immatures; 20 Feb. 1999 (J. Reddell, M. Reyes), 3 immatures; Vera Cruz Shaft, 23 March 1998 (M. Reyes), 1 immature; 9 Sept. 1998 (J. Krejca, M. Reyes), 2 immatures; 22 April 1999 (M. Reyes), 1 female [matured 17 Oct. 2000]; 15 Oct. 2001 (M. Reyes), 1 female [matured 20 Jan. 2003], 1 immature; 19 Nov. 2002 (M. Reyes), 1 male, 1 female, 1 immature; Well Done Cave, 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 4 females, 1 immature; Winston's Cave, 13-14 Dec. 1993 (J. Ivy, L. McNatt, G. Veni), 1 female; Wurzbach Bat Cave, 4-5 Jan. 1984 (S. Harden), 1 female, 6 immatures; 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 2 immatures.

Comal County: Bracken Bat Cave, 19 Jan. 1963 (D. McKenzie, J. Reddell), 1 male (det. W. J. Gertsch) (AMNH); 5 April 1983 (R. Waters), 2 immatures (det. W. J. Gertsch); Brehmmer-Heidrich Cave, 19 Jan. 1963 (D. McKenzie), 1 male, 1 immature (det. W. J. Gertsch) (AMNH); Camp Bullis Cave No. 3, 21 Nov. 1996 (B. Johnson, J. Reddell, M. Reyes), 1 female, 1 immature; 29 Nov. 1996 (G. Veni), 2 females; Coreth Bat Cave, 28 Oct. 1995 (J. Reddell, M. Reyes), 2 males, 6 immatures; May 2000 (J. Krejca), 3 immatures; Ebert Cave, 30 Jan. 1988 (J. Reddell, M. Reyes); Fischer Cave (Reddell, 1970); Kappelman Cave, 15 March 1964 (J. Reddell, B. Russell), 1 female, 3 immatures (det. W. J. Gertsch) (AMNH); Kappelman Salamander Cave, 15 March 1964 (J. Reddell, B. Russell), 3 females, 2 immatures; Klar's Cave, April 1963 (B. Russell), 2 females (det. W. J. Gertsch) (AMNH); Little Gem Cave, 21 May 1965 (J. Reddell), 1 female, 2 immatures (det. W. J. Gertsch) (AMNH); Natural Bridge Caverns, 23 Feb. 1963 (D. McKenzie, J. Reddell), 1 female (det. W. J. Gertsch) (AMNH); 13 July 1963 (J. Reddell), 3 immatures (det. W. J. Gertsch) (AMNH); 23 Sept. 1989 (O. Knox, J. Reddell, M. Reyes), 1 immature; Startzville Bat Cave, 1983 (A.G. Grubbs), 1 female; Washington Cave, 21 Nov. 1996 (J. Reddell, M. Reyes), 1 female; Wyley's Cave, 21 Feb. 1988 (A. Cobb, J. Ivy, L. Palit, G. Veni), 1 female, 3 immatures; 25 Feb. 1988 (A. Cobb, G. Veni), 1 male.

Comments.—This species is present in caves throughout Central Texas and the Edwards Plateau. It builds tangled webs under rocks but can also be found actively crawling on the underside of rocks and in the open.

Dictyna sp.

Records.—*Bexar County*: Hornet's Last Laugh Pit, 3 June 2002 (J. Fant, C. Savvas), 1 female; Kick Start Cave, 30 May 2002 (G. McDaniel, C. Savvas), 1 immature.

Family Filistatidae
Filistatinella sp.

Record.—*Bexar County*: Record Fire 1 Cave, 30 Nov. 1993 (G. Veni), 1 male, 1 immature.

Comments.—The ecological status of this species is uncertain. The genus has been found in other Texas caves.

Family Gnaphosidae
Drassyllus sp.

Drassyllus sp.: Reddell, 1964:11; 1965:171; 1988:34; Veni, 1988:211.

Records.—*Comal County*: Bracken Bat Cave, 19 Jan. 1963 (D. McKenzie, J. Reddell), 4 subadult females (det. W. J. Gertsch) (AMNH); Robber Baron Cave (Reddell, 1988).

Comment.—This is an accidental.

Drassyllus gynosaphes Chamberlin

Record.—*Bexar County*: Backhole, 7 June 1994 (J. Ivy, G. Veni), 1 female.

Comment.—This is an accidental.

Scotophaeus blackwalli (Thorell)?

Herpyllus blackwalli: Eads, Wiseman, and Menzies, 1947:238; Reddell, 1964:11; 1965:171.

Record.—*Comal County*: Bracken Bat Cave (Eads, Wiseman, and Menzies, 1947).

Comments.—The identity of this cosmopolitan species should be verified. It has been reported from the entrance area of several bat caves in Central Texas; yet, in the revision of the genus, Platnick and Shadab (1977) listed no records for this genus from Texas.

Zelotes pseustes Chamberlin

Record.—*Bexar County*: Vera Cruz Shaft, 22 April 1999 (M. Reyes), 1 female.

Comment.—This is an accidental.

Family Hahniidae

Hahnia (?) sp.

Record.—*Bexar County*: Backhole, 20 Sept. 1994 (W. Elliott, J. Ivy), Zone 2, 1 immature.

Comment.—This specimen is too immature for further identification.

Hahnia sp.

Record.—*Comal County*: Washington Cave, Berlese of leaf litter, 21 Nov. 1996 (J. Reddell, M. Reyes), 1 immature.

Comment.—This genus is frequently found in leaf litter below cave entrances.

Hahnia flaviceps Emerton

Record.—*Bexar County*: Stone Oak Parkway Pit, 27 Jan., 6 Feb. 1993 (A. Grubbs), 1 female.

Neoantistea mulaiki Gertsch

Records.—*Bexar County*: Droll Cave, 2 June 1993 (J. Reddell, M. Reyes, G. Veni), 1 female; Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 male.

Family Leptonetidae

Neoleptoneta spp.

Neoleptoneta sp.: Reddell, 1988:34; Veni, 1988:62, 173.
Neoleptoneta spp.: Cokendolpher, 2004b:65.

Records.—*Bexar County*: Bear Cave, 3 July 1968 (J. Reddell, A. R. Smith), 2 immatures (det. W. J. Gertsch) (AMNH); Breached Dam Cave, 4 Oct. 1995 (J. Reddell, M. Reyes), 2 immatures; 31 March 1995 (J. Reddell, M. Reyes), 1 immature; Constant Sorrow Cave (Cokendolpher, 2004b); Cross the Creek Cave (Cokendolpher, 2004b); Kamikazi Cricket Cave, 19 Jan. 1986 (S. J. Harden), 1 female (det. W. J. Gertsch) (AMNH); Lithic Ridge Cave, 1 Oct. 1994 (G. Atkinson, L. Palit), 1 immature; Madla's Drop Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 male; Young Cave No. 1, 6 Sept. 1993 (J. Reddell, M. Reyes), 1 male.

Comal County: Deepwater Cave, 19 Oct. 1985 (A. Cobb), 1 female (det. W. J. Gertsch) (AMNH).

Comment.—Specimens from these caves (except Cross the Creek Cave which may be *N. bullis*) appear to represent one or more undescribed species.

Neoleptoneta bullis Cokendolpher

Neoleptoneta bullis Cokendolpher, 2004b:65-68, figs. 1-9.

Record.—*Bexar County*: Up the Creek Cave (Cokendolpher, 2004b).

Comments.—This species is known only from this cave. It possesses small eyes but may be troglobitic.

Neoleptoneta coeca (Chamberlin and Ivie)

Leptoneta sp.: Reddell, 1964:41.
Leptoneta spp.: Reddell, 1965:172.
Leptoneta coeca Chamberlin and Ivie, 1942:10, 84-85, fig. 9; Reddell, 1965:172; Gertsch, 1974:165, 167, 169, 170-171, figs. 50, 80, 67-68.
Neoleptoneta coeca: Cokendolpher, 2004b:64.

Records.—*Comal County*: Brehmmer Cave (Chamberlin and Ivie, 1942); Natural Bridge Caverns, 2 Sept. 1978 (A.G. Grubbs), 1 female, 1 immature (det. W. J. Gertsch as *Leptoneta*) (AMNH); 23 Sept. 1989 (O. Knox, J. Reddell, M. Reyes), 1 female lacking abdomen) (det. W. J. Gertsch) (AMNH).

Comments.—Brehmmer Cave is the correct name for Heidrich Cave used by Chamberlin and Ivie (1942). The specimens collected from Natural Bridge Caverns have not been re-examined but are presumably this species.

Neoleptoneta microps (Gertsch)

Leptoneta spp.: Reddell, 1970:405.
Leptoneta microps Gertsch, 1974:165, 169, 172-173, figs. 53, 77.
Neoleptoneta microps: Reddell, 1988:34; Veni, 1988:141; Cokendolpher, 200b:64.

Record.—*Bexar County*: Government Canyon Bat Cave (Gertsch, 1974).

Comment.—This endangered species is a troglobite.

Family Linyphiidae
Undetermined genus and species

Linyphiidae unidentified genus and species: Reddell, 1970:405.
Linyphiidae undetermined genus and species: Reddell, 1988:34.
Linyphiidae genus and species: Veni, 1988:249.

Records.—*Bexar County*: B-52 Cave, 6 Dec. 1994 (W. Elliott, J. Ivy), Zone 2, 1 immature; Black Cat Cave, 8 March 1987 (J. Reddell, M. Reyes), 2 immatures; Cave of the Skinny Snake, 2 June 1993 (J. Loftin, G. Veni), 1 immature; Dos Viboras Cave, 6 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Eagles Nest Cave, 5 April 1996 (W. Elliott), Zone 3, 1 immature; Zone 4, 1 immature; Flying Buzzworm Cave, 9 Jan. 1995 (J. Reddell, M. Reyes), 1 immature; Goat Cave, 24 May 1998 (J. Reddell, M. Reyes), 1 male; Berlese of leaf litter and bird nest, 24 May 1998 (J. Reddell, M. Reyes), 1 immature; Government Canyon Bat Cave, 24 May 1993 (J. Reddell, M. Reyes), 1 immature; Haz Mat Pit, 24 March 1998 (J. Reddell, M. Reyes), 1 immature; Isopit, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Madla's Cave, 24 May 1993 (J. Reddell, M. Reyes), Berlese of litter, 8 immatures; MARS Cave, 29 March 1995 (J. Reddell, M. Reyes), 1 immature; Scorpion Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Two Raccoon Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Underwater Cave, 30 July 1983 (G. Veni, R. Waters), 1 immature; Wurzbach Bat Cave, 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature; 22 May 1993 (J. Reddell, M. Reyes), Berlese of litter, 4 immatures.

Comal County: Rittiman Cave (Reddell, 1970); Snake Skin Pit, 19 Nov. 1996 (W. Elliott), 1 immature.

Comment.—The material is too immature to permit further identification.

Agyneta (?) sp.

Records.—*Bexar County*: Eagles Nest Cave, 15 Nov. 1993 (J. Ivy, L. McNatt, G. Veni), 2 immatures; 15 March 1994 (J. Ivy), Zone 3, 1 immature; Lone Gunman Pit, 10 Oct. 1997 (P. Sprouse, G. Veni), 1 immature; Wurzbach Bat Cave, 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 1 female.

Agyneta sp.

Meioneta sp.: Reddell, 1964:34; 1965:173; 1970: 406; 1988:35; Veni, 1988:64, 69, 90, 169.

Records.—*Bexar County*: Bear Cave, 3 July 1968 (J. Reddell, A. R. Smith), 2 females (det. W. J. Gertsch as *Meioneta* sp.) (AMNH); Black Cat Cave, 28 Nov. 1982 (S. Harden, R. Waters), 1 female (det. W. J. Gertsch as *Meioneta*) (AMNH); Cave, site #601, Stone Oak Karst Region north of Loop 1604 and U.S. 281 intersection, 12 Sept. 1999 (K. White), 5 immatures; Christmas Cave, 25 Dec. 1982 (R. Waters), 1 male (det. W. J. Gertsch as *Meioneta*) (AMNH); Elm Springs Cave (Reddell, 1988); Flying Buzzworm Cave, 9 Jan. 1995 (J. Reddell, M. Reyes), 1 immature; Forked Pit, 13 June 1993 (J. Loftin, S. Woods), 1 female; Game Pasture Cave No. 1, 2 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; Government Canyon Bat Cave, 11 Aug. 1965 (J. Fish, J. Reddell), 1 female (det. W. J. Gertsch as *Meioneta*) (AMNH); Holy Smoke Cave, 27 Sept. 2000 (C. Savvas), 2 immatures; Isopit Cave (Reddell, 1988); Max and Roberts Cave (=SWCA cave site no. 3008), Culebra Anticline, 28 Sept. 2000 (H. Bechtol, K. White), 1 immature; Rattlesnake Cave, 19 July 1989 (A. Cobb), 2 males, 6 females, 1 immature (det. W. J. Gertsch as *Meioneta*) (AMNH); Wurzbach Bat Cave, 4-5 Jan. 1984 (S. Harden), 2 males, 2 females (det. W. J. Gertsch as *Meioneta*) (AMNH).

Comal County: Bad Weather Pit, 3 Sept. 1972 (R. Fieseler), 1 female (det. W. J. Gertsch as *Meioneta*) (AMNH); Fischer's Cave, 14 July 1989 (A. Grubbs, A.H., C.T.), 1 male, 6 females (det. W. J. Gertsch as *Meioneta*) (AMNH); Kappelman Cave, 9 March 1968 (J. Reddell), 1 female (det. W. J. Gertsch as *Meioneta*) (AMNH); Kappelman Salamander Cave, 15 March 1964 (J. Reddell, B. Russell) (det. W. J. Gertsch as *Meioneta*) (AMNH); Klar's Cave (Reddell, 1965); Wyley's Cave, 23 Feb. 1988 (A. Cobb, G. Veni), 1 female (det. W. J. Gertsch as *Meioneta*) (AMNH).

Comments.—Specimens identified by W. J. Gertsch as *Meioneta* and many of the immatures likely belong to *A. llanoensis*. Further study will be required for confirmation.

Agyneta llanoensis (Gertsch and Davis)

Records.—*Bexar County*: Cave, site #602, Stone Oak Karst Region north of Loop 1604 and U.S. 281 intersection, 12 Sept. 1999 (K. White), 1 female, 1 immature; Cave, site #603, Stone Oak Karst Region north of Loop 1604 and U.S. 281 intersection, 12 Sept. 1999 (K. White), 1 female; B-52 Cave, 6 Dec. 1994 (W. Elliott, J. Ivy), 1 male; 10 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 1 male, 2 females, 1 immature; Bunny Hole, 24 Oct. 1994 (J. Reddell, M. Reyes), 2 females, 2 immatures; 31 March 1995 (J. Reddell, M. Reyes), 1 female; 9 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 2 males, 4 females; Cannonball Cave, 6-7 Nov. 2001 (P. Sprouse), 1 female, 1 immature; 21 Nov. 2001 (J. Reddell, M. Reyes), 1 female; 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 female, 1 immature; Dangerfield Cave, 5 Dec. 1997 (G. Veni), 1 female; 25 Jan. 1999 (P. Sprouse, G. Veni), 1 male, 3 females, 1 immature; 21 April 1999 (J. Reddell, M. Reyes), 7 females; 31 Oct. 2000 (J. Reddell, M. Reyes), 3 males, 3 females, 2 immatures; Dogleg Cave, 25 March 1998 (M. Reyes), 1 male, 2 females; Droll Cave, 2 June 1993 (J. Reddell, M. Reyes, G. Veni), 1 female; Eagles Nest Cave, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 female; Elm Springs Cave, no date (A. Grubbs), 1 male, 1 female, 1 immature; Elm Water Hole Cave, 10-11 May 2000 (M. Reyes), 2 females; Government Canyon Bat Cave, 24 May 1998 (J. Reddell, M. Reyes), 2 males, 2 females; Hairy Tooth Cave, 21 Jan. 1994 (W. Elliott, J. Ivy, G. Veni), 3 males; King Toad Cave, 1 June 1993 (J. Loftin, M. Reyes), 1 female; Linda's First Cave (Find), 13 June 1993, L. Loftin, J. Loftin, W. Woods), 1 female; Lone Gunman Pit, 8 Sept. 1998 (J. Cokendolpher, M. Reyes), 1 female; 21 April 1999 (J. Reddell, M. Reyes), 1 female [matured 15 June 1999]; Low Priority Cave, 29 March 1995 (J. Reddell, M. Reyes), 1 female, 1 immature; Max and Roberts Cave (=SWCA cave site No. 3007), Culebra Anticline, 28 Sept. 2000 (H. Bechtol, K. White), 1 female; Meusebach Flats Cave, 21 Nov. 1997 (G. Veni), 1 male; Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 male, 1 female; Peace Pipe Cave, 7 March 2001 (G. Veni), 1 female; 17 April 2001 (J. Reddell, M. Reyes), 1 female; Porcupine Parlor Cave, 29 March 2001 (G. Veni), 1 female; 18 April 2001 (J. Reddell, M. Reyes), 2 immatures; Raging Cajun Cave, no date (A. Grubbs), 1 female; Root Canal Cave, 7 Sept. 1998 (J. Reddell, M. Reyes), 2 immatures; 20 April 1999 (J. Reddell, M. Reyes), 1 male; 26 Oct. 2001 (J. Krejca, P. Sprouse), 1 female; Root Toupee Cave, 1 Nov. 2000 (J. Reddell, M. Reyes), 1 male, 3 females; Stevens Ranch Trash Hole Cave, 12 June 1993 (J. Loftin), 1 male, 2 females; Strange Little Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 male, 3 females, 1 immature; 5 Oct. 1995 (J. Reddell, M. Reyes), 1 male, 1 immature; SWCA Cave No. 3, 20 Sept. 2000 (K. White), 2 females; Tin Pot, 6 March 2001 (G. Veni), 1 male; 18 April 2001 (J. Reddell, M. Reyes), 2 males, 2 immatures; Wurzbach Bat Cave, 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 1 female, 2 immatures; 25 June 1993 (D. Bowles, A. Grubbs, J. Reddell, M. Reyes, R. Stanford), 1 female; Yellow Ball Cave, 7 Dec. 1999 (P. Sprouse, G. Veni), 1 female; 17 June 2000 (J. Reddell, M. Reyes), 1 female, 1 immature.

Comal County: Camp Bullis Cave No. 1, 22 Oct. 1996 (G. Veni), 2 males, 1 female, 1 immature; Ebert Cave, 30 Jan. 1988 (J. Reddell, M. Reyes), 1 female; Snakeskin Pit, 1 Nov. 1996 (P. Sprouse, G. Veni), 2 females; 19 Nov. 1996 (W. Elliott), Zone 2, 1 female.

Comments.—This species is extremely abundant in caves throughout Central Texas. It is usually found hanging from webs on cave walls.

Eperigone sp.

Eperigone sp.: Reddell, 1988:34-35.

Records.—*Bexar County*: Isopit, 1984 (R. Waters), 1 male, 1 female (det. W. J. Gertsch) (AMNH); Stealth Cave, 29 Oct. 1997 (P. Sprouse, G. Veni), 2 females, 2 immatures.

Comment.—The material will require further study.

Eperigone albula Zorsch and Crosby

Records.—*Bexar County*: Bob Wire Cave, 8.4 miles NW Helotes, 5 Aug. 1994 (A. G. Grubbs), 1 male, 1 immature; Eagles Nest Cave, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 female; 20 April 1999 (J. Reddell, M. Reyes), 1 male, 20 females, 19 immatures; Elm Water Hole Cave, 10-11 May 2000 (M. Reyes), 2 females; Leon Hill Cave, 24 May 2003 (J. Reddell, M. Reyes), 1 female; Record Fire 1 Pit, 18 Nov. 1993(J. Ivy, J. Treviño, G. Veni), 1 female; Toad Cave, no date (A. G. Grubbs), 1 male; Up the Creek Cave, 22 April 1999 (J. Reddell, M. Reyes), 1 male.

Comal County: Washington Cave, 21 Nov. 1996 (J. Reddell, M. Reyes), 1 female.

Comment.—This tiny spider is most often obtained in Berlese extraction of leaf litter from the caves (Cokendolpher and Buckle, 2004).

Eperigone maculata (Banks)

Records.—*Bexar County*: Backhole, 20 Sept. 1994 (W. Elliott, J. Ivy), Zone 2, 1 male, 2 immatures; Haz Mat Pit, 30 April 2003 (J. Reddell, M. Reyes), 1 female);

Kamikazi Cricket Cave, no date (A. Grubbs), 3 females, 1 immature; Madla's Cave, 24 May 1993 (J. Reddell, M. Reyes), Berlese of litter, 1 female; Madla's Drop Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; Persimmon Pit, no date (A. Grubbs), 1 female, 1 immature; Stevens Ranch Cave No. 1, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 2 females; Stone Oak Parkway Pit, 27 Jan., 6 Feb. 1993 (A. Grubbs), 1 male, 1 female, 4 immatures.

Comal County: Camp Bullis Bad Air Cave, 23 Oct. 1996 (P. Sprouse, G. Veni), 1 female; Washington Cave, 21 Nov. 1996 (J. Reddell, M. Reyes), 1 female.

Comment.—This species is frequently found as a troglophile in Texas caves.

Erigone n. sp.

Record.—*Bexar County*: Young Cave No. 1, 6 Sept. 1993 (J. Reddell, M. Reyes), 1 female.

Comment.—This is a blind species.

Family Liocranidae
Phrurotimpus sp.

Records.—*Bexar County*: Raging Cajun Cave, 22 Jan. 1994 (W. Elliott, J. Ivy, L. Palit, G. Veni), 1 immature; Wurzbach Bat Cave, 22 May 1993 (J. Loftin, J. Reddell, M. Reyes), 1 female.

Comment.—This is an accidental.

Scotinella sp.

Record.—*Bexar County*: Record Fire 1 Cave, 30 Nov. 1993 (G. Veni), 1 male.

Comments.—The identity of this species will require further study. It is an accidental.

Family Lycosidae
Undetermined genus and species

Records.—*Bexar County*: Constant Sorrow Cave, 8 Feb. 2001 (G. Veni), 1 immature; Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 immature.

Comal County: Python Pit, 12 March 1988 (M. Ulmer, G. Veni), 1 immature.

Comment.—This material is too immature to allow further identification.

Pardosa sp.

Record.—*Bexar County*: Georg's Hole, 25 Oct. 1996 (G. Veni), 2 immatures; 10 Nov. 1996 (B. Johnson), Zone 1, 1 immature.

Comment.—This is an accidental.

Pirata davisi Wallace and Exline

Pirata sp.: Reddell, 1970:406.
Pirata davisi Wallace and Exline, 1978:87-89, figs. 181-186; Reddell, 1988:35; Veni, 1988:77.

Records.—*Bexar County*: Bullis Hole (Reddell, 1970), 6 Oct. 1996 (G. Veni), 1 female, 1 immature; 20 Nov. 1996 (W. Elliott), Zone 2, 2 immatures.

Comment.—This is an accidental.

Rabidosa rabida (Walckenaer)

Records.—*Bexar County*: Backhole, 7 June 1994 (J. Ivy, G. Veni), 1 immature; Linda's First Cave (Find), 13 June 1993 (J. Loftin, L. Loftin, S. Woods), 1 immature; Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 female.

Comal County: Bain's Cave, 19 & 25 July 1987 (A. Cobb, J. Ivy, L. Palit, G. Veni), 1 female.

Comment.—This accidental is occasionally found in cave entrance areas.

Schizocosa saltatrix (Hentz)

Schizocosa saltatrix: Reddell, 1988:35; Veni, 1988:81, 83.

Records.—*Bexar County*: Ailor Hill Cave, 24 May 2003 (J. Reddell, M. Reyes), 1 female; Cave of the Bearded Tree, April 1982 (G. Veni), 1 male; Cave of the Half-Snake, April 1982 (G. Veni), 1 female.

Comment.—This accidental is occasionally found in cave entrance areas.

Family Miturgidae
Teminius affinis Banks

Records.—*Bexar County*: Backhole, 7 June 1994 (J. Ivy, G. Veni), 1 female; Banzai Mud Dauber Cave, 5 Dec. 1994 (C. Savvas, P. Sprouse), 1 immature; Hornet's Last Laugh Pit, 9 June 2002 (J. Reddell, M. Reyes), 1 immature; Power Pole 60 Feature, 30 April 2003 (J. Reddell, M. Reyes, G. Veni), 1 female; Strange Little Cave, 5 Oct. 1995 (J. Reddell, M. Reyes), 1 immature.

Comments.— The immatures are probably this species because it is the only member of the genus from this region. The ecological status of this species is unknown, but it has been found in several caves in Central Texas.

Family Nesticidae
Eidmannella sp.

Records.—*Comal County*: Bad Weather Pit (det. W. J. Gertsch) (AMNH); Python Pit, 12 March 1988

(M. Ulmer, G. Veni), 1 immature (det. W. J. Gertsch) (AMNH); Natural Bridge Caverns, 23 Sept. 1989 (O. Knox, J. Reddell, M. Reyes), 1 female (det. W. J. Gertsch) (AMNH); 1 March 1990 (O. Knox, J. Reddell, M. Reyes), 1 female (det. W. J. Gertsch) (AMNH).

Comments.—The specimens from Natural Bridge Caverns have the eyes reduced and may belong to *E. rostrata*.

Eidmannella sp. (blind)

Nesticus, blind species: Reddell, 1964:33.
Nesticus sp.: Reddell, 1965:174 [part—Kappelman Cave record only].

Records.—*Bexar County*: Madla's Cave, 7 June 1969 (R. Bartholomew), 1 female (det. W. J. Gertsch as *Nesticus pallidus*) (AMNH).

Comal County: Double Decker Cave, 5 Feb. 1978 (G. Darilek, T. Mills, D. Montgomery), 1 penultimate male (det. W. J. Gertsch) (AMNH); Kappelman Cave, 9 March 1968 (J. Reddell), 2 immatures (det. W. J. Gertsch as *Nesticus pallidus*) (AMNH); Tall Tales Cave, 17 Jan. 2000 (J. Reddell, M. Reyes), 1 immature.

Comment.—This material may belong to *E. rostrata*.

Eidmannella sp. prob. *pallida* Emerton

Records.—*Bexar County*: Dos Viboras Cave, Zone 2, 14 Dec. 1994 (W. Elliott, G. McDaniel), 1 immature; Zone 3, 1 immature; Hills and Dales Pit, Nov. 2000 (K. White), 1 immature; SARA Site 4 Cave, 17 Nov. 1993 (G. Veni), 1 immature; 6 June 1994 (J. Ivy, G. Veni), 1 immature; Stealth Cave, 25 Jan. 2000 (J. Reddell, M. Reyes), 1 immature; 14 Dec. 2000 (J. Reddell, M. Reyes), 3 immatures; Vera Cruz Shaft, 15 Dec. 2000 (M. Reyes), 1 immature.

Comal County: Coreth Bat Cave, 28 Oct. 1995 (J. Reddell, M. Reyes), 2 immatures.

Eidmannella pallida Emerton

Nesticus pallidus: Reddell, 1970:407 [part—Government Canyon Bat Cave record only].
Eidmannella pallida: Gertsch, 1984:54-60, 89-90, figs. 249-280, map 8; Reddell, 1988:35 [all records except Headquarters Cave]; Veni, 1988:141, 253; Cokendolpher and Reddell, 2001:27-28.
Eidmannella rostrata: Reddell, 1988:35 [misidentification; part—Dirtwater Cave record only]; Veni, 1988:110 [misidentification].

Records.—*Bexar County*: Cave site #303, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 female; Cave site #305, west of Helotes (Cokendolpher and Reddell, 2001); Cave site #701, west of Helotes, 1999 (K. White), 1 male, 4 females, 5 immatures; Alligator Lizard Cave (=Wren Cave), 8.3 mi. NW Helotes (Cokendolpher and Reddell, 2001); Black Cat Cave, 27 Jan. 1987 (J. Reddell, M. Reyes), 2 penultimate males (det. W. J. Gertsch) (AMNH); Caracol Creek Coon Cave, 26 Aug. 1987 (A. Cobb, S. Harden), 2 females (det. W. J. Gertsch) (AMNH); Dirtwater Cave, 2 Aug. 1983 (J. Ivy, G. Veni), 1 immature; I Think It's A Cave, 16 July 1987 (J. Ivy, G. Veni), 1 female (det. W. J. Gertsch (AMNH); Kamikazi Cricket Cave (Cokendolpher and Reddell, 2001); Max and Roberts Cave (SWCA no. 3007, 3008), Culebra Anticline, 28 Sept. 2000 (H. Bechtol, K. White), 3 females, 1 immature; Persimmon Pit, no date (A. Grubbs), 1 male, 1 immature; Porcupine Squeeze Cave (=Grubbs Cave No. 189), 6.1 km NE Helotes (Cokendolpher and Reddell, 2001); Robber Baron Cave (Cokendolpher and Reddell, 2001); SARA Site 4 Cave (Cokendolpher and Reddell, 2001); Stealth Cave, Camp Bullis (Cokendolpher and Reddell, 2001); Stevens Ranch Cave No. 1 (Cokendolpher and Reddell, 2001); Toad Cave, no date (A. Grubbs), 1 male; Voight's Bat Cave (Cokendolpher and Reddell, 2001); Young Cave No. 1 (Cokendolpher and Reddell, 2001).

Comal County: Bender's Cave, 17 July 1966 (J. Reddell, W. Russell), 1 immature (det. W. J. Gertsch) (AMNH); Brehmmer Cave (=Heidrich's Cave) (Gertsch, 1984); Coreth Bat Cave (Cokendolpher and Reddell, 2001); Grosser's Cave, 9 April 1967 (S. Fowler) (det. W. J. Gertsch) (AMNH).

Comments.—This species is extremely abundant in caves throughout Texas and parts of Mexico. It is a troglophile usually found hanging from webs along cave walls.

Eidmannella sp. prob. *rostrata* Gertsch

Eidmannella sp. [prob. *rostrata*]: Cokendolpher and Reddell, 2001:26.

Records.—*Bexar County*: Dirtwater Cave (Cokendolpher and Reddell, 2001); Dos Viboras Cave (Cokendolpher and Reddell, 2001); Georg's Hole, Zone 1, 10 Nov. 1996 (B. Johnson), 1 immature; Glinn's Gloat Hole (Cokendolpher and Reddell, 2001); Jabba's Giant Sink (Cokendolpher and Reddell, 2001); Madla's Cave, 7 June 1969 (R. Bartholomew), 1 female (det. W. J. Gertsch as *Nesticus pallidus*) (AMNH); Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 immature; Root Toupee Cave, 1 Nov. 2000 (J. Reddell, M. Reyes), 1 immatures; Stevens Ranch Cave No. 1 (Cokendolpher and Reddell, 2001); Two Hit Cave (Cokendolpher and Reddell, 2001).

Comal County: Camp Bullis Cave No. 1 (Cokendolpher and Reddell, 2001); Camp Bullis Cave No. 3 (Cokendolpher and Reddell, 2001); Double Decker Cave, 5 Feb. 1978 (G. Darilek, T. Mills, D. Montgomery), 1 penultimate male (det. W. J. Gertsch (AMNH); Kappelman Cave, 9 March 1968 (J. Reddell), 2 immatures (det. W. J. Gertsch as *Nesticus pallidus*) (AMNH); Tall Tales Cave (Cokendolpher and Reddell, 2001).

Eidmannella rostrata Gertsch

Nesticus sp.: Reddell, 1965:174 [part—Madla's Cave, Hitzfelder's Cave (Hitzfelder's Bone Hole), and Klar's Cave records only]; Reddell, 1970:407.

Nesticus pallidus: Reddell, 1970:407 [misidentification; part—Headquarters Cave record only].

Eidmannella rostrata Gertsch, 1984:60-61, 91, figs. 281-283, map 9; Reddell, 1988:35; Veni, 1988:74, 83, 121, 150, 158, 169, 177, 190, 211, 263; Cokendolpher and Reddell, 2001:28-31, fig. 1.

Eidmannella pallida: Reddell, 1988:35 [misidentification; part—Headquarters Cave record only]; Veni, 1988:146 [misidentification].

Records.—*Bexar County*: Backhole (Cokendolpher and Reddell, 2001); Banzai Mud Dauber Cave (Cokendolpher and Reddell, 2001); Bone Pile Cave, Government Canyon State Natural Area (Cokendolpher and Reddell, 2001); Braken Bat Cave, 22 Nov. 1980 (G. Veni), 1 penultimate male, 1 female (det. W. J. Gertsch) (AMNH); Breached Dam Cave (Cokendolpher and Reddell, 2001); Bullis Hole, Camp Bullis (Cokendolpher and Reddell, 2001); Caracol Creek Coon Cave (Cokendolpher and Reddell, 2001); Cave of the Bearded Tree , April 1982 (G. Veni), 1 female (det. W. J. Gertsch) (AMNH); Cave of the Half-Snake (Cokendolpher and Reddell, 2001); Charley's Cute Little Hole (Cokendolpher and Reddell, 2001); Cross the Creek Cave (Cokendolpher and Reddell, 2001); Eagles Nest Cave (Cokendolpher and Reddell, 2001); F-150 Cave, 11 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 female; Fair Hole (Gertsch, 1984); Flach's Cave (Cokendolpher and Reddell, 2001); Flying Buzzworm Cave (Cokendolpher and Reddell, 2001); Game Pasture Cave No. 1 (Cokendolpher and Reddell, 2001); Georg's Hole (Cokendolpher and Reddell, 2001); Government Canyon Bat Cave, Government Canyon State Natural Area (Cokendolpher and Reddell, 2001); Headquarters Cave (Cokendolpher and Reddell, 2001); Hector Hole, 11 April 2002 (J. Reddell, M. Reyes, G. Veni), 2 females, 1 immature; 15 April 2002 (J. Reddell, M. Reyes), 1 male, 1 female, 2 immatures; Helotes Blowhole (Cokendolpher and Reddell, 2001); Hitzfelder's Bone Hole [=Hitzfeler's Cave] (Gertsch, 1984); Hold Me Back Cave (Cokendolpher and Reddell, 2001); Isocow Cave (Cokendolpher and Reddell, 2001); Isopit (Cokendol-pher and Reddell, 2001); Low Priority Cave (Cokendolpher and Reddell, 2001); Madla's Cave (Gertsch, 1984); MARS Shaft (Cokendolpher and Reddell, 2001); Mattke Cave (Cokendolpher and Reddell, 2001); Max and Roberts Cave (=SWCA no. 3007, 3008, 3009), Culebra Anticline, 28 Sept. 2000 (H. Bechtol, K. White), 5 males, 16 females, 4 immatures; SWCA no. 3011, 28 Sept. 2000 (H. Bechtol, K. White), 2 females; Poison Ivy Pit (Cokendolpher and Reddell, 2001); Robber Baron Cave (Cokendolpher and Reddell, 2001); Root Canal Cave, 7 Sept. 1998 (J. Reddell, M. Reyes), 1 male [matured 5 Dec. 1998]; Scenic Overlook Cave (=Cave site #2101), Government Canyon Karst Fauna Region (Cokendolpher and Reddell, 2001); Stahl Cave (Cokendolpher and Reddell, 2001); Sunray Cave (=Cave No. 18), 4 mi. NE Helotes (Cokendolpher and Reddell, 2001); Surprise Sink, Government Canyon State Natural Area (Cokendolpher and Reddell, 2001); Up the Creek Cave (Cokendolpher and Reddell, 2001); Winston's Cave (Cokendolpher and Reddell, 2001); Wurzbach Bat Cave (Cokendolpher and Reddell, 2001).

Comal County: Badweather Pit (Gertsch, 1984); Bain's Cave, 19 and 25 July 1987 (A. Cobb, J. Ivy, L. Palit, G. Veni), 3 females (det. W. J. Gertsch) (AMNH); Bender's Cave (Cokendolpher and Reddell, 2001); Camp Bullis Bad Air Cave (Cokendolpher and Reddell, 2001); Camp Bullis Bat Cave (Cokendolpher and Reddell (2001); Camp Bullis Cave No. 1 (Cokendolpher and Reddell, 2001); Camp Bullis Cave No. 3 (Cokendolpher and Reddell, 2001); Ebert Cave (Cokendolpher and Reddell, 2001); Grosser's Cave (=Grosser's-Saur's Sink) (Cokendolpher and Reddell, 2001); Just Now Cave (Cokendolpher and Reddell, 2001); Klar's Cave (Cokendolpher and Reddell, 2001); Knee Deep Cave, 9 Aug. 1984 (S. Harden), 1 immature (det. W. J. Gertsch); 5 May 1985 (J. Reddell, M. Reyes), 1 male, 1 female, 3 immatures); Natural Bridge Caverns (Cokendolpher and Reddell, 2001); Preserve Cave, Honey Creek Preserve (Cokendolpher and Reddell, 2001); Snakeskin Pit (Cokendolpher and Reddell, 2001); Strosser's Sink (Gertsch, 1984); Wiley's Cave (Cokendolpher and Reddell, 2001).

Comments.—This species is abundant in the caves of south Central Texas. It is usually found hanging from cave walls. Considerable diversity in the degree of eye development may indicate that more than one species is now listed under this species.

Gaucelmus augustinus Keyserling

Gaucelmus augustinus: Kohls and Jellison, 1948:117; Reddell, 1964:16; 1965:174; 1970:406; Gertsch, 1984:6-11, 70-71, figs. 2-11, 15-16, 23-25, map 1; Reddell, 1988:35; Veni, 1988:267; Cokendolpher and Reddell, 2001:26.

Records.—*Bexar County*: Holy Smoke Cave, 20 Feb. 2000 (G. Veni), 2 females; Lost Pot Hole, Wurzbach Bat Cave, Young Cave No. 1 (Cokendolpher and Reddell, 2001b).

Comal County: Dierk Cave No. 1 (Reddell, 1970; Gertsch, 1984); Brehmmer Cave (=Heidrich's Cave) (Reddell, 1965; Gertsch, 1984); Coreth Bat Cave; Ebert Cave, Fischer Pit (Cokendolpher and Reddell, 2001b); Little Cave (Gertsch, 1984).

Comment.—This troglophile is frequently found in the caves of Texas and northern Mexico.

Family Pholcidae
Modisimus texanus Banks

Modisimus texanus: Reddell, 1988:35; Veni, 1988:181, 190, 258.

Records.—*Bexar County*: Boneyard Pit, 5 Dec. 1994 (R. Corbell, W. Elliott), Zone 1, 1 female, 1 immature; Bullis Hole, 6 Oct. 1996 (G. Veni), 2 males; Linda's First Cave (Find), 13 June 1993 (J. Loftin, L. Loftin, S. Woods), 1 immature; Niche Cave, 31 July 1983 (G. Veni), 1 female (det. W. J. Gertsch) (AMNH); NBC Cave, 15 Dec. 1993 (J. Ivy, L. McNatt, G. Veni), 1 female, 1 immature; Niche Cave, 31 July 1983 (G. Veni); Obvious Little Cave, 14 June 2001 (J. Cokendolpher), 1 female; Poison Ivy Pit, 15 Aug. 1981 (K. Menking, E. Short, G. Veni, R. Waters), 2 females; Record Fire 1 Cave, 30 Nov. 1993 (G. Veni), 2 females; World Newt Cave, 22 Nov. 1980 (G. Veni), 2 females (det. W. J. Gertsch) (AMNH); Wurzbach Bat Cave, 30 Jan. 1988 (A. Grubbs), 1 immature (det. W. J. Gertsch) (AMNH).

Comal County: Bender's Cave, 13 Sept. 1987 (D. Arburn, A. Cobb), 1 male (det. W. J. Gertsch) (AMNH); Brehmmer's Cave, 13 July 1988 (A. Cobb), 1 male (det. W. J. Gertsch) (AMNH); Just Now Cave, 14 Nov. 1996 (P. Sprouse, G. Veni), 1 male; Klar's Cave, 30 Jan. 1988 (M.K. Manning), 1 male (det. W. J. Gertsch) (AMNH).

Comment.—The immatures are probably this species because it is the only member of this genus recorded from the region.

Family Salticidae
Plexippus sp. prob. *paykulli* (Audouin)

Record.—*Bexar County*: Wurzbach Bat Cave, 22 May 1993 (J. Reddell, M. Reyes), Berlese of litter, 1 immature.

Comment.—This is an accidental.

Family Scytodidae
Scytodes sp.

Records.—*Bexar County*: Eagles Nest Cave, 20 April 1999 (J. Reddell, M. Reyes), 1 immature; Valley of Death Cave, 29 March 1994 (J. Reddell, M. Reyes), 1 female.

Scytodes intricata Banks

Record.—*Bexar County*: Strange Little Cave, 5 Oct. 1995 (J. Reddell, M. Reyes), 1 male, 2 immatures.

Comment.—This is probably an accidental.

Family Sicariidae
Loxosceles sp.

Record.—*Bexar County*: Record Fire 1 Cave, 30 Nov. 1993 (G. Veni), 2 immatures.

Loxosceles reclusa Gertsch and Mulaik

Loxosceles reclusa: Reddell, 1988:35.

Record.— *Bexar County*: Roan's Cave, 29 Sept. 1984 (J. Ivy, G. Veni), 1 female.

Comment.—The poisonous brown recluse spider is occasionally found in Texas caves.

Family Tetragnathidae
Undetermined genus and species

Record.—*Bexar County*: Meusebach Flats Cave, 21 Nov. 1997 (G. Veni), 1 immature.

Comment.—This is an accidental.

Leucauge venusta (Walckenaer)

Leucauge venusta: Reddell, 1970:404.

Record.—*Comal County*: Little Gem Cave (Reddell, 1970).

Comment.—This species is an accidental.

Tetragnatha sp.

Tetragnatha sp.: Reddell, 1964:18; 1965:170.

Records.—*Bexar County*: Haz Mat Pit, 24 March 1998 (J. Reddell, M. Reyes), 1 immature.

Comal County: Camp Bullis Cave No. 1, April 1963 (B. Russell), 1 immature (det. W. J. Gertsch) (AMNH).

Comment.—This species is an accidental.

Family Theridiidae
Undetermined genus and species

Record.—*Bexar County*: Cave of the Bee Spirits, 24 April 1983 (R. Waters), 1 immature.

Comment.—This immature is too young for further identification.

Achaearanea? sp.

Record.—*Comal County*: Camp Bullis Cave No. 1, 25 Jan. 2000 (J. Reddell, M. Reyes), 1 immature.

Comment.—This immature was too young for positive identification.

Achaearanea sp. prob. *porteri* (Banks)

Records.—*Bexar County*: Breached Dam Cave, 4 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Bullis Hole, 26 Oct. 1996 (G. Veni), 1 immature; Porcupine Squeeze Cave (=Grubbs Cave No. 189), 6.1 km NE Helotes, 12 Jan. 1995 (A. Grubbs, N. Lake, G. Wade), 4 immatures; Cave of the Skinny Snake, 2 June 1993 (J. Loftin, G. Veni), 1 immature; Constant Sorrow Cave, 6 March 2001 (G. Veni), 1 immature; F-150 Cave, 11 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 immature; Flying Buzzworm Cave, 17 Nov. 1997 (P. Sprouse, G. Veni), 1 immature; Get A Rope Cave, 23 Sept. 2000 (G. Veni), 3 immatures; Hornet's Last Laugh Pit, 9 June 2002 (J. Reddell, M. Reyes), 2 immatures; Ides of March Cave, 15 April 2002 (M. Reyes, G. Veni), 1 immature; John Wagner Ranch Cave No. 3, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 2 immatures; Record Fire 1 Pit, 18 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 immature; Robber Baron Cave, 21 Feb. 1986 (S. J. Harden), 2 immatures (det. W. J. Gertsch) (AMNH); Root Canal Cave, 26 Oct. 1995 (J. Reddell, M. Reyes), 1 immature; Stone Oak Parkway Pit, 27 Jan., 6 Feb. 1993 (A. Grubbs), 2 immatures; Surprise Sink, 24 May 1998 (J. Reddell, M. Reyes), 1 immature; Two Raccoon Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 immature.

Comal County: Kappelman Cave, 9 March 1968 (J. Reddell), 1 immature (det. W. J. Gertsch) (AMNH).

Achaearanea porteri (Banks)

Achaearanea porteri: Reddell, 1964:41; 1965:176; 1988:35; Veni, 1988:55, 64, 82, 110, 169, 173, 251, 258, 263, 267.

Records.—*Bexar County*: Cave, site #301, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 male; Cave, site #306, Government Canyon Karst Fauna Region, Jan. 2000 (H. Bechtol, K. White), 1 male, 1 immature; 40 mm Cave, 29 Nov. 1993 (J. Ivy, J. Reddell, M. Reyes), 1 female, 2 immatures; 5 Nov. 1995 (J. Reddell, M. Reyes), 1 immature; Assassin Cave, 18 Aug. 1985 (A. Cobb), 1 female, 1 immature (det. W. J. Gertsch) (AMNH); Banzai Mud Dauber Cave, 10 Nov. 2000 (J. Krejca, P. Sprouse), 1 immature; 15 Nov. 2000 (J. Krejca, P. Sprouse), 1 female; Bear Cave, 3 July 1968 (J. Reddell, A. R. Smith), 1 female; Boneyard Pit, 5 Dec. 1994 (R. Corbell, W. Elliott), Zone 1, 1 female, 1 immature; 7 Sept. 1998 (J. Cokendolpher, J. Krejca), 1 immature; Bunny Hole, 9 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 1 female; Cave of the Bee Spirits (Reddell, 1988); Charley's Hammer Hole, 9 Jan. 1995 (M. Reyes), 1 female; Cross the Creek Cave, 10 Sept. 1998 (J. Reddell, M. Reyes), 2 females; 31 Oct. 2000 (J. Reddell, M. Reyes), 1 immature; Dirtwater Cave, 2 Aug. 1983 (J. Ivy, G. Veni), 1 female, 1 immature; Dos Viboras Cave, 14 Dec. 1994 (W. Elliott, G. McDaniel), Zone 1, 1 female; Eagles Nest Cave, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 2 females; 15 Nov. 1993 (J. Ivy, L. McNatt, G. Veni), 2 females; 15 March 1994 (W. Elliott, J. Ivy), Zone 1, 2 females, 1 immature; 15 March 1994 (W. Elliott), Zone 2, 1 female, 1 immature; 23 Oct. 1995 (J. Reddell, M. Reyes), 1 female; Goat Cave, 24 May 1998 (J. Reddell, M. Reyes), 2 females; Government Canyon Bat Cave, 24 May 1993 (J. Reddell, M. Reyes), 1 male, 2 females; 24 May 1998 (J. Reddell, M. Reyes), 2 females; Hairy Tooth Cave, 21 Jan. 1994 (W. Elliott, J. Ivy, G. Veni), 1 female; Headquarters Cave, 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 1 female; Hogan's Cave, 21 May 1994 (G. Veni), 1 female; Holy Smoke Cave, 20 Feb. 2000 (G. Veni), 2 females; 7 March 2001 (G. Veni), 2 females; Isocow Cave, 1 female; Isopit, March 1983 (E. Short), 1 female, 1 immature; 15 June 1983 (J. Loftin, J. Reddell, M. Reyes), 1 immature; Kamikazi Cricket Cave, 3 Oct. 1984 (J. Ivy, G. Veni), 1 female; Lithic Ridge Cave, 4 June 1995 (G. Veni), 1 immature; 12 Sept. 2001 (G. Veni), 2 females, 2 immatures; Mattke Cave, 10 June 1993 (D. McKenzie, J. Reddell, M. Reyes), 1 female; Phil's Friggin Line Cave (Cave, site #803), west of Helotes, Nov. 1999 (K. White), 1 male; Poor Boy Baculum Cave, 19 Oct. 1994 (J. Ivy, G. Veni), 1 male; 15 Dec. 1994 (W. Elliott, B. Johnson), 1 immature; Porcupine Parlor Cave, 29 March 2001 (G. Veni), 2 males, 3 females, 5 immatures; Raging Cajun Cave, 22 Jan. 1994 (W. Elliott, J. Ivy, L. Palit, G. Veni), 1 female; Rattlesnake Cave, 19 July 1989 (A. Cobb), 2 females, 1 immature; Scorpion Cave, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 female; Stevens Ranch Cave No. 1, 1 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; Strange Little Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 male, 2 females, 3 immatures;

5 Oct. 1995 (J. Reddell, M. Reyes), 3 females; Tall Tales Cave, 10 Feb. 2000 (G. Veni), 1 female; 12 March 2000 (P. Sprouse), 1 immature; Three Fingers Cave, 22 June 1993 (J. Loftin, J. Reddell, M. Reyes), 1 male, 1 immature; Tin Pot, 6 March 2001 (G. Veni), 2 females; Unknown Cave, 13 Sept. 1984 (S. Harden, G. Veni), 1 female, 1 immature; Up the Creek Cave, 10 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M. Reyes), 1 female, 1 immature; Valley of Death Cave, 29 March 1994 (J. Reddell, M. Reyes), 1 male; Well Done Cave, 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 female, 1 immature; World Newt Cave, 22 Nov. 1980 (G. Veni), 2 females (det. W. J. Gertsch) (AMNH); Young Cave No. 1, 6 Aug. 1983 (J. Ivy, G. Veni), 1 female; 6 Sept. 1993 (J. Reddell, M. Reyes), 1 female.

Comal County: Little Bear Creek Cave, 30 Jan. 1988 (C. Biegert, C. Grant, P. Jauk, D. McKenzie, P. Reavely), 1 female (det. W. J. Gertsch) (AMNH); Natural Bridge Caverns, 13 July 1963 (J. Reddell) (det. W. J. Gertsch) (AMNH).

Comments.—This troglophile has been found in caves throughout Texas. Although most frequently found hanging from webs near cave entrances, it may also live in the dark zone.

Achaearanea tepidariorum (Koch)

Achaearanea tepidariorum: Reddell, 1988:35; Veni, 1988:211.

Record.—*Bexar County*: Robber Baron Cave, 26 Dec. 1980 (G. Veni), 1 female, 1 immature (det. W. J. Gertsch) (AMNH).

Comment.—This species is occasionally found hanging from webs near cave entrances.

Argorydes sp.

Record.—*Bexar County*:?Ailor Hill Cave, 26 May 2003 (B. Shade, G. Venni), 1 immature; John Wagner Ranch Cave No. 3, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 immature.

Comment.—This is probably an accidental.

Dipoena abdita Gertsch and Mulaik

Record.—*Bexar County*: Firing Lane 11 Cave, 5 Oct. 1995 (J. Reddell, M. Reyes), 1 female.

Comment.—This is probably an accidental.

Latrodectus sp.

Latrodectus sp.: Reddell, 1988:35.

Record.—*Bexar County*: Black Widow Pit (Reddell, 1988).

Comment.—This is a sight record.

Latrodectus mactans (Fabricius)

Latrodectus mactans: Kohls and Jellison, 1948:17; Reddell, 1964:37; 1965:177.

Records.—*Bexar County*: Strange Little Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 female.

Comal County: Little Brehmmer-Heidrich Cave (Kohls and Jellison, 1948).

Comment.—Black widow spiders are occasionally found hanging from webs near cave entrances.

Steatoda sp.

Steatoda sp.: Reddell, 1988:35; Veni, 1988:83.

Record.—*Bexar County*: Cave of the Half-Snake, April 1982 (G. Veni), 1 immature (det. W. J. Gertsch) (AMNH).

Comment.—This is probably an accidental.

Tidarren sp. prob. *sisyphoides* (Walckenaer)

Record.—*Bexar County*: Valley of Death Cave, 29 March 1994 (J. Reddell, M. Reyes), 1 immature.

Tidarren sisyphoides (Walckenaer)

Records.—*Bexar County*: B. J. Pit, 22 June 1993 (J. Loftin), 1 female; Bone Pile Cave, 29 Sept. 1996 (G. Veni), 1 female; Buzzard Egg Cave, 29 March 1995 (J. Reddell, M. Reyes), 1 female, 1 immature; Cave of the Skinny Snake, 2 June 1993 (J. Loftin, G. Veni), 2 females; Eagles Nest Cave, 9 Sept. 1998 (J. Reddell, M. Reyes), 2 females; Haz Mat Pit, 8 Sept. 1998 (J. Reddell), 1 female; John Wagner Ranch Cave No. 3, 15 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; Logan's Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, G. Veni), 1 female; Lost Mine Trail Cave, 17 June 1993 (J. Reddell, M. Reyes), 1 female; Winston's Cave, 21 Sept. 1994 (W. Elliott, J. Ivy), Zone 1, 1 female; World News Cave, 14 July 1993 (J. Reddell, M. Reyes), 1 female, 1 immature.

Comment.—This species is frequently found hanging from webs in the entrance area of caves.

Family Thomisidae
Undetermined genus and species

Record.—*Bexar County*: Cave of the Bearded Tree, April 1982 (G. Veni), 1 female (det. W. J. Gertsch) (AMNH).

Comment.—This is an accidental.

Xysticus sp.

Record.—*Bexar County*: Sharron Spring, 6 Nov. 2000 (J. Krejca, P. Sprouse), 1 immature.

Comment.—This specimen was taken from a mophead placed in the mouth of the spring.

Xysticus ferox (Hentz)

Xysticus ferox: Reddell, 1988:35; Veni, 1988:81.

Record.—*Bexar County*: Cave of the Bearded Tree (Reddell, 1988).

Comment.—This is an accidental.

Xysticus funestus Keyserling

Record.—*Bexar County*: Lone Gunman Pit, 1 Nov. 2001 (M. Reyes), 1 male.

Comment.—This is an accidental.

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A NEW SPECIES AND RECORDS OF *PSEUDOCELLUS* (ARACHNIDA: RICINULEI: RICINOIDIDAE) FROM CAVES IN YUCATÁN, MEXICO AND BELIZE

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ABSTRACT

The most highly troglomorphic member of the order is described as a new species of *Pseudocellus*. It is only known from Cebada Cave, Belize. New distribution records are listed and mapped for *Pseudocellus pearsei* (Chamberlin and Ivie) on the Yucatan Peninsula. The first gynandromorphic member of the order is recognized and discussed. Two additional undescribed species of *Pseudocellus* are mentioned from caves in Coahuila, Mexico, and Petén, Guatemala. The record from Cueva Sasaparilla, Rancho Las Pilas, Coahuila, is the most northern record for the order, exceeding that of the previous southern Texas, U.S.A., record.

INTRODUCTION

The arachnid order Ricinulei currently consists of a single family Ricinoididae, three genera (one in Africa and the other two in the Americas), and 56 species (Bonaldo and Pinto-da-Rocha, 2003; Harvey, 2003). Although the species from Africa and Central/South America are generally found in litter and soils, many of those (*Pseudocellus* spp.) from North America and Cuba inhabit caves. As noted by Platnick and Pass (1982), our knowledge of Central American *Pseudocellus* species is still fragmentary. This is also true for *Pseudocellus* from Mexico. Many species have been inadequately described/illustrated and frequently one of the sexes is unknown. Several undescribed species are known from surface litter habitats. During the course of this study, we examined many *Pseudocellus* previously unreported from Mexico and Central American caves including at least three undescribed species. The purpose of the present contribution is to introduce a new troglobitic species and to document other material from caves in the Yucatan Peninsula.

METHODS

All measurements are in mm and were made following the procedure outlined by Cooke and Shadab (1973). We have named the segments of the legs following Shultz (1989). They are coxa, trochanter (= trochanter I of legs III, IV of other authors), femur of legs I, II (= basifemur, telofemur in legs III, IV), patella, basitarsus (= metatarsus), telotarsus (= tarsus). The basifemur of legs III, IV is the same as trochanter II of other authors. Male leg III structure names follow those used by Cokendolpher (2000). Specimens are deposited at the

Texas Memorial Museum unless specifically indicated otherwise. Geographical coordinates are provided for the entrances of caves which have been investigated in recent years. Earlier records were mapped from data presented in Gertsch (1977) and Reddell (1977). This latter publication is especially helpful as it provides details on the locations of the various caves as well as information about the biological, physical, and historical features of the caves. Some additional information was obtained from Reddell (1981).

SYSTEMATICS

Pseudocellus Platnick

Diagnosis.—Body elongate, segment 12 longer than wide, ocelli either absent or an elongated light, translucent region on lateral sides of cephalothorax. Color of body generally pale orange to red; new species recorded below from cave in Guatemala very dark brown, like members of genus *Cryptocellus*.

Comments.—There are eighteen described species of *Pseudocellus* from Cuba, extreme southern U.S.A. and countries south to Panama (Harvey, 2003). Members of the genus are found in caves as well as in ground litter and soils. Those from southern Mexico and northern Central America are mapped in Fig. 1.

Pseudocellus krejcae, new species

Figs. 1-4

Type-data.—Belize: Cayo District, Cebada Cave, 8 May 1998 (J. Krejca), male holotype to be deposited at the American Museum of Natural History, New York.

Distribution.—Known only from the type locality (Fig. 1).

Etymology.—This species is named after Jean Krejca, for her many efforts in biological explorations of caves.

Diagnosis.—Copulatory apparatus with tips of fixed and movable pieces equal in lengths; tip of fixed process ending in single sharp point (Fig. 3). Distance from distal end of tibia to the basitarsal process, much greater than length of basitarsal process (Fig. 2). Tibiae II not enlarged, without clasping spines or tubercles. All leg femora longer than cephalothorax; all legs at least about twice as long as the total length of body (Fig. 4). Eleventh abdominal tergite without median raised area.

Comparisons.—Males similar to *P. sbordonii* (Brignoli) from Chiapas, Mexico, in that leg II is not enlarged or otherwise modified with spines or tubercles and copulatory apparatus ends in single sharp point (Brignoli, 1974: fig. 3G). These two species are easily distinguished by the differences in appendage lengths: those of *P. sbordonii* being much shorter.

Description, male (female unknown).—Total length excluding pygidium 6.72; cucullus 0.89 long, 1.33 greatest width; cephalothorax 1.69 long, greatest width 1.46; abdomen 4.58 long, 2.45 wide and 0.83 tall near front of tergite 12 (where widest). Appendage lengths (Table 1). Entire animal reddish-amber color; abdomen yellowish-amber; central portion of abdominal sternites 11, 12, anterior half of 13 darker reddish-brown; cephalothorax and legs light orangish-brown, distal ends of the leg segments lighter in coloration. Body large and elongate, without scales or obvious megaspines. Cephalothorax longer than wide, unicolorous, without ocelli. Cucullus wider than long, weakly bilobed anteriorly, rounded with base constricted, unicolorous, covered with fine granules, without tubercles. Abdomen dorsoventrally flattened; individual tergites flat or slightly convex, entire dorsal surface of the abdomen slightly depressed. Basal segment of pygidium distally notched, deeply dorsally and weakly ventral. Leg formula II>IV>III>I, with II being about twice as long as other legs. Legs without special armament or other obvious modifications (Fig. 4), no segment unusually widened; all femora approximately equal in width, femur I about 18.5 times as long as maximum width, femur II about 33 times as long as wide. Telotarsus II very elongate. Ends of the telotarsi (especially last two pairs) strongly bilobed and splayed, ventrally covered with brush of setae. Tarsal claws very slender, evenly curved (Fig. 2). Copulatory apparatus

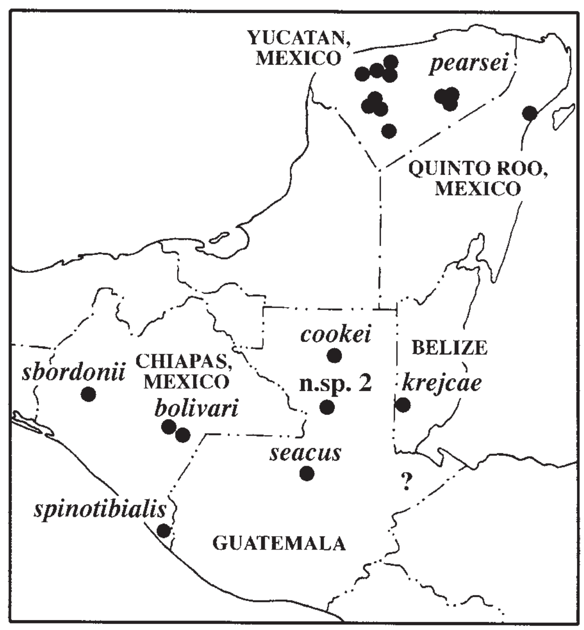


Fig. 1.—Map of northern Middle America depicting distributions of *Pseudocellus*; (from caves): *P. bolivari* (Gertsch), *P. cookei* (Gertsch), *P. krejcae* n. sp., *P. pearsei* (Chamberlin and Ivie), *P. sbordonii* (Brignoli), *P.* n. sp. 2; (surface habitats): *P. seacus* Platnick and Pass, *P. spinotibialis* (Goodnight and Goodnight), and ? = immature specimen described by Ewing (1929).

