TEXAS MEMORIAL MUSEUM
Speleological Monographs, 3

Studies on the CAVE AND ENDOGEAN FAUNA of North America II

Edited by James R. Reddell

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Cover: *Texella reyesi* Ubick and Briggs from Tooth Cave, Travis County, Texas
Photograph by Robert W. Mitchell

Composition and layout by William R. Elliott

This volume is dedicated to

DR. ROBERT W. MITCHELL

for his contributions to cave biology
and for his friendship and inspiration
throughout my biological career

PREFACE

The present volume is the second in a series devoted to the cavernicole and endogean fauna of North America, including Mexico. A majority of the species described in this volume are from Texas, but new species are also described from other states in the United States and from Mexico.

Texas has long been known for its unusual and diverse subterranean fauna. The first species to be recovered from the underground habitat was the remarkable blind salamander *Typhlomolge rathbuni* Stejneger from the old U.S. Fisheries artesian well in San Marcos, Hays County. The description of this species was soon followed by descriptions of new species of blind crustaceans.

Despite the interest generated by these descriptions only occasional collections were made in the state until Dr. Thomas C. Barr, Jr., then of Texas Technological College in Lubbock, visited several caves and encouraged visits by other speleologists. These discoveries in the late 1950s further emphasized the interest of the Texas cave fauna.

Shortly following the organization of the Texas Speleological Survey in 1961 an active program of biological study was initiated by James R. Reddell with the help of numerous cave explorers in the Austin area. Dr. Robert W. Mitchell of Texas Tech University in Lubbock encouraged a number of students, including William R. Elliott, to pursue biological studies in Texas caves as part of their graduate research.

In recent years the listing of five cave arthropods [the Tooth Cave spider *Leptoneta* (now *Neoleptoneta*) *myopica* Gertsch, the Tooth Cave pseudoscorpion *Microcreagris* (now *Tartarocreagris*) *texana* Muchmore, the Bee Creek Cave harvestman *Texella reddelli* Goodnight and Goodnight, the Kretschmarr Cave mold beetle *Texamaurops reddelli* Barr and Steeves, and the Tooth Cave ground beetle *Rhadine persephone* Barr] on the U.S. Fish & Wildlife Service List of Endangered Species has resulted in an extensive sampling program for Travis, Williamson, and adjacent parts of Burnet and Hays Counties. This study revealed the presence of a number of new species in this, the best-studied, part of the state, as well as better defining the ranges of other species. Two other species originally confused with two of the endangered species are described as new in this volume. Because populations of these species were included in the original endangered species listing they are also considered endangered by the U.S. Fish & Wildlife Service. *Texella* n.sp. (see Ubick and Briggs, this volume) was originally placed in *Texella reddelli*, and *Batrisodes (Excavodes)* n.sp. (see Chandler, this volume) was placed in *Texamaurops reddelli*.

Despite extensive collections throughout the state by a large number of students of cave biology and an eager cadre of cave explorers the fauna of the state remains poorly known. The continuing discovery of new species in the best-studied parts of the state indicates strongly that we have much to learn about the cave fauna of this remarkable region. Few distributions are adequately known and doubtless numerous new species await discovery in areas still barely touched.

The present volume includes taxonomic works on seven orders of arthropod. Of special significance are revisions of two of the more important groups occurring in Texas caves, the subgenus *Cicurella* of the genus *Cicurina*, and the harvestman genus *Texella*. Both groups occur outside Texas, but the center of diversity as presently understood is the karst region of central Texas. Also of considerable zoogeographic interest is the discovery of two Mexican genera of aquatic isopod in Texas: the cirolanid genus *Speocirolana* and the stenasellid genus *Mexistenasellus*. Holsinger continues his study of the amphipod fauna of Texas subterranean waters with description of significant new taxa from caves, springs, wells, and hyporheic habitats in Texas. Muchmore reviews the cave pseudoscorpions of Texas and New Mexico with description of additional new troglobites and troglophiles. Cokendolpher and Reddell revise the schizomid family Protoschizomidae, which though primarily Mexican includes one (undescribed) species in Texas. Roth describes the first troglobitic theridiid spider in North America. Finally, Chandler reviews the beetle family Pselaphidae in Texas caves, with descriptions of the first eyeless species of the genus *Batrisodes*. Altogether 110 new species are described in this

volume, of which 61 Texas species are believed to be troglobites and another 16 are Texas troglophiles. An additional nine troglobites (1 each from Alabama, Arizona, and New Mexico and 6 from Mexico) are also described.

The present volume includes only a few of the groups known to contain undescribed species in Texas caves. It is hoped that a future volume can be published covering additional families and orders, including millipedes, terrestrial isopods, entotrophs, and cave crickets.

Many of the species in this volume occur in areas undergoing rapid urbanization and may be listed as endangered in the future. Of species treated herein, four (two species of *Texella*, *Texamaurops reddelli*, and one species of *Batrisodes*) are considered as endangered by the U.S. Fish & Wildlife Service. Many of the caves from which fauna has been recorded have already been destroyed; others, including some of considerable biological importance, are seriously threatened. It is one of the goals of the present volume to make available to conservationists sufficient taxonomic and distributional information as to allow a determination to be made on the necessity of protecting species by their placement on the U.S. Fish & Wildlife Service List of Endangered Species.

My greatest debt of gratitude is to Dr. William R. Elliott for his invaluable contributions to the preparation of this book for the printer. His encouragement and friendship not only during preparation of this book but for many years have been an inspiration to me in my own work.

I wish to express my particular appreciation to the authors of the papers for their cooperation, especially where newly obtained material required revisions of the original manuscripts. I specially thank William R. Elliott, Andrew Grubbs, Scott Harden, David McKenzie, Marcelino Reyes, William Russell, and George Veni for their collecting efforts for many years. Without their cooperation and friendship we would know far less about the cave biology of Texas than we do. Dr. Robert W. Mitchell is thanked for his inspiration to me both as a friend and student; he has always provided whatever support was asked. Dr. Mitchell is also thanked for contributing the photograph on the cover of this volume.

TABLE OF CONTENTS

Holsinger, J.R. 1992. Four new species of subterranean amphipod crustaceans (Artesiidae, Hadziidae, Sebidae) from Texas, with comments on their phylogenetic and biogeographic relationships. Texas Mem. Mus., Speleol. Monogr., 3:1-22.

FOUR NEW SPECIES OF SUBTERRANEAN AMPHIPOD CRUSTACEANS (ARTESIIDAE, HADZIIDAE, SEBIDAE) FROM TEXAS, WITH COMMENTS ON THEIR PHYLOGENETIC AND BIOGEOGRAPHIC RELATIONSHIPS

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ABSTRACT

Four new stygobiont amphipod crustaceans are described from a variety of groundwater habitats (e.g., caves, springs, interstitial media) in south-central and western Texas. The new species are *Artesia welbourni* (Artesiidae), *Holsingerius smaragdinus* (Hadziidae), *Mexiweckelia hardeni* (Hadziidae), and *Seborgia hershleri* (Sebidae). The new locality records for *Artesia* in Culberson County, and *Holsingerius* and *Seborgia* in Val Verde County are the first for these genera outside the artesian well in San Marcos, Texas, whereas the new record for *Mexiweckelia* in Medina County documents a significant range extension for this genus from north-central Mexico to south-central Texas. *Seborgia relicta*, previously described from the artesian well in San Marcos, is also newly recorded from Medina County.

Both the phylogenetic and biogeographic implications of these new taxa are discussed at some length because they provide further insight into the origin and evolutionary biology of stygobiont crustaceans in southern Texas and northern Mexico.

INTRODUCTION

By far the greatest taxonomic diversity of subterranean amphipod crustaceans in North America is found in Texas, primarily in groundwater habitats of the Edwards Aquifer and associated Balcones fault zone in the south-central part of the state. In the most recently published paper on Texas subterranean amphipods (Holsinger and Longley, 1980), one new family, four new genera, and six new species were described from an artesian well in San Marcos. Some of these species were also recorded from nearby San Marcos Springs and deep artesian wells near San Antonio. Collecting of subterranean amphipods in Texas has continued since this study was published in 1980, resulting in many new locality records for previously described species and the discovery of a significant number of taxa new to science. In this paper four of these newly discovered species, all with close morphological affinities to the previously noted Edwards Aquifer well amphipod fauna, are described from subterranean groundwaters in Medina, Val Verde and Culberson counties. In addition, one species previously known only from the artesian well in San Marcos is recorded from Medina County.

Descriptions of the four new species raise the total number of stygobiont amphipods described from Texas to 21. This remarkably diverse fauna encompasses representatives of five families and nine genera. One of the new species belongs to the genus *Mexiweckelia*, which was previously recorded from

the state of Coahuila in northern Mexico (see Holsinger and Minckley, 1971) and is herein reported from Texas for the first time. The taxa treated in this paper are listed under their respective families, which are in turn arranged alphabetically.

SYSTEMATICS

FAMILY ARTESIIDAE HOLSINGER, 1980

Remarks.—Botosaneanu and Stock (1989) do not accept Artesiidae and Bogidiellidae as separate families and suggest that the two be united in the family Bogidiellidae. Their opinion is based in part on the recent description of *Aequigidiella* from two caves in Thailand, a genus which possesses certain characters that appear to bridge the gap between the two family groups.

Artesia welbourni, new species
Figs. 1-3

Material examined.—TEXAS: *Culberson County*: Border Cave, ca. 26 km SW of White City (New Mexico), female holotype and 2 female paratypes, W. C. Welbourn, 15 Apr. 1976.

The holotype is deposited in the National Museum of Natural History (Smithsonian Institution) (USNM 239480); paratypes are in the author's collection.

Diagnosis.—Medium-sized stygobiont species distinguished from *A. subterranea*, to which it is closely allied, by more spinose and/or setose appendages, especially gnathopods, pereopods, uropods and telson; reaching sexual maturity at larger size; and other small differences noted below. Largest female, 10.5 mm; male unknown.

Female.—Antenna 1: 55-60% length of body, ca. 33% longer than antenna 2; primary flagellum with 18 segments, esthetascs on most flagellar segments; accessory flagellum 1-segmented. Antenna 2 more setose than that of *A. subterranea*, flagellum with 7 segments. Mandible: molars conical, feeble, each with 1 apical seta; spine row with 7-8 plumose spines; cutting plates rather broad, lacinia mobilis of left finely serrate, that of right 4-dentate; palp segment 2 with 2-3 setae on convex inner margin, segment 3 subequal in length to segment 2 and bearing mixture of few long and short C(?) and E setae on inner margin toward distal end (apparently right mandible with more setae than left), outer margin of segment 3 with 2 or 3 B setae. Lower lip: inner lobes very broad, broader than outer lobes; lateral processes very short. Maxilla 1 very similar to that of *A. subterranea*, except apical spines on outer plate are weakly pectinate; palps symmetrical. Maxilla 2 similar in shape to that of *A. subterranea* but with more apical setae. Maxilliped: inner and outer plates and segments of palp with few more setae each than those of *A. subterranea*.

Gnathopod 1: propod large and prominent, palm elongate, becoming slightly convex distally, bearing row of about 18 short, peg-like spines on outer margin and row of 8 rather short setae on inner margin, proximal part of palm extending from end of dactyl nail to sharp defining angle nearly straight and bearing row of ca. 6 spines of unequal length; posterior margin very short, without setae. Dactyl curved, not reaching to defining angle. Carpus short and squat, with posterior lobe bearing setae and pubescens. Coxa very small, shallow, with 2 short marginal setae at anterolateral corner. Gnathopod 2: propod as long as, but only ca. 2/3 as broad as that of gnathopod 1; palm elongate, slightly convex distally, bearing ca. 19 rather short, peg-like spines on outer margin and few short setae on inner margin, part of palm between end of dactyl nail and defining angle with ca. 3 long spines and long setae; posterior margin of propod relatively short, with 1 set of 2 short setae; superior medial setae singly inserted, inferior medial setae in 1 cluster near defining angle. Dactyl curved, not reaching to defining angle when closed. Carpus with posterior lobe bearing 2 or 3 clusters of setae. Coxa small, shallower than corresponding body segment, bearing 3 short marginal setae.

Pereopods 3 and 4 subequal, although one or the other sometimes with few more spines and/or setae; coxae about as deep as corresponding body segments, longer than broad, margins with 4 or 5 setae and lateral faces with few hair-like setae; bases with 5-6 short spines on anterior margin, 5-8 setae of varying lengths on posterior margin. Pereopod 7 little longer than pereopod 6, ca. 55-60% length of body, ca. 20% longer than pereopod 5. Coxae of pereopods 5 and 6 broadly expanded and deeper than corresponding body segments, that of 5 broader and more setose than that of 6; ventral margins broadly rounded, with 1 to 4 setae, lateral faces with few hair-like setae; coxa of pereopod 7 shallow and not expanded. Bases of pereopods 5 and 6 comparatively narrow, widening distally but lacking distoposterior lobes; anterior and posterior margins rather spinose, anterior with short spines, posterior with longer spines; basis of pereopod 7 broader than those of pereopods 5 and 6, narrowing distally but

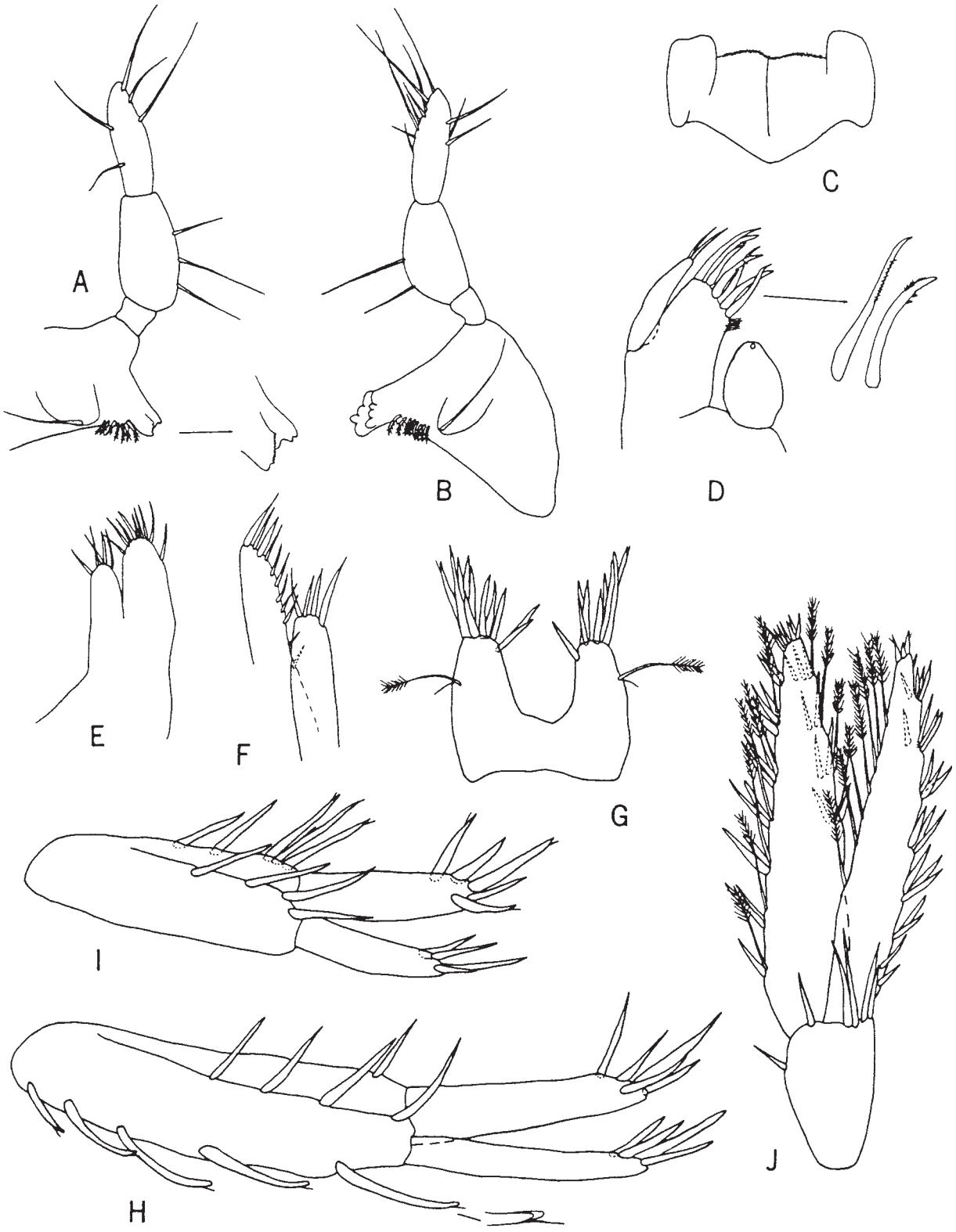

Fig. 1.—*Artesia welbourni*, new species, paratype female (10.5 mm), Border Cave, Culberson Co., TX: A, B, left & right mandibles (cutting plates of left enlarged, incisor probably broken); C, lower lip; D, E, maxillae 1, 2; F, inner and outer plates of maxilliped; G, telson; H, I, J, uropods 1, 2, 3. (Maxillae and plates of maxilliped to larger scale than other mouthparts; telson and uropods to same scale.)

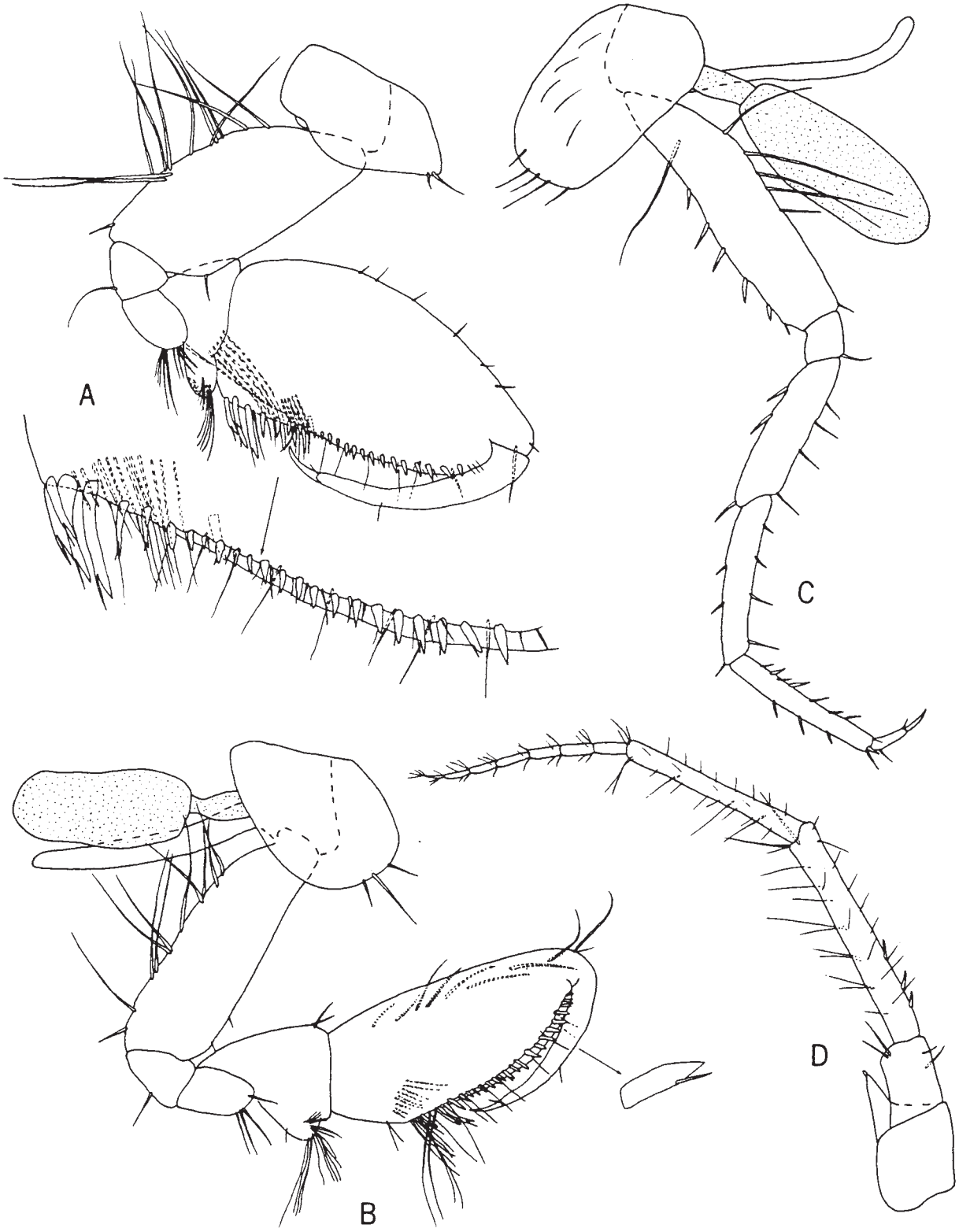

Fig. 2.—*Artesia welbourni*, new species, paratype female (10.5 mm), Border Cave, Culberson Co., TX: A, gnathopod 1 (lateral m enlarged); B, gnathopod 2 (lateral view; palmar spine enlarged); C, pereopod 4; D, antenna 2. (All structures to same scale.)

also lacking distoposterior lobe. Segments 5 and 6 of pereopod 7 with long setae, those of pereopods 5 and 6 without long setae. Dactyls of pereopods 5-7 relatively long, those of 5 and 6 about 50% length of corresponding propods, that of 7 about 38% length of corresponding propod. Dactyl of pereopod 5 with 1 ventral seta, that of pereopod 6 with 1 set of 2 setae and that of pereopod 7 with 2 sets of 2 setae each. Coxal gills 2-6 oblong, peduncles short but distinct. Brood plates narrow, lacking setae in specimens examined.

Pleonal plates with small, distoposterior corners and 1 short seta each; ventral margins lacking spines. Pleopods: inner and outer rami with nearly twice number of flagellar segments as those of *A. subterranea*, all setae plumose, none clothespin like; peduncles with 2 coupling spines each. Uronites like those of *A. subterranea*, i.e., uronites 1 and 2 each bearing 2 dorsolateral spines. Uropod 1 very similar to that of *A. subterranea*, except peduncle usually with 5, instead of 4, basofacial spines (becoming progressively larger toward distal end). Uropod 2 rami about like those of *A. subterranea*, but peduncle more spinose and bearing up to 9 long spines on distal half. Uropod 3 approximately 16% length of body: inner and outer rami subequal in length; outer little less broad, armed with clusters of spines on outer margin and row of plumose setae on distal half of inner margin; outer ramus bearing spines and plumose setae on inner and outer margins and spines only on apex. Telson little broader than long, with deep U-shaped cleft; lobes with 9-10 apical spines each; lateral margins bearing 1 long, threadlike, partly plumose seta each toward distal end.

Type-locality.—Border Cave, Culberson Co., Texas, is developed in an outcrop of gypsum bedrock of the Permian-aged Castile formation that floors a rather broad gypsum plain just east of the Guadalupe and Delaware mountains (see Fig. 11). The cave is over 305 m long and gives access in two places to lower level lakes of deep phreatic water. Unconfirmed reports by SCUBA divers indicate that one or both of these lakes may be more than 40 m deep. The single entrance to Border Cave is situated at the end of a relatively deep desert arroyo, which, along with the entire cave, apparently floods completely during any heavy rainfall.

Distribution and ecology.—This species is known only from its type locality, where it is apparently quite rare and is known only from three specimens that were collected by W. C. Welbourn in 1976 from one of two deep lakes situated approximately 152 to 213 m from the entrance. I visited Border Cave and this lake with colleagues in June 1978, but we failed to find additional specimens at that time. However, more recent visits to this lake in 1985 and 1986 by S. J. Harden and associates, resulted in the collection of 37 specimens of an undescribed species of the *hubbsi* group of the subterranean amphipod genus *Stygobromus* and specimens of an undescribed species of asellid isopod. But additional specimens of *A. welbourni* were not found. To my knowledge, the second, more remote, deep lake of this cave has not been biologically explored. However, according to S. J. Harden (in litt.), SCUBA divers have reported seeing numerous "crustaceans" [probably both amphipods and isopods] on dives in both Border Cave and nearby Wiggley Cave, which is located just east of the former and probably gives access to the same groundwater aquifer.

In response to rumored sightings of amphipods in caves to the north of Border Cave, I visited the Parks Ranch-Resurgence caves complex in June 1986. These caves are located in New Mexico approximately 21 km NE of Border Cave and on the same gypsum plain. Rather diligent searching in several parts of this system revealed only an occasional specimen of the widely distributed, epigean amphipod *Hyalella azteca* but no other crustaceans. These caves are shallow, apparently flood very quickly after a rainfall, and do not extend deep enough to intersect phreatic water. Thus, any potential they might have as habitats for populations of stygobiont amphipods is severely limited.

Because of their great size and depth (over 300 meters), both Carlsbad Caverns and Lechuguilla Cave, which are located in New Mexico only approximately 24 km north-northeast of Border Cave, would appear to have the potential for stygobiont crustacean faunas. Unlike Border Cave, however, they are excavated in limestone bedrock at higher elevations in the Guadalupe Mountains just west of the gypsum plain. To date, despite extensive explorations, neither is known to access phreatic water or contain any aquatic organisms.

Etymology.—It is a pleasure to name this species in honor of its collector, W. Calvin Welbourn, Curator of the Acarology Laboratory at Ohio State University.

FAMILY HADZIIDAE S. KARAMAN, 1943

Genus *Mexiweckelia* Holsinger and Minckley

Mexiweckelia Holsinger and Minckley, 1971:426 [in part]; Barnard and Barnard, 1983:644.

Revised diagnosis.—Without eyes and pigment,

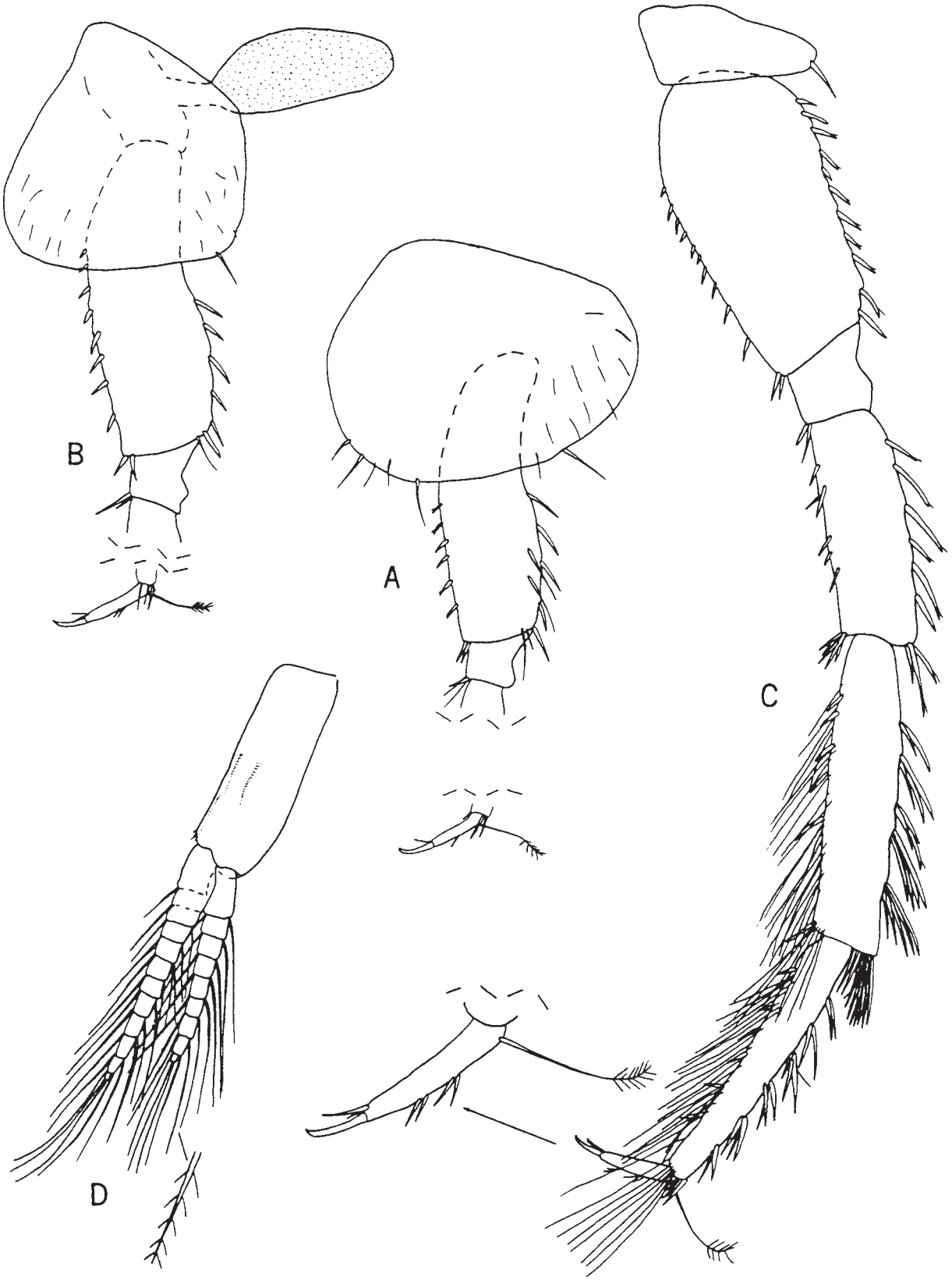

Fig. 3.—*Artesia welbourni*, new species, paratype female (10.5 mm), Border Cave, Culberson Co., TX: A, B, pereopods 3 & 4 (in part); C, pereopod 7 (dactyl enlarged); D, pleopod 3. (All structures to same scale.)

of stygobiont facies. Interantennal lobe small, rounded anteriorly. Antenna 1 longer than antenna 2; flagellum with esthetascs present only in male; accessory flagellum vestigial (?) or absent. Peduncular segment 4 of antenna 2 longer than segment 5. Buccal mass prognathous. Upper lip symmetrical, rounded and unnotched apically. Mandible: molar prominent, triturative, left lacking seta; lacinia mobilis present on both right and left mandibles; palp absent. Lower lip: inner lobes vestigial or absent, outer lobes (shoulders) high, lateral processes slender but distinct. Maxilla 1: inner plate not greatly expanded, with apical setae (sometimes plumose); outer plate with 7 apical serrate spines; palps usually asymmetrical (i.e., right broader apically and more spinose). Maxilla 2: inner plate narrowing toward apical end, with oblique row of naked facial setae, inner margin slightly convex. Maxilliped: inner plate rather long, expanded distally but not greatly so; outer plate extending beyond inner plate, broadening medially or distally, inner margin with short row of bladespines at or toward apex; palp segment 2 longest, segment 3 with distomedial lobe, segment 4 (dactyl) not greatly elongate, nail relatively short.

Gnathopod 1 weakly sexually dimorphic. Propod of female gnathopod 1 shorter than carpus, palm short, generally transverse, weakly armed with few small spines and setae; dactyl short and thick, nail short; carpus large, subtriangular, with prominent pubescent posterior lobe and several long setae. Propod of male gnathopod 1 proportionately little longer, palm with few more spines. Gnathopod 2 strongly sexually dimorphic. Propod of female gnathopod 2 relatively long and narrow, longer than carpus, palm short, oblique, bearing 2 rows of short, unnotched spines; posterior margin longer than palm, with several clusters of setae; carpus subtriangular, with pubescent posterior lobe and several sets of long setae. Propod of gnathopod 2 of male much broader distally, palm longer, oblique, bearing double row of short, unnotched spines; carpus comparatively shorter but also with distinct pubescent posterior lobe. Coxae of gnathopods 1 and 2 subequal, about as broad as deep; coxae 3 and 4 similar; coxa 4 unlobed; coxa 5 lobate. Pereopods 3 and 4 subequal. Pereopod 7 at least 50% length of body, little longer than pereopod 6, much longer than pereopod 5; bases of pereopods 5-7 not much expanded, distoposterior lobes usually distinct but not large; segment 6 moderately spinose and/or setose; dactyls rather short, lacking setules on upper margins. Coxal gills 2-6 relatively large, typically ovate and/or ellipsoidal, with distinct peduncles. Brood plates small and narrow, not bearing setae in material examined.

Pleonal plates variable, corners not produced, each bearing 1 setule. Pleopods normal, not sexually dimorphic, peduncles with few (typically 3) coupling spines on inner margins distally. Uronites free (not fused), 1 and 2 each armed with 2 dorsal spines, 3 with 2 or often more. Uropods 1 and 2 not sexually dimorphic; peduncle of 1 bearing 1 or 2 basofacial spines. Uropod 3 elongate, magniramous; outer ramus 1-segmented, outer margin with strong spines in clusters but lacking setae. Telson relatively short,about as long as broad; depth of apical incision (cleft) variable, very shallow or up to ca. 2/3 distance to base; lobes with 1 to 3 apical spines each.

Relationship.—Despite some fundamental differences that are noted below, *Mexiweckelia* is apparently closely related to *Holsingerius*, a genus originally based on *H. samacos* (Holsinger) (in Holsinger and Longley, 1980) from the artesian well in San Marcos and described by Barnard and Karaman (1982). These two genera have a number of important morphological characters in common. *Mexiweckelia* is also closely related to *Texiweckelia*, another genus recorded from the artesian well in San Marcos, as well as San Marcos Springs (see Holsinger and Longley, 1980).

Remarks.—The addition to *Mexiweckelia* of the new species described below, re-examination of the two species previously assigned to this genus, and re-evaluation of the closely allied genus *Holsingerius*, necessitates the revised diagnosis given above.

Mexiweckelia hardeni, n. sp., is the first record for *Mexiweckelia* outside Mexico and brings the total number of species in the genus to three. Two of these species occur in northern Mexico: *M. colei* from groundwaters of the Bolsón de Cuatro Ciénegas in Coahuila and *M. mitchelli* from Cueva de la Siquita in Durango (see Holsinger and Minckley, 1971; Holsinger, 1973).

Two discrepancies in the original descriptions of *M. colei* (see Holsinger and Minckley, 1971) and *M. mitchelli* (see Holsinger, 1973) are noted and should be corrected as follows. Structures on the flagellum of antenna 1 referred to erroneously as "tiny" or "slender" calceoli are esthetascs; basofacial spines were inadvertently omitted from the illustrations of uropod 1 (1 for *M. mitchelli* and 2 for *M. colei*); in *M. mitchelli*, the right molar has a seta, the left does not.

Mexiweckelia hardeni, new species
Figs. 4-6

Material examined.—TEXAS: *Medina County*: Hondo Creek hyporheic, 6.5 km E of Hondo, female holotype and 4 female paratypes, S. J. Harden, 18 Mar. 1988; additional paratypes collected by S. J. Harden include 1 female, 20 Jan. 1986 and 1 male, 23 Feb. 1988.

The holotype is deposited in the National Museum of Natural History (USNM 239477); paratypes are in the author's collection.

Diagnosis.—A small, interstitial species closely allied to *M. colei* from northern Mexico, but easily distinguished from that species and also from *M. mitchelli* by the telson, which has a very shallow apical notch, and peduncle of uropod 2, which is heavily spined toward distal end along dorsomedial margin. Largest male, 3.2 mm; largest female, 4.5 mm.

Female.—Antenna 1 about as long as body, ca. 50% longer than antenna 2; primary flagellum with 35 segments, esthetascs absent. Antenna 2 with 14 flagellar segments. Mandible very similar to that of *M. colei*: incisor 7-dentate; right mandible with 3-dentate lacinia mobilis, 2 accessory spines in spine row and molar seta; left mandible with 4-dentate lacinia mobilis, 3 accessory spines and molar seta absent. Lower lip like that of *M. colei*. Maxilla 1: inner plate with 11-12 apical, plumose setae; outer plate with 7 apical, serrate spines; palps asymmetrical, right distally expanded and bearing about 7 short, "thick" spines; left not expanded and bearing only about 4 generally weaker spines. Maxilla 2: inner plate narrowing distally, with oblique row of 15-16 facial setae. Maxilliped: inner plate with 3 bladespines and setae on apex and 2 medial setae subapically; outer plate broadening medially or distally, with short row of bladespines apically and subapically on inner margin; palp segment 2 longest, segment 3 narrower and with small distomedial lobe.

Gnathopod 1 very similar to those of *M. colei* and *M. mitchelli*; propod about nearly as long as carpus, palm very short, scarcely armed, bluntly rounded just below tip of closed dactyl, posterior margin rather long, without setae; dactyl short and thick, nail short and indistinct; carpus subrectangular, widening distally into broad pubescent lobe, lobe broadest at distal end, bearing several long setae; coxa about 4/5 as deep as broad, margin with 2 setae. Propod of gnathopod 2 narrow, elongate, palm short and oblique, with double row of 3 or 4 small spines, defining angle with 1 spine and 2 long setae; posterior margin long, with 3 sets of setae; superior medial setae singly inserted in row near anterior margin. Dactyl of gnathopod 2 bearing small bladespines on inner margin, nail rather short; carpus subtriangular, posterior margin broadly lobiform and pubescent toward distal end, lobe broadest at distal end, with 4 or 5 clusters of long setae. Coxa of gnathopod 2 subequal in size to that of gnathopod 1. Pereopods 3 and 4 subequal, coxae little broader than deep, each with 2 marginal setae, 4 not excavate or lobate. Pereopod 7 about 66% length of body, little longer than pereopod 6, about 33% longer than pereopod 5. Bases of pereopods 5-7 relatively narrow, distoposterior lobes small, scarcely produced; dactyls 30% to 40% length of corresponding propods. Coxal gills 2-6 large, prominent, ellipsoidal and/or subovate, with distinct peduncles. Brood plates small, narrow, nonsetose in material examined.

Pleonal plates: posterior margins slightly convex or nearly straight, corners rounded, each bearing 1 seta; plate 3 with 1 ventral margin spine. Pleopod peduncles with 3 coupling spines on inner margins. Uronites 1 and 2 each with 2 small, dorsodistal spines, 3 with 6 such spines in groups of 3. Uropod 1: inner ramus little longer than outer, shorter than peduncle, armed with about 5 apical spines; outer ramus with about 4 apical spines and 2 short spines on outer margin; peduncle with 10 spines, 2 of which are basofacial. Uropod 2: inner ramus longer than outer, shorter than peduncle, with about 5 apical spines; outer ramus bearing about 5 spines; peduncle rather spinose, bearing 3 or 4 spines on outer anterior margin distally and 9 spines (in row) on distal 3/5 of dorsomedial margin. Uropod 3 relatively long, ca. 22% length of body, rami subequal in length; outer ramus slightly narrower, outer margin armed with sets of spines in clusters of 3 but lacking setae, medial margin with singly inserted spines and plumose setae, apex with cluster of ca. 6 spines; inner ramus with singly inserted spines and plumose setae on both margins, apex with cluster of about 5 spines. Telson about as broad at base as long, narrowing distally, apical margin with very shallow notch, apical lobes with 3 spines each.

Male.—Differing principally from female in having esthetascs on antenna 1 and in structure of gnathopods as follows. Propod of gnathopod 1 little longer, palm with few more small spines, 1 or 2 relatively long inferior medial setae; dactyl little longer. Propod of gnathopod 2 proportionately larger, palm rather long, oblique, armed with double row of about 7 small, unnotched spine teeth, posterior margin about equal to palm in length, with

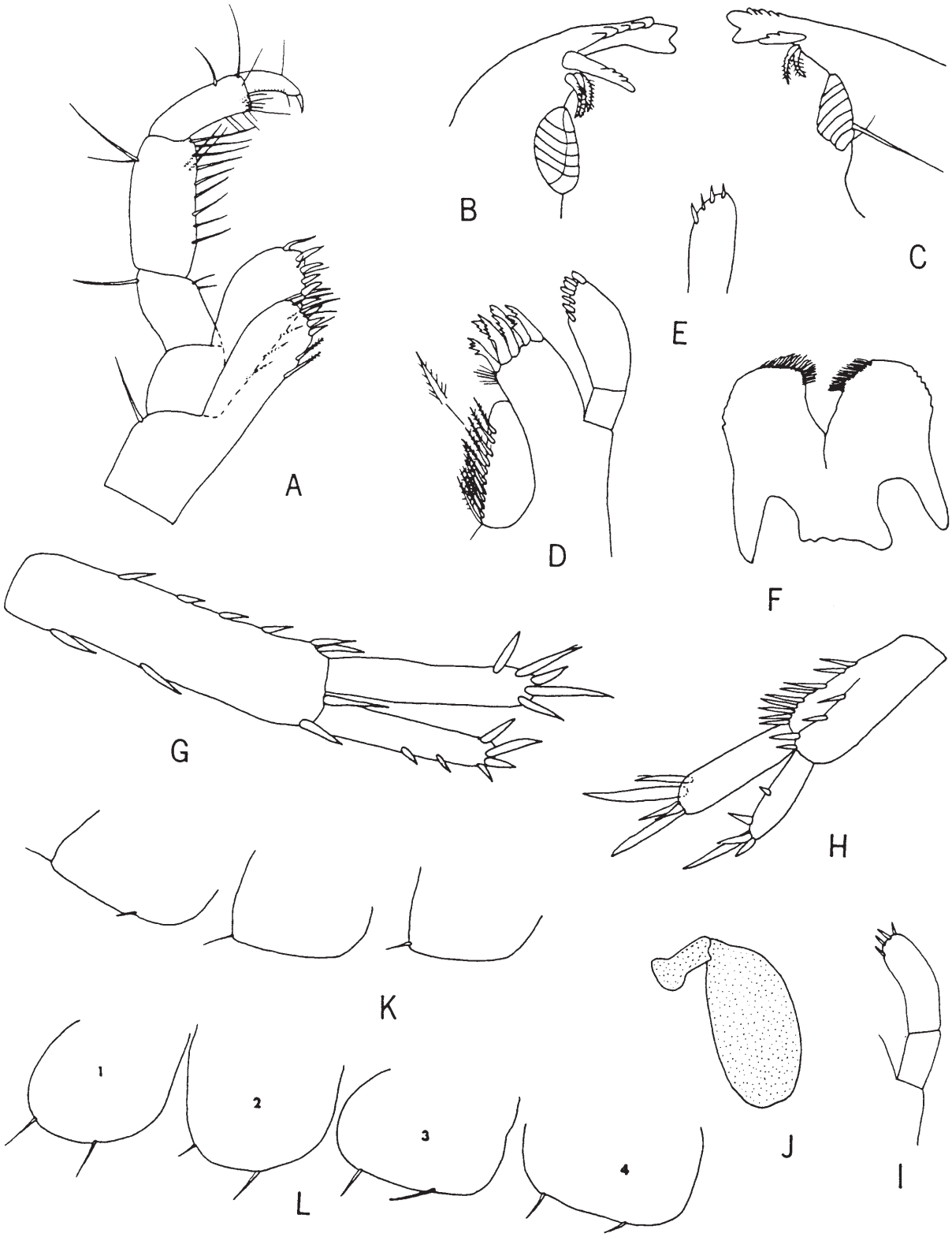

Fig. 4.—*Mexiweckelia hardeni*, new species, paratypes, Hondo Creek hyporheic, Medina Co., TX, female (4.5 mm): A, maxilliped; B, C, left & right mandibles; D, right maxilla 1; E, apex of palp of left maxilla 1; F, lower lip; G, H, uropods 2, 2. Female (3.7 mm): I, palp of left maxilla 1; J, coxal gill; K, pleonal plates; L, coxae 1–4. (Lower lip to smaller scale than other mouthparts; coxae and pleonal plates to same scale, coxal gill to smaller scale.)

2 sets of 1 or 2 setae each; dactyl rather long and slightly curved, closing beyond palm spines, nail rather short.

Type-locality.—Interstitial medium of shallow gravel banks of Hondo Creek, just south of the Balcones escarpment, in Medina Co., Texas (see Fig. 12). The bedrock in this area is composed of shales and sandstones of Late Cretaceous age.

Distribution and ecology.—This species is presently known only from the type locality, where it has been collected on three occasions from shallow pits dug into gravel banks of Hondo Creek or from baited jars placed in these pits. The amphipods apparently inhabit an interstitial habitat in the hyporheic (and/or parafluvial) zone of this stream. A rather detailed investigation of the hyporheic zone of Hondo Creek by S. J. Harden (in litt.) over a period of several years has resulted in the collection of flatworms, oligochaetes, hydrobiid snails, ostracodes, stenasellid isopods (*Mexistenasellus coahuila* Cole and Minckley — see Bowman, 1992, in this vol.), and amphipods. In addition to *M. hardeni*, the

Fig. 5.—*Mexiweckelia hardeni*, new species, paratypes, Hondo Creek hyporheic, Medina Co., TX, female (4.5 mm): A, B, gnathopods 1, 2 (palms and dactyls enlarged). Male (3.2 mm): C, gnathopod 2 (spines enlarged). (All gnathopods to same scale).

amphipod samples included a few specimens of the stygobionts *Stygobromus russelli* (Crangonyctidae) and *Seborgia relicta* Holsinger (Sebidae) (see below), and the common, epigean *Hyalella azteca* (de Saussure) (Hyalellidae).

Etymology.—It is a pleasure to name this species in honor of its collector, Scott J. Harden, who has made many important collections and observations of subterranean amphipods in Texas.

Genus *Holsingerius* Barnard and Karaman

Holsingerius Barnard and Karaman, 1982:180; Barnard and Barnard, 1983:650.

Remarks.—*Holsingerius* is known at present from the artesian well in San Marcos, Hays Co., Texas, where only 13 specimens have been recorded to date (see Holsinger and Longley, 1980), and from the new species described below from Emerald Sink, Val Verde County. This genus was recognized by Barnard and Karaman (1982) principally on the basis of: a) lacinia mobilis absent from right mandible; b) greatly expanded inner plate of maxilla 1, bearing approximately 40 apical setae; c) elongate inner plate of maxilla 2, with relatively straight inner margin and oblique row of approximately 100 facial setae; d) elongate, rectangular-shaped inner plate of maxilliped, which bears a row of setae on medial margin that extends well below base of the

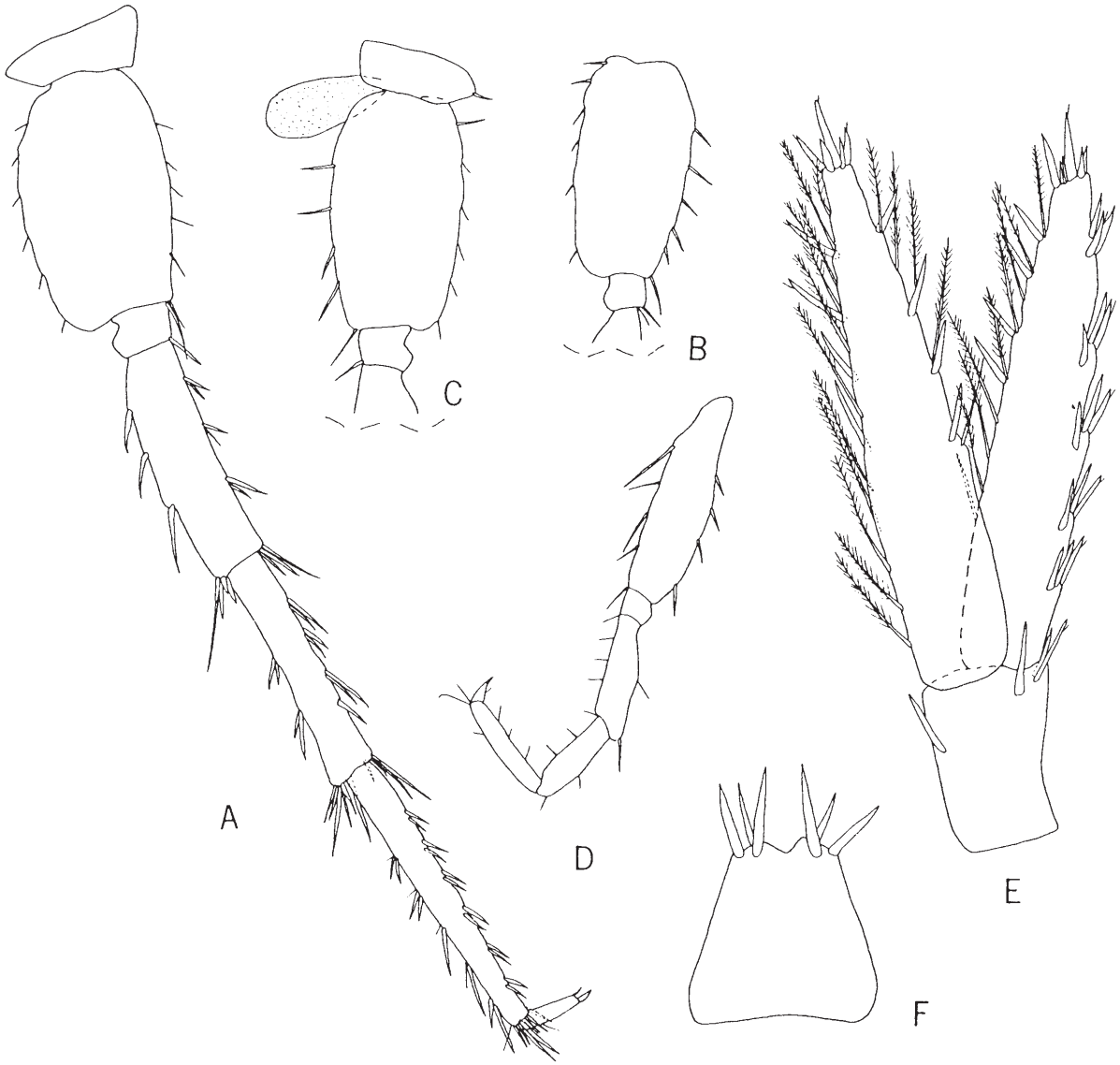

Fig. 6.—*Mexiweckelia hardeni*, new species, paratype female (4.5 mm), Hondo Creek hyporheic, Medina Co., TX: A, pereopod 7; B, C, pereopods 5 & 6 (in part); D, pereopod 3 (without coxa); E, uropod 3; F, telson. (Uropod and telson to larger scale than pereopods.)

plate; and e) coxa 1 larger than coxa 2. Despite these important differences, this genus and *Mexiweckelia* are apparently closely related, as already indicated. This relationship is strongly supported by several mouthpart characters of the new species described below that appear to be intermediate between the two genera. *Holsingerius* is also closely related to *Texiweckelia*, as evidenced by their number of shared similarities, which include especially the structure of the gnathopods, coxae, and uropods (see Holsinger and Longley, 1980).

Holsingerius smaragdinus, new species
Figs. 7-9

Material examined.—TEXAS: *Val Verde County:* Emerald Sink (Cave), 3.2 km N of Langtry, female holotype and 3 female paratypes, D. Canny and S. J. Harden, 25 May 1985; 2 female paratypes, R. M. Waters, 31 Mar. 1984.

The holotype is deposited in the National Museum of Natural History (USNM 239478); paratypes are deposited in the author's collection.

Diagnosis.—A medium-sized cavernicolous species intermediate in some mouthpart characters between *Mexiweckelia* and *Holsingerius* but having more characters of the latter and herein provisionally assigned to this genus. Distinguished from *Holsingerius samacos*, the only other species in this genus, by presence of a vestigial lacinia mobilis on right mandible; smaller inner plate of maxilla 1 with approximately 1/2 as many medial setae; shorter inner plate of maxilla 2, which is not sub-rectangular in shape and has significantly fewer facial setae; shorter row of plumose setae on inner margin of inner plate of maxilliped; absence of setules from upper margins of dactyls of pereopods 5-7; and presence of long, plumose setae on inner or outer rami of uropods 1 and 2. Largest female, 8.5 mm; male unknown.

Female.—Antenna 1 85-90% length of body, ca. 65% longer than antenna 2, primary flagellum with 39-42 segments, lacking esthetascs; accessory flagellum absent. Antenna 2 with 13 flagellar segments. Mandible: molars prominent; right mandible with spine apparently representing vestigial lacinia mobilis, 2 long plumose accessory spines and molar seta; left with well developed, 4-dentate lacinia mobilis, 2 accessory spines, but lacking molar seta. Inner lobes of lower lip vestigial or absent. Maxilla 1: inner plate with 19-20 medial, plumose setae; outer plate with 7 apical, serrate spines; palps symmetrical, broadest distally, bearing 4 spines at or near apex and 4-5 setae subapically (cf., *Holsingerius samacos*). Maxilla 2: inner plate narrowing distally, with oblique, submarginal row of ca. 29 naked, facial setae. Maxilliped: inner plate rather broad, bearing 4 bladespines apically and setae apically/subapically, and row of plumose setae on inner margin; outer plate broadest medially, bearing short row of bladespines on inner margin near apex; palp segment 3 with inner distal lobe.

Gnathopod 1: propod proportionately small, palm short, with few tiny spines and several setae, medial facial setae few, posterior margin longer than palm, with setae; carpus longer than propod, produced posteriorly into prominent, pubescent lobe which is broadest proximal to distal end (as in *H. samacos*), bearing several groups of long setae; posterior margin of basis setose; coxa rather deep and broadly expanded, with 2 short, marginal setae. Gnathopod 2: propod relatively narrow, elongate, narrowing slightly and unevenly distally, palm oblique, short, armed with double row of ca. 6 small spine teeth, defining angle with several tiny spines and 2 long setae, medial (inner facial) setae absent, but both anterior and posterior margins bearing row of long setae; dactyl short, rather stout, nail short; carpus subtriangular, posterior margin lobiform and pubescent, lobe broadest proximal to distal end (as in gnathopod 1 and in *H. samacos*), bearing 5 or 6 clusters of long setae; coxa smaller than that of gnathopod 1, little deeper than broad. Pereopods 3 and 4 subequal, bases rather broad and bearing short spines on anterior margin and longer (slender) spines on posterior margin; coxa about as deep as broad, with 2 marginal setules; coxa 4 not lobate. Pereopod 7 65-70% length of body, little longer than pereopod 6, ca. 25% longer than pereopod 5. Bases of pereopods 5-7 moderately broad, posterior margins broadly convex, distoposterior lobes well developed; dactyl of pereopod 5 about 50% length of corresponding propod, dactyls of pereopods 6 and 7 ca. 35-40% length of corresponding propods; dactyls without setules on upper margins. Coxal gills large, prominent, usually ellipsoidal, sometimes subovate, with distinct peduncles. Brood plates small, narrow, and nonsetose in material examined.

Pleonal plates similar to those of *H. samacos*, corners produced (especially plates 2 and 3), bearing 1 setule each. Pleopod peduncles with 6-7 coupling spines each on inner margins. Uronites 1 and 2 with 2 small dorsodistal spines each, uronite 3 with 6-8 such spines. Uropod 1: inner ramus subequal in length to outer, shorter than peduncle, with about 5 apical and 2 lateral spines; outer ramus with apical and lateral spines and row of 5 rather long, plumose

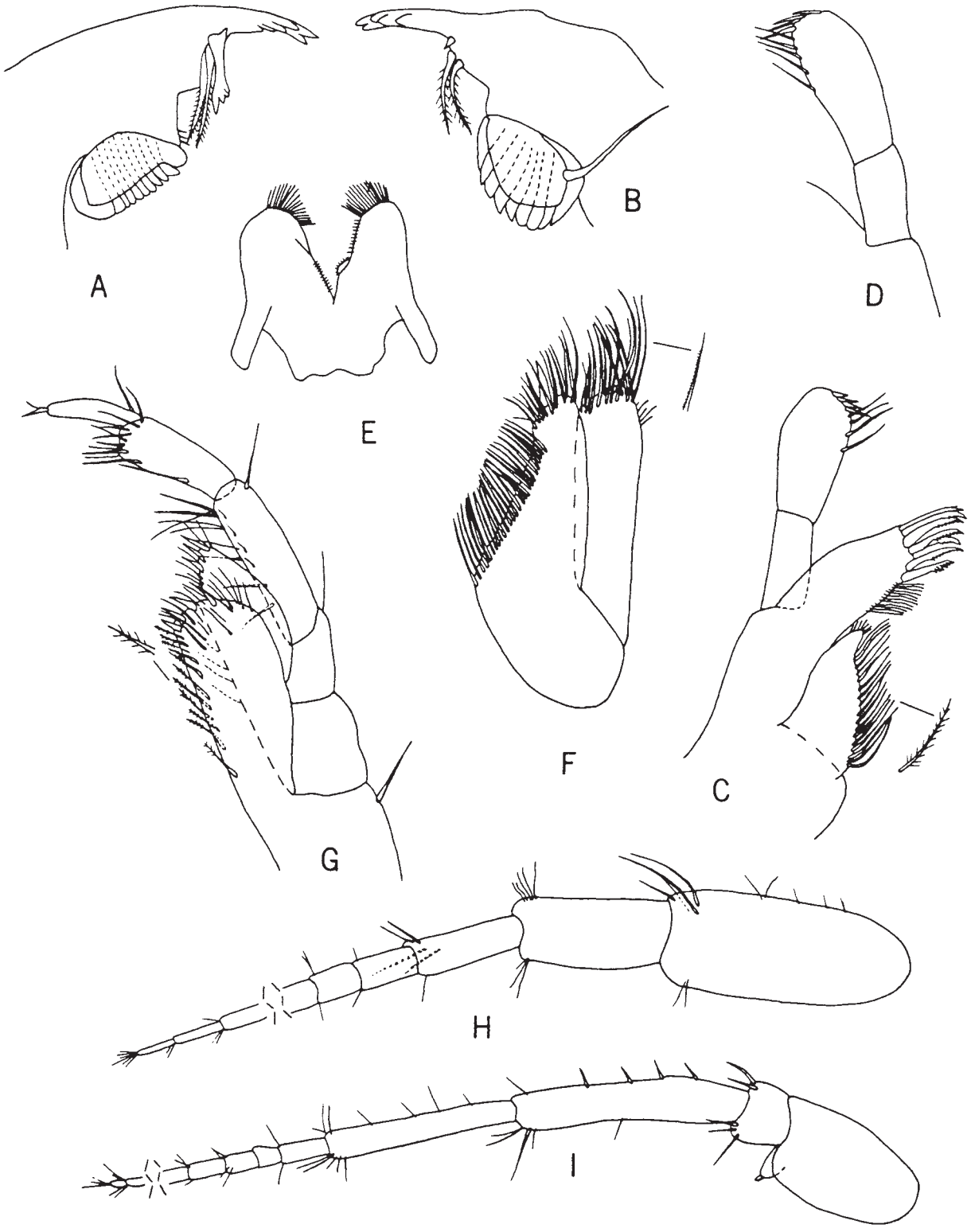

Fig. 7.—*Holsingerius smaragdinus*, new species, paratype female (8.0 mm), Emerald Sink, Val Verde Co., TX: A, B, left & right mandibles; C, left maxilla 1; D, palp of right maxilla 1; E, lower lip; F, maxilla 2; G, maxilliped; H, I, antennae 1, 2. (Lower lip to smaller scale than other mouthparts; antennae to same scale).

setae on upper margin; peduncle bearing about 12 spines, 3 of which are relatively large basofacial (cf. *H. samacos*). Uropod 2: inner ramus subequal in length to outer, with apical spines and row of rather long plumose setae on lower margin; outer ramus with about 5 apical spines; peduncle subequal to rami in length, armed with about 3 spines. Uropod 3 relatively long, about 22% length of body; rami of equal length but outer bearing spines only (in clusters of 2 or 3) on outer margin; inner margin of outer ramus and both margins of inner ramus with spines and plumose setae. Telson rather long, about 25% longer than broad; apical margin with deep, V-shaped cleft extending ca. 75% distance to base; apical lobes bearing 4 or 5 apical spines each; lateral margins lacking spines.

Type-locality.—Emerald Sink (or Emerald Cave), located on the Stockton Plateau in Val Verde Co., Texas (see Fig. 12), extends to a depth of approximately 91 m below the entrance and contains a deep lake of phreatic water on the lower level. The cave is excavated in limestones of the Buda and Devils River formations of Cretaceous age; a description of the cave was published by Kunath and Smith (1968).

Relationship.—Although this species does not

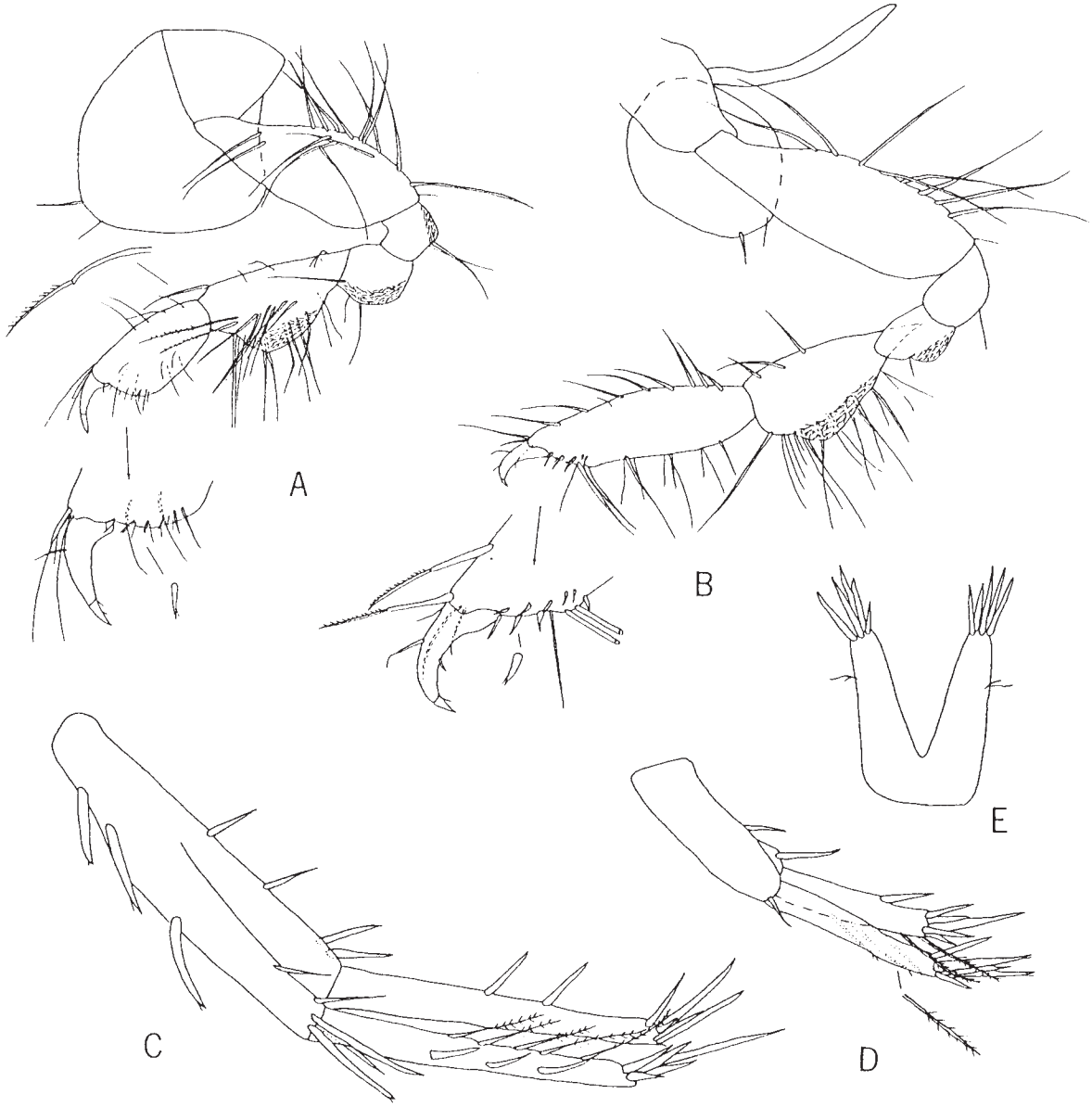

Fig. 8.—*Holsingerius smaragdinus*, new species, paratype female (8.0 mm), Emerald Sink, Val Verde Co., TX: A, B, gnathopods 1, 2 (palms enlarged), C, D, uropods 1, 2; E, telson. (Gnathopods to smaller scale than uropods and telson.)

have as many setae on the inner plates of maxillae 1 and 2 as *H. samacos*, the number is significantly greater than those observed in species of *Mexiweckelia*. Moreover, a close alliance between *H. smaragdinus* and *H. samacos* is evidenced by occurrence of the following character states in the former: elongate 1st antenna; vestigial lacinia mobilis of right mandible; symmetrical palps of maxilla 1; long, narrow propod of female gnathopod 2, which narrows unevenly toward distal end; less than distal position of posterior lobes of the carpus of both gnathopods; coxa 1 larger than 2; broad bases of pereopods with prominent distoposterior lobes; produced corners of pleonal plates; 6 or 7 coupling

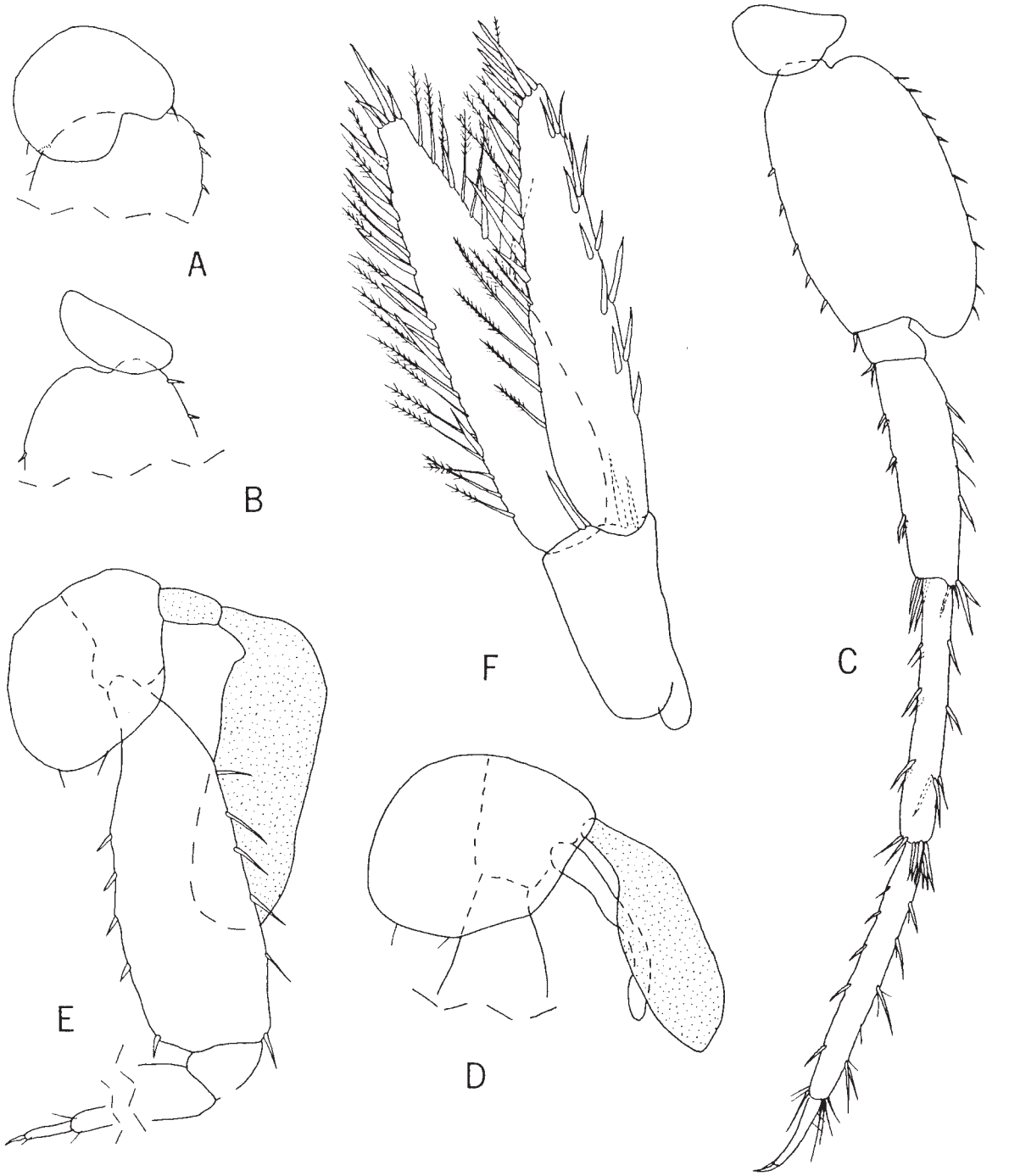

Fig. 9.—*Holsingerius smaragdinus*, new species, paratype female (8.0 mm), Emerald Sink, Val Verde Co., TX: A, B, coxae and upper part of bases of pereopods 5 & 6; C, pereopod 7; D, coxa, gill and brood plate of pereopod 3; E, pereopod 4 (in part); F, uropod 3. (Pereopods 5, 6 & 7 to smaller scale than pereopods 3 & 4, uropod 3 to larger scale.)

spines on pleopod peduncles; 3 large basofacial spines on peduncle of uropod 1; and deep, relatively wide cleft of telson. Although some of these similarities are probably more variable than others, this high number of shared characters, many of which are synapomorphies, clearly indicates a much stronger phylogenetic relationship of *H. smaragdinus* with *H. samacos* than with species of *Mexiweckelia.*

Distribution and ecology.—This species is known only from its type locality, where it has been collected twice from a phreatic lake, probably exceeding a depth of 10.6 m. The lake is also inhabited by the stygobiont cirolanid isopod *Speocirolana hardeni*, described by Bowman (1992, in this vol.).

Etymology.—The epithet *smaragdinus* is from Latin, meaning "emerald-green," and is used in reference to the type locality which is sometimes said to contain "emerald-green water."

FAMILY SEBIDAE WALKER, 1908

Genus *Seborgia* Bousfield

Seborgia Bousfield, 1970:164; Karaman, 1982: 86-87.
Relictoseborgia Karaman, 1982:91-92.

Remarks on taxonomic status.—*Seborgia* was erected by Bousfield (1970) for a single species, *S. minima*, which he described from an oligohaline-brackish water lake on Rennell Island in the British Solomon Islands in the South Pacific. A second species, *S. relicta*, was described from the artesian well in San Marcos, Texas, and assigned to this genus by Holsinger and Longley (1980).

On the basis of small differences in morphology between these species, Karaman (1982) proposed the new genus *Relictoseborgia* for *S. relicta*, while retaining *Seborgia* for *S. minima*. In support of his proposal, Karaman (1982) pointed out that the Texas artesian well species differed primarily by having a shallow lateral cephalic (interantennal) lobe combined with an obsolete anteroventral (inferior antennal) sinus, "non-telescopically-shaped" antenna 1, proportionately longer mandibular palp segment 1, larger inner lobes of lower lip, unequal-sized gnathopods, and peduncle of uropod 3 shorter than unisegmented ramus.

In my opinion most of these differences are minor or variable and all are within the accepted range of morphological parameters generally expected between species in the same genus (see also Holsinger and Longley, 1980; Holsinger, 1986a). However, in combination with each other and with the extreme geographic separation and significant habitat difference of these species, I agree with Karaman that these differences probably support some kind of recognition above the species level for these taxa. However, considering the lack of strong morphological differences and the fact that only two (now four) species are involved, full generic status may not be warranted. Instead, I propose dividing *Seborgia* into subgenera along the lines indicated below.

Subgenus *Seborgia* Bousfield, NEW RANK

Seborgia Bousfield, 1970:164; Karaman, 1982: 86-87.

Diagnosis.—Corresponding to the diagnosis for genus *Seborgia* given by Karaman (1982:86), except that eyes may be present and the inferior antennal (anteroventral) sinus is variable in depth.

Remarks.—This subgenus contains two species: *S. minima* Bousfield (1970), already mentioned above; and *S. schieckei* Ruffo (1983) from a brackish mesopsammic habitat on the coast of South Andaman Island in the Indian Ocean. Although *S. schieckei* is more closely allied morphologically with *S. minima* than *S. relicta*, its slightly less produced interantennal lobe and weak inferior antennal sinus are apparently intermediate between the two extremes noted in the other two species. To date, *S. schieckei* is the only eyed member of the genus.

Subgenus *Relictoseborgia* Karaman, NEW RANK

Relictoseborgia Karaman, 1982:91-92.

Diagnosis.—Corresponding to the diagnosis given for genus *Relictoseborgia* by Karaman (1982).

Remarks.—This subgenus contains two species: *S. relicta* (Holsinger, in Holsinger and Longley, 1980) from the artesian well in San Marcos, Hays Co., Texas and a new locality from Medina Co., Texas, noted below; and *S. hershleri*, new species, from Val Verde Co., Texas, described below.

Seborgia (Relictoseborgia) hershleri, new species
Fig. 10

Material examined.—TEXAS: *Val Verde County*: unnamed spring on east side of Devils River, ca. 32 km N of Del Rio, female holotype and 3 female paratypes, R. Hershler, 8 Sept. 1986;

additional paratypes collected by R. Hershler include 1 male (?) and 1 female, 1 Sept. 1986 and 3 females, 4 Sept. 1986.

The holotype is deposited in the National Museum of Natural History (USNM 239479); paratypes are deposited in the Texas Memorial Museum and author's collection.

Diagnosis.—A very small stygobiont species, closely allied with *S. relicta* and differing in only a few minor ways, which include apparent lack of setule on molar of mandible, few less setae on coxae of gnathopods and pereopods 3 and 4, fewer setae on bases of gnathopods; and possibly reaching sexual maturity at smaller size. Largest male, 1.3 mm; largest females, 1.6 mm.

Female.—Without eyes and pigment, of subterranean facies. Head and antennae very similar to those of *S. relicta*. Head with distinct rostrum, interantennal lobe broadly rounded but not produced, inferior antennal sinus very shallow or obsolete.

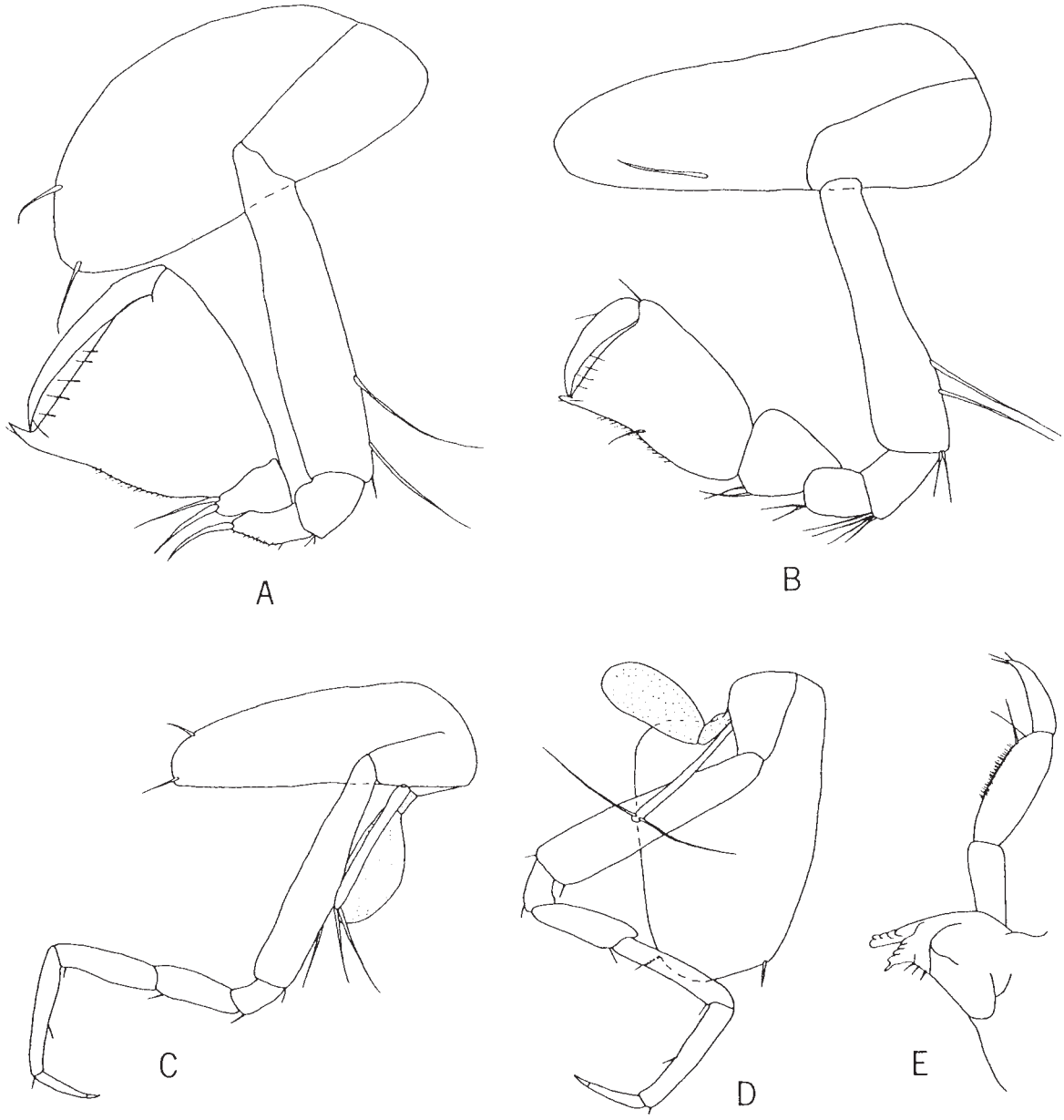

Fig. 10.—*Seborgia (Relictoseborgia) hershleri*, new species, paratype female (1.6 mm), unnamed spring, Val Verde Co., TX: A, B, gnathopods 1, 2; C, D, pereopods 3, 4; E, left mandible. (Gnathopods to larger scale than pereopods.)

Antenna 1 about 33% length of body, about 25% longer than antenna 2; primary flagellum with esthetascs; accessory flagellum 2-segmented (terminal segment rudimentary). Mouthparts generally like those of *S. relicta*, except for differences in mandible (but note that left and right mandibles are reversed in original description of *S. relicta* in Holsinger and Longley, 1980, fig. 23(e and f). Mandible: molar apparently lacking setule, incisor 5-dentate, lacinia mobilis of left 5-dentate; palp segment 1 relatively long, 2/3 to 3/4 as long as segment 2; palp segment 2 apparently little broader than that of *S. relicta*, with pilose inner margin and 2 setae distally; segment 3 lacking all but ca. 3 apical (E) setae. Lower lip with relatively large inner lobes. Maxilla 1: inner plate tapering distally, lacking apical setae; outer plate with 7 very weakly serrate spines; palps symmetrical, with few setae apically and subapically. Maxilla 2 reduced to single plate with broad base and 4-5 apical setae. Maxilliped: inner plate sublinear, with few apical setae; outer plate much broader, rounded apically, with fine setae on apex and few longer setae on inner margin distally.

Gnathopods subchelate. Gnathopod 1: propod prominent, almost twice size of propod of gnathopod 2, widest distally, palm transverse, bearing row of few setules on inside, defining angle produced into large spine-like process, posterior margin long, oblique, and piliferous in part; dactyl long, closing against inside of defining angle boss, nail indistinct; carpus short, squat, posterior lobe bearing 2 thick setae; basis long and slender, with 2 long setae on posterior margin near distal end; coxa deep, about 2 times deeper than broad, ventral margin with 2 relatively long setae. Gnathopod 2: propod little wider distally than proximally, not much expanded, palm short, transverse, bearing few setules on inside, defining angle produced into small spine-like process, posterior margin long and partly piliferous, with 1 or 2 short setae; dactyl closing against inside of defining angle, nail indistinct; carpus about 50% length of propod, slightly lobed posterior margin with 2 short setae; basis long and slender, bearing 2 long setae on outer margin near distal end; coxa deep and rather narrow, bearing 1 or 2 long setae toward distal margin. Pereopods 3 and 4 subequal except coxae differ; coxa 3 very deep, subrectangular, extending perhaps 90% length of corresponding basis, distal margin with 2 short setae; coxa 4 also very deep, but much broader, extending to end of corresponding basis, distal margin with 2 short setae; dactyls long, at least 50% length of corresponding propods. Pereopod 7 subequal in length to pereopod 6, longer than pereopod 5, ca. 50% length of body. Bases of pereopods 5-7 with broad distoposterior lobes, posterior margins convex and partly serrate; dactyls rather long, ca. 50% length of corresponding propods. Coxal gills and brood plates like those of *S. relicta*.

Posterior corners of pleonal plates weakly produced, acuminate, without setules. Pleopods normal for genus. Uronites without dorsal spines. Uropod 1: inner ramus little longer than outer ramus and peduncle, bearing 2 short spines near distal end, outer ramus with 1 or 2 short spines near distal end; peduncle with 2 spines distally. Uropod 2: inner ramus short, only about 1/2 length of outer ramus and peduncle; armed with 2 short spines near distal end; outer ramus with 1 or 2 short spines near distal end; peduncle with 2 spines distally. Uropod 3 uniramus; peduncle at least 2/3 length of ramus; ramus without spines. Telson little longer than broad, gently tapering distally, lacking spines or setae; apical margin entire (not cleft).

Type-locality.—Unnamed spring on east side of Devils River in a canyon just downstream from Slaughter Bend, Val Verde Co., Texas (see Fig. 11). This spring is also the type locality for a stygobiont hydrobiid snail, *Phreatodrobia coronae* Hershler, and is described in some detail by Hershler and Longley (1987).

Distribution and ecology.—This species is known only from its type locality, where it has been found in association with two other stygobiont amphipods: *Stygobromus* (possible new species of the *flagellatus* group) and an undescribed new genus of the family Hadziidae; the latter being much more common than the former. *Seborgia hershleri* was also collected with planarians, the hydrobiid snails mentioned above, copepods, and cirolanid isopods (*Cirolanides texensis* Benedict — see Bowman, 1992, this vol.). Of a total of 9 specimens collected to date (all during September), 8 were females and 5 of them were ovigerous. The females measured 1.4 to 1.6 mm in length; 4 were carrying 1 egg each, whereas the other had 2 eggs.

Devils River, which drains south to the Rio Grande, lies on the southwest corner of the Edwards Plateau and just west of the area included within the confines of the Edwards Aquifer (see Holsinger and Longley, 1980; Longley, 1981). The springs along the east side of Devils River emerge from subterranean aquifers developed in the Georgetown limestone of Cretaceous age. Much of the stygobiont fauna from these springs is closely allied taxonomically with that found farther east in the San Antonio and San Marcos pools of the Edwards Aquifer.

Etymology.—It is a pleasure to name this species in honor of its collector, Dr. Robert Hershler, Associate Curator of Mollusks at the Smithsonian Institution.

Seborgia (Relictoseborgia) relicta Holsinger

Seborgia relicta Holsinger (in Holsinger and Longley, 1980):45, figs. 23-25 [Type-locality: Artesian well in San Marcos, Hays Co., Texas]; Holsinger, 1986a:568; 1986b:102, 104.

Relictoseborgia relicta (Holsinger): Karaman, 1982:92.

Material examined.—TEXAS: *Medina County*: Hondo Creek hyporheic, 6.5 km E of Hondo, 1 female, S. J. Harden, 10 Apr. 1986.

Remarks.—The single ovigerous female collected from a shallow pit dug into a gravel bank along Hondo Creek is the first recorded occurrence for this species outside the artesian well in San Marcos. It also marks a range extension of approximately 120 km to the southwest, as shown in Fig. 11.

DISCUSSION

Recent discoveries of new species of subterranean amphipod genera from south-central and western Texas that were previously known only from the artesian well in San Marcos, Hays Co., Texas, or from isolated localities in the Basin and Range Province of north-central Mexico shed new light on the taxonomic and biogeographic relationships of stygobiont amphipods in southern North America. As indicated below, these discoveries have several important implications for the evolutionary biology

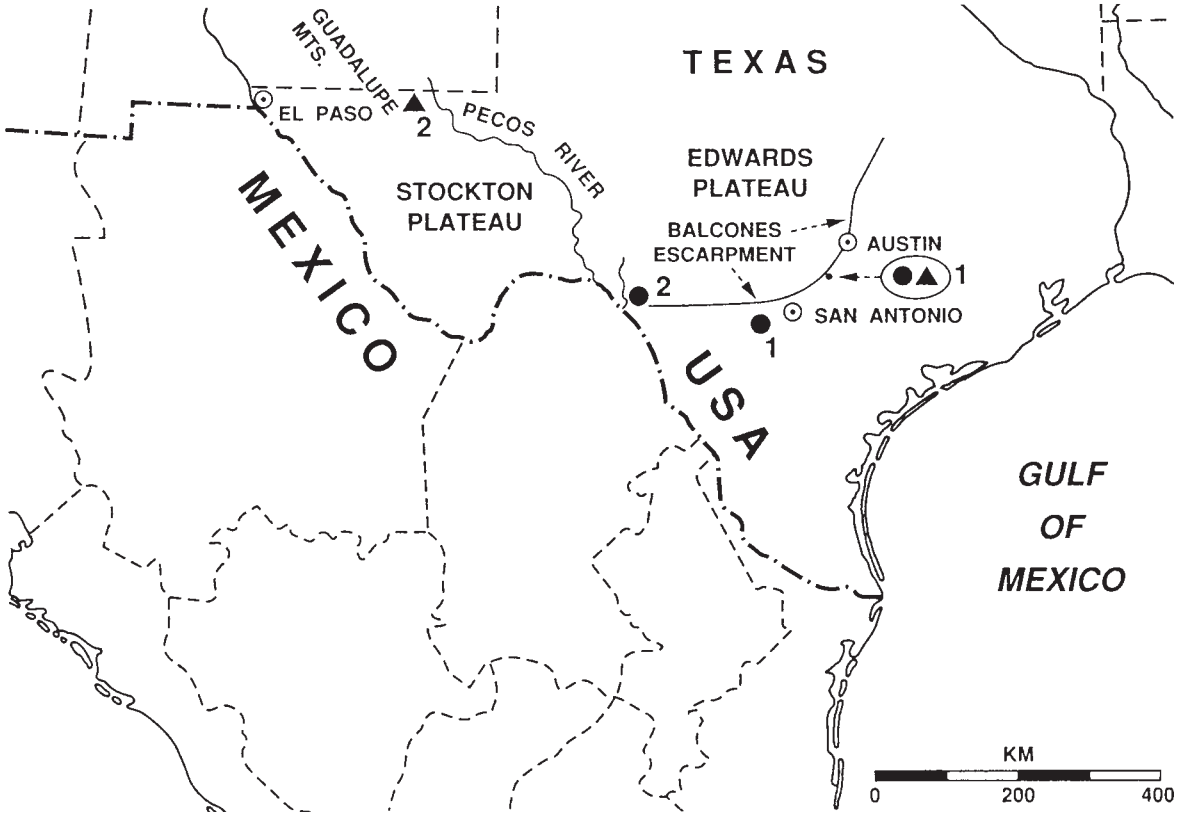

Fig. 11.—Geographic distribution of *Artesia* and *Seborgia* in Texas. Localities for *Artesia* indicated by closed triangles: 1, *A. subterranea* (artesian well in San Marcos, Hays Co.); 2, *A. welbourni* (Border Cave, Culberson Co.). Localities for *Seborgia* indicated by closed circles: 1, *S. relicta* (artesian well in San Marcos and Hondo Creek hyporheic, Medina Co.); 2, *S. hershleri* (unnamed spring on Devils River, Val Verde Co.).

of subterranean amphipod faunas of Texas and Mexico.

It has already been hypothesized that most of the non-crangonyctid subterranean amphipods of Texas and Mexico (e.g., artesiids, bogidiellids, hadziids, sebids) as well as other groups of stygobiont crustaceans (such as cirolanid and stenasellid isopods, and thermosbaenaceans), originated from marine ancestors through stranding in Late Cretaceous and/or early Cenozoic times (Holsinger and Longley, 1980; Bowman, 1982; Holsinger, 1986b). The inland, freshwater stygobiont members of these groups occur at present in areas that were once covered by shallow marine embayments. The distribution patterns of the new taxa fall well within areas previously subjected to Cretaceous embayments, and therefore offer further corroboration of the stranding theory.

The new locality for *Artesia* from Border Cave in Culberson County on the western fringe of the Great Plains, approximately 650 km west of the only other known locality for this genus in San Marcos (Fig. 11), is a significant range extension for this poorly understood stygobiont group. However, considering the great distance and potential dispersal barriers between these widely separate localities, the morphological similarity of *A. subterranea* from the artesian well in San Marcos and *A. welbourni* from Border Cave is surprising.

Border Cave is of further interest biogeographically for subterranean amphipods because it is inhabited by an undescribed species of the *hubbsi* group of *Stygobromus*. With one exception, this group is restricted to far western United States and southwestern Canada (Holsinger and Shaw, 1986). In the southwestern United States only one other species is recorded from southeastern Arizona, approximately 500 km to the west of Border Cave.

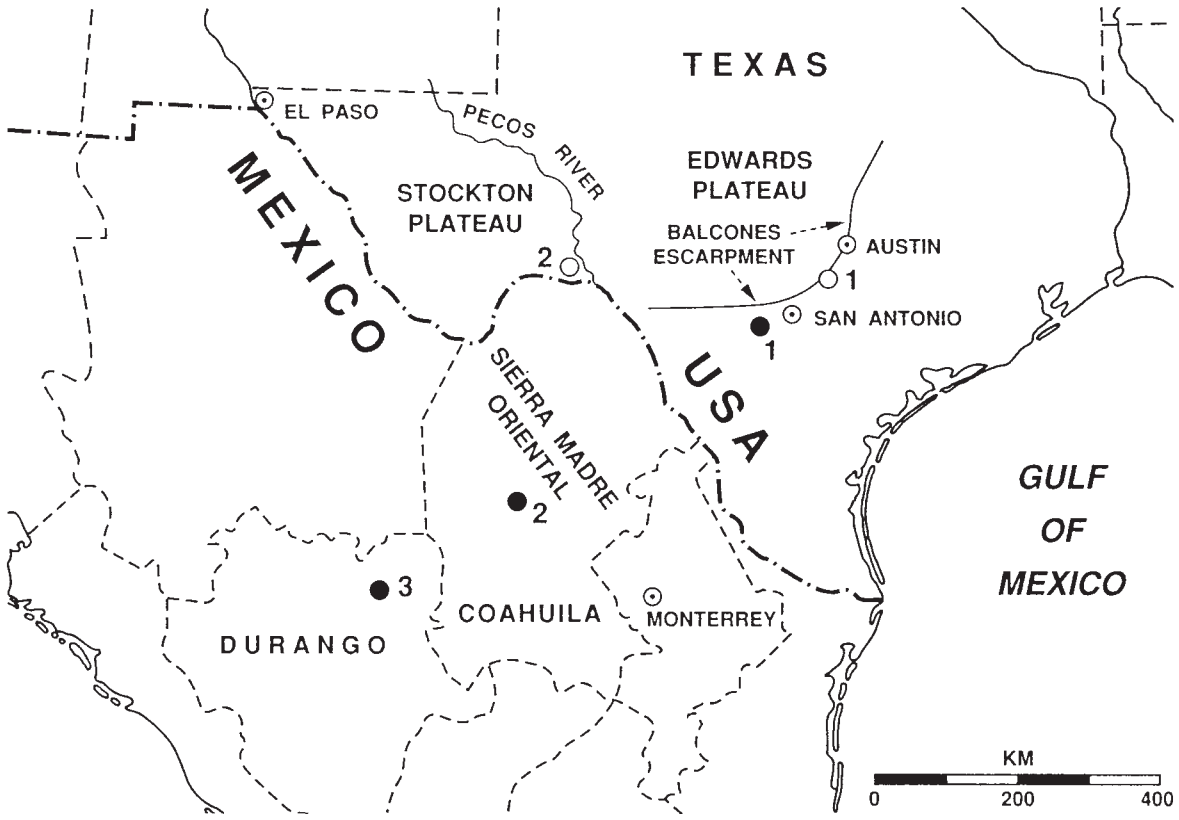

Fig. 12.—Geographic distribution of *Holsingerius* and *Mexiweckelia* in Texas and Mexico. Localities for *Holsingerius* indicated by open circles: 1, *H. samacos* (artesian well in San Marcos, Hays Co.); 2, *H. smaragdinus* (Emerald Sink, Val Verde Co.). Localities for *Mexiweckelia* indicated by closed circles: 1, *M. hardeni* (Hondo Creek hyporheic, Medina Co.); 2, *M. colei* (Bolsón de Cuatro Ciénegas, Coahuila); 3, *M. mitchelli* (Cueva de la Siquita, Durango).

Of biogeographic interest for the hadziid amphipods is the newly extended range of *Mexiweckelia* from Cuatro Ciénegas, Mexico northeastward across the Sierra Madre Oriental for approximately 400 km to Medina Co., Texas. The present distribution track of this genus (see Fig. 12) extends from northeastern Durango, Mexico to a point just southwest of San Antonio in Medina Co., Texas. This track overlaps the northern part of the distribution track of the stygobiont stenasellid isopod *Mexistenasellus* (see Bowman, 1982; 1992, this vol.). The congruence of these tracks can be interpreted to suggest that the evolutionary history of these two crustacean genera was influenced by the same factors.

The high number of characters shared by *M. colei* in Mexico and *M. hardeni* in Texas suggest that these taxa are probably sister-species with an immediate common ancestor. Paralleling the close phylogenetic relationship of the amphipods is the finding by Bowman (1992, in this vol.) that populations of the stygobiont isopod genus *Mexistenasellus* from the same localities as the amphipods are so similar that they apparently represent the same species. There is also significant overlap of this northern *Mexiweckelia-Mexistenasellus* track with the northern part of the range of the stygobiont cirolanid isopod *Speocirolana* (see also Bowman, 1992, this volume), offering further evidence for an important generalized crustacean track from north-central Mexico north and northeast into south-central Texas.

Also of interest for hadziids is *Holsingerius smaragdinus*, the second described species for this genus and the first record outside the artesian well in San Marcos. The new locality extends the range of the genus westward for approximately 350 km, from the Edwards Plateau across the Pecos Valley to the Stockton Plateau (Fig. 12). With respect to some of its mouthparts, *H. smaragdinus* appears to be intermediate between *Holsingerius* and *Mexiweckelia*, suggesting that these two genera are closely allied phylogenetically. This close relationship is strongly supported by a cladistic analysis (Holsinger, in prep.), which shows that *Mexiweckelia* and the several hadziid genera from the Edwards aquifer, including both *Holsingerius* and *Texiweckelia*, compose a nested subset of genera with a relatively recent common ancestry.

Finally, two new localities are noted for the rare, "dwarf" genus *Seborgia*, marking both significant range extensions and additional habitats for this group. The new locality for *S. relicta* in the hyporheic zone of Hondo Creek in Medina County is the first for this species outside the artesian well in San Marcos and extends the range of this species southwest for approximately 120 km (Fig. 11). It also documents the occurrence of this species from a shallow groundwater (hyporheic) habitat outside the deep phreatic waters of the Edwards Aquifer, per se.

Signifying an even greater range extension for this genus is the discovery of the closely similar species, *Seborgia hershleri*, from a spring in the Devils River gorge, approximately 250 km west of San Marcos (Fig. 11) and just west of the Uvalde pool of the Edwards Aquifer. The morphological similarities of *S. relicta* from Hays and Medina counties and *S. hershleri* from Val Verde County are striking, and the few differences noted between the two are conceivably within the limits of geographic variation. However, because nothing is presently known about variation in the few rare species of this genus, and because of the apparent geographic isolation of the populations, I have elected to treat the Val Verde populations as a separate species.

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TWO SUBTERRANEAN AQUATIC ISOPOD CRUSTACEANS NEW TO TEXAS: *MEXISTENASELLUS COAHUILA* (COLE AND MINCKLEY, 1972) (ASELLOTA: STENASELLIDAE) AND *SPEOCIROLANA HARDENI*, NEW SPECIES (FLABELLIFERA: CIROLANIDAE)

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ABSTRACT

Mexistenasellus coahuila is reported from wells and hyporheic waters in Bexar and Medina Counties. Illustrations are given of selected features and differences from type material from Coahuila, Mexico, are noted. *Speocirolana hardeni*, new species, is described from Bexar and Val Verde Counties; it is similar to *S. thermydronis*, but has longer and more slender pereopods and uropods.

In this paper I add 2 species, one new, to the known isopod fauna of Texas, and bring up to date the records of *Cirolanides texensis*, which now number 24.

STENASELLIDAE DUDICH, 1924

Mexistenasellus Cole & Minckley, 1972

Until now North American isopods of the family Stenasellidae have been reported only from Mexico, where 6 species of *Mexistenasellus* and 2 species of *Etlastenasellus* are known to occur (summarized in Bowman, 1982b). The northernmost of these stenasellids has been found recently in southern Texas, as documented below.

Mexistenasellus coahuila Cole and Minckley, 1972
Figs. 1, 5a

Mexistenasellus coahuila Cole and Minckley, 1972: 315-320, figs. 1-31; Cole, 1984:8-9.
Mexistenasellus sp.: Henry, Lewis, and Magniez, 1986:460.

Material.—TEXAS: *Bexar County*: spring on E bank of San Antonio River, 23 Oct. 1985 (Scott J. Harden), 2 males, 4 females (USNM 242471); 26 Oct. 1985 (Scott J. Harden, D. Kern, C. Lindblom), 1 male, 1 female (USNM 242472); Leon Creek powerplant well no. 1, 30 July 1979 (R. Rutland), 1 male (USNM 250357); well in Brackenridge Zoo, San Antonio, 3 Sept. 1976 (H. Karnei), 1 female (USNM 250358); 22 May 1981 (M. Brzozowski), 1 female (USNM 250359); 10 June 1981, 1 male (USNM 250360). *Medina County*: hyporheic zone, Hondo Creek: 4 mi. E Hondo, spring 1986 (Scott J. Harden), 3 males, 6 females (USNM 250187); 12 May 1987 (Scott J. Harden), 5 males, 8 females (USNM 250188); S of Highway 90, spring 1986 (Scott J. Harden), 1 male, 8 females (USNM 250189).

Remarks.—*Mexistenasellus coahuila* was described from thermal springs (>30°C) of the Cuatro

Ciénegas basin, central Coahuila, Mexico. Until now it has been known only from the type-locality. The Texas specimens fit Cole and Minckley's description except for some minor details as follows:

The uropods are slightly longer than the pleotelson. In *M. coahuila* they are distinctly shorter.

The pleotelson has a few dorsal setae not shown by Cole and Minckley.

On the exopod of the male pleopod 1 the distomedial setae are much longer than the distolateral setae. In Cole and Minckley's Fig. 24 they are only slightly longer. But in one of their paratypes mounted on a slide the medial setae are much longer.

The arrangement of setae on the exopod of pleopod 3 is slightly different.

The exopod of pleopod 5 is unarmed in the Mexican specimens; in the Texas specimens a seta is present on the suture between segments 1 and 2.

The Mexican specimens were "bright red in life."

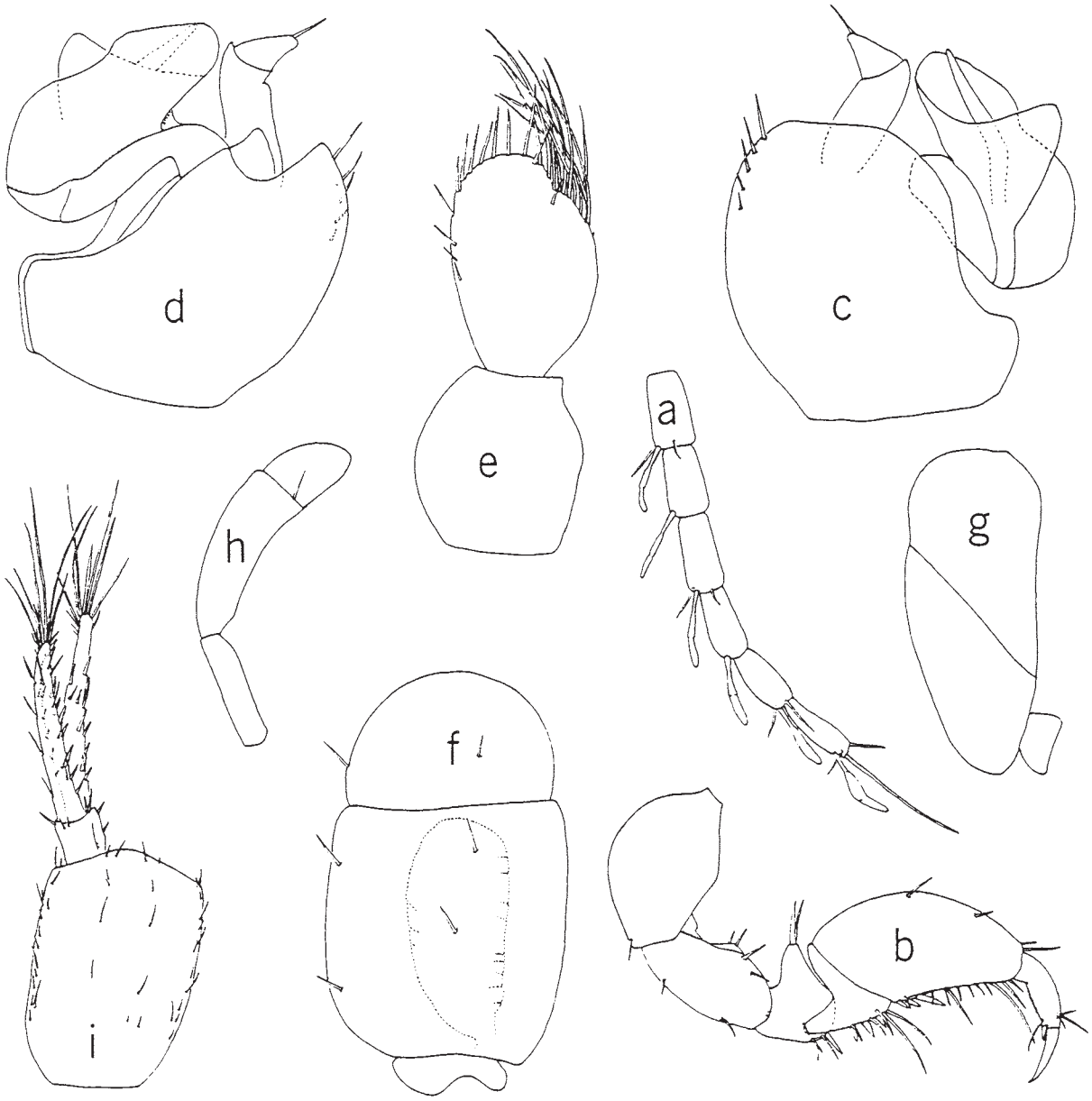

Fig. 1.—*Mexistenasellus coahuila*, a-b female, b-i male: a, antenna 1, distal segments of flagellum; b, pereopod 1; c, pleopod 2, anterior; d, pleopod 2, posterior; e, pleopod 1; f, pleopod 3; g, pleopod 4 exopod; h, pleopod 5 exopod.

A note by Scott Harden that accompanied the 23 October specimens reads, "Bright, +/- 'crimson' red pigment on head, telson, pereopods, and posterior margin of pereonites. Darker ('brighter') in some specimens than others."

The penes, previously undescribed in *M. coahuila*, are shown in Fig. 5a. They are widely separated and about half the length of pereonite 7. They broaden gradually in the proximal 2/3, then turn laterad and narrow to a rounded apex. The paired vas deferens, packed with sperm in the specimen illustrated, are parallel and separated by less than their width in pereonite 7. Near the distal end of the pereonite they turn laterad at nearly right angles and at the bases of the penes bend abruptly posteriad.

CIROLANIDAE Dana, 1853

Speocirolana Bolívar y Pieltain, 1950

The genus *Speocirolana* comprises 6 known species (summarized in Bowman, 1982a), all from caves in Mexico. The new species described herein is the first found outside of Mexico. It is most similar to its geographically nearest congener, *S. thermydronis* Cole and Minckley, 1966, but as pointed out below, the 2 species are easily distinguishable.

Speocirolana hardeni, new species
Figs. 2-4

Material.—TEXAS: *Bexar County*: Artesian Well no. 4, 1978-1979 (Henry Karnei, Glenn Longley), 14 specimens; CPS Leon Creek Well no. 1, 27 Aug. 1979 (Rick Rutland), 1 specimen; Verstraeten Well, 1977-1978 (Henry Karnei), 46 specimens. *Val Verde County*: Emerald Sink, 2 miles N of Langtry, 31 March 1984 (Randy M. Waters), male holotype, 17.9 mm (USNM 250182); paratypes, male 18.8 mm, 2 females 17.0, 19.0 mm (USNM 250183); 26 May 1985 (D. Canny, Scott Harden), 2 paratypes, male 17.1 mm, female 19.8 mm (USNM 250184). Slaughter Bend Springs (29°39'N, 100°55'W), 29 September 1984 (Robert Hershler), 1 juvenile (non-type) 4.7 mm (USNM 250185).

Description.—Length of largest male 22.4 mm, of largest female 27.0 mm. Body about 3.7X as long as wide, widest at pereonite 6. Anterior margin of head with slight median concavity, without rostrum. Frontal lamina conical, narrowly rounded anteriorly, not projecting ventrally. Measured in dorsal midline, pereonites 1-4 subequal in length, pereonites 5-7 subequal in length, each about 1/3 longer than pereonites 1-4. Pereonites 4-7 with transverse furrows, that of pereonite 7 almost reaching lateral margins. Coxae 2-3 reaching posterior margins of pereonites, rounded posteriorly; coxae 4-7 produced beyond posterior margins of pereonites into pointed processes, coxa 7 reaching or slightly exceeding posterior margin of pleonite 1. Epimera of pleonites with posteroventral corners angular but scarcely produced. Pleotelson about as long as basal width, about 1.4X length of pleon; lateral margins sparsely armed with minute setae, slightly convex; apex pointed, slightly obtuse.

Antenna 1 reaching beyond midlength of pereonite 1, peduncle segment 3 about 1.4X length of segment 2; flagellum with up to 18 segments, each segment with esthete except segments 1, 14, and 18. Antenna 2 reaching posterior margin of pereonite 6, peduncle segment 5 nearly 2X length of segment 4, flagellum with up to 40 segments.

Mandible incisors 3-cuspid, cusps more deeply separated in right incisor, which is covered externally by that of left; left lacinia with 13 marginal spines, molar with 27 marginal spines; palp segment 2 about 1.5X length of segment 1, with row of setae on distal 3/5 of lateral margin. Maxilla 1 exopod with 12 terminal spines; endopod with 3 long plumose spines and 2 shorter setae. Maxilla 2 with 5 and 7 pectinate spines on palp and exopod respectively; endopod with 13 setae. Maxilliped endite with 13 marginal setae and 2 retinacula; palp segments densely setose on medial margins, with 1 seta on lateral margin of segment 3, 2 on segment 4.

Pereopod 1 propus about 2.3X as long as wide; posterior margin (palm) laterally with 2 shallow lobes each bearing a stout spine, medially evenly rounded, hirsute. Pereopod 2 propus more slender, 1.7X as long as wide, palm weakly and evenly convex, bearing 3 spines more slender than those in pereopod 1. Pereopod 3 like pereopod 2, but segments slightly more slender and elongate.

Pereopods 5-7 slender, progressively longer posteriorly. Anterior and posterior margins wtih setules; basis with 1 or 2 retrorsoplumose setae on proximal part of posterior margin; merus, carpus, and propus each with short spine near midlength of anterior margin and clusters of long spines at antero- and posterodistal corners.

Exopods of pleopods 1-4 with plumose setae on posterior and much of lateral margins; pleopod 5 exopod with setae limited to distolateral corner; exopod of pleopod 1 undivided; exopods of pleopods 2 and 3 with partial sutures; exopods of pleopods 4 and 5 completely divided. Endopods

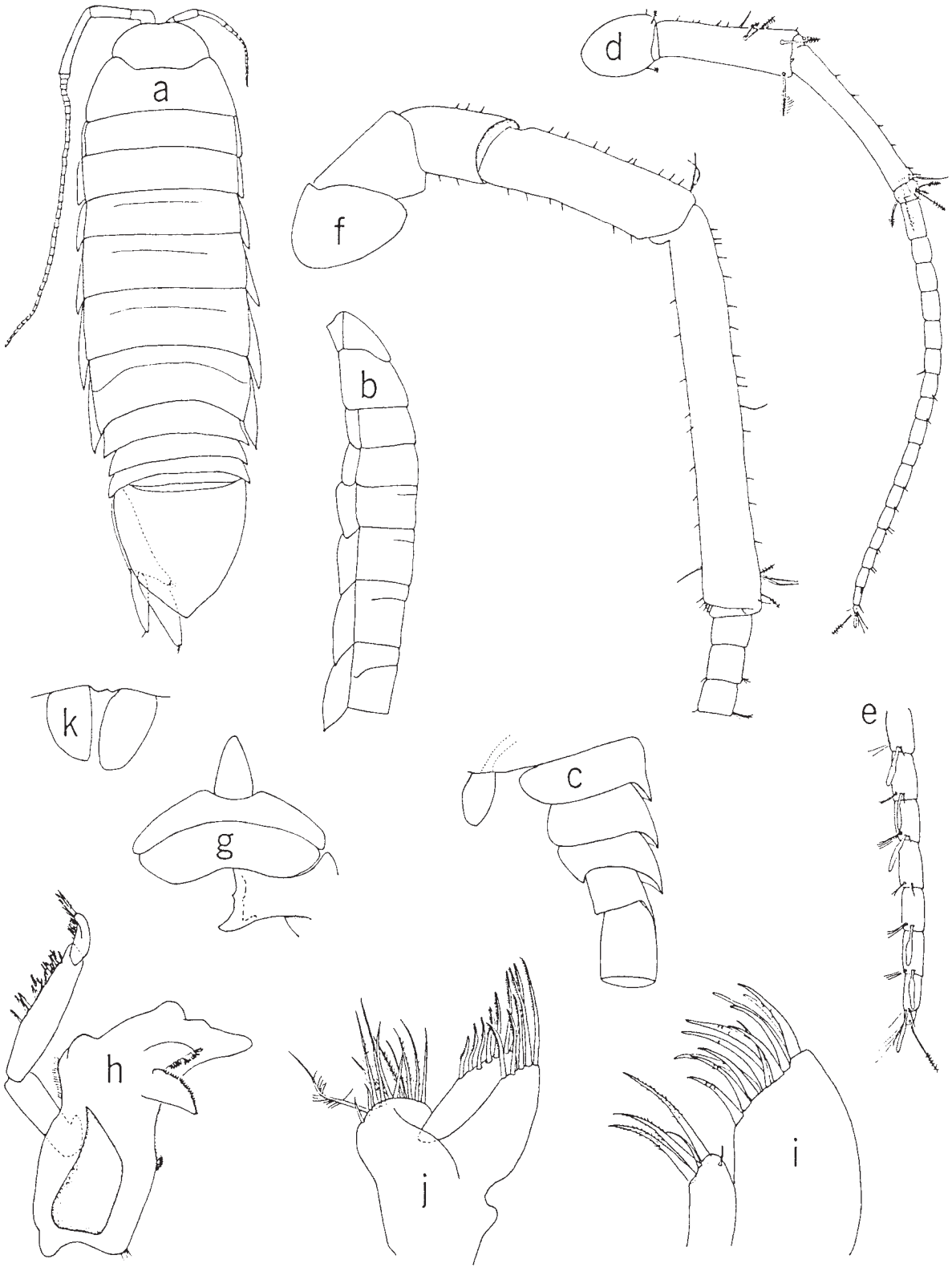

Fig. 2.—*Speocirolana hardeni*, a-b, d-j female, c, k male: a, habitus, dorsal; b, head and pereon, lateral; c, pleon, left side, ventral; d, antenna 1; e, antenna 1, distal segments of flagellum; f, antenna 2, peduncle, dorsal; g, buccal area, ventral; h, left mandible; i, left maxilla 1; j, left maxilla 2, k, penes.