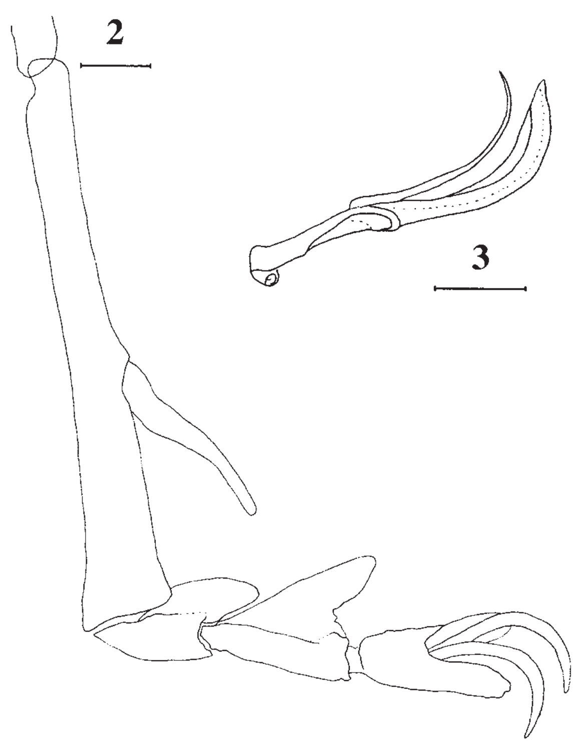
slender and elongate, with fixed process evenly curved anteriorly; tip of fixed process pointed, without enlarged ventral lobe; process strongly grooved, movable piece sheathed by fixed process; movable piece slender, smoothly rounded, ending in single fine tip (Fig. 3).

Comments.—This species is extraordinary in many characters, so much so that it would be easily placed in a separate genus if it were not for the fact that these differences are all related to troglomorphisms. The very elongated, smooth appendages, large body size, lack of ocelli, bilobed leg telotarsi with long claws and tufts of setae are the most obviously troglomorphic characters.

This species is also significant in that it is the most troglomorphic member of the order, thus far encountered. In the previously described more troglomorphic species [*Pseudocellus reddelli* Gertsch and *Pseudocellus sbordonii* (Brignoli) from Durango and Chiapas, Mexico, respectively], femur II is approximately 2-2.5 times the length of the cephalothorax, whereas femur II of the new species is 3.5 times longer than the cephalothorax.

The apparent lack of ocelli may be because the body is so pale in coloration that the lighter colored ocelli do not contrast. This is the case with immatures of other congeners.

The single known specimen was collected from the water surface as it was 'walking' it's way across the surface tension of a still pool that was knee to waist deep



Figs. 2-3.—*Pseudocellus krejcae*, n. sp., male holotype: 2, leg III, anterior view (with copulatory apparatus removed); 3, enlargement of copulatory apparatus, anterior view (scale lines = 0.25 mm).

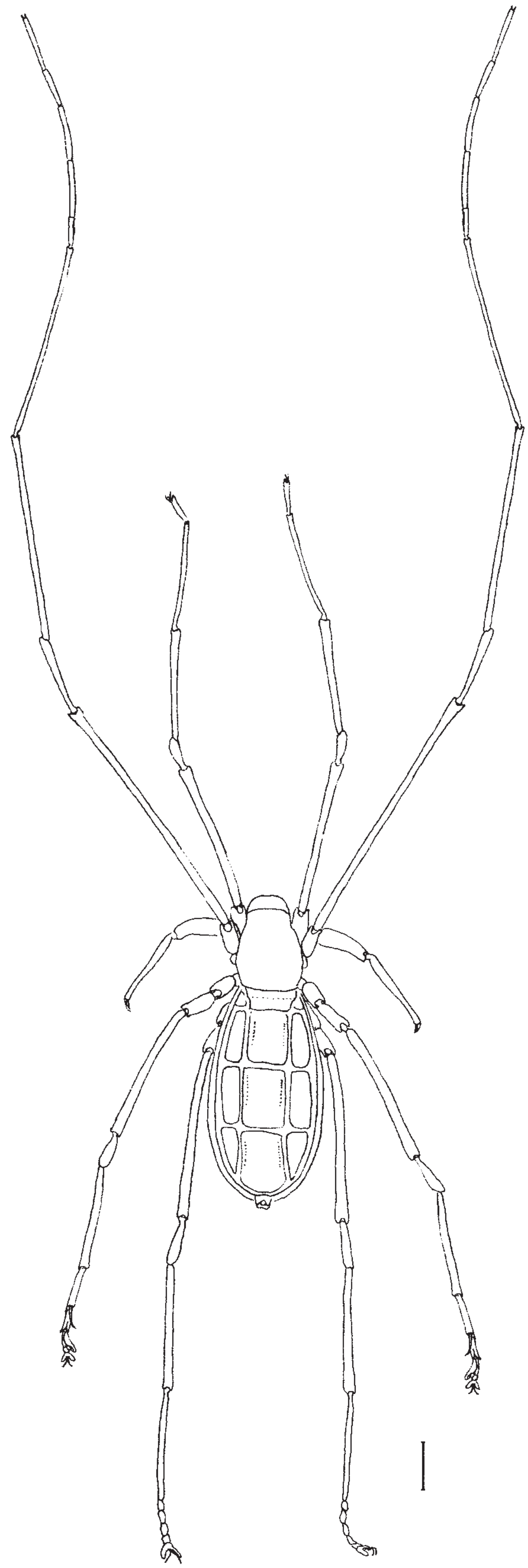


Fig. 4.—*Pseudocellus krejcae*, n. sp., male holotype: 4, dorsal aspect (scale line = 1 mm).

Table 1.-Appendage lengths (/= width of femur) in mm.

Appendage	I	II	III	IV	Palp
Coxa	0.84	0.94	0.84	0.76	0.76
Trochanter	0.68	0.84	0.72	0.78	0.56
Basifemur	—	—	0.76	0.76	0.38
Femur (Telofemur)	3.32 / 0.18	5.98 / 0.18	3.34/0.20	3.70/0.20	1.30
Patella	0.90	1.72	1.04	0.96	—
Tibia	2.64	4.88	2.48	2.74	1.90
Basitarsus	2.76	4.50	1.96	2.08	—
Telotarsus (Tarsus)	0.88	6.12	1.30	1.48	0.29
Total	12.02	24.98	12.44	13.26	5.19

(Krejca, pers. comm., 2003). It is unknown if this species commonly travels over water, but the very elongated slender legs and flattened body would certainly aid in such activity. The leg claws and telotarsi are also very elongate. The ends of the telotarsi (especially last two pairs) are strongly bilobed, splayed and ventrally covered with setae. These modifications could also help keep the animal from breaking the surface tension of the water.

The type locality is part of the longest cave system in Central America. Cebada Cave is a segment in the Chiquibul Cave System of west-central Belize and eastern Guatemala. Over 65 km of large cave passages have been surveyed, including the largest known passages and cave room in the Western Hemisphere. Further details on these remarkable caves and the known biology are presented by Miller (1996), Reddell and Veni (1996), Williams (1996), and Czaplewski et al. (2003). The only known specimen of this species was collected in a section of Cebada Cave called "The Limp." This area of the cave is 5 km due east of the entrance (UTM 269200E, 1842250N).

Pseudocellus pearsei (Chamberlin and Ivie)
Fig. 1

Cryptocellus pearsei Chamberlin and Ivie, 1938:104-107. Gertsch, 1977:134-136.
Pseudocellus pearsei: Platnick, 1980:352; Harvey, 2003:181-182.

New Records.—MEXICO, *Quintana Roo*, Gruta de las Caritas, 8 km N Akumal (20°25'N -87°18'W), 3 July 2003 (F. Devos, J. Mis, J. Reddell, M. Reyes), 2 males, 1 female; Grutas de los Aluxes, Gruta Sur, Pueblo Puerto Aventuras, 4 July 2003 (H. Beltram, F. Devos, J. Reddell, M. Reyes), 2 males. *Yucatán*, Actun Bek, 3.3 km SE San Francisco Grande (UTM 0349433, 2288149, WGS84), 14 July 2003 (J. Reddell, M. Reyes), 3 males, 1 female; Actun Kaua, Kaua, 10 December 2001 (J. Reddell, M. Reyes), 2 males; Actun Olem, 1.4 km N Xbohom (UTM 0346032, 2275404, WGS84), 10 July 2003 (J. Reddell, M. Reyes), 3 males, 1 immature; Actun Oxlodt, 1 km W Kaua, 5 January 2002 (J. Reddell, M. Reyes), 1 male; Cenote Jabin, 1.5 km W Kaua (UTM 0350366, 2280759, WGS84), 5 January 2003 (J. Reddell, M. Reyes), 1 male, 1 female, 1 immature; Cenote Katak Chukum, 2 km SW Kaua (UTM 0349836, 2279276, WGS84), 5 January 2002 (J. Reddell, M. Reyes), 1 male, 1 immature; Cenote Kudzil, 2 km N San Lorenzo (UTM 353911, 2288818, WGS84), 6 January 2003 (J. Reddell, M. Reyes), 3 males, 3 females, 7 immatures; Cenote Xcopteil, 4 km SW Dzeal (UTM 0346969, 2272309, WGS84), 30 December 2002 (J. Reddell, M. Reyes), 2 males, 1 female, 1 immature; 2 January 2003 (J. Reddell, M. Reyes), 1 male, 3 females (TMM), 1 male, 1 female, 1 gynandromorph (Museum of Texas Tech University); Cueva de Agua Escondida, 2 km S Muchucuxcah, 29 December 2001 (J. Reddell, M. Reyes), 3 males; 6 January 2002 (J. Reddell, M. Reyes), 1 male; Cueva de Arrollada, 5.4 km N Kaua (UTM 0351998, 2286338, WGS84), 14 July 2003 (J. Reddell, M. Reyes), 1 female.

Comments.—There is a distinct median raised area on the 11th abdominal tergite of males of this species. Previous authors have not mentioned this character. The tibial II clasping spines on the prolateral side of the males can be much smaller than that illustrated by Gertsch (1977: fig. 6), but are always present. The variation in size is apparently not correlated with geography and in one case males with shorter and longer spines occurred in the same cave. Some males had a normal-sized spine on the prolateral margin and a smaller spine on the retrolateral margin of the tibia. The morphology of the male third legs is indistinguishable.

Gynandromorphs have been recorded from several arachnid orders (Cokendolpher and Sissom, 1988; Reddell and Cokendolpher, 1995). The specimen reported here is the first for the order Ricinulei. It appears to be female except for the right leg III which has a copulatory apparatus. The copulatory apparatus has only the basal piece, the distal pieces apparently broken off. The abdomen lacks the raised area found on males as well as clasping spines on leg tibiae II. The genital lip and spermathecae are of normal female size and shape.

Pseudocellus n. spp.

Comments.—Among the material examined were specimens of two unnamed species. Because these are not from the Yucatan Peninsula, we are not naming the new species here. However, we are providing a few notes which will help others to recognize these species. Although both of the unnamed species are from caves, only the northern species is a troglobite with slender, elongated appendages.

Pseudocellus n. sp. 1.—Mexico, Coahuila, Cueva Sasaparilla, Rancho Las Pilas, 130 km WSW Ciudad Acuña, 23 August 1997 (D. A. Hendrickson, J. Krejca, J. C. Brown), 1 male, 1 female. This locality was listed as "Cueva de Rancho Las Pilas", "90 km SW" of Ciudad Acuña by Hendrickson et al. (2001: p. 318, 328, fig. 1). A brief description of the cave and mention of the ricinulei was also made by those authors. This is an unnamed large troglobitic species with the male tibiae II enlarged. It is similar to *P. osorioi* (Bolívar y Peltain), except that species does not have an enlarged tibia II. This is the most northern record for the order, exceeding that of the southern Texas, U.S.A., record for *P. dorotheae* (Gertsch and Mulaik).

Pseudocellus n. sp. 2.—Guatemala, Petén, Dos Pilas, Sayaxché (16°31'N, 90°10'W), Cueva del Río Murciélagos, 25 March 1993 (A. Cobb, B. Luke), 2 males, 2 immatures; Kaxon Pec (Cave), May 1993 (A. Cobb), 2 females. This is an unnamed species that exhibits no characters suggesting that it is restricted to life in caves. The body is very large and robust. The coloration is very dark brown, almost black. Males have two large pointed tubercles (not connected at base) on tibia I.

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THE HARVESTMAN FAMILY PHALANGODIDAE. 5. NEW RECORDS AND SPECIES OF *TEXELLA* GOODNIGHT AND GOODNIGHT (OPILIONES: LANIATORES)

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ABSTRACT

Seven new species of *Texella* Goodnight and Goodnight are described from central Texas: *T. hartae*, new species, and *T. youngensis*, new species, are plesiomorphic members of the *brevistyla* subgroup; *T. hilgerensis*, new species, *T. whitei*, new species, *T. tuberculata*, new species, and *T. elliotti*, new species, are members of the *mulaiki* infragroup most closely related to *T. cokendolpheri* Ubick and Briggs; and *T. dimopercula*, new species, is a member of the *spinoperca* infragroup. Many new records are provided for previously described species and the biogeography of the genus in central Texas is discussed in the light of the new data. Two previously recorded cavernicole and one epigean species are now known from both cave and surface habitats.

INTRODUCTION

The harvestman genus *Texella* is among the richest and morphologically diverse of the Phalangodidae and exhibits complex patterns of distribution and troglomorphy. In the previous revision (Ubick and Briggs, 1992), we described 21 species, mostly from the Balcones Escarpment of central Texas. Since that time, and as a consequence of diligent collecting efforts of the Texas Speleological Survey, a large collection of *Texella* was made available by James Reddell and Andy Grubbs which greatly exceeds the number of specimens available for the earlier study.

Because of this abundance of specimens coupled with time constraints it has not been possible to fully analyze this new collection. Although most of the new species are here described and new records of known species given, some obvious new species have been omitted. During the course of this work it has become apparent that a thorough description of a species requires careful study of minute male structures, possible only through scanning electron microscopy. Consequently, no attempt has been made to describe apparent new species represented here by only females or unique males. A second omission is a character analysis of *T. reyesi* Ubick and Briggs, which represents the bulk of the new material. It would be interesting to see what effect these additional specimens have on the pattern of clinal variation observed earlier (Ubick and Briggs, 1992). Hopefully, both of these projects can be completed at some future date.

MATERIALS AND METHODS

The format of this study follows that of Ubick and Briggs (1992). Specimens studied using scanning electron microscopy are indicated in the "Material examined" sections as "SEM." All measurements, unless otherwise stated, are in mm.

The majority of the 420 specimens studied are from the Texas Memorial Museum (TMM), the primary types are deposited at the California Academy of Sciences (CAS), and some specimens are with D. Ubick (CDU).

Abbreviations: Penis morphology: AS = apical spine of ventral plate prong, BF = basal fold of stylus, BK = basal knob of glans, BS = basal segment of glans, DS = dorsal setae of ventral plate prong, LS = lateral setae of ventral plate prong, ML = middle lobe of glans, PSL = parastylar lobe (s) of glans, S = stylus, SA = stylar apophysis, VP = ventral plate of penis, VPP = ventral plate prong, VS = ventral setae of ventral plate prong. Somatic morphology:, AT = anterior tubercles of scute, GO = genital operculum, LII/SL = leg II/ scute length, POP = postopercular process, TC = tarsal count, TrIV = trochanter of leg IV

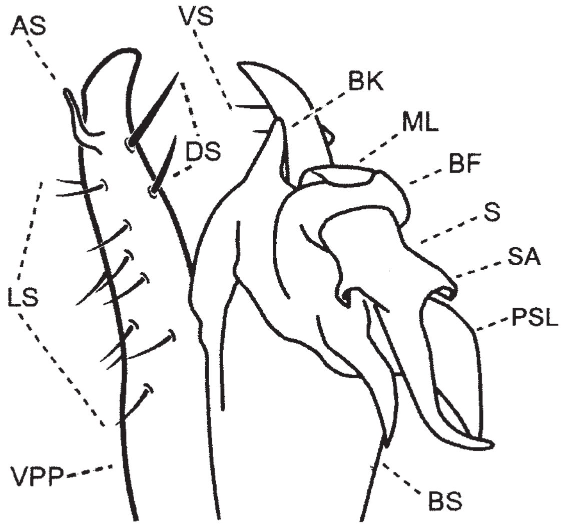
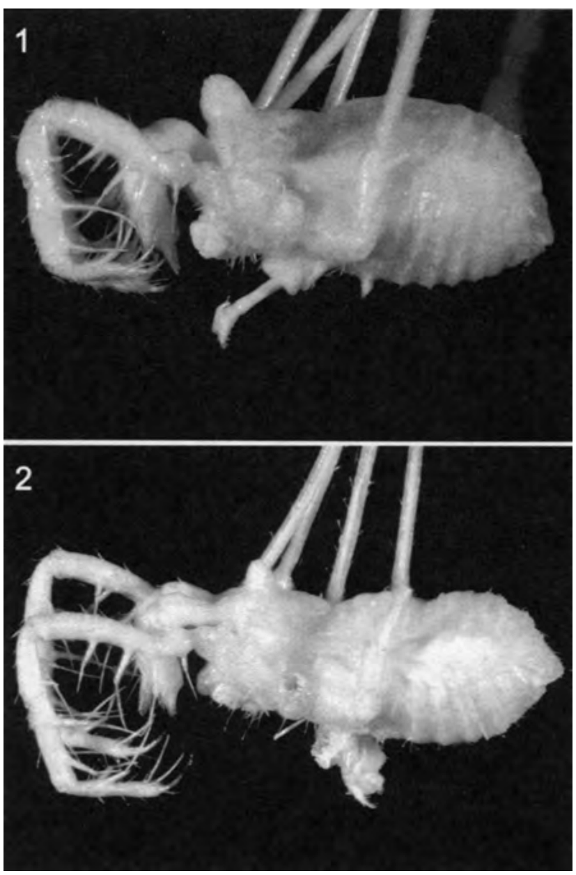


Fig. 3.-*Texella* penis morphology, dorsolateral view.



Figs. 1-2.-Male *Texella cokendolpheri* complex, lateral view of critical point dried specimens imaged with auto-montage. 1–*T. hilgerensis*, new species, troglobite with lower level troglomorphy, showing large eyemound, robust palpi, and moderately developed secondary sexual structures. 2–*T. elliotti*, new species, troglobite with higher level troglomorphy, showing reduced eyemound, slender palpi, and virtual absence of secondary sexual structures.

TAXONOMY

Texella Goodnight and Goodnight, 1942
The *bifurcata* group

Texella bifurcata (Briggs)

Sitalcina bifurcata Briggs, 1968:29.
Texella bifurcata Ubick and Briggs, 1992:174.

New records.–UNITED STATES: California: **Shasta Co**.: Nasoni Creek at Road 27, 122°12.5'W, 40°54.6'N, 8 June 1995 (D. Ubick, DUC), 2 females; Samwell Cave, el. 1450', 30 August 1996 (D. Ubick, DUC), 1 female; Samwell Cave, entrance, 14 April 2000 (J. Ledford, DUC), 1 female.

The *mulaiki* group
The *brevistyla* subgroup

Notes.–This subgroup was previously hypothesized to be the most basal in the *mulaiki* group in lacking both an SA and ML (Ubick and Briggs, 1992). The two new species, which in genital morphology are closest to *T. brevistyla* Ubick and Briggs, give further support to this interpretation by introducing additional plesiomorphies to the subgroup. Both species have a glans that lacks a BF and both have a compressed, rather than tubular, stylus. This is in contrast to the condition in *T. brevistyla* and *T. jungi* Ubick and Briggs, but similar to the state in the most plesiomorphic species groups of *Texella*, *bifurcata* and *kokoweef*. Given these symplesiomorphies, the absence of a BK in these species (also lacking in *brevistyla*, but not in *T. jungi*) is most probably a primitive state, and not a character reversal as in some members of the presumably more distantly related *spinoperca* infragroup.

Texella hartae, new species
Figs. 4-15; Maps 1, 4, 5.

Diagnosis.–This species has transverse bands of maculations on the body and is distinctly darker than others in the *brevistyla* subgroup. The male genitalia have long sinuous PLS, as in *T. brevistyla* and *T. youngensis*, which differ from the former in not being spiraled and from the latter in having double points on the apex (Fig. 8).

Type.–Male holotype from 3.7 mi NE Helotes (Surface site S00), Bexar County, Texas, collected on 28 November 1994 by A.G. Grubbs, deposited in CAS.

Etymology.–The specific name is in honor of the late Margret Hart, a speleologist who worked to preserve the Bexar County karst.

Description.–Total body length, 1.49-1.86. Scute length 1.08-1.30, width 1.05-1.25. Eyemound length 0.25-0.30, width 0.26-0.31, height 0.16-0.22. Leg II length 2.75-3.21, leg II/ scute length 2.32-2.60. (N = 9). Color yellowish-orange to yellowish-brown with transverse bands of dark, granular maculation on opisthosoma and irregular blotches on prosoma; legs brown to dark gray; tarsi white. Body with uniform covering of small tubercles and larger ones scattered on eyemound, dorsally and laterally on scute, and on posterior margins of tergites. Scute with AT in two rows, marginal row of 3-4 tubercles and submarginal row of 2-5 smaller tubercles (Fig. 5). Eyemound a rounded cone, eyes with well developed retina and cornea (Fig. 5). Palpal megaspines: trochanter none; femur 3 ventrobasal, 1 mesodistal; patella 1 ectal, 2 mesal; tibia 2 ectal, 3 mesal; tarsus 2 ectal, 2 mesal (Fig. 6). TC: 3-5-4-5.

Male (holotype): Total body length 1.86. Scute length 1.25, width 1.20. Eyemound length 0.30, width 0.31, height 0.22. GO length 0.29, width 0.32. POP short triangular 0.07. Leg II length 3.14, leg II/ scute length 2.51. TrIV spur short, 0.25 (Fig. 7). Genital operculum triangular, with unmodified anterior margin (Fig. 15). Penis VPP gradually curved ventrally, tapering apically; with 2 dorsal, about 12 lateral, and about 6 ventral setae; AS short, slightly longer than prong width, sharply bent, apically with several short points; Glans: BK absent; ML absent; PSL long ribbonlike, apically with two hooks, longer than stylus; S straight, compressed, tapering, with subapical point; without apparent BF or SA (Figs. 8-11).

Female (allotype): Total body length 1.80. Scute length 1.30, width 1.25. Eyemound length 0.30, width 0.31, height, 0.21. GO length 0.25, width 0.25. Leg II length, 3.08; leg II/ scute length 2.37. Genital operculum rounded with 2 pairs of small teeth apically (Fig. 13). Ovipositor surface with microspines arranged in transverse series, with two apical teeth and 7 pairs of apical setae (Figs. 12, 14).

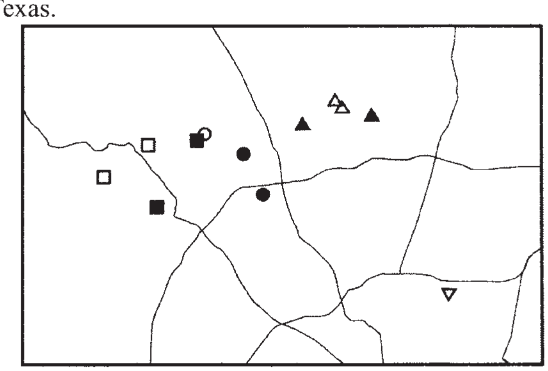
Variation.–Individuals vary in the amount of maculation; the palest (two males from surface site S01) are yellowish to yellowish-orange, the darkest (from surface site S00) are yellowish to grayish brown. AT varies from 3-4 marginal tubercles and 2-5 submarginals. In males the TrIV spur ranges from 0.12-0.25 and the POP from 0.03-0.08.

Sexual dimorphism.–In addition to the secondary sexual processes found on males, the TrIV spur and POP, this species has a conspicuously dimorphic genital operculum which differs in both size and shape between the sexes. In males the operculum is broadly triangular with a length of 0.28-0.30 and a basal width of 0.29-0.32 (N = 6); in females it is more rounded and smaller, 0.20-0.25 long and 0.24-0.25 wide (N = 3). Also in females, the GO apical margin has 2 pairs of teeth which are absent in the male.

Natural history.–This species is known only from epigean habitats.

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Surface sites S 00 and S 01, 3.7 mi NE Helotes, 28 November 1994 (A.G. Grubbs, TMM, CAS), 6 males (holotype, paratypes, SEM), 3 females (allotype, paratypes, SEM); Surface site 101604, 5.5 mi E Helotes, 10 April 1995 (A.G. Grubbs, TMM), 1 female (paratype), 2 juveniles.

Distribution.–Known only from Bexar County, Texas.



Map 1. North central Bexar County showing collection localities of the *Texella cokendolpheri* complex, *T. cokendolpheri* Ubick and Briggs (inverted open triangle), *T. hilgerensis*, new species (open triangles), *T. elliotti*, new species (closed triangles), *T. tuberculata*, new species (open squares), and *T. whitei*, new species (closed squares), and the eastern component of the *brevistyla* subgroup, *T. youngensis*, new species (open circle) and *T. hartae*, new species (closed circles). Lines represent the main roadways to the north of San Antonio.

Texella youngensis, new species
Figs. 16-23; Maps 1, 4, 5.

Diagnosis.–This species is most closely related to *T. brevistyla* and *T. hartae* and differs from the former in not having spiraled PSL and from the latter in having the PSL terminating in a single hook (Figs. 20, 22) and in lacking maculations on the body.

Type.–Male holotype from Young Cave No. 1, Bexar County, Texas collected on 6 September 1993 by J. Reddell and M. Reyes, deposited in CAS.

Etymology.–The specific name refers to the type locality.

Description.–Male (holotype): Total body length 1.57. Scute length 1.15, width 1.10. Eyemound length 0.27, width 0.27, height 0.17. GO length 0.30, width 0.32. POP short triangular 0.07. Leg II length 3.21, leg II/ scute length 2.79. TrIV spur short 0.11 (Fig. 19). Color orange brown; legs brown; tarsi white. Body with uniform covering of small tubercles and larger ones scattered on eyemound, dorsally and laterally on scute, and on posterior margins of tergites (Fig. 16). Scute with AT in two rows, marginal row of 4 tubercles and submarginal row of 2 smaller tubercles (Fig. 17). Eyemound a rounded cone with apical tubercles, eyes with well developed retina and cornea. Palpal megaspines: trochanter none; femur 3 ventrobasal, 1 mesodistal; patella 1 ectal, 2 mesal; tibia 2 ectal, 3 mesal; tarsus 2 ectal, 2 mesal (Fig. 18). TC: 3-5-4-5. Genital operculum triangular, with unmodified anterior margin. Penis: VPP gradually curved ventrally, tapering apically; with 2 dorsal, about 12 lateral, and about 6 ventral setae; AS short, slightly longer than prong width, sharply bent, apically with sparse brush; Glans: BK absent; ML absent; PSL long, ribbonlike, apically with single hook, longer than stylus; S straight, compressed, tapering, lacking subapical point; without apparent BF or SA (Figs. 20-23).

Female: Unknown.

Natural history.–This species is sympatric with *T. whitei*, new species, and another troglobitic opilionid, *Chinquipellobunus madlae* (Goodnight & Goodnight) (Cokendolpher, 2004).

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Young Cave # 1, 6 September 1993 (J. Reddell and M. Reyes, CAS), 2 males (holotype and paratype, SEM).

Distribution.–Known only from Young Cave # 1, Bexar County, Texas.

The *mulaiki* subgroup
The *mulaiki* infragroup

Notes.–In addition to the diagnosis given in Ubick and Briggs (1992), the females in this infragroup differ from most other *Texella* in having ovipositors which lack both microspines and apical teeth. Males have a weakly developed BK, which seems to be absent in at least some species.

Natural history.–All species in this infragroup are troglobites, showing depigmentation and complete eye loss, and are known only from caves. There is variation, however, in other troglomorphic characters, as in appendage length and degree of reduction of the eyemound (compare Figs. 1 and 2).

Texella mulaiki Goodnight and Goodnight
Figs. 24, 25; Maps 2, 4, 5.

Texella mulaiki Goodnight and Goodnight, 1942:10; 1967:6. Ubick and Briggs, 1992:199.

New records.–UNITED STATES: Texas: **Hays Co**.: Ezell's Cave (type locality), San Marcos, 28 October 1967 (J. Reddell, TMM), 1 juvenile; Tricopherous Cave, San Marcos, 20 November 2001 (J. Joost, J. Reddell, M. Reyes, G. Veni, TMM), 1 female. **Travis Co**.: Cave X, 15 June 1996 (M. Sanders, TMM), 1 male; Get Down Cave, Austin, 20 September 1990 (J. Reddell, M. Reyes, G. Veni, TMM), 1 female, 1 juvenile; 24 August 1996 (M. Sanders, TMM), 2 juveniles; 4 August 1997 (M. Sanders, TMM), 1 male; Maple Run Cave, 2 December 1990 (L.J. Graves, TMM), 1 juvenile; 31 January 1991 (J. Reddell, M. Reyes, TMM), 1 male; Salamander Mountain Cave, 11 August 1996 (M. Sanders, TMM), 1 male, 3 females, 2 juveniles; Whirlpool Cave, 12 January 1992 (J. Wolff, TMM), 2 males (SEM).

Distribution.–Known from Hays and Travis counties, Texas.

Texella cokendolpheri complex

Notes.–The following species of the *Texella mulaiki* infragroup, all from Bexar Co., have similar male genitalia and so appear to be closely related. The few observed genitalic differences include the shape and armature of the SA, with the stylar teeth ranging from slender to stout, and the number of setae on the VPP. More differences are evident in the development of the secondary sexual structures: the POP may be absent to over half the length of the genital operculum, and the spur on trochanter IV may likewise be absent to just longer than the trochanter width. Additionally, all species in this complex have at least some thorn-like tubercles on the eyemound, which appear to be absent in other species in the infragroup. The number and size of these thorns, as well as the size of the eyemound, varies between the species in this complex, as does the degree of troglomorphy.

Texella cokendolpheri Ubick and Briggs
Figs. 26, 27, Maps 1, 4, 5.

Texella cokendolpheri Ubick and Briggs, 1992:198.

New record.–UNITED STATES: Texas: **Bexar Co**.: Robber Baron Cave (type locality), E end of Domed Passage, 16 October 1994 (J. Loftin, D. Pearson, TMM), 1 female.

Texella hilgerensis, new species
Figs. 1, 28-39, Maps 1, 4, 5.

Diagnosis.–Males of this species differ from others in the *mulaiki* infragroup in having a POP about one-half the length of the GO and a stout TrIV spur which is longer than the TrIV width (Fig. 34).

Type.–Male holotype, collected in Hilger Hole, Camp Bullis, Bexar Co., Texas, on 7 September 1998 by J. Reddell and M. Reyes, deposited in CAS.

Etymology.–The specific name refers to the type locality.

Description.–Total body length 1.80-1.88. Scute length 1.06-1.34, width 1.02-1.12. Eyemound length 0.30-0.32, width 0.30, height 0.20-0.24. Leg II length 11.3-14.0, leg II/ scute length 9.74-11.2. (N = 3). Color yellowish-white, appendages white. Rugosity smooth (Figs. 28-30). Scute without AT. Eyemound broadly cylindrical, with several apical tubercles, lacking retina and cornea (Fig. 32, 33). Palpal megaspines: trochanter 1 ventral; femur 3 ventrobasal, 1 mesodistal; patella 1 ectal, 1 mesal; tibia 2 ectal, 2 mesal; tarsus 2 ectal, 2 mesal (Fig. 31). TC 4-7-5-5.

Male (holotype): Total body length 1.80. Scute length 1.34, width 1.12. Eyemound length 0.32, width 0.30, height 0.20. GO length 0.25, width 0.21 (Fig. 35). POP 0.12 (Fig. 34). Leg II length 14.02; leg II/ scute length 10.5. TrIV spur 0.20 (Fig. 34). Genitalia (paratype from Well Done Cave). Genital operculum pointed, roughly pentagonal. Penis: VPP curved ventrally, with 2 dorsal, 5 ventral, and 8 lateral setae confined to apical half of prong; AS straight, pointed, about 1/3 VPP width. Glans: BK not evident; ML present; PSL crescent-shaped with 2 subapical lobes, shorter than S; S straight, slender; BF present; SA with long, thin teeth and serrated carina (Figs. 36-39).

Female: Unknown.

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Hilger Hole, Camp Bullis, 7 September 1998 (J. Reddell, M. Reyes, CAS), 1 male (holotype); Well Done Cave, Camp Bullis, 15 April 2002 (J. Reddell, M. Reyes, G. Veni, CAS, TMM), 2 males (paratypes, SEM);

Distribution.–Known only from Bexar County, Texas.

Texella whitei, new species
Figs. 40-59; Maps 1, 4, 5.

Diagnosis.–Males of this species differ from others in the *mulaiki* infragroup in having a POP about half the length of the GO (Figs. 41, 45, 46), a TrIV spur which is slender and straight and slightly less than the width of the TrIV (Figs. 41, 45), and a strongly tuberculate eyemound (Figs. 42, 43, 54, 55).

Type.–Male holotype, collected in Young Cave No. 1, Bexar Co., Texas, on 6 September 1993 by J. Reddell and M. Reyes, deposited in CAS.

Etymology.–The specific name is in honor of Kemble White, collector of this and other interesting species of *Texella*.

Description.–Total body length 1.56-1.86. Scute length 1.20-1.24, width 0.94-1.20. Eyemound length 0.20-0.27, width 0.20-0.28, height 0.18-0.25. Leg II length 11.32-13.04, Leg II/ scute length 9.36-10.87. (N = 4). Color yellowish-white, legs and palpi white. Rugosity fine, body appearing smooth (Figs. 40, 41, 52). Scute with 0-1 pair AT (Figs. 43, 55). Eyemound cylindrical, with several pointed tubercles on top and anterior margin, lacking retina and cornea (Figs. 42, 43, 54, 55). Palpal megaspines: trochanter 1ventral; femur 3 ventrobasal, 1 mesodistal; patella 1 ectal, 1 mesal; tibia 2 ectal, 2 mesal; tarsus 2 ectal, 2 mesal (Figs. 44, 53). TC 4-6 to 8-5-5.

Male holotype: Total body length 1.56. Scute length 1.24, width 1.20. Eyemound length 0.28, width 0.28, height 0.25. GO length 0.27, width 0.25 (Fig. 46). POP 0.08 (Fig. 45, 46). Leg II length 12.9, Leg II / scute length 10.4. Tr IV spur 0.12 (Fig. 45). TC 4-7-5-5. Genital operculum apically pointed, roughly pentagonal (Fig. 46). Penis: VPP bent ventrally, with 2 dorsal, 3 ventral, and about 12 lateral setae. AS short, pointed, about 0.6 VP width. Glans: BK small, ML present, PSL leaflike, scalloped laterally, convex mesally, S tubular, BF present, SA with long pointed basal tooth and weakly serrate carina (Figs. 47-51).

Female (allotype): Total body length 1.86. Scute length 1.20, width 1.10. Eyemound length 0.20, width 0.20, height 0.18. GO length 0.24, width 0.29. Leg II length 11.82, leg II/ scute length 9.85. Tr IV lacking ventral tubercle. TC 4-7/6-5-5. Genital operculum apically rounded (Fig. 57). Ovipositor surface wrinkled, lacking apparent microspines, apical teeth not present, with 7 pairs of apical setae (Figs. 56-58).

Juvenile: Color white. Total body length 1.20. Scute length 1.05, width damaged. Leg II length 11.66, leg II/ scute length 11.10. TC 4-?/7-5/?-5. This is a later, perhaps penultimate, instar.

Variation.–The number and placement of tubercles on the eyemound varies somewhat. The specimen examined with SEM has a small pair of AT which were not present (or visible) in the remaining specimens. The POP varies from 0.08-0.11 and the TrIV spur from 0.10-0.12.

Natural history.–This species is sympatric with *T. youngensis* and a troglobitic opilionid, *Chinquipellobunus madlae* (Goodnight & Goodnight), in Young Cave No. 1 (Cokendolpher, 2004).

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Sir Doug's Cave, site # 802, W of Helotes, November 1999 (K. White, TMM), 1 male (paratype, SEM), 2 females (paratypes, SEM), 1 juvenile; Young Cave No. 1, 6 September 1993 (J. Reddell, M. Reyes, CAS, TMM), 1 male (holotype), 1 female (allotype), 1 juvenile.

Distribution.–Known only from Bexar County, Texas.

Texella tuberculata, new species
Figs. 60-71; Maps 1, 4, 5.

Diagnosis.–Males of this species differ from others in the *mulaiki* infragroup in having a POP about 0.12-0.33 the length of the GO (Figs. 61, 66, 67), a TrIV spur about 0.25-0.33 the width of TrIV (Figs. 61, 66), and a strongly tuberculate eyemound (Figs. 64, 65).

Type.–Male holotype, collected in Surprise Sink (Cave), Government Canyon State Natural Area, Bexar Co., Texas, on 24 May 1998 by J. Reddell and M. Reyes, deposited in CAS.

Etymology.–The specific name refers to the strongly tuberculate eye mound.

Description.–Total body length 1.56-2.00. Scute length 1.06-1.30, width 0.92-1.20. Eyemound length 0.20-0.23, width 0.20-0.25, height 0.15-0.20. Leg II length 10.68-13.56, leg II/ scute length 9.4-11.3. (N = 5). Color yellowish-white, abdomen pinkish-white, legs yellowish, tarsi and palpi white. Rugosity fine, body appearing smooth (Figs. 60-62). Scute without AT. Eyemound cylindrical, with several pointed tubercles apically, lacking retina and cornea (Figs. 60, 61, 64, 65). Palpal megaspines: trochanter 1 ventral; femur 3 ventrobasal, 1 mesodistal (plus small tubercle); patella 1 ectal, 1 mesal (plus tubercle); tibia 2 ectal, 2 mesal; tarsus 2 ectal, 2 mesal (Fig. 63). TC 4-6 to 8-5-5.

Male (holotype): Total body length 1.70. Scute length 1.20, width 1.08. Eyemound length 0.20, width 0.25, height 0.20. GO length 0.24, width 0.25. POP 0.03. Leg II length 13.56, leg II/ scute length 11.3. TrIV spur 0.03. TC 4-8/7-5-5. Genital operculum triangular (Fig. 67). Penis: VPP parallel, bent ventrally, with 2 dorsal, 5 ventral, and 14 lateral setae. AS straight, pointed, about 0.5 VP width. Glans: lacking BK, ML present, PSL rounded rectangular, S straight, compressed, BF present, SA with slender lateral teeth and very weakly serrate carina (Figs. 68-71).

Female (allotype): Total body length 1.60. Scute length 1.30, width 1.10. Eyemound length 0.20, width 0.23, height 0.15. GO length 0.23, width 0.25. Leg II length 12.2, leg II/ scute length 9.38. Tr IV lacking ventral tubercle. Genital operculum rounded, lacking apical armature. Ovipositor surface probably lacking microspines, apex lacking teeth, and with about 7 pairs of setae.

Variation.–There is variation in the sexually dimorphic structures in males. Both the TrIV spur and POP vary in size from 0.03 to 0.05.

Natural history.–This species occurs sympatrically with another troglobitic opilionid, *Chinquipellobunus madlae* (Goodnight & Goodnight), in both Logan's Cave and Surprise Sink (Cokendolpher, 2004).

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Logan's Cave, 8 June 1993 (J. Loftin, J. Reddell, M. Reyes, TMM), 1 male (paratype); Surprise Sink (Cave), Government Canyon State Natural Area, 7 October 1995 (G. Veni, A. Hill, TMM), 1 female (allotype); 24 May 1998 (J. Reddell, M. Reyes, TMM), 2 males (holotype and paratype, SEM), 1 female (paratype).

Distribution.–Known only from caves in northern Bexar County, Texas.

Texella elliotti, new species
Figs. 2, 72-83; Maps 1, 4, 5.

Diagnosis.–Males of this species differ from others in the *mulaiki* infragroup in having a tiny POP, from 0.1-0.2 length of GO, and lacking a TrIV spur (Fig. 78). This highly troglomorphic species has a conspicuously reduced eyemound (Figs. 72, 73, 76, 77) and attenuated palpal segments and megaspines (Fig. 75).

Type.–Male holotype, collected in Winston's Cave No. 1, Bexar Co., Texas, on 1 February 1994 by W. Elliott and L. McNatt, deposited in CAS.

Etymology.–The specific name is in honor of Bill Elliott, collector of this and many other interesting *Texella* species.

Description.–Total body length 1.42-1.70. Scute length 0.98-1.02, width 0.90-0.92. Eyemound length 0.18-0.20, width 0.15-0.20, height 0.13-0.15. Leg II length16.2-16.5; leg II/ scute length 16.2-16.6. (N = 2). Color yellowish-white, legs white. Rugosity smooth (Figs. 72-74). Scute lacking AT (Fig. 77). Eyemound conical, with few tubercles, lacking retina and cornea (Figs. 72, 73, 76, 77). Palpal megaspines: trochanter 1 ventral; femur 3 ventrobasal, 1 mesodistal; patella 1 ectal, 1 mesal; tibia 2 ectal, 2 mesal; tarsus 2 ectal, 2 mesal (Fig. 75). TC 4-6 to 10-5-5.

Male (holotype): Total body length 1.42. Scute length 1.02, width 0.90. Eyemound length 0.20, width 0.15, height 0.15. GO length 0.24, width 0.22. POP 0.02. Leg II length 16.5; leg II/ scute length 16.2. TrIV spur absent (Fig. 78). TC 4-7/10-5-5. Genitalia (paratype from Headquarters Cave). Genital operculum pointed, roughly pentagonal (Fig. 79). Penis: VPP apically attenuated, with 2 dorsal, 6 ventral, and 13 lateral setae; AS straight, pointed, about 2/3 width of VPP. Glans: BK not evident, ML present, PSL elongate with scalloped ectal margin, shorter than stylus, S straight, slightly compressed, BF present, SA with long pointed teeth and ectally convex carina (Figs. 80-83).

Female: Unknown.

Natural history.–This species occurs sympatrically with another troglobitic opilionid, *Chinquipellobunus madlae* (Goodnight & Goodnight), in both Headquarters Cave and Winston Cave but occupies relatively lower and wetter parts of the caves (Cokendolpher, pers. com.).

Material examined.–UNITED STATES: Texas: **Bexar Co**.: Headquarters Cave, 26 October 1995 (J. Reddell, M. Reyes, CAS), 1 male (paratype, SEM); Winston's Cave, 1 February 1994 (W. Elliott, L. McNatt, CAS), 1 male (holotype).

Distribution.–Known only from Bexar County, Texas.

The *reddelli* subgroup
The *reddelli* infragroup

Texella reddelli Goodnight and Goodnight
Maps 2-5.

Texella reddelli Goodnight and Goodnight, 1967:7.
Ubick and Briggs, 1992:207.

Notes.–The new records not only expand the distribution of this species but, more interestingly, include three epigean localities, two in Burnet and one in western Travis counties. The epigean specimens were closely examined, including with SEM, and were found to be similar to those from caves, even having the same tarsal count, but with a shorter leg II/ scute length: 3.10-3.11 (N = 3), compared to 3.81-5.20 (N = 14) for the cavernicoles.

This species was collected sympatrically with *T. dimopercula* at the epigean sites near Spicewood and is probably also sympatric with *T. grubbsi* Ubick and Briggs, which occurs on epigean sites nearby. Only *T. reddelli* has been found in the caves in this region (MVN and Waldman). On the other hand, only *T. grubbsi* occurs in Cave Y, Travis County. Our previous record of *T. reddelli* from that cave was based on female specimens and was in error. Recent collections included a male, clearly *T. grubbsi*, which necessitated reexamination of all specimens from that cave and a more careful comparison of females of the two species. Although the females are similar, we have been able to find some differences between them. *T. reddelli* is somewhat larger (SL = 1.30-1.66; N = 14) than *T. grubbsi* (SL = 1.21-1.31; N = 6), has a more robust eyemound, a somewhat less distinct cervical groove, a higher tarsal count [(3-5-5-6 in *T. reddelli* (except for one specimen; see below) and 3-5-5-5 in *T. grubbsi*)], and a smaller genital operculum (using a ratio of GO width to width of venter at lateral junction of coxae II and III, *T. reddelli* is 0.20-0.28 (N = 12) whereas *T. grubbsi* is 0.33-0.40 (N = 2).

Two male specimens are unusual in lacking retinae. One of these is epigean, from 5 mi NW Spicewood, and the other from Spider Cave. As the presence or absence of retinae was the most obvious differentiating character between this species and *T. reyesi* Ubick and Briggs, the specimens were more thoroughly examined. The first specimen is one of three from that epigean locality and the only one without retinae. It resembles the other epigean specimens closely and other *T. reddelli* in having a relatively high number of AT on the scute: 4-5 pairs, compared to 0-3 pairs for *T. reyesi*. Its loss of retina does not correlate to any troglomorphic modification, in fact its leg II/ scute length (3.10) is identical to the other epigean specimens, and so this loss appears to be a random deformity.

The second specimen without retinae, from Spider Cave, differs from other *T. reddelli* in having a very low tarsal count: 3-4/?-5/4-5, compared to 3-5-5-6 for all other members of the species. [The previous record in Ubick and Briggs (1992) of lower tarsal counts in this species was in error, being based upon specimens of *T. grubbsi* from Cave Y]. This specimen also has a larger number of AT on the scute (5 pairs) than *T. reyesi* and a leg II to scute length ratio of 4.6, which falls within the range of *T. reddelli*. The retinal loss here, as in the previous specimen, likewise does not appear to be a consequence of increased troglomorphy, given the lower tarsal count. Further material from Spider Cave would be needed to ascertain if this loss is an individual variant, as is assumed, or characteristic of the population, which would require further explanation.

New records.–UNITED STATES: Texas: **Burnet Co**.: County Road 404, 5 mi NW Spicewood, talus, 11 September 1994 (A.G. Grubbs, TMM), 1 male, (epigean site); County Road 404, 6 mi NW Spicewood, site 2, 18 September 1994 (A.G. Grubbs, TMM), 1 male (SEM), 1 female, (epigean site); MVN Cave, 4-5 mi W Spicewood, 20 March 1993 (A.G. Grubbs, T. Whitfield, TMM), 2 males, 3 juveniles; 21 February 1995 (A.G.

Grubbs, C. Waid, TMM), 2 males; MVN Cave, 5 mi W Spicewood, no date, (A.G. Grubbs, TMM), 3 females, 1 juvenile; Waldman Cave, 4-5 mi W Spicewood, 27 March 1993 (A.G. Grubbs, TMM), 1 female; 21 February 1995 (A.G. Grubbs, TMM), 1 male. **Travis Co.**: Pedernales River and Hwy 71, 23 mi W Austin, 20 September 1994 (A.G. Grubbs, TMM), 1 female, (epigean site); Jester Estates Cave, 18 March 1991 (L. Sherrod, TMM), 1 male, 2 females; Little Bee Creek Cave, 17 June 1993 (W. Elliott, TMM), 2 females; Little Black Hole, 9 June 1994 (W. Elliott, P. Sprouse, TMM), 1 female, Spider Cave, 23 June 1999 (C. Abbruzzese, TMM), 1 male; Spider Cave, 14 April 1991 (W. Elliott, TMM), 1 juvenile; Stark's North Mine, Austin, 18 September 2000 (J. Jenkins, TMM), 3 males.

Distribution.–Known from Burnet and Travis counties, Texas.

Texella reyesi Ubick and Briggs
Maps 2, 4, 5.

Texella mulaiki, Goodnight and Goodnight, 1967:6 (in part)
Texella reddelli, Goodnight and Goodnight, 1967:7 (in part).
Texella reyesi Ubick and Briggs, 1992:211.

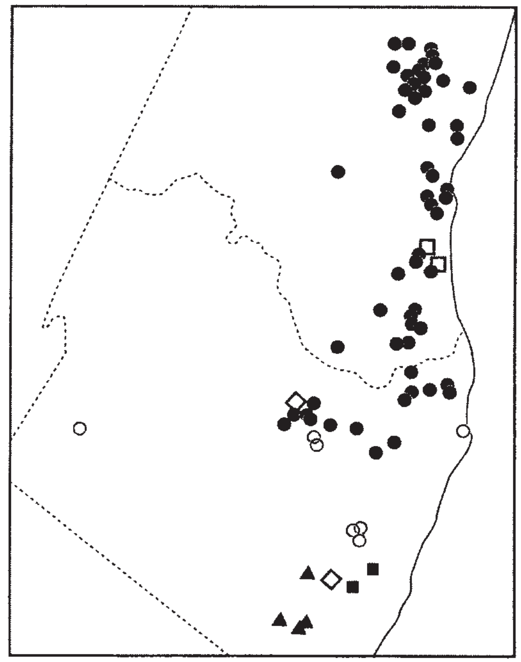
Notes.–As no other troglobitic species of *Texella* is known to occur in this distribution, records of females and juveniles are here included, albeit tentatively. According to J. Reddell (pers. com.) the following caves of this species have recently been destroyed: Puzzle Pit and Twisted Elm Cave (Travis County) and Black Cat Cave and Cassidy Cave (Williamson County).

New records.–UNITED STATES: Texas: **Travis Co.**: Barker Ranch Cave No. 1, 12 July 2000 (J. Krejca, V. Loftin, W. Russell, TMM), 1 juvenile; Cave, site # 401, near FM620, approx. 1-2 mi. S of Williamson Co. line, 1999 (P. Sunby, TMM), 1 male; Cold Cave, May 1994 (M. Warton, TMM), 1 male; Cotterell Cave, 19 February 1993 (J. Reddell, M. Reyes, TMM), 1 male; Featherman's Cave, 25 June 1998 (M. Sanders, TMM), 1 female; 25 June 1999 (M. Sanders, TMM), 1 female; Gallifer Cave, 20 April 1991 (J. Reddell, M. Reyes, TMM), 2 males, 3 females; Hole-in-the-Road Cave, 20 September 1998 (J. Reddell, M. Reyes, TMM), 1 female; Jest John Cave, 23 June 2000 (M. Sanders, TMM), 1 male, 1 female; Jollyville Plateau Cave, 10.8 mi W Austin, 26 December 1994 (M. Warton, TMM), 1 penultimate male; 11 April 1995 (A.G. Grubbs, G. Waid, TMM), 1 juvenile; Millipede Cave, 26 September 1992 (M. Warton, TMM), 1 male, 2 females; MWA Cave, 4 January 1995 (M. Warton, TMM), 1 male, 1 female, 1 juvenile; Puzzle Pit, 10.8 mi W Austin, 16 January 1995 (M. Warton, TMM), 1 male, 1 female, 1 juvenile; 11 April 1995 (A.G. Grubbs, G. Waid, TMM), 1 female; Stovepipe Cave, 25 October 1990 (J. Reddell, M. Reyes, L. Sherrod, TMM), 1 male, 3 females, 3 juveniles; Twisted Elm Cave, 10.8 mi W Austin, 11 April 1995 (A.G. Grubbs, TMM), 1 male, 1 juvenile; West Rim Cave, 9 April 1992 (M. Warton, TMM), 1 female. **Williamson Co.**: Abused Cave, 21 April 1993 (M. Warton, TMM), 1 female; Apache Cave, 9 December 1993 (J. Reddell, M. Reyes, TMM), 1 juvenile; Beck Bat Cave, 24 October 1991 (L. Sherrod, TMM), 1 male, 1 female; 15 May 1996 (J. Reddell, M. Reyes, TMM), 1 female; Beck Blowing Well (= Beck Blowing Cave), 13 September 1991 (M. Warton, TMM), 1 male; Beck Bridge Cave, 2.5 mi W Round Rock, 13 April 1995, (A. Grubbs, TMM), 1 female, 1 juvenile; Beck Horse Cave, 25 October–5 November 1991 (L. Sherrod, TMM), 1 female, 1 juvenile; Beck Pride Cave, 1 September 1991 (W. Elliott, J. Reddell, M. Reyes, M. Warton, TMM), 1 juvenile; 21 May 1996 (J. Reddell, M. Reyes, TMM), 1 female; Beck Rattlesnake Cave, 31 March 1993 (D. Allen, L. J. Graves, D. Love, TMM), 1 male, 1 female; 5 April 1993 (Big Half, D. Allen, L.J. Graves, D. Love, TMM), 1 male; Beck Tex-2 Cave, 14 September 1991 (M. Warton, TMM), 1 female; Black Cat Cave, 2.5 mi W Round Rock, 13 April 1995 (A.G. Grubbs. G. Waid, TMM), 1 female, 1 juvenile; Broken Zipper Cave, 16 March 1993 (M.Warton, TMM), 1 female; Buzzard Feather Cave, 15 March 2001 (L.J. Graves, TMM), 1 male; Cassidy Cave, 13 June 1996 (M. Warton, TMM), 2 males; Cat Cave, 28-29 April 1999 (R. Price, M. Warton, TMM), 2 males, 1 female; Cat Hollow Bat Cave, 2.5 mi W Round Rock, 16 April 1995 (A.G. Grubbs, TMM), 1 female; Cat Hollow Cave No. 1, 1 September 1990 (B. Larsen, TMM), 1 juvenile; 30 June 1992 (M. Warton, TMM), 4 males, 1 female, 1 juvenile; Cat Hollow Cave No. 2, 30 June 1992 (M. Warton, TMM), 2 females; Cave, site # 502, 2.3 mi W of IH 35 on I 431, 12 September 1999 (K. White, TMM), 2 juveniles; Cave Coral Cave, 14 January 2000 (J. Reddell, M. Reyes, TMM), 1 male; Chaos Cave, 14 January 2000 (L.J. Graves, J. Reddell, M. Reyes, TMM), 1 male, 1 female; 14 April 2000 (P. Sprouse, J. Reddell, M. Reyes, TMM), 2 males; Choctaw Cave, 20 August 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; Crescent Cave, April 1994 (M. Warton, TMM), 1 male; Deliverance Cave No. 1, 18 November 1993 (J. Reddell, M. Reyes, TMM), 1 male, 1 female, 1 juvenile; Deliverance Cave No. 2, 17 November 1993 (M. Reyes, TMM), 2 females; Do Drop In Cave, 23 November 1993 (J. Reddell, M. Reyes, TMM), 1 male, 4 females; 28 September 1995 (P. Sprouse, TMM), 1 male; Double Dog Cave, 25 March 1994 (J. Reddell, M. Reyes, TMM), 1 female, 1 juvenile; Dragon Fly Cave, 11 July 1994 (J. Reddell, M.

Reyes, TMM), 1 male, 1 juvenile; 29 May 2001 (M. Reyes, TMM), 1 male; Duckworth Bat Cave, 21 April 1999 (M. Warton, TMM), 2 juveniles; Electro-Mag Cave, 4 November 1994 (J. Reddell, M. Reyes, TMM), 1 female; El Tigre Cave, 2.5 mi W Round Rock, 13 April 1995 (A.G. Grubbs. G.Waid, TMM), 1 female; Ensor Cave, April 1994 (M. Warton, TMM), 1 female; Eulogy Cave, April 1994 (M. Warton, TMM), 2 juveniles; Fence-Line Sink, 7 September 1992 (J. Reddell, M. Reyes, TMM), 1 male; Flat Rock Cave, 25 May 1992 (R. Aalbu, J. Reddell, M. Reyes, TMM), 2 males, 3 females; 25 June 1992 (M. Reyes, TMM), 1 female; Flint Wash Cave, 4 June 1991 (J. Reddell, M. Reyes, TMM), 1 female; Flowstone Rift Cave, March 1994 (M. Warton, TMM), 2 females; Formation Forest Cave, 31 March 1993 (J. Reddell, M. Reyes, TMM), 1 male; Fortune 500 Cave, 28 April 1998 (J. Reddell, M. Reyes, TMM), 1 female; Hatch Cave, 5 February 1999 (M. Warton, TMM), 1 female, 1 juvenile; Holler Hole Cave, 29 March 1994 (J. Reddell, M. Reyes, TMM), 1 male, 2 juveniles; 11 April 1994 (J. Reddell, M. Reyes, TMM), 1 female; Hollow Oak Cave,18 March 1996 (M. Warton, TMM), 1 male; Hourglass Cave, 5 June 2001 (L.J. Graves, M. Reyes, TMM), 1 male, 1 female; Jackhammer Cave, 24 June 1993 (D. Allen, TMM), 1 male, 1 female; Joint Effort Cave, 25 June 1997 (J. Reddell, M. Reyes, TMM), 1 female; Karankawa Cave, 20 April 1994 (J. Reddell, M. Reyes, TMM), 1 female; Killian Cavern, Mayfield Ranch, 22 October 1998 (M. Warton, TMM), 1 male; Kiva Cave No. 1, 6 February 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; 6 March 1994 (J. Reddell, M. Reyes, TMM), 1 female, 1 juvenile; Leachate Cave, April 1994 (M. Warton, TMM), 1 juvenile; Lineament Cave,1 June 1993 (M. Warton, TMM), 1 female; 12 June 1993 (J. Reddell, M. Reyes, TMM), 1 male; Lobo's Lair, 1 September 1991 (W. Elliott, J. Reddell, M. Reyes, M. Warton, TMM), 1 male, 1 female; Mayfield Cave, 27 April 1998 (M. Warton, TMM), 1 juvenile; Mayor Elliott Cave, 25 April 1997 (W.R. Elliott, TMM), 1 male; Medicine Man Cave, 6 April 1994 (J. Reddell, M. Reyes, TMM), 1 male; Mongo Cave, Upper Mayfield Ranch, April 1999 (M. Warton, TMM), 1 juvenile; Mosquito Cave, 23 May 1998 (M. Warton, TMM), 1 female; Mustard Cave, 31 May 1993 (J. Reddell, M. Reyes, TMM), 1 juvenile; 12 June 1993 (J. Reddell, M. Reyes, TMM), 2 females; Near Miss Cave, 2 November 2000 (J. Reddell, M. Reyes, TMM), 1 male, 1 female; O'Connor Cave, 31 March 1993 (D. Allen, L.J. Graves, TMM), 1 male, 2 females; Ominous Entrance Cave, 30 March 1993 (J. Reddell, M. Reyes, TMM), 1 female; On Campus Cave, 7 May 1992 (L.J. Graves, M. Warton, TMM), 3 males, 1 female; 18 May 1992 (J. Reddell, M. Reyes, TMM), 1 male, 3 females; Onion Branch Cave, 29 April 1998 (J. Reddell, M. Reyes, TMM), 1 male, 1 juvenile; Polaris Cave, 19 April 1994 (J. Reddell, M. Reyes, TMM), 1 female; Posh Cave, Mayfield Ranch, 26 January 1999 (M. Warton, TMM), 1 juvenile; Powwow Cave, 19 September 1994 (J. Reddell, M. Reyes, TMM), 2 juveniles; Price is Right Cave, Mayfield Ranch, 18 January 1999 (M. Warton, TMM), 1 female; Priscilla's Cave, 19 September 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; Priscilla's Well Cave, 19 September 1994 (J. Reddell, M. Reyes, TMM), 1 female; Pussy Cat Cave, 5 June 1991 (W. R. Elliott, TMM), 1 female; Red Crevice Cave, 31 May 1991 (J. Reddell, M. Reyes, TMM), 1 juvenile; Rockfall Cave, 27 April 1993 (J. Reddell, M. Reyes, TMM), 1 female; Rootin Tootin Cave, Mayfield Ranch, 9 December 1998 (M. Warton, TMM), 2 females, 1 juvenile; Round Rock Breathing Cave (=Step-Down Cave), 22 February 1993 (J. Reddell, M. Reyes, TMM), 1 male; 14 April 1998 (M. Warton, TMM), 1 male; Sam Bass Hideaway Cave, 14 January 2000 (J. Reddell, M. Reyes, TMM), 1 female; 14 April 2000 (P. Sprouse, J. Reddell, M. Reyes, TMM), 1 male; Scoot Over Cave, May 1994 (M. Warton, TMM), 2 females; Serta Cave, April 1994 (M. Warton, TMM), 1 female; Shaman Cave, August 1994 (M. Warton, TMM), 1 male; 29 September 1994 (J. Reddell, M. Reyes, TMM), 1 male, 1 female, 1 juvenile; 27 November 1995 (W. Elliott, TMM), 1 male; Short Stack Cave, 19 May 1995 (J. Reddell, TMM), 1 juvenile; April 1994 (M. Warton, TMM), 1 female; Stalagroot Cave, 26 February 1993 (W.R. Elliott, G. Veni, TMM), 1 female, 1 juvenile; Stepstone Cave, 14 January 2000 (J. Reddell, M. Reyes, TMM), 1 female; 14 April 2000 (P. Sprouse, J. Reddell, M. Reyes, TMM), 1 female; Swarm Cave, 14 April 2000 (P. Sprouse, J. Reddell, M. Reyes, TMM), 1 female; Temples of Thor Cave, 13 May 1991 (W. Elliott, J. Reddell, M. Reyes, TMM), 2 males, 3 females; Texella Cave, 24 September 1991 (J. Reddell, M. Reyes, TMM), 1 juvenile; 28 September 1991 (J. Reddell, M. Reyes, TMM), 2 females; 8 April 1996 (M. Warton, TMM), 1 female; The Abyss Cave, 6 March 1994 (J. Reddell, M. Reyes, TMM), 1 female, 1 juvenile; March 1994 (M. Warton, TMM), 1 male, 1 female, 1 juvenile; Thin Roof Cave, 28 April 1998 (J. Reddell, M. Reyes, J. Wolff, TMM), 1 juvenile; Tres Amigos Cave, April 1994 (M. Warton, TMM), 1 male; Turner Goat Cave, 21 July 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; Underline Cave, 30 October 1990 (J. Reddell, M. Reyes, TMM), 1 male; Under-the-Fence Sink [= Under the Fence Cave], 14 April 2000 (P. Sprouse, J. Reddell, M. Reyes, TMM), 1 male; Underdeveloped Cave, April 1994 (M. Warton, TMM), 2 juveniles; Undertaker Cave, 24 June 1993 (L.J. Graves, C. Savvas, TMM), 1 male, 1 female; Unearthed Cave, 17 November 1993 (J. Reddell, M. Reyes, TMM), 1 female, 1 juvenile; Ute Cave, 23 November 1993 (J. Reddell, M. Reyes, TMM), 1 juvenile; 8 February 1996

(J. Reddell, M. Reyes, TMM), 1 female; Venom Cave, 17 November 1993 (J. Reddell, M. Reyes, TMM), 1 male, 3 females; Venturi Cave, March 1994 (M. Warton, TMM), 1 male; Vericose Cave, April 1994 (M. Warton, TMM), 1 female, 1 juvenile; War Party Cave, March 1994 (M. Warton, TMM), 1 female; 20 April 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; Waterfall Canyon Cave, 22 May 1992 (J. Reddell, M. Reyes, TMM), 1 male, 3 females, 1 juvenile; 25 June 1992 (M. Reyes, TMM), 1 male, 1 female; Weldon Cave, 30 April 1996 (M. Warton, TMM), 1 juvenile; Wild Card Cave, April 1994 (M. Warton, TMM), 1 female; Williams Cave No. 1, 1 August 1991 (W. Elliott, J. Reddell, M. Warton, TMM), 1 female; Wolf Rattlesnake Cave, 28 July 1991 (J. Reddell, TMM), 1 juvenile; Woodruff's Well, December 1993 (M. Warton, TMM), 1 juvenile; Yammas Cave, March 1994 (M. Warton, TMM), 1 juvenile; Yellow Hand Cave, December 1993 (M. Warton, TMM), 1 female; 29 March 1994 (J. Reddell, M. Reyes, TMM), 1 juvenile; You Dig It Cave, 9 December 1993 (J. Reddell, M. Reyes, TMM), 1 juvenile; Zapata Cave, March 1994 (M. Warton, TMM), 1 male, 1 female.