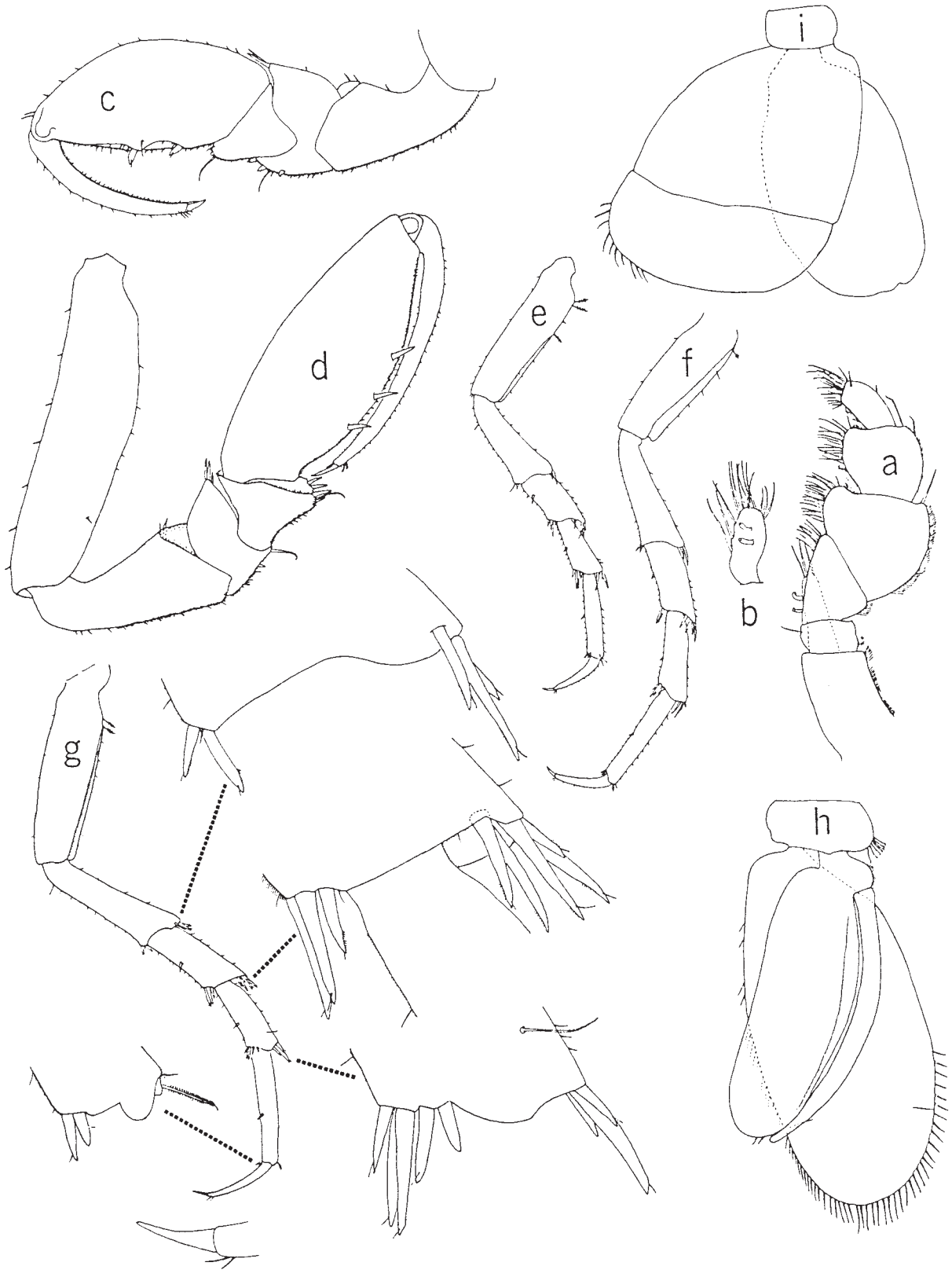

Fig. 3.—*Speocirolana hardeni*, a-b female, c-i male: a, left maxilliped; b, endite of same; c, pereopod 1; d, pereopod 2; e, pereopod 4; f, pereopod 5; g, pereopod 6; h, pleopod 2; i, pereopod 5.

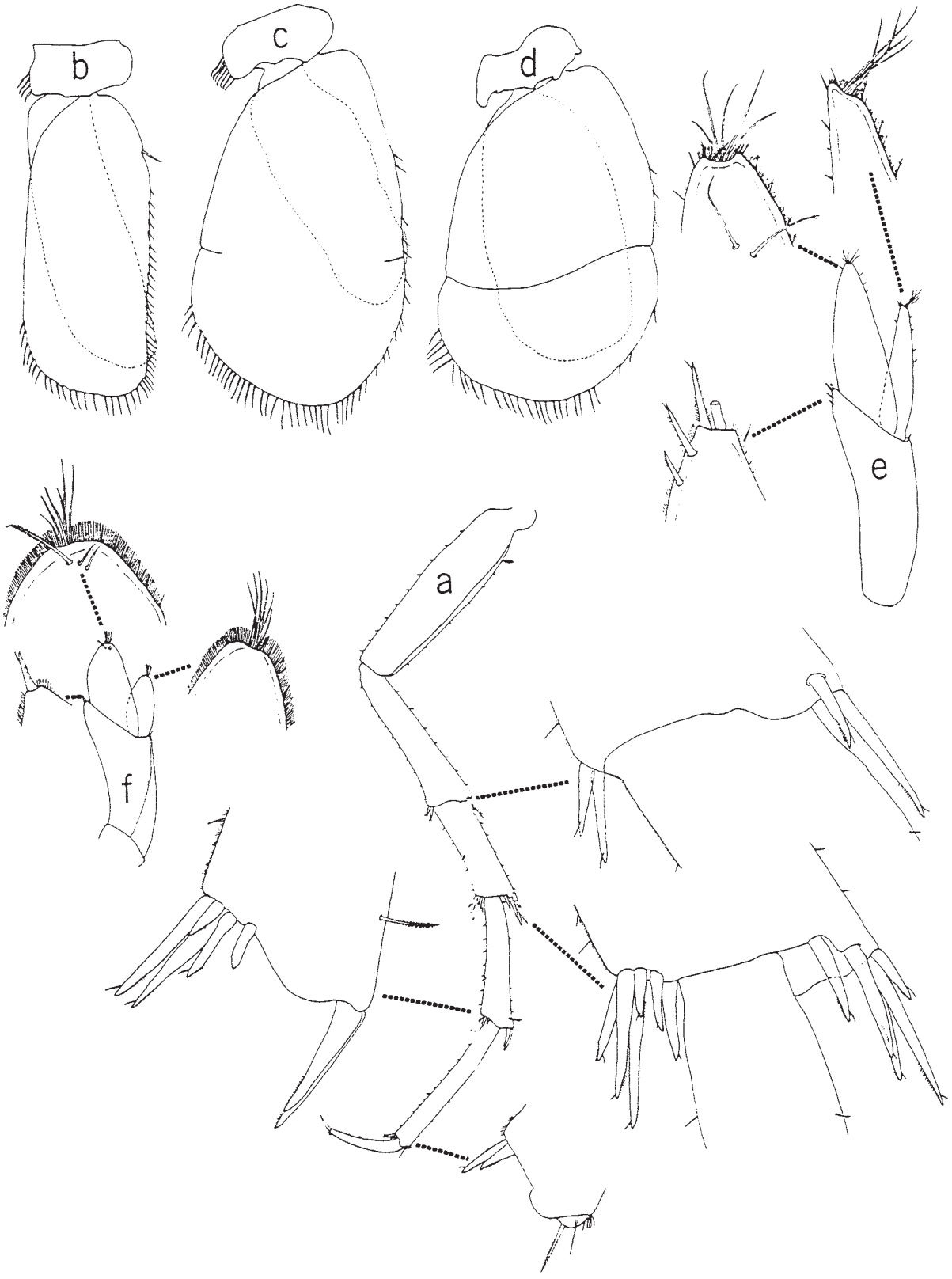

Fig. 4.—*Speocirolana hardeni*, a-d male, e female: a, pereopod 7; b, pleopod 1; c, pleopod 3; d, pleopod 4; e, uropod. *Speocirolana thermydronis* male: f, uropod.

unarmed, except in pleopod 2, which has 2 short setae on distal margin. Appendix masculina inserted near base of pleopod 2 endopod, slightly tapering distally to round tip reaching apex of endopod.

Uropod protopod about 3.6X as long as width at midlength, about 1.3X as long as endopod; distomedial corner with 2 apical and 2 subapical spines. Endopod subtriangular, about 3X as long as wide, apex with concavity bearing 5 long setae, 2 additional long setae inserted subapically on dorsal surface. Exopod about 0.8X length and 0.6X width of endopod, apex oblique, produced medially, with cluster of about 5 long setae arising from shallow concavity and directed posterolaterally.

Etymology.—Named for Scott Harden, whose energetic collecting has led to great improvements in our knowledge of the aquatic isopods of Texas.

Comparisons.—*Speocirolana hardeni* and *S. thermydronis* differ from the other 5 species of *Speocirolana* in having the apex of the pleotelson pointed; the apex is rounded or truncate in the other species. *Speocirolana hardeni* and *S. thermydronis* also differ in lacking spines on the margins of both uropod rami; the other species have marginal spines on the endopod or on both rami. The absence (or near absence) of marginal setae on the endopods of pleopods 1 and 2 also separates *S. hardeni* and *S. thermydronis* from the remaining species, all of which have marginal setae on these endopods.

Speocirolana hardeni and *S. thermydronis* differ most obviously in the shape and armament of the uropods. The rami of *S. thermydronis* are shorter and more rounded, and the armament of the apices of the rami and the medial prolongation of the protopod are quite different (compare Fig. 4e and Fig. 4f). the pereopods of *S. hardeni* are more slender and elongate than those of *S. thermydronis* (compare Fig. 4a herein with Fig. 16 of Cole and Minckley, 1966).

Cirolanides texensis Benedict, 1896
Fig. 5b,c

In my redescription of *Cirolanides texensis* in 1964, I listed the distributional records known at that time. I take this opportunity to bring this list up to date. Records are listed by county in alphabetical order.

Records.—TEXAS: *Bexar County*: Artesian Well no. 4; Isopit Cave; Leon Creek Powerplant Well no. 1; O.R. Mitchell Well; Twin Pits Cave, 10 km N of San Antonio; Verstraeten Well. *Burnet County*: Longhorn Caverns. *Comal County*: Honey Creek Cave; Python Pit; LCRA Well, New Braunfels.

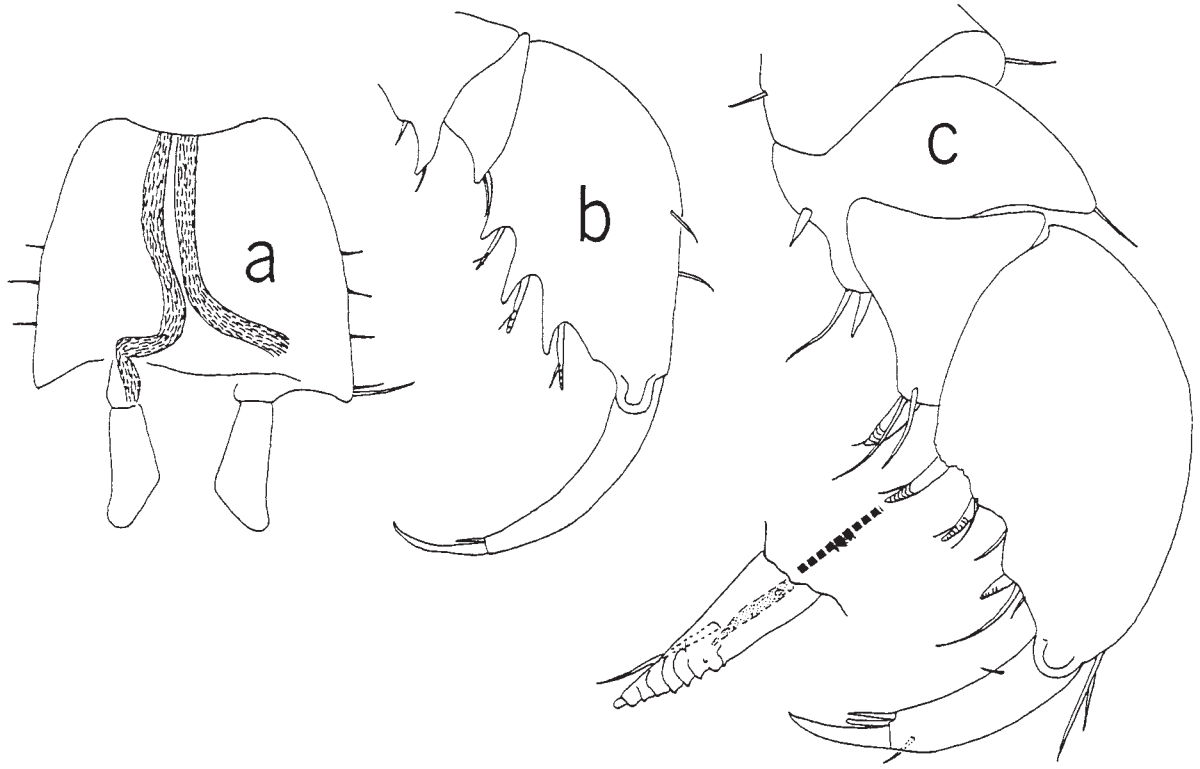

Fig. 5.—*Mexistenasellus coahuila*: a, male pereonite 7, ventral, showing vas deferens and penes. *Cirolanides texensis*, from Verstraeten Well, right pereopod 1, lateral: b, 5.7 mm juvenile; c, 13 mm male.

Crockett County: 0-9 Well. *Edwards County*: Devil's Sinkhole, Rocksprings. *Hays County*: Ezell's Cave, San Marcos; Marcia's Well, San Marcos, cave at 85 ft. depth; artesian well at fish hatchery, San Marcos. *Kerr County*: Stowers Cave, 13 mi. NW of Hunt. *Medina County*: Valdina Farms Sinkhole. *Real County*: Bonner Fallout Shelter Cave, 5 mi. N of Leakey. *Schleicher County*: Cave Y, 5 mi. N of Eldorado. *Uvalde County*: Indian Creek Cave, 22 mi. NW of Uvalde; McNair Cave; Rambie's Cave, 2 mi. N of Uvalde. *Val Verde County*: Diablo Cave, 15 mi. NW of Del Rio, calyx hole entrance; Four-Mile Cave, 4 mi. N of Del Rio; H.T. Miers Cave, 24 mi. N of Del Rio; Unnamed spring, ca. 20 mi. N of Del Rio, just E of Devil's River; Little Diablo Cave, 1 mi. from calyx hole entrance to Diablo Cave; Slaughter Bend Springs (29°39'N, 100°55'W).

Gnathopod development.—The gnathopod (pereopod 1) of *Cirolanides* has a precocious development. Fig. 5 shows, to the same scale, gnathopods from a 5.7 mm juvenile and a 13 mm adult male from the same sample. Although the juvenile body length is only 44% of that of the adult, the length of its propus is 82% of that of the adult; thus the juvenile propus has grown allometrically at nearly twice the rate of the body. In addition, the palm of the juvenile propus has 3 conspicuous narrow teeth that are reduced to low rounded lobes in the adult. The juvenile dactyl is slightly longer and much more slender than that of the adult.

Precocious gnathopod development does not occur in *Speocirolana*. Its presence in *Cirolanides* suggests a need for the juvenile to handle objects that a gnathopod developing isometrically could not cope with.

DISCUSSION

The occurrence of the same species (*Mexistenasellus coahila*) and a species pair (*Speocirolana thermydronis* and *S. hardeni*) in localities in northern Mexico and southern Texas separated by about 300 (*Speocirolana*) or 400 (*Mexistenasellus*) km suggests the earlier existence of continuous ranges from which fragmentation has led to the present isolated populations. A similar history for the subterranean amphipod genus *Mexiweckelia* is discussed by Holsinger (1973).

This is publication No. N.S.-55 of the Texas Memorial Museum.

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REVISION OF THE PROTOSCHIZOMIDAE (ARACHNIDA: SCHIZOMIDA) WITH NOTES ON THE PHYLOGENY OF THE ORDER

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ABSTRACT

The predominantly Mexican family Protoschizomidae is revised to include 11 species in two genera. *Protoschizomus* Rowland is recognized for seven species, five of which are placed in two species groups: the *pachypalpus* group includes *P. pachypalpus* (Rowland) (Tamaulipas), *P. rowlandi* n. sp. (San Luis Potosí), and *P. occidentalis* Rowland (Colima); the *sprousei* group includes *P. sprousei* n. sp. and *P. purificacion* n. sp. (both from Tamaulipas). Two species known only from females, *P. treacyae* n. sp. and *P. gertschi* n. sp. (both from Tamaulipas), are not placed in species groups. *Agastoschizomus* Rowland includes *A. lucifer* Rowland (San Luis Potosí), *A. huitzmolotitlensis* Rowland (San Luis Potosí), *A. stygius* n. sp. (Hidalgo), and *A. patei* (Tamaulipas). Several undetermined immature specimens, including the first species of the family from Texas and the U.S.A., are also recorded. The female genitalia are described for the first time for members of the Protoschizomidae. A new system for naming articles in the female flagellum and a revised method for numbering flagellar setae are provided. The phylogeny of the order Schizomida is discussed, and a cladogram of the families and protoschizomid genera and species is provided. The available data on habitats and cave life are recorded. *Agastoschizomus patei* may be paedomorphic, the first for the order.

INTRODUCTION

The family Protoschizomidae is a small distinctive group of the order Schizomida known only from southwestern Texas (U.S.A.) and Mexico. The first member of the family Protoschizomidae was described by Rowland (1971) as *Agastoschizomus lucifer* and placed in the Hubbardiidae (=Schizomidae). The subfamily Megaschizominae was named by Rowland (1973b) to include *Agastoschizomus* and the African genus *Megaschizomus* Lawrence. Rowland (1975b) later recognized the distinctness of the American forms and proposed the family Protoschizomidae to include *A. lucifer*, *A. huitzmolotitlensis* Rowland, *Protoschizomus pachypalpus* Rowland, and *P. occidentalis* Rowland. *Megaschizomus* was retained in the monotypic subfamily Megaschizominae in the Hubbardiidae (=Schizomidae).

In the present paper we redescribe the known species, describe five new species of *Protoschizomus*

and two new species of *Agastoschizomus* and describe for the first time the female genitalia of the Protoschizomidae. A phylogeny for the two families of the order and members of Protoschizomidae is provided.

METHODS

The methods and terminology essentially follow those of Reddell and Cokendolpher (1985), except for some anatomical terms which follow van der Hammen (1986). We have not followed all of van der Hammen's scheme as some doubt of its validity exists (see Shear et al., 1987; Shultz, 1989). The female genital sternites were examined in lactophenol. Routine examinations were of specimens placed in alcohol in small dishes. Positioning of specimens was best maintained by anchoring them in fine white sand. Black sand was sometimes used to view light colored structures. Examinations using compound microscopes were made while the specimen or dissected part(s) were placed on a microscope slide (generally a depression slide) in 100% glycerol. A small tuft of cotton placed in the glycerol was used to anchor the specimens. Specimens were never mounted with Balsam or similar media, a practice that should be discouraged since detailed studies at higher magnifications are severely hampered when specimens cannot be rotated.

We, as well as other earlier authors, have used misleading terminology regarding the "spines" of the pedipalps. According to "The Torre-Bueno Glossary of Entomology," a spine is not separated from the cuticle by a joint. This is not the case with the "spines" on the schizomid pedipalp. These structures are more correctly referred to as spinose-setae. Likewise, the use of spur(s) has sometimes been misused. A spur is a thick cuticular appendage connected to the body wall by a joint. The use of spur for the process on the mesal margin of the pedipalp trochanter appears correct, whereas such a reference to structures on the pedipalp basitarsus-tarsus is incorrect. Although these pedipalpal structures are more correctly termed spines, these structures have been commonly referred to as spurs for many years. For that reason we shall continue to refer to the basitarsal-tarsal spurs. Our use of the term plumose in earlier publications is somewhat misleading. As used by Harvey (in press), pilose is a better term to describe this condition.

The propeltidium was measured from the posteriormost seta on the anterior process to the posterior margin of the propeltidium. Leg and pedipalp segments were measured from dorsolateral joint to dorsolateral joint. The numbering of the setae on the chelicerae follows Lawrence (1969) (see Fig. 1a).

The setae on the protoschizomid flagellum are essentially divided into two groups: larger setae and microsetae. The microsetae are relatively uniform in size and shape and are found only on the distal tip of the flagellum and on the ventral surface of the male flagellum either on or posterior to the retractable

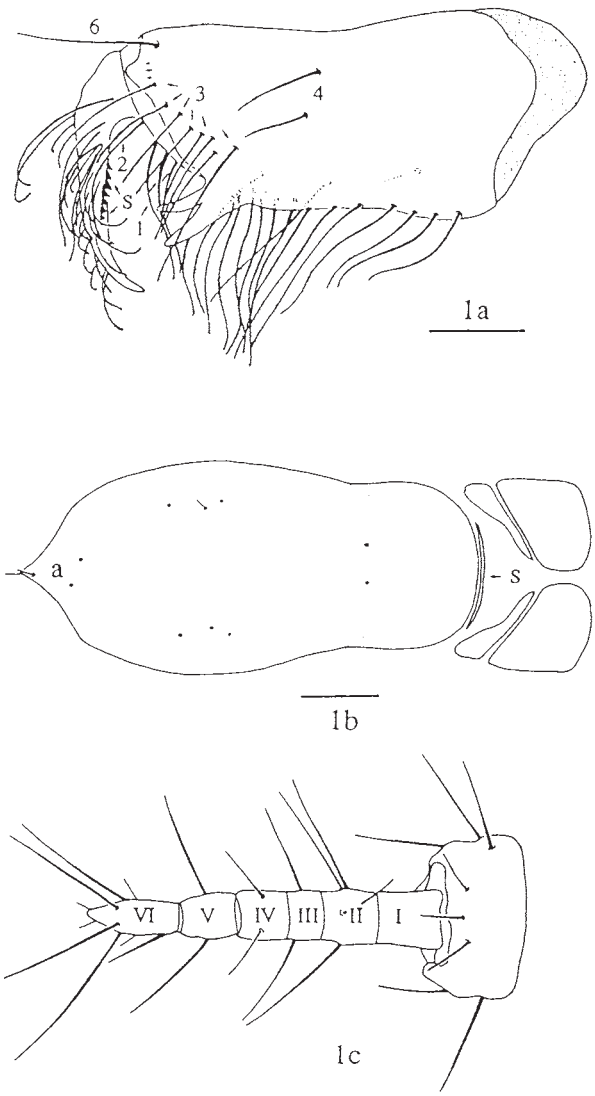


Fig. 1.—1a, Chelicera of male *Agastoschizomus huitzmolotitlensis*. Setal group numbering follows that of Lawrence (1969). Type 5 setae lacking in Protoschizomidae, S = serrula. 1b, Pro-, meso-, and metapeltidium of female *Protoschizomus rowlandi*. S = sclerite between propeltidium and split mesopeltidium; A = anterior process with row of two setae, followed by pair of setae at base. 1c, Dorsal view of female flagellum of *Megaschizomus mossambicus* (redrawn from Lawrence, 1958). Numerals refer to segment/article positions; see methods for further details. Scale lines = 0.2 mm.

lobes. The larger setae vary greatly in size and occur as simple pointed structures, or somewhat flattened with pilose borders, or as round pointed structures with pilose distal ends. Harvey (in press) noted the recurring pattern of setae and introduced the first notation for labeling the larger setae on the flagellum of schizomids (Hubbardiidae of Australia). While protoschizomids have all of the setae noted by Harvey, several other setae can be found on protoschizomid flagella, thus necessitating a renumbering of the setae. We have attempted to correlate our numbers with those of Harvey. Whereas Harvey only numbered larger setae, we have attempted to number all setae (except a terminal microseta, which is difficult to observe). We have done this because some setae will be microsetae on some species and larger setae on other species.

Female flagellum: Dorsal surface bearing up to five medial setae [dm1, dm2, dm3 (pair of setae), dm4] and up to four pairs of lateral setae (dl1, dl2, dl3, dl4). Ventral surface bearing up to eight medial setae [vm1, vm2 (pair of setae), vm3 (submedial pair of setae), vm4 (pair of setae), vm5] and two pairs of ventrolateral setae (vl1, vl2). From the relative positions on the adult female flagellum, the following correlations are suggested [Harvey (in press)=present system]: dm1=dm1, not present=dm2, not present=dm3, dm2=dm4, dl1=dl1, not present=dl2, dl2=dl3, not present=dl4, vm1=vm1, vm2=vm2, not present=vm3, vm3=vm4, vm4=vm5, vl1=vl1, vl2=vl2. The lateral setae are variable as to position and often appear to switch positions from dorsolateral to ventrolateral. An alternate hypothesis is that the said setae are not homologous and represent losses and gains, respectively. Since this would involve two steps (loss and gain) we feel it is more parsimonious to assume a shift in position. Several setae are short and sometimes thinner in the Protoschizomidae: dm3, dl1, dl4. In some specimens dl4 appear to be microsetae. A single microseta (larger in *A. patei* females), which we have not numbered, is often present on the most terminal area of the flagellum.

Male flagellum: The setation is similar, but never exactly the same as in females. In *A patei*, several pairs of setae have shifted to a ventral position. This shift is not noted in females or other males. Possibly the presence of ventrolateral lobes in the other species precludes the varying of setae. Numbering of setae is greatly aided by noting that vm3 are usually off-centered and that dm3, dl1, and dl4 are generally small in size.

There are five positions on the female flagellum of schizomids where annuli can occur. These areas may be evident as thinnings of the cuticle (sometimes only on ventral surface) or as clean breaks in the cuticle. We have numbered these areas, based on the genus with the greatest number of annuli (*Megaschizomus*), to standardize our descriptions and discussion (Fig. 1c). The positions of the annuli are always in the same place relative to the larger setae: segment I contains no setae; segment II with dm1, dm2, dl1, vm1-vm3; segment III with dm3, vm4; segment IV with dm4, dl2, vl1, and segment V with dl3, dl4, vm5, vl2. Position 2 annuli found in Hubbardiidae do not occur in protoschizomids. The distinction between segments and articles is not entirely clear. When examined under 100x the divisions between segments appear as breaks in the cuticle. The lines are generally thin and sometimes difficult to see. No musculature is evident and it is unlikely that these segments can be moved. Attempts to bend the flagellum at a segmental junction in a preserved specimen result in a clean break at that border. Subdivisions of the segments are evident by areas of thinned cuticle. These zones are sometimes quite wide and appear lighter in color than the surrounding cuticle. Segments do not appear to break at these subdivision zones and in preserved specimens this zone will withstand some bending. When the flagellum is divided by breaks in the cuticle we refer to the resulting subdivisions as segments. When a segment or entire flagellum is divided by only thinnings in the cuticle we refer to the resulting units as articles. Annuli are also present in juveniles but not in the flagellum of mature males.

The following acronyms have been used to designate museums in which the specimens are deposited:

AMNH - American Museum of Natural History, New York

CAS - California Academy of Sciences, San Francisco

TMM - Texas Memorial Museum, Austin (all specimens formerly reported in the collection of Texas Tech University have been transferred to TMM).

Character relationships were first examined using McClade (Maddison and Maddison, 1987). An exact analysis was performed using Hennig86 (Farris, 1988) which is "guaranteed" to find all of the most parsimonious cladograms. All multistate characters we treated as non-additive (unordered). To attempt to reduce the ambiguity of the strict consensus, successive approximations character weighting was applied. Because none of the characters conflicted, this produced identical results. Autapomorphic characters were not coded for the matrix. By doing

so we reduced the data matrix from 92 to 44 characters.

In determining the polarity of character states we have generally followed the five "rules of thumb" used by Shear and Gruber (1983): "1) occurrence in outgroups speaks for plesiomorphy, 2) less differentiated, more homonomously patterned meristic characters are plesiomorphic, 3) states resembling those in juveniles are plesiomorphic, 4) characters consistently correlated with others known to be apomorphic are likely themselves to be apomorphic, and (5) correlations between morphological and chronological or ecological positions (as in the foregoing) are to be used with caution."

PHYLOGENY OF THE PROTOSCHIZOMIDAE

The Uropygi and Schizomida (superorder Camarostomata) differ from other members of the Arachnidea (Tetrapulmonata, Megoperculata) by numerous synapomorphies. These include: fusion of the pedipalp coxae, posterior narrowing of the intercoxal region, reduction or loss of a postcerebral pharynx, presence of 2-3 transverse bridges with 1-2 fenestra on the endosternite, great elongation of the patellae of leg I, presence of two well-developed trichobothria distodorsally on leg tibiae I, single trichobothrium on tibiae II-IV each, presence of pretarsal depressor muscles originating from the posterior walls of patellae II-IV, absence of postgenital eversible appendages, presence of a pygidial exocrine gland, presence of a multi-jointed pygidial flagellum, absence of a distinct middle piece on the spermatozoan axonome, female grasping of male abdomen during mating, and the presence of a prenymph and four nymphal instars (Weygoldt and Paulus, 1979; Shear et al., 1987; van der Hammen, 1989; Shultz, 1990; Shultz, pers. comm.). Several other characters are known to separate Uropygi and Schizomida from other Arachnidea, but their polarities have not been established. These characters are found in spermatogenesis and spermatozoa morphology (Alberti and Palacios-Vargas, 1987).

In order to better understand the relationships within the Protoschizomidae, we first investigated

Table 1.—Characters and presumed polarities for cladistic analyses of selected taxa of the superorder Camarostomata. 0 = plesiomorphic; 1,2,3 = apomorphic.

0. Heart segments V and VI well developed (0), prosomal heart segements absent (1).
1. Prodorsum not divided into pro-, meso-, and metapeltidia (0), divided (1).
2. Anterior process absent (0), present (1).
3. Anterior prodorsum without seta (0), with setae (1).
4. Median eyes present (0), absent (1).
5. No setal pairs on prodorsum (0), with pairs of setae (1).
6. Two pairs stigmata in segments VIII and IX (0), one pair in VIII (1).
7. Eight pairs intestinal diverticula in the abdomen (0), with six pairs (1).
8. Anterior abdominal neuromeres absent (0), eight abdominal neuromeres present (1).
9. Propeltidium and tergites without distinct setal pattern (0), with (1).
10. Tergites without microsetae (0), tergites I-II with pairs of microsetae (1).
11. Pointed process on coxa 2 absent (0), present (1).
12. Unable to jump, femur IV not enlarged (0); able to jump, femur IV and its associated muscles enlarged (1).
13. Male flagellum divided into many segments (0), undivided (1).
14. Cheliceral fixed digit with two teeth (0), with three teeth (1), with more than three teeth (2).
15. Cheliceral serrula with rounded knobs (0), with hyaline teeth (1).
16. Cheliceral brush absent (0), present (1).
17. Row of two setae on anterior process (0), one seta (1), pair of setae followed by single seta on anterior process (2).
18. No seta at base of anterior process (0), pair of setae (1).
19. More than two pairs dorsal propeltidial setae (0), two anteriorly placed setal pairs present (1), two widely spaced setal pairs present (2).
20. Pedipalps sexually dimorphic (0), not dimorphic (1).
21. Male and female pedipalps of approximaly equal length as compared to the body length (0), male pedipalps longer (1).
22. Pedipalpal trochanter not produced (0), slightly produced (1).
23. Basitarsal-tarsal spurs symmetrical (0), slightly asymmetrical (1), asymmetrical (2).
24. Femur IV less than 4.8 times longer than deep (0), more (1).
25. Trochanter IV about 1/3 length of femur IV (0), about 1/2 length (1,2).
26. Tergite III with two setae (0), with four setae (1).
27. Male sternites with scattered or irregular rows of setae (0), with two distinct rows of setae (1).
28. Sternite VI long (0), short (1).
29. Eight dorsoventral muscles (0), seven (1).
30. Female flagellum with segments and articles (0), with segments only (1), without segments or annuli (2).
31. Female flagellum with position 2 annulus (0), annulus absent (1).
32. Flagellar setal patterns same in both sexes (0), patterns different (1).
33. Dm2 seta not present on female flagellum (0), present (1,2).
34. Dm2 seta not present on male flagellum (0), present (1).
35. Vm4 setae present on male flagellum (0), absent (1).
36. Dm4 seta present on female flagellum (0), absent (1).
37. Male flagellum not expanded distally (0), expanded (1,2).
38. Male flagellum with distinct stalk (0), without stalk (1).
39. Male flagellum over 3x long as wide (0), less than 3x (1,2).
40. Male flagellum distally rounded (0), laterally compressed distodorsally (1).
41. Microsetae at base of flagellum lobes (0), microsetae on lobes (1), microsetae absent (2).
42. Spermathecae with one pair lobes with pits (0), one pair lobes without pits (1), two or more pairs lobes without pits (2).
43. Receptaculum margins smooth without pits (0), smooth with pits (1), lobed with pits (2), saw-toothed with pits (3).

the relationships of the order and then those for members of the family. The character numbers in the following discussion are the same as those appearing in Tables 1-2 and Fig. 2.

Some authors consider the Schizomida to be a suborder of Uropygi, whereas others consider it an order. We, like some previous authors, prefer to recognize the Schizomida and Uropygi as separate orders within the Camarostomata. Most authors combining the two orders emphasize the existence of plesiomorphies or characters of undetermined polarity. Some of the differences between Schizomida and Uropygi are as great as the differences among the Uropygi, Amblypygi, and Araneae. Shear et al. (1987) suggested that the pygidial exocrine gland was an autapomorph for the Uropygi. This is not the case, as such glands are also present in the Schizomida (Brignoli, 1973).

Synapomorphies for the Uropygi are: pedipalps chelate, coxal gland orifices associated with leg III absent, lateral tergocoxal muscle inserted on the pleural membrane adjacent to the coxa, presence of ommatoids on dorsal surface of anal somite, flagellum with clear regions ventrally which are sensitive to light, presence of five posterior abdominal neuromeres, and modification of cheliceral cleaning organ.

The Schizomida can be separated from the Uropygi as well as other Arachnidea by the following synapomorphies: prosomal heart segments absent (character 0); prosoma divided into pro-, meso-, and metapeltidia (character 1); modification of the anterior portion of the prosoma into a pointed process (character 2); presence of setae on and basal to the anterior process of the propeltidium (character 3); median eyes absent (character 4); presence of pairs of dorsal setae on the propeltidium (character 5); stigmata lacking on segment IX (character 6); with six pairs of intestinal diverticula in the abdomen (character 7); with eight anterior abdominal neuromeres (character 8); male flagellum not divided into numerous segments (character 13); propeltidium and tergites with distinct setal pattern (character 9); tergites I-II with pairs of microsetae (character 10); anterior distal tip of coxa II prolonged as a sharp process (character 11); ability to jump, femur IV and its associated muscles being enlarged (character 12). Three additional characters are known which appear to be synapomorphies for the Schizomida, but because they have only been determined (examined) in a single species of Hubbardiinae we do not code them for the data matrix: absence of a posteriorly directed dorsal endosternite suspensor muscle; absence of anterior transpatellar muscle; and absence of the posterior patellotibial muscle. Additional characters are known (Millot, 1942) for which we have not determined the polarities. Specifically, uropygids have four pairs of prosomatic diverticula, schizomids have one pair;

Table 2.—Character states in selected members of the superorder Camarostomata (0 codes plesiomorphic condition; 1,2,3 codes apomorphic conditions; ? codes unknown condition or condition not relevant to region of cladogram being resolved). 1, Uropygi; 2, *Protoschizomus pachypalpus*; 3, *P. rowlandi*; 4, *P. occidentalis*; 5, *P. sprousei*; 6, *P. gertschi* (male unknown); 7, *P. purificacion* (male unknown); 8, *P. treacyae* (male unknown); 9, *Agastoschizomus lucifer*; 10, *A. huitzmolotitlensis* (female unknown); 11, *A. stygius* (male unknown); 12, *A. patei*; 13, Megaschizominae; 14, Hubbardiinae.

	Taxa													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Character														
0.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
1.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
2.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
3.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
4.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
5.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
6.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
7.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
8.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
9.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
10.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
11.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
12.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
13.	0	1	1	1	1	?	?	?	1	1	?	1	1	1
14.	0	0	0	0	0	0	0	0	0	0	0	0	1	2
15.	?	0	0	0	0	0	0	0	0	0	0	0	1	1
16.	0	0	0	0	0	0	0	0	0	0	0	0	1	1
17.	?	0	0	0	0	0	0	0	1	1	1	1	2	0,3
18.	0	1	1	1	1	1	1	1	1	1	1	1	0	0
19.	?	1	1	1	0	0	0	0	0	0	0	0	0	0,2
20.	0	1	1	1	1	?	?	?	1	?	?	1	0	0
21.	?	1	1	1	0	0	0	0	0	0	0	0	?	?
22.	?	0	0	0	1	0	1	0	0	0	0	0	?	?
23.	?	0	0	0	0	0	0	0	0	0	0	0	1	2
24.	?	0	0	0	0	0	0	0	1	1	1	1	0	0
25.	0	1	1	1	1	1	1	1	0	0	0	0	2	0
26.	?	1	1	1	0	0	0	0	0	0	0	0	?	?
27.	?	0	0	0	0	?	?	?	1	1	?	1	0	0
28.	?	1	1	1	1	1	1	1	0	0	0	0	0	0
29.	0	0	0	0	0	0	0	0	0	0	0	0	1	1
30.	?	0	0	?	0	0	0	0	0	?	0	2	0	1
31.	?	1	1	?	1	1	1	1	1	?	1	1	0	0,2
32.	?	1	1	?	1	?	?	?	1	?	?	1	0	1
33.	?	0	0	?	0	1	0	0	0	?	2	0	0	0
34.	?	0	0	0	0	?	0	?	1	1	?	1	0	0
35.	?	1	1	0	0	0	0	0	0	0	0	0	?	?
36.	?	0	0	?	1	0	1	0	0	?	0	0	0	0
37.	?	1	1	1	1	?	?	?	0	0	?	0	0	0,2
38.	?	1	1	1	1	?	?	?	1	1	?	1	0	0
39.	?	0	0	0	0	?	?	?	1	1	?	1	0	0,2
40.	?	1	1	0	0	?	?	?	0	0	?	0	?	?
41.	?	0	0	0	1	?	?	?	0	2	?	0	?	?
42.	?	0	0	0	0	0	0	0	0	?	0	0	1	2
43.	?	1	1	1	0	0	0	0	0	?	3	2	?	?

uropygids have no frontal gland, whereas one frontal gland is present in schizomids; uropygids have paired ovaries, but ovaries are unpaired in schizomids; uropygids have 12 esophageal neuromeres, schizomids nine.

The Schizomida are currently divided into three families, one of which is extinct. Because the specimens of the extinct family Calcitronidae (from Miocene or Pliocene deposits in Arizona, U.S.A.) are generally in bad condition, character states are hard if not impossible to determine. Rowland (1975a) reviewed the characters and accepted the leg tarsi as having 7:5:4:4 segments. The leg tarsi in the Uropygi, Hubbardiidae, and Protoschizomidae are 7:3:3:3. Because the few specimens of Calcitronidae known do not show characters needed to verify their placement in the Schizomida (synapomorphies listed above), an alternate hypothesis can be produced in which the tarsal count 7:3:3:3 is derived in the Schizomida (minus Calcitronidae) and Uropygi. The plesiomorphic condition is found in the Calcitronidae. In such a scheme the Calcitronidae would become the sister group and represent an unnamed order. While Amblypygi have numerous tarsal I segments (many more than 7), their legs II-IV counts are like the Schizomida and Uropygi (Shultz, 1990). The genus *Calcoschizomus* (currently placed in Hubbardiidae) is likewise extinct and like the members of the Calcitronidae the only known specimens are not preserved sufficiently well to determine the character polarities. Members of the Calcitronidae and *Calcoschizomus* will not be mentioned in the following discussion, because of the uncertainty of the characters.

Rowland (1975b) in erecting the family Protoschizomidae did not discuss the phylogenetic relationships of the family but from the name of the family he clearly indicated he felt it to be more primitive than the Hubbardiidae (=Schizomidae). In his unpublished dissertation, Rowland (1975a) elaborated on his reasons for considering the Protoschizomidae to be primitive. He presented several proposed transformation sequences in which the structure of the chelicerae and female flagellum were used to support his hypothesis.

The family Protoschizomidae was defined on the basis of the presence of eight pairs of dorsoventral abdominal muscles, the female flagellum with distinct segments, the absence of a serrula and brush on the chelicera, only two teeth on the fixed digit of the chelicera, the presence of "true spines" (see materials and methods on terminology) on the pedipalp, the symmetrical placement of the spurs of the pedipalp, the ratio of claw and spur lengths to the dorsal length of the pedipalp basitarsus-tarsus, the length/depth ratio of trochanter IV and femur IV, and the degree of separation of the mesopeltidial plates. Rowland (1975b) did not compare the Protoschizomidae with the Uropygi, the generally recognized sister group of the Schizomida.

Rowland (1975b) and Rowland and Reddell (1979a) distinguished the genera *Agastoschizomus* and *Protoschizomus* on the basis of several ratios: gap between mesopeltidial plates/width of plate, length/width ratio of metapeltidial plates, width/length ratio of sternites IV-VII, length of claw and spurs/dorsal length of pedipalp basitarsus-tarsus. These ratios appeared quite distinctive at that time since only two small epigean (*Protoschizomus*) and two large cavernicole (*Agastoschizomus*) species were known. With the discovery of several additional cavernicoles (described herein) exhibiting varying degrees of adaptation to the subterranean habitat, the ratios used to separate the two genera appear to have limited significance at the generic level. We retain the two genera with greatly different diagnoses based on characters apparently unrelated to the degree of specialization for cave existence. The following is a discussion of characters used earlier for separation of the genera and characters which we consider to be more phylogenetically significant.

Cheliceral teeth (character 14): The fixed digit of the chelicerae of the Protoschizomidae all have two teeth with essentially the same shape as in the Uropygi. The apomorphic conditions of three and many more than three teeth are found in the Hubbardiidae. Megaschizominae have three teeth whereas Hubbardiinae have many more than three teeth.

Cheliceral serrula (character 15): The Hubbardiidae possess a distinct row of hyaline teeth (serrula) on the mesal margin of the movable jaw of the chelicerae which probably function as a cleaning organ. The family Protoschizomidae lacks a true serrula, but does have in the same place a series of small rounded to sharp knobs or teeth similar in position and shape to those in the Amblypygi. Uropygids lack teeth. We have recorded the number of teeth in the serrula, but intraspecific variation in this character makes it of limited value even for species recognition.

Accessory teeth: Harvey (in press) first noted the importance of small rounded teeth on the lateral margins of the movable jaw of the chelicerae and named them accessory teeth. Megaschizominae have seven teeth, whereas Hubbardiinae have 0-3 teeth. Because these teeth are also missing in all protoschi-

zomids their absence is considered to be plesiomorphic.

Cheliceral brush (character 16): The Hubbardiidae have a brush of setae (type 5) on the base of the fixed cheliceral digit. The plesiomorphic condition of no brush is known in the Protoschizomidae and Uropygi.

Mesal setation of the chelicerae: We have recorded the number of setae for each species of Protoschizomidae, but intraspecific variation in this character makes it of limited value.

The anterior process of the propeltidium is downturned in most Hubbardiidae and Protoschizomidae. The straight forward-pointing process in *A. patei* is considered to be an autapomorphy.

Within the order, several patterns have been observed in the setation on the anterior process of the propeltidium. As already noted the presence of these setae is a synapomorphy for the order. In the Protoschizomidae there is either one or a row of two setae on the process. *Protoschizomus* (Fig. 1b) shares a row of two setae with all New World Hubbardiidae, with the exception of species of *Hubbardia*. In *Hubbardia*, *Megaschizomus*, *Trithyreus*, and most Old World species assigned (most incorrectly) to *Schizomus* the anterior process bears a pair of setae followed by a single seta. The presence of a row of two setae in *Protoschizomus* and Hubbardiidae implies that this is the plesiomorphic condition in the protoschizomids. *Agastoschizomus* lost one seta (character 17).

Pair of setae at base of process (character 18): In the Protoschizomidae there is a pair of setae at the base of the anterior process of the propeltidium. This pair is absent from the Hubbardiidae and Uropygi.

Setae on anterolateral margin of propeltidium: Megaschizominae have six or seven setae, in addition to the setae on and at the base of the anterior process, on the anterior margin of the propeltidium. All other Schizomida and Uropygi lack setae in this region.

The number of dorsal setae and placement on the propeltidium varies somewhat intraspecifically, but species of the *P. pachypalpus* group all have three or four pair, whereas other protoschizomid species have one or two pair. Members of Hubbardiidae have two to five pair. In the Protoschizomidae where the lower number of pairs occurs it is the posteriormost pairs that are absent, whereas in species of Hubbardiidae with two pair, the middle pairs are absent. Because different setal pairs appear to have been lost, we suggest the plesiomorphic condition for the order is more than two pairs (character 19). Further support for this polarity assignment is the widespread occurrence of this condition in the order.

Eyes: The Protoschizomidae and Megaschizominae lack eyespots. The Hubbardiidae usually have distinct eyespots, but these are sometimes absent, most frequently in cavernicolous species. A few species of Old World Hubbardiidae have distinct faceted lateral eyes. Lateral eyes are present in other Arachnidea indicating this is a plesiomorphic condition. However, the widespread loss of eyes in the Schizomida suggest that the presence of lateral eyespots and eye facets is a reversal or a new structure. The apomorphic interpretation of the eyespots is correlated with other characters in the Hubbardiidae known to be apomorphic.

Posterodorsal abdominal process: Some species of Hubbardiinae have a distinctly developed process at the posterior margin of abdominal segment XII. The absence of this process in the Protoschizomidae, Megaschizominae, and many species of Hubbardiidae implies that absence is the plesiomorphic condition.

Pedipalps: The shape of the pedipalp is useful in species recognition. In the Hubbardiidae the pedipalp may be highly modified both in shape and armature and appears of use in constructing phylogenies. Unlike many species of Hubbardiidae and Uropygi, the male and female pedipalps in the Protoschizomidae are essentially the same shape and possess the same armature (character 20). However, the male pedipalp is distinctly longer than the female pedipalp in relation to body length in the *P. pachypalpus* group. This condition is considered to be a reversal in the Protoschizomidae (character 21). The increase in size of the spurs and claw in the Protoschizomidae is generally correlated with body size. The claw is greatest in *A. patei* and almost as large in other species of *Agastoschizomus*. These are also the most troglomorphic species and this is probably an adaptation to cave life and possibly correlated with a more active hunting strategy of the cavernicole in a food poor environment. Large claws also occur in Megaschizominae and *Trithyreus*, both with large species.

Pedipalp trochanter produced distally: The distal margin of the trochanter of the pedipalp in most species of Protoschizomidae is not produced; it is slightly produced in *P. sprousei* and *P. purificacion*. It is distinctly produced in Megaschizominae. In the Hubbardiinae it may not be produced or may be highly produced and bear spurs or spinose-setae on the distal margin. The pedipalps of juveniles are not produced, implying that this is the plesiomorphic condition. The slightly produced trochanter in some

Protoschizomus is considered a derived condition in the Protoschizomidae (character 22). The trochanter in the Uropygi can be slightly produced or not. When slightly produced, it is widened as well and not laterally compressed as in schizomids. We believe the slightly "produced" state in the Uropygi arose independently and is not homologous with the produced state in the Schizomida.

The pedipalpal trochanter has a spur on the mesal side in most Hubbardiidae. However, the spur is absent in some apparently unrelated genera in the Hubbardiinae. It is absent from all Protoschizomidae and Uropygi and its presence in the Hubbardiidae is tentatively considered to be a synapomorphy. Apparently, the spur has been secondarily lost (or derived) on several different occasions in the Hubbardiinae. Further studies, with emphasis on the occurrence of the mesal spur, are needed to confirm the polarity of this character.

Basitarsal-tarsal spurs on pedipalp (character 23): The spurs on the protoschizomid pedipalp are symmetrically placed with respect to the claw. In Megaschizominae they are slightly asymmetrical, whereas in the Hubbardiinae they are distinctly asymmetrical.

Spinose-setae on pedipalps: One of the characters used by Rowland (1975b) in defining the Protoschizomidae was the presence of thick "spines" with socketed bases on the pedipalp (see materials and methods on terminology). This character is, however, also shared by *Megaschizomus*, *Trithyreus*, and *Schizomus ashmolei* Reddell and Cokendolpher. There is a complete gradation between hair-like setae and spinose setae and it is obvious that spinose setae are only modified setae. The absence of rigid spinose setae on most species of Hubbardiinae, however, implies that the character is of some phylogenetic significance. All species of *Protoschizomus* and *Agastoschizomus* possess spinose setae on the tibia and some species also have spinose setae on the patella. *Protoschizomus gertschi* also has spinose setae on the femur. *Megaschizomus mossambicus*, *Trithyreus*, and *Schizomus ashmolei* have spinose setae on all segments. Most protoschizomids (except *A. patei*, *P. pachypalpus*, *P. rowlandi*, *P. sprousei*, *P. purificacion*) have spinose setae on the patella. Because the resulting matrix does not follow any pattern observed with other characters, we assume the difference between spinose setae and setae is minor.

Anterior sternum: The number of setae is given for the anterior sternum, but this character is of limited value even in species recognition. The presence of only one sternapophysial seta occurs in *A. patei*. A single male of *P. sprousei* and the only known specimen of *P. treacyae* also have a single sternapophysial seta. All other species of Schizomida possess two sternapophysial setae. The presence of only one seta is therefore of considerable interest but its phylogenetic significance is unknown since it occurs in species apparently not closely related.

Legs: The general increase in length and slenderness of the legs is almost certainly a troglomorphic adaptation. The epigean species (*P. pachypalpus* group) have legs I and IV shorter than the body, whereas all of the cave species have these legs longer than the body.

Tarsus I: *Agastoschizomus patei* has the first segment of tarsus I longest, whereas it is approximately equal to or shorter than the last segment in all other Schizomida.

Anterodorsal margin of femur IV: The anterodorsal margin of femur IV slopes posteriorly in all Protoschizomidae, Megaschizominae, *Trithyreus*, and *Schizomus ashmolei*. In the remaining Hubbardiinae the margin forms about a 90° angle.

Length of femur IV (character 24): Femur IV is less than 4.8 times longer than deep in *Protoschizomus* and Hubbardiidae, but more slender in *Agastoschizomus*. This is probably related to the greater specialization to cavernicolous life by the latter species. The effects of the change in femur thickness and associated musculature on the ability to jump have not been investigated.

Length of trochanter IV (character 25): Trochanter IV is about 1/2 the length of femur IV in Megaschizominae and *Protoschizomus*, and about 1/3 the length in *Agastoschizomus*, Hubbardiinae, and Uropygi. We presume this condition arose separately in the two groups and therefore we have assigned separate apomorphic states to those forms with longer trochanters.

Mesopeltidial plates: The smaller species of Protoschizomidae all have smaller plates, with the gap between them being greater. The increase in size of the plates and subsequent decrease in the gap appears directly correlated with size and probably provides greater support to the larger species. It is, therefore, of limited value phylogenetically.

The condition of the metapeltidium was originally used to separate genera in the Hubbardiidae, with species having an entire plate being placed in *Schizomus* (and later *Megaschizomus* was added) and those with a split plate being placed in *Trithyreus*. The value of this character for generic identification was questioned by Hansen and Sörensen (1905), although they provisionally utilized it in separating subgenera. They noted that the metapeltidium in

some species could be either split, entire, or only partially separated. Most later authors have rejected it as a character of generic value. It is, however, of value when used in conjunction with other characters in delineating phylogenetic lineages. The state of the metapeltidium appears consistent within at least some groups of species. In the Protoschizomidae the metapeltidium is divided in *Protoschizomus* and *A. lucifer*; it is entire in *A. huitzmolotitlensis*, *A. stygius*, and *A. patei*. The divided metapeltidium of *A. lucifer* is considered to have been derived in *Agastoschizomus*.

Setation of the abdominal tergites: This character is fairly consistent in the family Hubbardiidae and is of some use in determining relationships. Megaschizominae have a submarginal row of four anterior setae which is not found in other Hubbardiidae. Protoschizomidae frequently have extra anterior setae but these do not form a distinct row and are presumably not homologous to the setae of Megaschizominae.

The Hubbardiidae most frequently have two large posterior setae on segments I-VII, with four setae on segments VIII-IX. In some species of Hubbardiinae the lateral setae on segment VIII are missing. In other species there are multiple setae on one or more tergites. There is some variation in number of setae, but usually the extra setae are either unpaired or minute; where there is a question it is assumed that the typical number is the normal state. As already mentioned, the presence of microsetae on tergites I-II is a synapomorphy for the order. Some "*Schizomus*" have lost some or all of the microsetae. When microsetae are present on tergite I, there are three closely spaced (in a row) on each side of tergite II. A derived condition occurs in *A. patei* where there are still three microsetae per side but they occur as a triad (one centered in front of pairs of microsetae). Tergite I contains two posterior setae in all protoschizomid species except *A. stygius* in which the setae are missing. Tergite II always has two setae in the Protoschizomidae as do some Hubbardiidae. Tergite III has four setae in the *P. pachypalpus* group, but two setae in all other protoschizomid species (character 26). This character state is unresolved on the ordinal level because members of the Hubbardiidae have two, four, and more than four setae. Tergites IV-VII have four setae in the *P. pachypalpus* group but vary in other groups and genera, with both character states being present in some species.

Setation of the abdominal sternites: In the family Protoschizomidae there are always two rows of submarginal setae on sternites IV-VIII and sometimes on IX in the females. In the males of the *P. pachypalpus* group the setae are scattered or at most form two close-set highly irregular rows near the posterior margin of the sternites. In the only species of the *P. sprousei* group for which males are known, the anterior row of setae is situated near the middle of the sternite rather than near the anterior margin. Most species of Hubbardiinae have two irregular rows in both sexes. The apomorphic condition (character 27) is found in *Agastoschizomus* males, which have two distinct rows of setae.

Width/length ratio of sternites IV-VII: There is a general decrease in the width/length ratio with increased body size. Even so, this character appears to be useful in separating *Protoschizomus* from *Agastoschizomus*. The width/length ratio of sternite VI (character 28) is below 2.3 for *Protoschizomus*. This remains true even for the species of *Agastoschizomus* that are smaller than the largest *Protoschizomus*. The ratio is greater than 2.3 in *Agastoschizomus* and the Hubbardiidae.

Abdomen: In some species of Hubbardiinae (*Hubbardia* Cook, *Stenochrus* Chamberlin, and "*Schizomus*"), some segments of the abdomen may be extremely elongate. This elongation does not occur in the Megaschizominae or the Protoschizomidae.