Distribution.–Known from caves in Travis and Williamson counties, Texas.



Map 2. Western Williamson and Travis counties showing collection localities of *Texella* species: *mulaiki* infragroup, *T. mulaiki* Goodnight and Goodnight (triangles); *reddelli* infragroup, *T. reddelli* Goodnight and Goodnight (open circles), *T. reyesi* Ubick and Briggs (closed circles); *brevidenta* infragroup, *T. grubbsi* Ubick and Briggs (diamonds); and *spinoperca* infragroup, *T. spinoperca* Ubick and Briggs (closed squares), *T. fendi* Ubick and Briggs (open squares). The solid wavy line near the right margin represents highway 35.

The *brevidenta* infragroup

Texella grubbsi Ubick and Briggs
Maps 2-5.

Texella grubbsi Ubick and Briggs, 1992:225.

Notes.–The new records include 3 epigean localities and range extensions into Burnet and Travis counties. Among these records is a male from Cave Y, Travis Co., undeniably this species. Examination of additional samples makes it now clear that the previous record of *T. reddelli* from this cave, by Ubick and Briggs (1992) and based only upon female specimens, was in error. See discussion under *T. reddelli*.

New Records.–UNITED STATES: Texas: **Burnet Co**.: Double Horn Creek and Hwy 71, 4 mi W Spicewood, 19 January 1995 (A.G. Grubbs, TMM), 1 male; Double Horn Creek and Hwy 71, 4.9 mi SE Marble Falls, 4 October 1994 (A.G. Grubbs, TMM), 3 females; Roadside, 1.6 mi N Spicewood, 27 September 1994 (A.G. Grubbs, TMM), 1 male, 2 females. **Hays Co**.: Wissman's Sink, 10 mi W San Marcos, 22 April 1995 (A.G. Grubbs, N. Lake, TMM), 1 male, 1 female; 29 April 1995 (A.G. Grubbs, N. Lake, H. Drus, TMM), 1 male, 2 females; Wissman's Sink #2, 29 April 1995 (A.G. Grubbs, C. Jordan, TMM), 3 males, 2 females, 2 juveniles. **Travis Co**.: Cave Y, 4 June 1990 (J. Reddell, M. Reyes, TMM), 1 female; 14 June 1990 (J. Reddell, M. Reyes, TMM), 1 female; 12 October 1998 (M. Sanders, TMM), 1 female; 16 May 1999 (M. Sanders, TMM), 1 male, 1 female; Kretschmarr Double Pit, 14 April 1991 (J. Reddell, M. Reyes, TMM), 1 female; 20 April 1991 (J. Reddell, M. Reyes, TMM), 4 females; 29 April 1991 (J. Reddell, M. Reyes, TMM), 1 male, 1 female; 23 May 1992 (R. Aalbu, J. Reddell, TMM), 1 female.

Distribution.–Known from Burnet, Hays, and Travis counties, Texas.

The *spinoperca* infragroup

Texella renkesae Ubick and Briggs
Maps 4, 5

Texella renkesae Ubick and Briggs, 1992:228.

Notes.–The females differ from topotypic females in having lower tarsal counts (3-5-4-5 and 3-5/4-4-5/4 versus 3-5-5-5) and additional apical spines on the genital operculum (2 pairs versus 1 pair).

New Records.–UNITED STATES: Texas: **Hays Co**.: Maggens Sink Hole [not Magen Sink, as on label], 4.5 mi NNW Wimberly, 17 July 1994 (K. Maggens, A.G.

Grubbs, B. Johnson, TMM), 1 male; 29 January 1995 (A.G. Grubbs, K. Maggens, C. Jordan, D. Law, TMM), 2 females.

Distribution.–Known from Hays County, Texas.

Texella spinoperca Ubick and Briggs
Maps 2, 4, 5.

Texella spinoperca Ubick and Briggs, 1992:232.

New Records.–UNITED STATES: Texas: **Travis Co**.: Stinkin' Sink, 1 January 1998 (M. Sanders, TMM), 2 males; 5 January 1998 (M. Sanders, TMM), 1 male.

Distribution.–Known from Travis County, Texas.

Texella fendi Ubick and Briggs
Maps 2, 4, 5

Texella fendi Ubick and Briggs, 1992:232.

Notes.–The new records include six caves, for a species previously known only from epigean localities, and range extensions into Bell, Coryell, and Williamson counties.

New Records.–UNITED STATES: Texas: **Bell Co**.: Big Crevice, Ft. Hood, berlese of leaf litter, 13 May 1999 (J. Reddell, M. Reyes, TMM), 1 male; 6 June 2000 (J. Reddell, M. Reyes, TMM), 1 female; 13 June 2000 (J. Reddell, M. Reyes, TMM), 1 male; 14 June 2000 (J. Reddell, M. Reyes, TMM), 1 female; Long Joint Sink, October 1995 (M. Warton and Associates, TMM), 1 male; Viper Den Cave, 12 January 1995 (D. Allen, TMM), 1 female; 29 October 2002 (J. Reddell, M. Reyes, TMM), 1 female. **Coryell Co**.: Chigiouxs' Cave, 22 November 1994 (M. Warton, TMM), 1 female; 21 November 1995 (J. Reddell, M. Reyes, TMM), 2 males, 4 females, 1 juvenile; Jagged Walls Cave [not Jagged Edge Cave, as on label], 14 March 1992 (J. Reddell, M. Reyes, TMM), 1 female. **Williamson Co**.: Eclipse Cave, April 1994 (M. Warton, TMM), 1 female; Eclipse Cave, Rasmussen Tract, Hwy 3406, Round Rock, 3 June 1999 (R. Price, TMM), 1 female; Sinkhole on Mayfield Ranch, June 1999 (M. Warton, TMM), 1 female.

Distribution.–Known from Bell, Coryell, Fayette, and Williamson counties, Texas.

Texella dimopercula, new species
Figs. 84–99; Maps 3-5.

Diagnosis.–This species differs from others in the *spinoperca* group by the form of the GO: triangular in females with a single apical spine (Fig. 97) and trapezoidal in males (Fig. 95). The male seems closest to *T. homi*, from which it can be distinguished by details of the genitalia: PSL shorter than S and AS not feathery but with short apical branches (Fig. 89).

Type.–Male holotype collected from roadcut talus along County Road 404, 5 mi NW Spicewood, Burnet Co., Texas, on 11 September 1994 by A. G. Grubbs, deposited in CAS.

Etymology.–The specific name is a contraction of "dimorphic operculum," and refers to the sexually dimorphic genital operculum characteristic of the species.

Description.–Total body length 1.51-1.85. Scute length 1.10-1.25, width 1.17-1.32. Eyemound length 0.26-0.30, width 0.27-0.30, height 0.17-0.20. Leg II length 2.94-3.20; leg II/ scute length 2.56-2.71. (N = 7). Color yellowish to orange brown, dorsally with fine maculation, darker along sides, appendages pale grayish-brown, tarsi white. Rugosity of fine uniform granulation (Fig. 84). Scute with 3 pairs AT (Fig. 85). Eyemound subspherical, eyes with retina and large cornea (Fig. 85). Palpal megaspines: trochanter with short ventral spinebearing tubercle; femur with 3 ventrobasal megaspines and 1 tubercle, and 1 mesodistal megaspine; patella 1 ectal, 2 mesal; tibia 2 ectal, 3 mesal; tarsus 2 ectal, 2 mesal (Fig. 86). TC 3-5-5-5.

Male (holotype): Total body length 1.57. Scute length 1.15, width 1.18. Eyemound length 0.27, width 0.28, height 0.20. GO length 0.30, width 0.32. POP absent. Leg II length 2.97, leg II/ scute length 2.58. TrIV with small ventral tubercle (0.01) (Fig. 87). Genital operculum trapezoidal (Fig. 95). Penis: VPP broadly spatulate, with 2 dorsal, 6 ventral, and 12 lateral setae; AS long, slightly curved, longer than VPP width, apically with several short branches. Glans: BK present as broadly rounded hump; ML absent; PSL claw-like, shorter than S; S straight tapering tube; BF present; SA either absent or represented vestigially in the laterobasal expansion of the S (Figs. 88-94).

Female (allotype): Total body length 1.51. Scute length 1.15, width 1.23. Eyemound length 0.28, width 0.29, height 0.17. Leg II length 3.07, leg II/ scute length 2.67. Genital operculum triangular with apical spine (Fig. 97). Ovipositor with microspined cuticle on all but apical surfaces, with 2 large apical teeth and 7 pairs of apical setae (Figs. 96-99).

Sexual dimorphism.–The shape of the genital operculum varies conspicuously, being a large trapezoid in males (0.30-0.32 long, 0.32-0.35 wide; N = 3) and a smaller triangle with apical spine in females (0.22-0.24 long, 0.30-0.32 wide; N = 4). Females also have the mesal margins of coxae IV attenuated.

Natural history.–This species is known only from epigean localities, and has been collected sympatrically with *T. reddelli* and within a few miles from *T. grubbsi*.

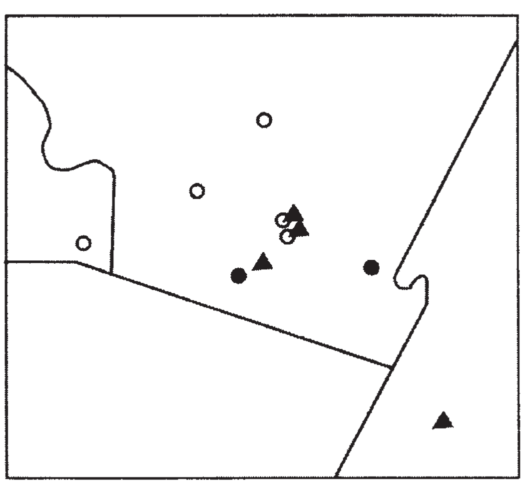
Material examined.–UNITED STATES: Texas: **Burnet Co**.: 1 mi SSW Marble Falls, roadcut talus, 18

September 1994 (A. G. Grubbs, TMM), 4 males (paratypes, SEM); 1 mi S Marble Falls, 22 September 1994 (A.G. Grubbs, TMM), 4 males, 1 female (paratypes); Hamilton Creek Road, 4 mi NE Marble Falls, 22 September 1994 (A.G. Grubbs, N. Lake, C. Thibodaux, TMM), 4 females (paratypes); 5 mi W Spicewood, County Road 404 (Surface site #2), 9 November 1995 (A.G. Grubbs, TMM), 2 males (paratypes); 5 mi NW Spicewood, County Road 404, roadcut talus, 11 September 1994 (A.G. Grubbs, TMM), 1 male (holotype), 2 females (allotype, paratype, SEM); Moon rocks surface, 21 February 1995 (A.G. Grubbs, G. Waid, TMM), 2 males, 1 female (paratypes); 6 mi NW Spicewood, County Road 404, roadcut, 18 September 1994 (A.G. Grubbs, TMM), 2 males, 1 female (paratypes); 5.2 mi NW Spicewood, County Road 404, (Site 2), 13 November 1994 (A.G. Grubbs, TMM), 5 males (paratypes, SEM), 4 females (paratypes), 1 juvenile; 5 mi W Spicewood, County Road 404, (Site 1), 29 November 1994 (A.G. Grubbs, TMM), 2 males (paratypes). **Llano Co.**: 5.7 mi SW Marble Falls, Hwy 71 and Horseshoe Creek, 6 October 1994 (A.G. Grubbs, TMM), 1 male (paratype).

Distribution.–Known from Burnet and Llano counties, Texas.

DISCUSSION

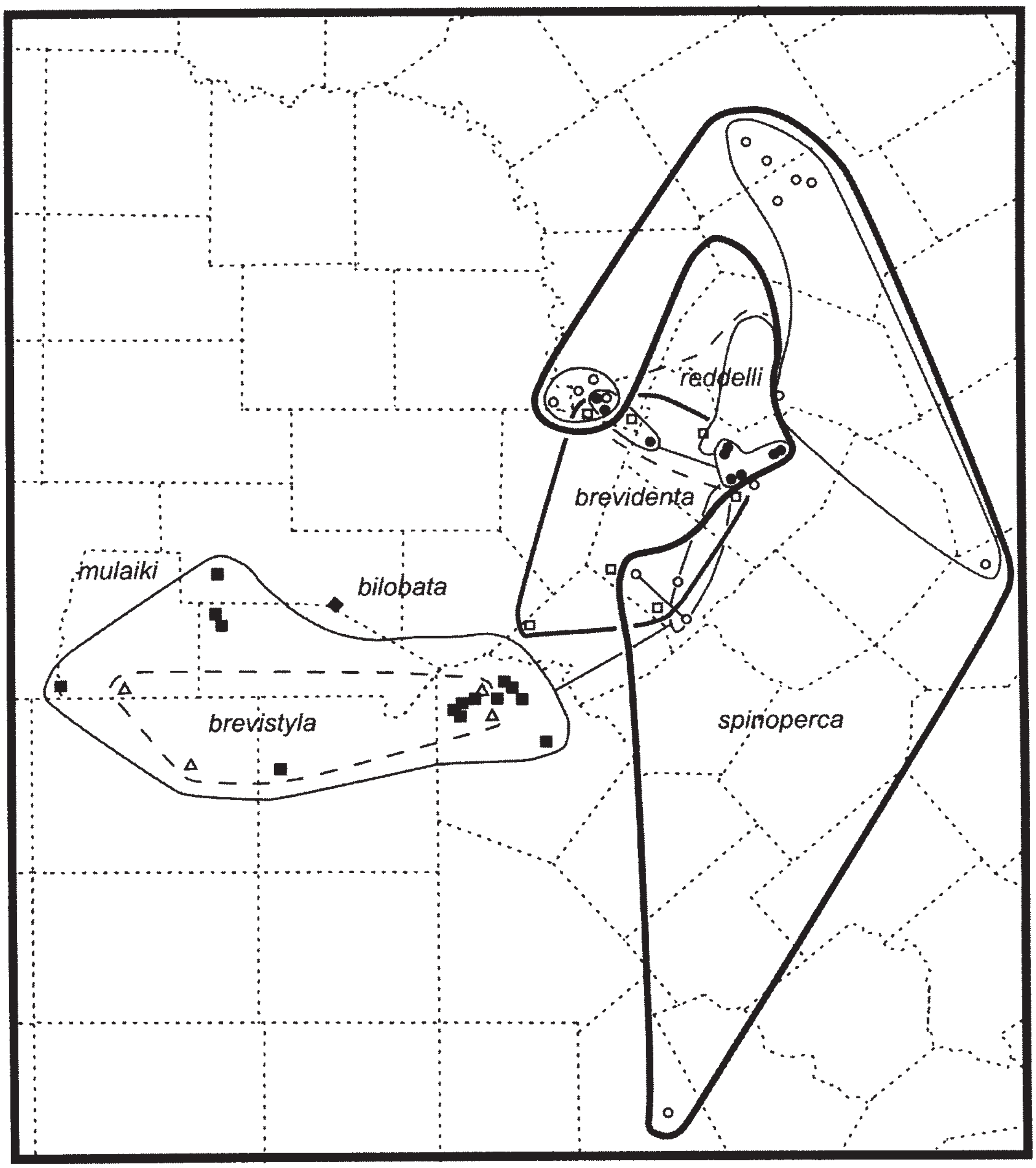
Species criteria.–One important question that this study grappled with is an objective criterion for delimiting species. Most phalangodid species are distinguished by both somatic and genitalic characters. Useful somatic characters include secondary sexual structures, form of the eyemound, body pigmentation, and rugosity. But the most important characters, and those most informative for phylogenetic analysis, are genitalic. The male genitalia are particularly useful and show great morphological exuberance. However, of the new species described here, three are characterized by large morphological gaps in the penis morphology and four by very small gaps which, using uniformly objective criteria, may be considered as just variants of one species (*T. cokendolpheri* Ubick and Briggs). What is significant here, is that the former species are epigean or troglophilic and belong to the *brevistyla* subgroup and *spinoperca* infragroup, whereas the latter, of the *mulaiki* infragroup, are all troglobites. This same trend was also observed in other phalangodids, with large gaps between the epigean species of *Calicina* (Ubick and Briggs, 1989) and *Sitalcina* (Briggs, 1968; Ubick and Briggs, in progress) and small gaps in troglobitic species of *Banksula* (Ubick and Briggs, 2002) and the serpentine endemic *Microcina* (Briggs and Ubick, 1989).



Map 3. Burnet and adjacent counties showing collection localities of *Texella* species: *reddelli* infragroup, *T. reddelli* Goodnight and Goodnight (triangles); *brevidenta* infragroup, *T. grubbsi* Ubick and Briggs (closed circles); *spinoperca* infragroup, *T. dimopercula*, new species (open circles).

Placement of new species.–The seven new species here described are fairly well accommodated in the previously proposed classification (Ubick and Briggs, 1992). Two of these, *T. hartae* and *T. youngensis*, have male genitalia with a stylus shorter than the parastylar lobes (Figs. 8, 20) and lack a stylar apophysis (Figs. 9, 22), both characteristic of the *brevistyla* subgroup. The two are most similar to *T. brevistyla* in having long, ribbonlike parastylar lobes, but differ in some interesting features. The stylus in both new species is much more laterally compressed and lacks any indication of a basal fold, which is vaguely represented in *T. brevistyla* and more strongly so in *T. jungi*, the only other members of the subgroup (compare Figs. 9 and 22 to figs. 54 and 68 in Ubick and Briggs, 1992). Using outgroup comparison, a compressed stylus and the absence of a basal fold are plesiomorphic as they occur in both of the basalmost species groups of *Texella*, *bifurcata* and *kokoweef*. On the basis of these characters, the two new species appear to be the most plesiomorphic elements of the *brevistyla* subgroup, which itself has been argued to be the basalmost of the *mulaiki* species group. On the other hand, the two species also have an apical spine on the ventral plate which is apically polyfurcate (Figs. 11, 23). This condition was interpreted as a synapomorphy for the *brevidenta* and *spinoperca* infragroups and its presence in *T. hartae* and *T. youngensis* clearly dilutes the strength of the character. Despite this fact, the two species do not appear to belong to either the *brevidenta* or *spinoperca* infragroups. A search for characters has turned up two additional synapomorphies for these infragroups that are not present in *T. hartae* nor *T. youngensis*. The first is a deeper bifurcation of the ventral plate, pointed along the ventrobasal margin, and extending to about one-half the length of the truncus, and found in most members of the two infragroups (Fig. 90 and figs. 162, 188, 199 in Ubick and Briggs, 1992). In *T. hartae*, *T. youngensis,* and other *Texella*, the bifurcation is shallower, taking up less that 1/2 of the truncus length (usually only 1/3 of the length), and having a rounded ventrobasal margin (Figs. 9, 21). The second character that appears to be restricted to the two groups is a wider ventral plate prong with an enlarged and mesally bent dorsal margin; compare Fig. 88 to an unmodified prong in Fig. 8. Thus, the polyfurcate apical spine in *T. hartae* and *T. youngensis* seems best interpreted as a parallelism.

The third new species, *T. dimopercula*, appears to be a member of the *spinoperca* infragroup as the male has a deeply bifurcate ventral plate (Fig. 90) and a wide ventral plate prong (Fig. 88), and the female an apical tubercle on the genital operculum (Fig. 97). This species resembles *T. fendi* and *T. homi* in having both a reduced POP and TrIV spur. It also shares with the former



Map 4. Central Texas showing distribution of *Texella* species and groups: *brevistyla* subgroup (triangles); *bilobata* infragroup (diamond); *mulaiki* infragroup (closed squares), the southernmost and easternmost records refer to yet undescribed species; *T. mulaiki* Goodnight and Goodnight is a disjunct oval connected by straight line); *reddelli* infragroup (*T. reddelli* Goodnight and Goodnight represented by closed circles, *T. reyesi* Ubick and Briggs by enclosed region to the north); *brevidenta* infragroup (open squares, *T. brevidenta* Ubick and Briggs is the southwestern locality, *T. grubbsi* Ubick and Briggs, all others); *spinoperca* infragroup (open circles), *T. fendi* Ubick and Briggs is the enclosed area in the northeast, *T. dimopercula*, new species, to the northwest, and *T. rekesae* Ubick and Briggs with two disjunct records in the west).

a long AS with only short apical branches (Fig. 94) and with the latter the absence of a stylar apophysis (or, perhaps, its reduction to a vague lateral flange; Fig. 93). From both of these species, *T. dimopercula* differs in having some apparent plesiomorphies [a distinct, if poorly developed, basal knob (Fig. 88) and claw-like parastylar lobes (Fig. 89)], which suggest its relatively basal position to the two.

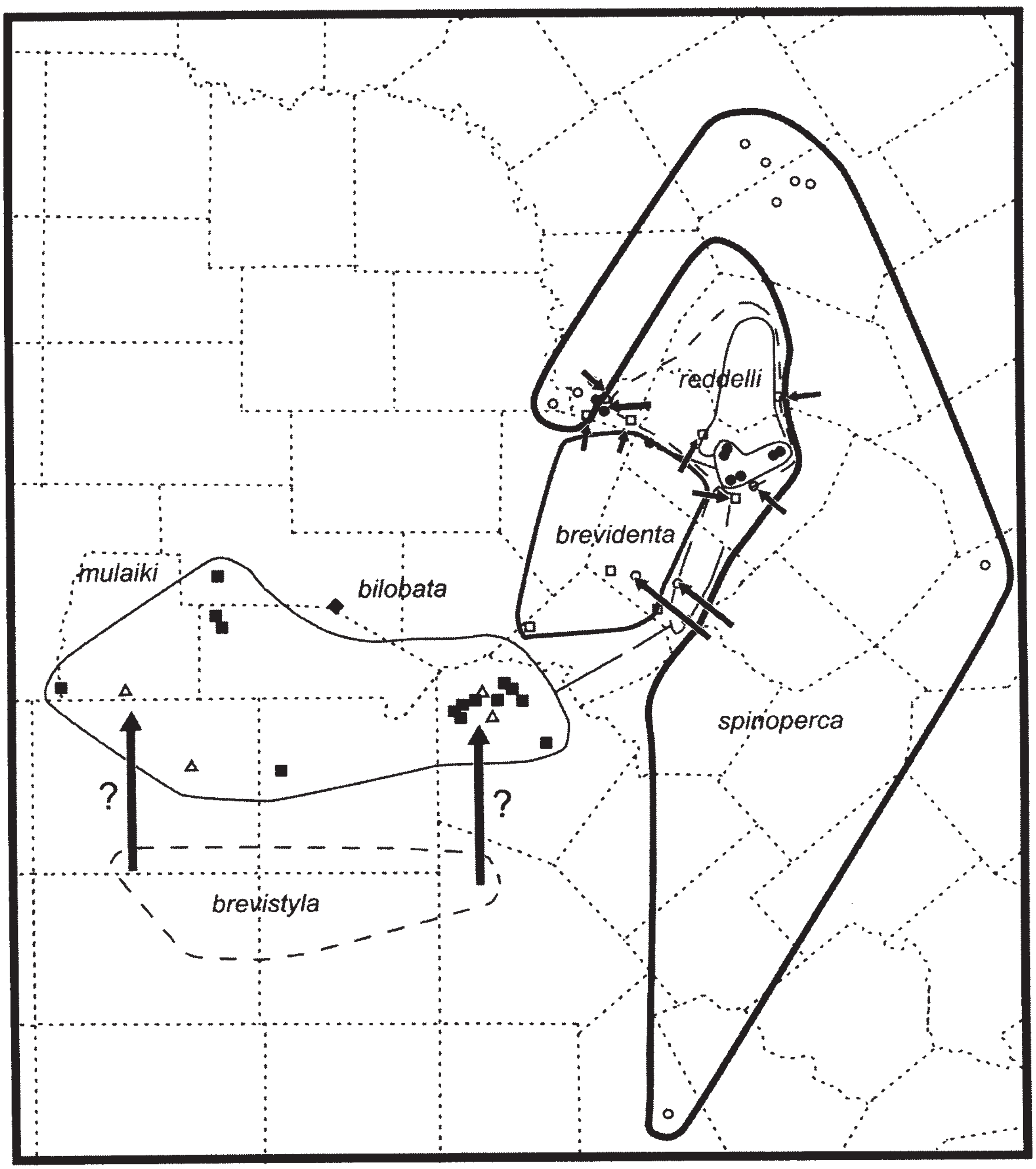
The remaining four new species unambiguously belong to the *mulaiki* infragroup and are most closely related to *T. cokendolpheri*, based on the similarity of male genitalia: a stylar apophysis with a basal tooth and a slightly convex carina with lightly serrate edge (Figs. 38, 49, 69, 83). The species of this *cokendolpheri* complex may be differentiated by minor differences in the genitalia (size of stylar apophysis tooth, convexity of carina, and distribution of setae on the ventral plate prongs) as well as the relative development of the secondary sexual structures (where both the postopercular process and trochanteral spur may be well developed to absent). A new character observed is the presence of thorn-like tubercles on the eyemound. Although absent in *T. mulaiki* (Figs. 24, 25), they occur in all members of the *cokendolpheri* complex, being few and small in *T. cokendolpheri* (Figs. 26, 27) and *T. elliotti* (Figs. 76, 77), but numerous and large in the remaining three species (Figs. 32, 33, 42, 43, 54, 55, 64, 65). These thorns appear to vary indirectly with increasing troglomorphy, with the least troglomorphic species having more thorns in addition to larger eyemounds, shorter appendages, and larger secondary sexual structures.

Biogeography.–Of the three species groups in *Texella*, the two basalmost, *bifurcata* and *kokoweef*, are known only from the Californian region. The third, *mulaiki* group, extends from southern New Mexico to Texas, and is most richly represented along the Balcones Escarpment of central Texas (see Map 4), which contains all three subgroups. Of these, the basal *brevistyla* contains epigean to troglophilic species and occupies the smallest range. The *mulaiki* subgroup includes the *bilobata* infragroup, represented by a single enigmatic epigean species, and the nominal infragroup, with several troglobitic species. The third infragroup, *longistyla*, occurs to the west, along the Texas-New Mexico border. The *mulaiki* infragroup is broadly sympatric with the *brevistyla* subgroup on the west and with the *reddelli* subgroup on the east. The *reddelli* subgroup occupies a much broader range than the others in central Texas and includes three infragroups. The most basal, the *reddelli* infragroup, occupies the region to the N and NW of the *mulaiki* infragroup. Of the two species, *T. reyesi* is troglobitic, having at least some degree of eye loss, and *T. reddelli* is troglophilic to epigean. The *brevidenta* and *spinoperca* infragroups together form a wide band of territory, completely encircling the *T. reddelli* infragroup, with the cavernicolous species occupying the median zone and the epigean ones along the periphery.

Although this paper greatly expands the area of apparent sympatry, closer inspection shows that these instances may not involve actual habitat sharing. To the two previously recorded cases of sympatry, between the cavernicolous *T. mulaiki* with *T. diplospina* and *T. renkesae*, some additional examples can now be added: *T. whitei* with *T. youngensis* and probably also *T. reyesi* with *T. grubbsi* and *T. fendi*, which have been recorded from adjacent caves. In all cases, the sympatry is between a troglobitic species (in the *mulaiki* infragroup or *T. reyesi*) and a troglophile (of the *spinoperca* infragroup or *brevistyla* subgroup). Thus there is no overlap in habitat as the troglophiles occur only at or near cave entrances and the troglobites only in the deeper regions of the cave. A truer form of sympatry in the genus can now be added, that between epigean species. *T. dimopercula* and *T. reddelli* have been collected together at two localities and *T. grubbsi* nearby, to where the three may well be truly sympatric. In all above cases, however, the sympatry is between members of different infragroups.

In a fully allopatric situation, the location of the barriers that presumably catalyzed the speciation events is apparent. Sympatry represents dispersal across these barriers and obscures their location. In *Texella* we have an interesting situation where most of the sympatry is between troglobitic and troglophilic species. Assuming that troglophiles are more mobile, which is reasonable given that they are at least potentially epigean, the most parsimonious explanation is that they have dispersed into the range of the troglobites. So, by undoing this dispersal it is possible to create a hypothetical predispersal distribution for the genus (see Map 5). The relationship between the *reddelli* subgroup and *mulaiki* infragroup becomes fairly well resolved, with the troglophiles peeled away from the troglobite distribution. The primary barrier between the subgroups becomes the outer margin of the *T. mulaiki* distribution. In fact, the most interesting region of *Texella* biogeography is just north of *T. mulaiki*, for here in close proximity live *T. grubbsi*, *T. reddelli*, and *T. spinoperca*, each representing a different infragroup. The region in Burnet County is ambiguous as the sympatry involves surface dwellers having the same dispersal potential. Also, the spatial relationship between the *brevistyla* subgroup and sympatric *mulaiki* infragroup is not clear, as the two ranges are fully sympatric rather than parapatric. Perhaps here, also, we have a dispersal by the troglophilic *brevistyla* subgroup, but as the subgroup is basal it may be occupying the original territory. Further discovery of additional species in this subgroup, possibly to the south or east of the known distribution may resolve this ambiguity.

The geological maps of this region were examined to find possible correlations between the distribution of current formations and the species groups and no obvious pattern was detected. It would seem that the speciation events that produced the infragroups predate the current geology. But perhaps there may be some correlation to the more recent speciation events? The best example for testing this is the *cokendolpheri* complex, which occupies a small region of north central Bexar County (Map 1). *T. cokendolpheri* is known from a single cave (Robber Baron) which is in limestone of the upper Cretaceous (the entrance in Pecan Gap Chalk and the bulk of the cave in somewhat younger Austin Chalk). The remaining four species, known from two localities each, are all from the lower Cretaceous Edwards Limestone and Glen Rose Formation (Veni, 1988, and pers. com.). Of these, the distributions of *T. tuberculata* and *T. whitei* are potentially interesting. Although the caves housing these species are restricted to the Edwards Limestone, in both cases the species' distributions are bisected by a band of the younger Glen Rose Formation. We have the situation here that either the boundary between these



Map 5.-Central Texas showing hypothetical, pre-dispersal distribution of *Texella* groups with arrows giving the minimum dispersal needed to achieve current state.

CLASSIFICATION AND DISTRIBUTION

Texella Goodnight & Goodnight, 1942		
bifurcata species group		
bifurcata (Briggs, 1968)	epigean/cave	NW CA-SW OR
kokoweef species group		
deserticola Ubick & Briggs, 1992	epigean	S CA
kokoweef Ubick & Briggs, 1992	cave	S CA
shoshone Ubick & Briggs, 1992	cave	S CA
mulaiki species group		
brevistyla subgroup		
brevistyla Ubick & Briggs, 1992	cave	TX:Uvalde
hartae, new species	epigean	TX:Bexar
jungi Ubick & Briggs, 1992	epigean	TX:Real
youngensis, new species	cave	TX:Bexar
mulaiki subgroup		
longistyla infragroup		
longistyla Ubick & Briggs, 1992	cave/epigean	NM-TX border
welbourni Ubick & Briggs, 1992	troglobite	S NM
mulaiki infragroup		
cokendolpheri Ubick & Briggs, 1992	troglobite	TX:Bexar
elliotti, new species	troglobite	TX:Bexar
hardeni Ubick & Briggs, 1992	troglobite	TX:Bandera
hilgerensis, new species	troglobite	TX:Bexar
mulaiki Goodnight & Goodnight, 1942	troglobite	TX:Hays-Travis
tuberculata, new species	troglobite	TX:Bexar
whitei, new species	troglobite	TX:Bexar
bilobata infragroup		
bilobata Ubick & Briggs, 1992	epigean	TX:Kerr
reddelli subgroup		
reddelli infragroup		
reddelli Goodnight & Goodnight, 1967	cave/epigean	TX:Travis-Burnet
reyesi Ubick & Briggs, 1992	troglobite	TX:Travis-Williamson
brevidenta infragroup		
brevidenta Ubick & Briggs, 1992	cave	TX:Comal
grubbsi Ubick & Briggs, 1992	cave/epigean	TX:Hays-Travis-Burnet
spinoperca infragroup		
dimopercula, new species	epigean	TX:Burnet-Llano
diplospina Ubick & Briggs, 1992	cave	TX:Hays
fendi Ubick & Briggs, 1992	cave/epigean	TX:Coryell-Fayette
homi Ubick & Briggs, 1992	epigean	TX:Live Oak
renkesae Ubick & Briggs, 1992	cave	TX:Hays
spinoperca Ubick & Briggs, 1992	cave	TX:Travis

two formations is not a barrier to the present day movement of the harvestmen or, if it is a barrier, that the speciation events must have predated the current geology. However, the distributions of *T. hilgerensis* and *T. elliotti*, which occur in both the Edwards Limestone and the Glen Rose Formation, appear to support the former option.

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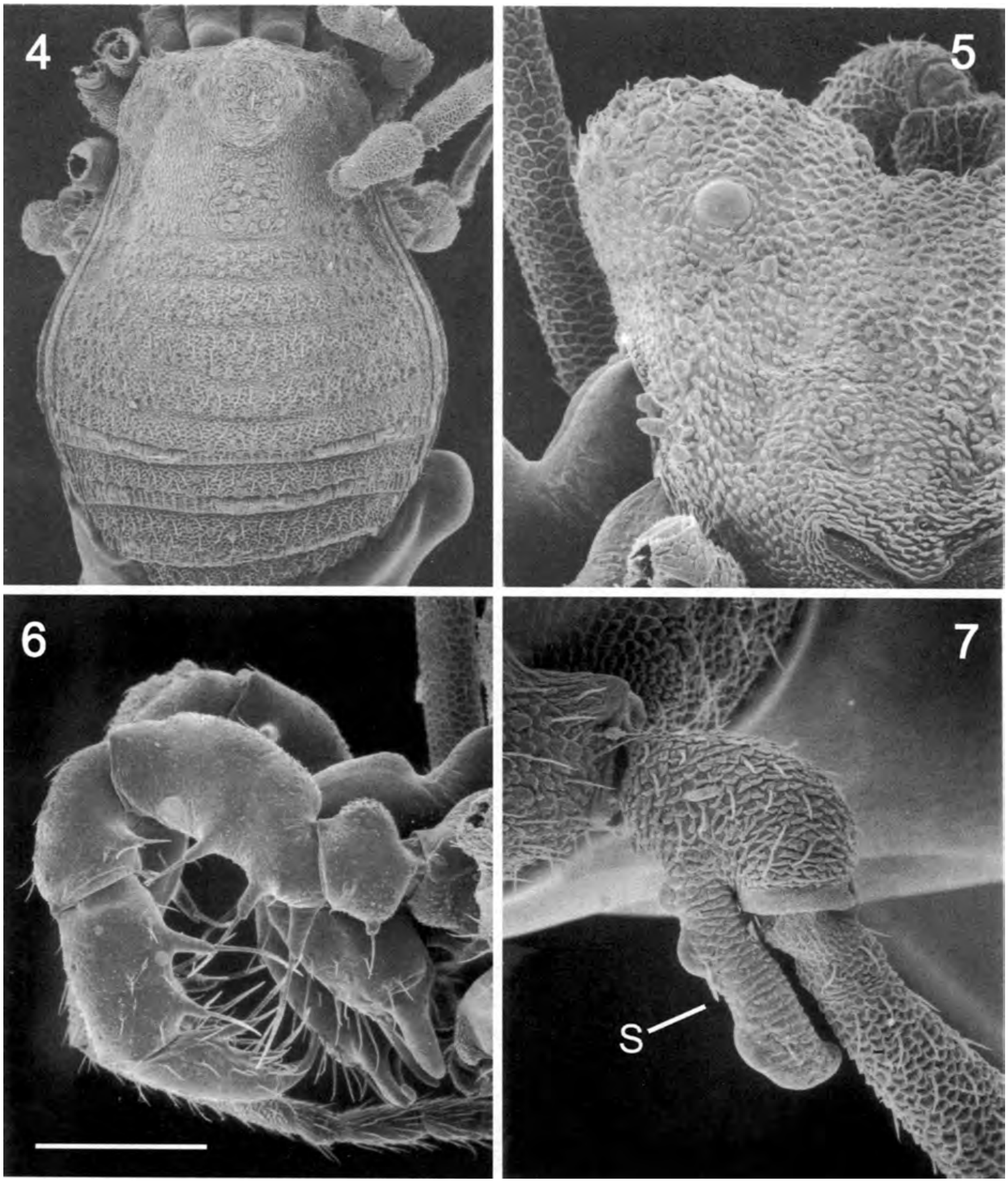
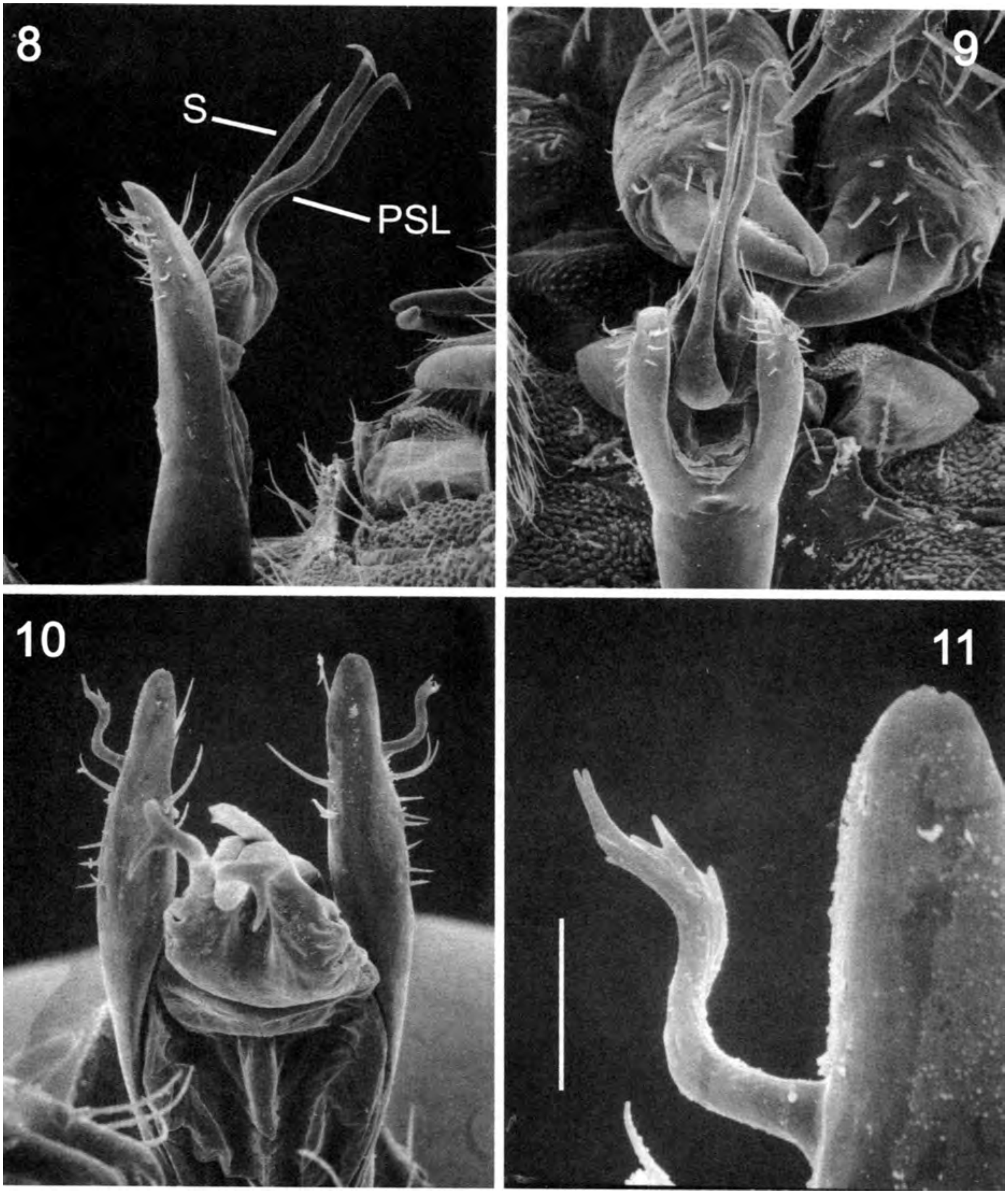
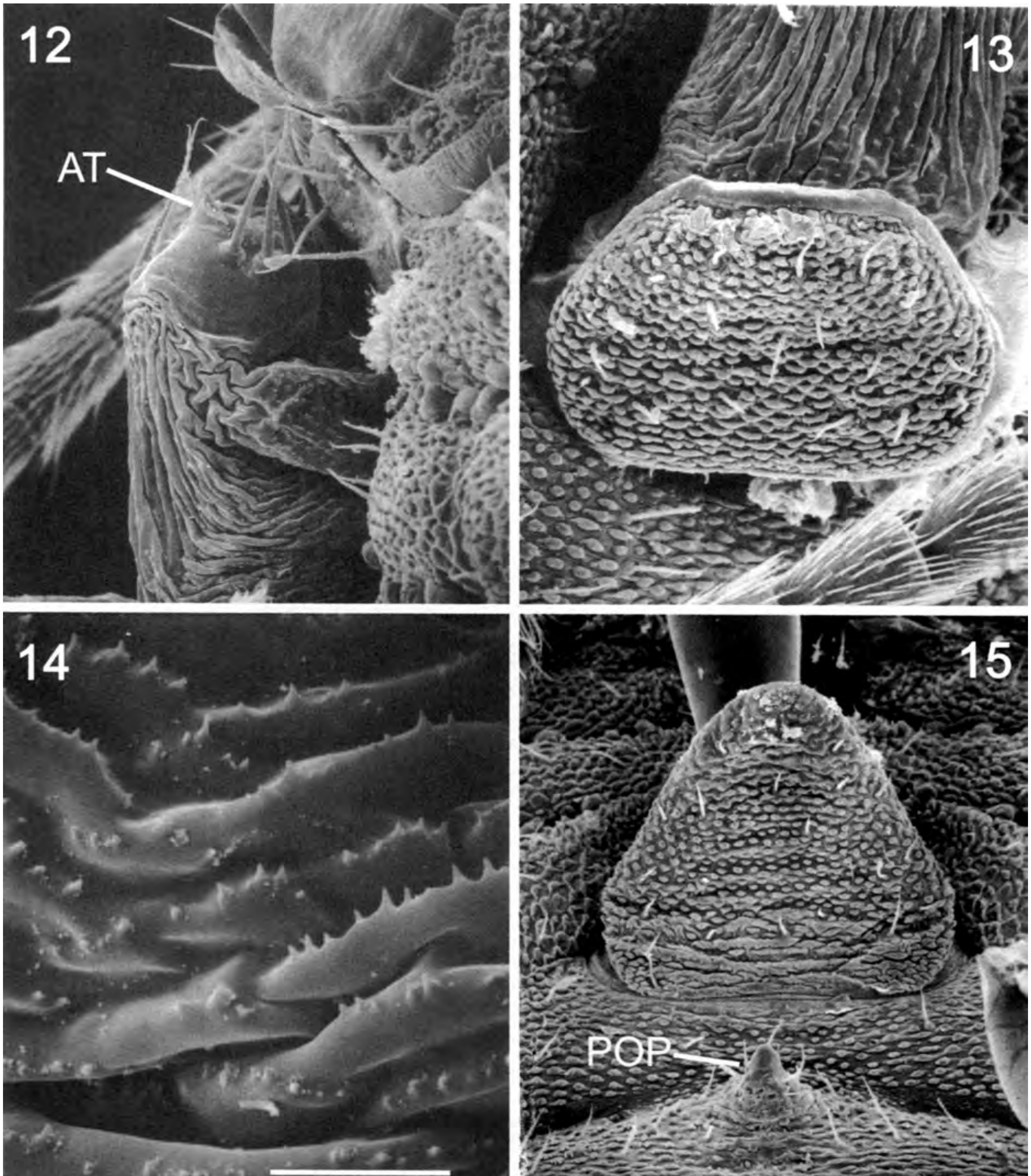


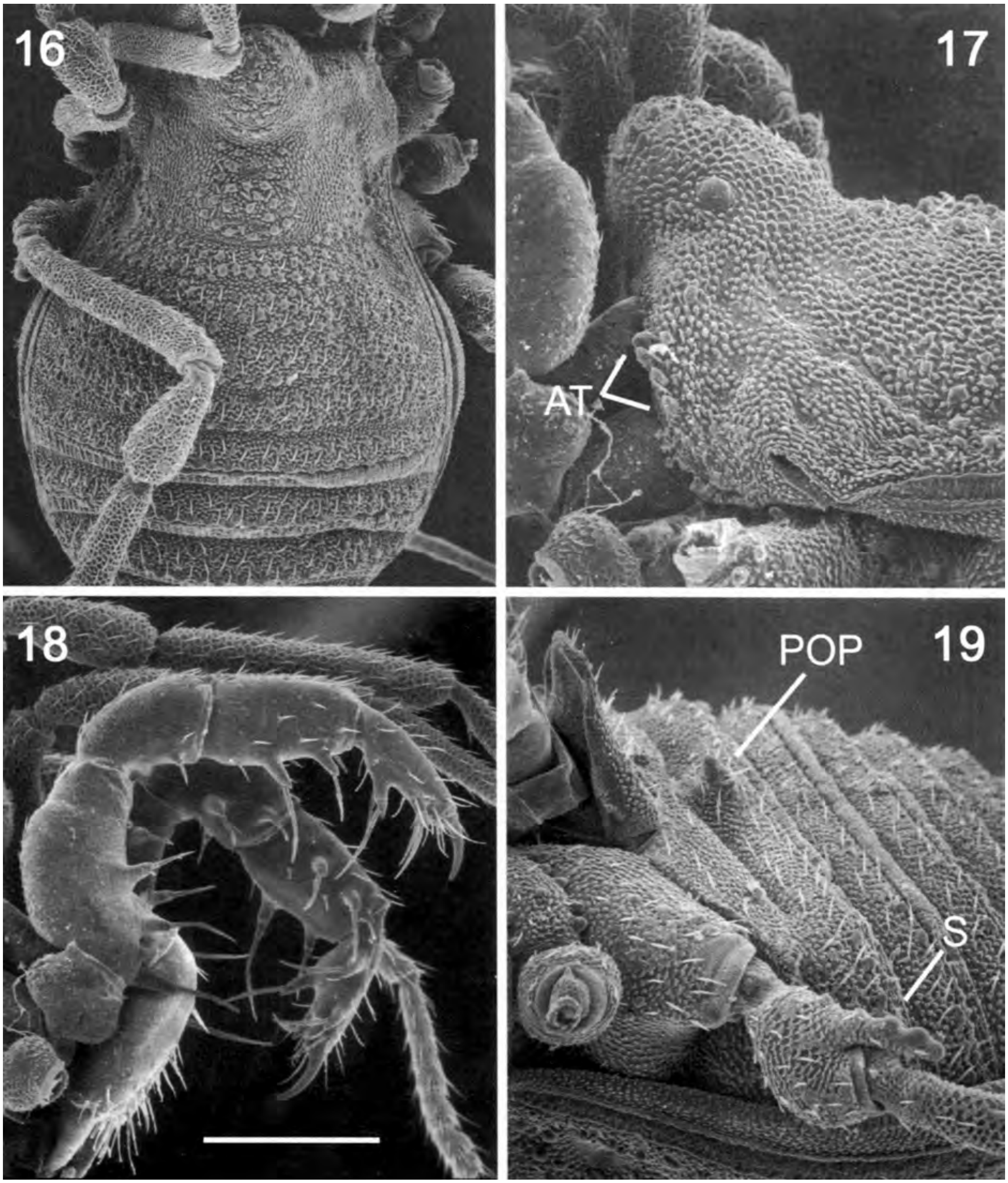
Figs. 4-7.-*Texella hartae*, new species, male. 4, Body, dorsal view. 5, Eyemound, lateral view. 6, Palpi, lateral view. 7, Trochanter IV, lateral view showing spur (S). Scale bar: 430 µm (4); 150 µm (5, 7); 250 µm (6).



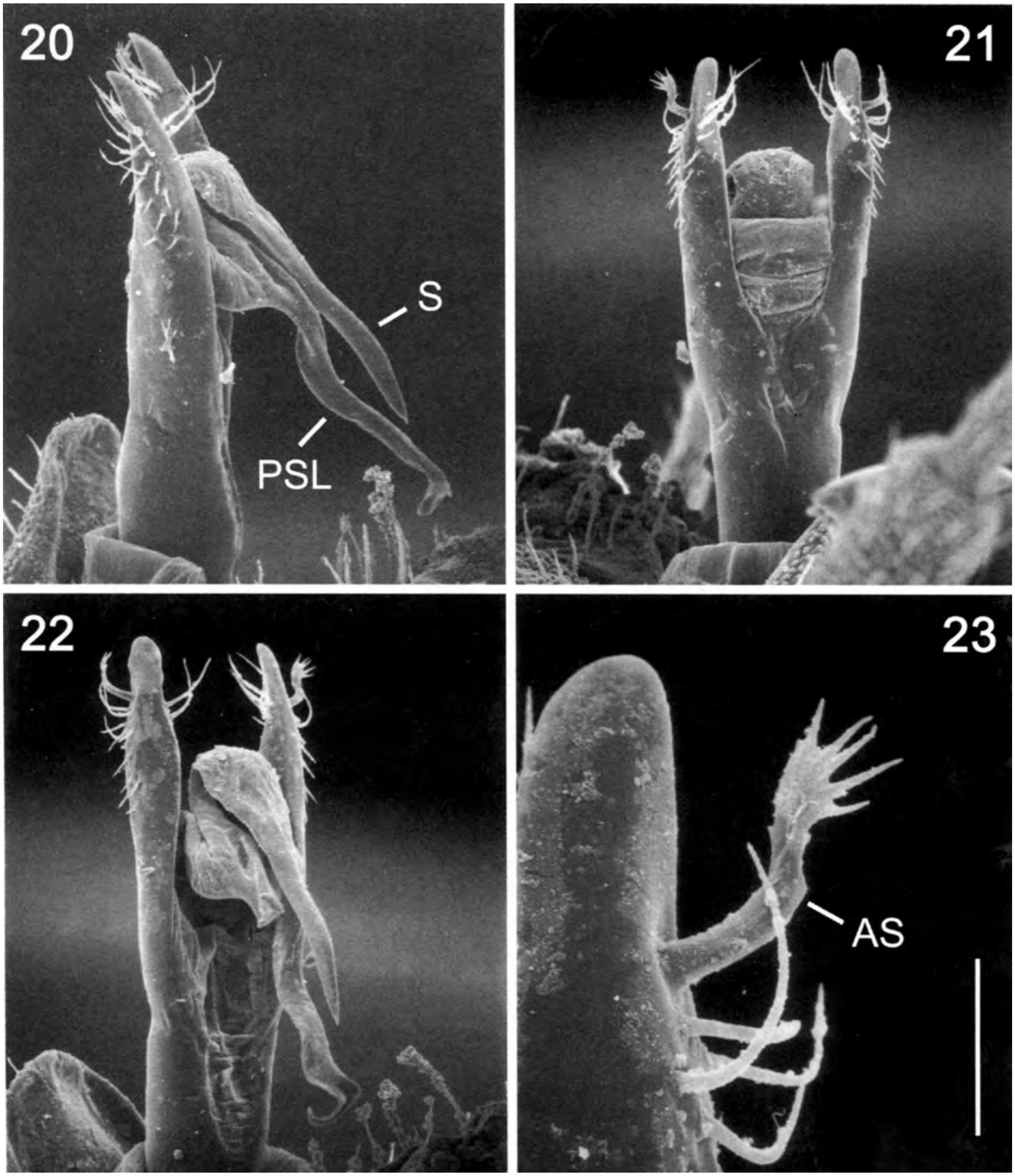
Figs. 8-11.-*Texella hartae*, new species, male genitalia. 8, Lateral view of penis, showing stylus (S) and parastylar lobes (PSL). 9, Ventroapical view of penis. 10, Dorsal view of penis. 11, Close-up of ventral plate prong showing apical spine. Scale bar: 150 μm (8); 200 μm (9); 60 μm (10); 20 μm (11).



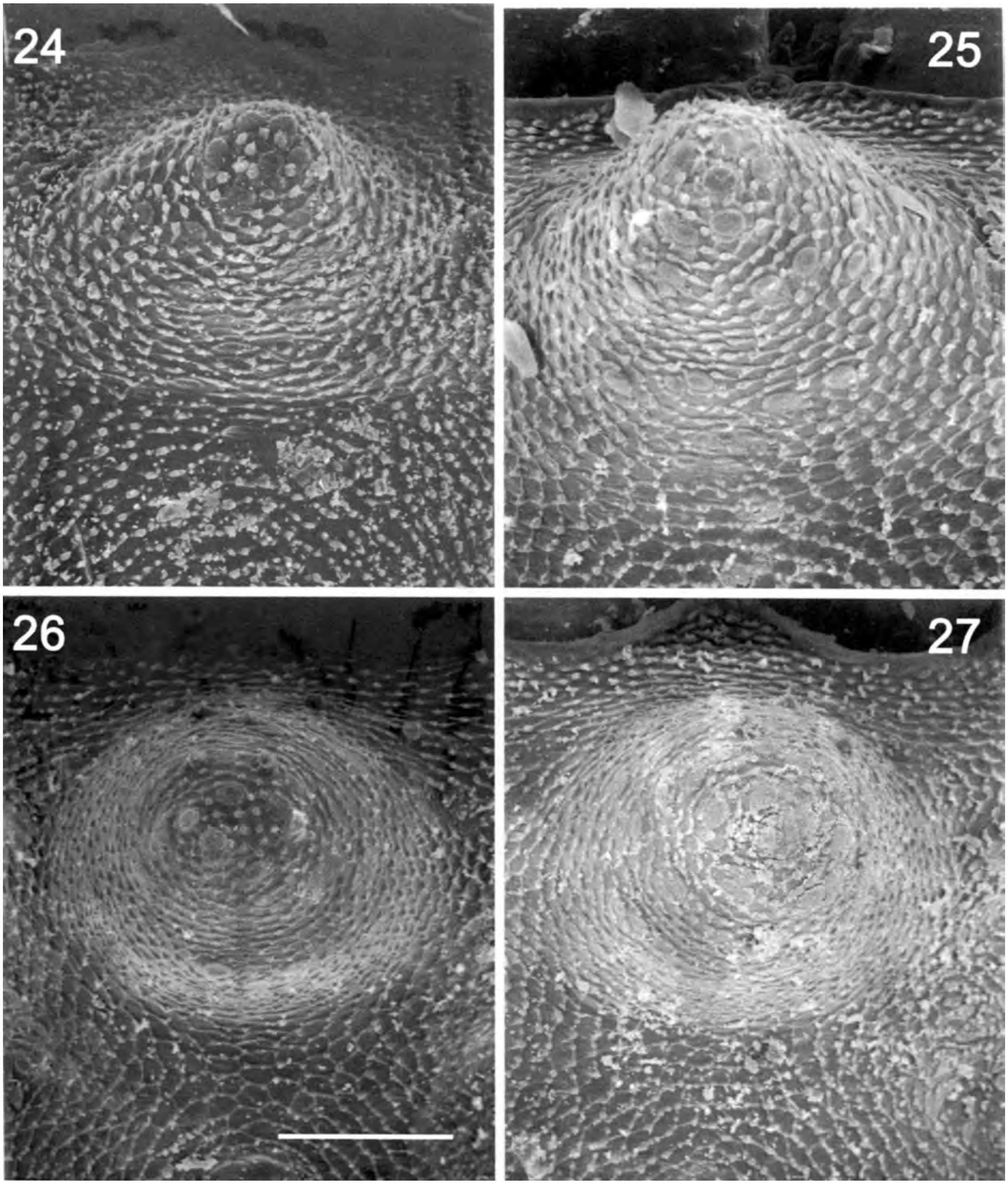
Figs. 12-15.-*Texella hartae,* new species. 12-14, female, 15, male. 12, Ovipositor, lateral view showing apical tooth (AT). 13, Genital operculum, ventroapical view. 14, Ovipositor, lateral view, close-up showing microspines. 15, Abdomen, ventral view showing genital operculum and postopercular process (POP). Scale bar: 100 μm (12, 13); 10 μm (14); 150 μm (15).



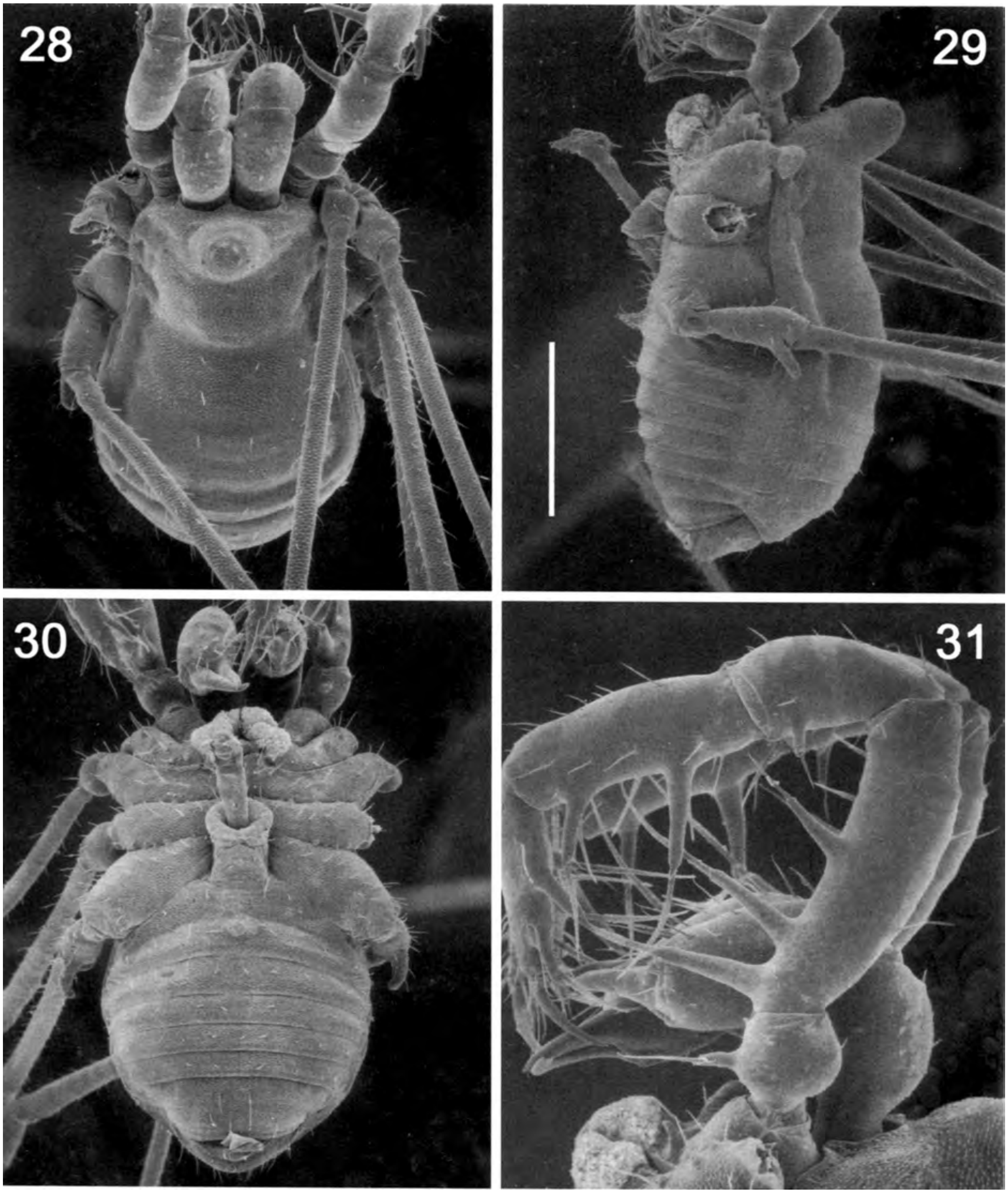
Figs. 16-19.-*Texella youngensis*, new species, male. 16, Body, dorsal view. 17, Scute, lateral view showing eyemound and anterior tubercles (AT). 18, Palpi, lateral view. 19, Abdomen, ventrolateral view showing postopercular process (POP) and trochanteral spur (S). Scale bar: 430 µm (16); 200 µm (17); 300 µm (18); 250 µm (19).