Abdominal muscles (character 29): The Protoschizomidae share with the Uropygi and Amblypygi the presence of eight dorsoventral muscles. The Hubbardiidae have lost the posteriormost pair.

All protoschizomids, except *P. rowlandi*, have 4-6 ventral setae on segment X of the abdomen. The derived condition, in *P. rowlandi*, is the occurrence of two setae.

Abdominal segment XII of protoschizomids generally has two dorsal setae. That of *A. stygius* are quite heavy and more spinose. The setae on male *A. huitzmolotitlensis* are very long and are extended over the flagellum.

The flagellum of some male Hubbardiidae (*Hubbardia*, "*Schizomus*", and Megaschizominae) is apparently (observation of preserved material only) carried with the posterior end up or arched forward towards the anterior end of the animal. Most Hubbardiinae and protoschizomids apparently do not hold the flagellum up. The IX sternite and tergite of some Hubbardiidae are modified so that the flagellum can be held up. These modifications include a shorter tergite IX than sternite IX length and arched and reduced ventral sternite.

Female flagellum: The flagellum is divided by annuli or rings in most schizomids. The annuli can occur as either thinnings in the cuticle or as breaks

in the cuticle. As already mentioned in the methods section, we consider segments to be subdivisions separated by breaks in the cuticle and subdivisions separated by a thinning of the cuticle as articles. This results in the use of opposite terms used by most previous authors. They apparently did not examine these annuli with sufficient magnification. Segments occur in all major groups of schizomids, whereas articles are apparently found only in Megaschizominae and Protoschizomidae. The loss of articles in the Hubbardiinae is considered a synapomorphy (character 30). The complete absence of all annuli in *A. patei* is an autapomorphy. While the reverse (development of articles is a synapomorphy for Megaschizominae and Protoschizomidae) is more parsimonious, not requiring a reversal, it is not consistent with other characters considered to be apomorphic. Treating the absence of articles as apomorphic resulted in a longer tree length (55 rather than 54) when examined using Hennig86.

The maximal number of annuli (five) occurs in the Megaschizominae. Lawrence (1958) reported that the female flagellum of *Megaschizomus* consisted of three segments, but his illustration (redrawn in Fig. 1c) showed annuli at five positions. From his description it appears he considered annuli at positions 4 and 5 to be true segmental divisions. Our examination of a female *Megaschizomus* suggests just the opposite; positions 1-3 are segmental divisions and positions 4 and 5 are only zones of thinned cuticle. The flagellum we examined was incomplete, missing the latter two positions. When we tried to position the specimen for examination, the basal segments broke apart cleanly, indicating that they were indeed segmental junctions. As already noted, no true articles are recorded for the Hubbardiinae. The number of subdivisions in the Protoschizomidae ranges from 0-5.

An annulus (segmental break) in position 1 is considered plesiomorphic as it occurs in both the Hubbardiidae and Protoschizomidae. The loss of this annulus in *A. stygius* is an autapomorphy. An annulus (segmental break) occurs at position 2 in only members of the Hubbardiidae (both Megaschizominae and Hubbardiinae). This annulus was apparently secondarily lost in some Hubbardiinae (character 31). An annulus at position 3 (segmental break) is known from all family level groups of schizomids. As it is also missing from numerous unrelated taxa in the Hubbardiinae and Protoschizomidae presence/absence of an annulus at position 3 will likely be useful only in separating congeneric species. An annulus at position 3 is found in *A. lucifer*, *P. pachypalpus*, *P. purificacion*, *P. rowlandi*, and *P. sprousei*. An annulus (thinning in cuticle in Megaschizominae and Protoschizomidae) is present at position 4 in both families of schizomids and its absence in some Hubbardiinae is considered to be a reversal. An annulus (thinning of the cuticle) is present at position 5 in the Megaschizominae and Protoschizomidae. It is apparently absent from the Hubbardiinae and *P. gertschi* and is therefore considered to have been lost on at least two occasions.

As noted by Harvey (in press), the flagellar setation of the Hubbardiidae appears to be unique. While the same setae are present in the Hubbardiinae as are present in the Megaschizominae and Protoschizomidae, the absence of setae resulting in the pattern dm1, dm4, dl3, vm1, vm2, vm4, vl1, vm5, vl2 is a synapomorphy for the Hubbardiinae. Harvey also noted that male and female flagella have the same number of setae and that the setae occur at approximately the same positions in the Hubbardiinae. This is not the case in the Protoschizomidae and is considered to be a derived state (character 32). Among female protoschizomids, dm2 is lacking from all species except *P. gertschi* and *A. stygius* (character 33). Because these species are apparently unrelated (based on other characters) and because dm2 do not occur in the Hubbardiidae, we suggest these setae developed independently. Seta dm2 is also lacking in penultimate males of *P. sprousei* and *P. purificacion* as well as adult males of *P. sprousei*, *P. pachypalpus*, *P. rowlandi*, and *P. occidentalis* (character 34). Several other setae are known to be absent from male protoschizomid flagella: vm4 from *P. pachypalpus* and *P. rowlandi* (character 35); dm3 from *A. patei*; vm5 from *A. huitzmolotitlensis* [note that vm5 may also be missing from male *A. patei* - we have not labeled it in our drawing but suggest it is one of the off- centered pairs numbered dl2, the second dl2 seta being absent (aberrant individual). Discovery of additional male *A. patei* should resolve this matter.]. Only females of *P. sprousei* and *P. purificacion* lack dm4 (character 36).

Male flagellum: The male flagellum of protoschizomids provides the best characters for distinguishing species. It also appears to be useful in delineating generic limits. In *Protoschizomus* the flagellum is distinctly enlarged distally (character 37), whereas in *Agastoschizomus* it does not increase in width distally. Since most species of Hubbardiidae also have apically enlarged flagella it is likely that this is the plesiomorphic state.

The male flagellum of protoschizomids (except *A. patei*) and Megaschizominae has soft, sometimes eversible areas. The males with these soft areas also

have small pores over the surface of the flagellum (especially distolaterally). Because the flagellum is grasped by the female during mating we suggest these soft areas might be squeezed by the female, possibly causing an exocrine secretion to be emitted through the pores. Such a system is known in Opiliones (cheliceral glands in the Ischyropsalidoidea), where the male produces a material that is eaten by the female during courtship and mating. The apparent absence of flagellar glands or sacs in the Hubbardiidae suggest this is a synapomorphy for the other schizomids. Because this is inconsistent with other known apomorphies for the order, we suggest these glands are retained in some Hubbardiidae. Rowland and Lawrence (both keen observers) studied protoschizomids and Megaschizominae but failed to note the soft regions or pores. With this in mind it is easy to understand why these structures could be missed on the much smaller Hubbardiinae. The published drawings of many Hubbardiinae reveal numerous lobes and surface depressions which could be the soft regions of the flagellum. It is for this reason we are considering the presence of these characters to be plesiomorphic. The loss of soft regions and surface pores in *A. patei* and some Hubbardiinae are considered derived.

The male flagellum of protoschizomids (excluding *A. patei*) and Megaschizominae have numerous "spicules." Although it is suggestive of some form of stridulation we are unable to locate opposing sound producing structures. Because the surface of the female flagellum is imbricate, it is possible these spicules are the remnants of the tips of the imbricate "scales." The male flagellum of *A. patei* is like that of juveniles and females. It lacks segmentation, eversible lobes, and pores, and the surface integument is imbricate. Because all other schizomids show marked adult and sexual dimorphism in the flagellum, we suggest *A. patei* is paedomorphic.

The absence of ventrolateral lobes also serves to separate *A. patei* from *Protoschizomus* and other species of *Agastoschizomus*. Because these lobes are not present in the Hubbardiidae, we assume they were secondarily lost in *A. patei*. Among the species with ventral lobes, all (except *P. sprousei*) have the tips of the lobes curved inward. The tips of *P. sprousei* curve outward.

The flagellum of the Protoschizomidae is without a distinct ventrally inserted stalk (character 38), whereas in the Hubbardiidae the stalk is distinct and especially so in Megaschizominae where it gives the appearance of comprising a separate segment. The male stalk is homologous to the first three segments (two in protoschizomids) in the female and juvenile flagella, as determined by setation. The male flagellum of *Protoschizomus* and most Hubbardiidae is less than three times as long as wide (character 39), whereas it exceeds three times in *Agastoschizomus*.

The distodorsal end of the male flagellum is laterally compressed in *P. pachypalpus* and *P. rowlandi*. This area is rounded in other protoschizomids (character 40).

Microsetae are often present on the ventral surface of male flagella which also have ventral lobes. Such setae are missing from *A. huitzmolotitlensis*, placed on the ventral lobes in *P. sprousei*, or placed near the base of the lobes in *A. lucifer*, *P. pachypalpus*, *P. occidentalis*, and *P. rowlandi*. This latter condition is considered plesiomorphic (character 41). Because no species without lobes have microsetae, we conclude the microsetae were independently lost in *A. huitzmolotitlensis*.

In *P. sprousei* males, the apex of the flagellum is triangular in shape. The apex in other protoschizomids is rounded.

In *P. pachypalpus*, the basal half of the male flagellum is strongly constricted and this character is considered an autapomorphy. Other protoschizomids have the base gradually or not constricted. The basal stalk of the flagellum in male *P. sprousei* is very broad, whereas the stalk is narrow in all other protoschizomids.

The male flagellum of *P. occidentalis* has two pairs of slit-sensilla lateral to the dm1 seta. This condition is considered an autapomorphy.

Some of the setae (dm3, dm4, dl2, dl3, vl2) on the male flagellum of *A. patei* are enlarged and have pilose borders on the distal half. This is considered an autapomorphy.

Female genitalia: Brignoli (1973) first noted the value of the spermathecae to the taxonomy of the Hubbardiinae. Rowland (1973c) indicated that the spermathecae were of limited value in distinguishing species due to interspecific variation. Rowland and Reddell (1979a, 1979b, 1980, 1981) described and illustrated the spermathecae of all New World species of the subfamily Hubbardiinae for which females were available. Reddell and Cokendolpher (1985) illustrated the spermathecae of the African subfamily Megaschizominae and the eastern Asia *Trithyreus* and Cokendolpher (1988) the species of Hubbardiinae from Japan and Taiwan. Reddell and Cokendolpher (1991) illustrated the only true member of *Schizomus* and Harvey (in press) illustrated the spermathecae of five new genera of

other Hubbardiinae. The spermathecae of no species of the Protoschizomidae have been up to now described or illustrated.

The spermathecae of the subfamily Hubbardiinae consist of one to multiple pairs of lobes, some of which are simple and not sclerotized, whereas others terminate in enlarged sclerotized bulbs (receptacula). The spermathecae of the Megaschizominae consist of a single pair of sclerotized lobes with the basal two-thirds being somewhat rugose and the spermathecae of *Trithyreus* have one pair of doubled lobes without pits (Reddell and Cokendolpher, 1985). The spermathecae of the Protoschizomidae comprise a single pair of lobes which are often shallowly pitted over most of their surface (character 42). The spermathecae of the Uropygi (Weygoldt, 1971, and pers. obs.) are quite different from those of the Schizomida and are not easily compared. The spermathecae of many primitive spiders and Amblypygi consist of two lobes which are pitted and appear very similar to those of the Protoschizomidae. While of some value in species recognition, the spermathecae do not appear to be helpful in distinguishing protoschizomid genera. In some species the spermathecae are distinctly enlarged distally. The spermathecae of the only known female of *P. treacyae* differ; one lobe is enlarged, the other simple.

The margins of the receptaculum are relatively smooth, without numerous pits in *A. lucifer*, *P. sprousei*, *P. gertschi*, *P. purificacion*, and *P. treacyae*. The margins are saw-toothed with many pits in *A. stygius*; lobed with numerous pits in *A. patei*, and smooth with numerous pits in *P. pachypalpus* group members (character 43).

The spermathecae are widened basally or with enlarged receptaculum in all protoschizomids except *A. stygius*. The gradually narrowed (towards the receptaculum) spermathecae are considered an autapomorphy for *A. stygius*.

A gonopod has been discovered in some Hubbardiinae. It is apparently absent from the remaining Hubbardiidae and Protoschizomidae.

Cladogram

At first glance, one might question why we have presented a cladogram. While it is true many of the relationships and characters are unresolved, we felt our data could serve as a starting point. This is the first attempt to apply cladistics to any taxa within the order. It is hoped our efforts will stimulate others to examine characters more closely. It is immediately evident that the unresolved areas contain species in which one sex is unknown. Unlike many other groups of animals, one cannot simply re-collect at the type locality to obtain the needed material. In almost all cases the type localities are caves (some very deep and inaccessible) and specimens are scarce. Additional material, if obtained, may help resolve the cladogram further.

The analysis resulted in 117 equally parsimonious solutions, each 54 steps long and with no character conflicts (i.e., the consistency and retention indices are both 1.00). The strict consensus of those 117 cladograms is presented in Fig. 2.

Based on our cladistic analysis, the order Schizomida is easily divided into two families: Protoschizomidae and Hubbardiidae. The Protoschizomidae are likewise split into two clades: *Protoschizomus* and *Agastoschizomus*. We can easily distinguish four species in *Agastoschizomus*: *A lucifer*, *A. huitzmolotitlensis*, *A. stygius*, and *A. patei*.

The genus *Protoschizomus* can be separated into the *P. pachypalpus* group, the *P. sprousei* group, and two unplaced species. As with *Agastoschizomus*, the missing data from species known from single sexes is the major problem.

DISTRIBUTION

The family Protoschizomidae is known only from the eastern part of the Sierra Madre Oriental in the states of Hidalgo, San Luis Potosí, and Tamaulipas and the state of Colima in Mexico; and the southern edge of the Edwards Plateau in Texas, U.S.A. (Fig. 3). The genus *Protoschizomus* includes three epigean species, one each in Colima, San Luis Potosí, and Tamaulipas and four cavernicole species in the state of Tamaulipas. *Agastoschizomus* includes four cavernicole species in the states of Hidalgo, San Luis Potosí, and Tamaulipas. A single immature specimen not placed in a genus is restricted to a single cave in Val Verde County, Texas. Each species is extremely limited in its distribution, with most known only from one locality. *Protoschizomus pachypalpus* has been collected only within a few kilometers of Gómez Farías, Tamaulipas. *Agastoschizomus lucifer* occurs in three caves within 15 kilometers of each other. *Agastoschizomus patei* is definitely known (from adult specimens) only from one cave, but may occur in two other caves within a few kilometers of the type-locality.

The three epigean species of *Protoschizomus* are widely separated. *Protoschizomus pachypalpus*

inhabits tropical deciduous forest along the eastern slopes of the Sierra de Guatemala in Tamaulipas; *P. rowlandi* occurs in the coastal plain east of Ciudad Valles in San Luis Potosí; *P. occidentalis* is the only species of Protoschizomidae known from southwestern Mexico and the Pacific drainage.

The cavernicole species of *Protoschizomus* appear to be less troglomorphic than the species of *Agastoschizomus*, but are known only from caves. *Protoschizomus gertschi* inhabits a single cave near Miquihuana in the western Sierra Madre Oriental. It is separated from the species of the Purificación region by the Río Guayalejo. The occurrence of four species of Protoschizomidae in the Purificación region is remarkable. *Agastoschizomus patei* is a highly troglomorphic species and is probably representative of a very early invasion of the caves of this region. *Agastoschizomus* sp. cf. *patei* (known only from immature specimens) is sympatric in Cueva del Tecolote with *P. sprousei*. The three species of *Protoschizomus* in the Purificación region are each known only from a single cave, but should be found in other nearby caves with additional collecting. *Protoschizomus sprousei* occurs only in Cueva del Tecolote near the village of Los San Pedro at an elevation of 1,450 m. The remaining two species, *P. purificacion* and *P. treacyae* occur in Cueva X at an elevation of 1,950 m and in Cueva del Borrego at an elevation of 1,980 m, respectively; both of these caves are located near the village of Conrado Castillo. The occurrence of three species of the same genus in the caves of this area is paralleled by the carabid beetle genus *Mexaphaenops* Bolívar y Pieltain with four species in the same area. *Mexaphaenops febriculosus* Barr is found at lower elevations only a few kilometers from Cueva del Tecolote. Three species, *M. jamesoni* Barr, *M. mackenziei* Barr and *M. sulcifrons* Barr inhabit caves in the Conrado Castillo area. As with *Mexaphaenops*, the presence of three species of *Protoschizomus* in the same area may represent different times of invasion of the cavernicole habitat. *Protoschizomus purificacion* exhibits a lesser degree of troglobitic modification

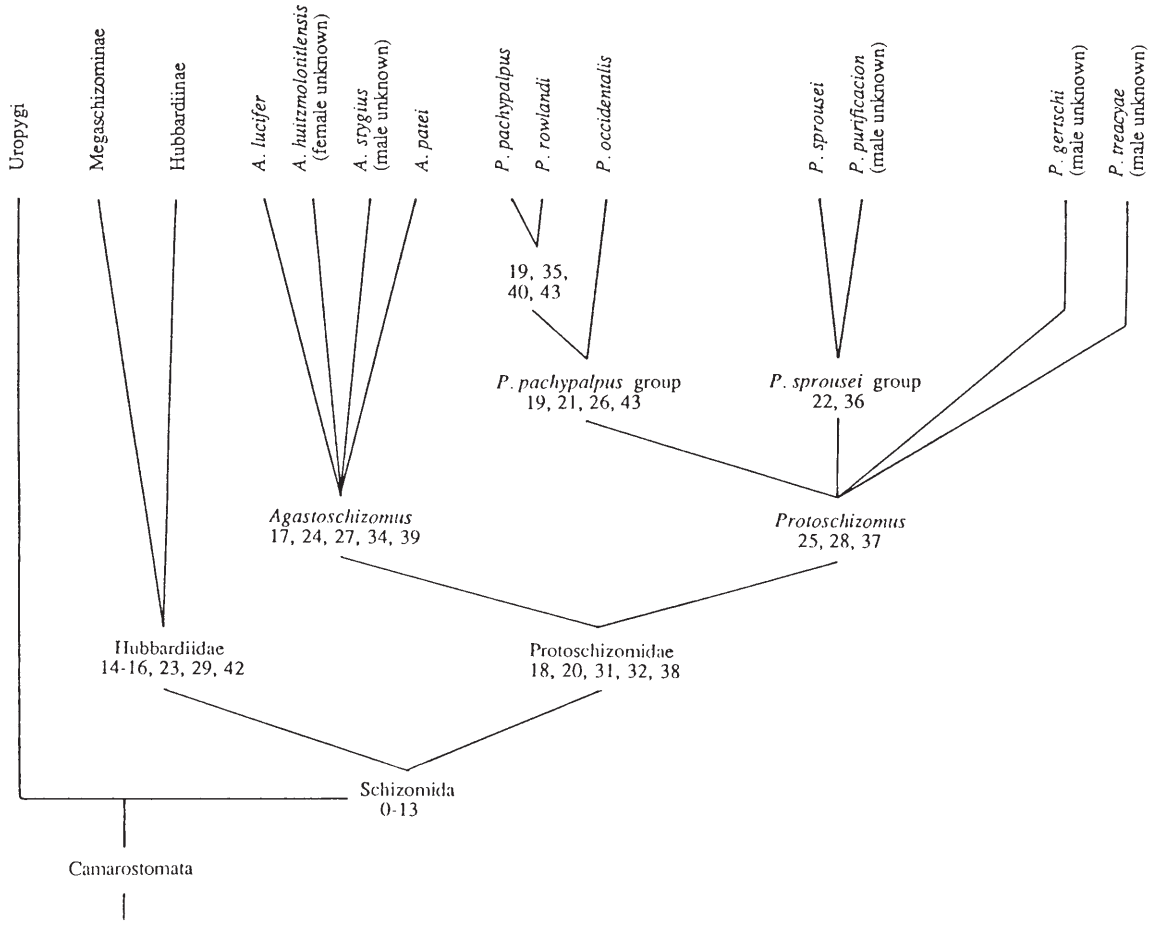


Fig. 2.—Cladogram of selected members of the superorder Camarostomata. See text for explanation and Tables 1 and 2 for character list (autapomorphies have been excluded) and presumed polarities.

than *P. treacyae* and may be a more recent cave immigrant.

The four species of *Agastoschizomus* are isolated from each other. *Agastoschizomus lucifer* inhabits the Sierra de El Abra, a low mountain range along the eastern slopes of the Sierra Madre Oriental. The Río Tamuín cuts through the cavernous limestone and thus isolates this species from *A. huitzmolotitlensis* which inhabits a higher elevation in the Sierra Madre Oriental near Xilitla. To the south of this region the Río Moctezuma cuts through the cavernous limestone and thus isolates *A.*

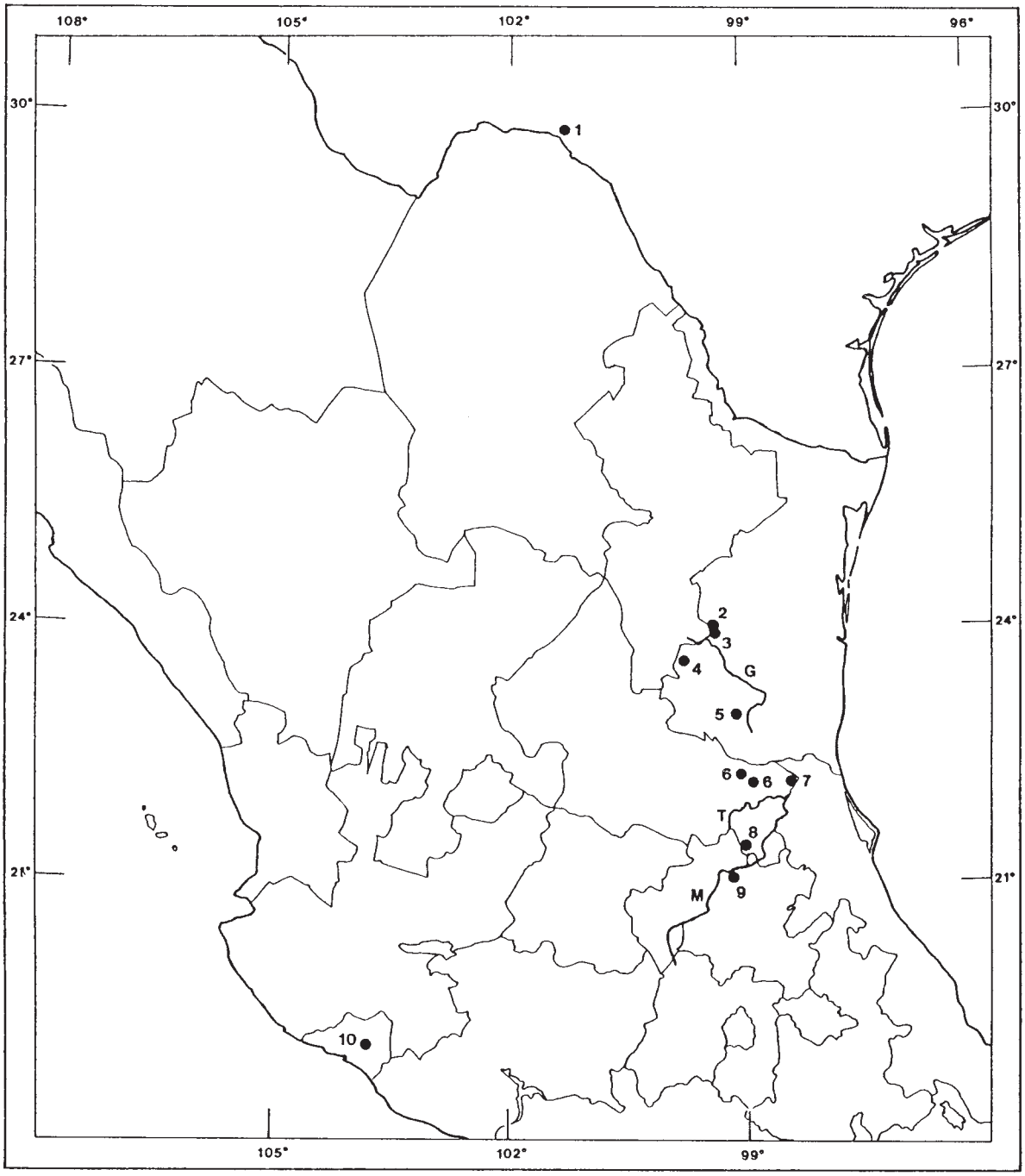


Fig. 3.—Distribution of Protoschizomidae. 1, Genus and species undetermined (immature only); 2, *Protoschizomus purificacion*, *P. treacyae*; 3, *Agastoschizomus patei*, *P. sprousei*; 4, *P. gertschi*; 5, *P. pachypalpus*; 6, *A. lucifer*; 7, *P. rowlandi*; 8, *A. huitzmolotitlensis*; 9, *A. stygius*; 10, *P. occidentalis*. Heavy outlines are rivers. G = Río Guayalejo; M = Río Moctezuma; T = Río Tamuín.

huitzmolotitlensis from *A. stygius* to the south in Hidalgo. *Agastoschizomus patei* is isolated from *A. lucifer* by the Río Guayalejo.

The undescribed species from Texas is a tropical relict now isolated in the cavernicole environment by the surrounding semi-arid surface. Other tropical relicts in Central Texas caves include among others the pseudoscorpion *Leucohya texana* Muchmore, two species of the opilionid genus *Hoplobunus* Banks, the amblypygid *Phrynus* n. sp., and the nicoletiid silverfish *Texoreddellia texensis* (Ulrich).

FAMILY PROTOSCHIZOMIDAE ROWLAND

Megaschizominae: Rowland, 1973c:136 (part).

Protoschizomidae Rowland, 1975b:1-2; Rowland, 1975a:25, 27, 339; Rowland and Reddell, 1979a: 161, 162, 166, 174; Rowland and Reddell, 1980:1; Cokendolpher, 1981:6; Reddell, 1981:65, 124, 125; Rowland and Reddell, 1981:19; Levi, 1982:76; Elliott, 1984a:15; E[lliott], 1984b:8; Reddell and Cokendolpher, 1984:5; Reddell and Cokendolpher, 1985:48; Elliott and Reddell, 1985:214.

Diagnosis.—Medium to large, 4.0 to 12.4 mm total length excluding flagellum. Anterior process of propeltidium generally downturned, with one or two setae and with pair of setae at base of process. Mesopeltidia large, gap between plates 0.1 to 0.6 anterior width of one plate. Eight pairs of dorsoventral abdominal muscles. Female flagellum with or without segments and articles. Sternite VI 2.0 to 4.8 times wider than long. Male flagellum with or without retractable lateral lobes. Female spermathecae consisting of one pair of single lobes with shallow pits over most of their surfaces. Cheliceral serrula not composed of hyaline teeth, but represented by a row of blunt, nearly hemispherical knobs or stout teeth; brush (type 5 setae) at base of fixed digit absent; fixed digit with two teeth; ratio of pedipalpal claw length to dorsal length of basitarsus-tarsus 0.6:1 to 1.3:1; basitarsal spurs symmetrical, long, about 0.3 to 0.7 dorsal length of basitarsus-tarsus. Femur IV 3.0 to 8.25 times as long as deep.

Type-genus.—*Protoschizomus* Rowland, 1975b (by original designation).

Distribution.—MEXICO: Tamaulipas, San Luis Potosí, Hidalgo, Colima. U.S.A.: Texas.

Included genera.—*Agastoschizomus* Rowland, 1971; *Protoschizomus* Rowland, 1975b.

Protoschizomus Rowland

Protoschizomus Rowland, 1975b:2; Rowland, 1975a: 25, 27, 334, 337, 339, 343-346, 378, figs. 286-287 (manuscript name); Rowland and Reddell, 1979a:166; Levi, 1982:76; Elliott and Reddell, 1985:214.

Type-species.—*Agastoschizomus pachypalpus* Rowland, 1973a (by original designation).

Diagnosis.—Epigean and cavernicole species. Medium to large species, 4.0 to 8.3 mm total length excluding flagellum. Propeltidium with two setae on anterior process. Anterior process down-turned apically. Anterior sternum with one or two sternapophysial setae. Gap between mesopeltidial plates 0.3 to 0.6 anterior width of one plate. Sternites V-VIII of male with two rows of setae or with scattered setae. Sternite VI 3.1 to 4.8 times wider than long; width/length ratio versus body length, 0.8 to 2.3. Female flagellum with segments and articles. Male flagellum enlarged distally, with retractable ventrolateral lobes. Female pedipalp in proportion to body length 0.7 to 1.0 pedipalp length of male. Pedipalpal spur about 0.3, claw about 0.6 to 0.8 dorsal length of basitarsus-tarsus. Femur IV 3.0 to 4.5 times longer than deep.

Distribution.—MEXICO: Tamaulipas, San Luis Potosí, Colima.

Included species.—*P. pachypalpus* (Rowland), *P. rowlandi* n. sp., *P. occidentalis* Rowland, *P. sprousei* n. sp., *P. gertschi* n. sp., *P. purificacion* n. sp., *P. treacyae* n. sp.

pachypalpus group

Diagnosis.—Epigean. Medium sized species, 4.0 to 4.6 mm total length. Propeltidium with three or four pairs dorsal setae. Anterior sternum with two sternapophysial setae. Males with scattered or two very irregular rows of setae on sternites IV-IX. Pedipalp claw about 0.6 to 0.8 dorsal length of basitarsus-tarsus. Pedipalps of females in proportion to body length 0.6 to 0.7 pedipalp length of male. Legs I and IV shorter than body length.

Distribution.—MEXICO: Tamaulipas, San Luis Potosí, Colima.

Included species.—*P. pachypalpus* (Rowland), *P. rowlandi* n.sp., *P. occidentalis* Rowland.

Protoschizomus pachypalpus (Rowland)
Figs. 2-5, 22-23, 38-45

Agastoschizomus pachypalpus Rowland, 1973a:6,

Key to Species and Genera of Protoschizomidae

1a. Male flagellum without ventrolateral lobes (Fig. 97); female flagellum without segments or articles (Fig. 102) (Tamaulipas) ..... *A. patei*

1b. Male flagellum with ventrolateral lobes; female flagellum segmented 2

2a. Anterior process of propeltidium with one seta; male flagellum not distally enlarged ..... *Agastoschizomus* 3

2b. Anterior process of propeltidium with two setae (Fig. 1b); male flagellum distally enlarged ..... *Protoschizomus* 5

3a. Metapeltidium divided (San Luis Potosí) ..... *A. lucifer*

3b. Metapeltidium undivided 4

4a. Femur IV 4.8 times longer than wide; abdominal tergite I with one pairs of large posterior setae (San Luis Potosí) ..... *A. huitzmolotitlensis*

4b. Femur IV 6.0 times longer than wide; abdominal tergite I without large posterior setae (Hidalgo) ..... *A. stygius*

5a. Propeltidium with three or four pairs dorsal setae (Fig. 1b); male sternites IV-VIII with scattered or two irregular rows of setae ..... *P. pachypalpus* group 6

5b. Propeltidium with two pairs dorsal setae; male sternites IV-VIII with two regular rows of setae 8

6a. Male flagellum broadly joined at base (Fig. 52), vm4 seta present (Fig. 27); spermathecae robust (Fig. 57) (Colima) ..... *P. occidentalis*

6b. Male flagellum less broadly joined at base, vm4 seta missing; spermathecae long and slender 7

7a. Propeltidium with three pairs setae; male flagellum 1.7 times as wide as long, strongly constricted basally (Fig. 39) (Tamaulipas) ..... *P. pachypalpus*

7b. Propeltidium with four pairs setae; male flagellum 2.0 times as wide as long, not strongly constricted basally (Fig. 46) (San Luis Potosí) ..... *P. rowlandi*

8a. Female flagellum with dm4 seta missing; pedipalp trochanter slightly produced ..... *P. sprousei* group 9

8b. Female flagellum with dm4 seta present; pedipalp trochanter not produced 10

9a. Female flagellum with segment/article V present (Fig. 9); spermathecae long, slender, not enlarged apically (Fig. 64) (Cueva del Tecolote, Tamaulipas) ..... *P. sprousei*

9b. Female flagellum with segment/article V absent (Fig. 73); spermathecae short, enlarged apically (Fig. 76) (Cueva X, Tamaulipas) ..... *P. purificacion*

10a. Female flagellum with all setae present (Figs. 10-11), segment/article V missing (Fig. 10); femur IV 4.2 times as long as deep (San Luis Potosí) ..... *P. gertschi*

10b. Female flagellum with dm2 seta missing (Fig. 14); segment/article V present (Fig. 14); femur IV 3.7 times as long as deep (Cueva del Borrego, Tamaulipas) ..... *P. treacyae*

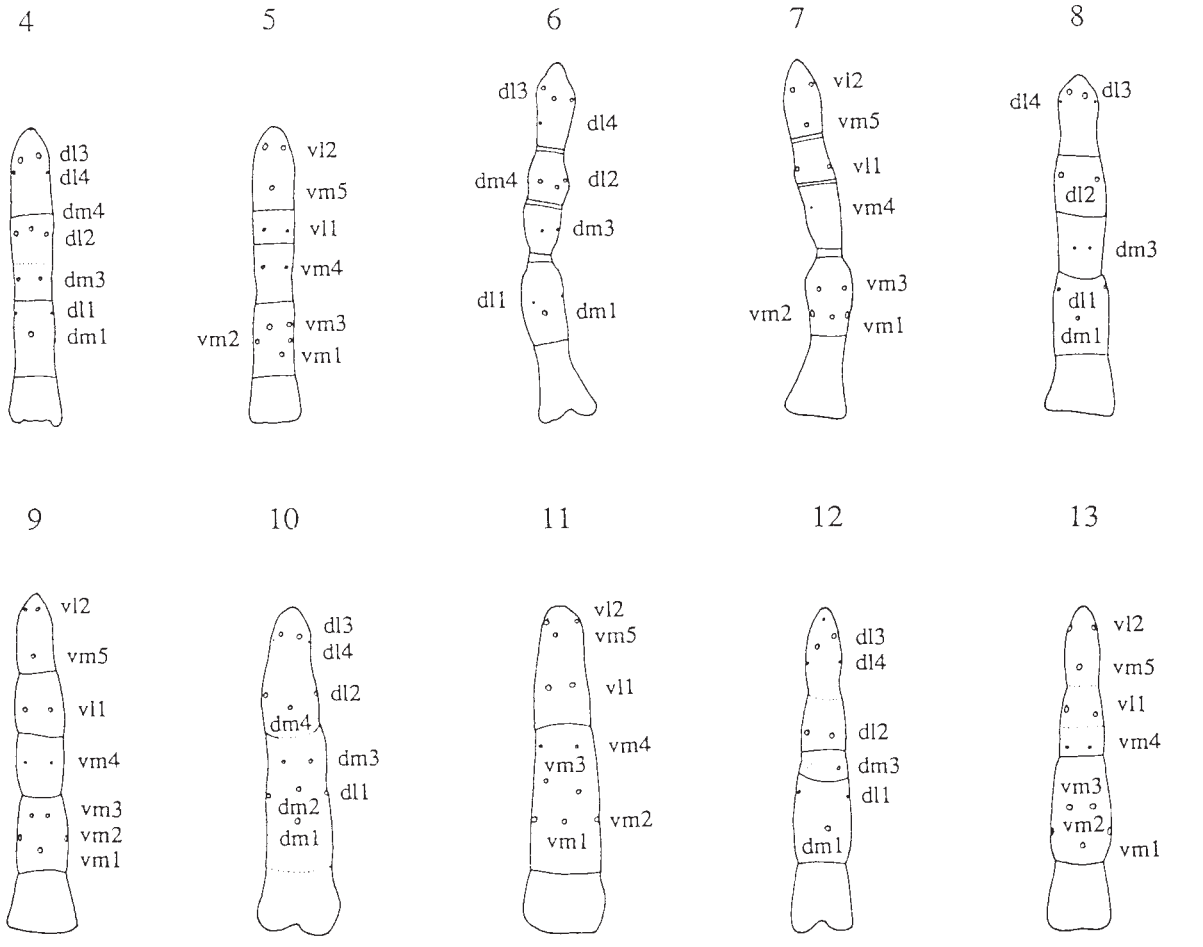
8-10, figs. 5-7; Rowland, 1973c:136; Rowland, 1975a:27, 40; Rowland, 1975b:2.

Protoschizomus pachypalpus: Rowland, 1975a: 14-15, 27, 40-42, 46-49, 167-168, 211, 213, map 3, figs. 12, 15, 18-19 (part—all records except 51.5 mi. (82.9 km) E Ciudad Victoria on highway 70); Rowland, 1975b:2-6, fig. 2 (part—all records except 51.5 mi. (82.9 km) E Ciudad Victoria); Rowland and Reddell, 1979a:162, 167-169, 174, figs. 2, 5-7 (part—all records except 51.5 mi. (82.9 km) E Ciudad Victoria); Reddell, 1981: 124.

Material examined.—MEXICO: *Tamaulipas*: Nacimiento del Río Frío, 4.8 km S of Gómez Farías, 140 m elev., 12 March 1969 (J. Reddell), female holotype and female paratype (AMNH); Arroyo Nacimiento del Río Frío, 140 m elev., 16 Feb. 1970 (R.W. Mitchell), 2 female, 1 immature paratypes (AMNH); Gómez Farías, 300 m elev., 6 Jan. 1964 (J. Reddell, D. McKenzie, L. Manire), 1 female paratype (AMNH); 10 km SE of Gómez Farías, 4 km W of Highway 85, 21 May 1982 (N. Strenth), 1 male (AMNH), 1 male, 1 female, 1 immature (TMM); 21 May 1982 (H.L. McCutchen), 1 female (TMM); 24 May 1982 (H.L. McCutchen), 1 immature (TMM); 96.5 km S of Ciudad Victoria, 17 Nov. 1948 (H.B. Leech), ex bromeliad, 2 females, 1 immature (CAS). Vial containing immature paratype from type locality actually contains 1 immature and 1 female labeled "paratypes." Vial from Arroyo Nacimiento del Río Frío contains only 1 female paratype and is labeled "paratype."

Diagnosis.—This species is most closely related to *P. rowlandi* but the male flagellum is more robust with a more distinct basal stalk. *Protoschizomus pachypalpus* possesses three pairs of setae on the propeltidium, whereas *P. rowlandi* has four pairs.

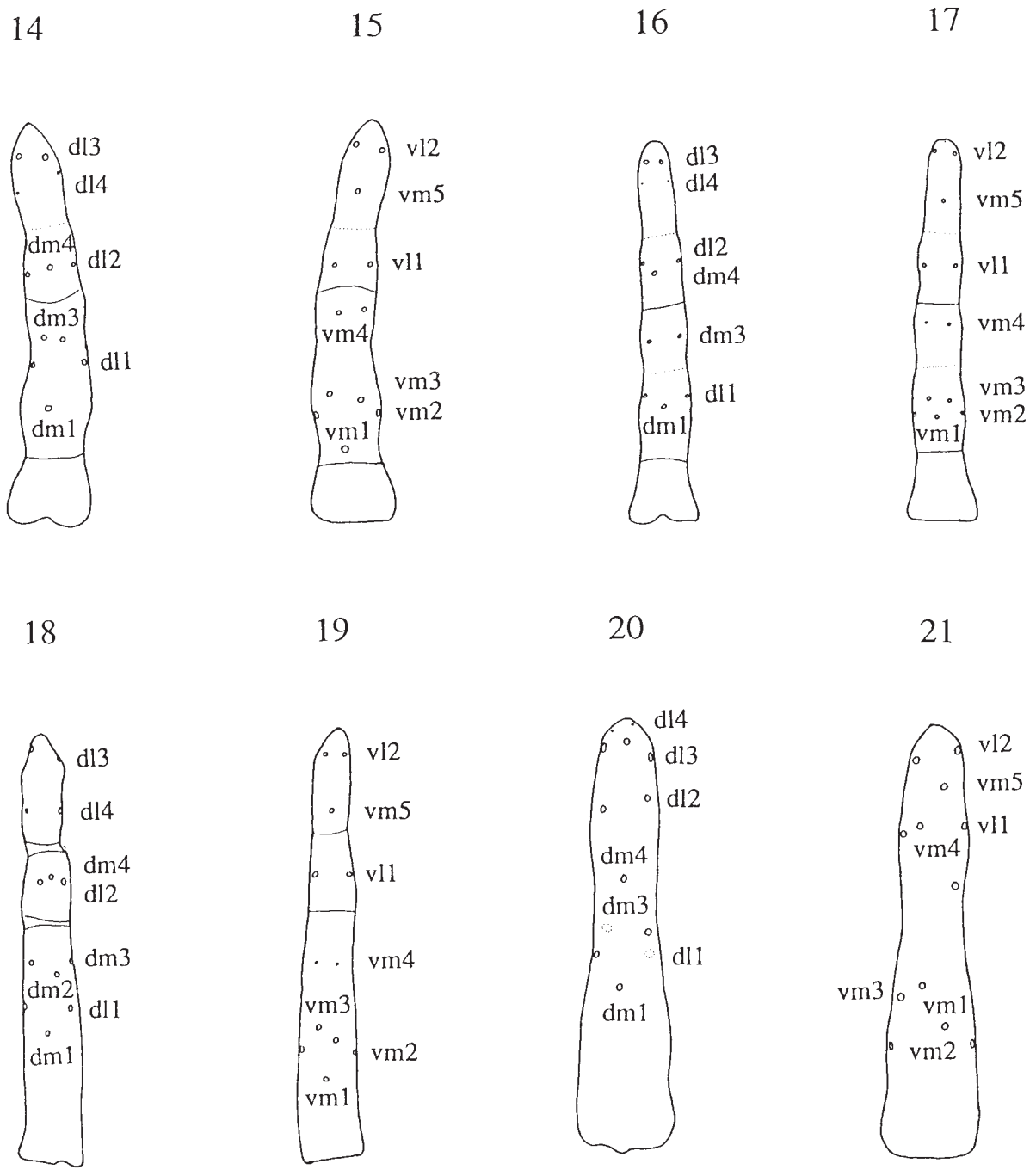
Description.—Male (length from distal margin of propeltidium to base of flagellum, 4.26 mm). Light brown, cephalothorax and pedipalps slightly darker.



Figs. 4-13—Setation and annuli placement on flagella of female protoschizomids: *Protoschizomus pachypalpus*: 4, dorsal aspect; 5, ventral aspect. *P. rowlandi*: 6, dorsal aspect; 7, ventral aspect. *P. sprousei*: 8, dorsal aspect; 9, ventral aspect. *P. gertschi*: 10, dorsal aspect; 11, ventral aspect. *P. purificacion*: 12, dorsal aspect; 13, ventral aspect.

Cephalothorax: Propeltidium 1.12 mm long, 0.68 mm wide; anterior process with row of two setae and with one pair of setae at base; with two pairs dorsolateral setae (anteriormost slightly more dorsad) about 1/3 from anterior margin and one pair dorsal setae about 1/4 from posterior margin. Gap between mesopeltidial plates about 0.6 anterior width of one plate. Metapeltidium separated by distinct membranous strip. Anterior sternum with 10 setae, plus two sternapophysial setae; posterior sternum with four setae.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with three pairs anterior microsetae



Figs. 14-21.—Setation and annuli placement on flagella of female protoschizomids: *Protoschizomus treacyae*: 14, dorsal aspect; 15, ventral aspect. *Agastoschizomus lucifer*: 16, dorsal aspect; 17, ventral aspect. *A. stygius*: 18, dorsal aspect; 19, ventral aspect. *Agastoschizomus patei*: 20, dorsal aspect; 21, ventral aspect.

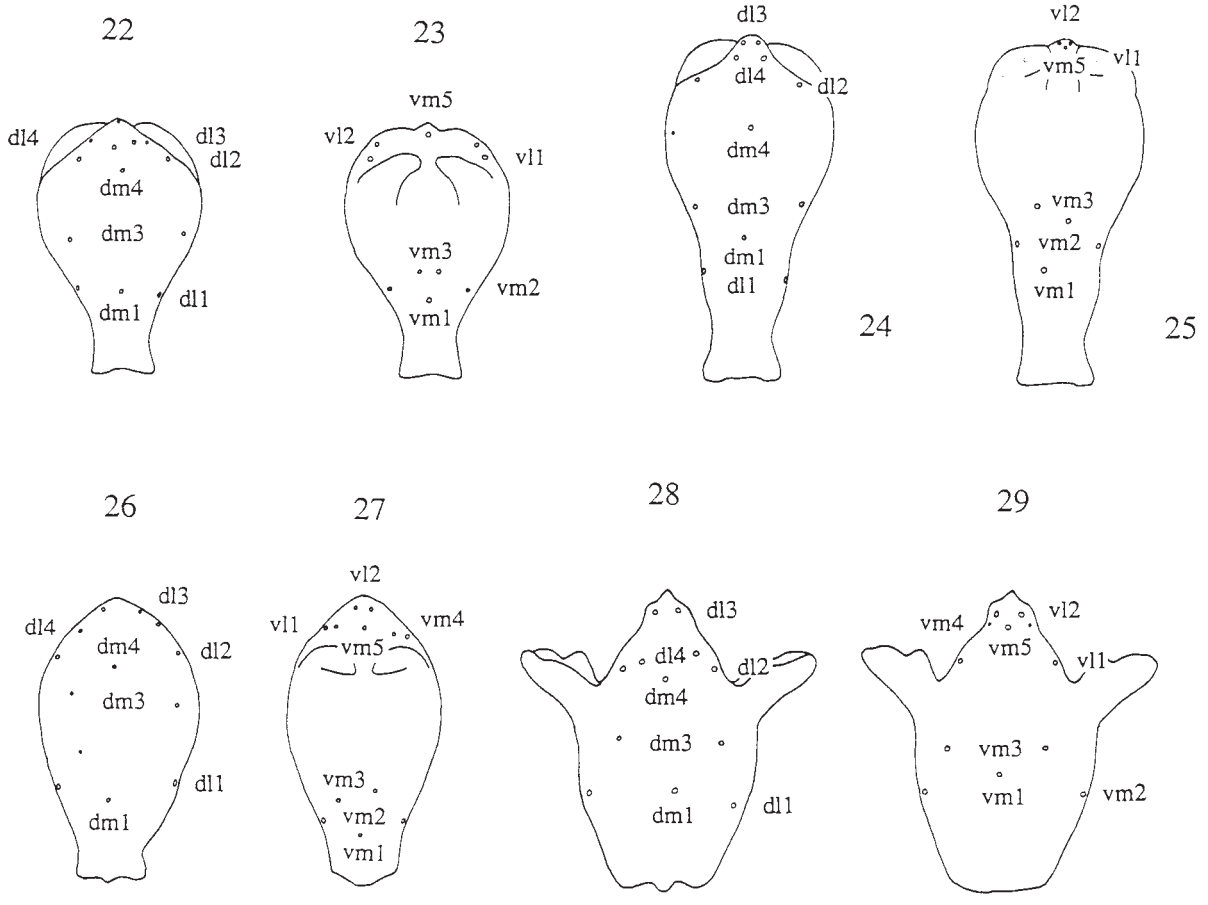
(in row) and one pair large posterior setae; tergites III-VII with one pair dorsal and one pair dorsolateral setae each; tergite VIII with six setae along posterior margin and four dorsolateral setae near middle of tergite; tergite IX with two dorsolateral and two lateral setae. Sternite VI about 4.0 times as wide as long; width/length ratio versus body length, 1.1. Sternites V-VIII with two irregular rows of setae near posterior margin, IX with scattered setae. Segments X-XI telescoped. Segment X with one pair lateral and four ventral setae. Segment XI with one pair lateral and seven ventral setae. Segment XII with one pair dorsal, one pair dorsolateral, one pair lateral, and eight ventral setae. Flagellum (Figs. 22-23, 38-39) 0.46 mm long, 0.26 mm wide; with short base, expanding to club about as wide as long and enlarged distally; with pairs of short unsclerotized ventral lobes near lateral margins of club; dm2 and vm4 setae absent.

Pedipalps (Fig. 40): Trochanter not produced distally. Patella with two spinose setae on ventrolateral margin. Tibia with three spinose setae on ventrolateral margin. Spur about 0.3, claw 0.8 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with nine teeth. Setae: 1=3; 2=2; 3=10; 4=1; 5=0; 6=1; all strongly pilose except seta 6 pointed.

Legs: Leg I, including coxa, 4.62 mm long; basitarsal-tarsal proportions: 15:3:4:3:4:3:13. Femur IV (Fig. 41) about 3.0 times as long as deep.

Female holotype (length from distal edge of propeltidium to base of flagellum, 4.42 mm). Propeltidium 1.02 mm long, 0.66 mm wide. As in male except as follows: Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 3.8 times wider than long; width/length ratio versus body length, 1.2. Flagellum (Figs. 4-5, 42) 0.42 mm long; dm2 seta missing; segments/articles I, III-V present. Spermathecae (Figs. 43-44): one pair long, slender, distinctly curved lobes only very slightly increasing in width apically. Pedipalp length in proportion to body length about 0.7 as long as

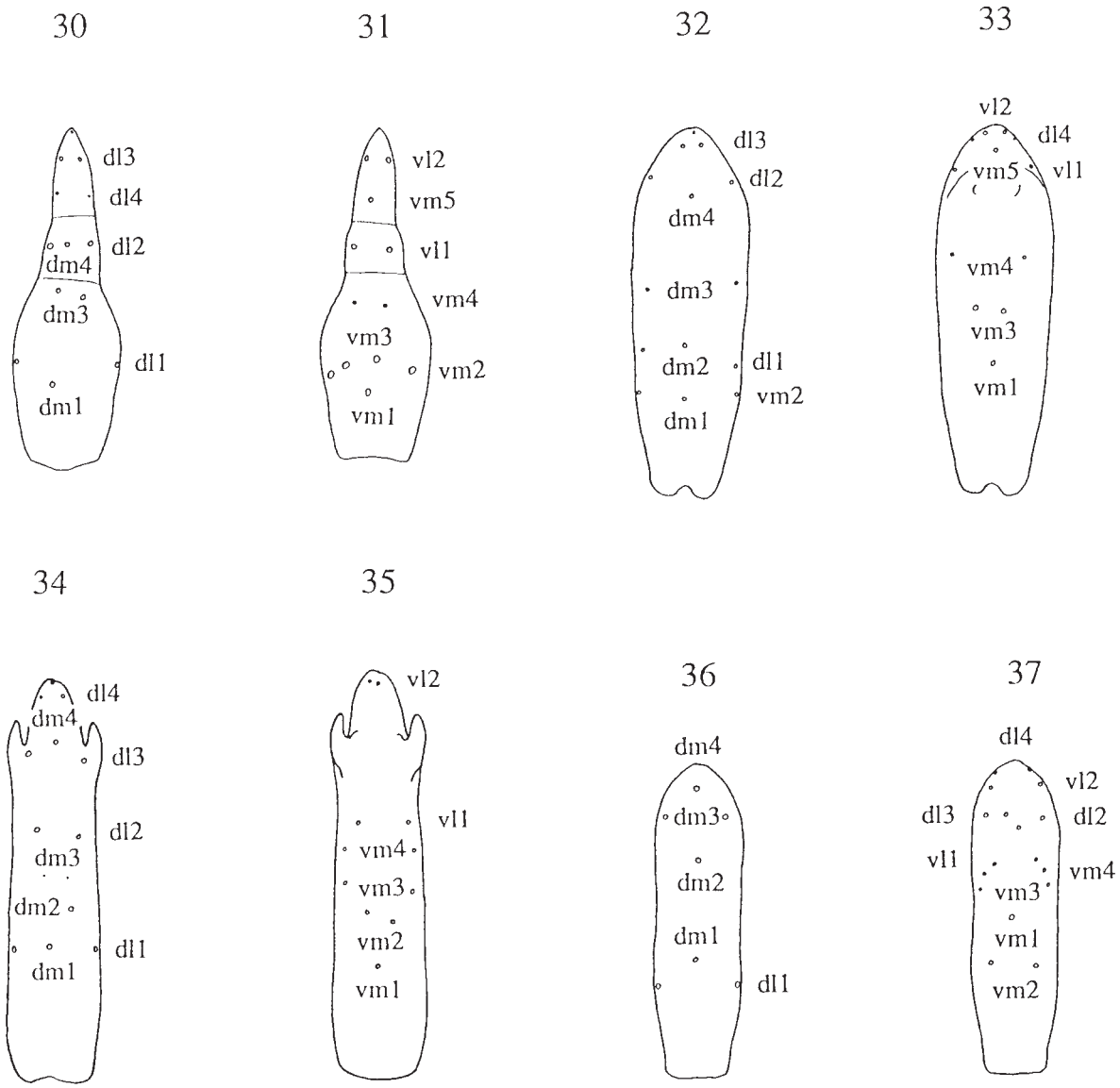


Figs. 22-29.—Setation on flagella of male protoschizomids: *Protoschizomus pachypalpus*: 22, dorsal aspect; 23, ventral aspect. *P. rowlandi*: 24, dorsal aspect; 25, ventral aspect. *P. occidentalis*: 26, dorsal aspect; 27, ventral aspect. *P. sprousei*: 28, dorsal aspect; 29, ventral aspect.

male pedipalp; claw about 0.6 dorsal length of basitarsus-tarsus. Leg I, including coxa, 3.94 mm long; basitarsal-tarsal proportions: 9:3:3:3:3:3:12. Femur IV about 3.4 times as long as deep.

Variation: Tergite VIII in one specimen possessed three anterior and six posterior setae, whereas another specimen possessed five anterior and seven posterior setae. Rowland (1973a) stated that the holotype female possessed five pairs of dorsal propeltidial setae; one of these pairs is doubtless that at the base of the anterior process, but a re-examination of the holotype and other specimens studied by Rowland reveals only three pairs of dorsal propeltidial setae. He also stated that the anterior sternum possessed 11 setae. We could find only ten on all specimens studied, including the holotype. Finally, we have been unable to verify the setation of the abdominal tergites. The holotype has apparently cleared somewhat since collected and it is possible that we have missed some broken setae.

Measurements (mm).—Male (female holotype): Pedipalp: trochanter 0.10 (0.10); femur 0.64 (0.48); patella 0.58 (0.42); tibia 0.54 (0.40); basitarsus-tarsus 0.28 (0.22); total 2.14 (1.62). Leg I: trochanter 0.32 (0.28); femur 0.94 (0.82); patella 1.02 (0.88); tibia 0.94 (0.78); basitarsus 0.34



Figs. 30-37.—Setation on flagella of male protoschizomids: *Protoschizomus purificacion*: 30, dorsal aspect; 31, ventral aspect. *Agastoschizomus lucifer*: 32, dorsal aspect; 33, ventral aspect. *A. huitzmolotitlensis*: 34, dorsal aspect; 35, ventral aspect. *Agastoschizomus patei*: 36, dorsal aspect; 37, ventral aspect.