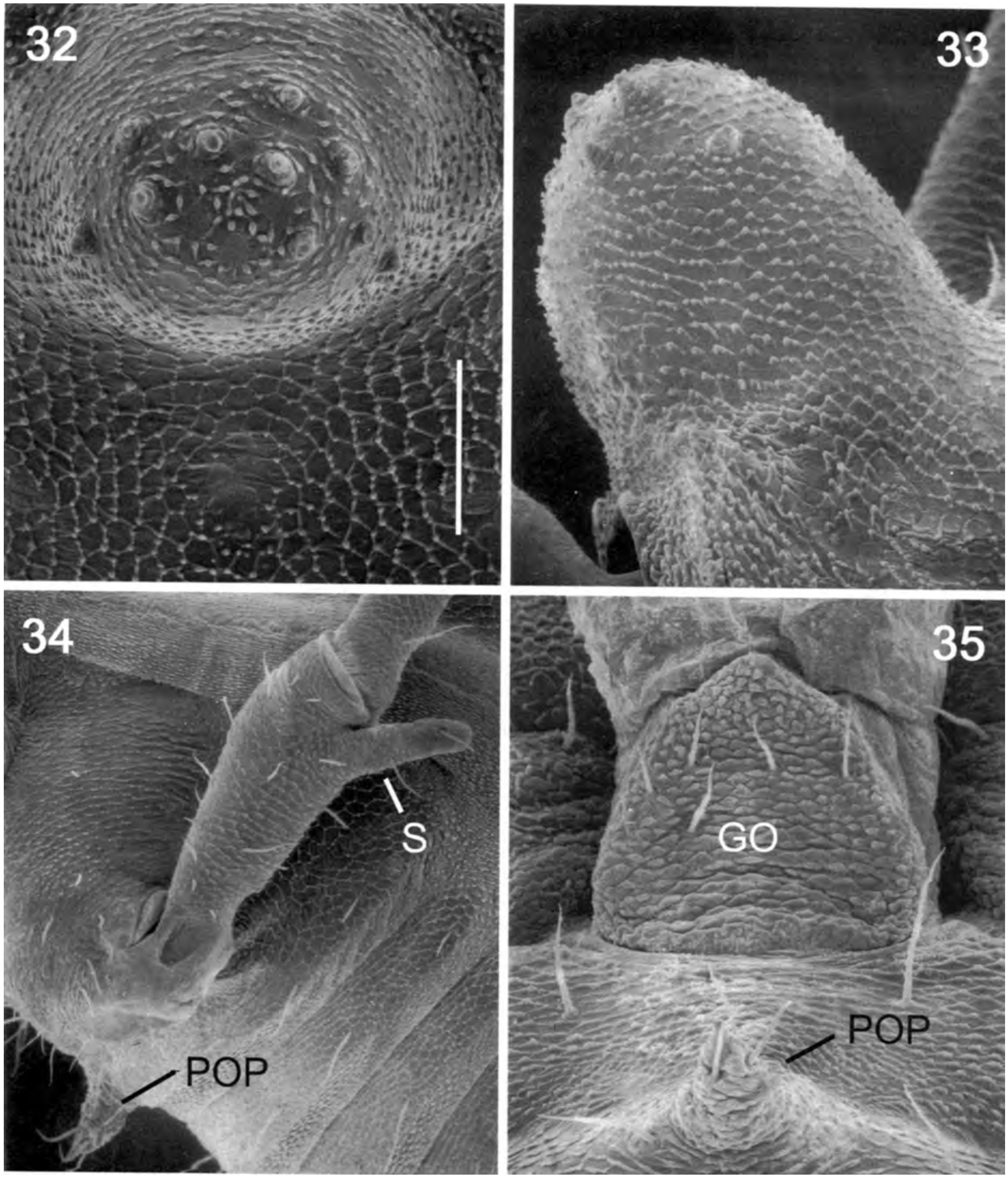
Figs. 20-23.-*Texella youngensis*, new species, male genitalia. 20, Lateral view of penis showing stylus (S) and parastylar lobes (PSL). 21, Ventral view of penis. 22, Dorsal view of penis; note broken parastylar lobe. 23, Left ventral plate prong, dorsal view showing anterior spine (AS). Scale bar: 150 μm (20-22); 30 μm (23).



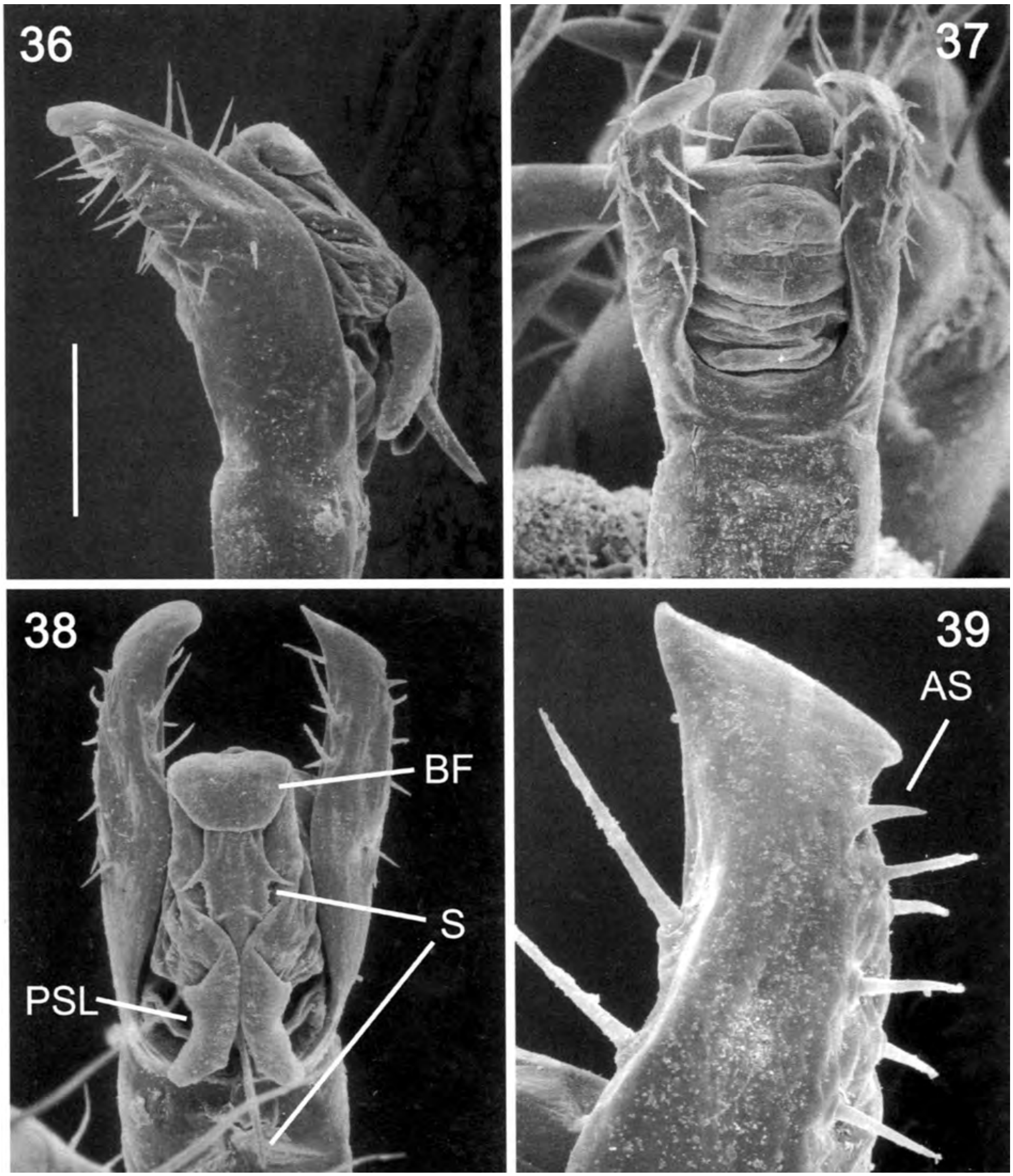
Figs. 24-27.-*Texella* species, eyemound, dorsal view. 24, 25, *T. mulaiki* Goodnight and Goodnight. 26, 27, *T. cokendolpheri* Ubick and Briggs. 24, 26, Male. 25, 27, Female. Scale bar: 100 μm.



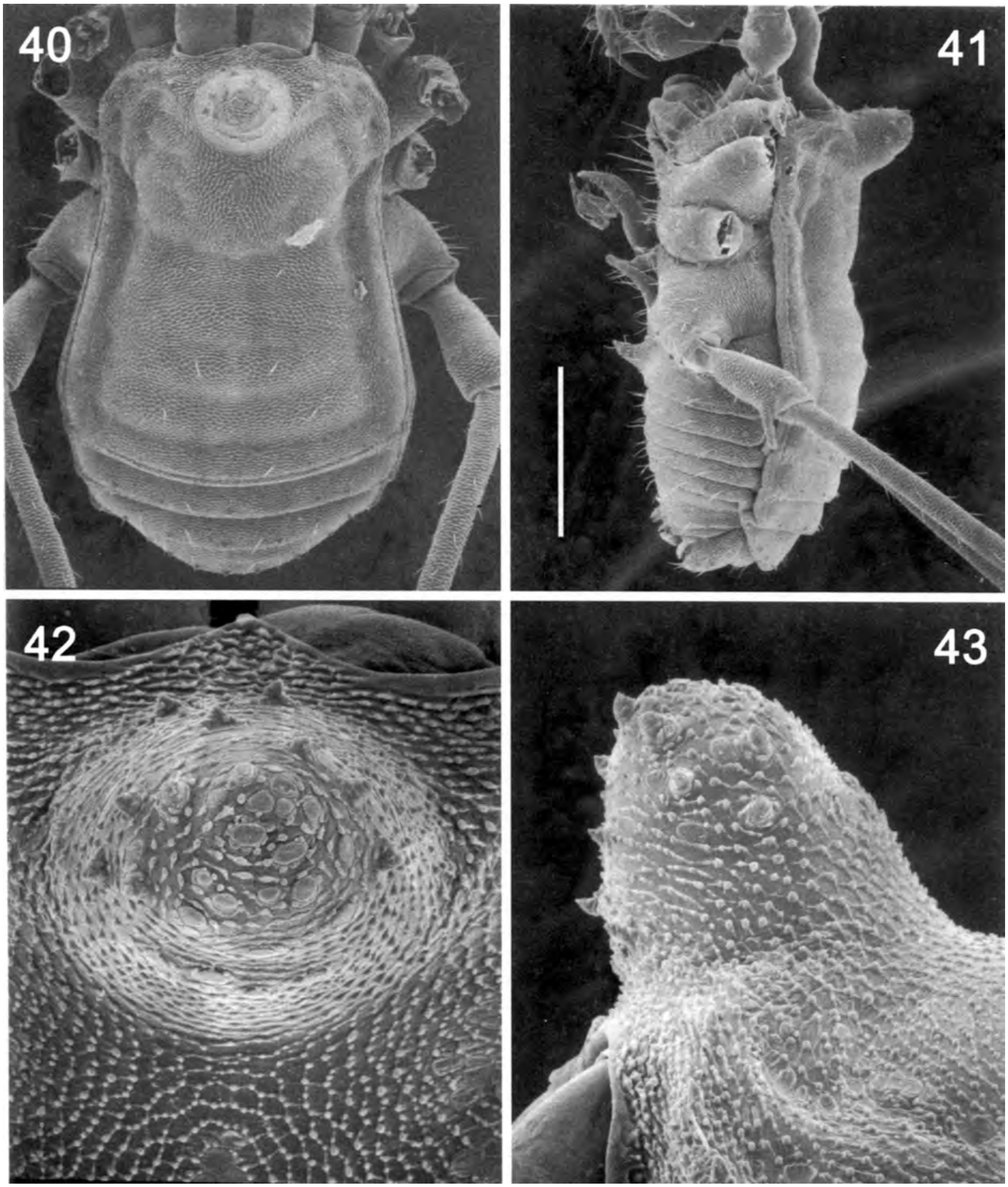
Figs. 28-31.-*Texella hilgerensis*, new species, male from Well Done Cave. 28, Body dorsal view. 29, Body lateral view. 30, Body ventral view. 31, Palpi lateral view. Scale bar: 600 µm (28-30); 300 µm (31).



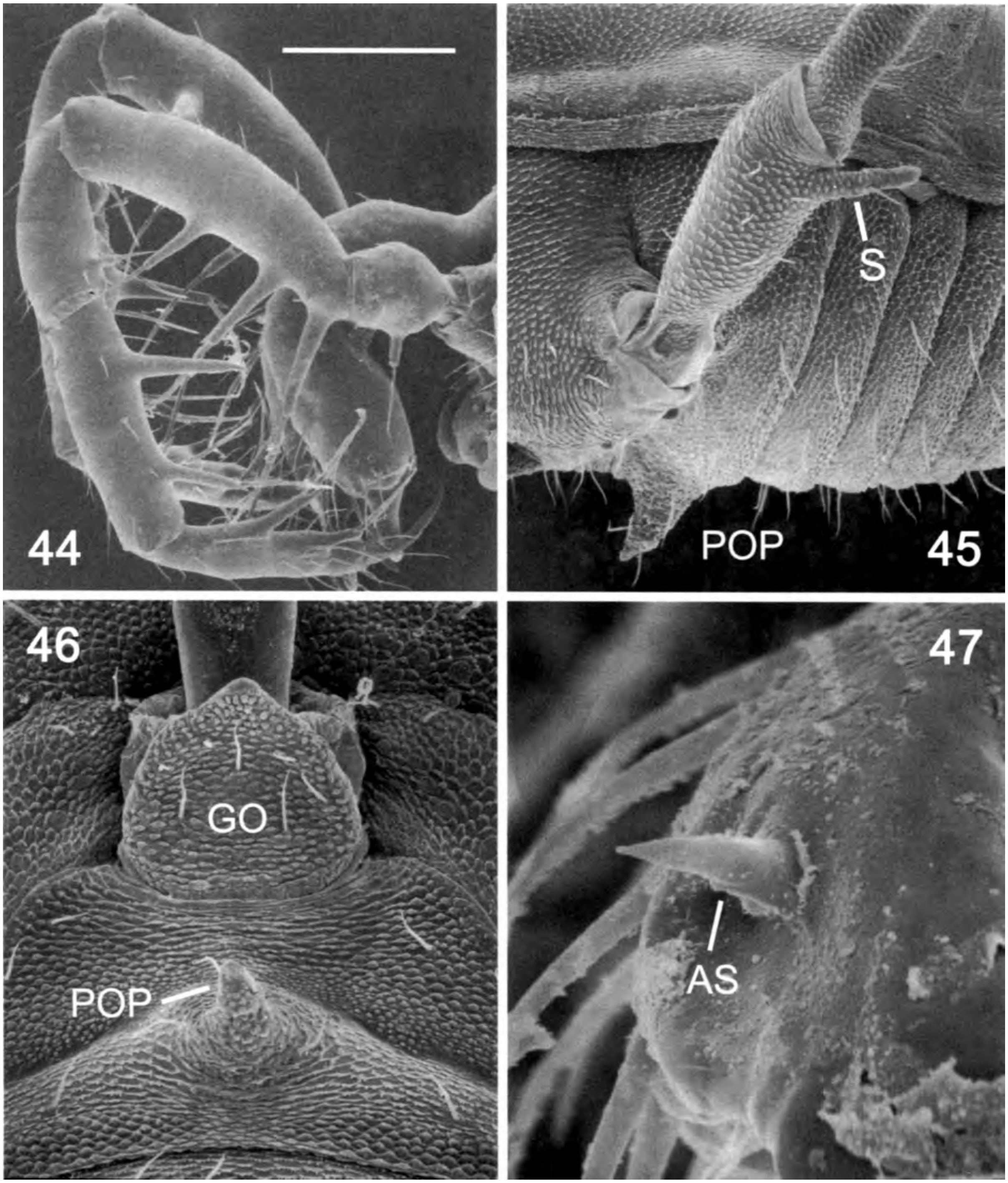
Figs. 32-35.-*Texella hilgerensis*, new species, male from Well Done Cave. 32, Eyemound dorsal view. 33, Eyemound lateral view. 34, Abdomen lateral view showing trochanteral spur (S) and postopercular process (POP). 35, Abdomen ventral view showing genital operculum (GO) and postopercular process (POP). Scale bar: 100 µm (32, 33, 35); 200 µm (34).



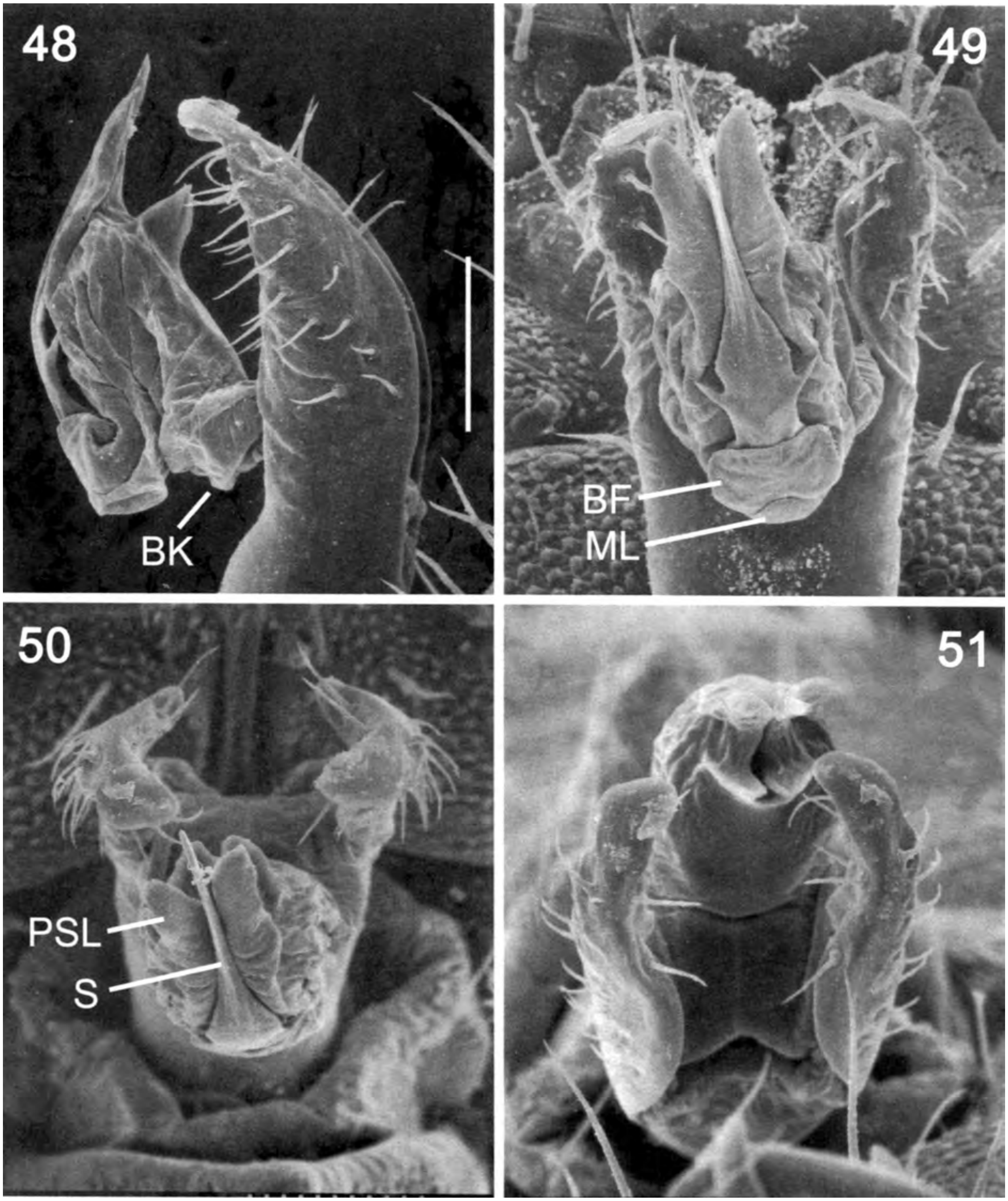
Figs. 36-39.-*Texella hilgerensis*, new species, male from Well Done Cave, genitalia. 36, Lateral view of penis. 37, Ventral view of penis. 38, Dorsal view of penis showing basal fold (BF), stylus (S), and parastylar lobes (PSL). 39, Left ventral plate prong, dorsal view of apex showing apical spine (AS). Scale bar: 75 µm (36-38); 25 µm (39).



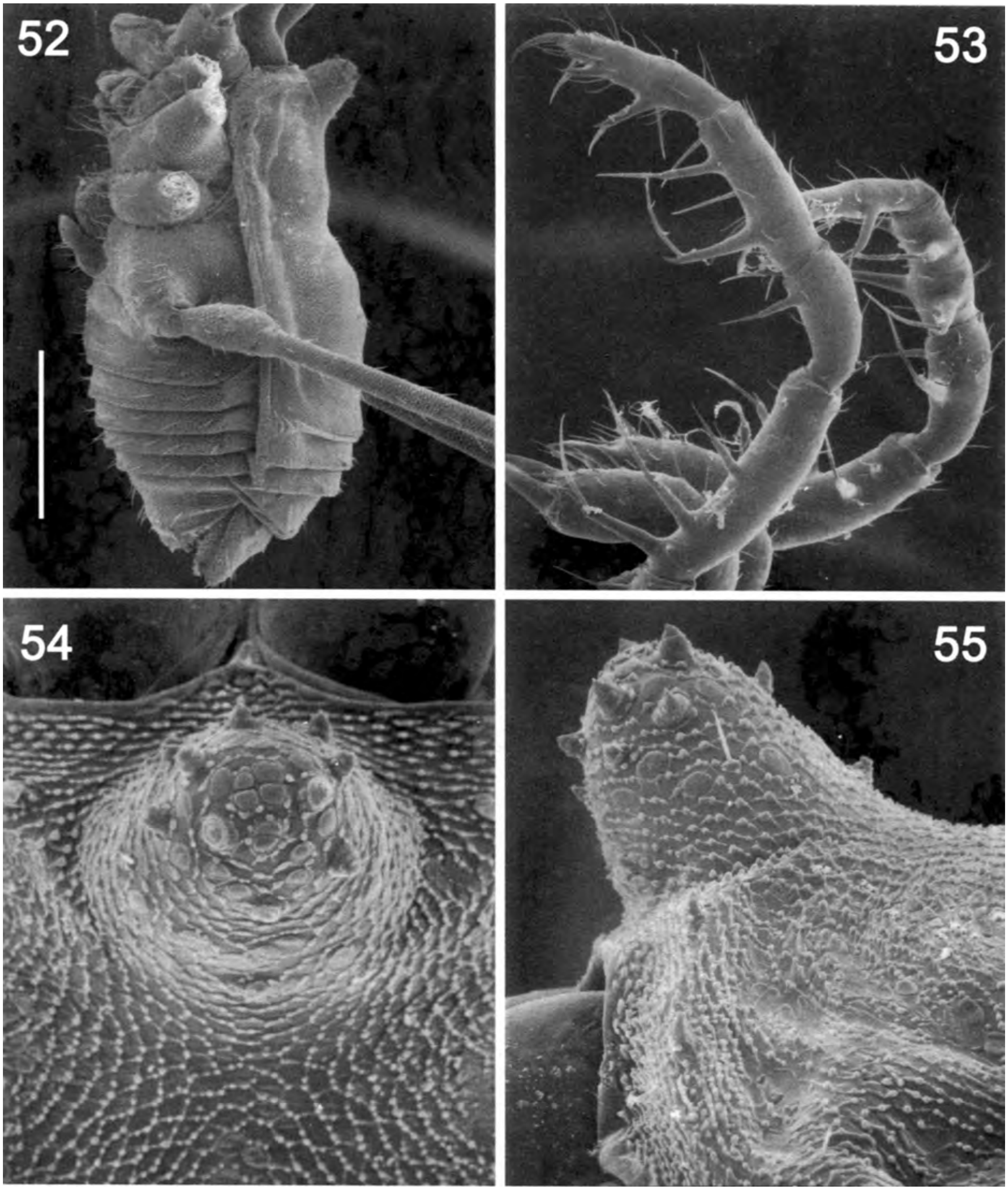
Figs. 40-43.-*Texella whitei*, new species, male from Sir Doug's Cave. 40, Body dorsal view. 41, Body lateral view. 42, Eyemound dorsal view. 43, Eyemound lateral view. Scale bar: 430 µm (40, 41); 100 µm (42, 43).



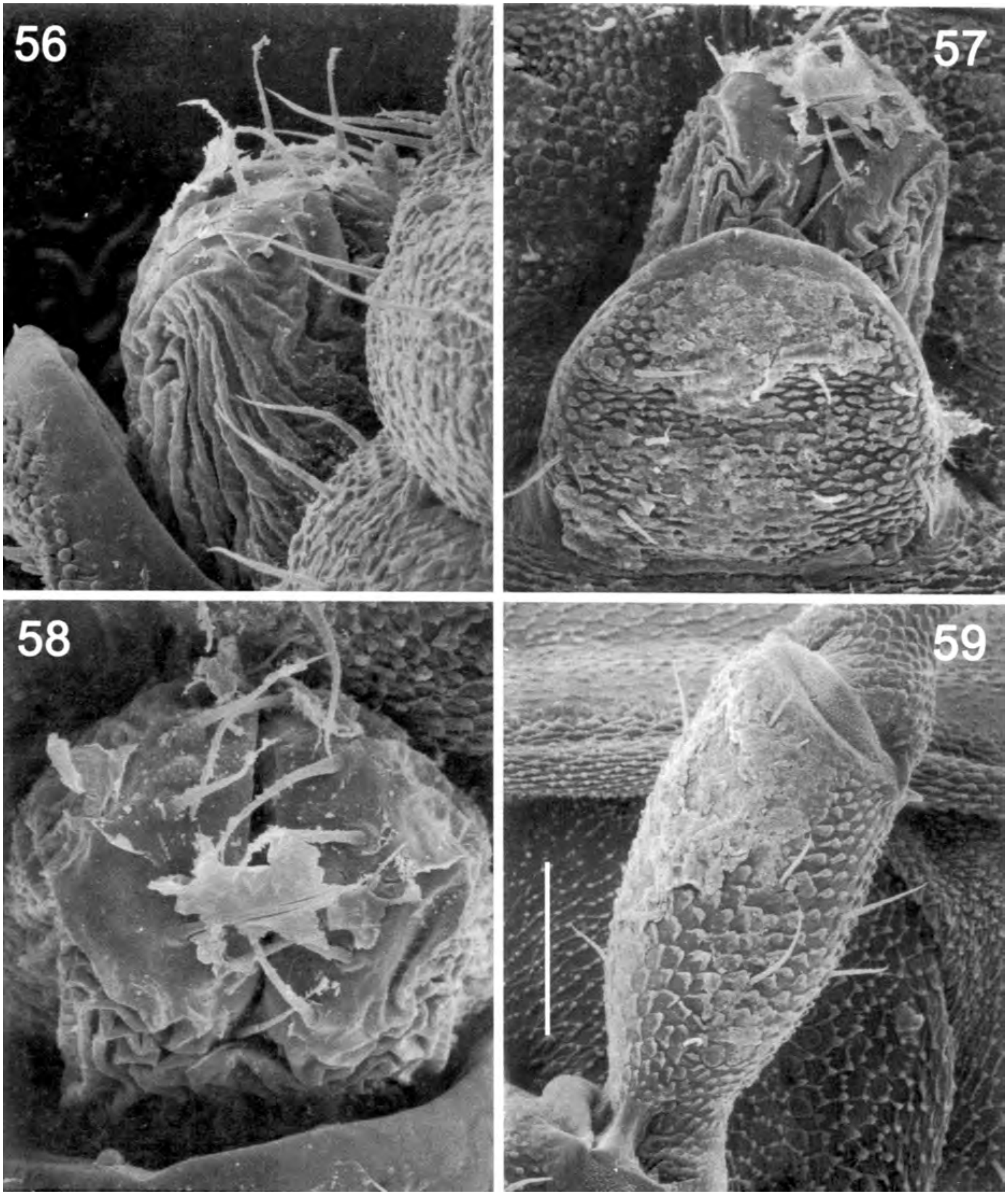
Figs. 44-47.-*Texella whitei*, new species, male from Sir Doug's Cave. 44, Palpi lateral view. 45, Abdomen lateral view showing trochanteral spur (S) and postopercular process (POP). 46, Abdomen ventral view showing genital operculum (GO) and postopercular process (POP). 47, Ventral plate prong, apical view showing apical spine (AS). Scale bar: 300 µm (44); 150 µm (45, 46); 10 µm (47).



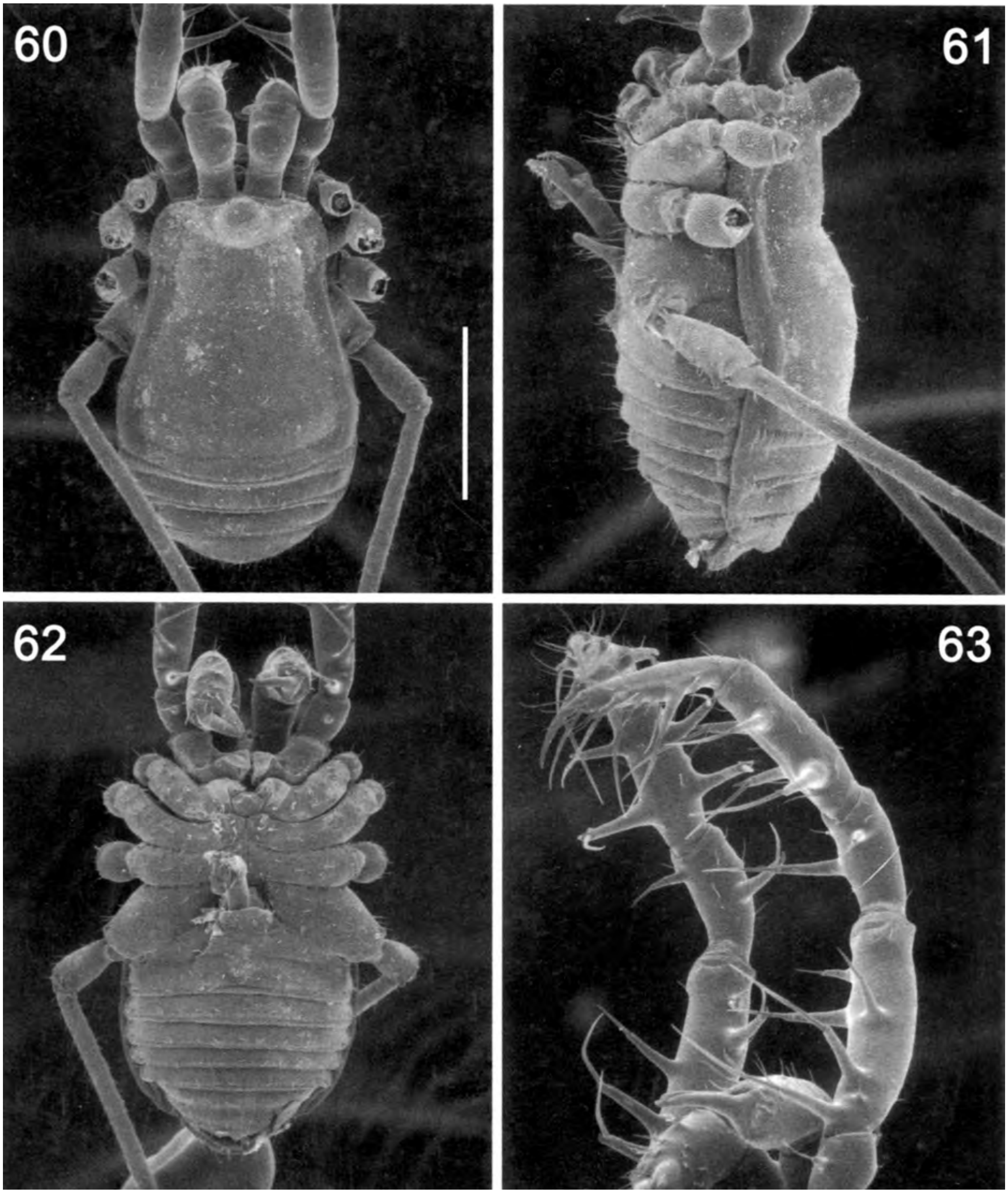
Figs. 48-51.-*Texella whitei*, new species, male from Sir Doug's Cave, penis. 48, Lateral view showing basal knob (BK). 49, Ventral view showing median lobe (ML) and basal fold (BF). 50, Apical view showing stylus (S) and parastylar lobe (PSL). 51, Dorsal view. Scale bar: 75 µm.



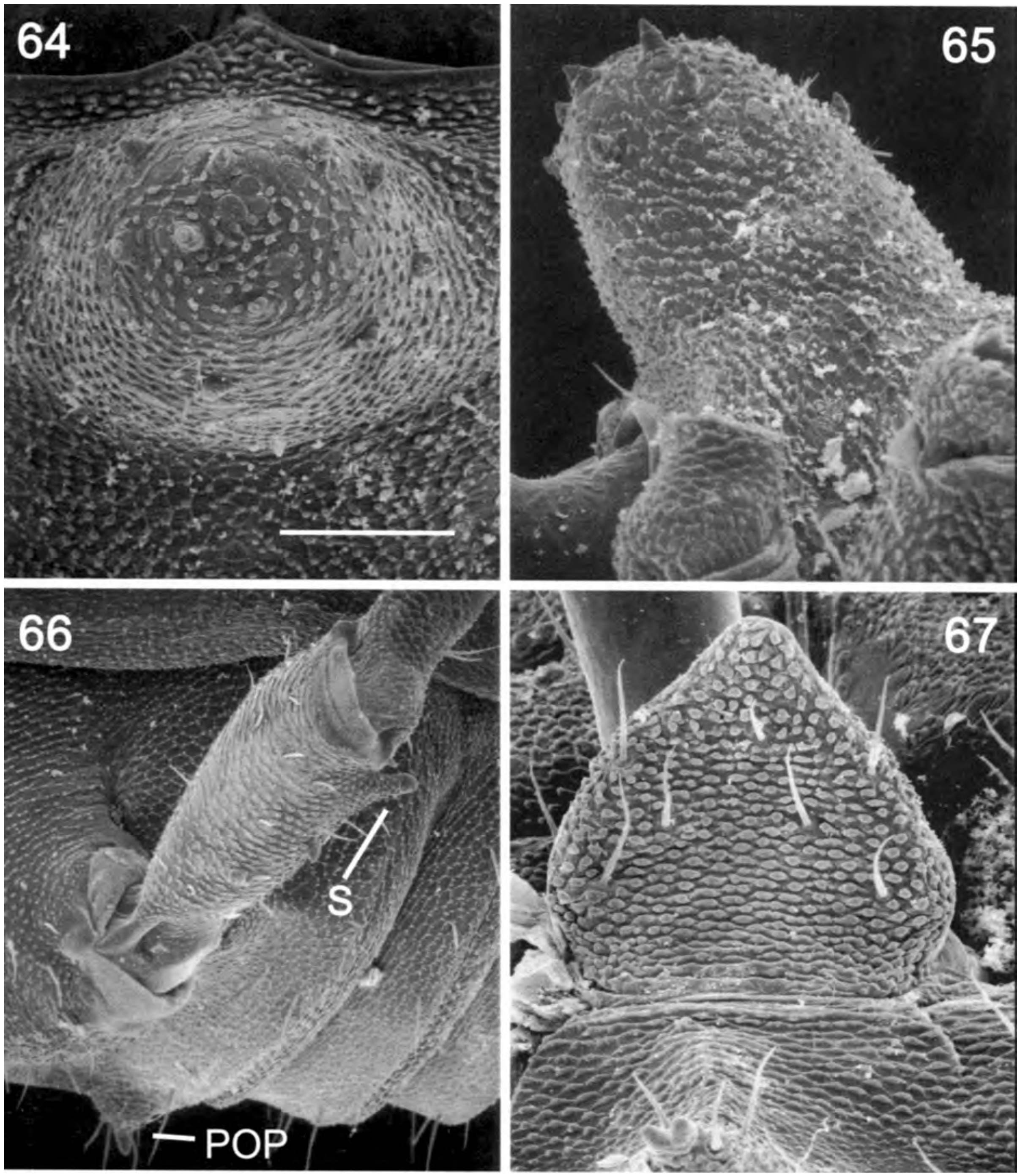
Figs. 52-55.-*Texella whitei*, new species, female from Sir Doug's Cave. 52, Body lateral view. 53, Palpi lateral view. 54, Eyemound dorsal view. 55, Eyemound lateral view. Scale bar: 500 µm (50); 430 µm (51); 100 µm (52, 53).



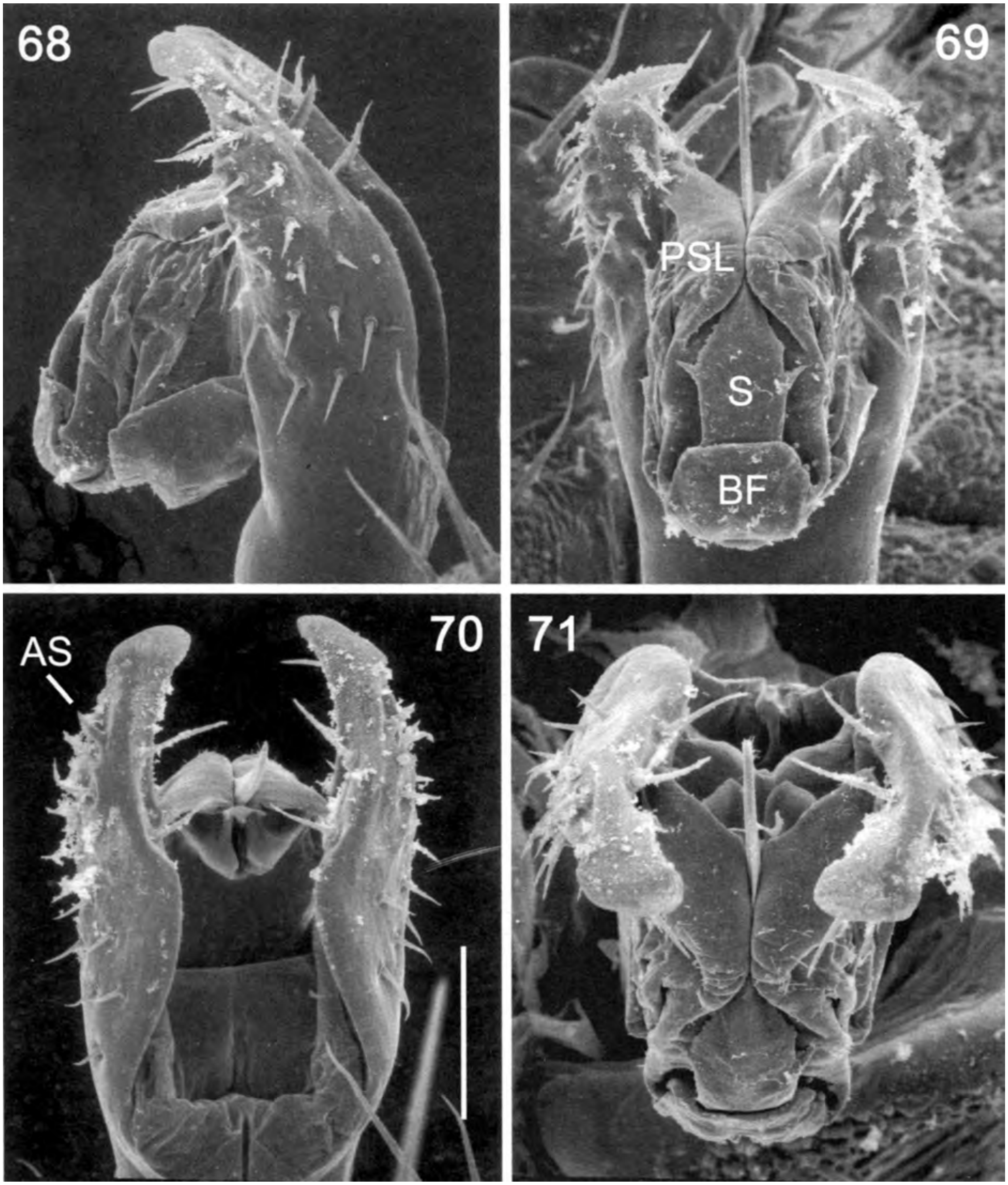
Figs. 56-59.-*Texella whitei*, new species, female from Sir Doug's Cave. 56, Ovipositor lateral view. 57, Genital operculum and ovipositor ventral view. 58, Ovipositor apical view. 59, Trochanter IV lateral view. Scale bar: 75 µm (56); 100 µm (57, 59); 60 µm (58).



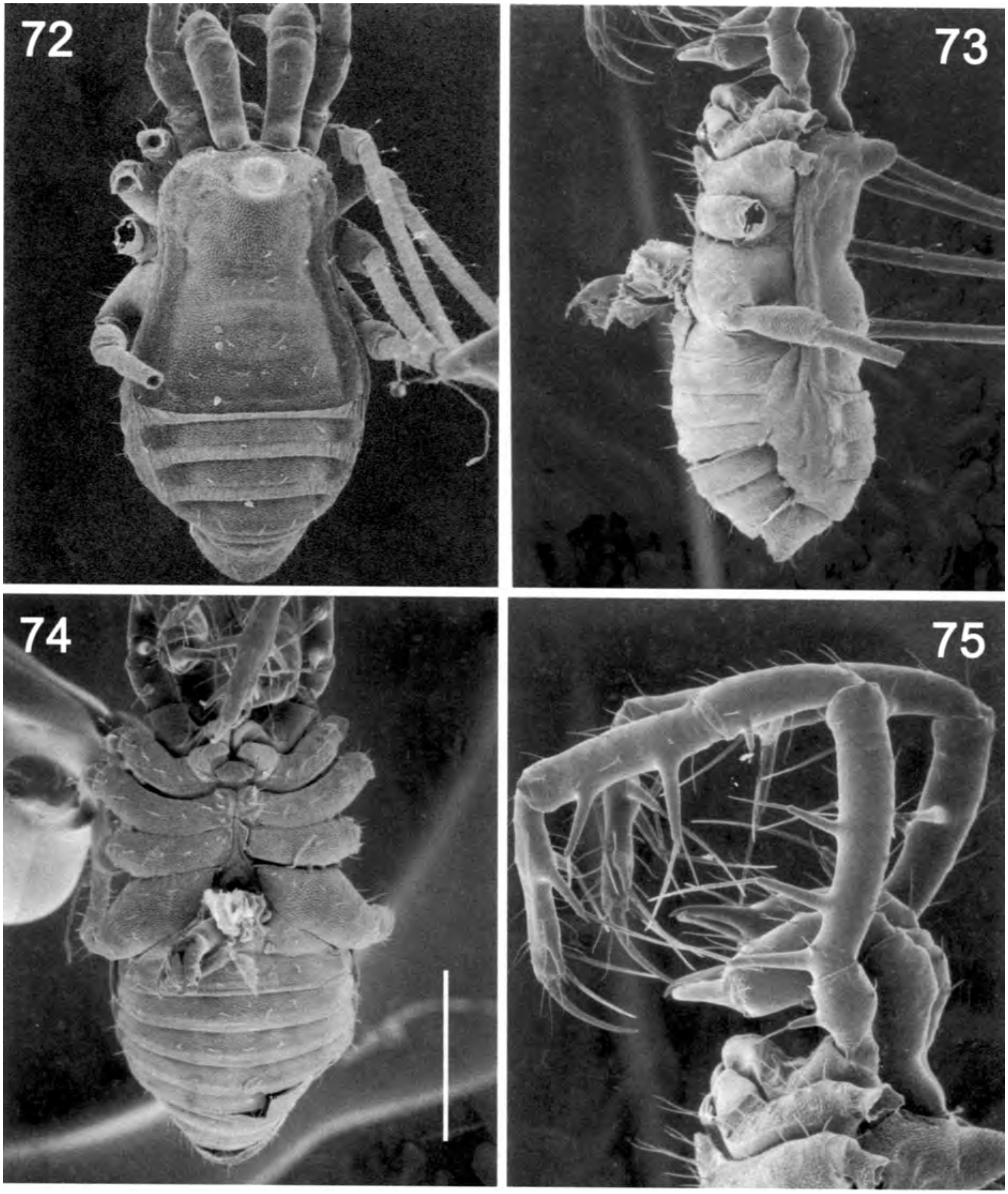
Figs. 60-63.-*Texella tuberculata*, new species, male from Surprise Sink. 60, Body dorsal view. 61, Body lateral view. 62, Body ventral view. 63, Palpi ventrolateral view. Scale bar: 750 μm (60, 62); 600 μm (61); 500 μm (63).



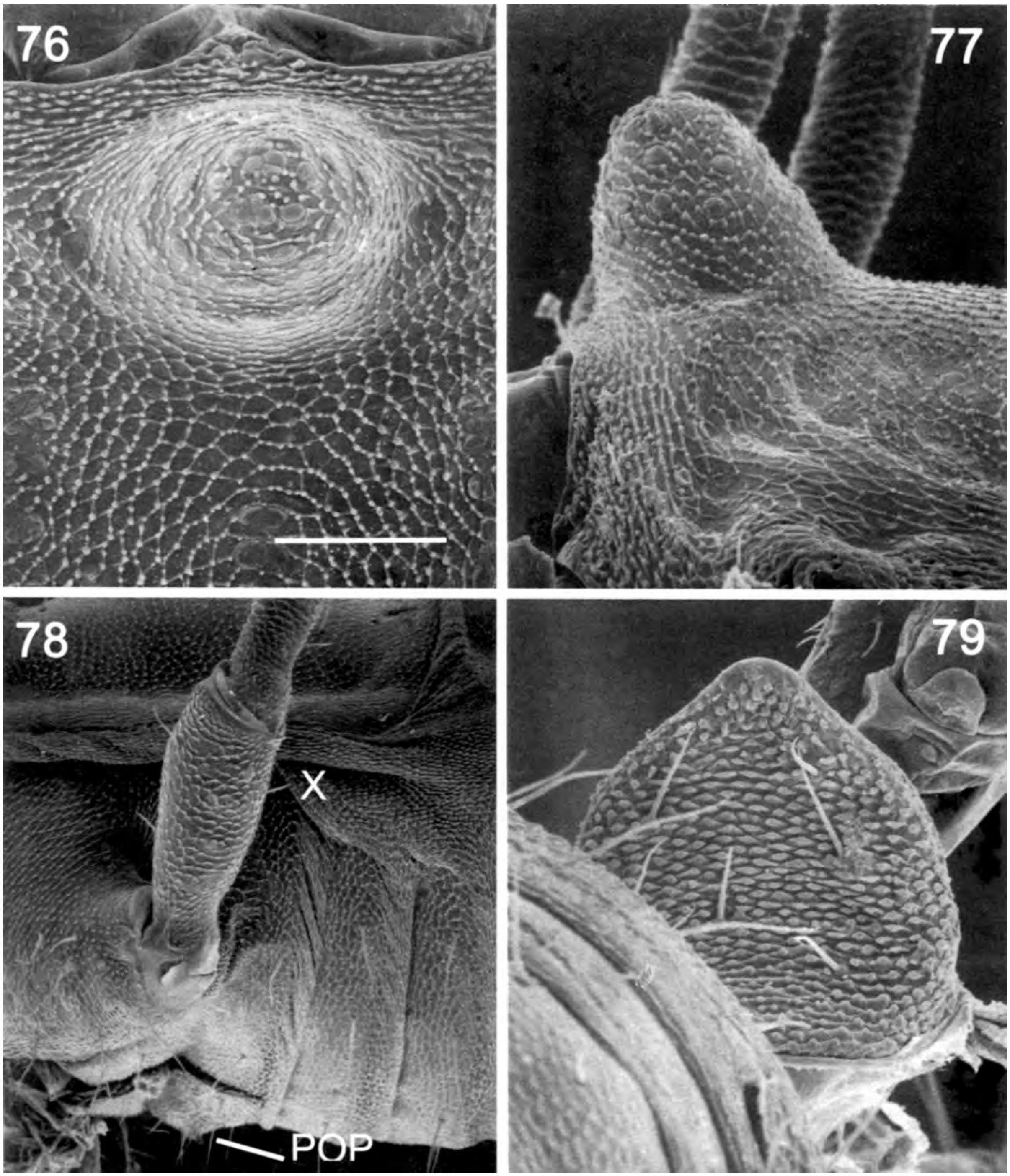
Figs. 64-67.-*Texella tuberculata*, new species, male from Surprise Sink. 64, Eyemound dorsal view. 65, Eyemound lateral view. 66, Abdomen lateral view showing trochanteral spur (S) and postopercular process (POP). 67, Genital operculum, ventral view. Scale bar: 100 μm (64, 65, 67); 176 μm (66).



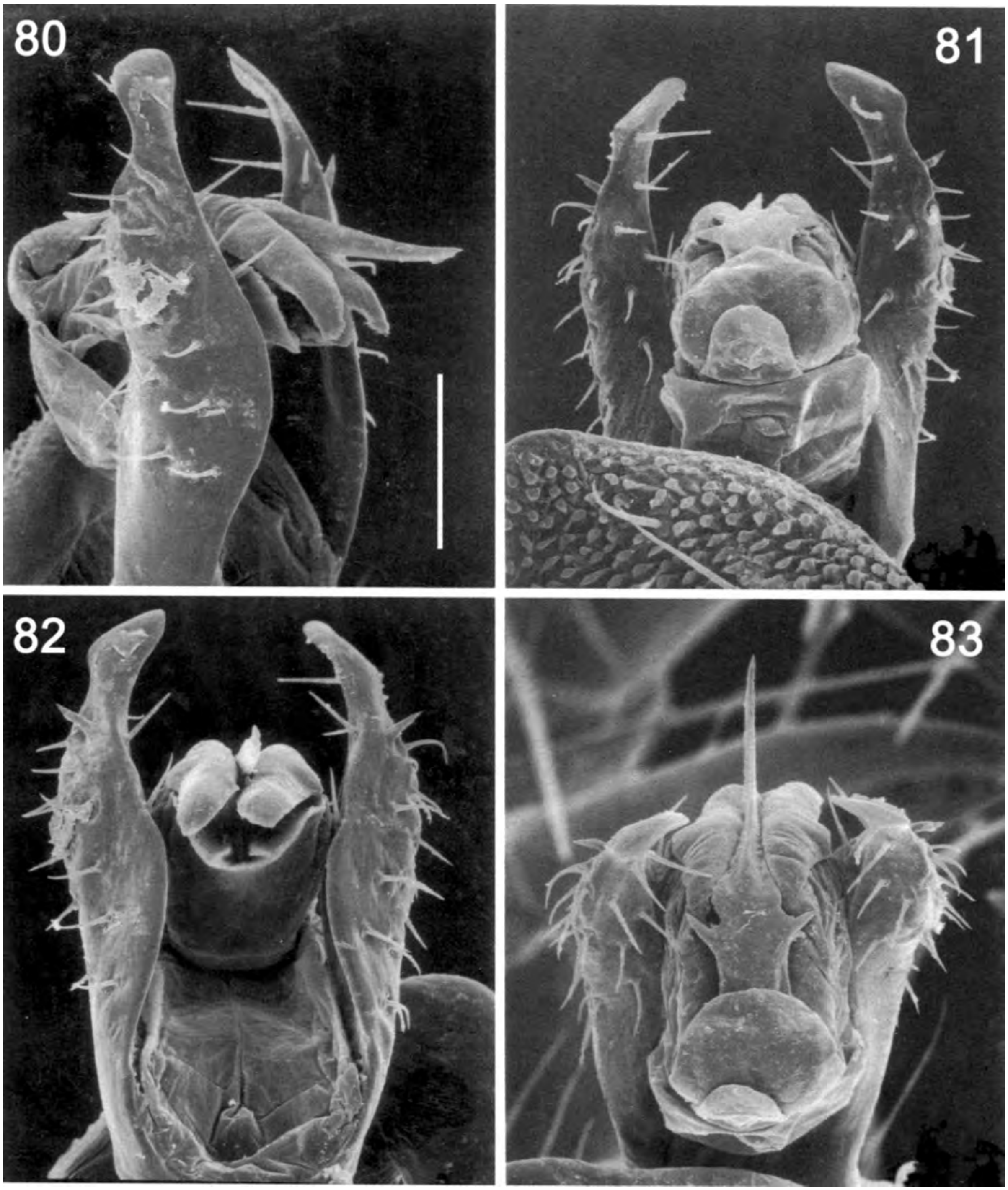
Figs. 68-71.-*Texella tuberculata*, new species, male from Surprise Sink, penis. 68, Lateral view. 69, Ventral view showing basal fold (BF), stylus (S), and parastylar lobes (PSL). 70, Dorsal view showing apical spine (AS). 71, Apical view. Scale bar: 75 μm (68-70); 60 μm (71).



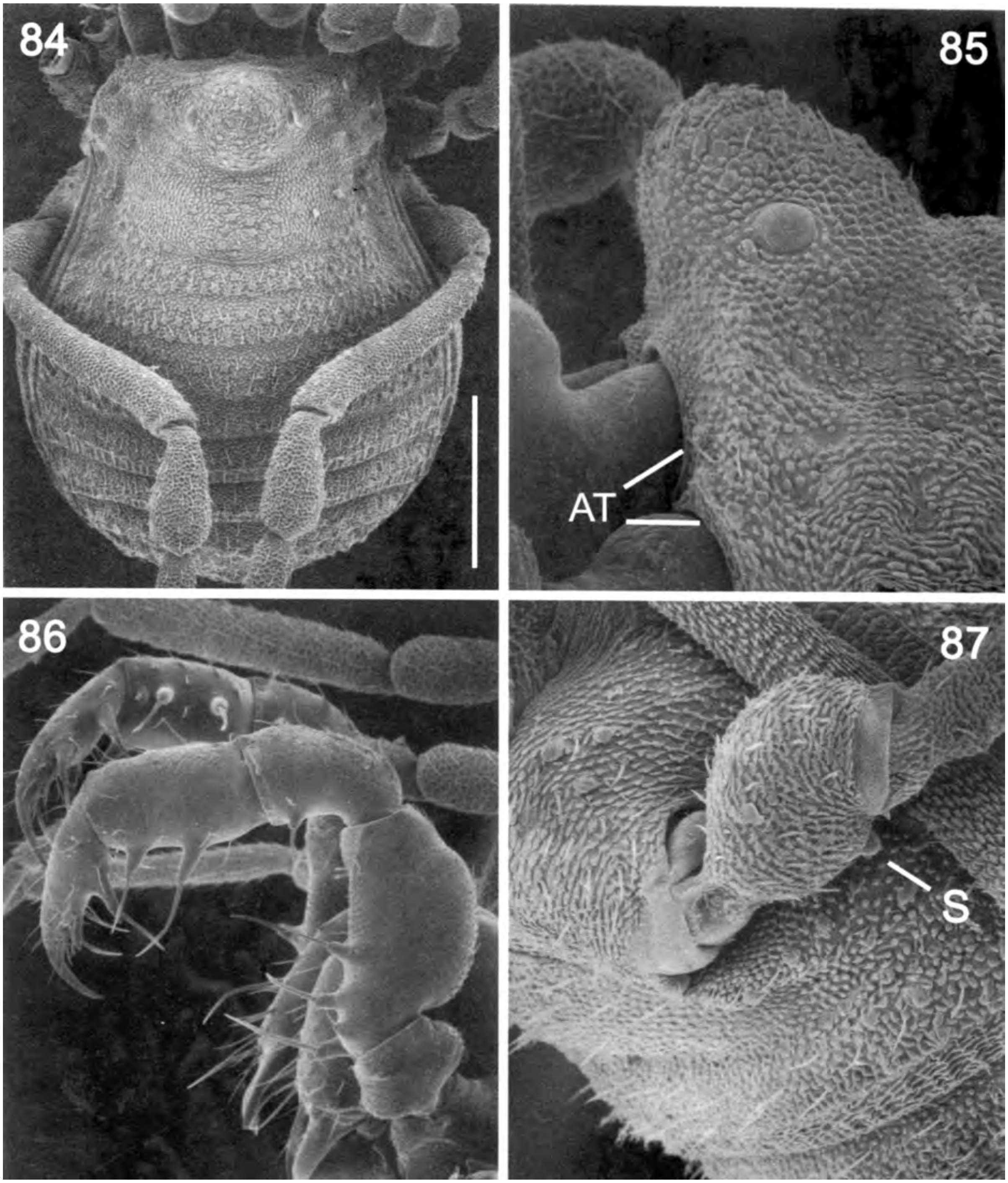
Figs. 72-75.-*Texella elliotti*, new species, male from Headquarters Cave. 72, Body dorsal view. 73, Body lateral view. 74, Body ventral view. 75, Palpi lateral view. Scale bar: 600 µm (72-74); 300 µm (75).



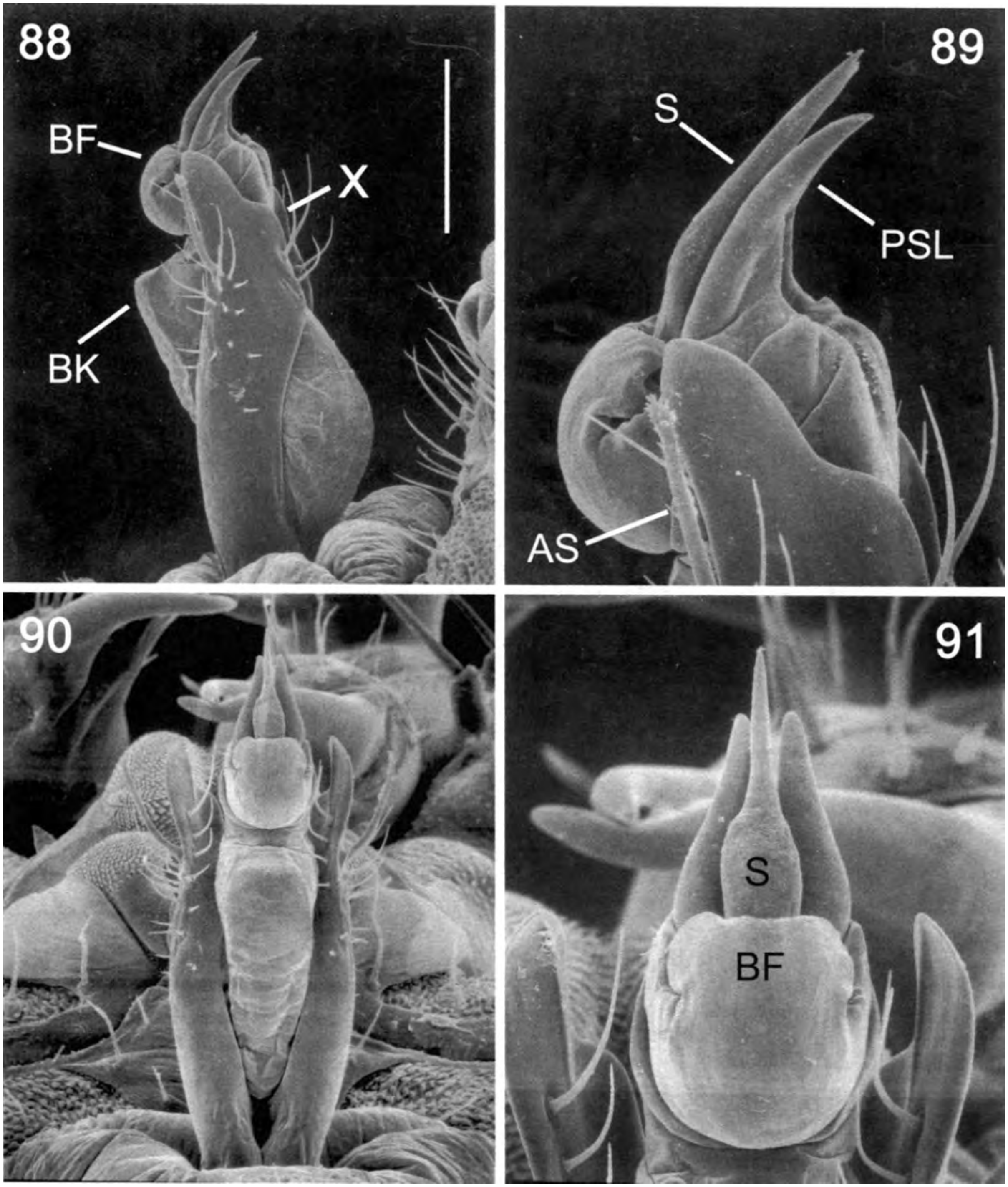
Figs. 76-79.-*Texella elliotti*, new species, male from Headquarters Cave. 76, Eyemound dorsal view. 77, Eyemound lateral view. 78, Abdomen lateral view showing absence of trochanteral spur (X) and reduced postopercular process (POP). 79, Genital operculum ventral view. Scale bar: 100 µm (76, 77, 79); 200 µm (78).