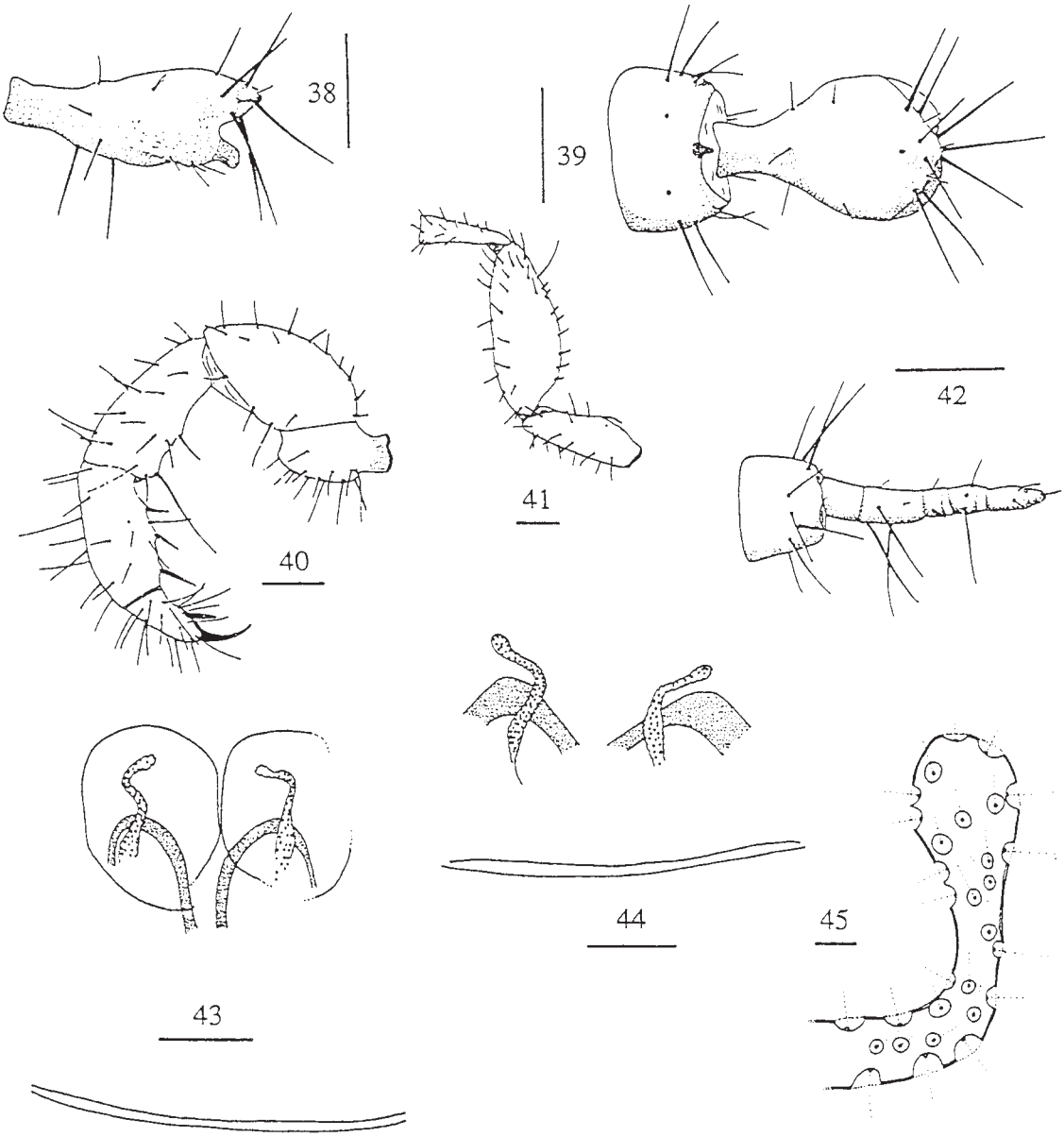
(0.34); tarsus 0.64 (0.58); total 4.20 (3.68). Leg II: trochanter 0.16 (0.18); femur 0.76 (0.72); patella 0.44 (0.42); tibia 0.48 (0.44); basitarsus 0.36 (0.38); tarsus 0.34 (0.36); total 2.54 (2.50). Leg III: trochanter 0.20 (0.22); femur 0.74 (0.70); patella 0.36 (0.36); tibia 0.40 (0.36); basitarsus 0.42 (0.52); tarsus 0.36 (0.36); total 2.48 (2.52). Leg IV: trochanter 0.56 (0.54); femur 0.94 (0.82); patella 0.50(0.48); tibia 0.72 (0.64); basitarsus 0.54 (0.52); tarsus 0.42 (0.38); total 3.68 (3.38).

Habitat.—This species has been collected from the undersides of rocks on steep hillsides and along a roadcut at the type-locality. It has also been reported from bromeliads. Vegetation in the Gómez Farías region is classified as tropical deciduous forest and is well-described by Martin (1958).

Protoschizomus rowlandi new species
Figs. 1b, 2-3, 6-7, 24-25, 46-51

Agastoschizomus pachypalpus Rowland, 1973a:6, 8-10, figs. 5-7; Rowland, 1975a:27, 40 (part); Rowland, 1975b:2 (part).

Protoschizomus pachypalpus: Rowland, 1975b:2-6,



Figs. 38-45.—*Protoschizomus pachypalpus*: 38, male flagellum, lateral aspect; 39, male flagellum, dorsal aspect; 40, male pedipalp, lateral aspect; 41, male femur IV, lateral aspect; 42, female flagellum, lateral aspect; 43-44, female spermathecae (43 from Nacimiento del Río Frío, 44 from 10 km SE Gómez Farías); 45, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 38-42, 0.1 mm for Figs. 43-44, and 0.01 mm for Fig. 45.

fig. 2 (part—51.5 mi. (82.9 km) E Ciudad Victoria on highway 70 record only); Rowland, 1975a: 27, 40–42, 46–59, 167-168, 211, 213, map 3, fig. 15 (part—51.5 mi. (82.9 km) E Ciudad Victoria on highway 70 record only); Rowland and Reddell, 1979a:162, 167-169, 174, figs. 2,7 (part—51.5 mi. (82.9 km) E Ciudad Victoria on highway 70 record only).

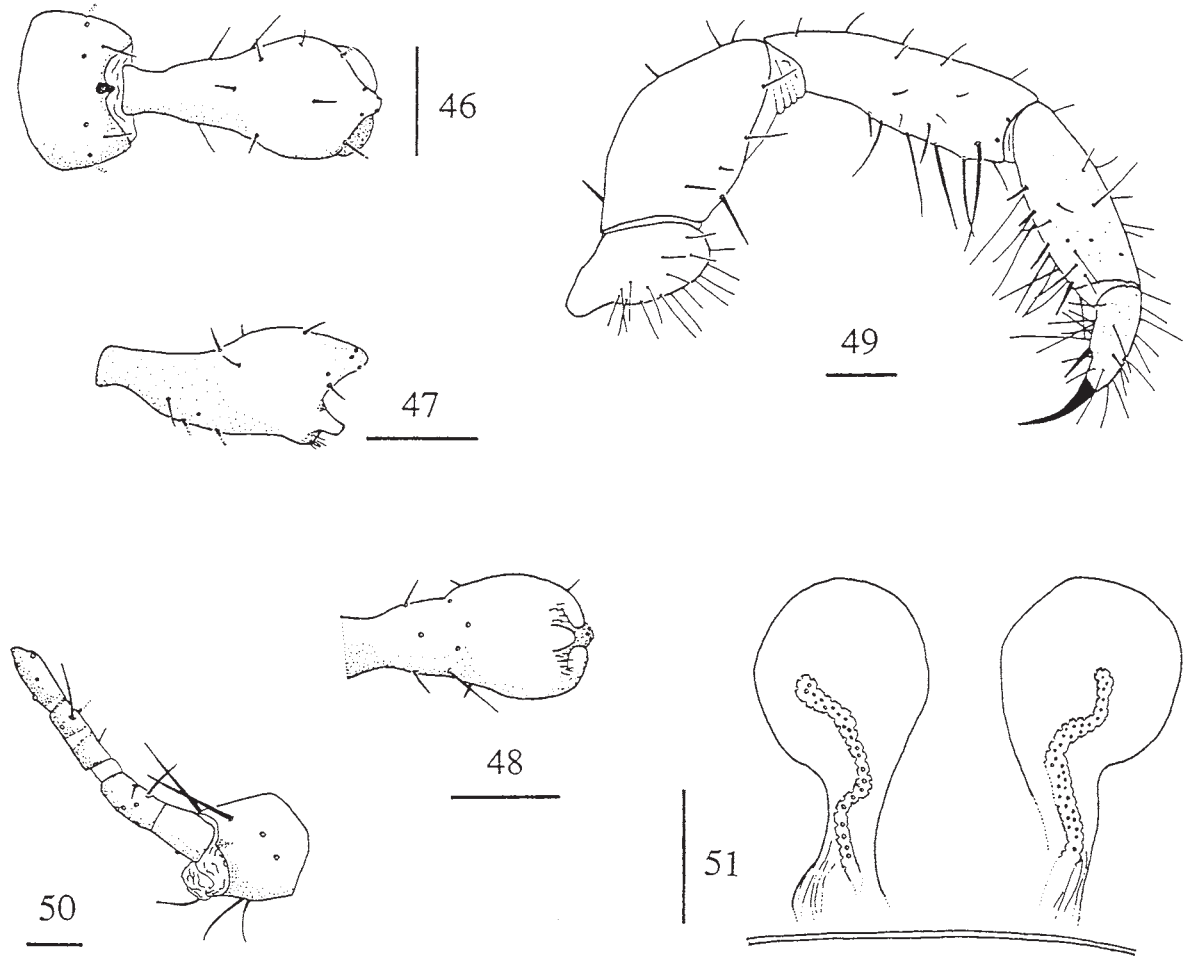
Material examined.—MEXICO: *San Luis Potosí*: 51.5 mi. (82.9 km) E of Ciudad Valles on Highway 70, 17 Oct. 1972 (B. Firstman, V. Roth), male holotype, female paratype (AMNH).

Etymology.—This species is named for J. Mark Rowland in recognition of his many contributions to the study of schizomids.

Diagnosis.—This species is distinguished from *P. pachypalpus* by the shape of the male flagellum, which is more slender and has a less distinct stalk than in *P. rowlandi*. There are four pairs of setae on the propeltidium in *P. rowlandi* versus three pairs in *P. pachypalpus*.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 4.64 mm); dark orangish red (probably artificially darkened due to preservation and storage).

Cephalothorax: Propeltidium 1.16 mm long, 0.70 mm wide; with row of two setae on anterior process and one off-centered pair setae at base of process; with one pair small widely spaced setae about 1/5 from distal edge, two pairs (second pair tiny) setae 2/5 from distal edge, and one pair closely spaced setae about 1/4 from posterior margin. Gap between mesopeltidial plates 0.4 anterior width of one plate. Metapeltidium distinctly separated by membranous suture. Anterior sternum with 10 setae, plus two sternapophysial setae; posterior sternum with four setae.



Figs. 46-51.—*Protoschizomus rowlandi*: 46, male flagellum, dorsal aspect; 47, male flagellum, lateral aspect; 48, male flagellum, ventral aspect; 49, male pedipalp, lateral aspect; 50, female flagellum, lateral aspect; 51, female spermathecae. Scale lines = 0.25 mm for Figs. 46-49, 0.1 mm for Figs. 50-51.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergites III-VII with one (?) pair dorsal and one (?) pair dorsolateral setae; tergite VIII with two rows of four setae; tergite IX with one pair dorsolateral and one pair lateral setae. Sternites V-IX with scattered setae. Sternite VI about 3.1 times as wide as long; width/length ratio versus body length, 1.5. Segments X-XI telescoped; segments X-XI with one pair dorsolateral, one pair ventrolateral, and one pair ventral setae each; segment XII with one pair dorsal, one pair dorsolateral, one pair lateral, and ten (?) ventral setae. Flagellum (Figs. 24-25, 46-48) 0.56 mm long, 0.28 mm wide; with gradually widening stalk ending in prominent bulb; dorsal surface extending over pair of unsclerotized ventrolateral lobes; setae dm2 and vm4 missing; vl1 setae are on the inner face of the ventral lobes; unnumbered unpaired setae present laterad to dm4.

Pedipalps (Fig. 49): Trochanter not produced distally. Patella with two ventrolateral spinose setae, distalmost very long. Tibia with four strong ventrolateral spinose setae. Spur about 0.3, claw about 0.7 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with eight teeth, increasing in length basally. Setae: 1=3; 2=2; 3=11; 4=2; 5=0; 6=1.

Legs: Leg I, including coxa, 4.70 mm long; basitarsal-tarsal proportions: 11:3:4:3:3:4:14. Femur IV about 3.25 times as long as deep.

Female paratype (length from distal edge of propeltidium to base of flagellum, 4.20 mm); light tan. Propeltidium 1.06 mm long, 0.58 mm wide. Gap between mesopeltidial plates 0.5 anterior width of one plate. Tergites as in male except: tergites III-VI with one pair dorsal and one pair dorsolateral setae each; tergite VII with one pair dorsal, one pair dorsolateral, and one pair lateral setae; tergite VIII with one pair dorsal, one pair dorsolateral, and one pair lateral setae near posterior margin and two pairs dorsolateral setae near anterior margin. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 3.1 times as wide as long; width/length ratio versus body length, 1.4. Flagellum (Figs. 6-7, 50) 0.46 mm long; dm2 seta missing; segments/articles I, III-V present. Spermathecae (Fig. 51) of one pair of elongate, curved lobes only slightly increasing in size apically. Pedipalp length in proportion to body length about 0.7 length of male pedipalp; claw about 0.8 dorsal length of basitarsus-tarsus. Leg I, including coxa, 3.96 mm long; basitarsal-tarsal proportions: 9:2:3:3:3:3:12. Femur IV about 3.0 times as long as deep.

Measurements (mm).—Male holotype (female): Pedipalp: trochanter 0.14 (0.14); femur 0.74 (0.54); patella 0.86 (0.44); tibia 0.70 (0.44); basitarsus-tarsus 0.32 (0.22); total 2.76 (1.78). Leg I: trochanter 0.32 (0.26); femur 1.02 (0.86); patella 1.06 (0.90); tibia 0.94 (0.78); basitarsus 0.26 (0.22); tarsus 0.66 (0.54); total 4.26 (3.56). Leg II: trochanter 0.14 (0.16); femur 0.80 (0.72); patella 0.48 (0.44); tibia 0.46 (0.44); basitarsus 0.36 (0.32); tarsus 0.36 (0.38); total 2.60 (2.46). Leg III: trochanter 0.24 (0.20); femur 0.76 (0.70); patella 0.40 (0.34); tibia 0.40 (0.32); basitarsus 0.46 (0.40); tarsus 0.42 (0.40); total 2.68 (2.36). Leg IV: trochanter 0.56 (0.48); femur 1.04 (0.92); patella 0.56 (0.48); tibia 0.74 (0.64); basitarsus 0.68 (0.56); tarsus 0.48 (0.44); total 4.06 (3.52).

Comments.—Previous reports of this species have been given as "E Ciudad Victoria," but the correct locality is "E Ciudad Valles."

Protoschizomus occidentalis Rowland
Figs. 2-3, 26-27, 52-58

Protoschizomus occidentalis Rowland, 1975b:3-6, fig. 1; Rowland, 1975a:27, 41-43, 46-59, 167-168, map 3, fig. 14; Rowland and Reddell, 1979a:162, 167-169, 174, figs. 1, 7; Reddell, 1981:124.

Material examined.—MEXICO: *Colima*: 20.9 km SW Colima, 16 July 1972 (A. Jung), male holotype, female paratype (AMNH).

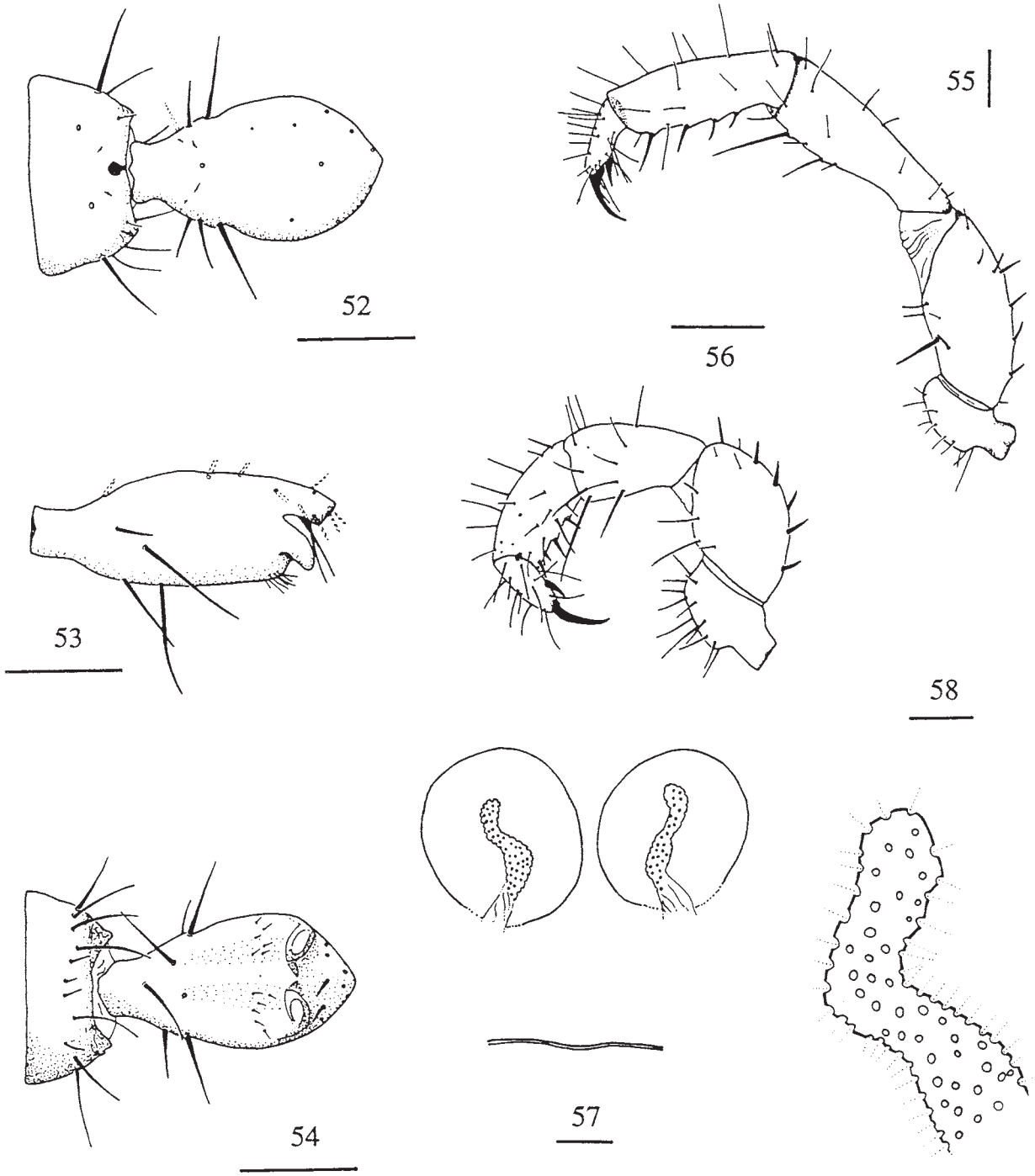
Diagnosis.—This species has a wider basal stalk in the male flagellum than its closest relatives, *P. pachypalpus* and *P. rowlandi*. Females may be separated by the shorter spermathecal lobes in *P. occidentalis* than in *P. pachypalpus*. Males may also be distinguished from both *P. pachypalpus* and *P. rowlandi* by retaining seta vm4, which is lost in both of those species.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 4.00 mm); light orangish tan.

Cephalothorax: Propeltidium 1.04 mm long, 0.64 mm wide; with row of two setae on anterior process and one pair setae at base of process; with one pair of widely spaced dorsal setae about 2/5 from distal edge and one pair closely spaced setae about 1/4 from posterior margin; third pairs of tiny setae slightly posterior to larger anterior pair. Gap between mesopeltidial plates 0.5 anterior width of one plate. Metapeltidium divided by narrow suture.

Anterior sternum with 11 setae plus two sternapophysial setae; posterior sternum with four setae.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergites III-VII with one pair dorsal and one pair dorsolateral setae each; tergite VIII with one pair dorsal, one pair dorsolateral, and one pair lateral setae; tergite IX with one pair dorsolateral and one pair lateral setae. Sternites V-VIII with two irregular rows of



Figs. 52-58.—*Protoschizomus occidentalis*: 52, male flagellum, dorsal aspect; 53, male flagellum, lateral aspect; 54, male flagellum, ventral aspect; 55, male pedipalp, lateral aspect; 56, female pedipalp, lateral aspect; 57, female spermathecae; 58, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 52-56, 0.05 mm for Fig. 57, 0.01 mm for Fig. 58.

setae near posterior margin, sternite IX with one irregular row of setae. Sternite VI about 4.8 times as wide as long; width/length ratio versus body length, 0.8. Segments X-XI telescoped; segments X-XI with one pair dorsolateral, one pair ventrolateral, and five ventral setae each; segment XII with one pair dorsal, one pair dorsolateral, one pair lateral, and nine ventral setae. Flagellum (Figs. 26-27, 52-54) 0.52 mm long, 0.24 mm wide; gradually expanded distally with triangular apex projecting over pair of unsclerotized ventrolateral lobes; dm2 seta missing.

Pedipalps (Fig. 55): Trochanter not produced distally. Patella with two short and one long spinose setae. Tibia with four ventrolateral spinose setae. Spur about 0.3, claw about 0.6 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with seven long pointed teeth. Setae: 1=3; 2=6; 3=12; 4=3; 5=0: 6=1, all but seta 6 pilose.

Legs: Leg I, including coxa, 4.64 mm long; basitarsal-tarsal proportions: 9:3:4:3:3:3:13. Femur IV about 3.0 times as long as deep.

Female (length from distal edge of propeltidium to base of flagellum, 4.04 mm). Propeltidium 1.00 mm long, 0.60 mm wide. Tergite setation as in male, except one additional lateral pair each on VI and VII. Sternites V-IX with two distinct rows of submarginal setae. Sternite VI about 4.8 times as wide as long; width/length ratio versus body length, 0.8. Flagellum missing. Spermathecae (Figs. 57-58) of one pair of short curved lobes not increasing in size apically. Pedipalp (Fig. 56) length in proportion to body length about 0.7 male pedipalp length. Leg I, including coxa, 3.84 mm long; basitarsal-tarsal proportions: 12:3:4:3:3:3:10. Femur IV about 2.7 times as long as deep.

Measurements (mm).—Male holotype (female paratype): Pedipalp: trochanter 0.14 (0.14); femur 0.78 (0.50); patella 0.82 (0.46); tibia 0.72 (0.42); basitarsus-tarsus 0.32 (0.22); total 2.78 (1.74). Leg I: trochanter 0.34 (0.28); femur 1.00 (0.78); patella 1.06 (0.82); tibia 0.98 (0.78); basitarsus 0.22 (0.28); tarsus 0.62 (0.52); total 4.22 (3.46). Leg II: trochanter 0.14 (0.16); femur 0.82 (0.66); patella 0.44 (0.38); tibia 0.46 (0.38); basitarsus 0.36 (0.28); tarsus 0.34 (0.34); total 2.56 (2.20). Leg III: trochanter 0.20 (0.20); femur 0.74 (0.62); patella 0.38 (0.34); tibia 0.36 (0.32); basitarsus 0.42 (0.36); tarsus 0.36 (0.32); total 2.46 (2.16). Leg IV: trochanter 0.54 (0.46); femur 1.04 (0.82); patella 0.54 (0.46); tibia 0.70 (0.60); basitarsus — (0.48); tarsus — (0.40); total — (3.22).

Comment.—Rowland and Reddell (1979a) reported that the paratype female was immature; examination of the genitalia has shown it to be mature.

sprousei group

Diagnosis.—Cavernicoles. Medium to large species, 5.2 to 8.2 mm total length not including flagellum. Propeltidium with two pairs dorsal setae. Anterior sternum with one or two sternapophysial setae. Sternites V-VIII of male with one distinct row of setae near middle of sternite and one row near posterior margin. Pedipalp claw about 0.9 to 1.0 dorsal length of basitarsus-tarsus. Female pedipalps equal in length to males. Legs I and IV longer than total body length.

Distribution.—MEXICO: Tamaulipas.

Included species.—*P. sprousei* n.sp., *P purificacion* n.sp.

Protoschizomus sprousei new species
Figs. 2-3, 8-9, 28-29, 59-65

New species of schizomid: P. Sprouse, 1985:39.

Material examined.—MEXICO: *Tamaulipas*: Cueva del Tecolote, Los San Pedro, 1,450 m elev., 18 Nov. 1984 (P. Sprouse), male holotype (AMNH), female paratype (AMNH); 21 Nov. 1984 (D. Pate), 1 immature (TMM); 21 Nov. 1984 (P. Sprouse), female paratype, 2 immature females (TMM); 24 Nov. 1985 (P. Sprouse), 2 male, 1 female paratypes, 5 immatures (TMM); 26 Nov. 1985 (P. Sprouse), 3 immatures (TMM); 22-28 Nov. 1986 (P. Sprouse), 1 immature (TMM); March 1990 (P. Sprouse), 3 immatures (TMM).

Etymology.—This species is named for Peter S. Sprouse in recognition of his outstanding work in studying the caves and cave fauna of Mexico.

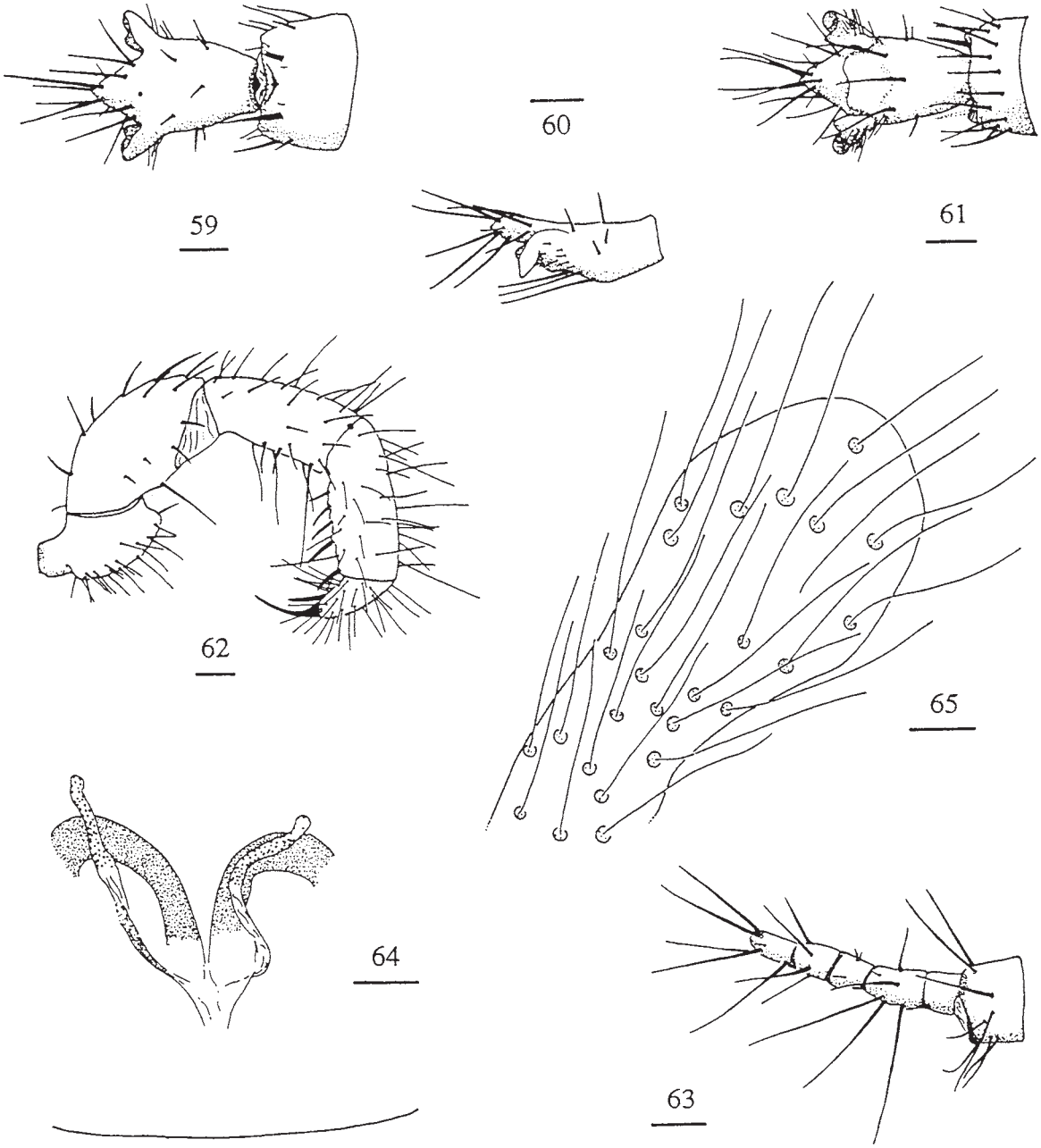
Diagnosis.—*Protoschizomus sprousei* has segments/articles I and III-V in the female flagellum. The broad basal stalk, more lateral position of the retractable lobes which curve outward, and distinctly triangular apex of the male flagellum separates *P. sprousei* from other species of *Protoschizomus* for which males are known.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 6.12 mm). Body, pedipalps, and chelicerae orangish brown; legs light tan.

Cephalothorax: Propeltidium 1.80 mm long, 0.94 mm wide; with two setae in a row on anterior process, one pair of closely set setae at base of anterior process, one pair of widely spaced long setae about 4/9 from distal margin, and one pair

closely set short setae about 1/3 from posterior margin. Gap between mesopeltidial plates 0.3 anterior length of one plate. Metapeltidium distinctly divided. Anterior sternum with six setae plus two sternapophysial setae; posterior sternum with four setae.

Abdomen: Tergite I well-sclerotized, with two pairs anterior microsetae (in row) setae and one pair large posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergite III with one pair dorsal setae; tergites IV-VII with one pair large dorsal setae and one pair small dorsolateral setae each; tergite VIII with one pair large dorsal setae, one small dorsolateral seta on left side, and one pair lateral setae; tergite IX with one pair dorsolateral and one pair lateral setae. Segment X with four ventral and two ventrolateral setae; segment XI with five ventral and two ventrolateral setae; segment XII with two very strong dorsal setae, two smaller dorsolateral



Figs. 59-65.—*Protoschizomus sprousei*: 59, male flagellum, dorsal aspect; 60, male flagellum, lateral aspect; 61, male flagellum, ventral aspect; 62, male pedipalp, lateral aspect; 63, female flagellum, lateral aspect; 64, female spermathecae; 65, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 59-63, 0.1 mm for Fig. 64, 0.01 mm for Fig. 65.

setae, and ten ventral setae. Sternites V-VIII with two distinct rows of setae, one row along posterior margins and one row near middle of sternites, IX with anterior row irregular. Sternite VI about 3.6 times as wide as long; width/length ratio versus body length, 1.7. Flagellum (Figs. 28-29, 59-61) 0.62 mm long, 0.34 mm wide; widest near middle with pointed apex and pair of lightly sclerotized ventrolateral lobes projecting posterolaterally from near apex; dm2 seta missing.

Pedipalps (Fig. 62): Trochanter slightly produced distally. Patella with three spinose setae on ventrolateral surface. Tibia with five spinose setae on right pedipalp and four spinose setae on left pedipalp (which increase in length and width distally) on ventrolateral margin. Spur about 0.5 and claw about equal to dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with eight rounded teeth. Setae: 1=3; 2=3; 3=10; 4=2; 5=0; 6=1. Setae 1-3 pilose; 4, 6 pointed.

Legs: Leg I, including coxa, about 10.30 mm long; basitarsal-tarsal segment proportions: 17:6:6:7:7:6:22. Femur IV about 4.5 times as long as deep.

Female paratype: As in male except as follows: Length from distal margin of propeltidium to base of flagellum, 8.26 mm. Color reddish orange. Propeltidium 2.26 mm long, 1.10 mm wide. Tergite IV with one pair dorsal setae; tergite VIII with one pair dorsal, one pair dorsolateral, and one pair lateral setae near posterior margin and one pair dorsolateral setae near middle. Setation of segments X-XII also varies slightly. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 3.6 times as wide as long; length/width ratio versus body length, 2.3. Flagellum (Figs. 8-9, 63) 0.88 mm long; dm2 and dm4 setae missing; segments/articles I, III-V present. Spermathecae (Figs. 64-65) of one pair of curved elongate lobes only slightly enlarged apically. Chelicerae serrula with eight rounded teeth; setae: 1=3; 2=7; 3=16; 4=2; 5=0; 6=1. All setae except 6 long and pilose. Pedipalp equal in length to male pedipalp. Leg I, including coxa, 10.98 mm long; basitarsal-tarsal proportions: 20:7:7:7:8:7:22. Femur IV about 3.8 times as long as deep.

Variation: An examination of four additional adults revealed the following differences from the holotype: two specimens had only one dorsolateral seta on tergite IV; two specimens had one pair dorsal and one pair lateral setae; one specimen had one pair dorsal, one pair dorsolateral, and one pair lateral setae on tergite VIII; one specimen had one pair dorsal, one pair dorsolateral, and one pair lateral setae on tergite IX. One specimen had seven setae and one had five setae on the anterior sternum. One specimen had six and one had four spinose setae on the pedipalp tibia. The flagellum of two juveniles consisted of two segments and was enlarged basally (annuli at positions 4 and 5). Because of the reduction in segmentation and enlargement, we presume them to be penultimate males. Earlier instar juveniles (presumably of both sexes) have no segments in the flagellum. The setation of the juvenile males is the same as the female except dm4 is present.

Measurements (mm).—Male holotype (female paratype): Pedipalp trochanter 0.22 (0.36); femur 1.00 (1.30); patella 0.88 (1.18); tibia 0.88 (1.20); basitarsus-tarsus 0.40 (0.56); total 3.38 (4.60). Leg I: trochanter 0.74 (0.76); femur 2.24 (2.56); patella 2.90 (2.88); tibia 2.20 (2.24); basitarsus 0.38 (0.40); tarsus 1.10 (1.20); total 9.56 (10.04). Leg II: trochanter 0.54 (0.44); femur 1.70 (2.04); patella 0.88 (1.12); tibia 1.20 (1.38); basitarsus 0.84 (0.98); tarsus 0.78 (0.82); total 5.94 (6.78). Leg III: trochanter 0.44 (0.40); femur 1.64 (1.98); patella 0.86 (1.04); tibia 0.98 (1.20); basitarsus 0.96 (1.12); tarsus 0.82 (0.88); total 5.70 (6.62). Leg IV: trochanter 1.00 (1.10); femur 2.26 (2.30); patella 1.06 (1.26); tibia 1.48 (1.90); basitarsus 1.28 (1.46); tarsus 0.82 (0.98); total 7.90 (9.00).

Habitat.—This species is relatively abundant in Cueva del Tecolote. The cave is, with the exception of the Sistema Purificación, the most extensive in the Purificación region. More than 11 kilometers of passage have been surveyed in the cave and it is in excess of 230 m deep. During the rainy season the cave receives an enormous amount of floodwater and is heavily polluted by sewage from the town of Los San Pedro (Sprouse et al., 1987).

Protoschizomus purificacion new species
Figs. 2-3, 12-13, 30-31, 72-77

Material examined.—MEXICO: *Tamaulipas*: Cueva X, Conrado Castillo, 1,950 m elev., 27 Dec. 1986 (P. Sprouse), female holotype (AMNH); 15 April 1980 (D. Pate), immature male paratype (TMM).

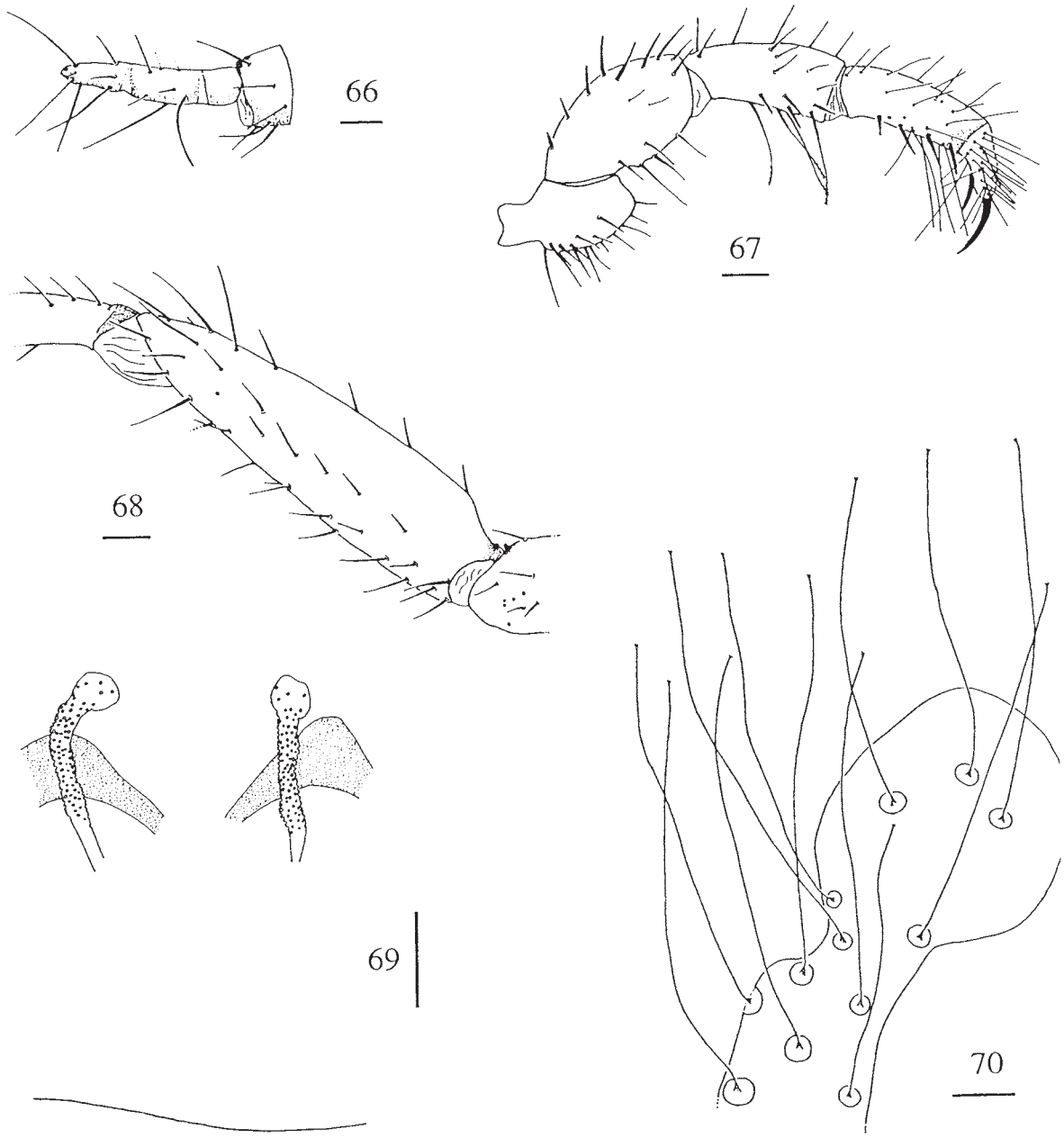
Etymology.—The species name is based on the Purificación region in which area Cueva X is located; it is used as a noun in apposition.

Diagnosis.—*Protoschizomus purificacion* is distinguished from all other species of *Protoschizomus* by the segmentation of the female flagellum, where segments/articles I and III–IV are present.

Description.—Female holotype (length from distal edge of propeltidium to base of flagellum, 5.26 mm); light tan.

Cephalothorax: Propeltidium 1.34 mm long, 0.80 mm wide; with two setae in row on anterior process and one pair of setae at base of process; with one pair widely separated setae about 1/3 from distal edge and one closely spaced pair about 1/4 from posterior margin of propeltidium. Gap between mesopeltidial plates 0.4 anterior width of one plate. Metapeltidium divided by a faint line. Anterior sternum with 10 setae, plus two sternapophysial setae; posterior sternum with four setae.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergite III with one pair dorsal setae; tergite IV with one pair dorsal setae and one dorsolateral seta on right side; tergites V-VII with one pair dorsal and one



Figs. 66-70.—*Protoschizomus gertschi*: 66, female flagellum, lateral aspect; 67, female pedipalp, lateral aspect; 68, female femur IV, lateral aspect; 69, female spermathecae; 70, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 66-68, 0.1 mm for Fig. 69, 0.01 mm for Fig. 70.

pair dorsolateral setae each; tergite VIII with one pair dorsal and one pair lateral setae and one dorsolateral seta on left; tergite IX with one pair dorsolateral and one pair lateral setae. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 3.5 times as wide as long; width/length ratio versus body length, 1.5. Segments X-XI with two lateral and five ventral setae each; segment XII with two large dorsal, two dorsolateral, and 11 ventral setae. Flagellum (Figs. 12-13, 73) 0.62 mm long; dm2 and dm4 setae missing; segments/articles I, III-IV present. Spermathecae (Figs. 76-77) of one pair short curved lobes which are enlarged apically; neck of apical enlargement appearing elastic.

Pedipalps (Fig. 72): Trochanter very slightly produced distally. Femur with two ventrolateral spinose setae. Tibia with four strong ventrolateral spinose setae. Spur about 0.5, claw about 0.9 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with nine rounded teeth; setae: 1=3; 2=4; 3=10; 4=2; 5=0; 6=1; all setae except 4 and 6 pilose.

Legs: Leg I, including coxa, 6.42 mm long; basitarsal-tarsal proportions: 11:3:5:4:4:4:17. Femur IV about 3.5 times as long as deep.

Male adult unknown.

Immature paratype male: The flagellum (Figs. 30-31, 74-75) of this specimen is distinctly three segmented (annuli at positions 4 and 5), with the basalmost segment widened, as in two specimens of *P. sprousei* as discussed above. The setation of the flagellum is like the female except dm4 is present. Also both dm3 setae are present, suggesting the missing seta on the female is abnormal; dm2 seta missing. This specimen is otherwise similar to the female holotype except as follows: Anterior sternum with nine setae. Tergite IV with one pair dorsal setae; tergite VIII with one pair dorsal and one pair lateral setae. Cheliceral serrula with eight rounded teeth; setae: 1=4; 2=3; 3=9; 4=2; 5=0; 6=1.

Measurements (mm).—Female holotype: Pedipalp: trochanter 0.20; femur 0.80; patella 0.72; tibia 0.70; basitarsus-tarsus 0.30; total 2.72. Leg I: trochanter 0.44; femur 1.50; patella 1.54; tibia 1.34; basitarsus 0.26; tarsus 0.80; total 5.88. Leg II: trochanter 0.32; femur 1.24; patella 0.64; tibia 0.72; basitarsus 0.52; tarsus 0.56; total 4.00. Leg III: trochanter 0.32; femur 1.12; patella 0.60; tibia 0.64; basitarsus 0.70; tarsus 0.58; total 3.96. Leg IV: trochanter 0.72; femur 1.42; patella 0.76; tibia 1.06; basitarsus 0.92; tarsus 0.62; total 5.50.

Habitat.—Cueva X, the only known locality for this species, is 183 m long and 25 m deep.

Unplaced Species

The following two species are known only from females and cannot now be placed in a species group.

Protoschizomus gertschi new species
Figs. 2-3, 10-11, 66-70

Agastoschizomus sp.: Rowland and Reddell, 1977:80, 82, fig. 1; Reddell, 1981:26, 124, 125, fig. 21.

Material examined.—MEXICO: *Tamaulipas*: Sótano de Riachuelo, 6.5 km N and 2 km E of Miquihuana, 2,500 m elev., 16 February 1981 (P. Mothes Jameson, R. Jameson), female holotype (AMNH), immature paratype (TMM).

Etymology.—This species is named in honor of Willis J. Gertsch in recognition of his work on New World Schizomida and his studies on the cavernicole fauna of North America.

Diagnosis.—The apically enlarged and rounded spermathecal lobes and rounded pedipalp trochanter serve to distinguish *P. gertschi* from other species of *Protoschizomus*. The presence of only segments/articles I and IV also distinguish this species from all others.

Description.—Holotype female (length from distal edge of propeltidium to base of flagellum, 5.96 mm). Abdomen and legs yellowish brown; propeltidium, chelicerae, and pedipalps light reddish brown.

Cephalothorax: Propeltidium 1.68 mm long, 0.92 mm wide; with two setae in row on anterior process and a pair near anterior edge of propeltidium; with one pair of dorsal setae located about 1/5 from posterior margin of propeltidium, and one seta on right side of propeltidium slightly anterior to middle. Gap between mesopeltidial plates 0.4 anterior width of one plate. Metapeltidium divided by narrow suture. Anterior sternum with seven setae, plus two sternapophysial setae; posterior sternum with four setae.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one large pair posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergite III with one pair dorsal setae; tergite IV with one pair dorsal setae and one small dorsolateral seta on left side; tergite V with one pair dorsal and one pair dorsolateral setae, and one lateral seta; tergites VI-VII with one pair dorsal and one pair dorsolateral setae; tergite VIII with one pair dorsal,

one pair dorsolateral, and one pair lateral setae; tergite IX with one pair dorsolateral and one pair lateral setae. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 3.8 times wider than long; width/length ratio versus body length, 1.6. Segments X-XI telescoped; segment X with six ventral and ventrolateral setae; segment XI with seven ventral and ventrolateral setae; segment XII with two dorsal, two dorsolateral, and 10 ventral setae. Flagellum (Figs. 10-11, 66) 0.56 mm long; with complete set of setae; segments/articles I and IV present.

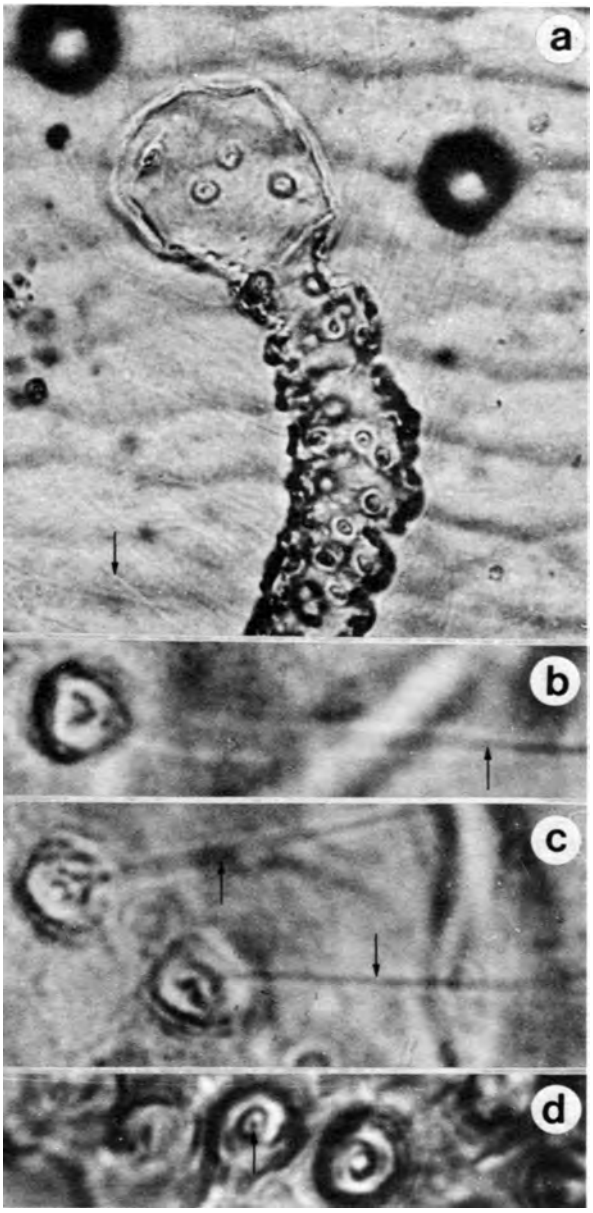


Fig. 71.—*Protoschizomus gertschi*: a, female spermathecal lobe; b-c, details of lobe microtubules; d, detail of microtubule base.

Spermathecae (Figs. 69-71) of one pair lobes, with slender stalks and rounded enlarged apical bulbs.

Pedipalps (Fig. 67): Trochanter not produced distally. Femur with six or seven strong spinose setae decreasing in size distally. Patella with four strong spinose setae along ventrolateral margin and three or four long pilose strong spinose setae on mesal margin. Tibia with four strong spinose setae and two long setae along ventrolateral margin. Spur about 0.5, claw about 0.9 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with nine teeth. Setae: 1=3; 2=4; 3=11; 4=2; 5=0; 6=1. All denticles rounded and many setae broken, suggesting this is an older adult.

Legs: Leg I, including coxa, about 7.90 mm long; basitarsal-tarsal segment proportions: 14-3-5-5-4-4-17. Femur IV (Fig. 68) about 4.2 times as long as deep.

Male unknown.

Immature paratype: As in holotype except there is a pair of dorsolateral setae slightly anterior to middle of the propeltidium; dorsolateral seta on right side of abdominal tergite IV missing; only one pair of dorsal setae on tergite V; and only one pair of dorsal and one pair lateral setae on tergite VIII.

Measurements (mm).—Female holotype: Pedipalp: trochanter 0.44; femur 1.80; patella 0.80; tibia 0.74; basitarsus-tarsus 0.38; total 4.16. Leg I: trochanter 0.50; femur 1.88; patella 1.92; tibia 1.56; basitarsus 0.38; tarsus 1.02; total 7.26. Leg II: trochanter 0.36; femur 1.52; patella 0.88; tibia 0.94; basitarsus 0.74; tarsus 0.68; total 5.12. Leg III: trochanter 0.44; femur 1.50; patella 0.78; tibia 0.86; basitarsus 0.92; tarsus 0.68; total 5.18. Leg IV: trochanter 0.84; femur 1.78; patella 0.86; tibia 1.38; basitarsus 1.16; tarsus 0.82; total 6.84.

Habitat.—Sótano de Riachuelo is a 60 m deep cave which receives some floodwater (Mothes, 1982). The cave is also home to two remarkable troglobitic carabid beetles, *Miquihuana rhadiniformis* Barr and *Paratrechus laticeps* Barr.

Comments.—This species, although smaller and less-attenuated than *A. lucifer*, *A. stygius*, and *A. huitzmolotitlensis*, is probably restricted to cave life. The absence of the left anterior seta on the propeltidium is probably an abnormal condition, since this seta is present in the paratype.

Protoschizomus treacyae new species
Figs. 2-3, 14-15, 78-81

Material examined.—MEXICO: *Tamaulipas*: Cueva del Borrego, 0.5 km S of Conrado Castillo,

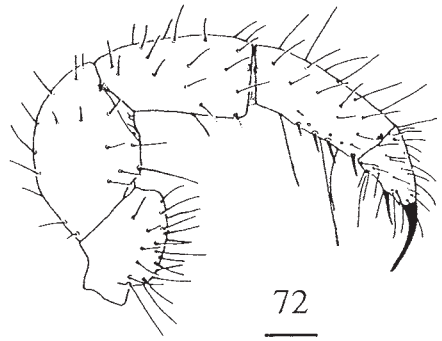
1,980 m elev., 26 Dec. 1986 (T. Treacy Sprouse), female holotype (AMNH).

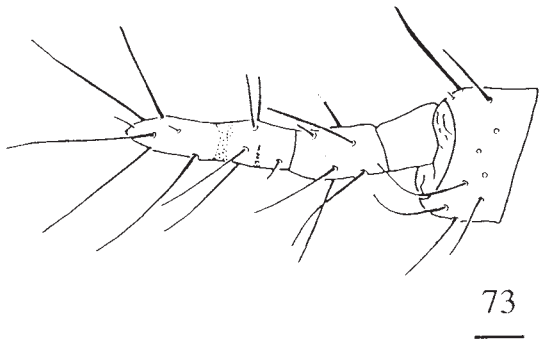
Etymology.—The species is named in honor of Terri Treacy, who collected this and many other interesting cave animals.

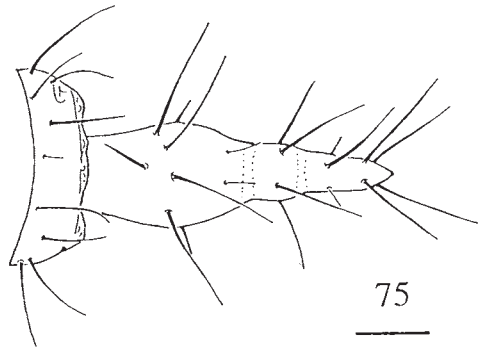
Diagnosis.—The species is readily identified by the segmentation of the female flagellum where segments/articles I, IV, and V are present.

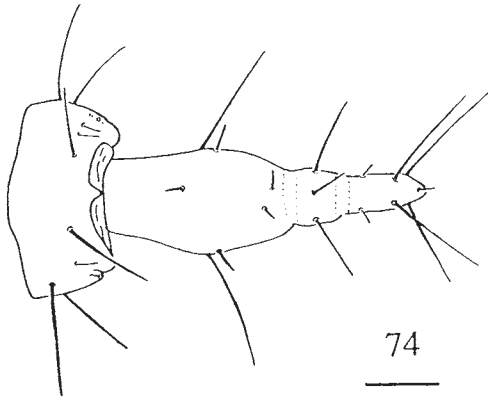
Description.—Female holotype (length from distal edge of propeltidium to base of flagellum 6.36 mm). Propeltidium, pedipalps, chelicerae, and legs I orangish brown; abdomen and legs II-IV light tan.

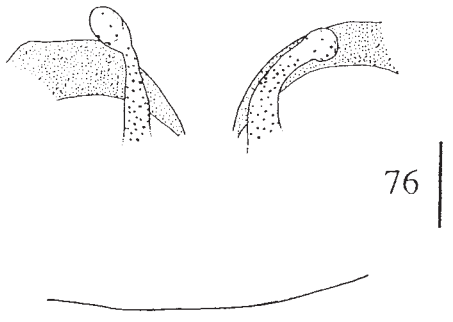
Cephalothorax: Propeltidium 1.72 mm long, 0.90 mm wide; with two setae in a row on anterior process and one pair of setae at base of anterior process; with one pair of widely spaced setae about 1/3 from distal margin, one small seta on right side immediately behind pairs of setae, and one pair closely spaced setae about 1/4 from posterior margin. Gap between mesopeltidial plates 0.5

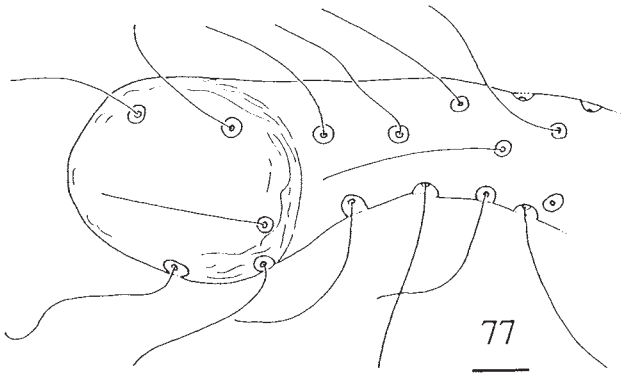












Figs. 72-77.—*Protoschizomus purificacion*: 72, female pedipalp, lateral aspect; 73, female flagellum, lateral aspect; 74, penultimate male flagellum, dorsal aspect; 75, penultimate male flagellum, ventral aspect; 76, female spermathecae; 77, detail of spermathecal lobe.