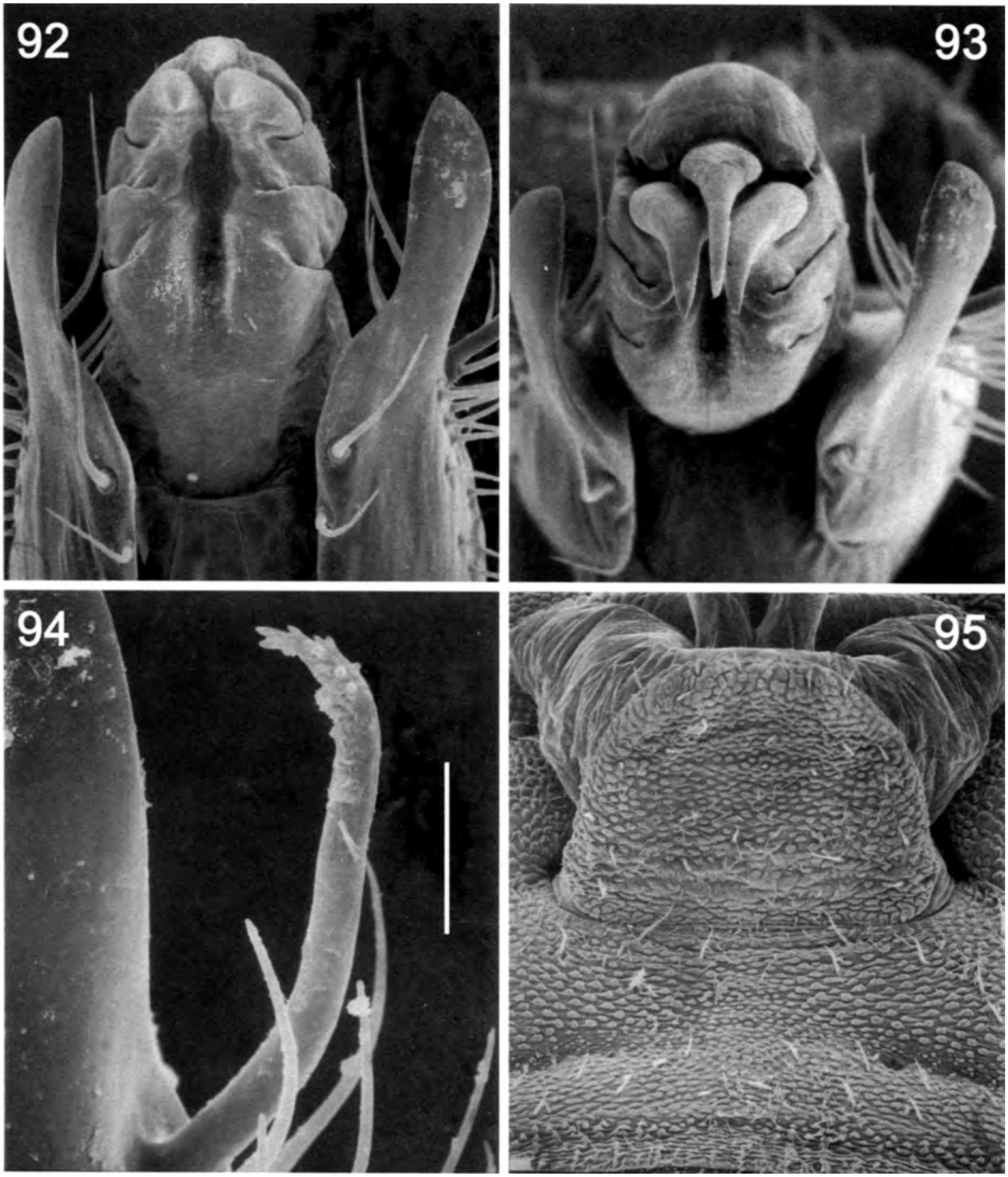
Figs. 80-83.-*Texella elliotti*, new species, male from Headquarters Cave, penis. 80, Dorsolateral view. 81, Ventral view. 82, Dorsal view. 83, Apical view. Scale bar: 75 μm.



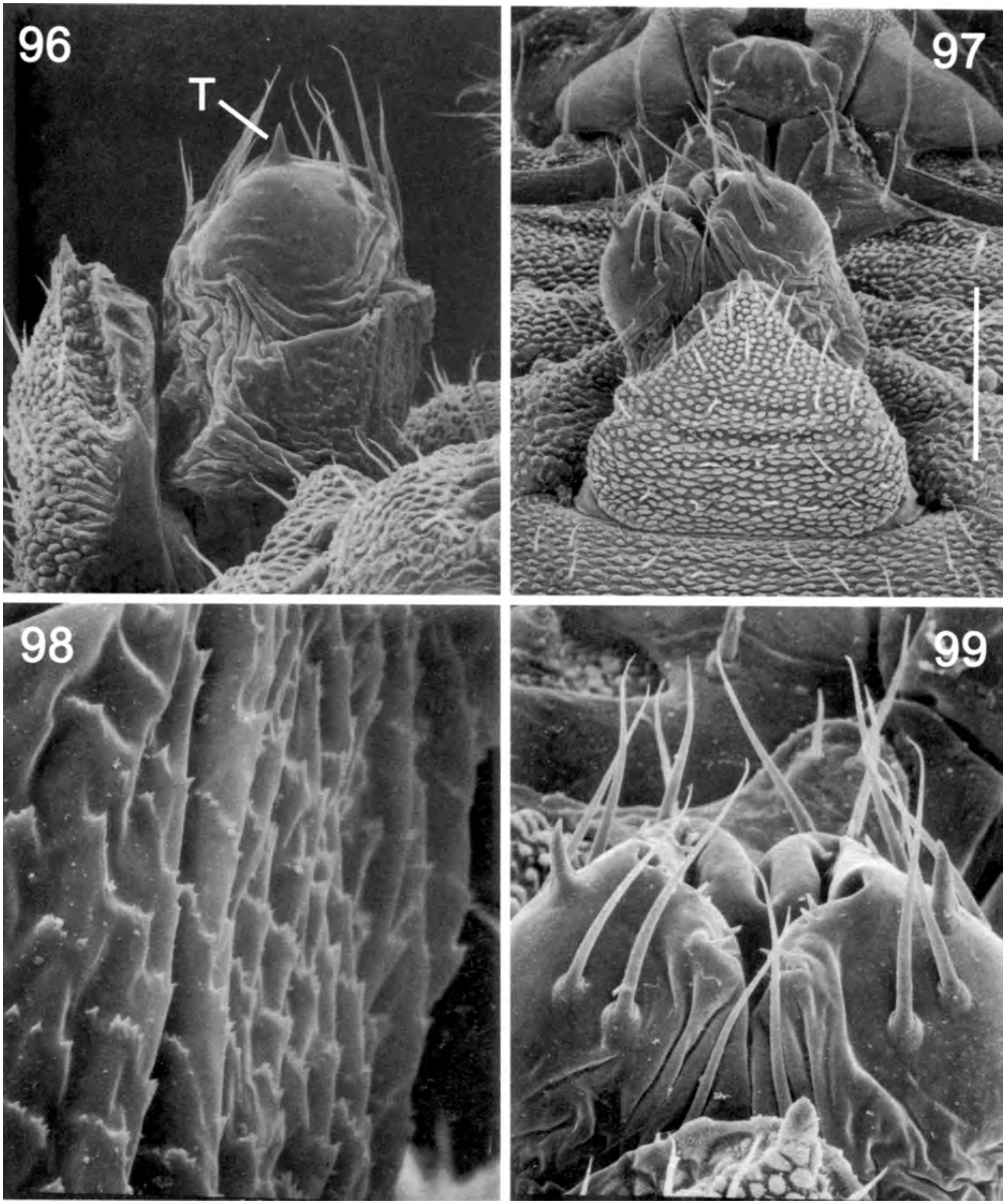
Figs. 84-87.-*Texella dimopercula*, new species, male. 84, Body, dorsal view. 85, Scute, lateral view showing eyemound and anterior tubercles (AT). 86, Palpi, lateral view. 87, Abdomen, lateral view showing reduced trochanteral spur (S). Scale bar: 430 μm (84); 150 μm (85, 87); 300 μm (86).



Figs. 88-91.-*Texella dimopercula*, new species, male genitalia. 88, Lateral view of penis showing basal knob (BK), basal fold (BF), and dorsal flange of VPP (x). 89,Close-up of glans showing stylus (S), parastylar lobe (PSL), and apical spine (AS). 90,Ventral view of penis. 91,Close-up of glans showing basal fold (BF) and stylus (S). Scale bar: 150 µm (88, 90); 60 µm (89, 91).



Figs. 92-95.-*Texella dimopercula*, new species, male genitalia. 92,Penis, dorsal view. 93,Penis, dorsoapical view. 94, Apical spine. 95,Genital operculum, ventral view. Scale bar: 60 μm (92, 93); 20 μm (94); 150 μm (95).



Figs. 96-99.-*Texella dimopercula*, new species, female genitalia. 96,Ovipositor, lateral view showing apical tooth (T). 97, Genital operculum and ovipositor, ventral view. 98,Ovipositor, close-up of lateral view showing microspines. 99,Ovipositor, apical view. Scale bar: 100 μm (96); 150 μm (97); 15 μm (98); 60 μm (99).

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REVALIDATION OF THE HARVESTMAN GENUS *CHINQUIPELLOBUNUS* (OPILIONES: STYGNOPSIDAE)

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ABSTRACT

The harvestman genus *Chinquipellobunus* Goodnight and Goodnight is removed from synonymy with *Hoplobunus* Banks and transferred from the Phalangodidae: Phalangodinae to the Stygnopsidae. Member species are only known from caves in Coahuila and Nuevo León, Mexico, and Texas, U.S.A. The type species *Chinquipellobunus osorioi* Goodnight and Goodnight is rediagnoised and illustrated. *Pellobunus mexicanus* Goodnight and Goodnight, *Hoplobunus russelli* Goodnight and Goodnight and *Hoplobunus madlae* Goodnight and Goodnight are all newly transferred to *Chinquipellobunus*. Each is rediagnoised and illustrated. A new species is described from a cave in Coahuila, Mexico. A taxonomic key for identification of adult males is provided. All previously published records of members of this genus from caves in Querétaro, Mexico, are rejected as misidentifications.

INTRODUCTION

The harvestman genus *Chinquipellobunus* was described by Goodnight and Goodnight (1944) for a single troglobitic species (*C. osorioi*) from three caves in Nuevo León, Mexico. They originally placed the genus in the subfamily Phalangodinae of the Phalangodidae. The following year, they (1945) listed the genus in the subfamily Stygnopsinae and recorded new records from two of the previously known caves. Then, in 1953, these same authors synonymized their genus under *Hoplobunus* Banks (1900) in the Phalangodinae. This was the last taxonomic treatment of the genus and species; although the specific name (in combination with *Hoplobunus*) has appeared in regional lists and a catalogue (Reddell, 1981; Kury and Cokendolpher, 2000; Kury, 2003).

Goodnight and Goodnight (1971) described *Pellobunus mexicanus* from one of the recorded caves for *Chinquipellobunus osorioi*; but did not mention this latter species. It is not clear why they thought this species belonged in *Pellobunus* Banks, 1905, because it would key to *Hoplobunus* in their 1953 key to the phalangodid genera of Mexico (in the same paper where they synonymized *Chinquipellobunus*). The descriptions of the two species do not differ much, but an examination of the genitalia revealed that they are distinct congeneric species. The paratype of *Pellobunus mexicanus* from Querétaro is excluded from the type series as it is misidentified. Although the relationship has been suspected for many years, it was not examined in detail before now because *Pellobunus mexicanus* was placed in the family Samoidae (Phalangodidae: Samoinae in older literature) and considered to be a troglophile, whereas *Hoplobunus* (=*Chinquipellobunus*) *osorioi* was placed in the Stygnopsidae (Phalangodidae: Stygnopsinae) and was considered a troglobite.

Examination of the "*Hoplobunus*" spp. known from caves in Texas revealed that they too belonged to

Chinquipellobunus. A new species was also discovered among misidentified museum material of "*Pellobunus mexicanus*" and is described herein.

MATERIALS AND METHODS

All specimens listed (unless indicated otherwise) are from the Texas Memorial Museum, Austin. Those specimens listed as AMNH are from the American Museum of Natural History, New York. In rare cases where the penis was extended from the body in preserved specimens, the penis was removed by simply grasping and pulling it free from the body with forceps. Not extended penes were removed for examination by cutting the cuticle of both coxae IV back to almost the spiracles, starting at the front edges of the genital opening and moving posteriorly and laterally in a triangular pattern. A sharp microscapel is essential in making the two cuts. Once cut, the anterior end of the cuticle can be lifted with forceps and the penis grabbed with a second forceps and pulled loose. These harvestmen are very hard bodied and applying just enough pressure to cut the cuticle, but not crush or break the specimen is difficult. The penis and attached sheaths can then be placed in lactophenol (for clearing) or glycerine. The adhering sheaths can be forced back or removed with microprobes and forceps. The penis is then placed on a slide and examined with incident and transmitted light. The figures of the genitalia were obtained by the use of a digital Sony Mavica camera mounted on a Nikon-SL3D compound microscope. The photographs were then combined either directly in Photoshop by cutting and pasting in-focus areas or by the use of Combine-Z software. Combine-Z was used only when a greater depth of field was needed. The penis glans would sometimes expand and evert if the specimen was left in lactophenol for one to several days.

RESULTS AND DISCUSSION

Family Stygnopsidae

Chinquipellobunus Goodnight and Goodnight, status restored

Chinquipellobunus Goodnight and Goodnight, 1944:1.
Hoplobunus (in part): Goodnight and Goodnight, 1953:19, 20; 1967:1-2; Edgar, 1990:548; Kury, 2003:237.
Pellobunus (in part): Goodnight and Goodnight, 1971:44; Kury, 2003:224.

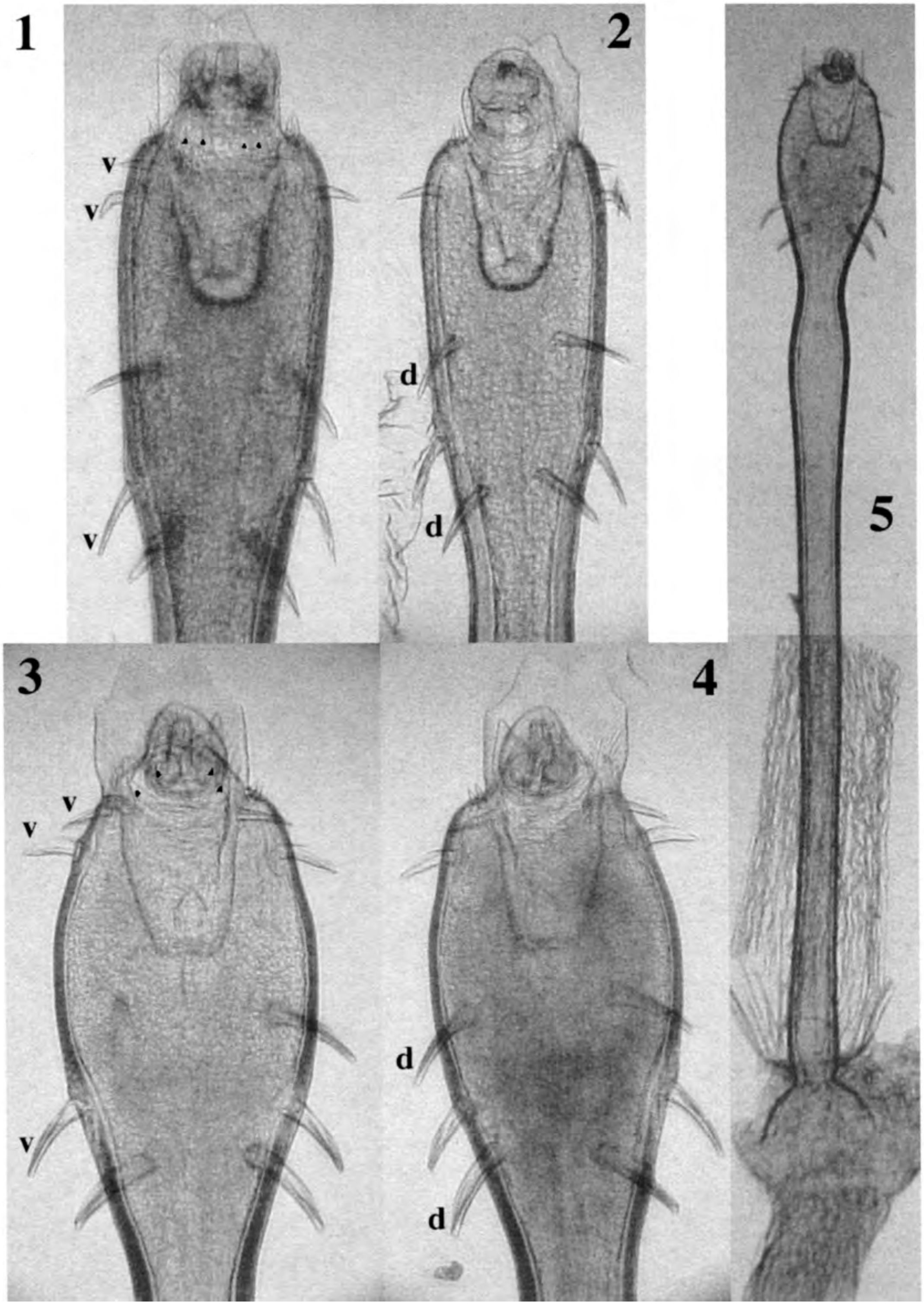
Type species.—*Chinquipellobunus osorioi* Goodnight and Goodnight, 1944, by original designation and monotypy.

Diagnosis.—Large cavernicolous stygnopsid harvestmen with a pair of relatively short pointed spicules on the ventral surface of the ventral extension of the penis truncus and a pair of spines on the anterolateral margin of the truncus; truncus with 2 dorsal macrosetae and 3 pairs (rarely 4) of ventral macrosetae.

Description.—Dorsum with five distinct areas, all dorsal areas and free tergites without median armature: scute without projections on the lateral margin between coxae III and IV; without lateral projections on area V. Ocular tubercle a rounded cone; smooth to tuberculate,

TAXONOMIC KEY TO ADULT MALE *CHINQUIPELLOBUNUS*

1. Eyes present, femur IV with distinct ventral row of large tubercles (Goodnight and Goodnight, 1944: figs. 8, 9; 1971: fig. 15), truncus extension bilobed (Figs. 5, 6), caves of Nuevo León, Mexico 2
   Eyes present or absent, femur IV without tubercles except sometimes small ones on distal third, truncus extension rounded (Figs. 7-13), caves of Coahuila, Mexico and Texas, USA 3
2. Penis truncus gradually widened distally, not constricted basal to macrosetae; paired spicules in almost straight line side-by-side on ventral face of truncus extension (Fig. 1) .... *C. osorioi*
   Penis truncus club-shaped distally, constricted basally to macrosetae (Fig. 5); paired spicules with median pair more anterior (Fig. 3) .... *C. mexicanus*
3. Distal end of penis truncus with enlarged sacs which extend dorsally, pair of anterolateral spines on ridge extending anterior to sacs (Figs. 12, 13) .... *C. coahuilaensis* n. sp.
   Distal end of penis truncus without sacs or laterally directed ridges (Figs. 7-10) 4
4. Eyes present, distal end of truncus acutely angled, widest distally (Figs. 7, 8) .... *C. russelli*
   Eyes absent, distal end of truncus more rounded, widest more basally (Figs. 9-11) .... *C. madlae*



Figs. 1-5.—*Chinquipellobunus* male genitalia: 1 (ventral, distal end), 2 (dorsal, distal end) *C. osorioi* from Gruta de Carrizal, Nuevo León. 3 (ventral, distal end), 4 (dorsal, distal end), 5 (ventral) *C. mexicanus* from Grutas del Palmito, Nuevo León. Truncus extension spicules are blackened to emphasize placement, d = spines on dorsal surface, v = spines on ventral surface.

no large tubercles or spines; slightly separated from anterior median margin of the cephalothorax; with or without eyes. Coxae II maxillary lobes absent. Femur of palpus without a median apical spine; tibia and tarsus rounded, not flattened. Tarsal segments 5-7:10-17:6-8:7-10. Distitarsus of first leg with 2 segments; second with 3 segments; metatarsi not divided into astragali and calcanea; metatarsi of legs III and IV simple; untoothed double claws; without distinct tarsal scopula or pseudonychium. Penis with truncus enlarged distally and extended ventrally under glans, but not tagmatized as a ventral plate; with two pairs of spicules ventrally (blackened in Figs. 1, 3, 8, 10, 12); with two pairs of spines on anterolateral borders of truncus (Fig. 11pr); glans an eversible sac (spiny or smooth) which ends with the stylus; parastylar lobes attached to base of glans, large and pointed distally (Fig. 6); stylus thick, fusiform, eversible from glans (Fig. 6).

Included taxa.—Four previously described and one new species are herein recognized in *Chinquipellobunus*; although it is noted under *C. madlae* that the species likely consists of several undiagnosed cryptic species.

Comments.—Members of this genus are tropical relicts known only from caves. Other members of this family are known from surface and cave habitats in eastern Mexico (Chiapas to Tamaulipas).

Up to this point the eversible nature of the stylus has not been noted in the Stygnopsidae. The Phalangodidae and Oncopodidae have the glans complex eversible, but in all other subfamilies it is either completely unfoldable (Biantidae), partially unfoldable (Assamiidae, Stygnopsidae) or fixed (Gonyleptidae).

Chinquipellobunus osorioi Goodnight and Goodnight, combination restored
Figs. 1, 2, 6

Chinquipellobunus osorioi Goodnight and Goodnight, 1944:1-3, figs. 4-9 [in part, not Grutas del Palmito]; Goodnight and Goodnight, 1945:3 [in part, not Grutas del Palmito]; Reddell, 1967:24 [in part, not Grutas del Palmito].
Chipinquelobunus osorioi: Bonet, 1946:115 [erroneous spelling].
Hoplobunus osorioi: Goodnight and Goodnight, 1953:20 [by implication]; Reddell, 1971:35; Reddell, 1981:165; Reddell, 1982:250, 267; Kury and Cokendolpher, 2000:155; Kury, 2003:237.

Diagnosis.—Eyes present. Penis truncus gradually widened distally, without sacs or laterally directed ridges, without constriction basal to macrosetae; paired spicules, equal sized, in an almost straight line side-by-side at base of truncus extension; extension bilobed; glans covered with spicules, when inflated pointed, when deflated more rounded in appearance. Femur IV of male with distinct ventral row of tubercles.

Type locality.—MEXICO: Nuevo León: Gruta del Carrizal, 10 km SW El Candela.

Type specimens examined.—Male holotype (AMNH).

Other Records.—MEXICO: *Nuevo León*: Grutas de Villa de García (=Cueva Garcia), 7 km NW Villa de Garcia (Goodnight and Goodnight, 1944); material not examined.

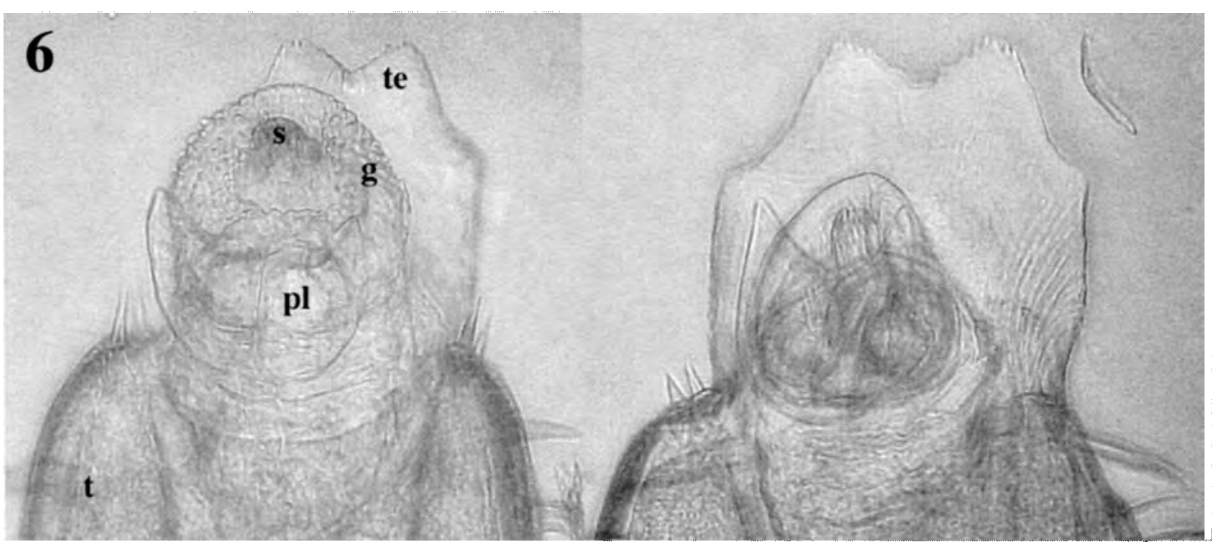
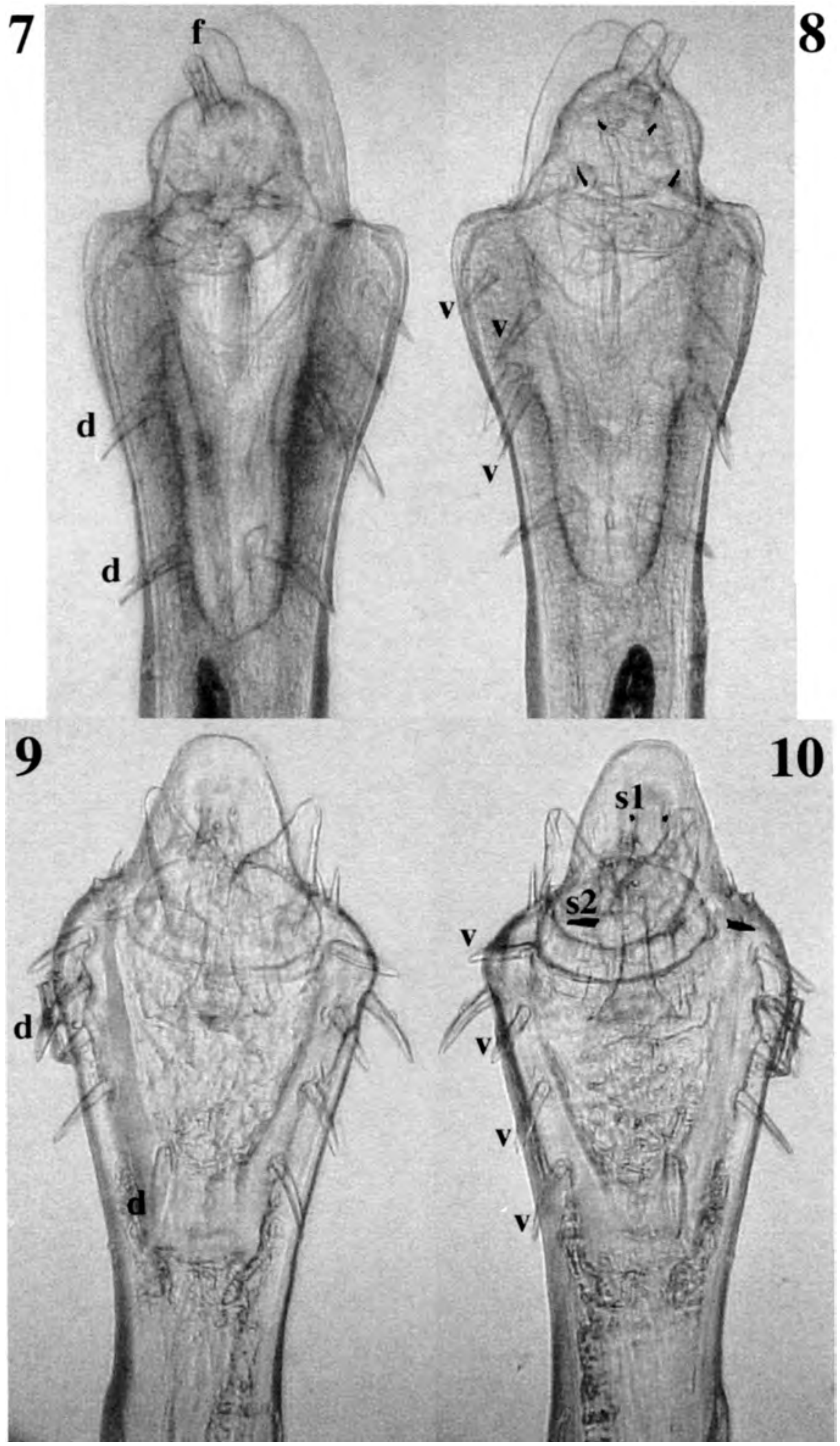


Fig. 6.—*Chinquipellobunus* male genitalia (dorsal aspect of distal tips of penes): (left) *C. osorioi* from Gruta de Carrizal, Nuevo León. (right) *C. mexicanus* from Grutas del Palmito, Nuevo León. g = glans, pl = parastylar lobes, s = stylus, t = truncus, te = truncus extension.



Figs. 7-10.—*Chinquipellobunus* male genitalia (distal ends of penes): 7 (dorsal), 8 (ventral) *C. russelli* from Diablo Cave, Texas. 9 (dorsal), 10 (ventral) *C. madlae* from Indian Creek Cave, Texas. Truncus extension spicules are blackened to emphasize placement, d = spines on dorsal surface, v = spines on ventral surface, f = finger-like projection, s1 = distal pair of spicules, s2 = basal pair of spicules.

False Records (misidentifications).—MEXICO: *Querétaro*: Sótano de El Tigre, 25 km SW Jalpan (paratype listed by Goodnight and Goodnight, 1971). Sótano Encantado, 3 km W LA Ciénega, 20 km NNE Pinal de Amoles (Goodnight and Goodnight, 1973). *Nuevo León*: Grutas del Palmito (= Gruta Palmito) (Goodnight and Goodnight, 1944)

Comments.—The specimens from Grutas del Palmito mentioned in the original publication were misidentified and are correctly *C. mexicanus*. The leg tarsi of *C. osorioi* were listed as 5:12:6:6 in the original description; the holotype male is correctly 5:10:6:6.

Chinquipellobunus mexicanus (Goodnight and Goodnight), new combination
Figs. 3-6

Chinquipellobunus osorioi Goodnight and Goodnight, 1944:1-3, figs. 4-9 [in part, only Grutas del Palmito]; Bolívar y Pieltain, 1944:26; Goodnight and Goodnight, 1945:3 [in part, only Grutas del Palmito]; Reddell, 1967:24 [in part, only Grutas del Palmito].
Daddy longlegs: Jackson and Wood, 1975:59; Jackson and Wood, 1982:59.
Pellobunus mexicanus Goodnight and Goodnight, 1971:38, 39, 44, figs 14-16 [in part-Nuevo León records]; Reddell, 1973:39; 1982:267; Lazcano Sahagún, 1986b:72, 74; Rambla and Juberthie, 1994:218; Kury and Cokendolpher, 2000:155 [in part-Nuevo León records]; Kury, 2003:224 [in part-Nuevo León records].
Pellobusum mexicanus: Reddell, 1973:34 [erroneous spelling].
Pellobonus mexicanus: Lazcano Sahagún, 1986a:48 [in part-Nuevo León records, erroneous spelling]

Diagnosis.—Eyes present. Penis truncus club-shaped distally, constricted basally to macrosetae, without sacs or laterally directed ridges; paired spicules, equal sized, at base of truncus extension, median pair slightly more anterior; extension bilobed; glans smooth. Femur IV of male with distinct ventral row of tubercles.

Type locality.—MEXICO: Nuevo León: Grutas del Palmito, 7 km SW Bustamante.

Type specimens examined.—Female holotype (reported as male in original publication) and 2 male, 2 female paratypes collected by Remington (AMNH).

Other Records.—Grutas del Palmito (= Gruta Palmito) (Goodnight and Goodnight, 1944).

New Records.—Mexico: *Nuevo León*: Cueva del Precipicio, Bustamante, 5 Feb. 1983 (J. Cradit), 1 female. Cueva Sendero Luminoso, Potrero Chico, 8 Sept. 1999 (P. Sprouse), 1 male, 1 female, 2 immatures.

False Records (misidentifications).—MEXICO. *Querétaro*. Sótano de El Tigre, 25 km SW Jalpan (paratype listed by Goodnight and Goodnight, 1971; Lazcano Sahagún, 1986b:72). Sótano Encantado, 3 km W La Ciénega, 20 km NNE Pinal de Amoles (Goodnight and Goodnight, 1973; Lazcano Sahagún, 1986b:73).

Comments.—The apparently smooth glans is either secondarily derived or appears smooth because the sac was deflated in the specimens examined. A spiny glans is known for other members of the family (see illustrations in Silhavy, 1974, 1977). The leg tarsi of the female holotype are 5:14:6:6. It has well developed row of ventral spines on femur IV, like males.

Chinquipellobunus russelli (Goodnight and Goodnight), new combination
Figs. 7, 8

Hoplobunus russelli Goodnight and Goodnight, 1967:4, fig 4; Reddell, 1981:165; Edgar, 1990:548.

Diagnosis.—Eyes present. Penis truncus gradually widened distally, without sacs or laterally directed ridges, without constriction basal to macrosetae; paired spicules

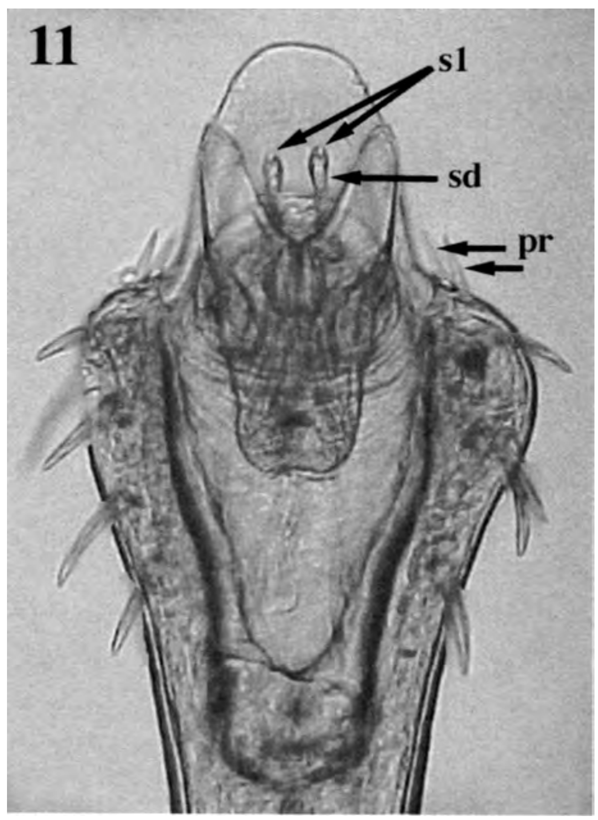


Fig. 11.—*Chinquipellobunus madlae* male from Stowers Cave, Texas; transmitted light view of dorsal surface of distal end of penis. s1 = spicules (distal most pair), sd = duct leading to spicules, pr = pair of spines on anterolateral margin of truncus.

at base of truncus extension, median pair more anterior and about half the length of posterior; extension rounded; glans covered with spicules, with anteriorly directed "finger" below stylus when everted (when not everted spicules and finger not evident). Femur IV of male without ventral row of tubercles.

Type locality.—U.S.A.: Texas: Val Verde County: Diablo Cave.

Type specimens examined (AMNH).—Male holotype, female paratype from Diablo Cave, male paratype from Ladder Cave, 2 male paratypes from Calyx Hole.

Other Records.—*Val Verde County*: Ladder Cave (Goodnight and Goodnight, 1967).

False Records (misidentifications).—U.S.A.: Texas: *Medina County*: Valdina Farms Sinkhole (Goodnight and Goodnight, 1967).

Comments.—The records of this species from Valdina Farms Sinkhole are *C. madlae*. *C. russelli* was incorrectly reported in the original publication to have the tarsi numbered: 5:5:6:5. The holotype is 5:12:6:6 and the paratypes are 5:10-11:6:6. The parastylar lobes on the holotype male are collapsed and the distal morphology is unknown. The paratypes show that the lobes are pointed very much like that illustrated for *C. madlae* (Fig. 9).

Chinquipellobunus madlae (Goodnight and Goodnight), new combination
Figs. 9-11

Hoplobunus madlae Goodnight and Goodnight, 1967:2, fig 5; Reddell, 1981:165; Edgar, 1990:548; Rambla and Juberthie, 1994:218.

Diagnosis.—Eyes absent (both the retina and cornea). Penis truncus gradually widened distally, without sacs or laterally directed ridges, without constriction basal to macrosetae; paired spicules at base of truncus extension, median pair much further anterior, about one-third to one-fourth length of lateral; extension rounded; glans appears smooth. Femur IV of male without ventral row of tubercles.

Type locality.—U.S.A.: Texas: Uvalde County: Rambie's Cave.

Type specimens examined.—Female holotype (AMNH).

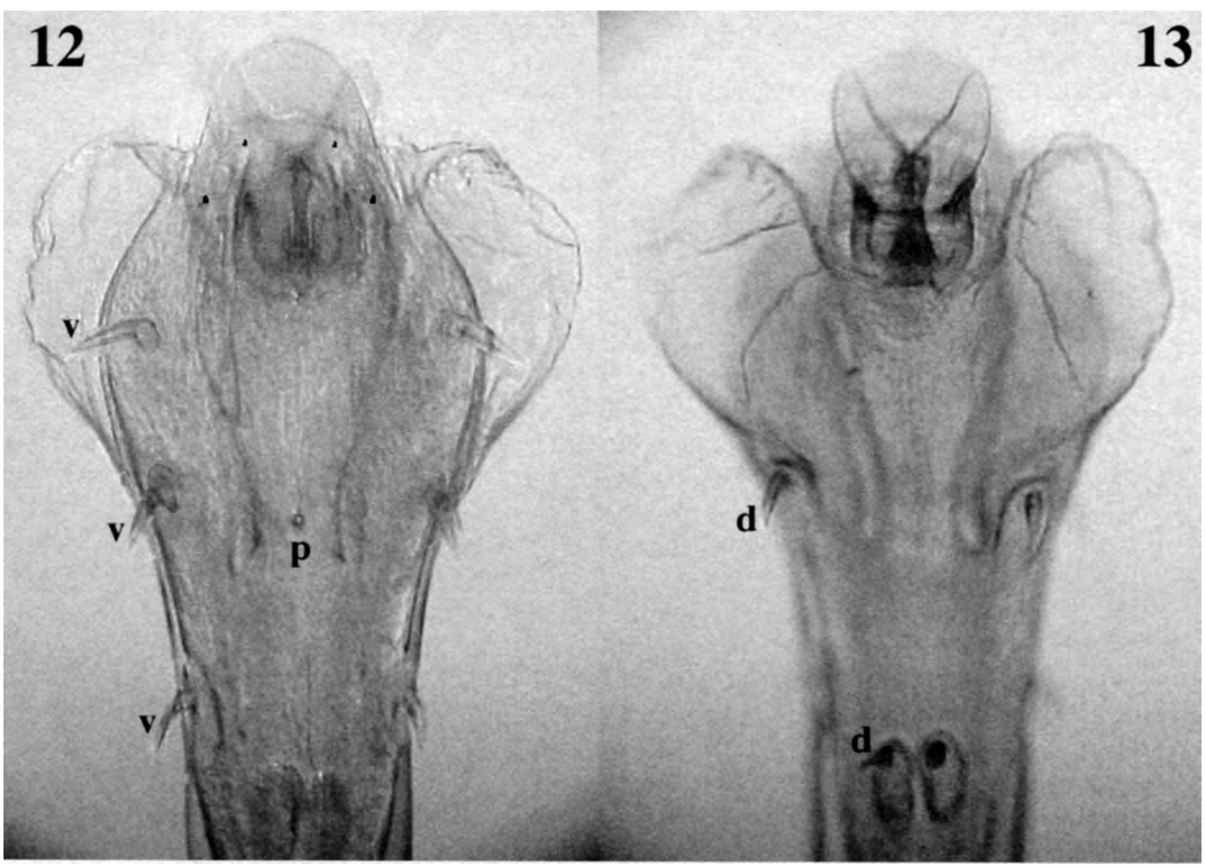
Other Records.—TEXAS: *Bandera County*: Love Creek Ranch Cave; Haby Salamander Cave. *Bexar County*: B-52 Cave, Camp Bullis; Backhole Cave, Camp Bullis; Banzai Mud Dauber Cave, Camp Bullis; Black Cat Cave; Bunny Hole, Camp Bullis; Cave Site #3004 (SWCA), Culebra Anticline; Cave Site #303 (SWCA), Government Canyon Karst Region; Cave Site #602 (SWCA), Stone Oak Karst Region; Cave Site #701 (SWCA), West of Helotes; Crownridge Canyon Cave, Crownridge Canyon Natural Area; Dancing Rattler Cave, Government Canyon State Natural Area; Eagles Nest Cave, Camp Bullis; Elmore Cave; Flach's Cave, Camp Bullis; Genesis Cave; Headquarters Cave, Camp Bullis; Helotes Blowhole; Helotes Hilltop Cave; Hills and Dales Pit; Hold Me Back Cave, Camp Bullis; Isocow Cave, Camp Bullis; Isopit; John Wagner Ranch Cave No. 3; Kamikazi Cricket Cave; Kickstart Cave; Logan's Cave; Lone Gunman Pit, Camp Bullis; Lost Pot Cave; Low Priority Cave, Camp Bullis; Madla's Cave (AMNH); MARS Pit, Camp Bullis; MARS Shaft, Camp Bullis; Pain in the Glass Cave, Camp Bullis; Platypus Pit, Camp Bullis; Por Boy Baculum Cave, Camp Bullis; Porcupine Squeeze Cave; Ragin' Cajun Cave; Robber's Cave; Root Canal Cave, Camp Bullis; Root Toupee Cave, Camp Bullis; Scorpion Cave; Stahl Cave, Camp Bullis; Surprise Sink; Three-Fingers Cave; Winston's Cave, Camp Bullis; Wurzbach Bat Cave; Young Cave No. 1. *Comal County*: Brehmer Cave (AMNH); Cactus Cave; Camp Bullis Bad Air Cave, Camp Bullis; Coreth Bat Cave; Honey Creek Cave; Knee Deep Cave; Natural Bridge Caverns; Wyley's Cave. *Edwards County*: Deep Cave (AMNH); Fountain Cave. *Kendall County*: Cascade Caverns; Day After Cave; Cueva de los Tres Bobos; Pfeiffer's Water Cave. *Kerr County*: Seiker's Cave; Stowers Cave. *Kinney County*: Baker's Crossing Cave; Palace Cave. *Medina County*: Boehme's Cave; Valdina Farms Sinkhole. *Terrell County*: Sorcerer's Cave; Troll Cave. *Uvalde County*: Barn-Sized Fissure Cave; Carson Cave (AMNH); Frio Queen Cave; Indian Creek Cave; Jester's Gold Cave; Moss Pit Cave; Rambie's Cave (AMNH). *Val Verde County*: Dandridge Spring Cave; Four-Mile Cave (TMM and AMNH); H.T. Miers Cave.

Comments.—The holotype was reported to be a male (Goodnight and Goodnight, 1967), but is actually an adult female. No other specimens are known from the type locality. The male illustrated herein is from a nearby cave (Indian Creek Cave) in the same county. The tarsal segments were reported to be 6:15:7:7. The holotype is 7:?leg missing:8:10 and specimens from Indian Creek Cave are: 6:15-17:8:8. See comment under *C. mexicanus* regarding a smooth glans.

There is a duct leading to each of the distal spicules on the ventral surface of the truncus extension. These ducts were also observed on *C. coahuilaensis*, but not on the other species. Their functions are unknown.

The identity of *C. madlae* is somewhat questionable, because the original species description is based upon a single female. I have examined that female and both males and females from other caves in Uvalde County and do not see any major differences between them and specimens from elsewhere in Texas. Even so, there is some reservation about calling them all *C.*

madlae. It is remarkable that such a large highly troglobitic animal would be found throughout such a range (much of central Texas caves). Because of the very troglobitic nature of the animals it is certain that they would be unable to travel above ground. Many of the populations have been isolated from each other (both geologically and geographically) for very long periods of time. These same regions share a variety of troglobitic spiders, pseudoscorpions, and *Texella* harvestmen, which have evolved into many different species. Either *Chinquipellobunus* populations in Texas are evolving at a much slower rate than other arachnids or the morphological differences that would distinguish species are so slight that they are not easily recognized. Because all *Chinquipellobunus* '*madlae*' specimens from caves in Texas are highly troglomorphic, it is possible that the development of these morphologies is all convergent on the most highly troglomorphic condition for this genus: large size, blind, depigmented, few large spines or granules, etc. Because these specimens were isolated in the karst in which they developed they would not come into contact with other related species. Therefore, they probably did not have pressures to select for differences in genital morphologies to avoid interspecies matings. Some differences in depigmentation, granulation, sizes, and spine morphology of the penes were noted but they could not be correlated to any known geological track. Other differences (for example depigmentation and reduction in the number of dorsal granules) were detected in specimens from the nearby Stahl and Flach's Caves, but it was also seen in specimens from Pain in the Glass Cave and other caves outside of Bexar County. Because these characters are generally associated with a more troglomorphic condition it is possible these are different species, but because of their isolated distributions they would not likely be the same different species. Without detection of additional different characters the separation of these various populations is not currently possible and taxonomically they are all treated as representing a single species. This could change with further study. Genetic data might be useful in identifying different populations. Discovering significant genetic differences would rekindle the search for morphological differences that would help support the description of new species.



Figs. 12, 13.—*Chinquipellobunus coahuilaensis* n. sp. male from Sumidero de Alicantre, Coahuila: 12 (ventral, distal end of penis), 13 (dorsal, distal end of penis). Truncus extension spicules are blackened to emphasize placement, d = spines on dorsal surface, v = spines on ventral surface, p = pore.

***Chinquipellobunus coahuilaensis*, new species**
Figs. 12, 13

Diagnosis.—Eyes present. Penis truncus gradually widened distally with enlarged sacs which extend dorsally, two pairs of anterolateral spines on ridge extending anterior to sacs, without constriction basal to macrosetae; paired spicules at base of truncus extension, median pair much further anterior, anterior about half length of posterior; extension rounded; glans appears smooth. Femur IV of male without ventral row of large tubercles (few tubercles on distal third).

Etymology.—This is the first member of the Laniatores harvestman recorded from the state of Coahuila. Therefore, it is appropriate to name the species after the state.

Type-data.—Sumidero de Alicantre, 10 mi. W Cuatrociénegas, Coahuila, Mexico, Aug. 1964 (B. Russell, AMNH), male holotype.

Description.—Male (female unknown) reddish-brown in color; appendages lighter in color distally with tarsi creamy yellow. Entire body and legs (except for tarsi) covered with small rounded tubercles. Total length excluding chelicerae 4.50 mm, cephalothorax 1.25 mm long, greatest width of abdomen 2.30 mm. Ocular tubercle low, 0.50 mm long, 0.75 mm wide; eyes small but darkly pigmented. Palps and chelicerae removed and apparently lost. Leg lengths (femora, followed by tibiae in mm), I= 1.90, 1.45; II= 2.80, 2.40; III= 2.45, 1.70, IV= 3.20, 2.40. Leg femora III, IV curved to follow outline of abdomen; IV femora with ventral row of short bluntly rounded tubercles on distal third. Leg tarsi 5:9/10:6:6.

Comments.—The single known specimen is intermediate in appearance between *C. russelli* (less tuberculate body) and *C. mexicanus* (most tuberculate body in genus). The new species is about the same size as *C. russelli*; both being much smaller than *C. mexicanus*. *C. coahuilaensis* has the shortest legs when compared to body length of any member of the genus. Even so, the arid environment of the surface around the cave suggest that this species might be a troglophile.

The Goodnights identified and labeled the specimen as *Pellobunus mexicanus* (no date given), but I am unable to locate this record in any of their publications. Likewise, I (as well as J. Reddell, pers. com. 2003) have not been able to locate any trip report or fauna checklist for the single known locality: Sumidero de Alicantre.

The opening on the ventral side of the truncus (Fig. 12p) appears to be a pore, although no duct leading to it is evident. Such a structure was not observed on any other species.

ACKNOWLEDGMENTS

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NEW SPECIES AND RECORDS OF CAVERNICOLE *RHADINE* (COLEOPTERA: CARABIDAE) FROM CAMP BULLIS, TEXAS

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ABSTRACT

Seven species of the ground beetle genus *Rhadine* are known from caves on Camp Bullis, Bexar and Comal counties, Texas. New records are included for *R. exilis, R. infernalis ewersi, R. speca,* and *R. howdeni*. Three new troglobitic species closely related to *R. speca* are described: *R. bullis, R. ivyi,* and *R. sprousei.*

INTRODUCTION

The ground beetle genus *Rhadine* is closely associated with the cavernicolous habitat in Texas. Five eyed (troglophile) and 12 blind (troglobite) named species have been recorded from Texas caves (Barr and Lawrence, 1960; Barr, 1960, 1974; Reddell and Cokendolpher, 2001). Several species await description. An additional seven troglophilic and two troglobitic species have been recorded from caves in northern Mexico (Barr, 1982). The only previous records of this genus from Camp Bullis are *Rhadine exilis* (Barr and Lawrence) and *R. infernalis ewersi* (Barr) from Headquarters Cave. Intensive studies of Camp Bullis in recent years have resulted in the discovery of additional records of these and other species. Two species, *Rhadine exilis* and *R. infernalis ewersi* were placed on the U.S. Endangered Species List in 2000 (Longacre, 2000).

Camp Bullis, a US Army installation, occupies 12,000 acres in Bexar and Comal counties, central Texas. Together with Camp Stanley on the northwest, they make up the Leon Springs Military Reservation. Ralph Ewers investigated Headquarters Cave on 19 April and 10 May 1959, at which time he collected specimens later described as *R. exilis* and *R. infernalis ewersi*. David McKenzie and Bill Russell later studied the cave on 24 April 1966. The only other studies on Camp Bullis have been conducted as part of endangered species investigations funded by the U.S. Fish & Wildlife Service and the U.S. Army. These resulted in the discovery of many new records of *Rhadine* in all parts of the installation. Three new species have been discovered from geologically isolated limestone outcrops.

Cokendolpher (2004) discussed the evolution and zoogeography of blind spiders of the genus *Cicurina* Menge on Camp Bullis and Elliott (2004) on that of millipedes of the genus *Speodesmus* Loomis. The three new species all are closely related to *Rhadine speca* (Barr) from caves in Comal and Kendall counties, including the extreme northwestern portion of Camp Bullis. *Rhadine ivyi*, n. sp. is known only from a single cave in an isolated outcrop of Edwards Limestone in the Camp Bullis/ Dominion Subregion of the Edwards Outlier Karst Fauna Region (Veni et al., 2002). *Rhadine sprousei*, n. sp. is known only from a single cave in southcentral Camp Bullis in an outcrop of Glen Rose Limestone. Veni et al. (2002) placed this in the Upper Glen Rose Biostrome Karst Fauna Region. This region is comprised of a series of more or less isolated outcrops of Upper Glen Rose Limestone, and is not contiguous with other outcrops to the northeast. *Rhadine bullis*, n. sp. is known only from six caves in the northeast outcrop of the Upper Glen Rose Biostrome Karst Fauna Region, and is isolated from other outcrops placed in this region. *Rhadine speca* on Camp Bullis occurs only in deposits of the Lower Glen Rose Limestone in the Cibolo Creek Karst Fauna Region to the north of Cibolo Creek in extreme northwestern Camp Bullis. A record of this species from Eagles Nest Cave in the Stone Oak Karst Fauna Region in southwest Camp Bullis is considered probably erroneous. *Rhadine exilis* extends throughout much of Bexar County but is known only from caves in the Edwards Limestone in southern Camp Bullis. *Rhadine infernalis ewersi* is restricted to three caves on a single hilltop in extreme southwestern Camp Bullis, all in the Camp Bullis Southwest Subregion of the Stone Oak Karst Fauna Region.

Rhadine bullis, n. sp.
Figs. 1, 11, 14-17, 23

Type-data.—TEXAS: *Bexar County*: Stahl Cave, Camp Bullis, 21 April 1999 (J. Reddell, M. Reyes), male holotype (AMNH); 10 Nov. 1997 (G. Veni), 2 male paratypes (TMM); 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 1 male (TMM), female allotype (AMNH); Darling's Pumpkin Hole, Camp Bullis, 11 April

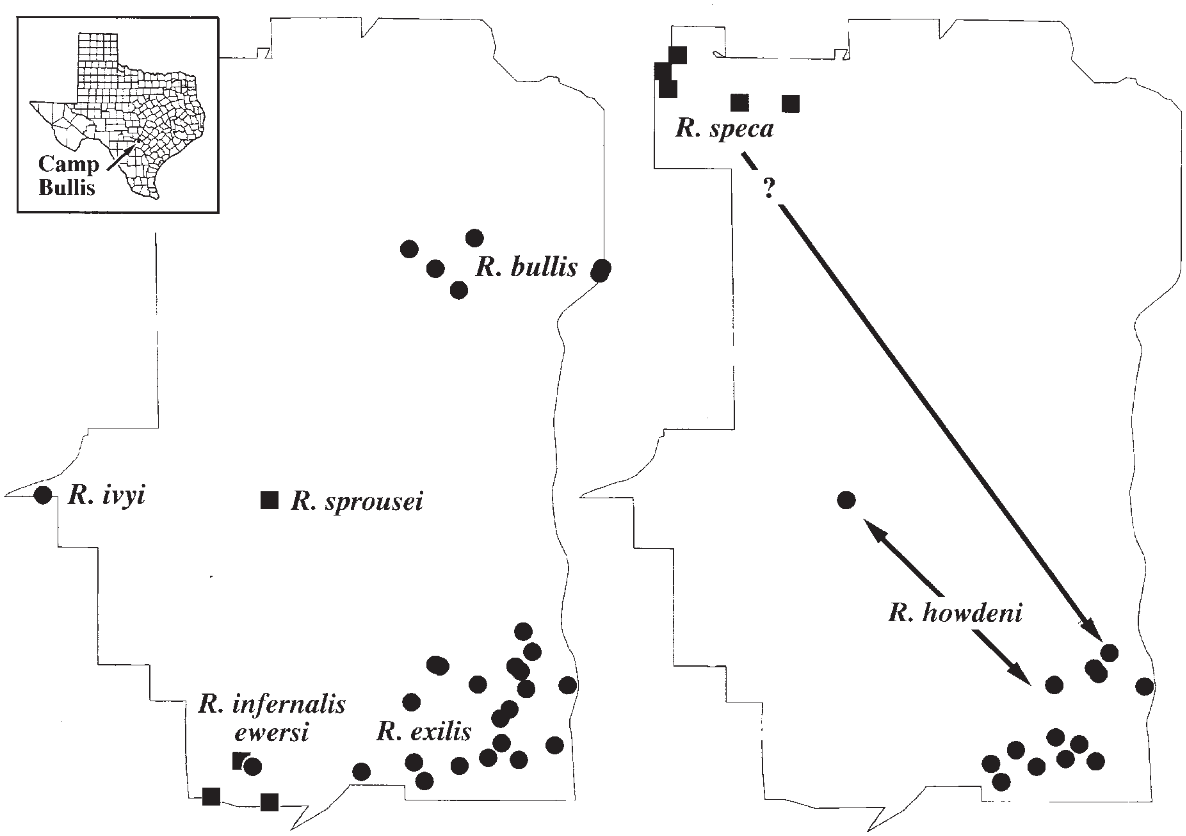


Fig. 1.- Distributions of *Rhadine* species from Camp Bullis, Bexar and Comal counties, Texas.

2002 (J. Reddell, M. Reyes, G. Veni), 1 female paratype (TMM); Flach's Cave, Camp Bullis, 2 Feb. 1999 (P. Sprouse), 1 male paratype (TMM); Hector Hole, Camp Bullis, 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 1 male paratype (TTU), 1 female paratype (TTU), 3 male, 5 female paratypes (TMM); Lone Gunman Pit, Camp Bullis, 8 Sept. 1998 (J. Cokendolpher and M. Reyes), 1 female paratype (TMM); Meusebach Flats Cave, Camp Bullis, 25 March 1998 (J. Reddell, M. Reyes), 2 female paratypes (TMM); 21 April 1999 (J. Reddell, M. Reyes), 1 male, 2 female paratypes (TMM).

Etymology.—The species is named for Camp Bullis and is a noun in apposition.

Diagnosis.—Form slender, integument subglabrous, pronotum about 0.5 as wide as long, with two pairs of submarginal setae; eye rudiment small (about 0.1 mm diameter); differs from *R. speca speca* by the less abruptly constricted neck, slightly emarginate labrum (biemarginate in *R. speca speca*), wider pronotum with constriction before basal margin, and maxillary palps not abruptly narrowed distally (narrowed distally in *R. speca speca*).

Description.—Length 6.82-8.80 mm. Form moderately slender, convex. Integument rufotestaceous, virtually glabrous, shining. Head 0.43-0.49 as wide as long, with shallow posteromedian depression; head narrows gradually to poorly defined cervical constriction; neck about one-half as wide as greatest head width; anterior margin of labrum essentially straight; frontal grooves broad, shallow, extending to about middle of eye; antennal ridge short, weak, with associated weak wrinkles extending slightly beyond supraorbital puncture; eye rudiment prominent, about 0.10 mm diameter. Pronotum about 0.5 as wide as long; widest at or near middle; anterior angles rounded, slightly narrower than basal margin; sides of disc glabrous, shining, subconvex in anterior one-half then nearly flat posteriorly; lateral margins gradually narrow to about middle, then gently arcuate to posterior margin; constricted just before posterior margin; posterior angles rounded; two pairs of setae present,

Fig. 2.- *Rhadine exilis* (Barr and Lawrence) from MARS Pit, Camp Bullis, Bexar County, Texas.

anteriormost about 1/3 distance from anterior margin of pronotum. Elytra 0.4 to 0.5 as wide as long, more than twice as long as pronotum; disc shining with light pubescence; subconvex, apical sinus about 1/2 as long as scutellum, apices sharply produced; longitudinal striae shallow but distinct; setae and trichobothria as in Fig. 11. Distal two segments of maxillary palps pubescent except for glabrous, pale tips. Antenna about 8/10 as long as body, segments III-IV subequal in length, segments I-III sparsely pubescent, others densely pubescent. Aedeagus and stylus as in Figs. 14-17.