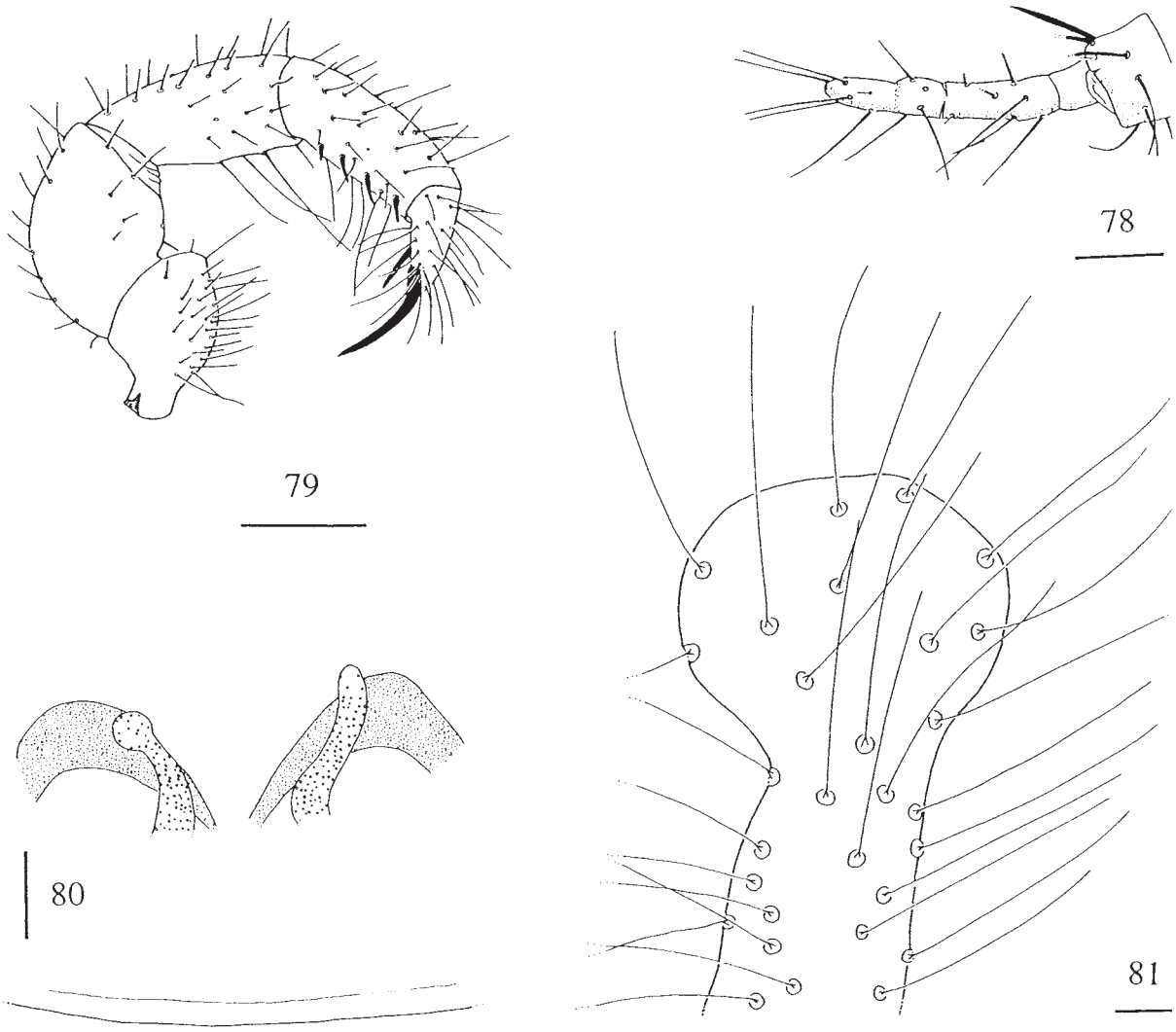
anterior width of one plate. Metapeltidium distinctly divided. Anterior sternum with nine setae, plus one sternapophysial seta; posterior sternum with three setae.

Abdomen: Tergite I well-sclerotized, with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with two pairs anterior microsetae (in row) and one pair large posterior setae; tergites III-V with one pair dorsal setae each; tergite VI with one pair large dorsal setae and one small dorsolateral seta on left side; tergite VII with one pair dorsal setae; tergites VIII-IX with one pair dorsal and one pair lateral setae each. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI 3.6 times as wide as long; width/length ratio versus body length, 1.8. Segments X-XII telescoped; segment X with two lateral and four ventral setae; segment XI with two lateral and six ventral setae; segment XII with two dorsal, two dorsolateral, two ventrolateral, and eight ventral setae. Flagellum (Figs. 14-15, 78) 0.74 mm long; dm2 seta missing; segments/articles I, IV, and V present. Spermathecae (Figs. 80-81) of one pair slightly curved lobes; left lobe slightly enlarged apically.

Pedipalps (Fig. 79): Trochanter not produced distally. Patella with three strong spinose setae on ventrolateral margin. Tibia with four strong spinose setae on ventrolateral margin. Spur about 0.5, claw about equal to dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with nine rounded teeth; setae: 1=3; 2=6; 3=13; 4=3; 5=0; 6=1; all setae except seta 6 pilose.

Legs: Leg I, including coxa, 8.90 mm long;



Figs. 78-81.—*Protoschizomus treacyae*: 78, female flagellum, lateral aspect; 79, female pedipalp, lateral aspect; 80, female spermathecae; 81, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 78-79, 0.1 for Fig. 80, 0.01 mm for Fig. 81.

basitarsal-tarsal proportions: 15:4:6:5:6:6:20. Femur IV about 3.7 times as long as deep.

Male unknown.

Measurements (mm).—Female holotype: Pedipalp: trochanter 0.20; femur 1.02; patella 0.92; tibia 0.98; basitarsus-tarsus 0.48; total 3.60. Leg I: trochanter 0.62; femur 2.30; patella 2.10; tibia 1.80; basitarsus 0.36; tarsus 0.96; total 8.14. Leg II: trochanter 0.34; femur 1.64; patella 0.88; tibia 1.00; basitarsus 0.82; tarsus 0.74; total 5.42. Leg III: trochanter 0.44; femur 1.56; patella 0.74; tibia 0.90; basitarsus 0.98; tarsus 0.78; total 5.40. Leg IV: trochanter 0.84; femur 1.84; patella 0.92; tibia 1.40; basitarsus 1.32; tarsus 0.86; total 7.18.

Habitat.—Cueva del Borrego is an extensive cave with 1,186 m of surveyed passage and a total depth of 58 m.

?*Protoschizomus* sp.

Material examined.—MEXICO: *Tamaulipas*: Cueva de Encino Mágico, Los San Pedro, 1,465 m elev., 27 Nov. 1986 (D. Pate), 1 immature (TMM).

Comment.—This is probably an early instar or very small species and is only tentatively placed in *Protoschizomus*.

Genus *Agastoschizomus* Rowland

Schizomus: Reddell, 1967:106; Reddell, 1971:28 (part).

Agastochizomus Rowland, 1971:13 (lapsus calami); Reddell and Mitchell, 1971b:1.

Agastoschizomus Rowland, 1971:13-14; Reddell and Mitchell, 1971a:145, 165; Reddell and Mitchell, 1971b:1; Briggs and Hom, 1972:1; Dumitresco, 1973:282; Reddell, 1973:33, 38; Reddell and Elliott, 1973:171; Rowland, 1973a:5-6, 8-10; Rowland, 1973b:197, 200-203; Rowland, 1973c: 136; Brignoli, 1974:150; Rowland, 1975a:8-9, 14-15, 27-28, 40, 43-50, 167-168, 181, 211, 334, 338-339, 343-346, 378; Rowland, 1975b:1-2, 5, 8-10; Rowland and Reddell, 1977:80-82, 85, 96; Rowland and Reddell, 1979a:162, 167-170, 174; Rowland and Reddell, 1980:21; Anonymous, 1982:961.

New genus of schizomid: Mitchell et al., 1977:56.

Agostoschizomus: Levi, 1982:76 (lapsus calami).

Diagnosis.—Cavernicoles. Large species, 7.00 to 12.40 mm total length excluding flagellum. Propeltidium with one seta on anterior process. Anterior process downturned or not apically. Anterior sternum with one or two sternapophysial setae. Gap between mesopeltidial plates 0.1 to 0.3 anterior width of one plate. Sternites V-VIII of male with two distinct rows of setae. Sternite VI 2.0 to 2.4 times as wide as long; width/length ratio versus body length 3.4 to 5.4. Female flagellum with or without segments and articles. Male flagellum not expanded distally, with or without retractable ventrolateral lobes. Female pedipalp in proportion to body length 0.9-1.2 pedipalp length of male. Pedipalpal spur about 0.5-0.7, claw about 1.1 to 1.3 dorsal length of basitarsus-tarsus. Femur IV 4.8 to 8.2 times longer than deep. Legs I and IV longer than body length.

Type-species.—*Agastoschizomus lucifer* Rowland, 1971 (by monotypy and original designation).

Agastoschizomus lucifer Rowland
Figs. 2-3, 16-17, 32-33, 82-87

Agastoschizomus lucifer Rowland, 1971:14-17, figs. 1-8; Reddell and Mitchell, 1971a:145, 165, figs. 3-4; Dumitresco, 1973:282; Reddell, 1973:33, 38; Reddell and Elliott, 1973:171; Rowland, 1973a:10; Rowland, 1973b:197, 200-202, figs. 2, 4; Rowland, 1973c:136; Brignoli, 1974:150; Rowland, 1975a:8-9, 14-15, 27-28, 43-50, 167-168, 181, 211, map 3, figs. 1, 8, 13, 16; Rowland, 1975b:8-10, fig. 4; Rowland and Reddell, 1977:80-82, 85, 96, fig. 1; Rowland and Reddell, 1979a:162, 167-170, 174, figs. 3, 7; Rowland and Reddell, 1980:21; Reddell, 1981: 16, 36, 65, 125-127, 320, 324, fig. 21; Anonymous, 1982:961, unnumbered fig.

Agastochizomus lucifer: Rowland, 1971:13 (lapsus calami).

New genus of schizomid: Mitchell et al., 1977:56.

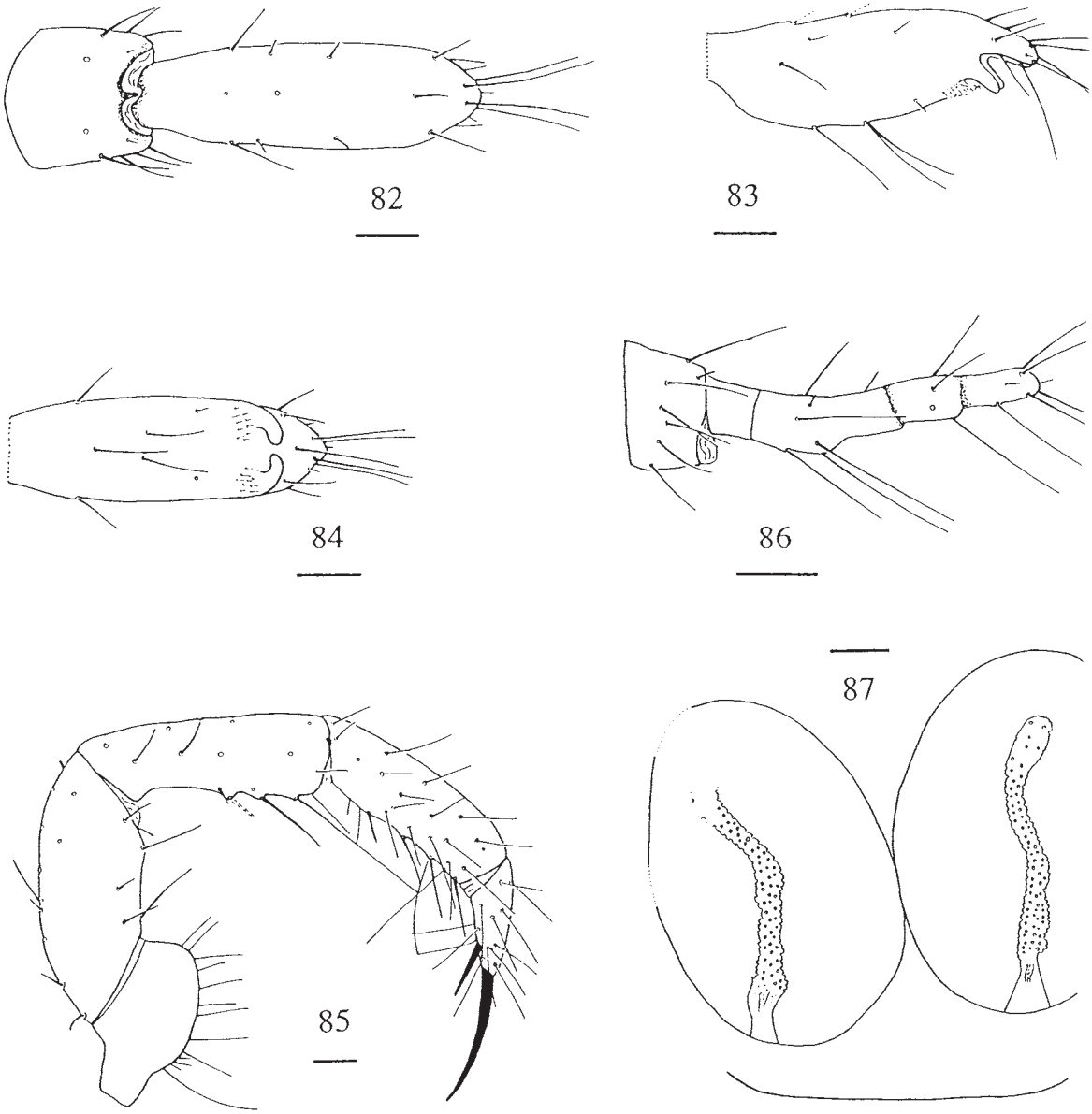
Material examined.—MEXICO: *San Luis Potosí*: Sótano de Matapalma, 21 km N of Ciudad Valles, 242 m elev., 29 May 1969 (R.W. Mitchell, F.E. Abernethy, T. Albert), 1 immature (AMNH); 30 Dec. 1972 (R. Fieseler), 1 immature (AMNH); El Sótano de la Tinaja, 10 km NNE of Ciudad Valles, 165.5 m elev., 9 April 1966 (J. Fish, D. McKenzie), male holotype, female paratype, 1 immature (AMNH); 18 Feb. 1970 (J.A.L. Cooke), 2 males, 1 female, 4 immatures (AMNH); 29 May 1974 (J. Prentice), 1 female (TMM); Sótano de Yerbaniz, 22.5 km N of Ciudad Valles, 241.5 m elev., 7 Jan. 1970 (coll. unknown), 1 female, 1 immature (TMM); 7 Jan. 1970 (S. Wiley), 1 female, 5 immatures (TMM); 9 Jan. 1970 (W. Elliott, S.

Wiley), 1 female (TMM); 17 Feb. 1970 (coll. unknown), 1 female, 7 immatures (TMM); 28 March 1970 (W. Elliott), female allotype, female paratype (AMNH); 8 Jan. 1971 (W. Elliott, J. Shepperd), male paratype (AMNH), 1 immature (TMM).

Diagnosis.—This is the only species of *Agastoschizomus* with a divided metapeltidium. Males may also be separated from males of *A. huitzmolotitlensis* by the shape of the male flagellum, which is more slender and more pointed apically in *A. huitzmolotitlensis* than in *A. lucifer*. The spermathecal lobes of *A. lucifer* are long and slender with a slight apical enlargement, whereas in *A. stygius* the lobes are short and decrease in size apically. Females may also be distinguished from *A. stygius* by the presence of segments/articles I and III-V in the female flagellum. *Agastoschizomus stygius* has only segments/articles IV and V present. The presence of ventrolateral lobes on the male flagellum and the presence of segments/articles on the female flagellum readily separate this species from *A. patei*.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 8.14 mm). Color orangish.

Cephalothorax: Propeltidium 2.24 mm long, 1.04 mm wide; with one apical seta on anterior process



Figs. 82-87.—*Agastoschizomus lucifer*: 82, male flagellum, dorsal aspect; 83, male flagellum, lateral aspect; 84, male flagellum, ventral aspect; 85, male pedipalp, lateral aspect; 86, female flagellum, lateral aspect; 87, female spermathecae. Scale lines = 0.25 mm for Figs. 82-86, 0.05 for Fig. 87.

and one pair setae at base of process; with one pair widely spaced setae 5/11 from anterior margin and one pair closely spaced setae 3/11 from posterior margin. Gap between mesopeltidial plates about 0.2 anterior width of one plate. Metapeltidium divided by narrow suture. Anterior sternum with nine setae, plus two sternapophysial setae. Posterior sternum with three setae.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior setae; tergites III-V with one pair dorsal setae each; tergite VI with one pair dorsal setae and one dorsolateral seta on right side; tergite VII with one pair dorsal and one pair dorsolateral setae; tergite VIII with one pair dorsal, one pair dorsolateral, and one pair lateral setae; tergite IX with one pair dorsal and one pair lateral setae and one dorsolateral seta on left side. Segment X with one pair dorsal, one pair lateral, and four ventral setae; segment XI with one pair dorsolateral, one pair lateral, and six ventral setae; segment XII with one pair large dorsal, six smaller dorsal, and 10 ventral setae. Sternite VI about 2.4 times as long as wide; width/length ratio versus body length, 3.4. Sternites IV-IX with two distinct submarginal rows of setae. Flagellum (Figs. 32-33, 82-84) 1.44 mm long, 0.40 mm wide, tubular with one pair short nonsclerotized retractable ventrolateral lobes; with complete set of setae.

Pedipalps (Fig. 85): Trochanter not produced distally. Patella with three strong ventrolateral spinose setae, increasing in length distally. Tibia with five strong ventrolateral spinose setae. Spur about 0.5, claw about 1.1 dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with eight teeth. Seta: 1=3; 2=6; 3=10; 4=2; 5=0; 6=1.

Legs: Leg I, including coxa, 14.82 mm long; basitarsal-tarsal proportions: 31:10:9:8:11:8:28. Femur IV about 5.3 times as long as deep.

Female from Sótano de Yerbaniz: As in male except as follows. Length from distal edge of propeltidium to base of flagellum, 12.40 mm. Propeltidium 3.02 mm long, 1.46 mm wide. Anterior sternum with eight setae; posterior sternum with four setae. Tergite VI with one pair dorsal setae and one dorsolateral seta on left side; tergite VIII with one extra dorsolateral seta on left side; tergite IX with one pair dorsal, one pair lateral, and one pair small setae on lateral margins about midway along length of tergite. Sternite VI about 2.3 times as wide as long; width/length ratio versus body length, 5.4. Sternites V-IX with two distinct submarginal rows of setae. Flagellum (Figs. 16-17, 86) 1.30 mm long; dm2 seta missing; segments/articles I, III-V present. Spermathecae (Fig. 87) of one pair of gently curved lobes with slightly enlarged apical bulb. Pedipalp length in proportion to body length about 0.9 male pedipalp length. Leg I, including coxa, 16.62 mm long; basitarsal-tarsal proportions: 33:10:10:10: 10:10:30. Femur IV about 5.4 times as long as deep.

Variation: An examination of 12 adult or late instar specimens reveals the following differences from the holotype: Two specimens were found to have only one pair of dorsal setae; a third specimen had the anteriormost pair, but one seta was missing in the posteriormost pair. Three specimens had only one pair of setae on tergite VI. One specimen had four pairs of setae on tergite VIII, the extra pair being very small lateral setae distad to the posterior margin; one specimen had one extra lateral seta distad to the posterior margin. One specimen had three pairs of setae on tergite IX, the extra pair being anterior to the posterior margin and very small. The anterior sternum included seven (one specimen), nine (one specimen), 10 (five specimens), and 11 (five specimens) setae. One specimen had three setae on the posterior sternum, seven specimens had four setae, and four specimens had two setae. These variations could not be correlated with sex, maturity/age, or locality.

Measurements (mm).—Male holotype (female): Pedipalp: trochanter 0.34 (0.44); femur 1.42 (1.90); patella 1.30 (1.66); tibia 1.22 (1.78); basitarsus-tarsus 0.72 (0.98); total 5.00 (6.76). Leg I: trochanter 0.70 (0.98); femur 3.64 (4.18); patella 4.14 (4.54); tibia 3.38 (3.54); basitarsus 0.62 (0.72); tarsus 1.50 (1.62); total 13.98 (15.58). Leg II: trochanter 0.48 (0.68); femur 2.60 (3.08); patella 1.40 (1.70); tibia 1.78 (2.00); basitarsus 1.30 (1.56); tarsus 1.14 (1.38); total 8.70 (10.40). Leg III: trochanter 0.58 (0.82); femur 2.54 (2.86); patella 1.22 (1.44); tibia 1.70 (1.96); basitarsus 1.48 (1.72); tarsus 1.22 (1.48); total 8.74 (10.28). Leg IV: trochanter 1.22 (1.64); femur 3.16 (3.78); patella 1.64 (1.82); tibia 2.68 (3.12); basitarsus 1.82 (2.22); tarsus 1.34 (1.56); total 11.86 (14.14).

Habitat.—The three caves from which this species has been collected are located in the Sierra de El Abra, a low mountain range extending from south of Ciudad Valles north to Ciudad Mante. All three caves are extensive systems receiving massive amounts of floodwater during the wet season (Mitchell et al., 1977). Vegetation of the region is characterized as thorn forest. Specimens have been found actively roaming across silt banks in total darkness.

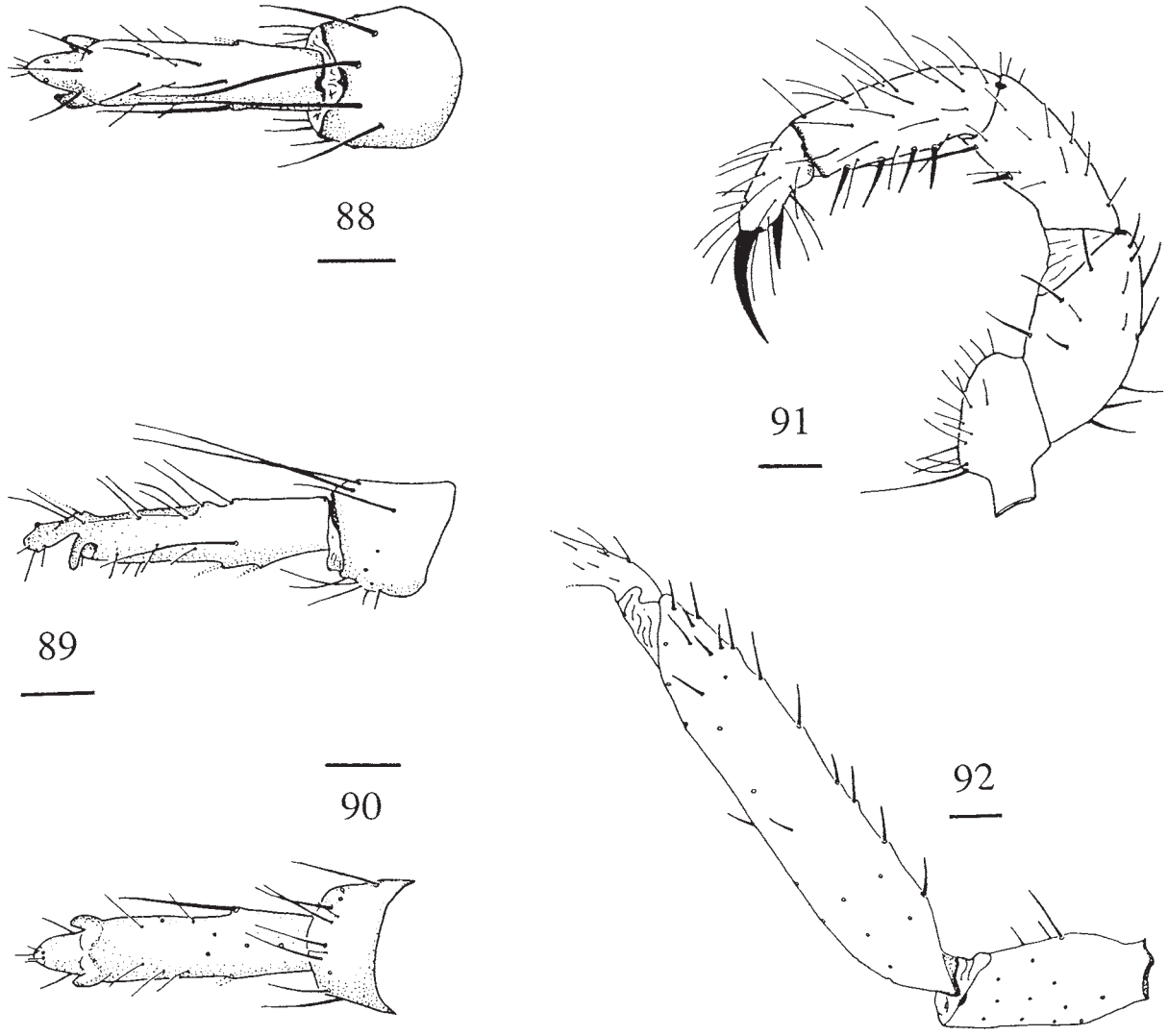
Agastoschizomus huitzmolotitlensis Rowland
Figs. 1a, 2-3, 34-35, 88-92

Schizomus sp.: Reddell, 1967:106; Reddell, 1971: 28 (part–Sótano de Huitzmolotitla record only).
Agastoschizomus huitzmolotitlensis Rowland, 1975b:6, 8-10, fig. 3; Rowland, 1975a:28, 44-50, 167-168, map 3, fig. 17; Rowland and Reddell, 1977:80-82, fig. 1; Rowland and Reddell, 1979a:162, 167, 169-170, 174, figs. 4, 7; Reddell, 1981:17, 26, 35, 65, 124-125, 320, fig. 21.

Material examined.—MEXICO: *San Luis Potosí*: Sótano de Huitzmolotitla, 1 km ESE of Tlamaya (=2 km NNW Xilitla), 600 m elev., 24 January 1964 (T. Raines, T. Phillips), male holotype (AMNH).

Diagnosis.—The more slender, apically pointed male flagellum of this species serves to separate it from *A. lucifer*. The presence of a pair of setae on abdominal tergite I separates this species from *A. stygius*. The two species may also be separated by the femur IV length/depth ratio (4.8 in *A. huitzmolotitlensis* versus 6.0 in *A. stygius*). The presence of ventrolateral lobes on the male flagellum readily separates this species from *A. patei*.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 7.0 mm); light orangish brown.



Figs. 88-92.—*Agastoschizomus huitzmolotitlensis*: 88, male flagellum, dorsal aspect; 89, male flagellum, lateral aspect; 90, male flagellum, ventral aspect; 91, male pedipalp, lateral aspect; 92, male femur IV, lateral aspect. Scale lines = 0.25 mm.

Cephalothorax: Propeltidium 1.66 mm long, 0.90 mm wide; with one seta on apical process and one pair of setae at base of process; with one pair of dorsal setae located about 1/3 from anterior margin of propeltidium. Gap between mesopeltidial plates about 0.2 anterior width of one plate. Metapeltidium undivided. Anterior sternum with 11 setae; posterior sternum with one seta, poorly sclerotized, triangular.

Abdomen: Tergite I with two pairs anterior microsetae (in row) and one pair large posterior dorsal setae; tergite II with three pairs anterior microsetae (in row) and one pair large posterior dorsal setae; tergites III-IV with one pair dorsal setae each; tergites V-VI with one pair dorsal and one pair dorsolateral setae each; tergite VII with one pair dorsal and one pair dorsolateral setae and one lateral seta on right side; tergite VIII with six setae near posterior edge of tergite and one pair dorsal and one pair dorsolateral setae near middle of tergite; tergite IX with one pair long dorsal and one pair short lateral setae near posterior margin, and one pair small dorsolateral setae near middle of tergite. Sternites IV-VIII with one row setae near middle of sternite and one row near posterior margin, IX with irregular anterior row. Sternite VI about 2.0 times as wide as long; width/length ratio versus body length, 3.5. Segment X with one pair dorsolateral, one pair lateral, and row of six ventral setae. Segment XI with one pair lateral and row of seven ventral setae. Segment XII with two very long posteriorly directed dorsal setae reaching about 2/3 length of flagellum, two shorter dorsolateral setae, and 11 ventral setae; longer than segments X-XI combined. Flagellum (Figs. 34-35, 88-90) 1.08 mm long, 0.26 mm wide; cylindrical, modified apically with pairs of retractable ventrolateral lobes; vm5 seta missing.

Pedipalps (Fig. 91): Trochanter not produced distally. Patella with two strong ventrolateral spinose setae, distalmost tapering to long pointed end. Tibia with four strong ventrolateral spinose setae. Spur about 0.5, claw about 1.2 times as long as dorsal length of basitarsus-tarsus.

Chelicerae (Fig. 1a): Serrula with 7 teeth; setae: 1=3; 2=1; 3=8; 4=2; 5=0; 6=1.

Legs: Leg I, including coxa, about 10.94 mm long; basitarsal-tarsal segment proportions: 20:7:6:7:6:5:21. Femur IV (Fig. 92) about 4.8 times as long as wide.

Female unknown.

Measurements (mm).—Male holotype: Pedipalp: trochanter 0.33; femur 1.02; patella 0.84; tibia 0.96; basitarsus-tarsus 0.44; total 3.59. Leg I: trochanter 0.56; femur 2.62; patella 3.06; tibia 2.48; basitarsus 0.46; tarsus 1.10; total 10.28. Leg II: trochanter 0.30; femur 2.22; patella 1.00; tibia 1.28; basitarsus 0.90; tarsus 0.78; total 6.48. Leg III: trochanter 0.34; femur 2.20; patella 0.88; tibia 1.26; basitarsus 1.08; tarsus 0.82; total 6.58. Leg IV: trochanter 0.90; femur 2.32; patella 1.12; tibia 1.90; basitarsus 1.40; tarsus 0.96; total 8.60.

Habitat.—Sótano de Huitzmolotitla is an extensive cave which contains an active stream and receives considerable floodwater during the wet season. The cave is 3,002 m long and 240 m deep (Russell and Raines, 1967). This species was collected from the mud room near the back of the cave.

Agastoschizomus stygius new species
Figs. 2-3, 18-19, 93-96

Agastoschizomus sp.: Rowland and Reddell, 1977:80, 82, fig. 1 (part—Sótano Hondo de Pinalito record only).

Agastoschizomus n.sp.: Reddell, 1981:26, 124-125, fig. 21 (part).

Material examined.—MEXICO: *Hidalgo*: Sótano Hondo de Pinalito, Pinalito (a village located at kilometer post 105 on highway 85 north of Jacala), 1,600 m elev., 1 Jan. 1976 (C. Soileau and P. Strickland), female holotype (AMNH), immature paratype (TMM).

Etymology.—The species name is from the Latin *stygius*, the lower world, referring to its cavernicole habitat.

Diagnosis.—The absence of the large posterior setae on abdominal tergite I separates this species from all other *Agastoschizomus*. The shape of the female spermathecae and femur IV length/width ratio also distinguishes this species from other *Agastoschizomus*. This species also may be distinguished from females of *A. lucifer* by possessing only segments/articles IV and V in the female flagellum, rather than I and III-V. This species may be separated from *A. patei* by the presence of segments/articles in the female flagellum.

Description.—Female holotype (length from distal edge of propeltidium to base of flagellum, 9.66 mm). Abdomen and legs orangish brown; propeltidium, chelicerae, and pedipalps reddish brown.

Cephalothorax: Propeltidium 2.50 mm long, 0.80 mm wide; with one seta on anterior process and pair of setae at base of process and three dorsal setae (two close-set setae on right side, one seta on left side). Gap between mesopeltidial plates about 0.3 anterior width of one plate. Metapeltidium entire, with only a faint midline along the posterior margin

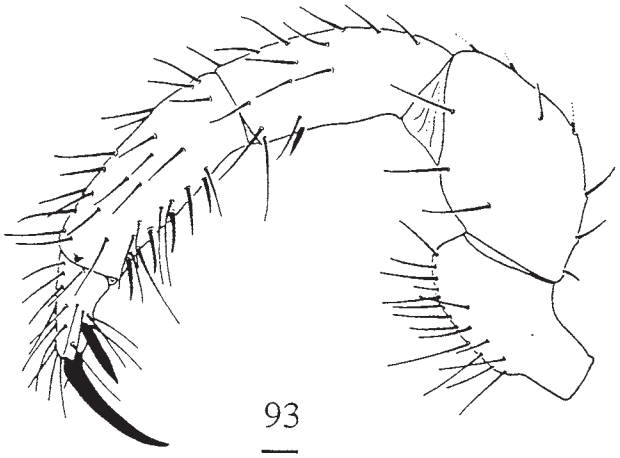
of the plate; plate strongly depressed; greatest width to length ratio about 1:1. Anterior sternum with seven setae, plus two sternapophysial setae; posterior sternum with three setae.

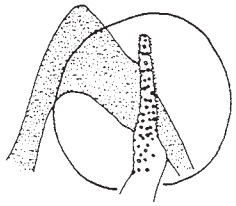
Abdomen: Tergite I with two pairs anterior microsetae (in row), no setae on posterior margin; tergite II with two pairs anterior microsetae (in row) and one pair large posterior setae; tergites III-IV with one pair dorsal setae each; tergites V-VII with two dorsal and two dorsolateral setae each; tergite VIII with two dorsal, two dorsolateral, and two lateral setae; tergite IX with two dorsal and two lateral setae. Sternites V-IX with two distinct submarginal rows of setae. Sternite VI about 2.7 as wide as long; width/length ratio versus body length, 3.6. Segments X-XII telescoped; segment X with one pair lateral and five ventral setae; segment XI with one pair dorsolateral and six ventral setae; segment XII with one pair dorsal spinose setae, one pair small and one pair large dorsolateral setae; one pair lateral setae; and 10 ventral setae. Flagellum (Figs. 18-19, 94) 1.44 mm long; with complete set of setae; articles IV and V present. Spermathecae (Figs. 95-96) of one pair of straight lobes without apical bulb and gently tapering from wider base towards apex.

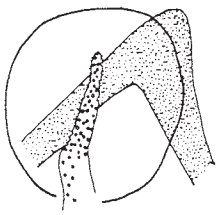
Pedipalps (Fig. 93): Trochanter not produced distally. Patella with one strong spinose seta and one very long whiplike seta on ventrolateral margin and with six long mesal setae. Tibia with five strong spinose setae and one long whiplike seta on ventrolateral margin and with five spinose setae tapering to long pilose ends and irregular row of long whiplike pilose setae on ventromesal margin; one long pilose whiplike seta ventrad to row of spinose setae. Spur about 0.5, claw about 1.3 dorsal length of basitarsus-tarsus.

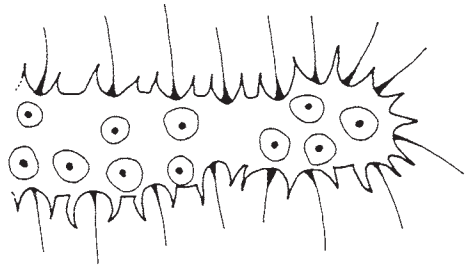
Chelicerae: Serrula with 10 teeth; setae: 1=3, 2=6, 3=20, 4=7, 5=0, 6=1; all setae except 6 pilose.

Legs: Leg I, including coxa, about 17.80 mm long; basitarsal-tarsal segment proportions: 26-7-7-7-7-25. Femur IV about 6.0 times as long as deep.









Figs. 93-96.—*Agastoschizomus stygius*: 93, female pedipalp, lateral aspect; 94, female flagellum, lateral aspect; 95, female spermathecae; 96, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 93-94, 0.1 mm for Fig. 95, 0.01 mm for Fig. 96.

Male adult unknown.

Immature paratype male: As in holotype except that there are only two dorsal setae on the propeltidium, the extra seta on the right side being absent; 11 setae on anterior sternum; 4 setae on posterior sternum; chelicerae with 5 type 2 and 14 type 3 setae; dm2 seta of flagellum missing.

Measurements (mm).—Female holotype: Pedipalp: trochanter 0.30; femur 1.98; patella 1.70; tibia 1.90; basitarsus-tarsus 0.90; total 6.78. Leg I: trochanter 0.98; femur 4.22; patella 5.36; tibia 3.92; basitarsus 0.60; tarsus 1.62; total 16.70. Leg II: trochanter 0.60; femur 3.18; patella 1.66; tibia 2.28; basitarsus 1.62; tarsus 1.28; total 10.62. Leg III: trochanter 0.74; femur 3.00; patella 1.50; tibia 2.34; basitarsus 1.84; tarsus 1.42; total 10.84. Leg IV: trochanter 1.40; femur 3.82; patella 1.78; tibia 3.28; basitarsus 2.42; tarsus 1.62; total 14.32.

Habitat.—Sótano Hondo de Pinalito is a 91 m deep, 198 m long cave (Bittinger, 1975; Sprouse, 1982).

Agastoschizomus patei new species
Figs. 2-3, 20-21, 36-37, 97-104

New genus of schizomid: Pate et al., 1987:91.

Material examined.—MEXICO: *Tamaulipas*: Cueva de la Llorona, 3.5 km SSE Yerbabuena, 1,860 m elev., 12-17 Oct. 1986 (P. Sprouse), male holotype (AMNH), 2 female paratypes (TMM); 16 Oct. 1985 (D. Pate), 1 female paratype (AMNH); 13-17 Oct. 1985 (P. Sprouse), 1 immature (TMM); 30 Dec. 1988 (A. Cobb), 1 female paratype (TMM); 15-17 March 1989 (P. Sprouse), 1 immature (TMM); 20 March 1989 (D. Pate), 2 immatures (TMM); March 1990 (P. Sprouse), 1 immature (TMM).

Etymology.—This species is named in honor of Dale L. Pate in recognition of his outstanding collections of Mexican cave fauna.

Diagnosis.—*Agastoschizomus patei* differs dramatically from other *Agastoschizomus* species: anterior process not downturned apically; anterior sternum with one sternapophysial seta. female and immature flagella without segments or articles; male flagellum without retractable ventrolateral lobes; and female pedipalp in proportion to body length 1.2 times longer than male.

Description.—Male holotype (length from distal edge of propeltidium to base of flagellum, 7.44 mm). Body light orangish brown; abdomen tan.

Cephalothorax: Propeltidium 1.72 mm long; 1.00 mm wide; with one seta on anterior process and one pair setae at base of anterior process; anterior process drawn to point, not downturned. Propeltidium with one pair lateral setae about 1/3 from distal margin, one seta on left in front of pair. Gap between mesopeltidial plates about 0.1 anterior width of one plate. Metapeltidium undivided. Anterior sternum with four setae plus one sternapophysial seta. Posterior sternum with four setae.

Abdomen: Tergite I with row of two pairs (plus one extra seta on left side) anterior microsetae and one pair large dorsal setae on posterior margin; tergite II with three pairs (plus one extra seta on left side) anterior microsetae and one pair large dorsal posterior setae; tergites III-V with one pair dorsal setae each; tergite VI with one pair large dorsal setae and one small dorsolateral seta on left side; tergite VII with one pair dorsal and one pair dorsolateral setae, and one lateral seta on left side; tergite VIII with one pair dorsal and one pair lateral setae; tergite IX with one pair lateral, and one dorsolateral seta on right side. Sternites III-IV with one row setae each; sternites V-IX with two distinct submarginal rows of setae. Sternite VI about two times as wide as long; width/length ratio versus body length, 3.7. Segments X-XII not telescoped. Segment X with one pair lateral and six ventral setae; segment XI with one pair lateral and seven ventral setae; segment XII with one pair dorsal, one pair dorsolateral, one pair lateral, and seven ventral setae. Flagellum (Figs. 36-37, 97-99) 0.84 mm long, 0.24 mm wide, tubular, without lateral lobes; vm5 seta is either missing or it is one of the off-centered pairs labeled dl2, in which case one of the dl2 setae is missing (aberrant individual).

Pedipalps (Fig. 100): Trochanter not produced distally; with scattered setae on ventral and ventromesal surfaces; femur, patella, tibia, and basitarsus-tarsus with scattered long setae (some pilose) on mesal and ventral surfaces. Lateral and dorsal setation as in Fig. 100. Spur about 0.6, claw about 1.33 times dorsal length of basitarsus-tarsus.

Chelicerae: Serrula with eight rounded teeth; setae: 1=3; 2=5; 3=16; 4=4; 5=0; 6=1. All with small barbs (6) or pilose (1-4).

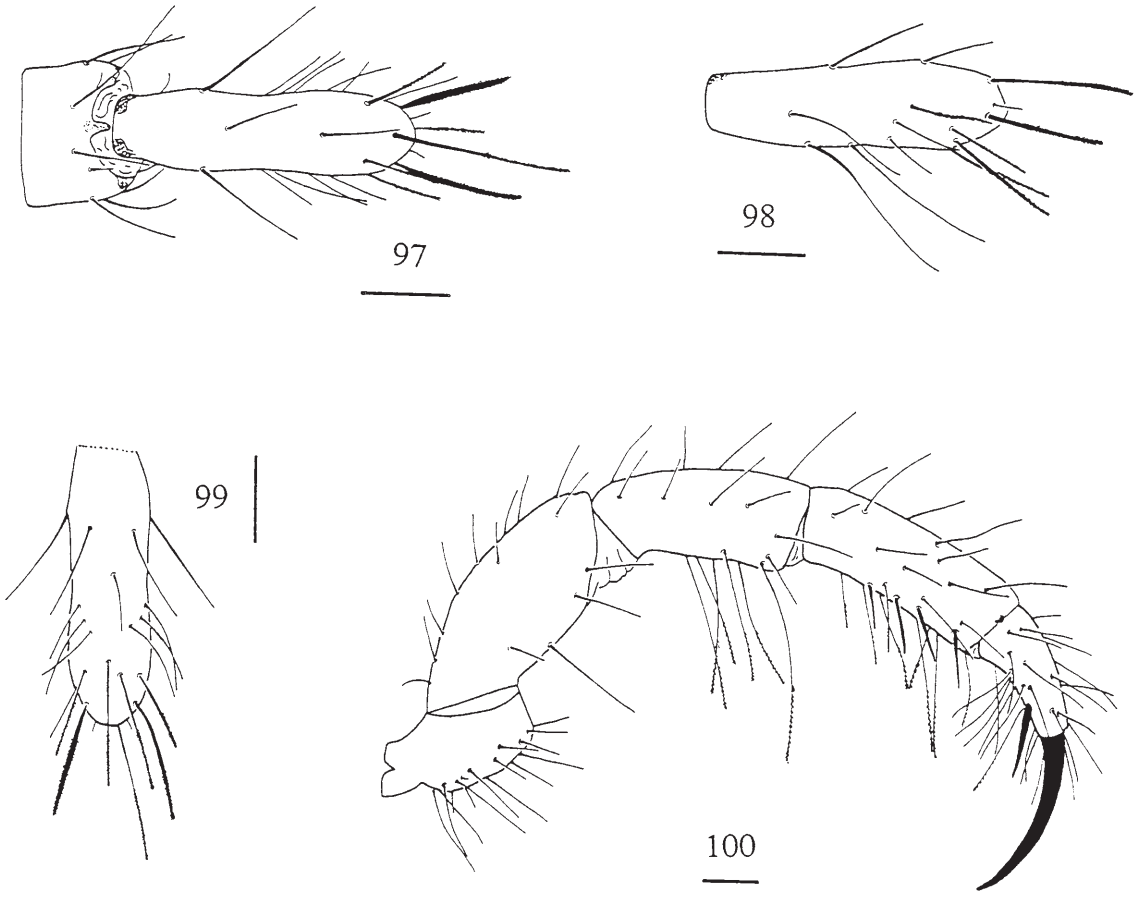
Legs: Leg I, including coxa, 16.98 mm long; basitarsal-tarsal proportions: 44:8:11:9:10:10:30. Femur IV about 8.25 times as long as deep.

Female paratype (length from distal edge of propeltidium to base of flagellum, 8.02 mm). Propeltidium 2.20 mm long; 1.30 mm wide. Otherwise as in male holotype except that the anterior right seta is present. Tergal setation as in male except as follows: tergite II with two triads (not in a row) of microsetae; tergite V with one pair dorsal setae and

one unmatched small dorsolateral seta on right side; tergite VI with one pair large dorsal and one pair small dorsolateral setae; tergite VII with one pair dorsal and one pair lateral setae, and one dorsolateral seta on right side; tergite VIII with one pair dorsal setae, one dorsolateral seta on right side, one pair lateral setae at posterior margin, and one small lateral seta on left side about middle of tergite; tergite IX with one pair dorsal and one pair lateral setae. Segment XI has only one lateral seta. Sternite VI 2.0 times as wide as long; width/length ratio versus body length, 4.0. Flagellum (Figs. 20-21, 102) 0.86 mm long; without segments or articles; dm2 seta missing. Spermathecae (Figs. 103-104) consisting of a single pair of slender straight lobes only slightly enlarging apically. Leg I, including coxa, 16.12 mm long; basitarsal-tarsal proportions: 40:9:10:9:11:10:29. Femur IV about 8.25 times as long as deep. Pedipalp setation as in male (Fig. 101). Pedipalp length in proportion to body length 1.2 male pedipalp length.

Variation: Some specimens occur with either two pairs dorsal setae or with one seta missing. Some individuals have five setae on the anterior sternum and three on the posterior sternum. Tergal setation is highly variable, with individuals possessing or lacking either one or two small dorsolateral setae. Two individuals lack the large dorsal setae on tergite IX.

Measurements (mm).—Male holotype (female paratype): Pedipalp: trochanter 0.26 (0.36); femur 1.16 (1.50); patella 1.02 (1.26); tibia 1.10 (1.38); basitarsus-tarsus 0.62 (0.78); total 4.16 (5.28). Leg I: trochanter 0.72 (0.64); femur 3.86 (3.82); patella 4.98 (5.02); tibia 4.16 (4.24); basitarsus 0.88 (0.86); tarsus 1.58 (1.54); total 16.18 (16.12). Leg II: trochanter 0.50 (0.36); femur 2.98 (3.08); patella 1.46 (1.50); tibia 1.30 (2.36); basitarsus 1.38 (1.42); tarsus 1.26 (1.34); total 7.88 (10.06). Leg III: trochanter 0.54 (0.48); femur 2.86 (3.06); patella 1.40 (1.42); tibia 1.30 (2.54); basitarsus 1.68 (1.68); tarsus 1.34 (1.38); total 9.12 (10.56). Leg



Figs. 97-100.—*Agastoschizomus patei*, male: 97, flagellum, dorsal aspect; 98, flagellum, lateral aspect; 99, flagellum, ventral aspect; 100, pedipalp, lateral aspect. Scale lines = 0.25 mm.

IV: trochanter 1.20 (1.10); femur 3.54 (3.96); patella 1.80 (1.84); tibia 3.44 (3.62); basitarsus 2.24 (2.34); tarsus 1.48 (1.56); total 13.70 (14.42).

Habitat.—The specimens of *A. patei* were collected in the California Chamber, a large moist breakdown-floored room about 300 m below the entrance. Cueva de la Llorona has a surveyed length of 3,136 m and a depth of 432 m (Pate et al., 1987).

Agastoschizomus sp. cf. *patei* new species

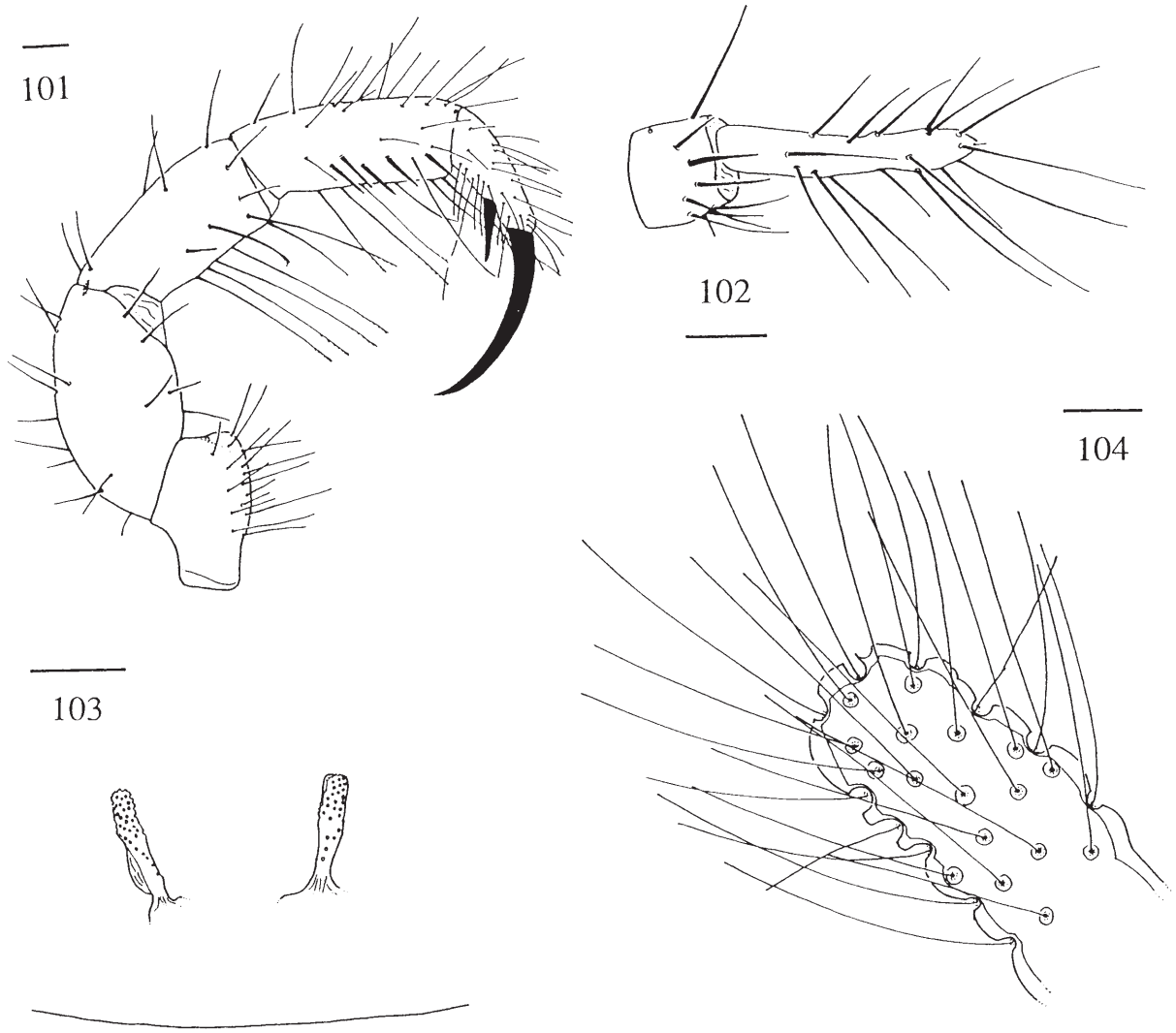
New species of schizomid: T. Sprouse, 1985:38; Sprouse and Sprouse, 1985:79.

Material examined.—MEXICO: *Tamaulipas*: Sótano de San Marcos, La Reforma, 800 m elev., 14-16 Oct. 1984 (P. Sprouse), 1 immature (TMM); Cueva del Tecolote, Los San Pedro, 1,450 m elev., 22-28 Nov. 1986 (T. Treacy Sprouse), 1 immature (TMM); 15-17 March 1989 (P. Sprouse), 1 immature (TMM); 20 March 1989 (D. Pate), 2 immatures (TMM).

Comments.—The immature specimens from these two caves generally agree with *A. patei*, but in the absence of adults we feel it premature to assign them to that species. The specimen from Sótano de San Marcos was collected at the back of the cave (Sprouse and Sprouse, 1985). This species is sympatric with *Protoschizomus sprousei* in Cueva del Tecolote. Two specimens from Cueva del Tecolote were collected in the Russian Dancer Borehole near the limit of exploration in the cave.

Agastoschizomus sp.

Agastoschizomus sp.: Rowland and Reddell,



Figs. 101-104.—*Agastoschizomus patei*, female: 101, pedipalp, lateral aspect; 102, flagellum, lateral aspect; 103, spermathecae; 104, detail of spermathecal lobe. Scale lines = 0.25 mm for Figs. 101-102, 0.01 mm for Fig. 103, 0.01 mm for Fig. 104.

1977:80, 82, fig. 1 (part—Cueva Piedra Ancha record only).

Agastoschizomus n.sp.: Reddell, 1981:26, 124-125, fig. 21 (part).

Material examined.—MEXICO: *Hidalgo*: Cueva Piedra Ancha, 19 Aug. 1965 (J. Reddell, J. Fish, W. Bell), 1 immature (TMM). *San Luis Potosí*: Cueva de San Pedro, 4 km N of Tlamaya, 900 m elev., 28 Dec. 1984 (P. Sprouse), 1 immature (TMM); Sótano de Tlamaya, Tlamaya, 650 m elev., 24 Dec. 1984 (P. Sprouse), 1 immature (TMM).

Comments.—The specimen from Cueva Piedra Ancha may belong to *A. stygius*. Material from Cueva de San Pedro and Sótano de Tlamaya may belong to *A. huitzmolotitlensis*. All of these records, however, are based on specimens too immature for positive placement.

Undetermined genus and species
Fig. 3

Protoschizomidae: Elliott, 1984a:15; Elliott, 1984b:8.

Schizomid: Elliott, 1984a:15; Elliott, 1984b:8; Elliott and Reddell, 1985:212.

Undetermined genus and species (troglobite): Elliott and Reddell, 1985:214.

?*Agastoschizomus* n. sp.: Reddell, 1985:5.

Material examined.—U.S.A.: *Texas*: Val Verde County: Seminole Sink [=Seminole Canyon Cave], Seminole Canyon State Historical Park, 27 May 1984 (W. Elliott, L. Bement), entrance talus cone, 1 immature (TMM).

Comments.—This specimen measures 1.90 mm long (including the flagellum). It is apparently an early instar, but clearly a member of the Protoschizomidae. Generic placement is not possible without adult material. This is certainly a relict population now isolated in a cave in Texas. The only other Texas schizomid is *Stenochrus mulaiki* (Gertsch) from the Rio Grande Valley. Seminole Sink is an important archeological site and the specimen was collected from the underside of a small rock deeply buried in the talus cone beneath the 10 m deep entrance sink. The cone was completely excavated during the archeological excavations in the cave but has since been replaced. Attempts to rediscover the species shortly after completion of the archeological study were unsuccessful, probably because the rocks had not yet had time to settle. The cave is in a state park and protected by a gate and by a policy of admittance only for scientific research. Hopefully it will be possible to find additional specimens and properly place this significant species. This cave also harbors a tropical relict amblypygid, *Phrynus* n. sp.

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DISTRIBUTION PATTERNS AND SPECIATION IN NORTH AMERICAN CAVE SPIDERS WITH A LIST OF THE TROGLOBITES AND REVISION OF THE CICURINAS OF THE SUBGENUS *CICURELLA*

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ABSTRACT

The cave spiders of North America are discussed, with special emphasis on the distribution of troglobitic species. Lists are provided for the troglobitic spiders of the three principal regions in North America. The Appalachian region contains 18 species in four genera and four families. California contains a minimum of 20 species in seven genera and five families. The Texas fauna includes 61 species in four genera and four families.

The cicurinas are sedentary spiders that spin funnel webs and tangled lines of dry silk in and under surface detritus and in ground openings and caves. *Cicurina* is mostly an American genus with numerous species in most parts of North America and a few representatives in Japan, Korea, and Europe; the European species *Cicurina cicur* (Fabricius) is the type of the genus. The present paper deals only with the taxa assigned to the subgenus *Cicurella* by Chamberlin and Ivie in 1940, which comprises a series of mostly small forms derived from standard eight-eyed types of which many are progressively losing or have lost their eyes. A few typical cicurellas with eight or six eyes occur in Arkansas and adjacent states as well as in Texas. Eyeless species so far are known mainly from Texas and most of these from caves in the Edwards Plateau region. A single eyeless *Cicurella* is found in Alabama and a few have been found in Mexico. The cicurellas can be characterized as a derivative American group featuring small size and loss of eyes nurtured in a special epigean and cavernicole habitat.

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DISTRIBUTION AND SPECIATION IN NORTH AMERICAN CAVE SPIDERS

Spiders have exploited the monotonous security of the cave habitat with some success and act there as predators of crawling and flying invertebrates. They enter all parts of caves and use them as transitory, semipermanent or permanent habitations. During many years I have been bringing together data on cave spiders from all parts of this country with the following results. More than 400 species belonging to 28 or more families have penetrated caves to variable distances and spend part or all of their lives there. This motley assemblage included big-eyed diurnal hunting spiders that depend on sight for their hunting and presumably could not exist long in caves. Many of the others are not bound by deep ties and move freely in caves and outside habitats that offer suitable conditions. The present discussion is concerned largely with spiders of the United States that seem to be obligative cavernicoles, that is those that live in caves and presumably cannot survive outside for long. Information on such taxa is available only from scattered publications so I have prepared a general

list and offered an analysis of our obligative spiders to allow comparison with such animals of other groups.

Recognition of troglobites is not so precise as could be wished and the certainty of this special status is a matter requiring much more information than mere presence of a blind taxon in a cave. There are some spiders with attributes of troglobites that do not live in caves. Blind spiders are found in termite nests in Africa and others with greatly reduced or obsolete eyes live in ant nests or under moist humus of tropical and temperate forests on many continents. Obsolescence of the eyes is not necessarily a measure of length of cave life or even indication of it. A few cavernicoles with essentially normal eyes have not been taken outside of caves; a prime example is *Phanetta subterranea* (Emerton), a cavernicole with small eyes studied by me on specimens from 141 caves ranging from Pennsylvania and Illinois south into Alabama, with so far no epigean records, but which live deep within caves often under litter and rocks. This taxon is listed arbitrarily as a troglophile. By contrast, in other instances I have assumed a more generous attitude in identifying troglobites and list a number with degenerated eyes in trivial remnants that are seemingly limited to single caves or cave systems. Spider troglobites share most of the special features of cave animals of other groups. The integument is pallid or whitish because of loss of pigment and often is less strongly sclerotized than in surface forms. The eyes show varying degrees of regression from mere loss of pigment to complete disappearance of all external vestiges. This occurs in regular pattern in spiders with loss first of the anterior median pair and then general reduction and gradual disappearance of the three remaining diads. The troglobite status is rarely reached without strong modification of the eyes: most of our obligative cavernicoles are eyeless or nearly so. Finally, in spiders and many other groups the appendages tend to become long and much thinner than in surface forms.

Spider troglobites have been derived from cryptozoic taxa of both primitive and specialized groups. Most are sedentary and spin webs in crevices on cave walls and ceilings or in or under detritus on the floors. Within these webs spiders have minimized need for sight and substitute an increasingly keen chemotactic sense centered in the hairs and setae of their appendages. Such sedentary types move to new stations only to satisfy food and climate needs. All of our American spider troglobites and most from world centers come from spiders of this type. The few hunting spiders that attain troglobite rank have likewise de-emphasized sight as a life requirement. A prime example is an eyeless troglobitic wolf spider, *Adelocosa anops* Gertsch, which lives in Koloa Cave, Kauai, Hawaii. Also in Hawaii occurs *Lycosa howarthi* Gertsch, a yellowish, essentially blind troglobitic species with vestigial eyes, known from several caves.

In 1985 Barr and Holsinger published a basic paper entitled "Speciation in Cave Faunas" in which a map was included of the major limestone areas of the United States, in which most of our cavernicole spiders are to be found. Spider troglobites are now known from the three principle areas as follows: 1. The Appalachian Valley and Western Plateaus; 2. The Texas Region; and 3. The cave areas of Central California. Absence of troglobites from various limestone nuclei outside of the cited districts reflects more than a failure of intensive collecting and indicates unlikely presence of troglobites. From none of the caves in Utah, Idaho, Arizona, and New Mexico have come spider troglobites in spite of intensive collecting by arachnologists. Carlsbad Caverns, one of our great caves, thus far lacks truly derivative types. It is likely that additional troglobites may be found in areas south of these three regions but few will be found much to the north of the indicated limits.

Spider Troglobites of Appalachia

Within this broad province are found many caves, including such giants as Mammoth and many others famous for their faunas. The great wealth of cave habitats of this region early became an explorative area for speleologists who found spider troglobites relatively numerous: at least 18 are so claimed and they belong to eight genera of four families. Especially numerous are taxa of the families Linyphiidae and Nesticidae and include 14 of the known troglobites. The first known American spider troglobite, *Anthrobia mammouthia*, a small whitish spider without trace of eyes, was described by Tellkampf in 1844 from Mammoth Cave in Kentucky; it is still the only species of its genus. Several additional cavernicoles were added by various students so that in 1960 Nicholas was able to list nine presumed obligative taxa from the United States: five of them do not now qualify for that status. American cave spiders are now known from quite large collections from many localities, so it is now possible to present a favorable picture of our fauna on the basis of new publications and much unpublished data in my possession. Our fauna shows similarity to the European one, with many of the

same families and genera, but also carries its distinctive American flavor.

The list of names and authors that follows refrains from duplicative listing available in our standard bibliographic journals. For the sake of completeness, undoubted new species taxa, some being studied elsewhere, are included for general interest and tentative completeness.

List of the Spider Troglobites of Appalachia

Family Linyphiidae

Anthrobia mammouthia Tellkampf, 1844. Kentucky, some bordering states.
Porhomma cavernicolus (Keyserling), 1886. Widespread from Illinois, Arkansas, Virginia, to Alabama.
Islandiana cavealis Ivie, 1965. Kentucky.
Islandiana muma Ivie, 1965. Virginia.
Islandiana speophila Ivie, 1965. West Virginia.
Smilax, new species. Iowa, Wisconsin.
Oreonetides, new species. Virginia.

Family Nesticidae

Nesticus dilutus Gertsch, 1984. Tennessee.
Nesticus furtivus Gertsch, 1984. Tennessee.
Nesticus valentinei Gertsch, 1984. Tennessee.
Nesticus barrowsi Gertsch, 1984. Tennessee.
Nesticus jonesi Gertsch, 1984. Alabama.
Nesticus stygius Gertsch, 1984. Tennessee.
Nesticus georgia Gertsch, 1984. Georgia.

Family Leptonetidae

Appaleptoneta georgia (Gertsch), 1974. Georgia.

Family Dictynidae

Cicurina (*Cicurina*), new species. Georgia.
Cicurina (*Cicurina*), new species. Alabama.
Cicurina (*Cicurella*), new species. Alabama.

Spider Troglobites of California

The small cluster of spots in the middle of California (Barr and Holsinger, 1985, p. 313) identifies rich cave localities in the foothills of the Sierran and Cascadian Mountain Ranges. All the troglobites belong to different genera than those of Appalachia and Texas. Most California caves are quite small but intensive collecting by Richard Graham, Darrell Ubick, and a growing group of interested students have indicated presence of a minimum of 20 troglobites belonging to five families. The families and seven genera are all strongly represented in the whole region by numerous epigean species. The California region has a very large fauna of cryptic agelenines (these now assigned to two special families), so it is not surprising that at least nine species representing three distinct genera have produced troglobites. Missing from this list is any troglobius species of *Cicurina*, which has produced a multiplicity of eyeless taxa in Texas and is also represented by three taxa in the Appalachia area.

It need not be surprising that only one of the listed troglobites has been formally named but the richness of the fauna in the cited area marks it as a special project. The presence of the genus *Telema* (its single eyeless species known only from a few caves in the French Pyrenees), earlier assigned to the American genus *Usofila*, is now known from California by numerous eyed species and several eyeless ones.

The listed undescribed taxa of the Californian region are being studied by several students.

List of the Spider Troglobites of California

Family Nesticidae

Nesticus potterius (Chamberlin), 1933. Shasta County.

Family Linyphiidae

Linyphiinae, new species. Amador County.
Linyphiinae, new species. Tulare County.

Family Leptonetidae

Calileptoneta, new species. Trinity County.

Family Cybaeidae

Cybaeus, new species. Shasta County.
Cybaeozyga, new species. Shasta County.
Cybaeozyga, new species. Shasta County.
Cybaeozyga, new species. Shasta County.

Family Dictynidae

Blabomma, new species. Shasta County.
Blabomma, new species. Calaveras County.
Blabomma, new species. Calaveras County.
Blabomma, new species. Tulare County.
Blabomma, new species. Calaveras County.
Blabomma, new species. Amador County.

Family Telemidae

Telema, new species. El Dorado County.
Telema, new species. Calaveras County.
Telema, new species. Shasta County.
Telema, new species. Tuolumne County.
Telema, new species. Tulare County.
Telema, new species. Siskiyou County.

Spider Troglobites of the Texas Region

A rich area of spider troglobite evolution is centered in the Texas plateaus. For more than 20 years a wealth of material has been gleaned from scores of Texas caves by James Reddell and numerous colleagues and students of the Texas Speleological Survey of Austin. The many troglobitic spiders so far found (and they are continuing to find more) belong to most of the families of the Appalachian Province but the generic emphasis is quite distinct. No species of *Nesticus* has been so far recorded but the nesticid genus *Eidmannella* (represented in Appalachia and Texas by *pallidus* which ranges deep into Mexico) has produced five troglobitic taxa of mostly eyeless status in Texas. The genus *Neoleptoneta*, comprising tiny generalized, six-eyed spiders of the family Leptonetidae, is relatively rich in species and the majority, perhaps 9 species, seem to be cave adapted. In that family we are now able to match the European fauna with a number of well-marked troglobites of this largely cavernicole family.

The outstanding troglobites of the Texas region are those of the genus *Cicurina*. This genus is rich in species all over the United States and most are cryptic types that abound under ground cover in mesic situations. Some 46 completely eyeless species of the subgenus *Cicurella* have been found in Texas caves and an additional one occurs in Alabama. The total number of troglobites now claimed for Texas is 61 and with the totals of 18 for Appalachia and 20 for California now reaches 99.

List of Spider Troglobites of the Texas Region

Family Linyphiidae

Islandiana unicornis Ivie, 1965. Childress and Wheeler Counties.

Family Nesticidae

Eidmannella delicata Gertsch, 1984. Val Verde County.
Eidmannella bullata Gertsch, 1984. Culberson County.
Eidmannella nasuta Gertsch, 1984. Medina County.
Eidmannella reclusa Gertsch, 1984. Travis County.
Eidmannella rostrata Gertsch, 1984. Edwards Plateau.

Family Leptonetidae

Neoleptoneta anopica (Gertsch), 1974. Williamson County.
Neoleptoneta coeca (Chamberlin and Ivie), 1942. Comal County.
Neoleptoneta concinna (Gertsch), 1974. Travis County.
Neoleptoneta devia (Gertsch), 1974. Travis County.
Neoleptoneta microps (Gertsch), 1974. Bexar County.
Neoleptoneta myopica (Gertsch), 1974. Travis County.
Neoleptoneta valverde (Gertsch), 1974. Val Verde County.
Neoleptoneta, new species. Hays County.
Neoleptoneta, new species. Bexar County.

Family Dictynidae

Cicurina buwata Chamberlin and Ivie, 1940. Travis and Williamson Counties.
Cicurina (*Cicurella*) taxa listed in following revision.

CICURINAS OF THE SUBGENUS *CICURELLA* OF TEXAS AND NEARBY STATES AND MEXICO

INTRODUCTION

The American *Cicurina* fauna was little exploited by students until publication by Chamberlin and Ivie in 1940 of "Agelenid Spiders of the Genus *Cicurina*." Wilton Ivie was assigned to preparation of a comprehensive review of the known species on the basis of much new material. Most of the systematic advances of that paper are to be credited to him for clarifying the systematic status and faunal wealth of these ecribellates in North America. He built the genus *Cicurina* to outstanding size even at this early date by doubling it to 47 taxa of which 23 were described as new. His keen analyses of the taxa and meticulous drawings of the genitalia mark his artistry. Wilton Ivie continued to collect and study *Cicurina* after joining me as a colleague at the American Museum of Natural History in New York, where he continued to prepare a supplement to the basic revisional paper. More than a dozen unknown

species from the United States and many more from Mexican localities were recognized by him and a few of these tentatively described and illustrated. None of this unfinished material was published but now forms part of the American Museum collection here with me in Portal, Arizona.

The present paper continues study of the cicurinas on the basis of large new collections from many epigean and cavernicole habitats of North America and limits itself to the subgenus *Cicurella* of the stem genus *Cicurina*. As now defined *Cicurella* comprises 73 species of eyed and eyeless taxa of which only 10 have so far been described. Within the United States most species occur in the state of Texas, except for two from Arkansas and single ones from Oklahoma, Missouri and Alabama. A few additional species are known from Mexico. Very little is known about the biology of this group of spiders. Typical species live in mesic conditions in or under ground objects or debris or in ground openings or caves. Often associated with the cicurellas as part of collections are numerous spiders in mature or developing stages of various families favoring such cryptic habitats. Among such neighbors but not necessarily living near them in their microhabitats as neighbors are a few standard cicurinas. The most notable one is the large eight-eyed *Cicurina varians* Gertsch and Mulaik now known from a high percentage of the caves of Texas.

SYSTEMATIC SECTION

FAMILY DICTYNIDAE

Agelenidae Simon, 1898:193-308; Comstock, 1912: 597; Chamberlin and Ivie, 1940:1-108; Petrunkevitch, 1911:530.

Cicurininae Lehtinen, 1967:353.

Discussion.—*Cicurina* are sedentary spiders with one pair of booklungs and a single tracheal spiracle immediately in front of the spinnerets. Their eyes typically are eight in number and lie in two essentially straight rows close to the clypeal edge; they may be reduced in size and number or even completely lost. Traces of an abortive cribellum (now called colulus) are apparent in front of the two anterior spinnerets. The cicurine genera are few in number and form a series without obvious near relatives. The familial position of the genus *Cicurina*, held for many years to be in the family Agelenidae, was changed by Lehtinen (1967, p. 353), with persuasive arguments, to the family Dictynidae. This action was tentatively accepted by Forster (1970, pp. 12, 127-139) and recently by Brignoli (1983) and Platnick (1989) in their catalogues. After again reviewing such dictynid genera as *Blabomma*, *Lathys*, and especially *Brommella*, I have tentatively followed Lehtinen and now place *Cicurina* in the family Dictynidae within its own special subfamily Cicurininae. I doubt that even the present tendency to break up unwieldy families into smaller units will soon result in holding the group Cicurininae as worthy of its own special ecribellate family.

Genus *Cicurina* Menge

Cicurina Menge, 1871:IV; Simon, 1898:265; Petrunkevitch, 1911:530-531; Comstock, 1912:564, 565, 596; Chamberlin and Ivie, 1940:1-108; Vogel, 1967:1-196; Bonnet, 1956:1086-1091.

Diagnosis.—The cicurinas of the subgenus *Cicurella* are pale sedentary spiders that offer few coloration or somatic features to allow easy identification of the multiplicity of allied taxa. The cephalothorax and appendages are pale yellowish to orange with head and distal parts of appendages somewhat darker. The chelicerae and mouth parts are orange to pale brownish. In general males have the carapace and legs somewhat darker, and eyeless species are paler than those of epigean habitats. Immature species of most habitats are whitish or faintly yellowish with some sheen on larger surfaces. Most cicurellas are small spiders and range from 1.2 mm to about 7 mm in total length with the average being about 3 mm and only a few range much beyond this average. The males are larger than the females with heavier legs and stouter hairs and spines. Inconspicuous pale hairs lie in rows on the carapace and are darker on the abdomen and leg segments. The true spines are little larger than some of the hairs in some females but they are darker and more developed in males. Loss of individual spines is frequent but here considered of minor systematic interest.

Description.—The carapace is longer than broad, moderately convex and well rounded on the sides, truncated across the clypeus, with the width of the eyes when present about half the greatest width of the carapace. Cephalic sutures are obsolete or faintly indicated but the thoracic fovea is present as a dark linear, slightly indented groove behind the middle of the carapace. From the side the carapace is nearly equal in height for five-sevenths of its length and from that point evenly sloping to the caudal margin. The clypeus in most eyed taxa is about equal in

height to the full diameter of an anterior lateral eye but becomes increasingly lower in those species that are in the process of losing or have lost some or all of the eyes. The eyes lie in two close rows near the front edge of the carapace and are of medium size. In eyed taxa the eyes are present as eight or six but all or some may be in various stages of reduction and disappearance, in extreme cases only evident as trivial black or whitish spots; all of the foregoing features are listed among the eyed taxa and briefly noted among the completely eyeless taxa. The eyes of the front row when the number is eight are in a moderately procurved line typically narrower than the four of the posterior row which is mostly straight or lightly curved. The triads of the six-eyed taxa may be close together or widely separated.

The sternum is longer than broad, suboval, with the posterior coxae separated by their width in females but somewhat less in males. The labium is as wide as long and about half as high as the endites. The chelicerae are stout, moderately geniculate, with small lateral condyle (boss) at base on the side. Each chelicera has two rows of teeth margining the long fang furrow: on the promargin are usually three teeth of which the middle one is often largest, and continued by a smooth or irregular carina nearly full length; on the retromargin is usually a variable series of four to ten teeth or denticles with those at base longest.

The legs are quite robust, especially in males, with the femora thickest and the fourth leg longest and more slender, in the leg formula 4123 of the subgenus. The full leg charts of the measurements of both sexes of an eight-eyed species (see *arkansa*) are given to illustrate the patterns of the group; with them comes the conclusion that such data contribute little to fuller understanding of the taxa. The femora are subequal in length. The patella-tibia index offers some indication of the comparative total leg lengths. The leg spines are well represented on all legs: they are weaker in females and little larger than many hairs; in males they are heavier and on some leg segments shorter and heavier. The typical spine patterns are presence of 1-1-1 median spines on dorsa of femora and tibiae and 2-2-2 or 2-2-0 ventral spines on tibiae and metatarsi of most legs. Special spinal reference is given only when such data appear necessary. The spine formulae of Chamberlin and Ivie are useful and presumably valid. I have preferred to emphasize the characters of eyes when present and genitalia of this distinctive group.

The segments of the male palpus feature a slender femur, a very short patella and a similarly short tibia which bears a long flattened apophysis typical of the entire genus. A small angular spur or groove on the prolateral side of the tibia presents trivial differences in size and position among the species. The cymbium is a concave bowl, the alveolus, into which the palpal bulb and elements are fixed. Most of the tegulum is flattened; the frontal smooth area is here called subtegulum and the large basal area often showing internal tubular structures is the tegulum. The embolus originates at the base of the tegulum as a thin black tube and curves around the subtegulum, sometimes coming free of the restraining groove; it offers little information for separation of the taxa. On the retrolateral side of the tegulum beyond the origin of the embolus lies a conspicuous rounded or twisted tegular process, the conductor, which continues as a very long coil lying free on the side of the palpus. The conductor is a principle mark of the cicurellas but offers few features in form or length to identify the various taxa.

The total number of mature males known from *Cicurella* collections, about a dozen, is only a fifth of the number of mature females, and this might bring the implication that the ratio of the sexes is an unequal one. In general many spider studies assign number superiority to the males but in general it is believed in spiders that the ratio of the sexes is essentially equal, at least in the beginning. Only 15 of the about 70 known taxa have assignable males, 8 among the eyed taxa, and 7 to the eyeless ones. Immature specimens of all grades of development cannot be assigned to specific taxa, but the frequent presence of obvious subadult males among immatures suggests that the disparity is due to other factors.

The abdomen is longer than wide, a suboval sac of medium height and is liberally clothed over most of its surfaces by short soft gray or whitish hairs. In most members of the cicurellas it is whitish to gray in color without any distinctive darker pattern. The epigynal area often shows some brownish color and has on each side the pinkish book lung openings and the central epigastric furrow through which the eggs are extruded. The internal tracheal system is presumed to be of the divided branch style described by Forster (1970, p. 14).

The six functional spinnerets are subapical in position at the end of the abdomen. The two short stout anterior spinnerets are well separated by nearly half their length. In front of them lies the colulus (aborted cribellum) reduced to a narrow brown sclerotized band and smooth area without setae about as wide as the space between the anterior lateral spinnerets. The two more slender posterior spinneret pairs lie close together in a slightly procurved row,

the posterior median pair short and close together, and the posterior lateral pair with short apical segment longer and more widely separated.

The epigynum is situated immediately in front of the genital orifice of the female, a narrow abdominal opening through which the eggs are extruded. The standard features of the *Cicurina* epigynum consist of a tubular element to receive the semen (the bursa) and conduct it to the storage unit (the spermathecum) to be held until the semen is delivered to the eggs through a fertilization duct. This generalized pattern fits the standard *Cicurina* and covers a

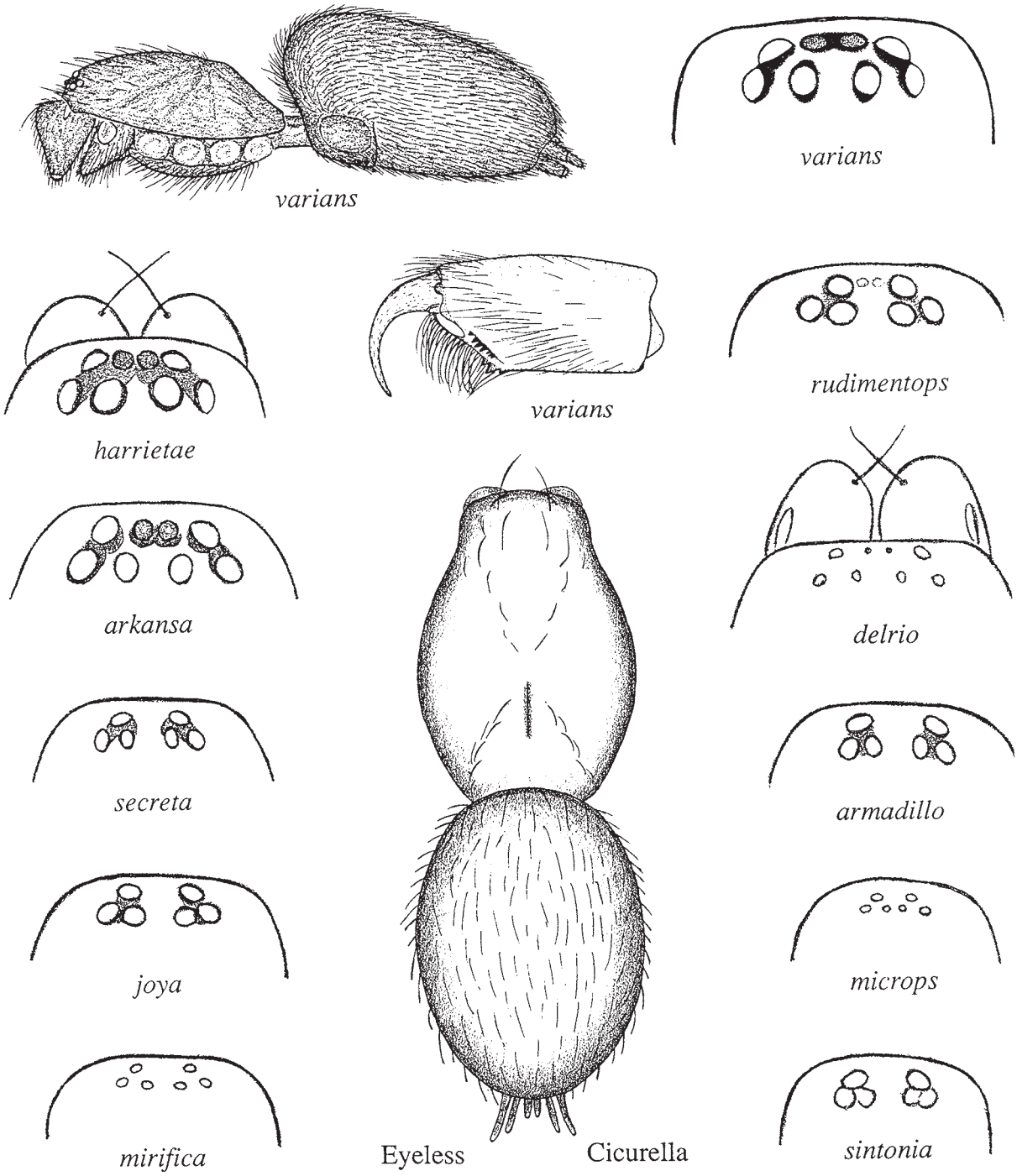


Chart 1.—Eye and body patterns of *Cicurina*.

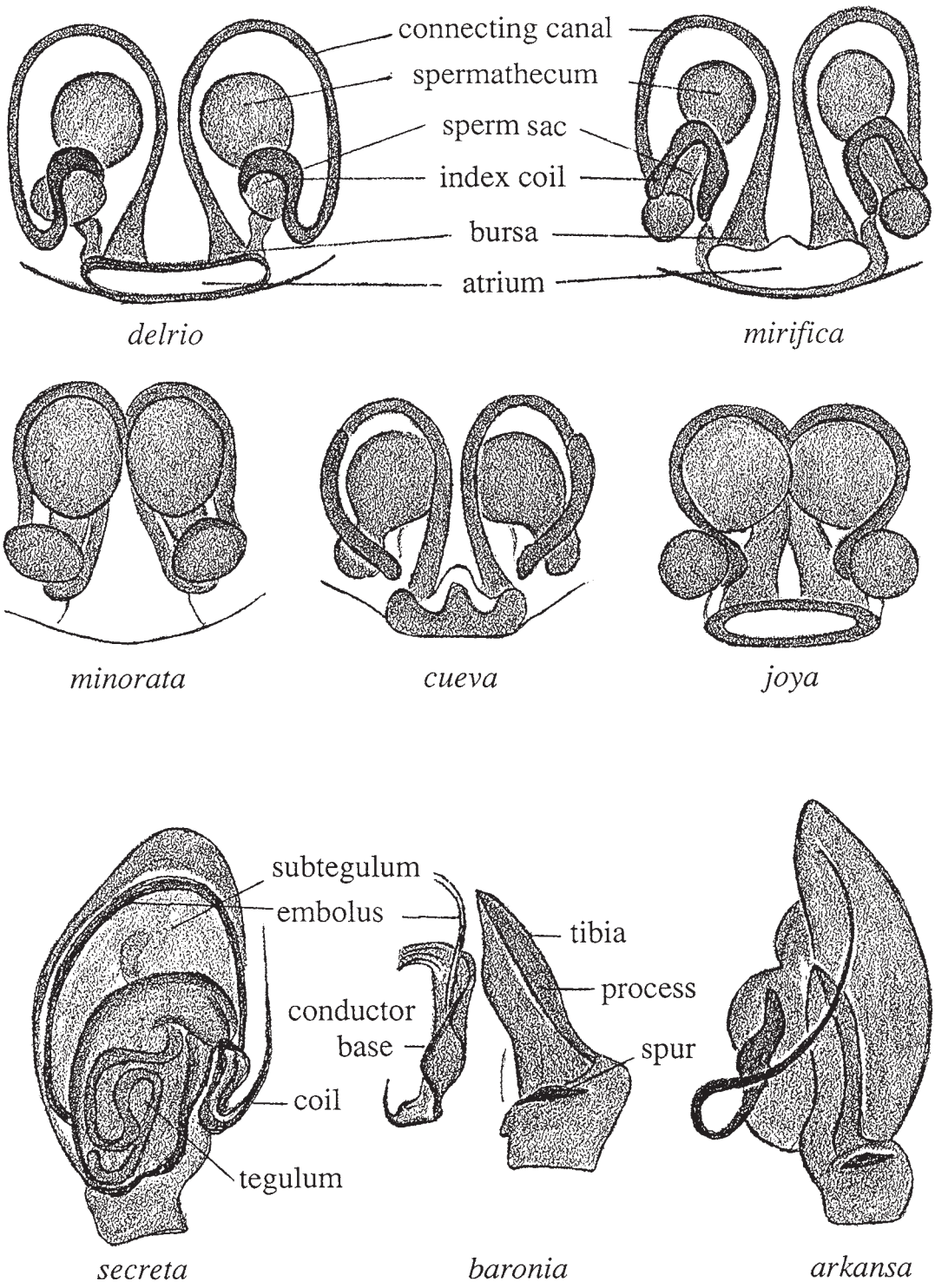
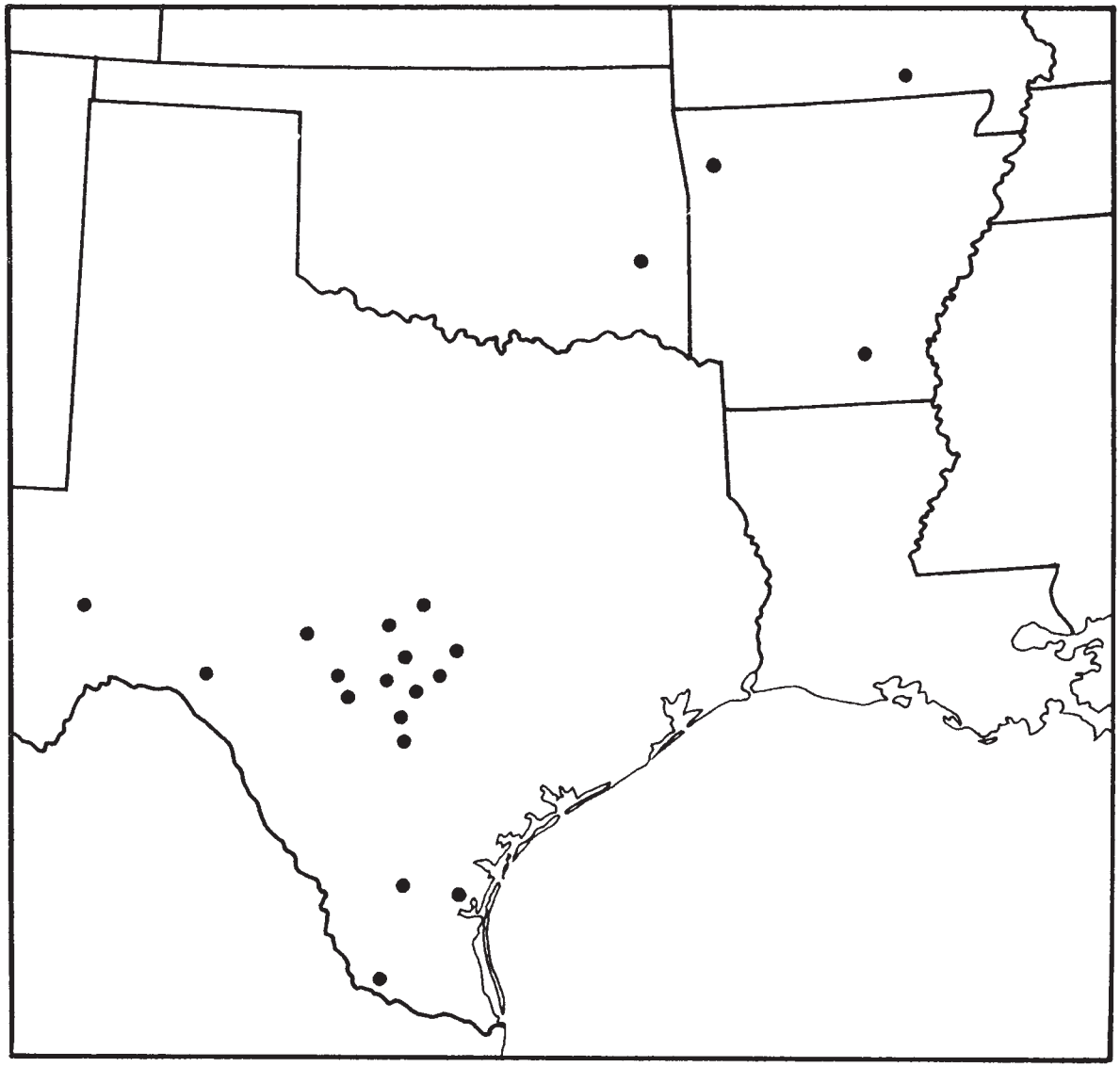


Chart 2.—Morphology of male and female genitalia of *Cicurina (Cicurella)* spp.

great many species of North America as well as the type of the genus, *Cicurina cicur* (Fabricius) of Europe. The subgenera *Cicurina* and *Cicurusta* have further modified it by development of a bursal bulb, a secondary spermathecum, and further elongation and complication of the connecting coils.

The present revision deals only with the taxa assigned to the subgenus *Cicurella* and comprehends a growing number of closely allied forms so far equal in number to those of all the other subgenera. No exotic taxa are known and it seems to be an exclusively American group. In basic features *Cicurella* differs from *Cicurina* only in the subdivision of the spermathecum by development of a blind sac, in some cases of sizable dimension, at the base of the principle body. The fertilization duct runs from the principle body of the spermathecum into the atrium. The entire epigynum is covered by a thin sclerotized sheet with only a single transverse opening, the atrium, in front of the genital orifice. In the various taxa the atria are typically narrow in width and shape but offer some detail for specific sorting of the taxa. The lightly sclerotized areas of the external epigynum may show internal details rather clearly or they may be largely undetailed or invisible, making necessary clearing with clove oil or other agents. The ventral (internal) view of the epigynum often brings out details of size, proportion, separation of parts, and good understanding of the whole structure. Each side of the epigynum is essentially a mirror image of the other but not rarely details of one side may be modified by positional changes. Both



Map 1.—Distribution of eyed *Ciucurina (Cicurella)* spp.

dorsal and ventral views are offered here for all epigyna to give exact information on the internal structures. Care must be taken during study of these small spiders: some epigyna measuring only 0.2 or 0.3 mm may float away in the preservative or be lost by sticking to forceps or dropping on unfavorable surfaces.

The descriptions that follow list verbal and illustrative data sufficient to make identification easy. The offered *diagnosis* aims to present a concise compendium of features separating the taxon from all known relatives: it is a succinct series of morphological, geographical and ecological characters that position the taxon among members of its special group and may even identify it specifically. In many taxa its role is adequately served by mention of a single genital feature or in cavernicoles of a single cave. The aim of the formal *description* is to offer a more complete picture of the taxon with some mention of the basic characters of eye pattern, measurements, and locality information but with reluctance to duplicate the general data of the preliminary diagnosis. In final analysis it has been concluded the specific characters are best shown in the details of the epigyna of females where most of the pertinent information is found. The presence of few adult males in the collection illustrates their existence but also shows that even among the few representatives their palpal figures give little data on specific identification. In that sex it is unfortunate that outside of good characters in eyed taxa that the characters of their quite complicated palpi offer little to separate the species.

LIST OF THE EYED TAXA

Descriptions of the seven previously described species and 16 additional new ones are listed with information on state and county localities as follows: ARKANSAS: Washington County: *secreta*, new species. Bradley County: *arkansa*, new species. MISSOURI: Oregon County: *harrietae*, new species. OKLAHOMA: Latimer County: *oklahoma*, new species. TEXAS: Bexar County: *minorata* (Gertsch and Davis); *gatita*, new species. Blanco County: *blanco*, new species. Burnet County: *marmorea*, new species. Comal County: *joya*, new species. Duval County: *rudimentops* Chamberlin and Ivie. Hays County: *aenigma*, new species. Kendall County: *pampa* Chamberlin and Ivie. Kerr County: *microps* Chamberlin and Ivie; *dorothea*, new species; *modesta*, new species. Kimble County: *rosae*, new species. Llano County: *texana* (Gertsch). Pecos County: *mirifica*, new species. San Patricio County: *sintonia*, new species. Starr County: *riograndе* Gertsch and Mulaik. Tom Green County: *hexops* Chamberlin and Ivie. Travis County: *armadillo*, new species. Val Verde County: *delrio*, new species.

Cicurina arkansa, new species
Chart 1, Figs. 1-2, 37-38

Diagnosis.—Eight-eyed epigean species of Bradley County, Arkansas; anterior median eyes subcontiguous; index coil of epigynum (Fig. 1) with a tight loop in subvertical position; conductor of male palpus (Fig. 37) with thin loop running to near end of cymbium.

Etymology.—Specific name for the State of Arkansas.

Description.—Female holotype: Length 2.4 mm. Carapace 1.2 mm long, 0.7 mm wide. Abdomen 1.2 mm long, 0.8 mm wide. Clypeal height full width of anterior lateral eyes; both eye rows (Chart 1) essentially straight with posterior medians separated by full diameter and half as far from subequal lateral eyes. Chelicerae: retromargin of fang with 9 teeth in close file.

	I	II	III	IV	Palp
Femur	0.95	1.00	0.80	1.00	0.20
Patella	0.20	0.20	0.15	0.20	0.12
Tibia	0.80	0.55	0.50	0.80	0.15
Metatarsus	0.55	0.58	0.60	1.00	
Tarsus	0.25	0.25	0.20	0.60	0.15
Total	2.75	2.58	2.25	3.60	0.62

Leg formula: 4123. First leg three times as long as carapace; fourth leg about four times as long as carapace; patella-tibia of first and fourth legs shorter than carapace; metatarsus-tarsus of fourth leg much longer than carapace; metatarsus of fourth leg slightly longer than carapace.

Epigynum (Figs. 1-2): spermathecum rounded lobe broadly jointed to smaller sac; thick connecting canal closely encircling spermathecal parts.

Male: Length 3.65 mm. Carapace 1.80 mm long, 1 mm wide. Abdomen 1.85 mm long, 0.85 mm wide. Eyes closer together than in female; both rows gently procurved to essentially straight; posterior median eyes separated by less than full diameter, half as far from subequal lateral eyes. Spines of first and fourth tibiae 2-2-2.

	I	II	III	IV	Palp
Femur	1.13	0.95	1.00	1.15	0.50
Patella	0.20	0.25	0.30	0.50	0.20
Tibia	1.00	0.40	0.30	1.00	0.20
Metatarsus	0.80	0.90	0.80	1.10	
Tarsus	0.60	0.55	0.50	0.63	0.60
Total	3.73	3.05	2.90	4.38	1.50

Key to the Eyed Females

1. Eight eyes present 2
   Six eyes present 6

2. Eight-eyed taxa with typical eyes and anterior median eyes of normal size 3
   Eight-eyed taxa with evanescent eyes; with anterior median eyes reduced to small dark or whitish spots 5

3. Index coil with wide loop across spermathecum (Figs. 9-10); epigean species of Oregon County, Missouri ..... *harrietae*, new species
   Index coil smaller loop 4

4. Eyes of front row subcontiguous; index coil with right loop (Figs. 1-2); epigean species of Bradley County, Arkansas ..... *arkansa*, new species
   Eyes of front row moderately separated; index coil narrow procurved loop (Figs. 3-4); epigean species of Starr County, Texas ..... *riograndе* Gertsch & Mulaik

5. Anterior median eyes reduced to whitish spots; index coil of epigynum procurved loop, connecting canals closely encircling spermathecal parts (Figs. 19-20); epigean species of Duval County, Texas ..... *rudimentops* Chamberlin & Ivie
   Anterior median eyes small dark spots; index coil heavy procurved loop (Figs. 21-22); cavernicole of caves of Val Verde County, Texas ..... *delrio*, new species

6. Anterior lateral eyes separated by about diameter 7
   Anterior lateral eyes separated by two or more diameters 14

7. Index coil absent 8
   Index coil present 9

8. Large oblong spermathecum with small twisted sac (Figs. 7-8); epigean species of Blanco County, Texas ..... *blanco*, new species
   Oval spermathecum with large rounded sac (Fig. 15); epigean species of Bexar County, Texas ..... *minorata*, new species

9. Index coil of typical transverse pattern 10
   Index coil of atypical pattern 11

10. Index coil thin canal in vertical position (Figs. 27-28); cavernicole from Black Cat Cave, Bexar County, Texas ..... *gatita*, new species
    Index coil forming wide loop around spermathecal parts (Figs. 29-30); epigean species of Hays County, Texas ..... *aenigma*, new species

11. Index coil small oval canal (Figs. 25-26); epigean species of San Patricio County, Texas ..... *sintonia*, new species
    Not as above 12

12. Index coil wide procurved canal (Figs. 35-36); Raven Ranch, Kerr County, Texas ..... *dorothea*, new species
    Not as above 13

13. Index coil short procurved canal (Figs. 11-12); epigean species of Burnet County, Texas ..... *marmorea*, new species
    Index coil thin transverse canal (Figs. 23-24); epigean species of Kendall County, Texas ..... *pampa* Chamberlin & Ivie

14. Index coil absent; round spermathecum with round sac (Figs. 33-34); epigean species of Travis County, Texas ..... *armadillo*, new species
Index coil present 15

15. Index coil narrow canal in oblique position between spermathecal parts 16
Index coil transverse canal 17

16. Round spermathecum with small round sac (Figs. 13-14); cavernicole of Heidrich's Cave, Comal County, Texas ..... *joya*, new species
Oblong spermathecum with small round sac (Fig. 16); epigean species of Kerr County, Texas ..... *microps* Chamberlin & Ivie

17. Connecting canal closely encircling spermathecal parts 18
Connecting canal widely encircling spermathecal parts 19

18. Index coil deeply procurved (Figs. 19-20); epigean species of Duval County, Texas ..... *rudimentops* Chamberlin & Ivie
Index coil short transverse canal 20

19. Suboval spermathecum with round sac (Figs. 17-18); epigean species of Washington County, Arkansas ..... *secreta*, new species
Oval spermathecum with twisted sac (Figs. 31-32); epigean species of Kimble County, Texas ..... *rosae*, new species

20. Index coil deeply procurved (Figs. 5-6); eyes evanescent, six pale eye spots; cavernicole of Amazing Maze Cave, Pecos County, Texas ..... *mirifica*, new species
Index coil heavy procurved loop joint S-shaped figure (Figs. 21-22); cavernicole of caves of Val Verde County, Texas ..... *delrio*, new species

Key to the Eyed Males

1. Eight-eyed species with eyes of anterior row subcontiguous; Bradley County, Arkansas ..... *arkansa*, new species
Six-eyed species 2

2. Anterior lateral eyes separated by about full diameter 3
Anterior lateral eyes separated by two or more diameters 6

3. Tarsal fold about half width of tarsal process 4
Tarsal fold less than half width of process 6

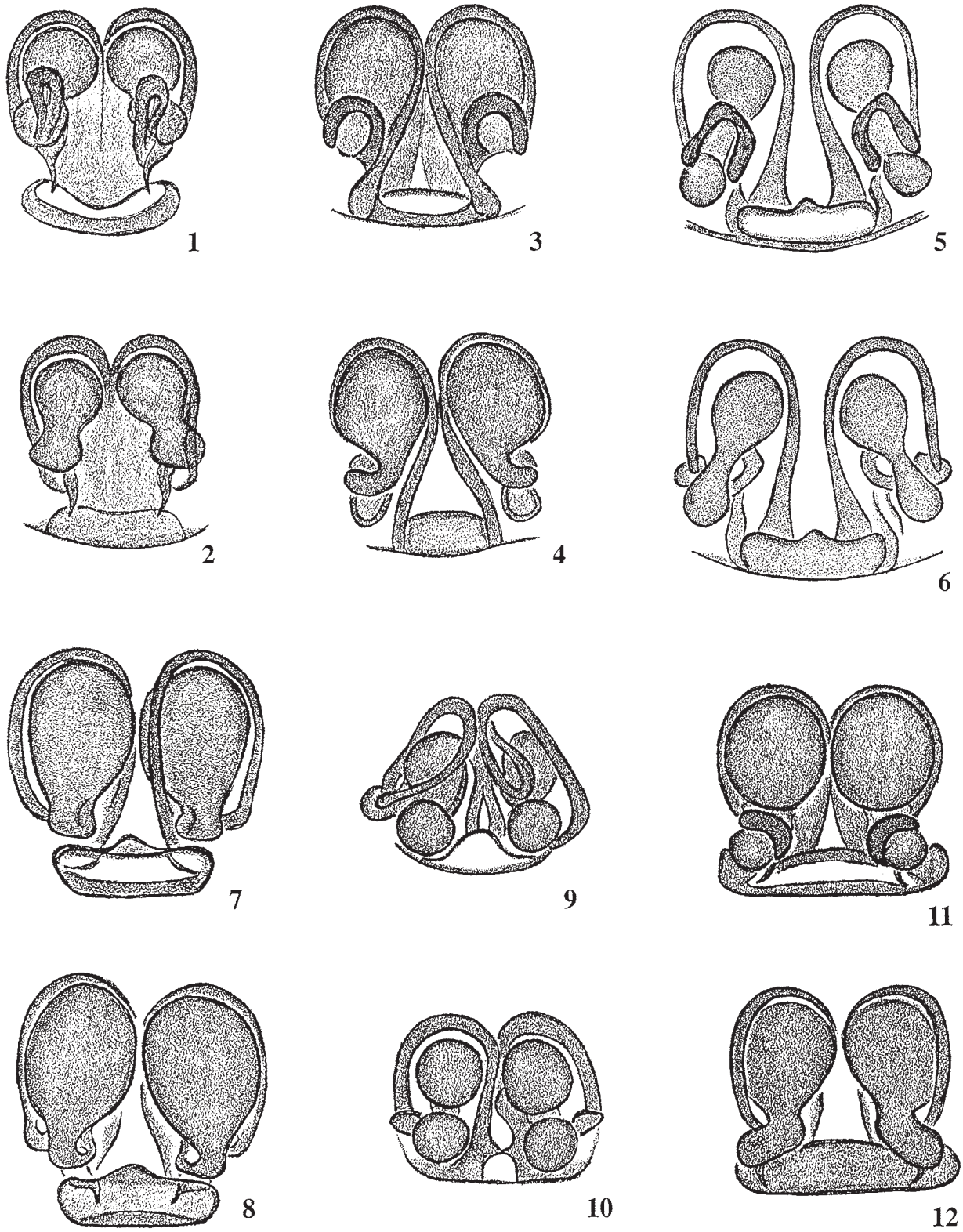
4. Tarsal process evenly curved at apex (Figs. 41-42) ..... *oklahoma*, new species
Tarsal process widened at apex 5

5. Tarsal process (Figs. 43-44) ..... *texana* (Gertsch)
Tarsal process (Figs. 39-40) ..... *secreta*, new species

6. Coil of conductor short, not much longer than base; Tom Green County, Texas ..... *hexops* Chamberlin & Ivie
Coil of conductor long fine spines continuing to near end of tegulum 7

7. Tarsal process with small notch at apex ..... *modesta*, new species
Tarsal process without apical notch 8

8. See details of Figs. 51 and 52; from Kerr County, Texas ..... *microps* Chamberlin & Ivie
See details of Figs. 47 and 48; San Patricio County, Texas ..... *sintonia*, new species



Figs. 1-12.—Ventral and dorsal views of epigyna of eyed *Cicurina* (*Cicurella*): 1-2, *arkansa*, new species; 3-4, *riogrande* Gertsch and Mulaik; 5-6, *mirifica*, new species; 7-8, *blanco*, new species; 9-10, *harrietae*, new species; 11-12, *marmorea*, new species.

Leg formula: 4123. First leg twice as long as carapace; fourth leg two and half times as long as carapace; patella-tibia of first and fourth legs shorter than carapace; metatarsus-tarsus of fourth leg about as long as carapace.

Male palpus (Figs. 37-38): tegulum with three incomplete tubules; tarsal process of tibia with long fold less than half its width; adjacent transverse spur of typical size.

Type-data.—Female holotype from Sumpter, Bradley County, Arkansas, 17 November 1963 (Leslie, collected from pine-oak woods) (AMNH).

Distribution.—Known only from Sumpter. Other records: September and November 1963 and 1964 (Leslie) (AMNH); September 1963, probably from can traps, in Exline-Peck Collection (CAS).

Cicurina harrietae, new species
Chart 1, Figs. 9-10

Diagnosis.—Eight-eyed epigean species of Alton, Oregon County, Missouri; eyes of front row contiguous (Chart 1); index coil of epigynum (Figs. 9-10) wide canal lying across spermathecum. Male unknown.

Etymology.—Specific name for the late Harriet E. Frizzell, friend and student of the genus *Cicurina.*

Description.—Female holotype: Length 4 mm. Carapace 1.7 mm long, 1 mm wide. Abdomen 2.4 mm long, 1.5 mm wide. Eye group half as wide as carapace and clypeus as high as full diameter of anterior lateral eye; eyes large (Chart 1) with tubercles black; anterior eye row moderately recurved with larger eyes contiguous; posterior eye row essentially straight with median eyes separated by less than full diameter and half as far from lateral eyes. Chelicerae: retromargin with 8 teeth, three of them larger. Leg lengths: first femur 1.3 mm, fourth femur 1.4 mm; first patella-tibia 1.7 mm; fourth patella-tibia 1.8 mm.

Epigynum (Figs. 9-10): spermathecum round with broad juncture to smaller round sac; connecting canals thick tubes rather closely encircling the spermathecum.

Type-data.—Female holotype from Alton, Oregon County, Missouri, May 1956 (W. F. Rushton) (AMNH).

Cicurina mirifica, new species
Chart 1, Figs. 5-6

Diagnosis.—Six-eyed cavernicole from Amazing Maze Cave, Pecos County, Texas; eyes evanescent with six pale eye spots in two widely separated triads; index coil of epigynum large angled U-shaped canal deeply procurved at middle of elongated spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *mirificus,* wonder, amazing.

Description.—Female holotype: Length 3.4 mm. Carapace 1.7 mm long, 1 mm wide. Abdomen 1.7 mm long, 1 mm wide. Eyes reduced in size and well separated. Anterior lateral eyes separated by 3 diameters. Posterior eye row recurved with eyes separated by more than diameter (Chart 1). Chelicerae: retromargin of fang with 3 teeth. Leg lengths: first femur 1.1 mm, fourth femur 1.1 mm; first patella-tibia 1.5 mm, fourth patella-tibia 1.6 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 5-6): elongate spermathecum prolonged into long rounded sac; connecting canals widely encircling spermathecal parts.

Type-data.—Female holotype and 1 immature from Amazing Maze Cave, near Fort Stockton, Pecos County, Texas, 1 March 1986 (A. Cobb) (AMNH).

Cicurina secreta, new species
Chart 1, Figs. 17-18, 39-40

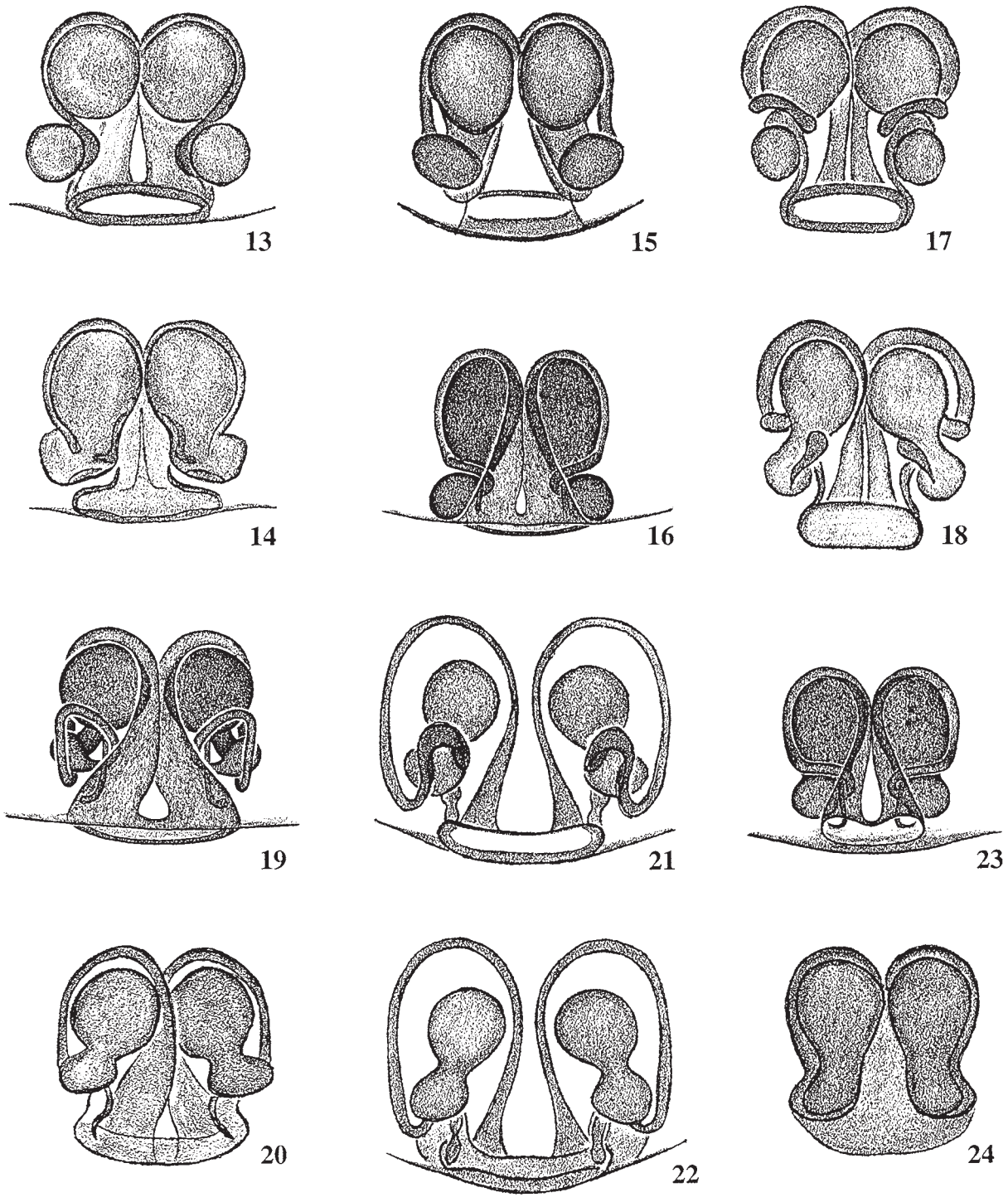
Diagnosis.—Six-eyed epigean species of Washington County, Arkansas; suboval spermathecum broadly joined to smaller rounded sac; index coil of epigynum narrow slightly procurved canal. Conductor of male palpus long coil.

Etymology.—Specific name from Latin *secretus,* secret, to set apart.

Description.—Female holotype: Length 5 mm. Carapace 2 mm long, 1.4 mm wide. Abdomen 3 mm long, 1.7 mm wide. Anterior lateral eyes (Chart 1) separated by nearly 2 diameters. Posterior eye row slightly procurved; median eyes separated by 2 diameters, nearly diameter from side eyes. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.65 mm, fourth femur 0.7 mm; first patella-tibia 2.1 mm, fourth patella-tibia 2.2 mm. Epigynum (Figs. 17-18): thick connecting canals closely circling spermathecum.

Male: Length 5.5 mm. Carapace 2.5 mm long, 1.8 mm wide. Abdomen 3 mm long, 1.7 mm wide. Eyes somewhat larger than those of female, with similar pattern. Retromargin of fang with 5 teeth. Leg lengths: first patella-tibia 1.3 mm, fourth patella-tibia 1.4 mm.

Male palpus (Figs. 39-40): tegulum with two thin tubules; tarsal process of tibia with long fold about half its width and transverse spur of typical size.



Figs. 13-24.—Ventral and dorsal views of epigyna of eyed *Cicurina* (*Cicurella*): 13-14, *joya*, new species; 15, *minorata* Chamberlin and Ivie; 16, *microps* Chamberlin and Ivie; 17-18, *secreta*, new species; 19-20, *rudimentops* Chamberlin and Ivie; 21-22, *delrio*, new species; 23-24, *pampa* Chamberlin and Ivie. [Figs. 16, 19, 23 from Chamberlin and Ivie, 1940]

Type-data.—Female holotype from Cove Creek Valley, Washington County, Arkansas, 15 miles south of Prairie Grove, December 1955 (F. Hite) (AMNH).