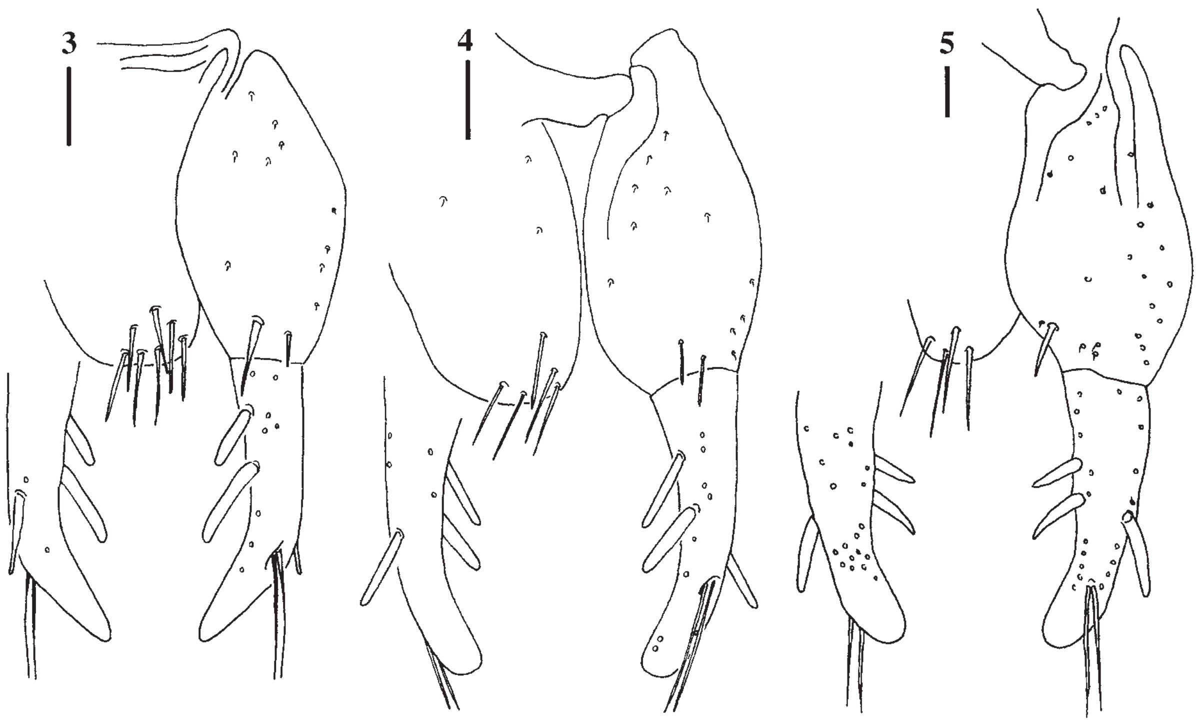
Comments.—This species is known only from six small caves in northeastern Camp Bullis (Fig. 1). All are formed in the biostrome unit of the upper Glen Rose Formation. They are geologically and geographically isolated from other caves containing troglobitic *Rhadine*. Stahl Cave is the only known locality for the spider *Cicurina* (*Cicurella*) *brunsi* Cokendolpher.

Rhadine exilis (Barr and Lawrence)
Figs. 1-4

Agonum (*Rhadine*) *exile* Barr and Lawrence, 1960:141-142; Barr, 1960:59, figs. 1D, 2M, 3F.
Rhadine exilis: Barr, 1974:16-17, fig. 9; Reddell, 1988:42.

Type-locality.—Marnock Cave [=John Wagner Ranch Cave No. 3], 1 mile north of Helotes, Bexar County, Texas, 2 July 1959 (Foye Moore and J.F. Lawrence), male holotype, female allotype, and 10 paratypes.

Camp Bullis records.—*Bexar County*: 40 mm Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 teneral male; B-52 Cave, 31 March 1995 (J. Reddell, M. Reyes), 1 male, 1 teneral male, 1 female, 2 teneral females; Backhole, 7 June 1994 (J. Ivy, G. Veni), 1 female; Boneyard Pit, 5 Oct. 1995 (W. Elliott, J. Ivy), Zone 5, 1 female; Bunny Hole, 31 March 1995 (J. Reddell, M. Reyes), 2 females; 24 Oct. 1995 (J. Reddell, M. Reyes), 1 male; Cross the Creek Cave, 31 March 1995 (J. Reddell, M. Reyes), 2 teneral males, 1 female, 2 teneral females; Dos Viboras Cave, 6 Oct. 1995 (J. Reddell, M. Reyes), 1 male; Eagles Nest Cave, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 1 male; 9 Sept. 1998 (J. Reddell, M. Reyes), 1 male; Headquarters Cave, 18 April 1959 (R. Ewers), male paratype (Barr and Lawrence, 1960); 16 June 1993 (S. Harden, J. Reddell, M. Reyes, G. Veni), 1 male; Hilger Hole, 1 April 1998 (J. Reddell, M. Reyes, B. Johnson), 1 male; 20 April 1999 (J. Reddell, M. Reyes), 1 male; Hold Me Back Cave, 1 Dec. 1993 (C. Savvas, G. Veni), 1 male; 21 Sept. 1994 (W. Elliott, J. Ivy), Zone 3, 1 female; 18 Oct. 1994 (G. Veni), 1 female; Isocow Cave, 15 Dec. 1993 (G. Veni), 1 female; 2 March 1994 (W. Elliott, G. Veni), Zone 4, 1 male, 1 female; 19 Sept. 1994 (J. Ivy, W. Elliott), Zone 4, 1 female; MARS Pit, 9 Oct. 1994 (M.



Figs. 3-5.- Ventral views of ovipositor styli, inserts are dorsal views of styli. 3, *R. exilis* from John Wagner Ranch Cave No. 3, Bexar County, Texas (from near the type locality); 4, *R. exilis* from Headquarters Cave, Camp Bullis, Bexar County. 5, *R. howdeni* (Barr and Lawrence) from Bunny Hole, Camp Bullis, Bexar County Scales = 0.05 mm.

Reyes), lower level, 1 male; 10 Sept. 1998 (J. Cokendolpher, J. Krejca), 1 male, 1 female; MARS Shaft, 4 March 1994 (J. Ivy), Zone 3, 1 female; Pain in the Glass Cave, 9 Dec. 1994 (C. Savvas, P. Sprouse, G. McDaniel), 1 female; Platypus Pit, 30 March 1995 (J. Reddell, M. Reyes), 1 female; Poor Boy Baculum Cave, 10 Oct. 1994 (P. Sprouse, C. Savvas), Nevada Shaft within Poor Boy Baculum Cave, 1 female; 19 Oct. 1994 (J. Ivy, G. Veni), 1 male; 27 Oct. 1994 (P. Sprouse), 1 female; 15 Dec. 1994 (W. Elliott, B. Johnson), Zone 2, 1 teneral male; Root Canal Cave, 26 Oct. 1995 (J. Reddell, M. Reyes), 1 female; 28 Jan. 1999 (G. Veni), bottom of First Pit, 1 teneral female; Root Toupee Cave, 20 April 1999 (M. Reyes), lower level, 1 male; Strange Little Cave, 29 Nov. 1993 (J. Reddell, M. Reyes), 1 male; Up the Creek Cave, 5 Oct. 1995 (J. Reddell, M. Reyes), 1 male. All specimens TMM.

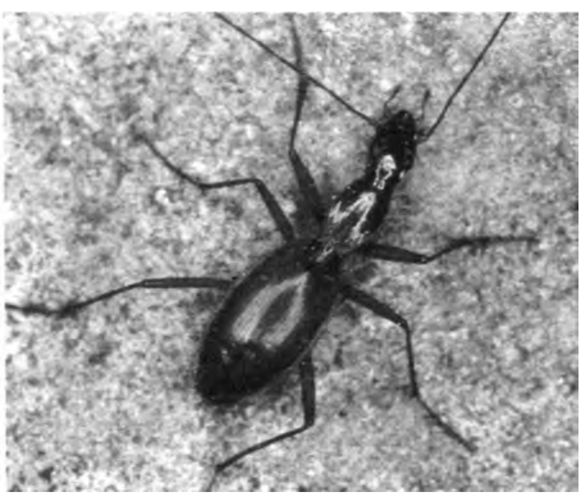


Fig. 6.- *Rhadine howdeni* from Root Canal Cave, Camp Bullis, Bexar County, Texas.

Comments.—This slender troglobite is found on Camp Bullis only in caves in the southern section of the installation (Fig. 1). Occasionally, it will be found in the same cave as the less cave-adapted and eyed *R. howdeni*. In Headquarters Cave it is found with *R. infernalis ewersi*.

Rhadine howdeni (Barr and Lawrence)
Figs. 1, 5, 6

Agonum (*Rhadine*) *howdeni* Barr and Lawrence, 1960:143-145; Barr, 1960:52, fig. 2E.

Camp Bullis records.—*Bexar County*: B-52 Cave, 6 Dec. 1994 (W. Elliott, J. Ivy), Zone 2, 1 male; Zone 3, 1 male; 31 March 1995 (J. Reddell, M. Reyes), 2 males, 2 females; Boneyard Pit, 5 Dec. 1994 (W. Elliott, R. Corbell), Zone 2, 1 male; Bunny Hole, 31 March 1995 (J. Reddell, M. Reyes), 1 male, 2 females; 10 Oct. 1995 (G. Veni), 1 female; 24 Oct. 1995 (J. Reddell, M. Reyes), 1 female; 9 Sept. 1998 (J. Cokendolpher, J. Krejca, J. Reddell, M.

Fig. 7.- *Rhadine infernalis ewersi* (Barr) from Headquarters Cave, Camp Bullis, Bexar County, Texas.

Reyes), 2 males, 1 female; Cannonball Cave, 6-7 Nov. 2001 (P. Sprouse), 1 male; 15 April 2002 (J. Reddell, M. Reyes, G. Veni), 2 males; Charley's Hammer Hole, 9 Jan. 1995 (M. Reyes), 1 female; Cross the Creek Cave, 31 Oct. 2000 (J. Reddell, M. Reyes), 1 male; Dogleg Pit, 27 Feb. 1995 (L. McNatt, B. Johnson), 1 male; 12 Nov. 1997 (P. Sprouse, G. Veni), 1 male, 1 female; 25 March 1998 (M. Reyes), 2 males; 1 Nov. 2001 (J. Reddell, M. Reyes), 1 male; Dos Viboras Cave, 9 Jan. 1995 (J. Reddell, M. Reyes), 1 male; 6 Oct. 1995 (J. Reddell, M. Reyes), 1 male; Eagles Nest Cave, 9 Nov. 1993 (J. Ivy, J. Treviño, G. Veni), 4 males; 22 Jan. 1997 (J. Ivy), 1 female; 9 Sept. 1998 (J. Reddell, M. Reyes), 1 male; Ides of March Cave, 15 April 2002 (M. Reyes, G. Veni), 1 male; Isocow Cave, 15 Dec. 1993 (G. Veni), 1 teneral male; 2 March 1994 (W. Elliott), Zone 2, 1 female; MARS Pit, 10 Sept. 1998 (J. Cokendolpher, J. Krejca), 1 male; Platypus Pit, 30 March 1995 (J. Reddell, M. Reyes), 1 male; Root Canal Cave, 15 Nov. 1994 (C. Savvas), 3 females; 26 Oct. 1995 (J. Reddell, M. Reyes), 1 male; 7 Sept. 1998 (J. Reddell, M. Reyes), 3 males; Root Toupee Cave, 5 Dec. 1994 (G. McDaniel, B. Johnson), 1 female; 1 Nov. 2000 (J. Reddell, M. Reyes), 1 male. All specimens TMM.

Comments.—This large, eyed species is usually found in caves near entrances in the southeastern portion of Camp Bullis (Fig. 1). *Rhadine howdeni* was described from Wilson's Cave, Kerr County, Texas, and also reported from several other caves in the Edwards Plateau (Barr, 1960).

Rhadine infernalis ewersi (Barr)
Figs. 1, 7

Agonum (*Rhadine*) *infernalis ewersi* Barr, 1960:55-56, figs. 1A, 2I.
Rhadine infernalis ewersi: Barr, 1974:23-24, fig. 11; Reddell, 1988:42.

Type-locality.—Headquarters Cave, Camp Bullis, Bexar County, Texas, 19 April and 10 May 1959 (Ralph Ewers), holotype male, allotype female, and 12 paratypes.

Camp Bullis records.—*Bexar County*: Flying Buzzworm Cave, 17 Nov. 1997 (P. Sprouse, G. Veni), 1 female; Headquarters Cave, 16 June 1993 (S. Harden, J. Reddell, M. Reyes, G. Veni), 3 males, 6 females; 29 Nov. 1993 (M. Reyes), 1 male; 8 Sept. 1998 (J. Cokendolpher, J. Reddell, M. Reyes), 1 male; Low Priority Cave, 14 Dec. 1994 (C. Savvas), 1 teneral female; 9 Jan. 1995 (J. Reddell, M. Reyes), 1 teneral male, 1 female; 29 March 1995 (J. Reddell, M. Reyes), 2 males, 2 females, 1 teneral female; 22 April 1999 (J. Reddell, M. Reyes), 1 female. All specimens TMM.

Comments.—This subspecies is known only from three caves on Camp Bullis (Fig. 1) and all are on the same hilltop. This species occurs with *R. exilis* within Headquarters Cave. *Rhadine infernalis infernalis* (Barr and Lawrence) is known only from Bexar County west of Camp Bullis.

Rhadine speca (Barr and Lawrence)
Figs. 1, 9, 10

Camp Bullis Records.—*Bexar County*: Eagles Nest Cave, 22 Jan. 1997 (J. Ivy), one male (TMM). *Comal County*: Bullis Hole, 6 Nov. 1996 (G. Veni), 1 male; 8 Nov. 1996 (P. Sprouse), 2 males; 20 Nov. 1996 (W. Elliott), Zone 1, 1 teneral female; Zone 4, 1 female; Camp Bullis Bad Air Cave, 23 Oct. 1996 (P. Sprouse, G. Veni), 1 male; 4 Nov. 1996 (P. Sprouse, G. Veni), 2 females; 22 Nov. 1996 (B. Johnson, J. Reddell, M. Reyes), 2 males, 5 females; Camp Bullis Bat Cave, 19 Nov. 1996 (W. Elliott, B. Johnson), Zone 2, 1 male; (W. Elliott), zone 3, 1 female; Camp Bullis Cave No. 1, 22 Oct. 1996 (G. Veni), 2 males, 2 females; 21 Nov. 1996 (B. Johnson, J. Reddell, M. Reyes), Zone 3, 2 females; 26 May 1998 (J. Reddell, M. Reyes), 1 female; 25 Jan. 2000 (J. Reddell, M. Reyes), 1 male; Glinn's Gloat Hole, 18 Jan. 2000 (J. Reddell, M. Reyes), 1 male; (P. Sprouse), 2 males 1 female; Snakeskin Pit, 1 Nov. 1996 (P. Sprouse, G. Veni), 1 male. All specimens TMM.

Comments.—These specimens are not assigned to a subspecies of *R. speca* pending study of additional material from other parts of Bexar, Comal, and Kendall counties. The specimens differ from *R. speca speca* by a more rounded pronotum and a less distinctly constricted neck. The record for Eagles Nest Cave is problematic and may be in error (mislabeled collections?). *Rhadine howdeni* has been taken near the cave entrance to Eagles Nest Cave, whereas *R. exilis* has been found near the end of the cave. No additional specimens of *R. speca* have been found in numerous searches, and there are no other records of two slender species inhabiting the same cave.

Rhadine speca speca (Barr)
Figs. 8, 22

Agonum (*Rhadine*) *specum* Barr, 1960:58-59, figs. 2L, 3E.
Rhadine speca speca: Barr, 1974:13-14.

Type-locality.—Century Caverns (=Cave Without A Name), Kendall County, Texas.

Specimens examined.—*Kendall County*: Cave Without A Name, 21 June 2003 (M. Burrell), 1 male, 1 female; Klar's Cave, 30 Jan. 1988 (M.K. Manning), 1 male. All specimens TMM.

Comments.—This subspecies is known only from caves in the lower Glen Rose Formation south of the Guadalupe River. Two other subspecies have been described. *Rhadine speca gentilis* Barr is known with certainty only from Little Gem Cave and Little Gem Cave Annex, 4 miles west of New Braunfels, and tentatively from Voges Cave, 9 miles north of New Braunfels, Comal County. *Rhadine speca crinicollis* Barr is known only from Kappelman Salamander Cave, 4 miles east of Bulverde, and Natural Bridge Caverns, about 1 mile southeast of Kappelman Salamander Cave, Comal County, Texas. The status of these subspecies will require further study.

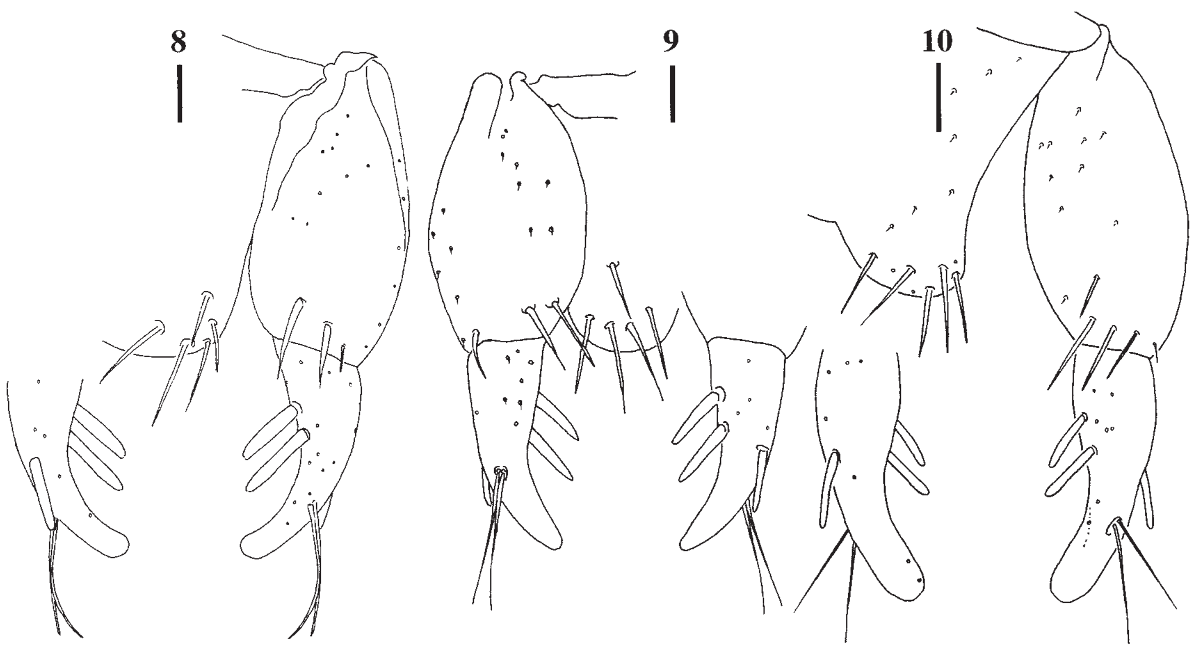
Rhadine sprousei, n. sp.
Figs. 1, 12, 18, 19

Type-data.—TEXAS: *Bexar County*: Cannonball Cave, Camp Bullis, 15 April 2002 (J. Reddell, M. Reyes), male holotype, female allotype (AMNH); 6-7 Nov. 2001 (P. Sprouse), 1 male, 1 female paratypes (TMM); 17 Nov. 2003 (J. Fant, G. Veni), 1 female paratype (TTU).

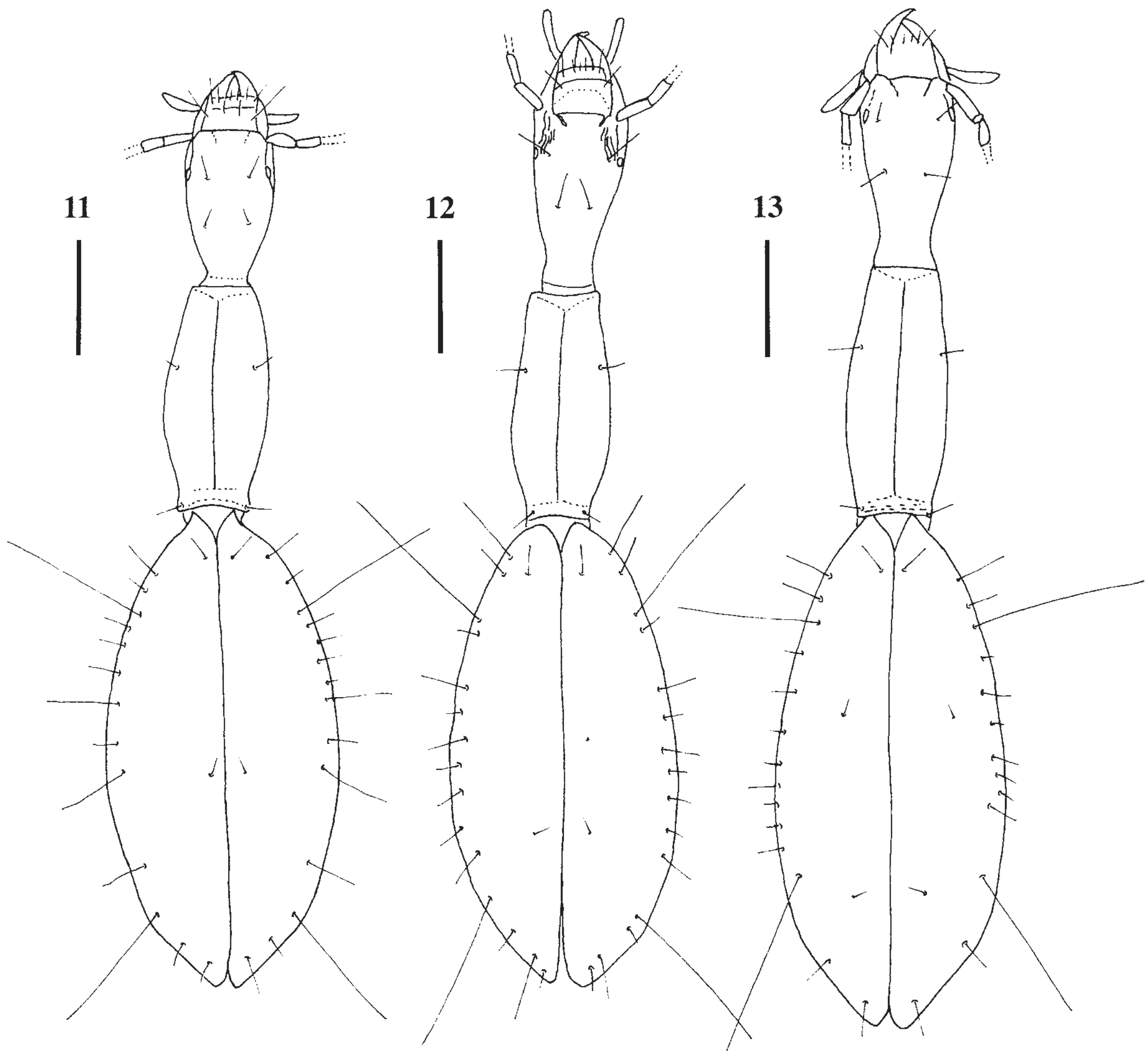
Etymology.—This species is named for Peter Sprouse, collector of the first specimens, in recognition of his contributions to the study of caves and cave biology.

Diagnosis.—Form slender, integument subglabrous, pronotum about 0.4 as wide as long, with two pairs of submarginal setae; eye rudiment very small (0.08 mm); occiput without posteromedian depression; elytral apices rounded. Most closely related to *R. ivyi* but with more slender head, lacking posteromedian depression on head, and smaller eye remnant.

Description.—Length 7.4-8.4 mm. Form moderately slender, convex. Integument rufotestaceous, virtually glabrous, shining. Head 0.43-0.45 as wide as long, without posteromedian depression; cervical constriction distinct, neck 0.45-0.51 as wide as head, labrum not emarginate; frontal grooves broad, shallow, extending midway to eye; antennal ridge short, weak, with associated strongly developed wrinkles barely reaching posterior edge of eye; eye rudiment small, about 0.08 mm diameter. Pronotum 0.39-0.41 as wide as long; anterior angles at near right angle, slightly narrower than basal margin; disc glabrous, shining, subconvex in anterior 1/4 then nearly flat posteriorly; lateral margins gradually widen to about 1/3 distance from posterior margin, then gently arcuate to posterior margin; posterior angles rounded; two pairs of setae present, anteriormost about 1/3 distance from anterior margin. Elytra 0.42-0.45 as wide as long, about 2.2 times length of pronotum; disc glabrous,



Figs. 8-10.- Ventral views of ovipositor styli, inserts are dorsal views of styli. 8, *R. speca speca* (Barr) from Cave Without A Name, Kendall County, Texas (type locality); 9, *R. speca* from Camp Bullis Bad Air Cave, Camp Bullis, Bexar County. 10, *R. speca* from Camp Bullis Cave No. 1, Camp Bullis, Bexar County. Scales = 0.05 mm.



Figs. 11-13. Dorsal views of new *Rhadine* taxa from Camp Bullis, Bexar County, Texas. 11, *R. bullis*, n. sp. from Stahl Cave; 12, *R. sprousei,* n. sp. from Cannonball Cave; *R. ivyi,* n. sp. from Vera Cruz Shaft. Scales = 1 mm.

shining, subconvex; apical sinus about 1/3 as long as scutellum, apices broadly rounded; longitudinal striae very shallow; setae and trichobothria as in Fig.12. Distal two segments of maxillary palps pubescent; distal 1/6 of distal segment pale and glabrous. Antenna about 8/10 as long as body; segments III-IV longest, III slightly longer than IV; segments I-III sparsely pubescent; others densely pubescent. Aedeagus and stylus as in Figs. 18,19.

Comments.— This species is known only from a single cave in central Camp Bullis (Fig. 1). All specimens were taken from clay banks near the end of the cave. The cave is formed in the biostrome unit of the Glen Rose Limestone. It is geographically isolated from the more robust *R. bullis,* which is also found in the biostrome unit.

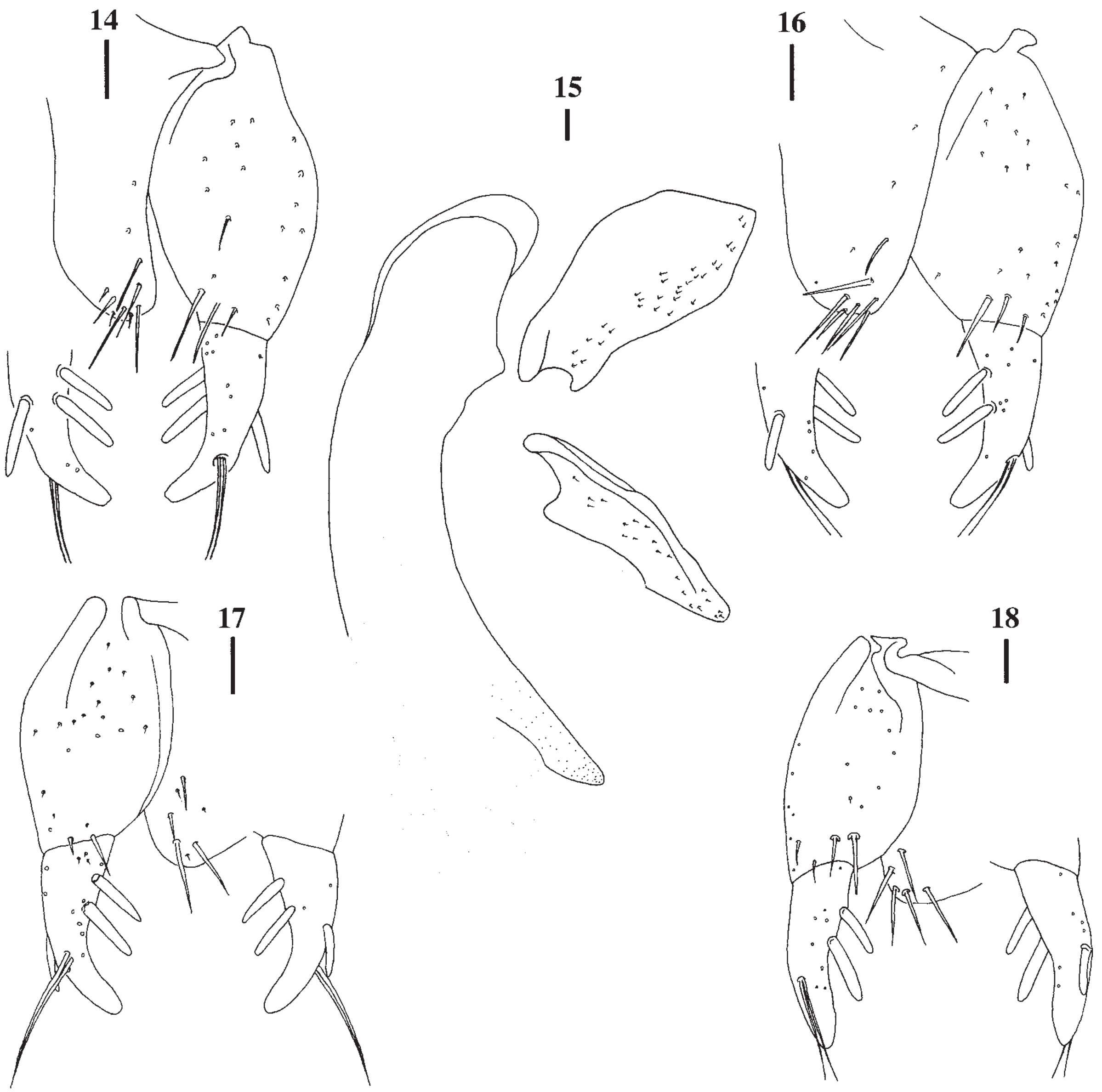
Rhadine ivyi, n. sp.
Figs. 1, 13, 20, 21

Type-data.—TEXAS: *Bexar County*: Vera Cruz Shaft, Camp Bullis, 23 March 1998 (M. Reyes), male holotype and male paratype (AMNH); 29 April 1999 (M. Reyes), female paratype (TMM).

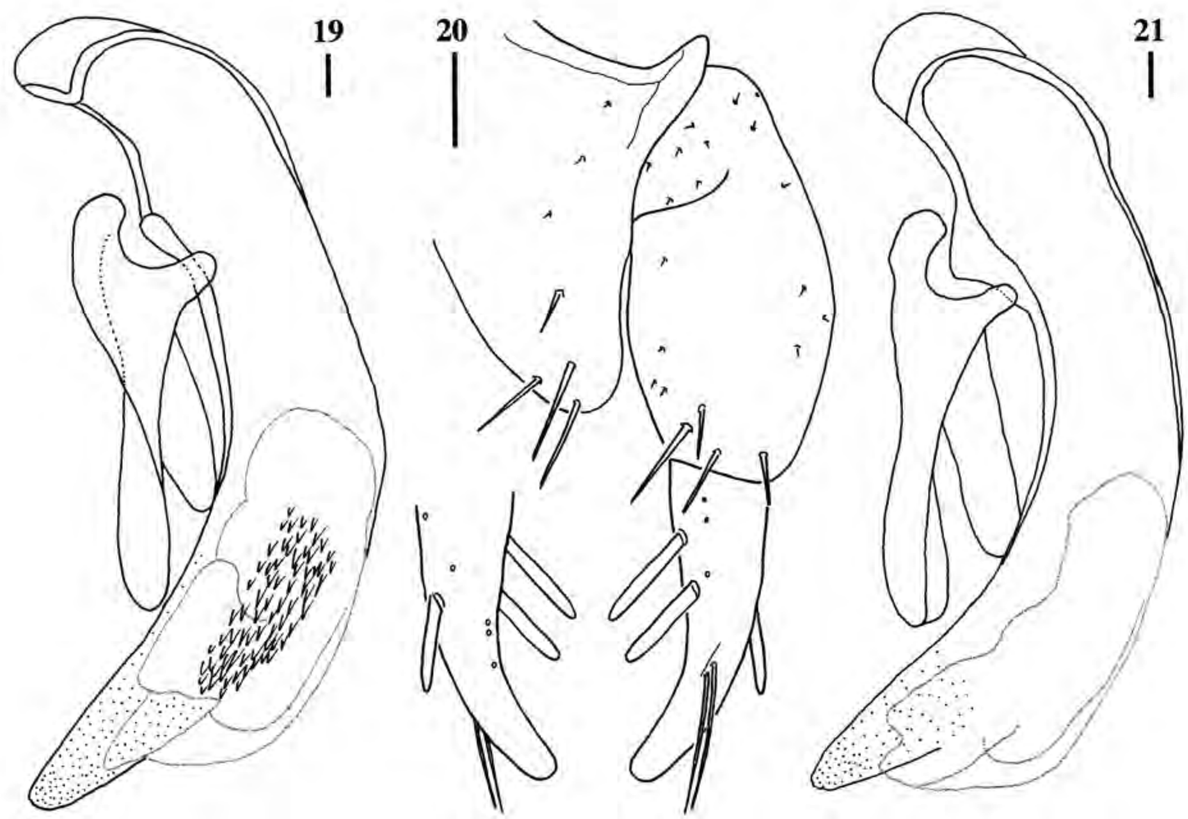
Etymology.—This species is named for the late Joe L. Ivy in recognition of his efforts to study and protect the caves of Camp Bullis in particular and Texas in general.

Diagnosis.—Form slender, integument subglabrous; pronotum about 0.4 as wide as long, with two pairs of submarginal setae; eye rudiment small (about 0.1 mm); occiput with posteromedian depression; elytral apices rounded; distinguished from *R exilis* by wider, less flattened pronotum, depression on head, rounded elytral apices, and shape of stylus. Distinguished from *R. speca* by more slender pronotum, narrower neck, rounded elytral apices.

Description.—Length 7.20-8.40 mm. Form moderately slender, convex. Integument rufotestaceous, virtually glabrous, shining. Head 0.42-0.51 as wide as long, with shallow posteromedian depression; cervical constriction distinct, neck 0.44-0.49 as wide as head; labrum indistinctly emarginate; frontal grooves broad, shallow, extending to back of eye; antennal ridge short, weak, with associated weak wrinkles barely reaching posterior edge of eye; eye rudiment prominent, about 0.1 mm diameter. Pronotum about 0.4 as wide as long; anterior angles rounded, slightly narrower than basal margin; disc glabrous, shining, subconvex in anterior 1/4, then nearly flat posteriorly; lateral margins gradually widen to about middle, then gently arcuate to posterior margin; posterior angles rounded; two pairs of setae present, anteriormost about 1/3 distance from anterior margin. Elytra 0.4 as wide as long, about 2.1 times length of pronotum; disc glabrous shining, subconvex; apical sinus less than half as long as scutellum, apices broadly rounded; longitudinal striae very shallow; setae and trichobothria as in Fig.13. Distal two segments of maxillary palps pubescent; distal 1/6 of distal segment pale and glabrous. Antenna about 8/10 as long as body; seg-



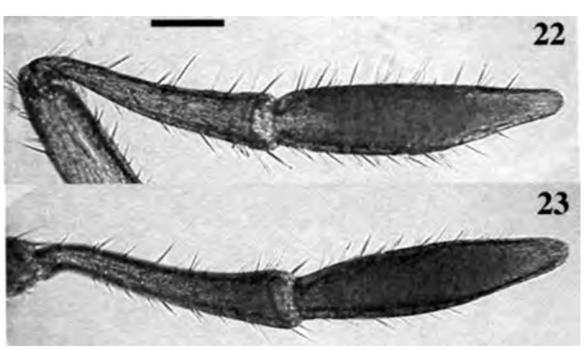
Figs. 14, 16-18.- Ventral views of ovipositor styli, inserts are dorsal views of styli, 15, ventral view of aedeagal median lobe and parameres. 14-17, *R. bullis*, n. sp. 14, 15 from Stahl Cave, Camp Bullis, Bexar County, Texas; 16, Lone Gunman Cave, Camp Bullis; 17, Meusebach Flats Cave, Camp Bullis; 18, *R. sprousei*, n. sp. from Cannonball Cave, Camp Bullis, Bexar County. Scales = 0.05 mm.



Figs. 19-21.- 19, ventral view of aedeagal median lobe and parameres of *R sprousei*, n. sp. from Cannonball Cave, Camp Bullis, Bexar County, Texas; 20, 21, *R. ivyi*, n. sp. from Vera Cruz Shaft, Camp Bullis; 20, Ventral view of ovipositor stylus, insert is dorsal view of stylus; 21, ventral view of aedeagal median lobe and parameres. Scales = 0.05 mm.

ments III-IV longest, subequal in length; segments I-III sparsely pubescent; others densely pubescent. Aedeagus and stylus as in Figs. 20, 21.

Comments.—This species is known only from a single cave in western Camp Bullis (Fig. 1). The two paratypes are teneral. This rare species has been found at the bottom of the 8 m deep vertical shaft entrance and in a small side passage about 5 m above the floor. The cave is formed in the upper Glen Rose Limestone, and is geologically and geographically isolated from all other known caves containing populations of troglobitic *Rhadine*.



Figs. 22-23.—Dorsal view of maxillary palps of *Rhadine* spp.: 22, *R. speca speca* (Barr) from Cave Without A Name, Kendall County, Texas; 23, *R. bullis*, n. sp. from Stahl Cave, Camp Bullis, Bexar County, Texas. Scale = 0.1 mm.

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We are especially grateful to Dusty Bruns and Jerry Thompson from Camp Bullis for their assistance throughout the period of studies on that facility. The project would not have been possible without the constant support of George Veni. Marcelino Reyes was a constant companion throughout work on Camp Bullis. We thank the following collectors for their efforts to increase our knowledge of the cave fauna of Camp Bullis: Rick Corbell, William R. Elliott, Scott Harden, Joe L. Ivy, Bruce Johnson, Jean Krejca, Gary McDaniel, Logan McNatt, Marcelino Reyes, Charley Savvas, Peter Sprouse, Joe Treviño, and George Veni. Mike Burrell, manager of Cave Without A Name, made special efforts to obtain specimens of *Rhadine speca speca* from the cave.

We appreciate the support of cave owners and managers who permitted access to their caves, and in some cases provided contracts for biological research that produced information included in this report. Major cave owners include the Texas Parks and Wildlife Department, and the U.S. Army's Camp Bullis. Portions of this study were also funded by these agencies. We thank Donald S. Chandler, University of New Hamshire, for reviewing the mansucript.

Specimen depositories are: AMNH (American Museum of Natural History, New York), TMM (Texas Memorial Museum), and TTU (Museum of Texas Tech University).

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SPEODESMUS CAVE MILLIPEDES. FOUR NEW SPECIES FROM CENTRAL TEXAS (DIPLOPODA: POLYDESMIDA: POLYDESMIDAE)

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ABSTRACT

Four new species of troglobitic millipedes are described from central Texas caves: *Speodesmus castellanus* from Fort Hood, Bell and Coryell counties; *S. falcatus* from Camp Bullis, north central Bexar County; *S. reddelli* from Government Canyon State Natural Area, Helotes and other points in northwestern Bexar and northeastern Medina counties; and *S. ivyi* from Camp Bullis and San Antonio, Bexar County, and Comal County. The closest relative of *S. castellanus* is *S. bicornourus*, from caves in Williamson, Travis, and Burnet counties, Texas. *Speodesmus falcatus* and *S. reddelli* are relatives of *S. echinourus*, which is distributed across the Edwards Plateau and parts of the Balcones Escarpment, central Texas. *Speodesmus ivyi* is similar to *Speodesmus* n.sp. 1, Val Verde County. Some characters previously thought to distinguish species groups of *Speodesmus* may be unsuitable for separating groups within the genus.

INTRODUCTION

The genus *Speodesmus* currently contains four described species: *S. echinourus* Loomis, 1939 (Fig. 1); *S. tuganbius* (Chamberlin, 1952), re-described by Shear (1974); *S. bicornourus* Causey, 1959; and *S. aquiliensis* Shear, 1984. All occur only in caves. At least six undescribed species are known from Texas caves; four are described in the current publication.

MATERIALS AND METHODS

During the course of cave studies since 1992 at Fort Hood, Camp Bullis, and other areas, 441 specimens of *Speodesmus* were collected, most of which I examined and identified. Specimens were collected by hand into 80% ethanol, labeled, and curated at the Texas Memorial Museum and in the author's private collection.

I studied specimens with the following procedures on a stereo microscope (up to 120 X) using a fiber-optics illuminator with incident light and a compound light microscope (up to 400X). Specimens were placed in a clear dish in 80% ethanol on a dark background and manipulated with minuten probes. Measurements were

Fig. 1.-*Speodesmus echinourus* Loomis, male about 10 mm long, in Wyatt Cave, Edwards County, Texas, 1974.

made of most specimens with a calibrated ocular micrometer or small scales placed in the dish. The sexes, size range, and number of preanal setae were recorded for each collection in a database. Representative, intact specimens were selected as types, the preferred holotype being male. The male gonopod was removed by hooking it with a minuten and pulling it off or by dissecting segment 7. Gonopods and other parts were temporarily mounted in a depression slide with glycerin for study and digital photography on the compound microscope. Drawings were traced from some prints and others were digitized on a computer. The drawings were further revised while studying specimens microscopically. A "troglomorphy index" was calculated for each species, based on leg length divided by body length; a higher index is more troglomorphic and more cave-adapted, with longer legs relative to body length. Holotypes and allotypes are deposited in the U.S. National Museum of Natural History; some paratypes and most collections are in the Texas Natural History Collections, Texas Memorial Museum, Austin; representative nontype specimens are held in my private collection. Records are listed with the number of adult males, adult females and immatures in that order in the form 1-1-1, followed by the size range of adults.

ACKNOWLEDGMENTS

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Fig. 2-*Speodesmus castellanus* n. sp., preserved holotype male from Rocket River Cave, Coryell County, Texas

TAXONOMY

Speodesmus castellanus, new species
Figs. 2-7, 8

Types.—I examined 117 specimens from 18 caves, from which I selected representative types, given below. The adult male holotype, female allotype and two male paratypes are from Rocket River Cave, Fort Hood, Coryell County, Texas, collected 16-17 January 1992 by Lee J. Graves, Mike Warton, and Charley Savvas. Deposited in the U.S. National Museum of Natural History and Texas Memorial Museum, Texas Natural History Collections (two male paratypes).

Etymology.—The species epithet, *castellanus*, is a Latin adjective referring to a fortress (Fort Hood). Common name: Fort Hood cave millipede.

Diagnosis.—Twenty segments in adults as in other central Texas *Speodesmus*, a smaller, sister species to *S. bicornourus*, about half as long (8-11 mm), with a similar, fused, nearly straight, telopodite in the gonopod, but the retrorse spine, prominent in *S. bicornourus*, is lacking or it is a vestigial bump in *S. castellanus*.

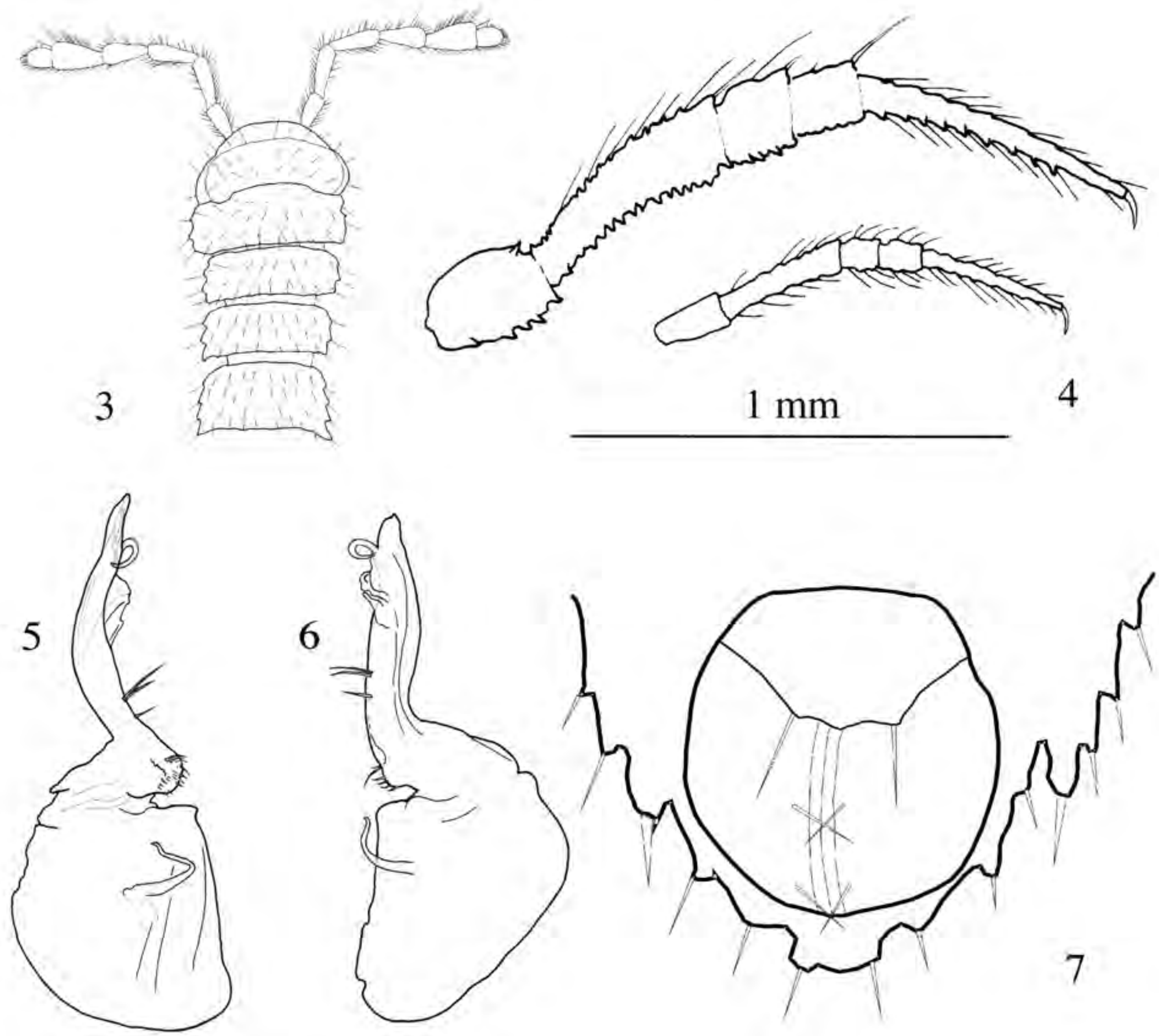
Description.—Male holotype (Figs. 2-7): A small, but highly troglomorphic form, 10.50 mm long, greatest width 0.95 mm (segment 2), body width/length ratio 9%. Head 0.95 mm wide, subglobular. Antenna 1.4 mm long, joint 5 widest with absent or small sensory organ, four conical tufts of setae on the tip of the antenna. Collum (segment 1) 0.91 mm wide, semicircular, with 30 setae arranged in 3 rows and 4 marginal setae, no teeth. Narrowest segment 19. Ozopore formula 5, 7, 9, 10, 12, 13, 15-18; ozopore on 18 very small. Anterior marginal teeth weak, nonporiferous segments with 3 marginal teeth, poriferous segments with 4 marginal teeth, each with a seta. Setation: Hirsute, with about 725 dorsal setae posterior to the head. Each of segments 2-4 with three rows of strong, acicular setae totalling about 30, including 3 setae on each lateral margin. Segments 5-19 with four or five irregular rows of setae, numbering about 32-53, including 4 setae on each lateral margin. Segment width/length ratio decreases toward segment 18, then increases. Preanal scale angular, with three vertices on posterior. Two setae on preanal scale (*bicornourus* condition). Periprocts swollen, with margins. Legs (Fig. 4): typical midbody leg 1.8 mm long (not including coxa), 0.15 mm wide, swollen, and clavate, with coarse granules on most joints. Leg width/length ratio 8%. Troglomorphy index (leg/body length) 17%.

Gonopods (Figs. 5-6): Large coxae closely appressed and flattened on mesal side, long coxal solenite with sharp bend in the middle and small hook at tip; fused telopodite, nearly straight from the mesal view; solenomerite without fimbriate pad at opening of the seminal canal; lateral branch of acropodite with flattened blade-like tip; mesal accessory branch hooked in a circular pattern with small barbs near the tip.

Female allotype: 10.2 mm long, greatest width 0.85 mm (segment 2), width/length ratio 9%. Head 0.92 mm wide, subglobular. Most features as in male except that the legs are shorter, more slender, and without tubercles. Typical midbody leg half as long as in male (0.92 mm), 40% as wide (0.06 mm), leg width/length ratio 7% (Fig. 4).

Two male paratypes: 10.2 and 9.5 mm long. Body width/length ratio 10-11%. Leg width/length ratio 6%. Troglomorphy index 15%.

Variation.—Eight adult males from the type locality ranged from 9.4-10.8 mm long; five adult females ranged from 10.0-11.5 mm long. All had two preanal setae. The largest male is 11.0 mm from Fellers Cave.



Figs. 3-7.-*Speodesmus castellanus* n. sp.. 3, head and five body segments of male holotype; 4. mid-body, male leg with large tubercles above, female leg at same scale below; 5, mesal view of left gonopod; 6, lateral view of left gonopod; 7, ventral view of preanal scale and epiproct.

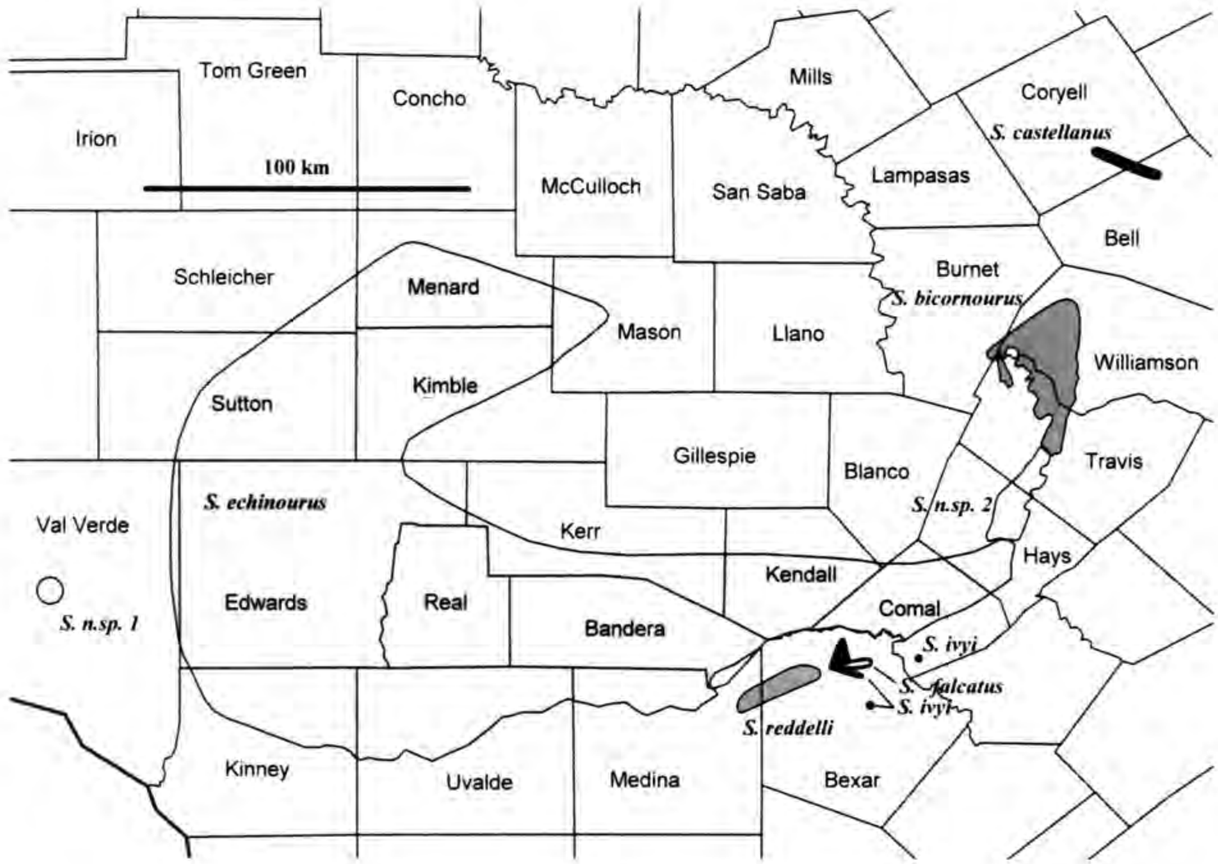


Fig. 8.-Map of central Texas, showing the ranges of eight *Speodesmus* species.

The smallest males are 8.0 mm from Bumelia and Keyhole caves. The series from Keyhole Cave tend to be small (8-9 mm males), while the Rocket River series tend to be large. One female from Triple J Cave is 9 mm and has three preanal setae.

Ecology.—Though highly troglomorphic, with relatively long legs, *S. castellanus* is moderately small and sometimes burrows in soil (James Reddell, pers. comm.). *Speodesmus bicornourus* is a giant in comparison, up to twice as long at 20 mm, and often is found walking on bare flowstone and other moist substrates.

Distribution.—Caves at Fort Hood, Bell and Coryell counties, Texas (Fig. 8). The 117 specimens were taken in 26 collections from nine caves in Bell County and nine caves in Coryell County, between January 1992 and June 2000. Nine collections (seven caves) had adult males, whereas 17 collections (11 caves) lacked adult males. Specimens were taken in all seasons, but there was no apparent seasonality in age or sex ratios in those collections that were large enough to assess these ratios. About 28% of the specimens were adult males, and 35% were adult females.

Records.—Adult males of *S. castellanus* have been identified from seven of 18 caves. The seven caves with males are distributed throughout the range of known caves at Fort Hood, so the 11 other caves probably belong to this species as well, although this is not certain.

Bell County: Bumelia Cave, 28 October 1994 (DA, DL), 1-0-0, 8 mm; Fellers Cave, 6 May 1998 (LJG, JRR, MR), 1-1-0, 10-11 mm; Lucky Rock Cave, 10 September 1997 (LJG, JRR, MR), 1-0-0, 8 mm; Price Pit, 6 May 1999 (JRR, MR), 1-2-0, 8 mm.

Coryell County: B.R.'s Secret Cave, 5 November 1992 (JRR, MR), 2-0-0, 10 mm; Keyhole Cave, 20 February 1999 (JRR, MR), 10-6-0, 8-9 mm; Rocket River Cave, 14 January 1992 (LJG, MW, CS), 2-2-0, 9.4-10 mm; 16 July 1992 (LJG, MW, CS), 21-13-17; 16 July 1993 (JRR, MR), 1-2-0.

Other Collections.— I could not assign the following collections from 15 caves to *S. castellanus* because adult males were lacking, but they probably belong to that species. However, four of the caves (names followed by asterisks) also have adult males from other collecting trips (see above).

Bell County: Buchanan Cave, 7 May 1998 (LJG, JRR, MR), 0-1-0, 14 mm; Fellers Cave*, 4 December 1992 (JRR, MR), 0-0-1; Figure 8 Cave, 9 February 1996 (MW), 0-0-1; 3 November 1998 (JC, MR), 0-1-0, 9 mm, enlarged gonopore; Lucky Rock Cave*, 22 February 1996 (DA, LJG, DL), 0-0-1; Sanford Pit Cave, 23 November

1994 (MW), 0-0-1; 4 November 1998 (JK), bottom of pit, 0-2-1, 8 mm; Streak Cave, 26 October 1997 (LJG, JRR, MR), 0-1-4,10 mm; Triple J Cave, 14 June 2000 (JK, JRR, MR, PS), 0-1-0, 9 mm, 3 preanal setae (extra one on left side).

Coryell County: Big Red Cave, 6 May 1999 (JRR, MR), 0-0-2; Copperhead Cave, 30 April 1998 (JRR, MR), 0-2-1, 8-9 mm; Cornelius Cave, 21 November 1995 (JRR, MR), 1 fragment; Ingram Cave, 7 April 1999 (JRR, MR), 0-2-1, 8 mm; Keyhole Cave*, 6 May 1999 (JRR, MR), 0-0-1; Mixmaster Cave, 9 March 1993 (JRR), 0-0-1; Rocket River Cave*, 27 October 1994 (MW) 2-1-2; Tippit Cave, 8 April 1999 (JRR, MR), 0-0-1.

Speodesmus falcatus, new species
Figs. 8-10, 18

Types.—I examined 85 specimens. Adult male holotype, female allotype and female paratype, collected in Cross the Creek Cave, Camp Bullis, Bexar County, Texas, 21 April 1999 by James R. Reddell and Marcelino Reyes; male paratype collected 10 September 1998 by the same. Deposited in the U.S. National Museum of Natural History (holotype and allotype) and Texas Memorial Museum, Texas Natural History Collections (paratypes).

Etymology.—The species epithet, *falcatus*, is a Latin adjective referring to the sickle-shaped gonopod. Common name: Sickled cave millipede.

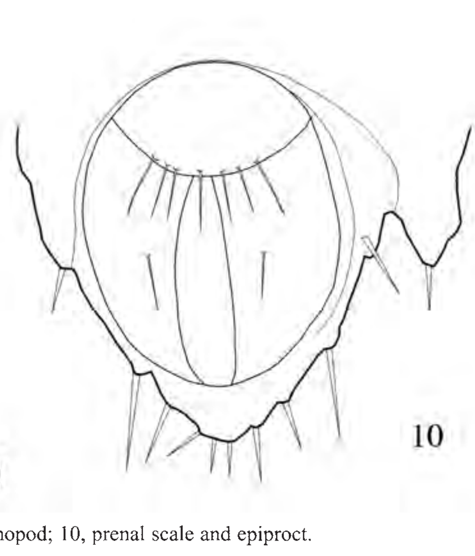
Diagnosis.—*Speodesmus falcatus* is closely related to *S. echinourus*, which occurs north of Cibolo Creek, but it has a prominent, mesal process on the gonopod, lacking in *S. echinourus*, and a longer, lateral retrorse barb. *Speodesmus reddelli* is slightly larger than *S. falcatus* and also has a long retrorse barb, but lacks the mesal process on the gonopod, and it occurs only in western Bexar and eastern Medina counties in a different karst area. At Camp Bullis smaller adults (7 mm) with a bifurcate epiproct probably are *S. ivyi* (described below).

Description.—Male holotype (Figs. 9-10): A large species, 20 segments in adults as in other *Speodesmus*, 16.0 mm long, ivory to white color, widest at segment 9 (1.2 mm), body width/length ratio 8%. Head 1.2 mm wide, ovoid. Antenna 2.3 mm, joint 6 widest with sensory organ. Collum (segment 1) 3.2 mm wide, arc-shaped, with 24 setae arranged in three rows and one marginal tooth on each side. Narrowest segment 19. Ozopore formula. 5, 7, 9, 10, 12, 13, 15-19. Anterior marginal teeth weak, nonporiferous segments with 3 marginal teeth, poriferous segments with 4 marginal teeth, each with a seta. Setation: About 520 dorsal setae posterior to the head. Each of segments 2-4 with three rows of strong, acicular setae totalling about 24, including 3 setae on each lateral margin. Segments 5-19 with three or four rows of setae, numbering about 24-28, including 3 setae on each lateral margin. Preanal scale rounded, with seven setae (*echinourus* condition). Legs: Typical midbody leg 2.2 mm long (not including coxa), 0.15 mm wide, with slight tubercles at the base of femoral setae. Leg width/length ratio 7%. Troglomorphy index 14%.

Gonopods (Fig. 9): Gonopod 510 µm long, curved, similar to *S. echinourus*, but a flattened, blade-like mesal process that gives the entire gonopod the appearance of a sickle from the ventral aspect. Mesal process tipped with small teeth. Much longer, lateral retrorse barb, which is small or lacking in some *echinourus* populations.

Female allotype: 16.0 mm, widest at segments 7 and 12 (1.2 mm), body width/length ratio 8%. Midbody leg 2.3 mm long, 1.3 mm wide, no tubercles, width/length ratio 6%. Troglomorphy index 14%. Preanal scale rounded triangle with 8 setae.

9


10


Figs. 9-10. *Speodesmus falcatus* n. sp. 9, ventral view of left gonopod; 10, prenal scale and epiproct.

Paratypes: Male 15.5 mm long, 7 preanal setae. Female 16.0 mm long, 8 preanal setae.

Variation.—Immatures have fewer preanal setae. Cross the Creek Cave: adults 13-16 mm, 4-6 preanal setae. Dos Viboras Cave: 14-16 mm, 4-13 preanal setae. Hold Me Back Cave: 15-17 mm, 5-9 preanal setae on males, 10 on a female, tooth near mesal base of mesal process of gonopod. MARS Pit: 5-7 preanal setae. MARS Shaft: 15-16 mm, 3-4 preanal setae, female with large everted cyphopods. Root Toupee Cave: 14-15 mm. Elmore Cave: 16 mm, 3-4 preanal setae.

Ecology.—*Speodesmus falcatus* is highly troglomorphic, and usually is found on moist surfaces. In vertical caves it has been found in all levels in the dark zone.

Distribution.—Known only from the Stone Oak Karst Fauna Region, north of San Antonio, Bexar County, Texas; seven caves in the southeastern portion of Camp Bullis, and one cave east of Camp Bullis. The range is about 2 by 8 km (Figs. 8 and 19). To date *S. falcatus* is the most common and abundant *Speodesmus* at Camp Bullis, but it is not found in all caves (see *S. ivyi* below).

Records.—*Bexar County*: Camp Bullis: Cross the Creek Cave, 31 March 1995 (JRR, MR), 1-1-2; 6 October 1995 (JRR, MR), 0-1-2; 10 September 1998, (JRR, MR), 1-1-1; 21 April 1999 (JRR, MR), 1-7-0; Dos Viboras Cave, 14 December 1994 (GM), Zone 3, dark, 71-72° F, 0-1-5; 9 January 1995 (JRR, MR), 2-0-4; 6 October 1995 (JRR, MR), 4-1-1; Hold Me Back Cave, 3 March 1994 (WRE), Zone 4, 1-0-0; 3 March 1994 (WRE, LM), Zone 3, 1-0-0; 9 November 2000 (JK, PS), 7-5-3, 3 females with everted cyphopods (genitalia) and triangular projections on posterior of coxae of segment 3 at edge of gonopore; 25 October 2001 (JK, PS), 0-1-1, female with everted cyphopods; 25 October 2001 (JK, PS), 5-4-8; MARS Pit, 29 October 2001 (JK, PS), 1-2-0; MARS Shaft, 4 March 1994 (JI), Zone 3, 1-0-0; 4 March 1994 (WRE), Zone 3, 0-3-3, 1 female with everted cyphopods (Fig. 11); 4 March 1994 (WRE), Zone 2, 0-5-1, three females with everted cyphopods; 20 September 1994 (WRE, JI), Zone 3, 70° F, 1-1-2; 20 September 1994 (WRE, JI), Zone 4, 69° F, 0-0-4; Root Toupee Cave, 17 November 1998 (PS, GV), 1-3-0; 20 April 1999 (MR), lower level, 3-1-0; Stone Oak Area: Elmore Cave, 14 July 1993 (JRR, MR), 1-1-1.

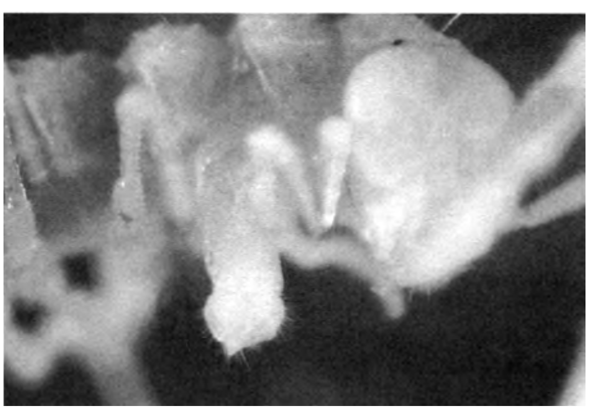


Fig. 11.-Preserved female *Speodesmus falcatus* n. sp. with everted cyphopods, from MARS Shaft, Bexar County, Texas.

***Speodesmus ivyi*, new species**
Figs. 8, 12, 13, 15, 16, 18

Types.—Up to 63 specimens from eight caves may belong to this species. Adult male holotype, female allotype and female paratype collected in Platypus Pit, from soil in Zone 2 just below the climbdown off the bottom of the entrance pit, Camp Bullis, Bexar County, Texas, 21 October 1997 by William R. Elliott and Joe Ivy. Deposited in the U.S. National Museum of Natural History and Texas Memorial Museum, Natural History Collections (paratype).

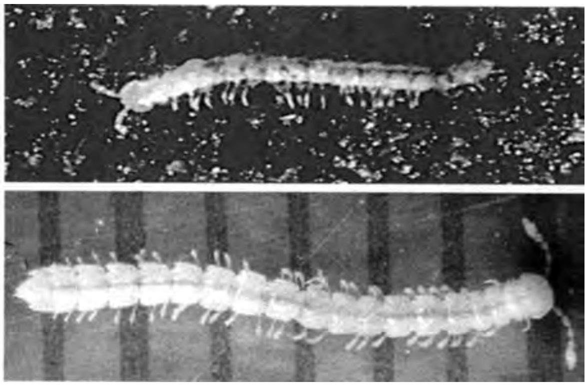
Etymology.—Named *ivyi* in memory of Joe Ivy, valiant cave explorer and surveyor, who died tragically on September 30, 2000, while exploring O-9 Well, Crockett County, Texas. Joe and I found this unusual species in Platypus Pit. Common name: Ivy's cave millipede.

Diagnosis.—This species is half the size of *S. reddelli* and *S. falcatus*, has very different gonopods, two preanal setae, and a bifurcate epiproct.

Description.—Male holotype: (Figs. 12, 13, 15, 16) A tiny species with 20 segments in adults and relatively short legs. Color ivory, length 7 mm, greatest width 0.6 mm at segment 18, narrowest 19, body width/length ratio 9%. Head ovoid, 0.6 mm wide. Antenna 0.8 mm long, widest at joint 6, with sensory organ. Collum with rounded anterior, straight posterior, 24 setae and rounded margins (no teeth). Marginal teeth of paranota indistinct on most segments, 4 on segment 8. Dorsal setation relatively reduced, with about 530 setae posterior to the head. Ozopore formula 5, 7, 9, 10, 12, 13, 15-18. Mid-body (segment 10) leg 0.71 mm, leg width 0.07 mm, leg width/length ratio 10%. Male legs lack tubercles and are not noticeably thickened. Preanal scale a truncated triangle with 2 setae. The epiproct (posterior tip of last segment) is unusual in being bifurcate, with two small processes each provided with a small seta (Fig. 15). Troglomorphy index 10%, less than other *Speodesmus* in this study.

Gonopods: Unusual among *Speodesmus*, curved, somewhat like *S. echinourus*, but with a thin, transparent, outer shelf from the tip to the lateral side. The retrose barb is modified into a curled, thickened rib at the lateroproximal margin (Fig. 16).

Female allotype: Ivory color, 7.0 mm long, greatest width 0.6 mm at segments 8 and 9, antenna 0.9 mm,



Figs. 12-13.-*Speodesmus ivyi*, n. sp. 12 (top), about 7 mm, burrowing in soil in Lewis Cave, Comal County, Texas, 1975; 13 (bottom), preserved male holotype, 7 mm, from Platypus Pit, Bexar County, Texas.

midbody leg 0.6 mm, ozopores 5, 7, 9, 10, 12, 13, 15-18. Two preanal setae, troglomorphy index 8%.

Female paratype: Ivory color, 6.8 mm long, 2 preanal setae.

Variation.—The author collected a series from Lewis Cave in July, 1974, and drew the gonopod for his dissertation. The male specimens dried out later and were not useable. I recently re-examined a Lewis Cave female, which was similar to the Platypus Pit specimens, with the same bifurcate epiproct, 7.5 mm long with 20 segments, body width/length ratio of 8%, 24 collum setae, weak marginal teeth on most paranota, same ozopore formula as holotype except a possible small ozopore on segment 19. In 1980 I studied specimens from Robber Baron Cave and found them to be similar to the Lewis Cave form. During the current study I re-examined the Robber Baron specimens, and I found the unique, bifurcate epiproct and gonopods like those in the Platypus Pit collection. Other localities in the Stone Oak and Alamo Heights Karst Fauna Regions that lack males are tentatively identified as *S. ivyi* on the basis of the unique, bifurcate epiproct, two preanal setae and small size. Adults are 6.5-7.5 mm long.

Ecology.—*S. ivyi* is the least troglomorphic of the central Texas species I have studied, with a troglomorphy index of 8-10%, compared to 14-17% in other species in this study. Its small size and short legs enable it to burrow between soil grains. In 1975 I photographed it burrowing in top soil, under ranch trash, in Lewis Cave, Comal County (Fig. 12). I saw it on soil in Platypus Pit in 1995, but I thought it was immature and did not collect it. From 1995 through 1998 Joe Ivy and I made regular ecological monitoring trips into Headquarters Cave, Eagles Nest Cave, Platypus Pit and MARS Pit. In numerous trips we never observed a *Speodesmus* in the first two caves, and we collected it but once in Playtpus Pit; MARS Pit contained *S. falcatus*. *Speodesmus ivyi* was collected but once in each of five Camp Bullis caves, but it may have been overlooked at other times because of its burrowing habits and small size.

Distribution.—Known from eight caves, five in Camp Bullis, two in San Antonio and one in Comal County.

Records.—*Bexar County*: Camp Bullis: Headquarters Cave, 8 September 1998 (JC, JRR, MR), 0-1-1; Hector Hole, 15 April 2002 (JRR, MR, GV), 0-1-1; Isocow Cave, 12 December 2001 (JK, TE), 0-0-1; Well Done Cave, 15 April 2002 (JRR, MR, GV), 3-3-0; Hollywood Park Area: Cueva Cave, 10 October 1983 (GV, CG), 0-1-0; San Antonio: Robber Baron Cave, spring 1977 (no collector recorded), 5-3-2; 11 December 1982 (RW), 1-0-0; 6 April 1983 (RW), 1-0-0; 31 March 1985 (DD, RW), 0-0-2.

Comal County: Bat Cave Area: Lewis Cave, 8 March 1968 (JRR, JF, SF), 15-8-11; 8 July 1975 (WRE, CSO, PST), 0-1-0.

Speodesmus reddelli, new species

Figs. 8, 14, 17-19

Types.—I examined 108 specimens from 15 caves. Male holotype and female allotype collected in Surprise Sink, Government Canyon State Natural Area, Bexar County, Texas, 21 April 1996 by George Veni, Karen Veni and Jim Kennedy. Male paratype collected 24 May 1998 by James R. Reddell and Marcelino Reyes. Holotype and allotype deposited in the U.S. National Museum of Natural History; paratype deposited in the Texas Memorial Museum, Texas Natural History Collections.

Etymology.—Named in honor of James R. Reddell, the leading student of cave life in Texas and Mexico for many years, who collected many of the examples of this new species. Common name: Reddell's cave millipede.

Diagnosis.—*Speodesmus reddelli* can be distinguished from *S. echinourus* by its larger size, gonopods more blade-like dorso-ventrad, longer retrorse barb, and fewer preanal setae (two to seven). *Speodesmus falcatus* is a similar size, but has sickle-like gonopods and seven preanal setae. *Speodesmus ivyi* is half the size of *S. reddelli* and *S. falcatus*, has very different gonopods and a bifurcate epiproct.

Description.—Male holotype (Figs. 14, 17, 18): A large, slender, highly troglomorphic species, 20 segments

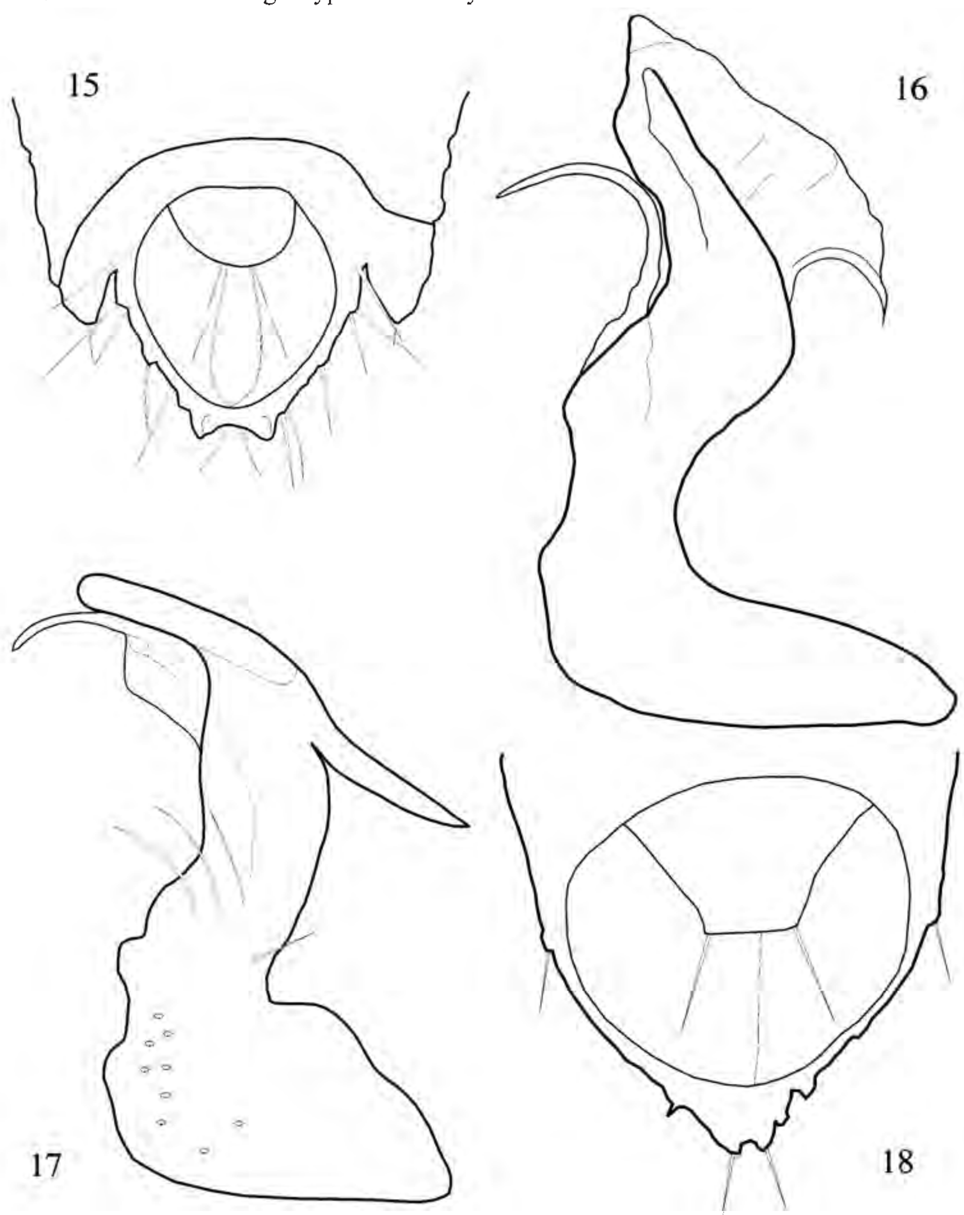
Fig. 14.-*Speodesmus reddelli*, n. sp., preserved male holotype, 16 mm, from Surprise Sink, Bexar County, Texas.

in adults, 16.0 mm long, translucent pale pinkish white, widest at segment 18 (1.07 mm), body width/length ratio 6%. Head 1.2 mm wide, ovoid. Antenna 3.0 mm, joint 6 widest with sensory organ. Collum 0.9 mm wide, arc-shaped, with 30 setae arranged in three rows and two marginal teeth on each side. Narrowest segment 19. Ozopore formula 5, 7, 9, 10, 12, 13, 15-18. Marginal teeth 4 on most, 5 on segment 8. Setation: Relatively hirsute, about 630 dorsal setae posterior to the head on the male (female has about 588). Segments 2-4 with three rows of setae totalling 28-30 each. Segments 5-19 with four rows of setae, numbering 29-36 per segment. Preanal scale a truncated triangle with two setae (Fig. 18); other localities have more setae. Legs: Typical midbody leg 2.6 mm long, 0.20 mm wide, no tubercles. Leg width/length ratio 8%. Troglomorphy index 16%.

Gonopods (Fig. 17): Curved, similar to *S. echinourus*, but blunter and with a more blade-like dorso-ventral aspect versus cylindrical, and a much longer, lateral retrorse barb, which is small or lacking in some *S. echinourus* populations.

Female allotype: 16.5 mm, widest at segment 9 (1.4 mm), body width/length ratio 9%. Antenna length 0.25 mm. Collum setae 29, with two teeth each side. Fewer dorsal setae (about 588) than male (about 630). Preanal scale and setae as in male.

Male and female paratypes: Male 16.0 mm, female 16.5 mm.



Figs. 15-18.- *Speodesmus* males. 15-16, *S. ivyi*, n. sp. 15, preanal scale and epiproct with bifurcate processes; 16, ventral view of left gonopod. 17-18, *S. reddelli*, 17, ventral view of left gonopod; 18, holotype preanal scale, with two setae, and epiproct, with single caudal process.

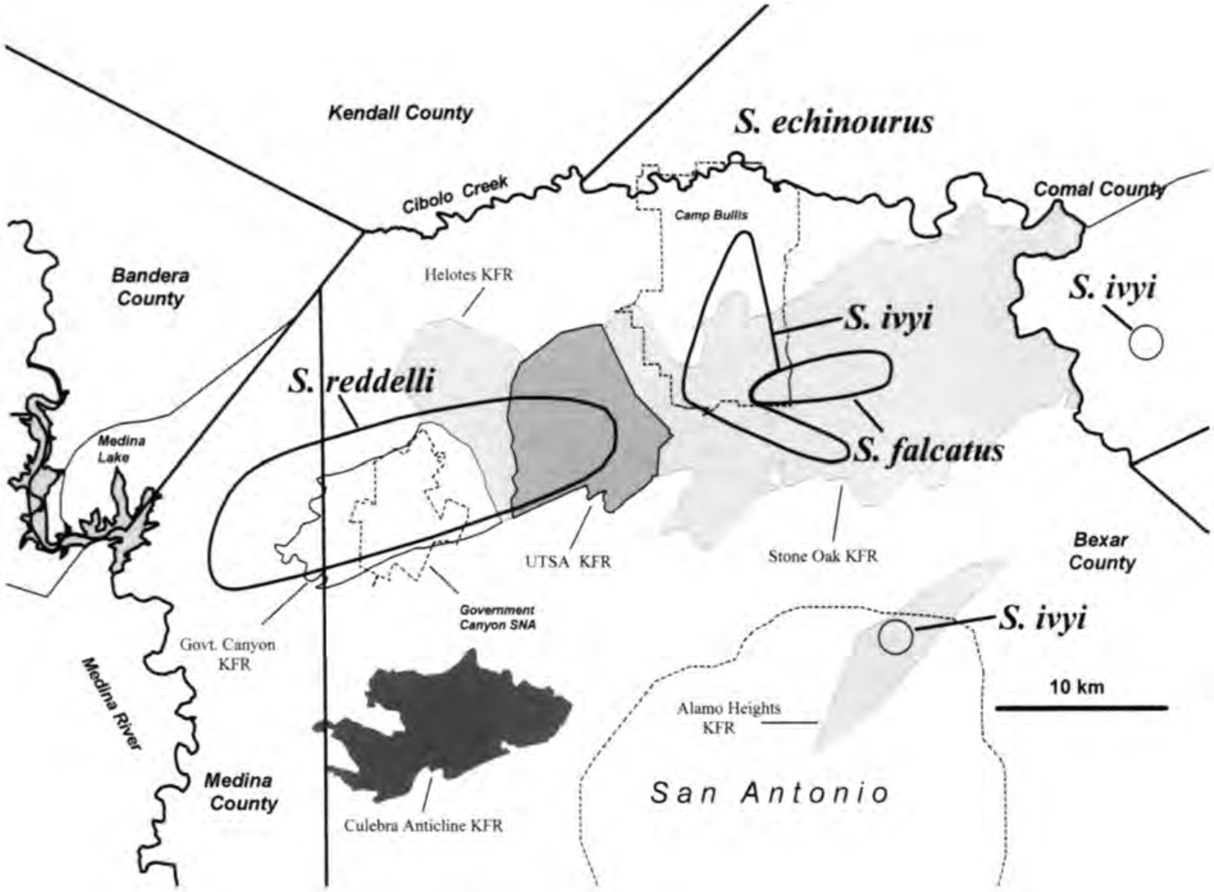


Fig. 19.-Map of the San Antonio area showing the ranges of five *Speodesmus* species, streams, karst faunal regions, counties, Camp Bullis and Government Canyon State Natural Area. All caves that were sampled contained just one *Speodesmus* species.

Variation.—Some populations are up to 20 mm long. Most central populations have two preanal setae, but those in John Wagner Ranch Cave No. 3, on the east, have two to four, while those from Goat Cave, Medina County, on the west, have seven. Some males from Logan's Cave have massive legs, an exaggerated sexually dimorphic character. Government Canyon Bat Cave: long legs without bumps. Lucky Hat Cave: male >17 mm, long legs. Porcupine Cave 15-16 mm. John Wagner Ranch Cave No. 3: 17-19 mm, 2-4 preanals; females with everted cyphopods. Kamikazi Cricket Cave: 16-19 mm, 2-3 preanals. Logan's Cave: some males with massive legs from August collection, 18-19 mm, 2-3 preanals. Madla's Drop Cave: 15-16 mm. 2 preanal setae. Crownridge Canyon Cave: no bumps. Robber's Cave: 18 mm, 2 preanal setae. Three-Fingers Cave: 16-17 mm, 2 preanal setae. "Surprise" Cave: 17.5 mm 7 preanals.

Ecology.—The size and troglomorphy of this species hint that it must be highly troglobitic, and by analogy it probably would be found on moist surfaces. However, often it is found in caves that are somewhat dry with only a few wet areas. For example, Surprise Sink is a 3-m-pit into two rooms with thick soil deposits and some flowstone, which are moderately dry. In Porcupine Cave, specimens were collected from wet flowstone in the dark zone. In John Wagner Ranch Cave No. 3 specimens were taken in breakdown crawls that were dry with little sediment, but with some wet areas. In Lithic Ridge Cave, it was collected from moist to wet soil, breakdown and flowstone (George Veni, pers. comm.). I have collected this species in Government Canyon Bat Cave on damp soil and weathered guano of *Myotis velifer.*

Distribution.—The range of *S. reddelli* is about 25 by 7 km, from northwestern Bexar County near Helotes to near Medina Lake, northeastern Medina County (Fig. 19). Known from 15 caves in the Government Canyon, Helotes and UTSA Karst Fauna Regions. Probably occurs in three other caves where no males were collected, within the known range.

Records.—*Bexar County*: Government Canyon Karst Fauna Region and State Natural Area: Government Canyon Bat Cave, 11 August 1965 (JRR, JF), 0-11-0; 24 May 1998 (JRR, MR), 1-1-0; Lithic Ridge Cave, 12 September 2001 (GV), 1-2-3; Lucky Hat Cave, 28 April 200 (MM), 1-0-1; Porcupine Cave, 12 September 2001 (GV), 2-2-2; Surprise Sink, 24 April 1996 (GV, KV, JKN), 2-0-0; Helotes Karst Fauna Region: Helotes Hilltop Cave, 30 August 1964 (OK), 1-8-0; John Wagner Ranch Cave No. 3 (= Adam Wilson's Cave, Jr.), 23 December 1962 (OK), 0-1-0; 6 October 1963 (JRR, JP), 1-0-0; 15 June 1993 (JL, JRR, MR, GV), 5-4-4; Kamikazi Cricket Cave, 19 January 1986 (AC), 1-0-0; Logan's Cave, 6 August 1993 (JL, JRR, MR, GV), 6-3-1; Madla's Drop Cave, 6 August 1993 (JL, JRR, MR, GV), 2-1-2; UTSA Karst Fauna Region: Crownridge Canyon Cave, 19 November 2002 (JRR, MR), 1-0-0; Robber's Cave, 22 June 1993 (JL, JRR, MR), 1-5-0; Three-Fingers Cave, 22 June 1993 (JL, JRR, MR), 3-4-0.

Medina County: Medina Lake Area: Goat Cave, 10 July 1966 (JRR), 2-0-0; "Surprise" Cave, 15 February 1964 (WHR, DM), 1-0-0; 15 February 1964 (JRR, DM), 0-1-0.

Speodesmus echinourus Loomis
Spiny cave millipede
Figs. 1, 19

Comments.—Besides the two new species described above, Camp Bullis contains *S. echinourus* in Camp Bullis Bad Air Cave, north of Cibolo Creek, within the known range of this species. The gonopod has a short retrorse barb, characteristic of this species. Less troglomorphic than *S. reddelli* and *S. falcatus*.

Records.—*Comal County*: Camp Bullis, Camp Bullis Bad Air Cave, 4 November 1996 (GV, PS), 1-1-1, 10 mm male, 11 mm female; 22 November 1996 (BJ, JRR, MR), Zone 2, 8-1-0.

Speodesmus sp., undetermined sp.

Comments.—Owing to a lack of adult males, the following collections could not be assigned to a species with certainty, although body size, number of preanal setae, and epiproct can provide a probable designation. Cave names followed by asterisks also have adult males from other collecting trips, which have been referred to *S. reddelli* or to *S. falcatus*.

Records.—*Bexar County* (from southwest to northeast): Culebra Anticline Karst Fauna Region: Stevens Ranch Trash Hole Cave, 12 June 1993 (JL), 0-1-0, 8.5 mm, 2 preanal setae, one process on epiproct. Not *S. ivyi*, although small.

Government Canyon Karst Fauna Region and State Natural Area (probably *S. reddelli*): Bone Pile Cave, 29 September 1996 (GV), 0-2-0, 16 mm, 2-3 preanal setae; 24 May 1998 (JRR, MR), 0-2-0, 18-19 mm; 12 September 2001 (GV), 2-2-0, 16-17 mm, 2 preanal setae, 2 females with everted cyphopods; Surprise Sink*, 5 February 1995 (AG), 0-3-0, 16-17 mm, 2 preanal setae; 7 October 1995 (GV, AH), 0-3-0, 16 mm, 2 preanal setae.

Helotes Karst Fauna Region (probably *S. reddelli*): Cave site #305, west of Helotes: 2000 (no exact date) (DB, KW), 0-1-0, 15 mm, 2 preanal setae; Christmas Cave, 25 December 1982 (RW, JI), 0-0-2, not *S. ivyi*, 2 preanal setae; John Wagner Ranch Cave No. 3*: 23 December 1962 (OK, CH), 0-2-0; 25 January 1985 (SH), 0-2-0, 17 mm, 2 preanal setae; 14 July 1993 (JRR, MR), 0-0-2, not *S. ivyi*; Kamikazi Cricket Cave*, 3 October 1984 (JI, GV), 0-0-5, 2 preanal setae; Logan's Cave*, 10 May1992 (GV), 0-3-0, 20 mm, 2 preanal setae.

UTSA Karst Fauna Region (probably *S. reddelli*): Hills and Dales Pit, 9 June 1989 (GV), 0-0-1; 1 November 2000 (KW), 0-0-1; Scorpion Cave, 1 June 1993 (JL, JRR, MR, GV), 0-2-0, 16-17 mm, 2 preanal setae; Young Cave No. 1, 6 September 1993 (JRR, MR), 1-1-0, 2 preanal setae.

Stone Oak Karst Fauna Region (probably *S. falcatus*): Camp Bullis: F-150 Cave, 11 April 2002 (JRR, MR), 0-0-1, immature male, 19 segments, 6.5 mm, one process on epiproct, 2 preanal setae, not *S. ivyi*; Hold Me Back Cave*, 1 December 1993, 14 March 1994?, 0-1-0; 21 September 1994, C Zone 5. 72-74° F, 0-0-1; 21 September 1994 (WRE, JI), Zone 2. 70° F, 0-0-1; 11 October 2000 (JK, PS), 0-1-0; MARS Pit*, 9 October 1995 (MR), Lower level, 0-0-1; East of Camp Bullis, Elmore Cave*, 24 October 1982 (RW), 0-2-2, 15 mm, 4-5 preanal setae; Hairy Tooth Cave, 28 June 1987 (AC), 0-1-0, 17 mm, 11 preanal setae.

Medina County: Quihi Area: Sixty Minute Cave: 17 October 1984, (JRR, DM), 0-1-0, 11 preanal setae.

DISCUSSION

Until now just two described species of *Speodesmus* were known from central Texas. *Speodesmus echinourus* Loomis was distributed in caves across the Edwards Plateau and in some caves along the Balcones Escarpment in Hays and Travis counties. *Speodesmus bicornourus* Causey is found primarily in northern Travis County and Williamson County, with a small morph in some outlying caves in Burnet and Lampasas counties (Fig. 8).

Shear (1973) described *Speodesmus pecki*, a 19-segmented species from a cave in Tamaulipas, Mexico, but he later removed it to the new genus *Sumidero* (Shear, 1982). Shear transferred *Speorthus tuganbius* Chamberlin, 1952, to *Speodesmus*. Shear (1984) described *Speodesmus aquiliensis* from a cave in Colorado; it appears to be close to *S. tuganbius* from New Mexico and West Texas in its deeply divided gonopod branches, but it bears five setae on the preanal scale, reminiscent of *S. echinourus*.

In my doctoral dissertation (Elliott, 1976), I studied *Speodesmus* specimens from 110 central Texas caves.

All populations seemed to have either two (*bicornourus*) or multiple (*echinourus*) setae on the preanal scale, except for a few individuals with three setae from populations that typically had two preanal setae. I had studied 726 specimens from 89 caves morphometrically, and I did univariate and multivariate analyses on three data sets: females, males, and male gonopods. Inter-populational variation was analyzed on the basis of geologic and physiographic variables with the purpose of relating their evolution to geologic history. I postulated two species groups which contained four undescribed species. The *echinourus* group had more than two preanal setae, but also curved gonopods. The *bicornourus* group had two preanal setae and straighter gonopods. The four new species were not formally published, but two of them are described herein as *S. ivyi* and *S. reddelli.* In a future paper I intend to describe two more species, one from Val Verde County (designated here as n.sp. 1) and another from Travis and Hays counties (n.sp. 2, Fig. 8).

In my dissertation the *echinourus* species group was considered a relative late-comer to Texas caves and had not speciated as much as the older *bicornourus* species group, nor had its two species diverged as much. I thought that the wider distribution of the *echinourus* species group probably was related to its having been isolated in caves at a later date than the *bicornourus* species group, at a time when more caves were available for colonization. A study of temporal variation in a few populations revealed some statistically significant changes in a decade's time. Secondary sexual dimorphism was quite similar in the two species groups, but minor intra-specific differences may indicate physical barriers to gene flow.

Since my dissertation many more specimens and several new species were collected, which now give us a better picture of variation and speciation patterns. For example, possessing two preanal setae may be a neotenic and plesiomorphic condition in the order Polydesmida; it is found in all immature *Speodesmus*, but it is also a plastic character in *Speodesmus*. I had observed variation in the number of preanal setae within *S. echinourus* before. Now we see within *S. reddelli* both *bicornourus* and *echinourus*-like populations. I have observed three preanal setae in some specimens of *S. bicornourus* and *S. castellanus*. The general shape of the gonopod may be a better guide to proposing species groups in *Speodesmus*, along with fundamentally different somatic characters, like the bifurcate epiproct in *S. ivyi*, also found in *S.* n.sp. 1 from Val Verde County.

It seems that *S. echinourus* could have evolved in Texas from an ancestor with two preanal setae. *Speodesmus reddelli* may represent an intermediate form on this path. Forms like *S. falcatus* speciated from an *echinourus*-like ancestor in isolated karst blocks along the Balcones Escarpment. Judging from the speciation patterns that we see in *Speodesmus* and other Texas troglobites, there probably are other *Speodesmus* species to be found in island-like karst blocks along the Balcones Escarpment. Camp Bullis has three species of *Speodesmus*, sometimes within 800 meters of each other, but never sympatric!

The small size and soil-burrowing behavior of *S. ivyi* (Fig. 12) may be a primitive condition derived from an edaphic ancestor. *Speodesmus castellanus* still burrows, although it is larger. Gigantism may evolve in some troglobitic millipedes as a result of humid conditions in the caves, which permit them to wander more freely without risking dessication. Increased setation is another adaptation to life in caves. *Speodesmus bicornourus, S. falcatus,* and *S. reddelli* have all evolved into such giant forms. *Speodesmus ivyi* is not limited to one karst block, but is from three different ones. It may have been isolated in caves only recently, or it may still be a part-time soil and crack-dweller, especially during moist conditions.

Fort Hood is an isolated karst area. The nearest known occurrence of *S. bicornourus* is in northern Williamson County, about 30 km to the south. A relatively caveless area lies between these two areas. I have identified outlying, small-bodied populations of *S. bicornourus* from caves in Burnet and Lampasas counties, which are isolated geologically and hydrologically from the central population in Travis and Williamson counties. The Fort Hood population lost the retrorse barb of the gonopod, but remained small. Within the central population of *S. bicornourus* there are notable size differences, with the largest body sizes found in northern Travis-southern Williamson counties, from Austin to Georgetown.

It seems likely that a small, soil-dwelling ancestor or ancestors inhabited central Texas in the past, but became isolated in caves because of a drying climate since the Pleistocene. Some populations remained small, soil-burrowing forms while others evolved gigantism where moist, extensive cave habitats were available.

Portions of Bexar, Burnet, Travis and Williamson counties have been divided into karst fauna regions by Veni (1992, 1994, 2002). These are hydrogeologically and biologically defined regions where discontinuities or physical narrowing of cavernous limestone areas pose barriers or restrictions to troglobite gene flow and thus promote speciation between isolated or nearly isolated faunas. Most barriers occur where cavernous limestone is removed by erosion. Restrictions to gene flow usually occur where regions are connected by relatively narrow sections of cavernous limestone, through strata of poorly cavernous limestone, along faults that might develop poorly permeable zones, and/or along faults that juxtapose cavernous strata against noncavernous or poorly cavernous strata. The karst fauna regions were delimited for terrestrial troglobites, such as *Rhadine* beetles, spiders, and others. Broad sections of cavernous limestone might be barriers or restrictions to gene flow if little or no portion of those rocks occurs above the water table.

Speodesmus reddelli and *S. falcatus* conform to Veni's karst fauna regions rather well (Fig. 19), but *S. ivyi* does not. I can find no obvious physiographic, lithologic or hydrologic barrier between *S. falcatus* and *S. ivyi*, which are in caves only 800 m apart within Camp Bullis. Relative elevations of the caves overlap, but there is a series of hills and shallow, dry creek bottoms between the two species.

The effect of the karst fauna regions on troglobite distribution is more pronounced with moderately advanced troglobites and species, like some spiders, which do not move far from their origin, as opposed to roving species. Highly advanced troglobitic species from different regions may appear to be the same because of convergence of troglomorphic features, but DNA studies may prove them to be distinct species (see Cokendolpher's discussion of *Chinquipellobunus madlae*, this volume). Species like *S. ivyi*, which may be part-time soil and crack dwellers, may not conform to any karst geology that we can map. This problem is reminiscent of the puzzling, wide ranges of some stygobites (aquatic troglobites), which sometimes are found in nonkarst areas. Some are more strict troglobites, while others are phreatobites, which can exist in nonkarst groundwater (Holsinger, 1994; Culver et al., 2003).

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MACROSCOPIC INVERTEBRATES OF HIDDEN AND HIDDEN CHIMNEY CAVES, EDDY COUNTY, NEW MEXICO

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ABSTRACT

An annotated list of 70 recent invertebrate species found to occur in Hidden Cave and Hidden Chimney Cave is provided; including new distributional and habitat records. An additional 12 species are recorded as being found only as subfossils from two stalagmites. The recent fauna consisted of arachnids, earthworms, gastropods, hexapods, myriapods, nematodes, and a terrestrial planarian. Subfossils of mites and lepidopterans were present. Temperature and relative humidity data for Hidden Cave are provided. The method and seasons of collection are described, as well as how these results might effect a management plan for the caves. Specific recommendations are made for the biological conservation of Hidden Cave and Hidden Chimney Cave.

INTRODUCTION

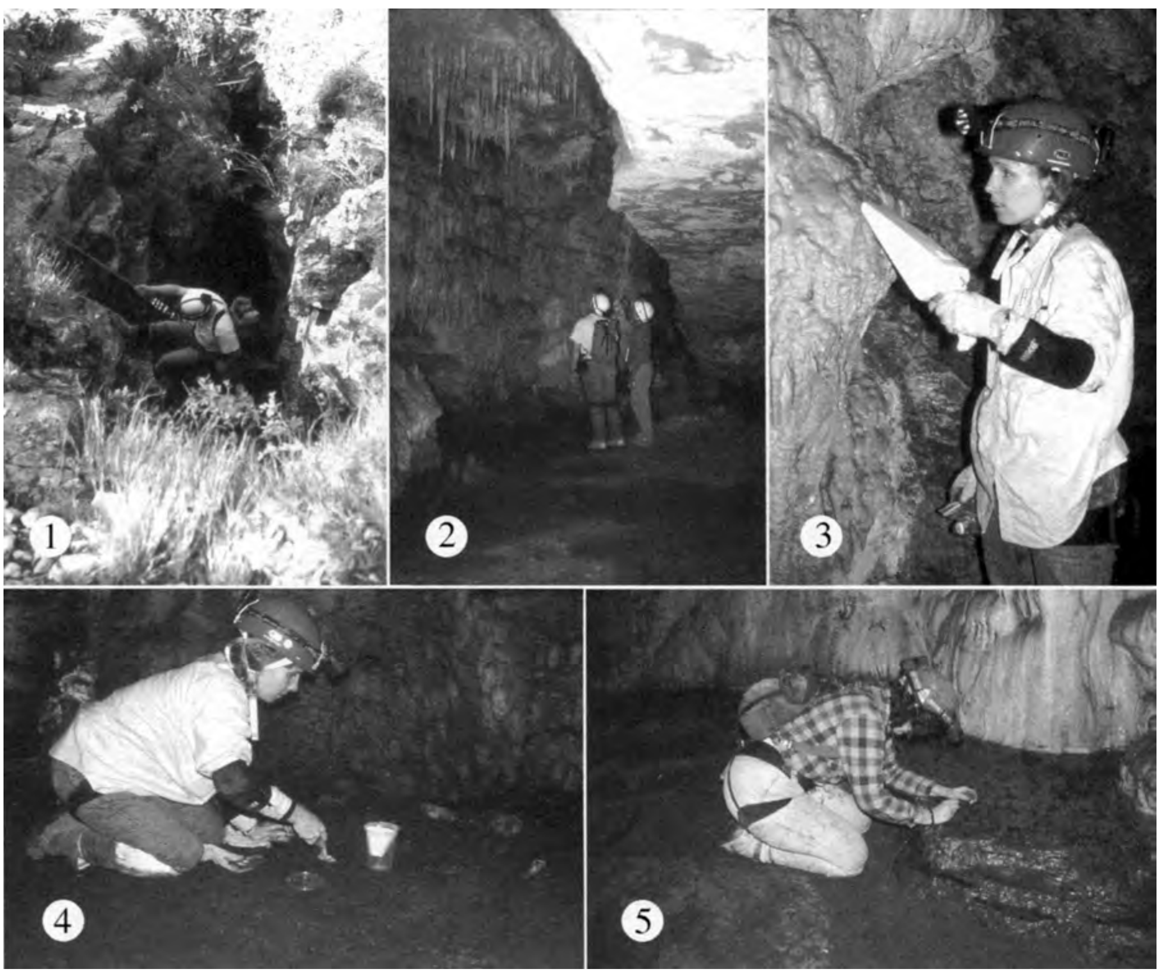
Southeastern New Mexico is famous for its large and scenic caves. Few studies, excluding those in Carlsbad Caverns, have investigated the faunas of these caves. The moist caves have served as refugia from the drying surface for many evolving species since the Miocene-Pliocene development of these limestone caves. The surface at Hidden Cave and some other nearby caves (within 3 km) in the Lincoln National Forest consists of a semi-arid region of sparse juniper-pine forest at approximately 2,000 m elevation. A few additional caves in the Lincoln National Forest are at higher and wetter elevations. The other regional caves (including Carlsbad Caverns) are at lower elevations (about 1,000-1,400 m) and the surrounding surfaces consist of Chihuahuan Desert grasslands. The caves at higher elevations in the Lincoln National Forest are of an older age (12 million years old; Polyak et al., 1998) than those now opening in the lower elevation grasslands (4 million years old).

Whereas some wide-ranging species might be found in these upper elevation caves, the caves are sufficiently old and isolated so that many could have unique species. Welbourn (1976) reported that more than 80 species have been identified from 55 limestone caves in the Guadalupe Mountains. To date, a listing of these taxa has not been published. Presumably, our records will greatly increase this total.

The objectives of our study were to compare the recent fauna in and adjacent to Hidden Cave with subfossils recovered from stalagmites and to provide an inventory of macroscopic invertebrates of the cave. The first objective has been completed (Polyak et al., 2001) and we here present the inventory. Because of the proximity of Hidden Chimney Cave, we also include an inventory of the recent fauna from that cave. Being concerned about cave conservation in general, we have prepared a discussion on topics of concern at Hidden Cave and Hidden Chimney Cave, and have made some specific recommendations for the biological conservation of these caves.

CAVES EXAMINED

Hidden Cave is located on a north-facing slope of the Guadalupe Ridge at an elevation of 2,005 m (Trout, 1992; Polyak et al., 2001). A breakdown mound at the base of the entrance divides Hidden Cave into two sections, one to the northwest toward the once artificial entrance (northern half) and the other to the large room south of the entrance (southern half). Hidden Cave is enterable by a rappel down a fissure-type pit. The entrance is large, about 12.8 m long and ~3 m wide, and not protected by rock overhangs or other coverings (Fig. 1). The northwest passageways can be entered via a 12.2 m entrance drop. An additional 7.3 m drop is required to reach the larger and more extensive south and west passageways. The walking passage is about one km in length.



Figs. 1-5.—Hidden Cave. 1, entrance viewed from the north side. 2, high ceilings and silty mud floors are common in much of the cave. 3, a hand held vacuum proved useful in collecting tiny invertebrates from flowstone and other formations. 4, baited pitfall traps with inner funnel were buried throughout the cave. 5, careful searching and hand collecting proved invaluable in the biological survey of these caves, especially collecting mites and springtails from the water's surface.

Table 1.—Temperatures and relative humidities in Hidden Cave during 1992.

Date	Entrance zone at top of breakdown	Dark zone in NW passage	Dark zone monohydro-calcite room	Twilight/dark big room in south passage	Dark zone north end of south passage
15 Feb.	8°C-65%RH	not recorded	11°C-87%RH	11°C-86%RH	not recorded
17 May	not recorded	10°C-94%RH	11°C-92%RH	11°C-91%RH	11°C-95%RH
15 Aug.	13°C-89%RH	12°C-93%RH	11°C-95%RH	11°C-92%RH	11°C-92%RH
24 Oct.	not recorded	12°C-93%RH	12°C-93%RH	11°C-92%RH	not recorded

Most of the floor in the cave is level to gently sloping and composed predominantly of silt and mud (Figs. 2, 4, 6). The floor sediment contains relatively abundant organic material which supplies nutrients for cave life. While some rain and water from snow melt enters the cave directly through the main entrance, most water flows through crevices in the roof and overlying rock and soil. Some water probably also flows down larger cracks from uphill joints. The water forms large shallow pools in both areas of the cave. These pools were full in February and were either dry or greatly reduced in August of the same year (1992). Dripping was rapid and almost a continuous pour immediately above the large pool near "The Great Wall of China" (a 16 m long rimstone dam speleothem) in the largest room during February. Temperature and relative humidity within the dark zone of the cave varied from 10-12°C and 87-95%RH during the four 1992 visits (Table 1). Welbourn (in Hill, 1987) gave April 1985 measurements of 11.7°C, 94%RH. Temperatures and relative humidities measured by Kevin T. Glover (pers. com.) in 1994, 1996, 1997, and 2003 (10 to 11°C and 75 to 95%RH) are also very similar to the 1992 values.

Another cave, Hidden Chimney, is located about 40 m from the entrance to Hidden Cave. This small cave consists of a single joint-controlled fissure-like passage. The main entrance is small, 0.3 m wide, 0.52 m tall, and partially covered so that debris and water does not enter in large quantities. The elevation at the main entrance to Hidden Chimney Cave is about 8.5 m above that of Hidden Cave. Once inside the cave, it opens up to walkways with 7-10 m ceilings. The twilight/entrance zone is about 8.5 m long and 3-5 m wide. The floor consists of washed-in soil and organic debris. Tree roots are present along the walls. This zone was dry and dusty on our collecting trip during October 1992. A return trip to

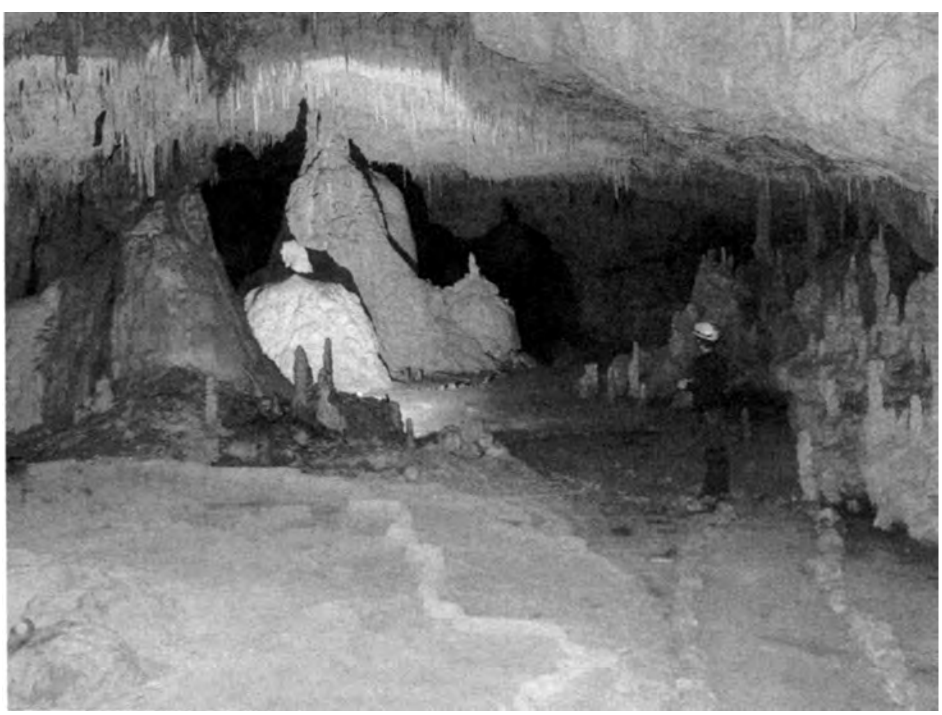


Fig. 6.—Large room with rimstone dams of Hidden Cave. To reduce damage to the cave floor a path has been outlined with piles of stones.

study the geology in November 1993, revealed the soil much more compact and covered with oak tree leaves. At the end of the twilight zone, the cave continues as a 24.7 m long, 0.7-1.2 m wide, steep-walled, joint-guided passage which leads to a drop in the floor of about 7.2 m. The first 16.8 m of the walking passage has a gently sloping mud floor whereas the last 7.9 m is on limestone that rises steeply in the back of the cave. The long passage runs perpendicular to the mountain ridge (NNW-SSE). While the floor of the lower level remains muddy, few active speleothems are present. No pools were observed during our two visits to the cave in October 1992 and November 1993.

RECENT HISTORY

Hidden Cave, known since the early 1900s, is one of the most popular and visited caves in the Guadalupe Mountains (Trout, 1992). It was a tourist (commercial) cave during the 1930s, and because the natural entrance is a vertical drop, an additional entrance was dynamited open to allow easy access (Trout, 1992). One of the early descriptions of the cave and its speleothems is provided by Nymeyer (1938). The artificial (horizontal) entrance made Hidden Cave easily accessible until 1988, when the U.S. Dept. of Agriculture (U.S.D.A.)-Forest Service cemented the entrance. Today, the artificial entrance is only large enough for rodents to use and human visitation to the cave is somewhat restricted. Average visitation from 1979 to 1989 was approximately 200 people per year (Trout, 1992). Closure of the artificial entrance, modifications in permitting, and temporary closure for restoration have reduced visitation to Hidden Cave.

Hidden Chimney Cave is small, not well known, and thus less visited.

GEOLOGY

Hidden Cave formed in the backreef dolostones of the Permian Capitan Reef Complex, within the Seven Rivers Formation (Jagnow, 1977) near the contact with the Yates Formation (Hill, 1987). Speleothems within the cave are typical of the Guadalupe Mountains and comprised almost entirely of carbonate minerals, the dominant of these are calcite, aragonite, and dolomite. Most speleothem growth probably occurred during the Pleistocene when climatic conditions were cooler and wetter. A thick organic-rich, silty mud deposit forms the almost level floor throughout most of the cave. Carbonate speleothem types include cave pearls, cave popcorn, cave shields, welts, columns, drapery, flowstone, helictites, lilypads, crusts, rimstone dams (up to 1.8 m in height; Hill, 1987), stalactites, and stalagmites. These are found on the ceiling, walls, and floor. Many of the speleothems are inactive (dry); however, dripping water, wet speleothems, and growth of dripstones are present throughout the cave.

Hidden Chimney Cave is formed along the same joint which runs NNW-SSE. The mineralogy of Hidden Chimney Cave is essentially the same as Hidden Cave. Most speleothem growth probably also occurred during the Pleistocene. Most speleothems are now inactive and all are composed of carbonate minerals. Cave popcorn is predominantly found, in addition to flowstone, drapery, soda straws, stalactites, and stalagmites. Some speleothems are darkly pigmented (dark brown to black) and at least two areas have color-banded drapery speleothems (cave bacon).

CLIMATE

The surface immediately surrounding the entrances to the caves is a mesic-xeric conifer/oak woodland. Rainfall data from the weather observation site nearest Hidden Cave about 25 km away (Pine Springs, Guadalupe Mountains, Culberson County, Texas, 300 m lower in elevation) reveals the average peak rainfall occurs during July, August, and September and the lowest average rainfall occurs during February and March (U.S. Dept. of Commerce, 1988-1992; Table 2). While the temperatures at Pine Springs are higher than those at Hidden Cave because of lower elevation, the measurements at Pine Springs are the most representative data available. The average annual temperature at Pine Springs was 14°C (U.S. Dept. of Commerce, 1992), 3°C warmer than the average annual we recorded within Hidden Cave. This difference is probably because of Hidden Cave's higher elevation and the location of its passage relative to its entrance, making the cave a cold-air trap.

SUBFOSSILS

The first records of subfossil invertebrates recovered from speleothems are reported by Polyak and Cokendolpher (1993). Polyak et al. (2001) found the mites encased in speleothems of late Holocene age (<4,000 years old), thus the distinction "subfossils." These invertebrates were recovered by dissolving small stalagmites in weak hydrochloric acid. Two small stalagmites containing the majority of the subfossil invertebrates were collected from Hidden Cave. Petrunkevitch (1945), Pierce (1950, 1951), and Rowland and Sissom (1980) reported fossil arthropods from a calcium carbonate deposit in northern Arizona referred to as onyx marble. We suspect the onyx marble could be of spelean origin. Invertebrates which were recovered from Hidden Cave stalagmites consisted mostly of mites and are listed in the results of this study.

Table 2.—Monthly and total rain/snow fall (in inches) at Pine Springs, Guadalupe Mountains, Culberson County, Texas (U.S. Dept. of Commerce, 1988-1992).

	1988	1989	1990	1991	1992	5 yr. Average
January	0.26	0.22	0.12	n/a	2.95	0.89
February	0.63	1.22	0.61	n/a	0.23	0.67
March	0.10	0.28	1.02	n/a	0.50	0.48
April	1.68	0.00	0.22	n/a	1.05	0.74
May	1.02	1.01	0.22	n/a	3.98	1.56
June	0.31	0.80	0.00	0.82	0.94	0.57
July	5.27	3.03	4.18	5.25	2.47	4.04
August	2.96	3.79	5.13	7.86	3.76	5.88
September	1.40	1.26	7.49	6.52	0.66	3.47
October	0.30	0.05	3.97	0.34	0.68	1.07
November	0.58	0.00	n/a	1.84	0.47	0.72
December	0.18	0.48	0.63	2.87	0.28	0.89
Totals	14.69	12.14	23.59*	25.50*	17.97	20.98

*Some data not available, total incomplete for this data set.

BIOLOGY

The only previous invertebrate collections from Hidden Cave reported in the literature are those recorded by Barr and Reddell (1967). In that paper, they recorded seven species: a spider, two millipeds, a dipluran, two camel crickets, and a crane fly. The only previous observations from Hidden Chimney Cave are unpublished records from the files at Carlsbad Caverns National Park revealing the presence of a tick (*Ixodes conepati* Cooley and Kohls) and a spider (*Cicurina* sp.). Records from other caves in the region (Barr and Reddell, 1967; Elliott, 1978; Welbourn, 1978) suggest the faunas of Hidden Cave and Hidden Chimney Cave should be much more extensive than previously recorded.

COLLECTION METHODS

Following are descriptions of the collection techniques used in Hidden Cave to ensure the fauna was adequately sampled and to determine which methods were most productive. Only hand collections (Fig. 5) were made in Hidden Chimney Cave and the following discussion is on methods used in Hidden Cave. While we made an effort each season to collect in every conceivable habitat (except vertebrate hosts for parasites), we are certain that we have not obtained every species present. Each trip to the cave produced at least one additional species not collected previously. Even relatively large invertebrates, capable of being seen with the unaided human eye, continued to be collected on subsequent trips. This was especially true for the rarer cave-adapted animals.

A collection trip was made each season: 15-16 February, 17 May, 15 August, and 24-25 October in 1992. We tried as many methods of collecting as we were aware. Hand collections were performed on each trip within the cave and on the surface within 60 m of the cave entrance. Specimens were placed alive in 15 ml vials for transport back to the laboratory or were preserved in 70-80% ethyl alcohol on site.

Pitfall traps were placed in the cave and on the surface for a 24-hour period during the summer and winter. The traps consisted of 16 oz plastic cups having a smaller bottomless plastic cup placed within and toward the lip of the larger cup so that whatever entered the cup would have difficulty escaping through the funnel (Fig. 4). Each cup was baited with one of three types of bait: tuna fish, grape jelly, or rancid liver. Thirty pitfall traps were placed in the cave and 12 on the surface. The traps remained in place for 24 hours. The pitfall trap samples which were not released in the cave were kept alive and transported to the laboratory. Further details on pitfall trap collections are provided by Cokendolpher et al. (2001).

Samples of litter were collected in the cave and on the surface, and extracted with Berlese funnels. A few active stalagmites and flowstone were wiped with cotton-tipped swabs to collect possible microscopic arthropods (see Polyak and Cokendolpher, 1993, for details).

A hand-held vacuum cleaner was used to extract small arthropods from the walls of the cave (Fig. 3). The vacuum's filter was removed and in its place, a wedging tool attachment with a sheet of chiffon placed inside, the ends held outside by a rubber band, was used to net any invertebrates. After vacuuming, the end of the chiffon bag was sealed with the rubber band and removed with its contents from the wedging tool. The chiffon sheet and trapped invertebrates were then placed into 70-80% ethyl alcohol.

One piece of fresh liver was placed in selected pools for a maximum of 24 hours to attract any aquatic life during the winter and summer trips. The liver was placed inside of a 5-dram plastic vial, which had a string tied to it. The lid of each vial also contained a smaller inverted tube (the outside edge was flush with the cap of the vial). The tube was slightly tapered so that it hindered the exit of any trapped invertebrates. Only larger pools were baited. A small plankton net was also used when pools were deep enough to pull the net through the water.

A handheld, 12 watt, ultraviolet light was used to find scorpions, some millipeds, and any other fluorescent invertebrates on the surface and within Hidden Cave.

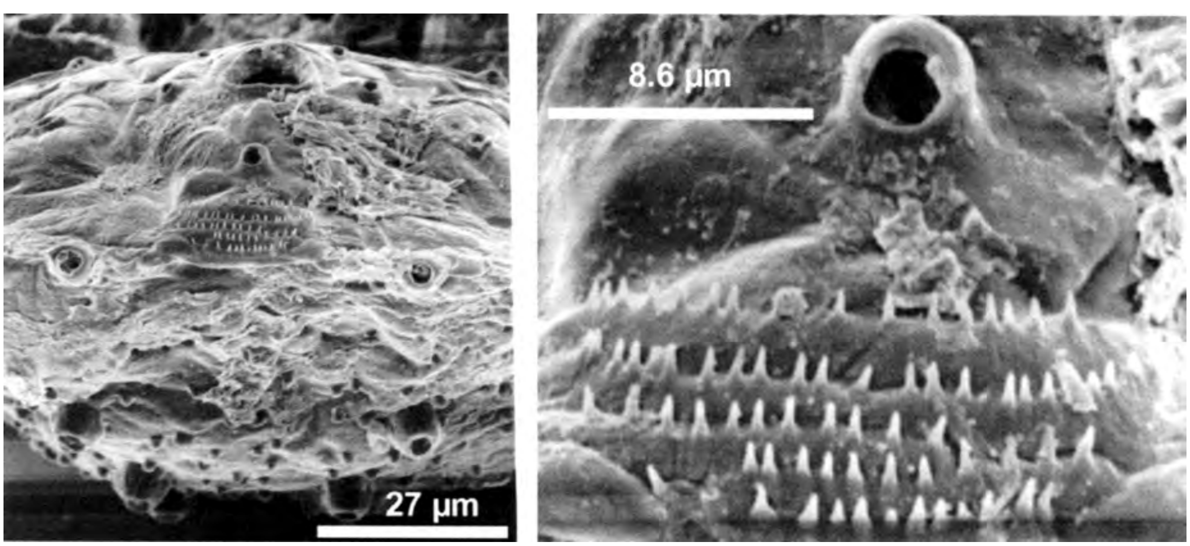
Some specimens were retained in the collections of the consulting taxonomists. Other examples are in the collection of the Texas Memorial Museum, The University of Texas at Austin, 2400 Trinity, Austin, Texas 78705, and the Arthropod Museum, Department of Entomology, Plant Pathology and Weed Sciences, New Mexico State University, Las Cruces, New Mexico 88003.

RESULTS

On the first trip (15 February 1992), the pools throughout Hidden Cave were full, and the cave was exceptionally wet. A small plankton net was pulled through the water of these pools. No invertebrates were recovered, and the use of a net was not tried again. Following the use of the net, bait was placed in two pools and left for 24 hours. Baits were tried again in the summer in the same two pools. Again, no invertebrates were obtained. Close observation of pools revealed rhagidiid mites and collembola on the water's surface. Copepods might have been overlooked. Cyclopids have been recorded from several caves in the area as well as from surface habitats (Barr and Reddell, 1967). However, since 1992 the cave and land surface have become increasingly drier.

The pitfall trapping with bait was successful. The two dominant invertebrates attracted to the baits in Hidden Cave were the crickets and diplurans. Cokendolpher et al. (2001) reported the results of those studies. As seen from Table 3, this method did not result in the collection of any species which was not collected by hand, except for the mite *Ceuthothrombidium cavaticum* which was removed from camel crickets obtained in pitfall traps. Extensive examination of camel crickets collected by hand should also reveal these mites. This method of collection is good for obtaining large numbers of individuals but apparently not sampling species diversity. Surface pitfall traps revealed numerous species which were not obtained by hand collections. Extensive pitfall trapping can be detrimental to certain cave species populations (Crawford and Senger, 1988), especially if the captured animals are not released. Large predators will eat smaller trapped animals and when large numbers of crickets are present they will trample each other and the smaller or more delicate invertebrates (diplurans).

The Berlese Funnel extractions from the caves yielded small invertebrates, mostly mites and springtails.



Figs. 7-8.—Micrographs of the subfossil mite *Paleozercon cavernicolus*: 7, posterior view of abdomen (ventral surface up) showing various pits, setal bases, and cribrum; 8, enlargement of cribrum and posterior-most ventral seta socket.

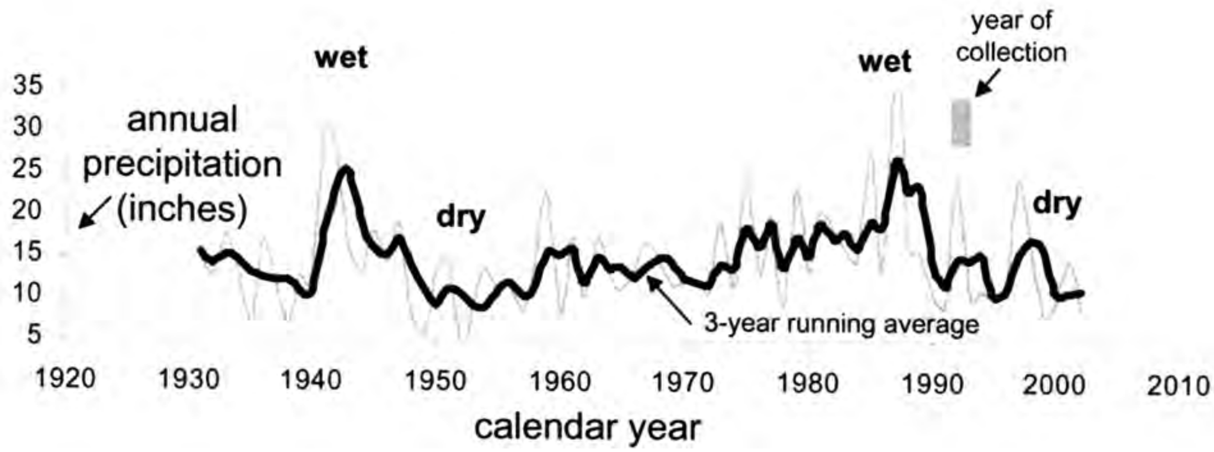


Fig. 9.—Graphs of annual and 3-year averaged precipitation (in inches) recorded at Carlsbad Caverns Climatological Station.

The method provided samples of species that were not obtained by other methods and should be part of any comprehensive faunal survey.

A symphylan was recovered by vacuuming flowstone. The symphylan represents a new class of invertebrates to Guadalupe Mountains caves. Additional methods of collection revealed no further material of this class. Collembola, mites, and flies were also obtained while vacuuming flowstone. Some species were captured only in this manner (Table 3). Although vacuuming proved to be a fruitful method of collecting small cave invertebrates, it has several drawbacks. First, the rechargeable batteries in the vacuum (Black & Decker Dustbuster, Cat. No. 9330A) only lasted long enough to sample a few square meters of flowstone. The weight and cumbersomeness of the vacuum cleaners is also significant when the unit has to be backpacked for considerable distances while hiking and rappelling. The noise of the unit is also loud and alien to a cave and could be disturbing to resident bats.

Our efforts at swabbing flowstone proved useful in finding arthropod fragments that were being incorporated into the speleothems. No species were obtained by this method that were not obtained by other methods.

We did not detect any fluorescent life in the cave. Millipeds of the genus *Stenodesmus* have fluorescent legs and body (Fig. 14), but the only specimens we obtained were by other methods. Scorpions, *Centruroides vittatus* (Wood) and *Pseudouroctonus apacheanus* (Gertsch and Soleglad), which fluoresce brightly were common on the surface near the entrance to the caves, but none were detected with UV light or by any other means in the caves. We found the weight and cumbersomeness of the light while hiking and climbing ropes to far outweigh any benefits it provided. We also noted it is awkard to use a UV light in a cave as it is difficult to see where one is walking. We had expected some of the minerals and fungi found in the cave to fluoresce. This did not happen and the only materials that fluoresced brightly were small pieces of debris left by cavers or which had washed into the cave.

A batfly (ectoparasite) was removed from a Western Big-eared Bat, *Corynorhinus townsendii* (Cooper), that was sleeping on the cave wall. Dead vertebrates (*Peromyscus* sp.) were searched for external parasites, no vertebrates (dead or alive) were collected, and the batfly was the only invertebrate removed from a vertebrate. Other vertebrates observed in Hidden Cave included a corn snake, *Pituophis melanoleucus* (Daudin), which had fallen into the cave, hibernating bats [*Pipistrellus hesperus* (Allen)] and nests of ringtails (*Bassariscus astutus* Lichtenstein) and/or packrats (*Neotoma* sp.).

In conclusion, it appears the most productive methods of collection of recent species (both by numbers and variety of species) in order of importance are: (1) hand collecting, (2) Berlese funnel extractions, and (3) vacuuming. The other methods either caught nothing or did not result in species that were not caught by one of the three methods mentioned above. From the results of Table 3, it is also clear that repeated trips should be made for an accurate assessment of a cave's fauna. The data from Table 3 are even more striking when it is considered that on each trip to the cave, 5-6 speleologists searched and collected by hand in the cave for several hours.

SUBFOSSIL FAUNA

We recovered at least 12 species of mites from two stalagmites collected from Hidden Cave. Polyak et al. (2001), using uranium series dating, showed that the mite-yielding stalagmites grew in Hidden Cave between 800 and 3,200 years ago. The mites are well preserved and considered subfossils because they are Holocene in age (less than 12,000 years old). Polyak et al. (2001) published a complete list of the subfossil mites, as well as the living mites collected in the cave and on the surface adjacent to the cave entrance. They noted that the subfossil species differed from the species found in the cave and on the surface around the cave, and the genera of many of these subfossil species are today found in more northern, cooler, or more mesic environments. They interpreted these results, along with the stalagmite growth, as evidence for a cooler, wetter late Holocene in the southwestern United States. Preservation of the subfossils was so complete that many were identified to morphospecies. A new genus and species, *Paleozercon cavernicolus* (Zerconidae: Acarina), was identified (Blaszak et al., 1995) as well as other new species, some of which are still not described.

The excellent state of preservation can be seen in Figs. 7 and 8. The cribrum is illustrated for the first time from this family, Zerconidae. Krantz and Redmond (1988) suggested that the spicules of the cribrum function as a dispersal platform for sex phermones.

UNIQUE FEATURES OF THE FAUNA

There were no animals located in the caves that are currently listed on state or federal endangered species lists. There are three endangered plants, two *Coryphantha* cacti and a *Hedeoma* pennyroyal, known from the surface in the region (U.S. Environmental Protection Agency, 1991). The only troglobites located in the caves during our study are also known to occur in other Eddy County caves, except for a collembolan (*Arrhopalites* sp.) and a mite (*Insculptoppia cavernalis*). A spider (*Thymoites* sp.) could also be unique to Hidden Chimney Cave. There is a female spider (reposited in the Texas Memorial Museum) from the Cave of the Madonna which may be the same species; further study is needed. Cave of the Madonna is located on Guadalupe Ridge about 5 km away from Hidden Chimney Cave. Other unidentified invertebrates from our study could be unique troglobites. Several of the other mostly undescribed mite species are only known from Hidden Cave. This might be more of a reflection of the lack of knowledge of the fauna of southeastern New Mexico than an indication of the uniqueness of these caves.

Trout (1992) stated in the Hidden Cave Management Plan that "Ongoing studies and observations over a 34 year period (1955 thru 1989) have indicated that the majority of 'ordinary' Guadalupe cave life forms (i.e. spiders, crickets, beetles, and centipedes) are now extinct and/or severely reduced within Hidden Cave." Unfortunately, no quantitative studies have been conducted in Hidden Cave, so comparisons through time are difficult. Trout's observations covered prior to and only a short period after the artificial entrance was closed. The fauna we detected was actually richer than that seen by Trout. From personal conversations with cavers who visited Hidden Cave prior to the closing of the artificial entrance, it appears that the cave is wetter now. However, the amount of water in Hidden Cave during our survey probably related to the exceptionally wet years during the 1980s and early 1990s rather than the closure of the artificial entrance. Rainfall data for Carlsbad Caverns show that period was the wettest since the early 1940s (Fig. 9).

CONSERVATION RECOMMENDATIONS

Management plans for Hidden Cave and other caves managed by the U.S.D.A.-Forest Service are being developed. Because Hidden Cave has been one of the most frequently visited caves in the Guadalupe Mountains, we have prepared some suggestions for its conservation.

Cavers and the public generally think of cave conservation as the preservation and restoration of cave speleothems. Whereas this is important, biological conservation is often a different matter. Preservation and restoration of habitats is the key to biological conservation. An unsightly cave can and often does contain a rich fauna. Water, habitat, food, and protection of species are the keys to good management.

Hidden Cave, and to a lesser extent Hidden Chimney Cave (as evidenced by active speleothems and a muddy floor), can receive a significant volume of water. Maintaining this flow necessitates the preservation of the catchment basin above and uphill from the caves. As these caves are located along joints which run through the ridge, areas on either side of the NNW-SSE joint above Hidden Cave [about 1,981 m elevation] should also be protected. There is at least one other cave on this ridge within the same joint system as Hidden Cave and Hidden Chimney Cave. It is located on the other side of the ridge, at about the same elevation. Activities such as deforestation or movement of large volumes of soil or rock should not be permitted in the interest of preserving the cave fauna. Maintaining a high humidity within the caves is important. The U.S.D.A.-Forest Service was correct in closing the artificial entrance to Hidden Cave. There still is air movement through the entrance which was not completely sealed. The small opening currently at the site of the former artificial entrance allows the movement of small vertebrates and invertebrates into the cave which could be predatory to cave inhabitants as well as a vent which allows dry air to move through the northern section of the cave. However, the size of the opening reproduces the original, natural form and is an important conservation action by the Forest Service.

Maintaining habitats includes the pools and mud floor as well as the beautiful speleothems. Traffic in the caves, especially in the much smaller Hidden Chimney Cave, not only disturbs the habitat by altering CO_2 and

H_2O levels in the air, but the floors are compacted. The numbers of visitors to Hidden Cave should be controlled and in the case of Hidden Chimney Cave, should be maintained at only a few visitors per year.

Recently established trails in Hidden Cave will help to protect areas where the rock and floor are easily altered. The muddy, rocky floor of the cave's entrance-twilight zone, especially the breakdown mound below the entrance drop, contains many interesting animals living under the rocks. Paving this area would be a mistake. The mud floors of both caves are easily compacted. Traffic should be limited to marked trails in Hidden Cave. In the case of Hidden Chimney Cave, the cave is so slender there is only room for a trail. Any trails constructed should not interfere with the natural runoff/flow of water within the caves. Likewise, small sections of the entrances to both caves contain areas that can be dry and powdery. These too contain biota and should be preserved.

Oil and gas exploration and extraction, if allowed in the region of the caves, should be below the caves on the ridge. By doing so, no contaminants could accidentally enter the caves. Any road construction should ideally not be in the water catchment basin for the caves. Because the extent of the joints and area involved in water catchment have not been fully established, this would be of high priority if drilling is proposed.

Although we used numerous collection techniques, we were able to obtain at least one additional species each trip to Hidden Cave. This is probably true for any extensive sampling program in a relatively large cave. As expected, the rarer animals in the cave were those which were most elusive. With this in mind, we encourage governmental and private agencies to consider whether they have adequately examined a cave before announcing that it does or does not contain a threatened or unique fauna. A fauna reported to consist of only common wide-ranging species, especially with only hand collections from a single visit, might actually contain numerous elusive and rare animals. The only previously published records from Hidden Cave (Barr and Reddell, 1967) revealed no unique elements. Likewise, unpublished records from the files at Carlsbad Caverns National Park (David Ek, pers. com. 1992) revealed only common wide-ranging species from Hidden Chimney Cave (*Cicurina* sp. and *Ixodes conepati*). Our study revealed both of these caves to have unique elements. Results of captures in Hidden Cave (Table 3) indicate how season and repeated collection efforts affect the perception of a cave's fauna.

Leaching and runoff of surface contaminants into both Hidden Cave and Hidden Chimney Cave is a major concern. Both caves are located on the side of the ridge which could allow contaminated water to wash in from a considerable distance uphill as well as through joints on the other side of the ridge. For this reason, we encourage the U.S.D.A.-Forest Service to ban the use of aerial applications of pesticides over the ridge above the caves. In the event of forest fires, we also suggest that the use and selection of retardants to be used above or uphill from these caves be examined carefully.

Fire retardants and suppressants are primarily composed of ammonium polyphosphate (Fire-Trol® LCA-R and LCG-R products), diammonium sulfate and polyammonium phosphate (Phos-Chek® D-75F and D-75R), and hexylene glycol (Firefoam® 103 and 103B). While these chemicals appear relatively safe and biodegradable, all LC_{50} and LD_{50} data available are for vertebrates (rodents, birds, rabbits, trout, minnow) and two aquatic invertebrates *Daphnia magna* and *Hyalella azteca* (see review in Adams and Simmons, 1999). For the water flea, the LC_{50} is 1,000 mg/l at 24 hours (Material Safety Data Sheet for Phos-Chek® D-75F and D-75R, 17 May 1993). While this level of concentration would be difficult to reach in a large pond or flowing stream treated with the retardant, dumping the material directly from an aircraft into a cave system would quickly exceed this level. Until laboratory data are available to indicate the LD_{50} to terrestrial arthropods and other invertebrates, we recommend that no retardants or suppressants be used directly over caves. Further problems have been noted with retardants containing sodium ferrocyanide (see review in PR Newswire, 2002; Marshall, 2003) and should be avoided until they are demonstrated as safe. According to Norris et al. (1978), Fire-Trol® LCA-R has a migration on stream banks of less than three meters, depending on soil/rock surfaces and weather conditions. If other retardants and suppressants have similar migrations, three meters would be the absolute closest a hand-sprayed product should be used near a cave entrance and still might result in material washing/leaching in from higher up in the ridge. Because the surface near Hidden Cave is permeable, we suggest that a three-meter margin be extended from the footprint of the cave rather than just three meters from the entrance. These are minimal standards and assume the applicators can actually direct the retardant. For aerial application, we would follow the requirement of 300-meter buffer zone used for waterways.

Absolutely no carbide (spent or otherwise) or batteries should be dumped in the caves or on the surface where the toxic materials might leach into the cave. Organic matter carried in by cavers should be shaken to detach any resting invertebrates before it is removed from the cave. Logs or other pieces of wood washed into the cave, as well as dead animals, should be left to rot and serve as food for the cave biota. If such objects are deemed unsightly or hazardous to cavers, the rotting material should be moved to a moist, out of the way, section of the cave.

General collecting of macroscopic invertebrates should not be allowed in these two caves, especially in Hidden Chimney Cave because of its small size. Except under special circumstances, *Rhadine* beetles, *Eperigone* spiders, *Speodesmus* millipeds, campodeids, and crickets should not be removed from the caves. These were well sampled in our study and many museum specimens are available. Non-destructive data collection methods (e.g., mark-recapture, live trapping, etc.) should be used with these groups of animals. No more than five pairs of museum specimens should be obtained of the rarer species that remain undescribed or unidentified. Systematic collections of microbiological samples as well as parasites should be obtained whenever they can be properly preserved and/or identified.

On 3/4/72, Jerry L. Trout of the U.S.D.A..-Forest Service inventoried both Hidden Cave and Hidden Chimney Cave. Hidden Cave was graded on the Cave Inventory/Management form as being 20BS; i.e., biological and speleothem significance. Hidden Chimney was ranked 20N; i.e., no special attraction or significance. Our data indicate that both caves are significant biologically and each contains fauna which is apparently unique to each, or at least not obtained in both caves or any other cave in previous collections.

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ANNOTATED LIST OF THE MACROSCOPIC INVERTEBRATES

Phylum Aschelminthes
Order Dorylaimida
Family Dorylaimidae

Mesodorylasimus sp.: The single specimen obtained was an adult female (males are needed for a specific identification). It was found on the mud floor of the northwest passage of Hidden Cave in February 1992. George Poinar (pers. com.) reported that this genus is found in wet terrestrial-aquatic habitats and its members are predaceous on other nematodes, small oligochaetes, and arthropods.

Phylum Platyhelminthes
Class Turbellaria
Order Tricladida
Family?

Genus & species: A single small planarian was obtained during February 1992 in Hidden Cave. It was located on mud under a rock at the base of the entrance pit (8°C). The area receives partial light during the daytime. Although a considerable effort was made to locate additional specimens in and above the cave on three additional trips, no new material was discovered. The specimen had two eyes and an approximately 5-mm-long uniformly dark gray to black dorsal surface. It was taken alive to the laboratory for rearing to adulthood, but died and decomposed before it could be preserved and identified. Neither Hyman (1943) nor Ball and Sluys (1990) listed any terrestrial planarians west of a line between Wisconsin and Louisiana. Reddell (1965) listed a member of the introduced family Bipaliidae from a cave in central Texas.

Phylum Annelida
Class Clitellata
Order Haplotaxida
Family ?

Genus & species: A single immature earthworm was collected during October 1992 in the dark zone from under rocks at bottom of the 9-m drop in Hidden Chimney Cave. Because of the immature state it could not be identified further. Additional unidentified worms were obtained in the twilight zone of the northern section of Hidden Cave under a rock in August 1992.

Family Enchytraeidae

Henlea/Fridericia sp.: Mature worms were taken during May and October 1992 on a muddy bank and under rocks in the northern section of Hidden Cave.

Fridericia sp.: During August and May 1992, immature and adult worms were respectively collected in the twilight zones of the northern and southern sections of Hidden Cave.

Henlea sp.: A mature worm was collected during October 1992 in Hidden Chimney Cave in the dark zone from under rocks at bottom of the 9-m drop.

Phylum Arthropoda
Class Arachnida
Order Acariformes
Suborder Prostigmata

Family Bdellidae

Bdella sp.: Three samples of this mite were collected: one from the surface about six meters from the Hidden Cave entrance and two from its twilight and twilight/dark zones. The sample from the surface was obtained in February from Berlese funnel extraction of oak litter, whereas those in the cave were on wet flowstone during August 1992. All were larvae and protonymphs and therefore cannot be identified to species. Because these mites are predatory, they must be feeding on other minute arthropods like other mites, collembola, and their eggs. Many bdellid species are recorded from the U.S.A., especially California and the midwest. However, only *Bdella muscorum* Ewing has previously been recorded from New Mexico (Atyeo, 1960:377). That species is widespread and probably has a Holarctic distribution. Bdellids have been collected from caves before, but none to date are troglobites (Sabina Swift, pers. com. 1995). Two other species of bdellid mites were obtained during February 1992 from the surface, within 60 meters of the entrance to Hidden Cave. They are: a tritonymph of *Biscirus* possibly *arenarius* Wallace and Mahon (subfamily Spinibdellinae) from conifer litter Berlese funnel extraction; and a protonymph of *Cyta* sp. (subfamily Cytinae) from Berlese funnel extraction of oak litter.

Family Ereynetidae

Ereynetes sp.: A single specimen was recovered from a calcite seed (Polyak, 1992), where it had died and was being engulfed into a speleothem. The specimen was from the dark zone in the northern section of Hidden Cave.

Family Neothrombidiidae

Ceuthothrombium cavaticum Robaux, Webb, and Campbell: Mites identified as this species were recovered from camel crickets (*Ceuthophilus carlsbadensis*) from the twilight and dark zones. This mite probably completes its life cycle in the caves. Nymphs and adults are probably free living, whereas the larvae are parasitic on camel crickets. Robaux et al. (1977) reported this mite from the same host from Lake Cave, Carlsbad Caverns National Park. It is otherwise known from two other species of camel crickets from central Texas and Nuevo León, Mexico.

Family Rhagidiidae

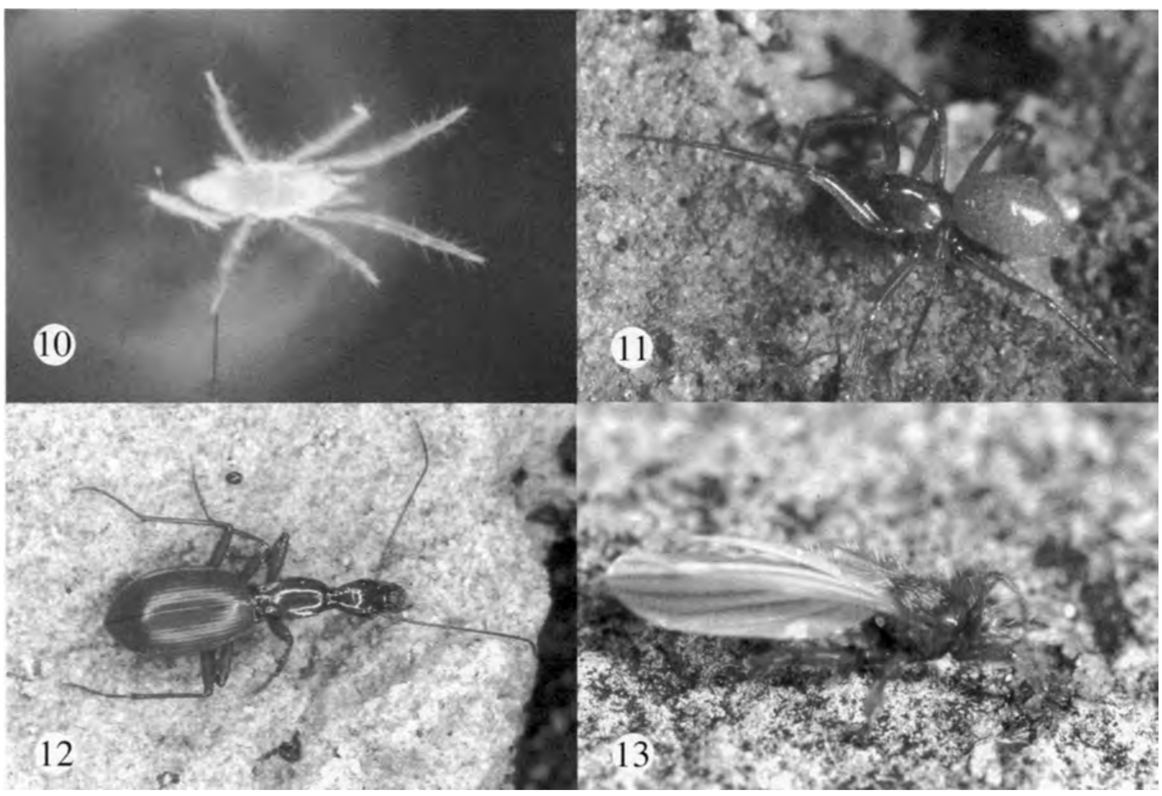
Robustocheles (*Lewia*) *hilli* (Strandtmann), Fig. 10: Adults and deutonymphs were collected on water and on mud near pools throughout Hidden Cave in dark zones. A female with eggs was collected in October 1992. A few other adults were obtained under rocks and wood in the twilight and dark zones. A single male was also collected under a rock on the surface within 60 m of the cave entrance during October 1992. *Robustocheles hilli* shows no morphological adaptations for life underground and is considered a troglophile. It is one of the most commonly encountered rhagidiids in North American caves (Utah, Kentucky, Virginia, Tennessee, Georgia, Indiana, and Arizona; Zacharda, 1985). It also frequently occurs in the Arctic tundra (Strandtmann 1971; Zacharda, 1980). Perhaps this can be explained by the hypothesis that the formerly epigean populations of *R. hilli* in the U.S.A. were pushed to the more southern regions of North America as late as the Wisconsinan glaciation where they survive as cave disjunct populations. A second species of rhagidiid, *Foveacheles mexicana* Zacharda, was also taken on the surface in conifer litter.

Suborder Astigmata
Family?

Genus and species: Numerous parasitic/phoretic mites were removed from a cryptopid centipede found in the dark zone of the southwestern passage of Hidden Cave at the back of the north walk. The specimens have not been identified.

Family Acaridae

Tyrophagus putrescentiae (Schrank): Adults of this mite were collected during February 1992 by Berlese funnel extraction of what appeared to be bat guano from the dark zone of the southern passage, about 30 m south of the 3-m drop in the very back of this section. Females were also taken from surface Berlese funnel extraction of juniper/oak litter about 18 m ENE of the cave entrance and from mosses and liverworts in a rock crevice about 9 m N of the cave entrance. Berlese funnel extraction of oak litter from about 6 m E of the cave entrance on the surface revealed the presence of females of a second species, *Tyrophagus zachvatkini* Volgin.



Figs. 10-13.—Troglophilic arthropods from Hidden Cave. 10, *Robustocheles hilli* mite on water surface. 11, female *Eperigone antraea* spider. 12, *Rhadine longicollis* ground beetle. 13, *Trichobius major* batfly that was removed from a bat and placed on a rock for the photograph.

Family Algophagidae

Fusohericia sp.: One damaged female of this mite was obtained in a Berlese funnel extraction of debris from the edge of a *Neotoma* rat nest. The nest was located in the dark zone of Hidden Cave's northern passage about 6 m north of the now-closed artificial entrance during August 1992. The mite is probably a surface contaminant.

Family Glycyphagidae

Fusacarus sp.: Adults and nymphs were obtained from Berlese funnel extraction of organic debris (wood, orange-colored fungus, and pine cones) found in an abandoned animal nest. The material was in the dark zone of Hidden Cave's northern passage near the now-closed artificial entrance during February 1992.

Family Histiostomatidae

Myianoetus sp.: Deutonymphs of this mite were found attached to *Pseudoleria* flies in the twilight and dark zones during May and August 1992. The flies were common in Hidden Cave on the walls, roof, and wet flowstone.

Suborder Oribatida
Family Cymbaeremaeidae

Ametroproctus sp.: This genus is known from a single recent species in North America. It is also reported from Colorado, Utah, and Washington (Marshall et al., 1987). Our sample was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001).

Family Damaeidae

Epidamaeus (*Epidamaeus*) sp.: The genus *Epidamaeus* Bulanova-Zachvatkina contains many species; over two dozen occur in the U.S.A. and Canada (Marshall et al., 1987). Member species are generally distributed in the northern and eastern sections of North America, but are lacking in the southwestern regions. Our sample was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001). Specimens of *Epidamaeus* (*Akrodamaeus*) sp. were found on the surface, but not in the cave.

"*Hungarobelba*" sp.: *Hungarabelba* Balogh is reported in North America from an unidentified species in Alberta and California (Marshall et al., 1987). Our sample was recovered from a stalagmite (Polyak et al., 2001) from Hidden Cave. A photograph of this species appears in the article by Polyak et al. (2001: fig. 3).

"*Porobelba*" sp.: The genus *Porobelba* Grandjean is otherwise known in North America from a species reported from Illinois, Indiana, and Kentucky (Marshall et al., 1987). Our samples were recovered from the two different stalagmites from Hidden Cave (Polyak et al., 2001). A photograph of this species appears in the article by Polyak et al. (2001: fig. 3).

Family Euphthiracaridae

Euphthiracarus sp.: This species of mite was obtained from a Berlese funnel extraction of bark and wood in the dark from the back of Hidden Cave's southern section near the 3-m drop. It was collected in February 1992. Although this species was obtained at the most remote area of the cave it does not appear to be cave-adapted. The specimens presumably washed in with the wood. We did not obtain further material on the surface. *Euphthiracarus* Ewing is a genus with 16 species being recorded from the U.S.A. and Canada (Marshall et al., 1987).

Family Galumnidae

Galumna sp.: Members of *Galumna* von Heyden are represented in North America by 20 described species. Members of this genus have been collected from throughout the country, but most species are from the more northern states. Wallwork et al. (1984) recorded a *Galumna* sp. from desert soil/litter near Las Cruces, New Mexico. We do not know if our species is the same. Our specimens were recovered from a stalagmite from Hidden Cave (Polyak et al., 2001).

Pergalumna sp.: The genus *Pergalumna* Grandjean contains 16 North American species. Like members of the preceeding genus, they are found predominantly in the northern states. Our material was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001). A photograph of this species appears in the article by Polyak et al. (2001: fig. 3).

Family Oppiidae

Multioppia neglecta Pérez-Iñigo: These mites were obtained from Berlese funnel extraction of organic debris (wood, orange-colored fungus, and pine cones) found in an abandoned animal nest in the dark zone of the northern passage near the now-closed artificial entrance of Hidden Cave during February 1992. This species was originally described from the middle xeric region of Spain and later encountered in Great Britain and Madeira. The New Mexico specimens are the first record of this species from the New World (Polyak et al., 2001). Other *Multioppia* spp. recorded from North America are all from the country's eastern section (Marshall et al., 1987).

Insculptoppia cavernalis Ohkubo and Cokendolpher: This species was obtained in Hidden Cave as both subfossils and living mites and reported as *Ramusella* n. sp. by Polyak et al. (2001) and described as new by Ohkubo and Cokendolpher (2002). Hidden Cave is the type and only known locality for this species. The subfossils were from a stalagmite (Polyak et al., 2001) and were at most 3,200 years old. The living mites were obtained from Berlese funnel extraction of organic debris (wood, orange-colored fungus, and pine cones) found in an abandoned animal nest in the dark zone of the northern passage near the now-closed artificial entrance. Other living mites were obtained on wet walls in both the northern and southern areas of the cave in the dark zones by vacuuming, and in water in the southern area of the cave. A photograph of a subfossil of this species appears in the article by Ohkubo and Cokendolpher (2002: fig. 3).

Family Phenopelopidae

Propelops canadensis (Hammer): This mite was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001) and from litter on the surface outside of the cave.

Family Scheloribatidae

Scheloribates sp. 1: Our sample was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001).

Scheloribates sp. 2: This species was also recovered from a stalagmite from Hidden Cave (Polyak et al., 2001). A photograph of this species appears in the article by Polyak et al. (2001: fig. 3).

Scheloribates sp. 3: Specimens of this species were recovered from a Berlese funnel extraction of organic matter from a mammal nest (*Bassariscus* ringtail?) in the dark section of the northwestern passage of Hidden Cave. The sample was obtained in February 1992. A fourth species of *Scheloribates* was obtained on the surface. Wallwork et al. (1984) reported recent samples of a *Scheloribates* sp. cf. *pallidus* (C.L. Koch) from desert soil/litter in New Mexico. It is unknown if this could be the same species as any of our species.

Family Tectocepheidae

Tectocepheus sp. [probably *velatus* (Michael)]: This material was recovered from a stalagmite from Hidden Cave (Polyak et al., 2001). *Tectocepheus velatus* is a wide-ranging recent species that has been recorded from the Holarctic, Australian, and Subantarctic regions. It has been recorded from desert soil/litter in New Mexico by Wallwork et al. (1984). A second unidentified, but distinct species of *Tectocepheus* was obtained on the surface outside of the cave.

Family Thyrisomidae

Oribella pectinata (Michael) "*sensu lato*": Mites were obtained from Berlese funnel extraction of organic debris (wood, orange-colored fungus, and pine cones) found in an abandoned animal nest in the dark zone of the northern passage near the now-closed artificial entrance of Hidden Cave. This species is otherwise known from the Palearctic region. The New Mexico specimens are smaller than normal and the sensillum is enlarged. It is not unusual to find specimens of this genus in caves in the Old World. The record from New Mexico is probably the first authentic record of the genus in North America (Marshall et al., 1987; Polyak et al., 2001).

Order Parasitiformes
Suborder Ixodida
Family Ixodidae

Ixodes conepati Cooley and Kohls: Barr and Reddell (1967) reported that this tick was parasitic on skunks and other mammals. We found a single male in the twilight zone of Hidden Chimney Cave during October 1992. This species of tick is recorded from Eddy County in New Mexico and from numerous counties in Texas (Kohls and Clifford, 1966; Keirans and Clifford, 1974; Cokendolpher and Polyak, 1996). It was originally described from a cave in Comal County, Texas (Cooley and Kohls, 1943). A picture of this species can be found in the article by Cokendolpher and Polyak (1996: fig. 4).

Suborder Mesostigmata
Family Laelapidae

Stratiolaelaps sp. 1: We collected three females and a male of this undescribed species from the 3-m drop in back of the southern section of Hidden Cave. This species was obtained by Berlese funnel extraction of bark and wood which had washed into the cave. Berlese funnel samples of similar material from the surface revealed only members of two undescribed species of *Gymnolaelaps*.

Stratiolaelaps sp. 2: The second undescribed species of this genus was obtained in the twilight section of the southern section of Hidden Cave. It was obtained from Berlese funnel extraction of fungus which was growing on some wood at the base of the breakdown pile.

Family Zerconidae

Paleozercon cavernicolus Blaszak, Cokendolpher, and Polyak: *Paleozercon* is a monotypic genus. Blaszak et al. (1995) described this species from specimens that were preserved in a stalagmite (Polyak et al., 2001) from Hidden Cave. This is the only recorded occurrence of this family from a cave in the New World.

Order Araneae
Family Dictynidae

Cicurina deserticola Chamberlin and Ivie: This species occurs in Hidden Cave and Hidden Chimney Cave. It was rarely collected in the former; one female (October) from the back of the southern passageway and one penultimate male (May) from the base of the drop, in the twilight zone of the southern passageway. Specimens were rather abundant in the latter cave during October. Two pairs were captured under rocks in the bottom of the southern passageway in the dark. A single female of this species was collected in February 1992 on the surface under a rock. A related but larger species, *Cicurina varians* Gertsch and Mulaik, was commonly encountered on the surface under rocks, but was not obtained in the caves. Elsewhere in Texas and New Mexico, *C. varians* is commonly found in caves. Welbourn (1978) recorded *C. deserticola* as a troglophile from the twilight and dark zones of New Cave, Carlsbad Caverns National Park, and Cokendolpher and Polyak (1996) recorded *C. varians* from the gypsum caves near Carlsbad.

Family Linyphiidae

Eperigone antraea (Crosby), Fig. 11: Barr and Reddell (1967) noted that this small darkly colored spider showed no special morphological modifications to suggest that it was an obligate cavernicole. They were the first to record it from Hidden Cave and listed it as a troglophile. This species was originally described from Carlsbad Caverns. It has since been recorded from numerous localities in Arizona, Colorado, Texas, and Mexico. It is frequently collected in caves (Millidge, 1987). This is the most frequently collected spider in Hidden Cave, but we failed to collect any during our visit to Hidden Chimney Cave. It is found under rocks, wood, and other debris throughout Hidden Cave. Although specimens were obtained from under rocks at the top of the entrance breakdown in full sunlight, they were not obtained on the surface.

Family Salticidae

Habrocestum acerbum Peckham and Peckham: A single female was collected from the entrance zone of the northwest passage of the cave under a rock in the mud. Other specimens, including a male, were observed and some were collected on the surface. Our sample from Hidden Cave must be regarded as an accidental visitor. Richman (1981) recorded this species from oak/juniper woods in Texas and northeastern Mexico. This is the first record of this species in New Mexico. Welbourn (1978) recorded a *Habrocestum* sp. as an accidental in Ogle Cave, Carlsbad Caverns National Park.

Family Theridiidae

Achaearanea porteri (Banks): Juvenile specimens were observed in webs in the twilight zone of Hidden Chimney Cave in October. Some specimens were reared to adulthood which permitted the specific identification. Barr and Reddell (1967) stated that this species was a troglophile and that it is one of the more frequently occurring spiders in caves of Texas. They also reported its occurrence in several gypsum caves in southeastern New Mexico and the Guadalupe Mountains in Texas. Levi (1955) reported it from New York to Indiana, south to Florida and Texas in the U.S.A., Bahama Islands, Mexico and Panama; generally in caves or under boards or rocks.

Thymoites n.sp.: A single female of this undescribed troglobitic species was found in a small web on the wall just above the mud floor of Hidden Chimney Cave. It was collected in October 1992. A second specimen that might be this same species was found in a nearby cave (about 5 km away), Cave of the Madonna, during June 1992. Unpublished records from the files at Carlsbad Caverns National Park (David Ek, pers. com. 1992) also list an undetermined specimen of this genus from another Lincoln National Forest cave, Wailing Cave. The only troglobitic spider of this genus thus far described is from Arizona (Roth, 1992).

Order Opiliones
Family Sclerosomatidae

Leiobunum townsendii Weed: A single specimen was collected in February 1992 on a stalagmite in the twilight zone of the southern passageway across from the Chinese Wall. This is the most abundant long-legged harvestman of Texas, New Mexico, and Arizona caves. It also occurs outside of caves in moist protected places. A specimen collected in August 1992 outside of the entrance to Hidden Cave was parasitized by an undescribed species of mite (Erythraeidae: *Leptus* sp.) (Cokendolpher, 1993).

Superclass Myriapoda
Class Chilopoda
Order Scolopendrida
Family Cryptopidae

Thalkethops sp. probably *grallatrix* Crabill (1960): A single specimen of this troglobitic centipede was collected in the dark zone of the southwestern passage at the back of the northwestern walk during August 1992. It was found walking on a silty mud floor. This species lacks the anal pair of legs (22 pairs present). The Hidden Cave specimen was carrying numerous astigmatid mites. *Thalkethops grallatrix* Crabill (1960) is the only described member of the genus and the only member of this family reported from a cave in the region. It is known with certainty only from Carlsbad Caverns National Park. An additional *Thalkethops* centipede is known (specimen in the Texas Memorial Museum) from near Hidden Cave in the Cave of the Madonna. This latter specimen was collected during June 1992. It is larger and more darkly colored than the Hidden Cave species, which is white to unpigmented. The specimen from the Cave of the Madonna also has only 22 pairs of legs and has longer antennae than the Hidden Cave specimen. Biologists collecting members of this genus should be careful to note if the 23rd pair of legs is dropped during capture and that the legs be recovered and preserved.

Order Lithobiida
Family Lithobiidae

Genus and species?: A single specimen was collected under a rock about 46 m from the entrance in the twilight zone of the northwest passage of Hidden Cave during October. Members of this family are often observed under rocks on the surface and are in need of taxonomic revision. A picture of a species of this family can be found in the article by Cokendolpher and Polyak (1996:fig. 5).

Class Diplopoda
Order Chordeumatida
Family Conotylidae

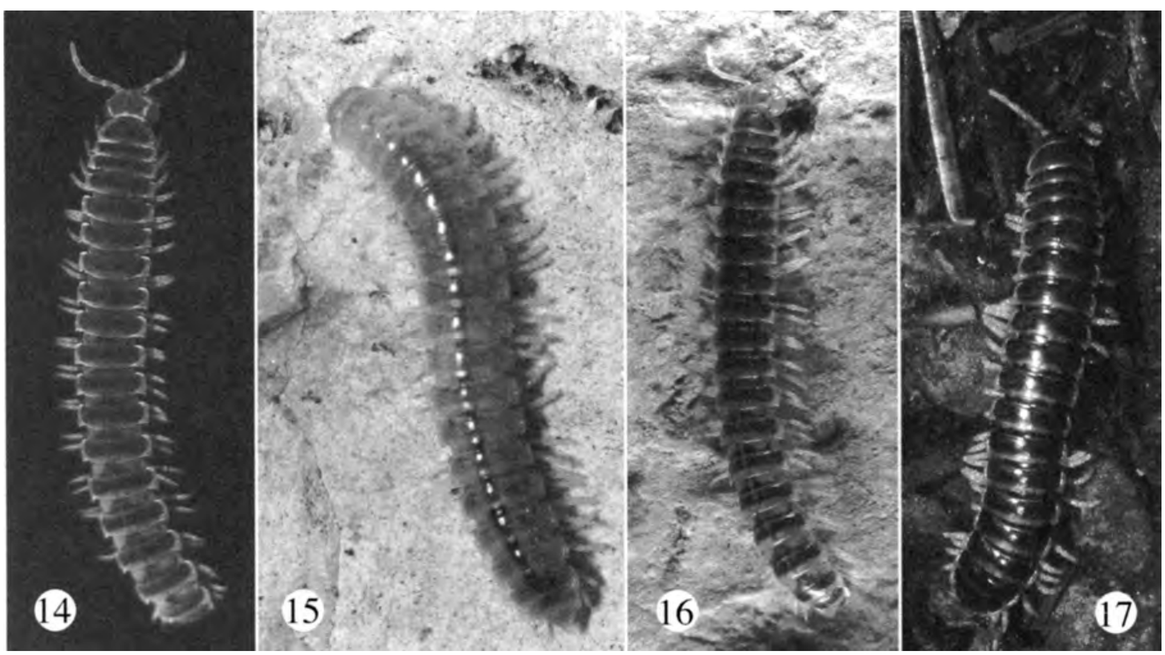
Austrotyla sp. prob. *montivaga* (Loomis): This species was reported from the twilight zone of Hidden Cave by Barr and Reddell (1967) as *Austrotyla specus montivaga* (Loomis). We collected a female and a juvenile male presumably of this species (an adult male is needed for specific identification), from under rocks in the twilight zone of the northwest passage. None were obtained on the surface. Hoffman (1999) listed this species from the mountains of southeastern Arizona.

Order Julida
Family Parajulidae

Hakiulus zakiwanus (Chamberlin): This milliped was common on the surface in February and October 1992 as adults. Juveniles were present in August and none were observed in May 1992. A single specimen was found in Hidden Cave under a rock at the base of the entrance pit in October 1992. It is considered an accidental visitor to the cave. A specimen found dead under a rock at the surface rim of the cave entrance was parasitized by a mermithid nematode. Because the nematode was a juvenile, it could not be identified further. Mermithids in millipeds are rarely reported and this species is almost certainly undescribed.

Order Polydesmida
Family Polydesmidae

Speodesmus tuganbius (Chamberlin): Chamberlin (1952) originally described this species from Carlsbad Caverns. Barr and Reddell (1967) reported this species was "occasionally found on small accumulations of guano and organic debris in side passages and near the end of larger passages" in Hidden Cave and Cottonwood Cave. This species is known from numerous caves in southeastern New Mexico and extreme western Texas (Shear, 1974; Mitchell and Reddell, 1972; Barr and Reddell, 1967; Cokendolpher and Polyak, 1996). We found this small white milliped abundant in Hidden Cave



Figs. 14-17.—Males of *Stenodesmus tuobitus*. 14, fluorescence of specimen from Capitan Mountains (surface near Ft. Stanton Cave, New Mexico) under ultraviolet light. 15, depigmented troglophile from Hidden Cave. 16, small pigmented variety from Capitan Mountains (surface near Ft. Stanton Cave, New Mexico). 17, large darkly pigmented variety from Sacramento Mountains (surface at Karr Canyon, New Mexico).

during all seasons and in Hidden Chimney Cave during our single visit in October 1992. This troglobitic milliped easily desiccates and is most often obtained from muddy areas within caves. We also found it in mud under rocks at the entrance drop to Hidden Cave and in very moist conditions in the twilight zone. A picture of this species can be found in the article by Cokendolpher and Polyak (1996: fig. 6).

Family Xystodesmidae

Stenodesmus tuobitus (Chamberlin), Fig. 15: Two males of this species were obtained during May 1992 in Hidden Cave. The specimens were collected in the dark on the mud floor of the northwest passage. This is the first record of this species in a cave. Shelley (1987) reported that this milliped only occurs in what he felt were two allopatric populations: one in McKittrick Canyon (Guadalupe Mountains in Culberson County, Texas) and one northwest in a small section of the Sacramento Mountains (Otero and Lincoln counties, New Mexico). Shelley (1987) stated that the Guadalupe Mountains specimens were much lighter in color and smaller than the Sacramento Mountain specimens. Both Hidden Cave specimens are very pale and the cuticle was transparent in places (Fig. 15). Our specimens differ greatly in size, one matching the Sacramento Mountains population; the second specimen matching other Guadalupe Mountains specimens. During November a specimen was observed on the surface about a km away from Hidden Cave. This milliped (a male) was as small as the smallest male obtained in the cave, but it was very darkly pigmented. Shelley (1987) stated that he was unable to locate this species in the Capitan Mountains (north of the Sacramento Mountains). We now have a good series (both males and females) of this species from that mountain range (Fig. 16). They were collected 9 August 1993 from near the entrance to Ft Stanton Cave (2,066 m elevation) in Lincoln County, New Mexico, the most northern locality for the species. While the specimens are pigmented as reported from the Sacramento Mountains (Fig. 17) by Shelley (1987), these specimens are small like those from the southern parts of this species range. The habitat was similar to that at the surface above Hidden Cave, except the area was more heavily wooded by juniper trees. This species is fluorescent when exposed to ultraviolet light (Fig. 14) and possibly accounts for the reason why we were able to obtain hundreds of specimens in the Capitan Mountains, whereas Rowland found none. The specimens reported by Shelley (1987) to have been collected by the Cokendolphers from the Sacramento Mountains, were also obtained by the use of ultraviolet light at night.

Class Symphyla
Order Cephalostigmata
Family Scutigerellidae

Symphylella sp.: This species cannot be identified with the key to the cave *Symphylella* by Scheller (1986). It differs from all listed in the key, lacking lobes on the tips of the triangular process of tergites 2 and 3 and in the possession of 4+4 setae on the first rudimentary tergite. The setation of tergites 2-4 and cercus is similar to *S. vulgaris* (Hansen) (1903; pl. 7, fig. 1), *S. sierrae* Michelbacher (1939; fig. 1) and *S. reddelli* Scheller (1986, fig. 2). A single specimen was taken during August 1992 while vacuuming wet flowstone on the wall. This area is at the junction of the long walkway leading to the 3-m drop and the main room to the southern passageway of Hidden Cave and is in the dark zone.

Superclass Hexapoda
Class Entognatha
Order Collembola
Family Entomobryidae

Pseudosinella violenta (Folsom): This is the most abundant springtail species in caves of Texas, New Mexico and northern Mexico (Kenneth Christianson, pers. com. 1992). It is a troglophile with many populations showing slight troglomorphy. We obtained it throughout Hidden Cave under rocks and pieces of wood. It was found year-round, but most abundantly in May 1992. During May and August of the same year we also collected this species from under rocks on the surface. Samples were also obtained in baited pitfall traps on the surface.

Seira sp.: This undescribed species was collected from the twilight zone under rocks in the northwest passage of Hidden Cave during February 1992. We also obtained specimens on the surface under rocks and in baited pitfall traps during August and October 1992.

Tomocerus sp.: Specimens of this species were obtained during May 1992 on dead flies floating in a pool in the back of the northwest passage of Hidden Cave in total darkness.

Tomocerus flavescens (Tullberg): This species is a non-troglomorphic troglophile found all over North America. While Scott (1962) reported it from several counties in New Mexico, this is apparently the first record from southern New Mexico. We collected four specimens of this large species of springtail in Hidden Cave in the twilight and dark zones in May (1), August (1), and October (2) 1992. Christiansen and Bellinger (1980) reported that this was a common cave inhabitant.

Family Isotomidae

Isotoma sp.: Our cave collections of this species came from the dark zone about 6.1 m from the once artificial entrance (now closed) of Hidden Cave in debris from a *Neotoma* rat nest in August 1992. We collected this species as well as *Isotoma notabilis* Schäffer and *Isotoma viridis* Bourlet on the surface under rocks and other surface debris as well as among mosses and liverworts in rock cracks.

Family Sminthuridae

Arrhopalites sp.: This undescribed species is troglomorphic and potentially a troglobite. It was found on top of small pools of water in the dark zone of both the northwest and southern passages of Hidden Cave during May and August 1992.

Arrhopalites caecus (Tullberg): During August 1992 we collected this species by vacuuming the wet flowstone walls at the dark/twilight zone in the southern passageway of Hidden Cave. This species is otherwise known from numerous areas in scattered localities throughout the U.S.A., but apparently has not been collected in the northwestern or southern states (Christiansen and Bellinger, 1981). Scott (1964) recorded this species from New Mexico (Taos County).

Order Diplura
Family Campodeidae

Genus & species: According to Ferguson (1981, 1990), members of this undescribed genus are troglobitic and are found in the Guadalupe Mountains of western Texas and southeastern New Mexico. It is apparently, closely related to members of *Meiocampa* Silvestri. This species was reported from Hidden Cave as *Plusiocamapa* sp. by Barr and Reddell (1967). It is found throughout Hidden Cave, including the twilight zones, but it is most often obtained from the dark zone, on flat silty mud floors. Cokendolpher et al. (2001) reported on the seasonal bait preferences of this species in Hidden Cave. They also provided a photograph of this species (2001: fig. 4). According to records in the Lincoln National Forest cave files (letter from A. E. and C. A. Hill, 3 June 1976), "diplurans" were collected in Hidden Chimney Cave during May 1976.

Class Insecta
Order Coleoptera
Family Carabidae

Amara sp.: A specimen of this ground beetle was collected from under a rock in the entrance zone of the northwest passage of Hidden Cave in August. Another specimen was collected on the surface outside of Hidden Cave in October 1992.

Calathus sp.: This ground beetle was collected from the twilight zone of the southwest passageway of Hidden Cave under a rock in August. It was again collected in baited pitfall traps on the surface above Hidden Cave during August 1992.

Cyclotrachelus substriatus LeConte: This species was collected from under rocks in mud in the entrance and twilight zones at the base of the entrance pit to Hidden Cave in August 1992. During that same trip, we also collected this species on the surface in both tuna fish and rancid liver baited pitfall traps.

Pasimachus sp.: This species was collected from under a rock in mud in the entrance zone of the northwest passage of Hidden Cave in August 1992. It was also captured 1.5 m from the cave entrance on the surface under a rock during the same month.

Rhadine longicollis Benedict, Fig. 12: Examples of this troglophilic beetle have been recorded from numerous caves near Carlsbad and Artesia in New Mexico and Gyp Joint in Culberson County, Texas (Barr and Reddell, 1967; Cokendolpher and Polyak, 1996). We collected it and are apparently the first to record it in Hidden Cave and Hidden Chimney Cave. In other caves, it has been collected in the twilight zones and we are aware of a single specimen collected under a rock on the surface outside of Parks Ranch Cave near Carlsbad Caverns National Park (in November). In Hidden Cave and Hidden Chimney Cave it was found most often in dark zones with muddy floors. It was also collected in the twilight zones under rocks and pieces of wood. Several examples were collected which were light yellow in color. Although these had hardened cuticles, they are individuals which had recently molted. In this species it takes up to a couple of weeks before the cuticle darkens after molting (Thomas Barr, pers. com. 1993). Although never numerous, we were able to locate at least one specimen every trip.

Family Chysomelidae

Oedionychus sp.: A single example of this leaf beetle was collected in the twilight zone of the northwest passage of Hidden Cave during May. It was found on the bedrock floor. It is an accidental visitor to the cave.

Family Staphylinidae

Orus rubens Casey: Herman (1965) recorded this beetle from a gypsum cave near Carlsbad and from caves in central Texas. We collected several specimens in the entrance zone of the northwestern section of Hidden Cave under a rock in full sunlight. We also collected a specimen on the entrance breakdown at the base of the drop. A single specimen was obtained on the surface about halfway between the Hidden Cave and Hidden Chimney Cave entrances. It was found in a Berlese funnel sample of mosses and liverworts growing in a rock crack.

Quedius sp.: This is the first report of this genus from a cave in southeastern New Mexico. We collected six specimens throughout the cave from the twilight zone to the back of the southern passageway. Most of the specimens were taken from speleothems. Specimens were collected in May (1), August (3), and October (2) 1992.

Family Tenebrionidae

Eleodes dissimilis Blaisdell: A single specimen of this beetle was collected on a rock in the twilight zone of the southern passageway of Hidden Cave. This is apparently the first record of this darkling beetle from a cave. It was collected during May and is considered an accidental visitor to the cave.

Order Dicondylia
Family Gryllidae

Gryllus veletis (Alexander and Bigelow): This cricket is common on the surface at the entrances to Hidden Cave and Hidden Chimney Cave. Although we did not collect any within either cave, it would not be surprising to encounter them in the entrance zones to the caves. This is the large black field cricket of the region.

Family Rhaphidophoridae

Ceuthophilus carlsbadensis Caudell: Specimens were obtained during this study from both caves. Specimens were generally found in the dark zones and do not clump in small groups like the following species. Photographs of this cricket species appear in articles by Cokendolpher and Polyak (1996: fig. 7), Cokendolpher (2001, figs. 1-3), and Cokendolpher et al. (2001: fig. 1). Those authors also provided information on the seasonal and geographical distribution and bait preferences within Hidden Cave. Cokendolpher (2001) reported on the reproductive behavior of the cricket.

Ceuthophilus conicaudus Hubbell: This cricket is considered a trogloxene. It was reported by Barr and Reddell (1967) from Hidden Cave. They stated that this cricket leaves caves in considerable numbers during the summer nights. It is most often found clumped in domes near the entrance to caves, but can be found throughout the caves. We did not collect this species in Hidden Cave or Hidden Chimney Cave during our investigations. The crickets we encountered near the entrances in the twilight zone, typical habitat for *C. conicaudus*, were *C. longipes*. Two females of what might be this species (ovipositor shorter than typical specimens) were obtained in baited traps on the surface above Hidden Cave in August 1992. Photographs of this cricket species appear in the articles by Cokendolpher and Polyak (1996: fig. 8) and Cokendolpher et al. (2001: fig. 3).

Ceuthopilus longipes Caudell: This pale, cave-adapted cricket is known from several caves in Carlsbad Caverns National Park and nearby regions, as well as in the Guadalupe Mountains. We collected this species throughout Hidden Cave, in both the twilight zone and on walls from the entrance to the northwest passage. In Hidden Chimney Cave, we found this species rather abundant on the ceiling over the drop in the twilight zone. A subadult female (femur IV over 5 times as long as wide) was obtained in a baited trap on the surface above Hidden Cave during February 1992 and a juvenile was obtained under a rock near the entrance to Hidden Chimney Cave during October of the same year. A photograph of this cricket species appears in the article by Cokendolpher and Polyak (1996: fig. 2). Those authors also provided information on the seasonal and geographical distribution and bait preferences within Hidden Cave. Welbourn (1978) noted that Campbell had collected this species in pitfall traps outside of Spider Cave in Carlsbad Caverns National Park.

Order Diptera
Family Tipulidae

Genus and species: Barr and Reddell (1967) reported unidentified craneflies from the dim twilight zone of Hidden Cave. James Reddell (pers. com. 1992) reported that these were too badly damaged to be identified. We did not see any craneflies in the cave, but at least two species were seen on the surface.

Family Drosophilidae

Drosophila sp.: These small flies were collected abundantly on the surface in pitfall traps baited with rancid liver during February 1992. Specimens were collected by hand in Hidden Cave in the twilight zone of the southern section of the cave.

Family Helomyzidae

Pseudoleria sp.: Specimens of this fly were common in the twilight and dark zones of Hidden Cave in May, August, and October and in Hidden Chimney Cave during October 1992. Samples were obtained by hand as well as by vacuuming wet speleothems. Numerous specimens observed and captured during May and August were covered with Astigmata mites (*Myianoetus* sp.).

Family Mycetophilidae

Rymosia sp.: Specimens of this species were collected in the twilight and dark zones of Hidden Cave every season. They were also obtained in Hidden Chimney Cave during October 1992. We also collected this fly in baited pitfall traps (grape jelly and tuna fish) during August 1992. This genus needs taxonomic revision before species can accurately be determined. Larvae, presumably of this same species, were obtained from fungus growing on rotten wood during May and August in Hidden Cave. Specimens of this species were not observed on the surface. Flies of this species were found parasitized by fungi on 17 May 1992. The fungi from the twilight zone ceiling of the southern section of the cave are *Hirsutella* sp. and those from the dark zone in the northwestern section of the cave as *Verticillium* sp. Members of both of these genera are common insect pathogens. An additional specimen parasitized by a white fungus was observed (not collected) during November in Hidden Chimney Cave. This specimen was in the dark, at the bottom of the drop.

Family Phoridae

Genus and species: Specimens of this small fly were obtained in pitfall traps baited with each of the three baits used during August in Hidden Cave. Other material obtained in Hidden Cave was collected by hand during May, August, and October 1992. Specimens were from both the dark and twilight zones of the cave. Although traps were also baited on the surface, no specimens of this fly were obtained.

Family Sciaridae

Bradysia sp.: Members of this fly were found each season of 1992 in the northern section of Hidden Cave, the twilight zone as well as the dark zone about 46 m from the entrance. Members of this genus cannot be identified to species accurately, because the genus is in need of taxonomic revision. *Bradysia* sp. were also recorded from Carlsbad Caverns by Barr and Reddell (1967), where it apparently feeds on decaying vegetable matter as larvae.

Family Streblidae

Trichobius major Coquillett, Fig. 13: Although bats were not as a rule disturbed in either of the caves, a batfly was seen walking on the wing of a sleeping bat in Hidden Cave. The fly was easily collected and consequently we have a single record. The batfly was collected in October 1992 from a *Corynorhinus townsendii*. The bat was resting low on the wall along the back of the southern passageway in the dark zone of Hidden Cave. According to Cole (1969), this fly has been collected on *Myotis* in some eastern states and "bats" in Arizona. Barr and Reddell (1967) reported that this species was also taken from bats in Carlsbad Caverns and that some unidentified streblid flies had been taken on bats from Hidden Cave and nearby Cottonwood Cave. Because *T. major* is the only species recorded from southeastern New Mexico, the unidentified flies probably refer to this species.

Family Muscidae

Neomuscina tripunctata (Wulp): Members of this fly were in the twilight and dark zones of Hidden Cave and Hidden Chimney Cave during February and October 1992.

Order Hymenoptera
Family Formicidae

Camponotus sansabeanus torrefactus Wheeler: Several examples of this large carpenter ant were collected in August 1992 in the twilight zone of the northern and southern passageways of Hidden Cave. This ant is a wood nesting ant from the surface. These foragers are accidentals in the cave.

Monomorium minimum (Buckley): A single worker ant was taken during August 1992 in the dark zone at the back of the southern passageway at the 3-m drop area on flowstone in Hidden Cave. This small species was taken in a vacuum sample. This is a widespread surface species and considered an accidental in the cave.

Leptothorax cokendolpheri Mackay: Mackay (2000) reported that this species was collected within Hidden Cave. The colony was from the entrance drop under a rock and we consider it an accidental. A second record of this species was recorded by Mackay from the surface in Big Bend National Park, Brewster County, Texas.

Order Lepidoptera
Family?

Genus & species: Scales of unidentifiable lepidopterans were found as subfossils in a speleothem from Hidden Cave.

Family Lasiocampidae

Malacosoma californicum lutescens (Neomoegan and Dyar): Several larvae were observed in cracks in the wall at the top of the entrance breakdown to Hidden Cave. Similar larvae were seen under rocks on the surface. Presumably they were preparing to pupate. Collections were during May. This species is known as the western tent caterpillar. The larvae of this moth are recorded from a variety of trees, including *Prunus*, *Purshia*, *Quercus*, *Ribes*, and *Rosa* (Franclemont, 1973). Although we were not able to locate the tent of this species, oaks are common in the region and are presumably the food for these caterpillars.

Family Tineidae

Amydria arizonella Dietz: This troglophilic guano moth was found dead in some of the pools of water in the northwest passage of Hidden Cave in the dark zone

Table 3.—Invertebrates collected in Hidden Cave by season and method during 1992. Collection methods: H= hand, B= Berlese funnel extraction, F = subfossil, R = recent, T= baited pitfall trap, V= vacuuming. Seasons: Winter= 15-16 February, Spring= 17 May, Summer= 15 August, Fall= 24-25 October.

Taxa	Winter	Spring	Summer	Fall	Found Dead
Amara sp.			H		
Ametroproctus sp.					F
Amydria arizonella				H	
Arrhopalites caecus			V		
Arrhopalites sp.		H	H		
Austrotyla montivaga		H	H		
Bdella sp.				H	
Bradysia sp.	H	H	H	H	
Calathus sp.			H		
Camponotus sansabeanus			H		
Ceuthophilus carlsbadensis	H,T	H	H,T	H	
Ceuthopilus longipes	H,T	H	H,T	H	
Ceuthothrombium cavaticum			T		
Cicurina deserticola		H		H	
Cyclotrachelus substriatus			H		
Drosophila sp.	H				
Eleodes dissimilis		H			
Eperigone antraea	H,T	H	H	H	
Epidamaeus sp.					F
Ereynetes sp.					R
Euconulus chersinus					R
Euphthiracarus sp.	B				
Fridericia sp.		H	H		
Fusacarus sp.	B				
Fusohericia sp.			B		
Galumna sp.					F
Genus & sp., Astigmata			H		
Genus & sp., Campodeidae	H,T	H	H,T	H	
Genus & sp., Haplotaxida			H		
Genus & sp., Lepidoptera					F
Genus & sp., Lithobiidae				H	
Genus & sp., Phoridae		H	H,T	H	
Genus & sp., Tricladida	H				
Habrocestum acerbum		H			
Hakiulus zakiwanus				H	
Henlea/Fridericia sp.		H		H	
"*Hungarobelba*" sp.					F
Insculptoppia cavernalis	B		B,V		F
Isotoma sp.			B		
Leiobunum townsendii	H				
Leptothorax cokendolpheri	H				
Malacosoma sp.			H		
Mesodorylasimus sp.	H				
Meximachilis cokendolpheri	H		H		
Monomorium minimum			V		
Multioppia neglecta	B,S				
Myianoetus sp.		H	H,V		
Neomuscina tripunctata	H		H		

Table 3.—Cont. Collection methods: H= hand, B= Berlese funnel extraction, F = subfossil, R = recent, T= baited pitfall trap, V= vacuuming. Seasons.

Taxa	Winter	Spring	Summer	Fall	Found Dead
Oedionychus sp.		H			
Oribella pectinata	B				
Orus rubens		H	H		
Paleozercon cavernicolus					F
Pasimachus sp.			H		
Pergalumna sp.					F
"*Porobelba*" sp.					F
Propelops canadensis					F
Pseudoleria sp.		H	H,V	H	
Pseudosinella violenta	H,T,B	H	H,V,T	H	
Quedius sp.		H	H,T	H	
Rhadine longicollis	H,T	H	H,T	H	
Robustocheles hilli		H		H	
Rymosia sp.	H	H	H,T	H	
Scheloribates sp. 1					F
Scheloribates sp. 2					F
Scheloribates sp. 3	B				
Seira sp.	H				
Speodesmus tuganbius	H	H	H	H	
Stenodesmus tuobitus		H			
Stratiolaelaps n.sp. 1	B				
Stratiolaelaps n.sp. 2		B			
Symphylella sp.			V		
Tectocepheus velatus?					F
Thalkethops prob. *grallatrix*			H		
Tomocerus flavescens		H	H,T	H	
Tomocerus sp.		H			
Trichobius major				H	
Tyrophagus putrescentiae	B				

during October 1992. Davis (1972) reported that this was one of the most common species of moths to be found in U.S.A. caves and was especially abundant in Bat Cave at Carlsbad Caverns. It ranges over much of the southern portion of the country and has often been taken from surface habitats. Davis (1972) suggested that it is a facultative troglophile, living in nests of various mammals when not occurring in caves. A photograph of this moth species appears in the article by Cokendolpher and Polyak (1996: fig. 10).

Subclass Arachaeognatha
Order Microcoryphia
Family Machilidae

Meximachilis cokendolpheri Kaplin: We collected this species in the twilight zone under wood about 36.6 m from the entrance (February) and in the entrance zone (August 1992) to the northwest passage of Hidden Cave. Numerous other specimens were observed and some collected from under rocks on the surface. This species is only known from these samples (Kaplin, 1994).

Phylum Mollusca
Class Gastropoda
Family Zonitidae

Euconulus chersinus (Say): A single representative of this snail was collected in the entrance zone below the drop to the northwest passage of Hidden Cave. It is known from surface habitats throughout the eastern U.S.A. Fullington (1979) did not record it from the Guadalupe Mountains.

Glyphyalinia indentata paucilirata (Morelet): This zonitid snail was collected at the entrance to Hidden Cave as well as under rocks on the surface. Fullington (1979) reported that this snail is located throughout the Guadalupe Mountains at all elevations. He also reported that it had been found as fossils in Pine Springs Canyon, Guadalupe Mountains National Park. Although we did not obtain this species inside the cave, it is likely that they would wash in during the rainy seasons. Like the previously listed species, this snail is quite small and easily overlooked.

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