Distribution.—Known only from Cove Creek Valley. Other records: males, August 1952, 1961, 1962 (F. Hite) (AMNH); 6 October 1962, 2 males, 1 female (Exline Peck) (CAS).

Cicurina marmorea, new species
Figs. 11-12

Diagnosis.—Six-eyed epigean species from Marble Falls, Burnet County, Texas; anterior median eyes full diameter apart; index coil small procurved canal lying across spermathecal sac. Male unknown.

Etymology.—Specific name from Latin *marmorea*, marble, for Marble Falls.

Description.—Female holotype: Length 3.9 mm. Carapace 1.7 mm long, 1.3 mm wide. Abdomen 2.2 mm long, 1.35 mm wide. Clypeus narrow, about half diameter of anterior lateral eye. Posterior eye row essentially straight; median eyes slightly more than full diameter apart, their radius from posterior laterals. Chelicerae: retromargin of fang with 5 teeth. Leg segments: first femur 0.7 mm, fourth femur 0.75 mm; parts of legs missing.

Epigynum (Figs. 11-12): subround spermathecum, broadly joined to small round sac; broad connecting canals tightly encircling spermathecal parts.

Type-data.—Female holotype from 8 miles north of Marble Falls, Burnet County, Texas, 8 November 1964 (J. Reddell) (AMNH).

Cicurina pampa Chamberlin and Ivie
Figs. 23-24

Cicurina pampa Chamberlin and Ivie, 1940:79, Pl. VIII, fig. 60.

Diagnosis.—Six-eyed epigean species from Kendall County, Texas; anterior lateral eyes separated by full diameter; index coil of epigynum thin tube crossing between spermathecal parts. Male unknown.

Etymology.—Specific name from Spanish *pampa*, a grassy plain.

Description.—Female holotype: Length 2.1 mm. Carapace 0.95 mm long, 0.68 mm wide. Abdomen 1.15 mm long, 0.70 mm wide. Clypeal height about half diameter of anterior lateral eye; posterior eye row straight with median eyes 1.5 diameters apart, scarcely radius from lateral eyes. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first patella–tibia 0.77 mm, fourth patella-tibia 0.8 mm.

Epigynum (Figs. 23-24): oval spermathecum broadly joined to rounded sac; index coil and connecting canal closely encircling spermathecal parts.

Type-data.—Female holotype from Kendall County, Texas, December 1939 (D. and S. Mulaik) (AMNH).

Cicurina modesta, new species
Figs. 45-46

Diagnosis.—Six-eyed epigean species from Camp Verde, Kerr County, Texas; anterior lateral eyes separated by full diameter; conductor of male palpus with long coil reaching end of subtegulum. Female unknown.

Etymology.—Specific name from Latin *modestus*, modest.

Description.—Male holotype: Length 2.7 mm. Carapace 1.5 mm long, 1 mm wide. Abdomen 1.2 mm long and wide. Clypeus as wide as anterior lateral eye. Posterior eye row straight; median eyes separated by full diameter. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 0.9 mm, fourth femur 0.9 mm; first patella-tibia 0.95 mm, fourth patella-tibia 1 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Male palpus (Figs. 45-46): tegulum with three tubules; tarsal process with trivial subapical spur and long thin fold less than third its width and long transverse spur.

Type-data.—Male holotype and male from Camp Verde, Kerr County, Texas (W. Rogers), from pitfall traps (AMNH).

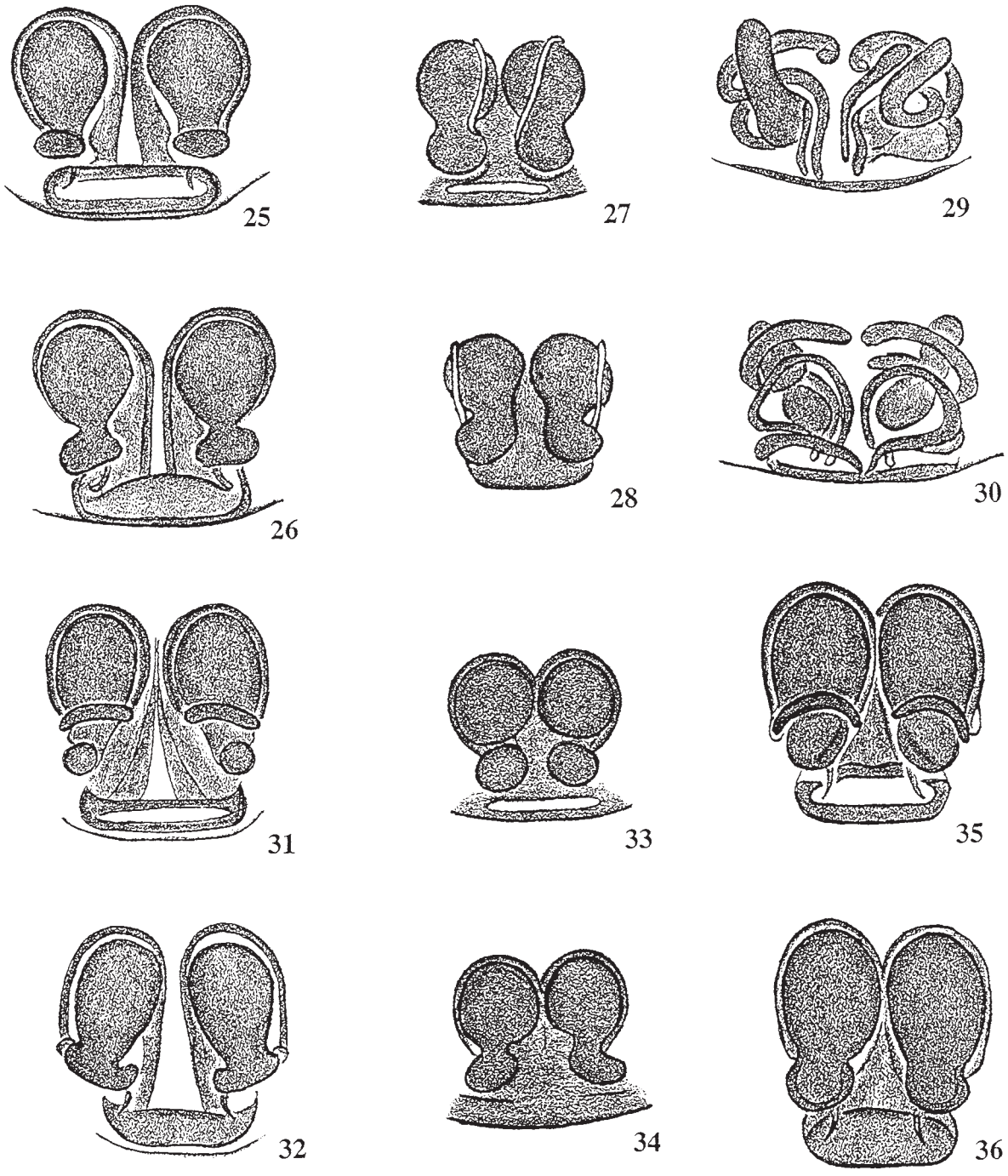
Cicurina hexops Chamberlin and Ivie
Figs. 49-50

Cicurina hexops Chamberlin and Ivie, 1940:79, Pl. XII, fig. 92.

Diagnosis.—Six-eyed epigean species from Water Valley, Tom Green County, Texas; anterior lateral eyes separated by two diameters; conductor of male palpus with short coil. Female unknown.

Etymology.—Specific name from Latin *hexops*, six eyes.

Description.—Male holotype: Length 2.1 mm. Carapace 0.9 mm long, 0.8 mm wide. Abdomen 1.2 mm long, 0.7 mm wide. Clypeus less than full diameter of anterior lateral eye. Posterior eye row straight; median eyes separated by 1.5 diameters,



Figs. 25-36.—Ventral and dorsal views of epigyna of eyed *Cicurina* (*Cicurella*): 25-26, *sintonia*, new species; 27-28, *gatita*, new species; 29-30, *aenigma*, new species; 31-32, *rosae*, new species; 33-34, *armadillo*, new species; 35-36, *dorothea*, new species.

about half as far from side eyes. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.58 mm, fourth femur 0.6 mm; first patella-tibia 0.65 mm, fourth patella-tibia 0.67 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-1.

Male palpus (Figs. 49-50): tegulum with parts of three tubules; conductor with rather short coil, its length about that of tegulum; tarsal process of tibia with thin fold about fourth its width and adjacent thin transverse spur.

Type-data.—Male holotype and additional male from Water Valley, Tom Green County, Texas, December 1939 (S. and D. Mulaik) (AMNH).

Cicurina oklahoma, new species
Figs. 41-42

Diagnosis.—Six-eyed epigean species from Red Oak, Latimer County, Oklahoma; clypeus as high as anterior lateral eye; conductor of male palpus with long coil with tip near end of subtegulum. Female unknown.

Etymology.—Specific name for the state of Oklahoma.

Description.—Male holotype: Length 2.02 mm. Carapace 1.2 mm long, 0.82 mm wide. Abdomen 0.82 mm long, 0.50 mm wide. Posterior eye row slightly procurved; median eyes separated by full diameter, nearly touching lateral eyes. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 0.95 mm, fourth femur 1.05 mm; first patella-tibia 1.10 mm, fourth patella-tibia 1.20 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-1.

Male palpus (Figs. 41-42): tegulum with two incomplete tubules; tarsal process of tibia with long fold about half its width and narrow transverse spur.

Type-data.—Male holotype from Red Oak, Latimer County, Oklahoma, 8-9 October 1976 (V. Roth) (AMNH).

Cicurina minorata (Gertsch and Davis)
Fig. 15

Chorizomma minorata Gertsch and Davis, 1936:6, fig. 8.
Cicurina minorata: Chamberlin and Ivie, 1940:80, pl. VIII, fig. 63, pl. XII, fig. 96.

Diagnosis.—Six-eyed epigean species from San Antonio, Bexar County, Texas; anterior lateral eyes separated by diameter; index coil completely lacking in usual position. Male unknown.

Etymology.—Specific name from Latin, *minimus*, very small.

Description.—Female holotype: Length 1.6 mm. Carapace 0.7 mm long, 0.47 mm wide. Posterior eye row straight with median eyes separated by long diameter, half as far from lateral eyes. Chelicerae: retromargin of fang with 5 small teeth. Leg lengths: first femur 0.46 mm; fourth leg missing.

Epigynum (Fig. 15): spermathecum oval with small laterally directed sac; connecting canals closely appressed to spermathecum.

Type-data.—Female holotype from San Antonio, Bexar County, Texas, December 1934 (L. I. Davis) (AMNH).

Cicurina texana (Gertsch)
Figs. 43-44

Chorizomma texana Gertsch, 1935:15, figs. 36-37.
Cicurina texana: Chamberlin and Ivie, 1940:78, Pl. XII, fig. 90, male only.

Diagnosis.—Six-eyed epigean species of Llano, Texas; anterior lateral eyes separated by long diameter; conductor of male palpus with long coil. Female unknown.

Etymology.—Specific name for the State of Texas.

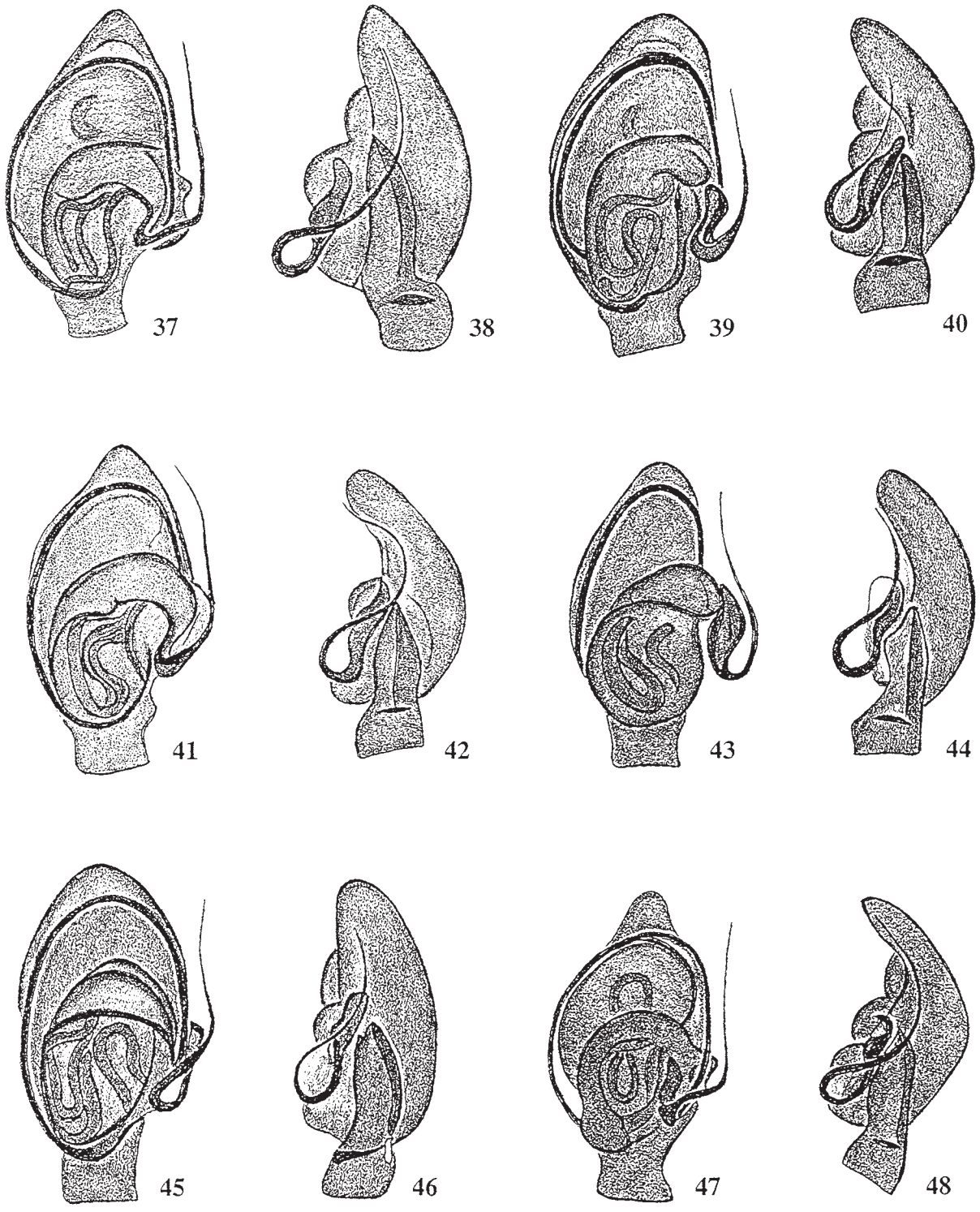
Description.—Male holotype: Length 2.2 mm. Carapace 1 mm long, 0.75 mm wide. Abdomen 1.15 mm long, 0.78 mm wide. Narrow clypeus half diameter of anterior lateral eye. Posterior eye row essentially straight; slightly smaller median eyes separated by little more than diameter, half as far from lateral eyes, which are equal in size to anterior lateral eyes. Chelicerae: retromargin of fang with 4 small teeth. Leg lengths: first femur 0.73 mm, fourth femur 0.75 mm; first patella-tibia 0.9 mm, fourth patella-tibia 0.97 mm. Leg spines: first and fourth tibiae 2-2-2.

Male palpus (Figs. 43-44): tegulum with two incomplete tubules; heavy conductor with long coil reaching end of subtegulum; tarsal process with fold nearly half its width and thin adjacent transverse spur.

Type-data.—Male holotype from Llano, Llano County, Texas, December 1934 (L. Irvy Davis) (AMNH).

Cicurina gatita, new species
Figs. 27-28

Diagnosis.—Six-eyed cavernicole from Black Cat Cave, Bexar County, Texas; anterior lateral eyes separated by full diameter; index coil of epigynum



Figs. 37-48.—Ventral and retrolateral views of male palpi of *Cicurina* (*Cicurella*): 37-38, *arkansa*, new species; 39-40, *secreta*, new species; 41-42, *oklahoma*, new species; 43-44, *texana* Gertsch; 45- 46, *modesta*, new species; 47-48, *sintonia*, new species.

thin canal directed vertically forward for full length of spermathecum.

Etymology.—Specific name from Spanish *gatita*, little cat.

Description.—Female holotype: Length 1.86 mm. Carapace 0.66 mm long, 0.50 mm wide. Abdomen 1.2 mm long, 0.8 mm wide. Clypeus narrow, about half diameter of anterior lateral eye. Eye group nearly two-thirds width of carapace; posterior eye row essentially straight with median eyes separated by 1.5 diameters, half as far from lateral eyes. Chelicerae: promargin of fang with 6 teeth. Leg lengths: first femur 0.5 mm, fourth femur 0.5 mm; first patella-tibia 0.6 mm, fourth patella-tibia 0.7 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 27-28): spermathecum oval with broadly attached oval sac; atrium slender transverse groove.

Type-data.—Female holotype from Black Cat Cave, Bexar County, Texas, 27 January 1987 (J. Reddell, M. Reyes) (AMNH).

Cicurina aenigma, new species
Figs. 29-30

Diagnosis.—Six-eyed epigean species from Hays County, Texas; spermathecum elongated and broadly joined to long sac; index coil wide ring around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *aenigma*, enigma, secret.

Description.—Female holotype: Length of damaged specimen 2 mm. Carapace 1 mm long, 0.66 mm wide. Clypeus as high as one diameter of anterior lateral eye. Anterior lateral eyes separated by full diameter. Posterior eye row essentially straight with median eyes separated by diameter. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.45 mm, fourth femur 0.5 mm; first patella-tibia 0.54 mm, fourth patella-tibia 0.66 mm.

Epigynum (Figs. 29-30): spermathecum elongated in mixture of canals and spermathecal elements, with much uncertainty of details.

Type-data.—Female holotype from Hays County, Texas, 15 April 1939 (D. and S. Mulaik) (AMNH).

Cicurina dorothea, new species
Figs. 35-36

Cicurina texana: Chamberlin and Ivie, 1940:78, pl. VIII, fig. 64 (female only).

Diagnosis.—Six-eyed epigean species from Raven Ranch, Kerr County, Texas; anterior lateral eyes separated by diameter; spermathecum long oval, broadly joined to smaller rounded sac. Male unknown.

Etymology.—Specific name for Dorothea Mulaik, collector of many Texas spiders.

Description.—Female holotype: Length 2.5 mm. Carapace 1 mm long, 0.65 mm wide. Abdomen 1.5 mm long, 0.65 mm wide. Clypeus half diameter of anterior lateral eye. Posterior eye row straight, with median eyes less than diameter apart, a radius from side eyes. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 0.7 mm, fourth femur 0.7 mm; first patella-tibia 0.8 mm, fourth patella-tibia 0.85 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 35-36): index coil broad moderately procurved canal across spermathecum; connecting canals thick, closely margining spermathecum.

Type-data.—Female holotype from Raven Ranch, Kerr County, Texas, August 1939 (D. and S. Mulaik) (AMNH).

Distribution.—Known only from Raven Ranch. Other record: December 1939 (D. and S. Mulaik), female.

Cicurina rosae, new species
Figs. 31-32

Diagnosis.—Six-eyed epigean species from 7 miles east of Junction, Kimble County, Texas, with anterior lateral eyes separated by 1.5 diameters; index coil of epigynum small, slightly procurved canal across spermathecum. Male unknown.

Diagnosis.—Specific name for Rose Carpenter, friend and collector of many Texas spiders.

Description.—Female holotype: Length 2.9 mm. Carapace 1.3 mm long, 0.9 mm wide. Abdomen 1.6 mm long, 1 mm wide. Clypeal margin less than diameter of anterior lateral eye, which are separated by 1.5 diameters; posterior eye row straight, with small middle eyes separated by 1.5 diameters, less than diameter from lateral eyes. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 0.8 mm, fourth femur 0.8 mm; first patella-tibia 1 mm, fourth patella-tibia 1.1 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 31-32): Spermathecum oval with short curved sac, appearing in ventral view as small round lobe; index coil and connecting canal thick and tightly margining the spermathecum.

Type-data.—Female holotype from 7 miles east of Junction, Kimble County, Texas, 19 November 1967 (Rose Carpenter) (AMNH).

Cicurina blanco, new species
Figs. 7-8

Diagnosis.—Six-eyed epigean species from Johnson City, Blanco County, Texas; anterior eyes separated by full diameter; index coil of epigynum not detectable in ventral view. Male unknown.

Etymology.—Specific name from Spanish *blanco*, white, in reference to Blanco County, used in apposition.

Description.—Female holotype: Length 2.8 mm. Carapace 1.1 mm long, 0.9 mm wide. Abdomen 1.7 mm long, 1.15 mm wide. Clypeal margin equal to half diameter of anterior lateral eyes, with median eyes separated by full diameter, about radius from lateral eye. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 0.7 mm, fourth femur 0.75 mm; first patella-tibia 1 mm, fourth patella-tibia 1 mm.

Epigynum (Figs. 7-8): Spermathecum elongate, suboval, with small twisted sac; connecting canal thick, closely appressed to spermathecal parts.

Type-data.—Female holotype from 10 miles east of Johnson City, near Pedernales River, Blanco County, Texas, 23 February 1986 (S. J. Harden) (AMNH).

Cicurina armadillo, new species
Chart 1, Figs. 33-34

Diagnosis.—Six-eyed epigean species from near Austin, Travis County, Texas; eyes of both rows separated by two diameters (Chart 1); index coil of epigynum not present between spermathecal lobes. Male unknown.

Etymology.—Specific name from Spanish *armadillo*, used in apposition.

Description.—Female holotype: Length 2.6 mm. Carapace 1 mm long, 0.7 mm wide. Abdomen 1.6 mm long, 0.85 mm wide. Clypeus narrow, about half diameter of anterior lateral eye. Anterior lateral eyes separated by two diameters. Posterior eye row moderately procurved with median eyes separated by about two diameters, a radius from posterior laterals. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.55 mm, fourth femur 0.58 mm; first patella-tibia 0.6 mm, fourth patella-tibia 0.65 mm. Leg spines: first and fourth tibiae 2-2-0.

Epigynum (Figs. 33-34): large round spermathecum with small rounded sac; connecting canal closely appressed to spermathecal parts.

Type-data.—Female holotype from near Austin, Travis County, Texas, 8 January 1948 (Cheldon), from armadillo nest (AMNH).

Cicurina rudimentops Chamberlin and Ivie
Chart 1, Figs. 19-20

Cicurina rudimentops Chamberlin and Ivie, 1940:76, pl. VIII, fig. 59.

Diagnosis.—Eight-eyed epigean species of Alice, Duval County, Texas; anterior median eyes reduced to whitish spots; dark anterior lateral eyes nearly two diameters apart; index coil of epigynum slender widely procurved canal across spermathecal sac. Male unknown.

Etymology.—Specific name from Latin *rudimentum* and *ops*, rudimentary eyes.

Description.—Female holotype: Length 2.1 mm. Carapace 1.05 mm long, 0.73 mm wide. Abdomen 1 mm long, 0.7 mm wide. Clypeal height less than full diameter of anterior lateral eye. Anterior eye row essentially straight. Posterior eye row straight; posterior median eyes separated by nearly two diameters. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 0.6 mm, fourth femur 0.6 mm; first patella-tibia 0.8 mm, fourth patella-tibia 0.9 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 19-20): round spermathecum narrowly joined to small oval sac; thick connecting canal narrowly ringing spermathecal parts.

Type-data.—Female holotype from 17 miles north of Alice, Duval County, Texas, December 1939 (D. and S. Mulaik) (AMNH).

Cicurina sintonia, new species
Chart 1, Figs. 25-26, 47-48

Diagnosis.—Six-eyed epigean species of Sinton, San Patricio County, Texas; anterior lateral eyes separated by full diameter; index coil short oval canal lying across spermathecum. Male palpus (Figs. 47-48).

Etymology.—Specific name for Sinton, Texas.

Description.—Female holotype: Length 2.7 mm. Carapace 1.35 mm long, 1 mm wide. Abdomen 1.35 mm long, 1 mm wide. Eyes small, evanescent; posterior row straight with smaller median eyes separated by about diameter. Patella–tibia of first and fourth legs 1 mm long.

Epigynum (Figs. 25-26): spermathecum oval, broadly joined to small rounded sac; connecting canal closely encircling spermathecum.

Male: Length 2.75 mm. Carapace 1 mm long and wide. Abdomen 0.82 mm long, 0.52 mm wide.

Eyes closer together than those of female but pattern essentially the same. Color mostly whitish but one male with carapace pale yellow. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.85 mm, fourth femur 0.95 mm; first patella-tibia 1.2 mm, fourth patella-tibia 1.4 mm.

Male palpus (Figs. 47-48): tegulum with one visible tubule and adjacent one on subtegulum; conductor with twisted base and long coil running near end of tegulum; tarsal process with thin fold third its width.

Type-data.—Female holotype and 4 males from Sinton, San Patricio County, Texas, 20 November 1959 (H. E. Laughlin) (AMNH).

Cicurina delrio, new species
Charts 1, 2, Figs. 21-22

Diagnosis.—Eight or six-eyed cavernicole of Val Verde County, Texas; eyes evanescent with widely separated anterior median eye spots present or absent (Chart 1); index coil of epigynum tight procurved hook across small spermathecal sac. Male unknown.

Etymology.—Specific name for Del Rio, Texas, used in apposition.

Description.—Female holotype: Length 4 mm. Carapace 1.9 mm long, 1.25 mm wide. Abdomen 2.1 mm long, 1.5 mm wide. Clypeal margin wide, about two diameters of anterior lateral eye. Anterior eye row straight with tiny medians 1.5 mm apart, about same distance from anterior lateral eyes. Posterior eye row slightly recurved; small median eyes about three diameters apart, two diameters from anterior lateral eyes. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first and fourth femora 1.6 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Epigynum (Figs. 21-22): round spermathecum widely joined to smaller rounded sac; thick connecting canal forming widely separated loop around spermathecal parts.

Type-data.—Female holotype from Sunset Cave, 12 miles NW Del Rio, Val Verde County, Texas, on Ellison Brite Ranch, 14 December 1962 (J. Reddell, W. Russell), on wall 50 feet from cave entrance (AMNH).

Distribution.—TEXAS: *Val Verde County*: Diablo Cave, Calyx Hole entrance, 12 August 1963 (J. Reddell, D. McKenzie), 1 female, 1 penultimate male from under rotting shirt. Unnamed cave (No. 8), half mile from Ladder Cave, 12 August 1963 (J. Reddell, D. McKenzie), 6 immature and 3 penultimate males, mostly from under rocks.

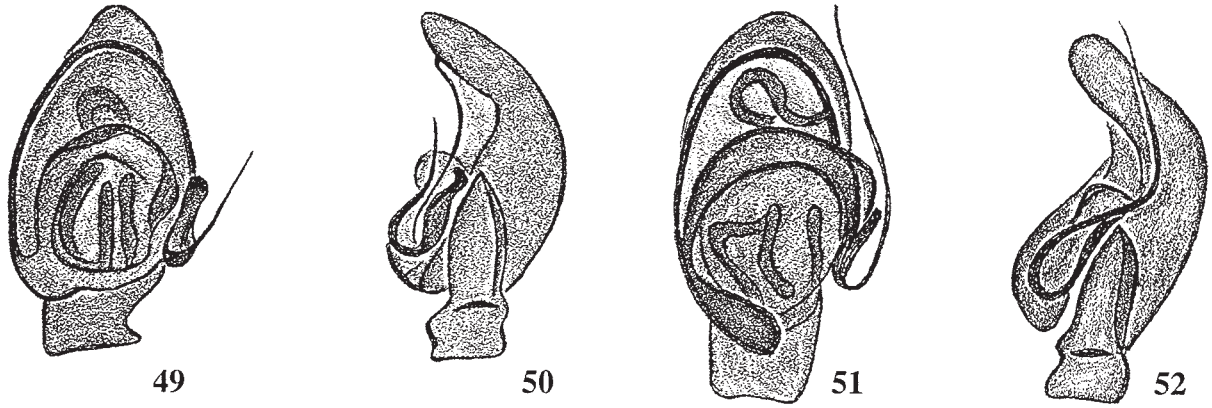
Cicurina joya, new species
Chart 1, Figs. 13-14

Diagnosis.—Six-eyed cavernicole of Heidrich's Cave, Comal County, Texas; anterior lateral eyes separated by nearly two diameters; index coil of epigynum thin tube crossing between spermathecal elements. Male unknown.

Etymology.—Specific name from Spanish *joya*, jewel, used in apposition.

Description.—Female holotype: Length 1.7 mm. Carapace 0.7 mm long, 0.53 mm wide. Clypeal margin equal in height to diameter of anterior lateral eye; posterior eye row slightly procurved; posterior median eyes separated by diameter, about two-thirds diameter from posterior lateral eyes. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 0.5 mm, fourth femur 0.52 mm; first patella-tibia 0.62 mm, fourth patella-tibia 0.7 mm. Leg spines: first tibia 2-2-0; fourth tibia 1-1-1.

Epigynum (Figs. 13-14): spermathecum round, broadly joined to small round sac; connecting canals closely encircling spermathecal parts.



Figs. 49–52.—Ventral and retrolateral views of male palpi of *Cicurina* (*Cicurella*): 49-50, *hexops* Chamberlin and Ivie; 51-52, *microps*, new species.

Type-data.—Female holotype from inside entrance of Heidrich's Cave, northwest of New Braunfels, Comal County, Texas, 19 March 1960 (W. J. Gertsch, Wilton Ivie) (AMNH).

Cicurina riogrande Gertsch and Mulaik
Figs. 3-4

Cicurina riogrande Gertsch and Mulaik, in Chamberlin and Ivie, 1940, p. 76, pl. VIII, figs. 57-58.

Diagnosis.—Eight-eyed epigean species from Rio Grande City, Starr County, Texas; small anterior median eyes half as large as anterior laterals; index coil of epigynum thin procurved loop. Male unknown.

Etymology.—Specific name for Rio Grande City, Texas.

Description.—Female holotype: Length 2.8 mm long. Carapace 1.55 mm long, 0.9 mm wide. Abdomen 1.25 mm long, 1 mm wide. Clypeus narrow, about half diameter of anterior lateral eye. Eye rows slightly procurved; posterior median eyes about two diameters apart, about diameter from side eyes. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first patella-tibia 1.1 mm, fourth patella-tibia 1.15 mm.

Epigynum (Figs. 3-4): round spermathecum narrowly joined to smaller suboval sac; index coil thin procurved canal around spermathecal sac; connecting canals rather closely circling spermathecum.

Type-data.—Female holotype from 5 miles east of Rio Grande City, Starr County, Texas, 12 January 1939 (S. Mulaik) (AMNH).

Cicurina microps Chamberlin and Ivie
Chart 1, Fig. 16, 51-52

Cicurina microps Chamberlin and Ivie, 1940:77, pl. VIII, figs. 61-62, pl. XII, fig. 91.

Diagnosis.—Six-eyed epigean species from Raven Ranch, Kerr County, Texas; eyes (Chart 1) small, evanescent, pearly white spots in two separated triads; slender conductor of male palpus with very long coil reaching end of cymbium (Figs. 51-52). Assigned female from Brady, Texas, unavailable, known from Ivie illustrations (see Fig. 16).

Etymology.—Specific name from Greek *microps*, small eyes.

Description.—Male holotype: Length 3.2 mm. Carapace 1.5 mm long, 1 mm wide. Abdomen 1.7 mm long, 1 mm wide. Clypeus about diameter of anterior lateral eye. Anterior lateral eyes 3 diameters apart, about radius from other eyes. Posterior eye row moderately procurved; median eyes about two diameters apart, about diameter from side eyes. Leg lengths: first patella- tibia 1.1 mm, fourth patella-tibia 1.4 mm.

Male palpus: tegulum with two incomplete tubules and one visible one on subtegulum; tarsal process with fold about third its width and adjacent spur of median size (Figs. 51-52).

Female allotype: Length 2.8 mm. Carapace 1.19 mm long, 0.7 mm wide. Eyes and other characters presumed to be similar to those of male.

Type-data.—Male holotype from Raven Ranch, south of Kerrville, Kerr County, Texas, 16 December 1939 (D. and S. Mulaik) (AMNH).

Distribution.—As above for male only, and presumed female allotype: South of Brady, McCulloch County, Texas, 12 December 1939 (D. and S. Mulaik) (AMNH).

LIST AND DISCUSSION OF THE EYELESS TAXA

The subgenera *Cicurata* and *Cicurella* of Chamberlin and Ivie featured spiders of relatively small size with progressive loss of eyes nurtured in special epigean and cavernicole habitats. The taxa studied mainly by Ivie included his first completely eyeless species, which he named *buwata* and assigned to the stem genus *Cicurina* with special knowledge of the meaning of that genus. Inasmuch as *buwata* is an unknown taxon with unknown type locality coming from an area where numerous species are known to occur, and not one can be singled out even as a plausible type species, the name *buwata* must be dropped as a *nomina inquirienda* of unknown status, and with it goes the unusable subgeneric name *Cicurata*. The subgenus *Cicurella*, with its well known type species, *Cicurina microps* Chamberlin and Ivie, has largely been used in a general but never in a generic sense by Ivie or following students. For the sake of editorial completeness the name *buwata* is listed at the end of the valid taxa of the genus.

A list of the eyeless taxa follows: descriptions of the 50 valid species are given with information on state and county localities of the United States and known data on the Mexican records. In this paper the generic name *Cicurina* covers all the taxa.

Descriptions of the 50 eyeless taxa follows: TEXAS: Williamson County: *browni*, *vibora*, *elliotti*, new species, and *buwata* Chamberlin and Ivie. Coryell County: *coryelli*, new species. Hays

County: *ezelli*, *russelli*, and *ubicki*, new species. Travis County: *travisae*, *reddelli*, *bandida*, *reyesi*, *wartoni*, and *cueva*, new species. Bexar County: *baronia*, *madla*, *vespera*, and *venii*, new species. Comal County: *reclusa* and *puentecilla*, new species. Medina County: *medina*, new species. Menard County: *menardia*, new species. Real County: *sheari* and *orellia*, new species. Bandera County: *bandera*, *obscura*, *sprousei*, and *mckenziei*, new species. Kerr County: *pastura* and *stowersi*, new species. Val Verde County: *patei*, *holsingeri*, and *porteri*, new species. Sutton County: *suttoni* and *barri*, new species. San Saba County: *sansaba* and *machete*, new species. Terrell County: *venefica*, new species. Kimble County: *caverna*, new species. Edwards County: *rainesi* and *gruta*, new species. Uvalde County: *uvalde*, *watersi*, *pablo*, *serena*, and *selecta*, new species. ALABAMA: Jefferson County: *wiltoni*, new species. YUCATAN: *maya* Gertsch. COAHUILA: *coahuila* Gertsch. NUEVO LEON: *leona*, new species.

Cicurina browni, new species
Figs. 53-54

Diagnosis.—Eyeless troglobite of Brown's Cave, Williamson County, Texas; epigynum like that of *vibora* with elongate spermathecum and large sac in suboblique position; two index coils crossing middle of sac; heavy connecting canals running beyond sac area. Male unknown.

Etymology.—Named for Brown's Cave.

Description.—Female holotype: Length 5.6 mm. Carapace 2.25 mm long, 1.6 mm wide. Abdomen 3.2 mm long, 2.4 mm wide. Chelicerae: retromargin of left side with 6 teeth, of right side 5. Leg lengths: first femur 2 mm, fourth femur 2.2 mm; first patella-tibia 2.4 mm, fourth patella-tibia 2.5 mm. Leg spines of first and fourth tibiae 2-2-2.

Type-data.—Female holotype, subadult female and 3 immature from Brown's Cave, Williamson County, Texas, 23 April 1989 (W. Elliott, J. Reddell, M. Reyes) (AMNH).

Cicurina vibora, new species
Figs. 55-56

Diagnosis.—Eyeless troglobite of Rattlesnake Filled Cave, Williamson County, Texas; ovate spermathecum with rounded sac close together at midline, turned in oblique position; two index coils draped together around sac; connecting canals limited to sac area. Male unknown.

Etymology.—Specific name for Mexican *vibora*, viper.

Description.—Female holotype: Length 5 mm. Carapace 2.5 mm long, 1.2 mm wide. Abdomen 2.5 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2 mm, fourth femur 2.1 mm; first patella-tibia 2.5 mm, fourth patella-tibia 2.8 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Female holotype and 2 immature from Rattlesnake Filled Cave (southwest of Cricket Cave), 24 August 1963 (J. Reddell, W. Russell) (AMNH).

Distribution.—TEXAS: *Williamson County*: Temples of Thor Cave, 13 May 1991 (J. Reddell, M. Reyes), 2 females, 5 immature.

Cicurina holsingeri, new species
Figs. 57-58

Diagnosis.—Eyeless troglobite of Seminole Canyon Cave, Val Verde County, Texas; round spermathecum with short rounded sac; index coil a thin loop the length of the spermathecum; connecting canal continuous with the index coil and forming loop around spermathecal parts. Male unknown.

Etymology.—Named for Dr. John R. Holsinger of Old Dominion University, specialist on many cave animals.

Description.—Female holotype: Length 2.7 mm. Carapace 1.4 mm long, 0.85 mm wide. Abdomen 1.3 mm long, 0.8 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 1.1 mm, fourth femur 1.3 mm; first patella-tibia 1.4 mm, fourth patella-tibia 1.5 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Seminole Canyon Cave, Seminole State Park, Val Verde County, Texas, 4 March 1983 (W.R. Elliott) (AMNH).

Distribution.—Known only from Seminole Canyon Cave. Other record: 21 May 1984 (Ralph L. Bement), 2 immature.

Cicurina menardia, new species
Figs. 59-60, 157-158

Diagnosis.—Eyeless troglobite of Powell's Cave, Menard County, Texas; oval spermathecum with broadly rounded sac; index coil heavy procurved canal across sac; connecting canal forming close loop around spermathecal parts. Male palpus (Figs. 157-158).

Etymology.—Specific name for Menard County.

Description.—Female holotype: Length 3.9 mm. Carapace 1.9 mm long, 1 mm wide. Abdomen 2 mm long, 1.2 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 1.4 mm, fourth femur 1.6 mm; first patella-tibia 1.8 mm, fourth patella-tibia 2 mm. Leg spines: first and fourth tibiae 2-2-0.

Male: Length 2.8 mm. Carapace 1.4 mm long, 1.1 mm wide. Abdomen 1.4 mm long, 1.1 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 1.2 mm, fourth femur 1.4 mm; first patella-tibia 1.5 mm, fourth patella-tibia 1.5 mm. Leg spines: first and fourth tibiae 2-2-2. Male palpus (Figs. 157-158).

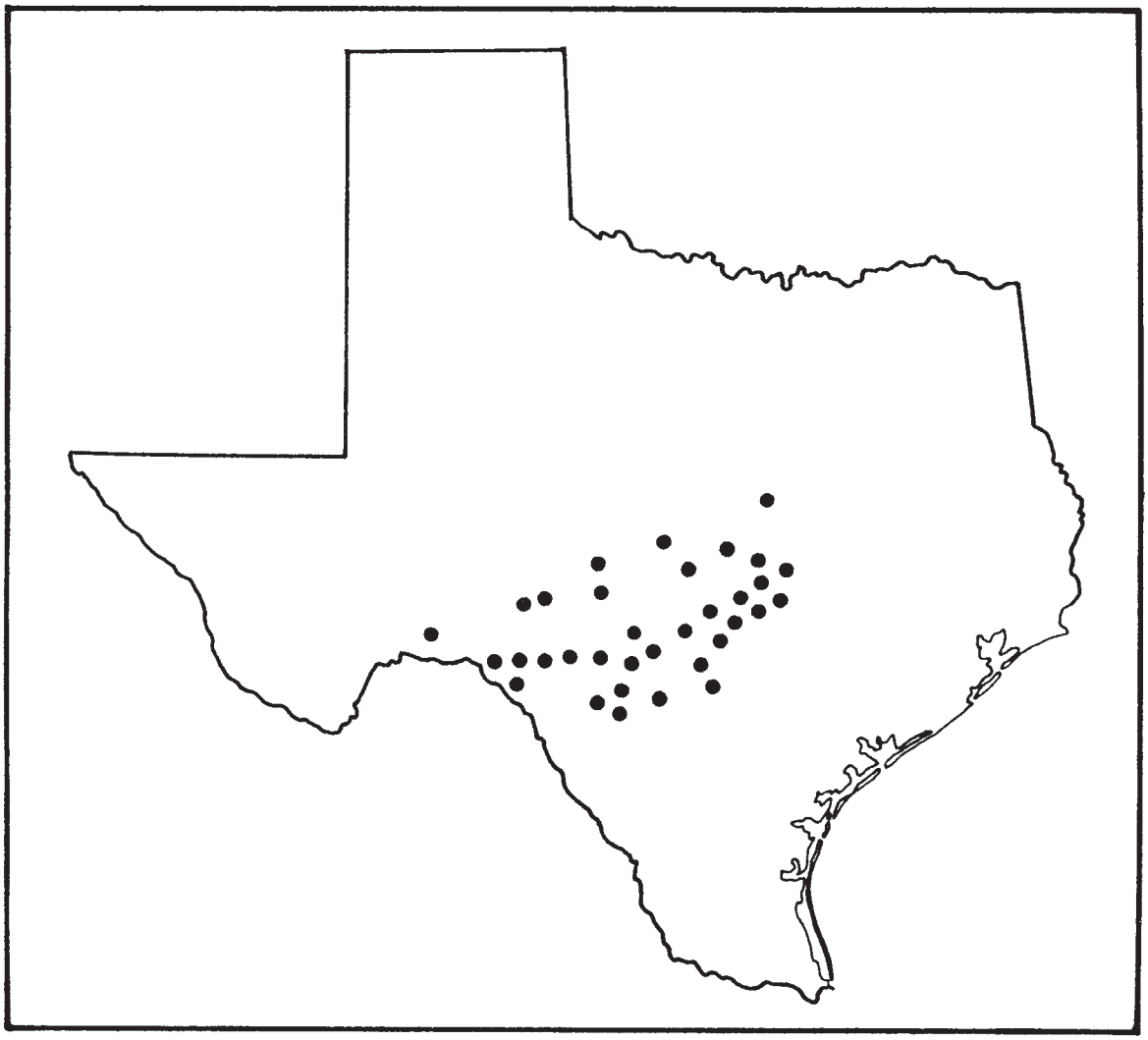
Type-data.—Female holotype from Powell's Cave, 8 miles west of Menard, Menard County, Texas, 16 September 1978 (J. Reddell), from M-section maze (AMNH).

Distribution.—Known only from Powell's Cave. Other records, 30 September 1967 (J. Reddell, D. Meredith), 2 females; 16 September 1964 (J. Reddell, D. McKenzie), 1 male, 3 females, 2 immature; 26 January 1989 (W.R. Elliott), 1 penultimate male; 28 January 1989 (W.R. Elliott), 1 immature; 28 October 1989 (George Veni), 1 immature.

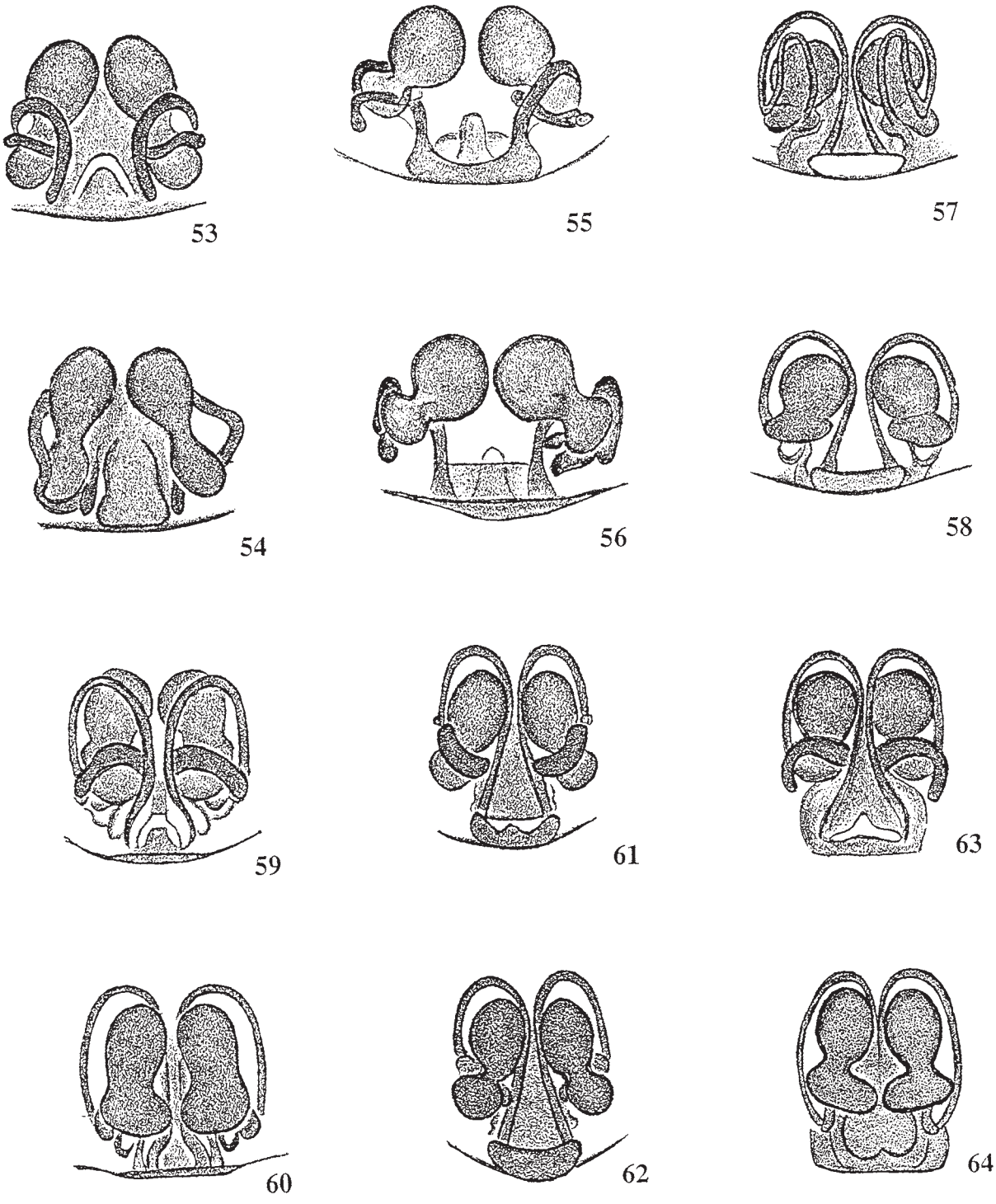
Cicurina ezelli, new species
Figs. 61-62

Diagnosis.—Eyeless troglobite of Ezell's Cave, Hays County, Texas; ovate spermathecum with large rounded sac; index coil of epigynum with large gently procurved canal across sac in oblique position; connecting canal forming quite close loop around spermathecal parts. Male unknown.

Etymology.—Specific name for Ezell's Cave.



Map 2.—Distribution of eyeless *Cicurina (Cicurella)* spp.in Texas.



Figs. 53-64.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 53-54, *browni*, new species; 55-56, *vibora*, new species; 57-58, *holsingeri*, new species; 59-60, *menardia*, new species; 61-62, *ezelli*, new species; 63-64, *travisae*, new species.

Description.—Female holotype: Length 2.6 mm. Carapace 1.5 mm long, 0.8 mm wide. Abdomen 1.1 mm long, 0.8 mm wide. Chelicerae: retromargin with three teeth. Leg lengths: first femur 1.2 mm, fourth femur 1.4 mm; first patella-tibia 2.3 mm, fourth patella-tibia 1.5 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-1.

Type-data.—Female holotype from Ezell's Cave, San Marcos, Hays County, Texas, 7 September 1963 (J. Reddell, D. McKenzie, R. Ballinger) (AMNH).

Distribution.—Known only from Ezell's Cave. Other records: 3 July 1978 (James C. Davis), 1 female, 18 July 1978 (James C. Davis), 1 female, 16 January 1978 (James C. Davis), 4 immature; 30 January 1965 (J. Reddell), 1 immature; 26 October 1967 (J. Reddell), 1 immature.

Cicurina travisae, new species
Figs. 63-70

Diagnosis.—Eyeless troglobite of Tooth Cave and adjacent caves of Travis County, Texas; oblong spermathecum broadly joined to rounded or laterally produced sac; index coil rounded to angled loop in procurved position; connecting canal of medium size forming loop well outside of spermathecal parts. Male unknown.

Etymology.—Specific name for Mrs. Nevenna Tsanoff Travis, tireless sponsor for preservation of caves.

Description.—Female holotype: Length 5 mm. Carapace 2.2 mm long, 1.42 mm wide. Abdomen 2.9 mm long, 2.2 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2.5 mm, fourth femur 2.7 mm.

Type-data.—Female holotype, female, and 10 immature from Tooth Cave, 15 miles NW of Austin, Travis County, Texas, 5 August 1963 (J. Reddell) (AMNH).

Distribution.—TEXAS: *Travis County*: Tooth Cave, 5 March 1964 (J. Reddell, D. McKenzie, T. Phillips), 2 females, 8 immature; 9 June 1964 (R. Mitchell), 6 immature; 14 May 1966 (J. Reddell), 1 female, 6 immature; 9 June 1967 (R.W. Mitchell), 6 immature; 7 April 1988 (D. Pate, W. Elliott), 4 immature; 19 August 1970 (J. Reddell), 1 female. Kretschmarr Cave, 2 March 1963 (J. Reddell, D. McKenzie), 5 immature; 2 June 1963 (J. Reddell, W.H. Russell), 1 female, 2 immature; 13 September 1963 (J. Reddell, B. Russell), 1 immature; 23 June 1968 (J. Reddell, R.W. Mitchell), 1 female, 2 immature; 21 February 1988 (M. Reyes), 1 female, 1 immature; 20 January 1963 (D. McKenzie), 1 female. Pisarowicz Cave, 21 April 1984 (J. Reddell, M. Reyes), 1 female, 1 immature; Salamander Cave, 26 April 1963 (J. Reddell, B. Russell), 11 immature; 6 April 1966 (J. Reddell), 1 female; Root Cave, 12 July 1984 (J. Reddell, M. Reyes), 4 immature; 1 April 1989 (J. Reddell, M. Reyes), 1 female, 2 immature; McDonald Cave (=Schulze Cave), 21 August 1963 (B. Russell), 12 immature; 4 October 1964 (J. Reddell), 1 immature; 12 May 1984 (J. Reddell), 1 immature; 18 May 1984 (D. Pate, J. Reddell, M. Reyes), 1 female, 2 immature; 15 December 1988 (J. Reddell, M. Reyes), 2 females, numerous immatures; 29 May 1989 (W. Elliott, J. Reddell, M. Reyes), 5 females, 14 immature. Amber Cave, 8 April 1984 (J. Reddell, M. Reyes), 1 female.

Cicurina wartoni, new species
Figs. 75-76

Diagnosis.—Eyeless troglobite of Pickle Pit Cave, Travis County, Texas; elongate spermathecum with large rounded sac in inclined position with sacs widely separated; index coil short procurved canal lying across sac; connecting canal forming loose loop around spermathecal parts. Male unknown.

Etymology.—Named for Mike Warton, diligent student of caves.

Description.—Female holotype: Length 6 mm. Carapace 3 mm long, 2.5 mm wide. Abdomen 3 mm long, 2 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2 mm, fourth femur 2.3 mm; first patella-tibia 3 mm, fourth patella-tibia 3.5 mm. Leg spines: ventral spines of first and fourth tibiae 2-2-2.

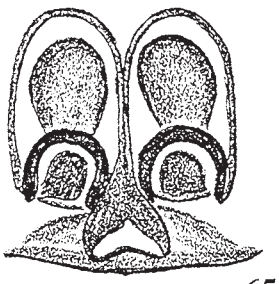
Type-data.—Female holotype from Pickle Pit Cave, 21 May 1990 (J. Reddell, M. Reyes, L. Sherrod) (AMNH).

Cicurina elliotti, new species
Figs. 73-74

Diagnosis.—Eyeless troglobite of Travis and Williamson Counties; elongate spermathecum and large rounded sac in mostly erect position; index coil heavy canal forming rounded or angled loop; connecting canal forming quite wide loop around spermathecal parts. Male unknown.

Etymology.—Named for Dr. William R. Elliott.

Description.—Female (Beck's Sewer Cave): Length 5.2 mm. Carapace 2.6 mm long, 1.6 mm wide. Abdomen 2.6 mm long, 2 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg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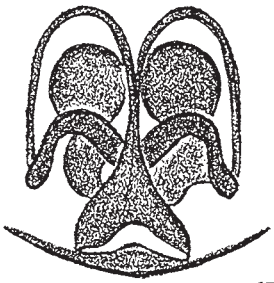
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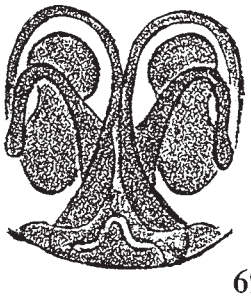
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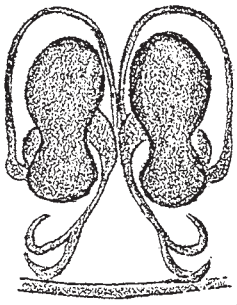
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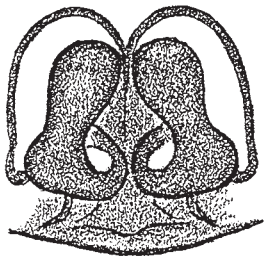
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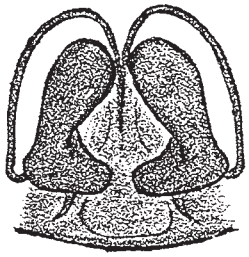
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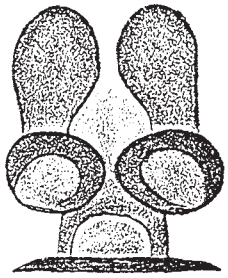
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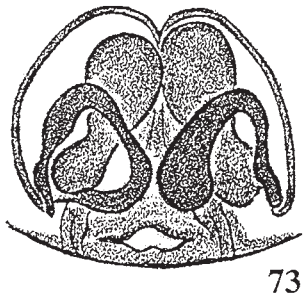
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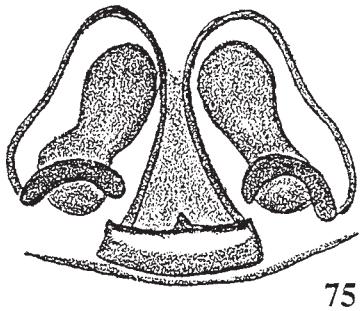
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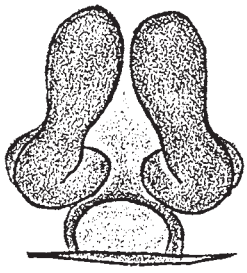
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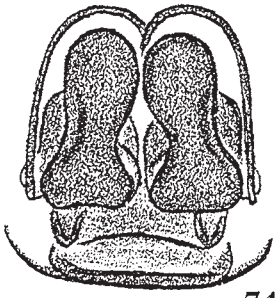
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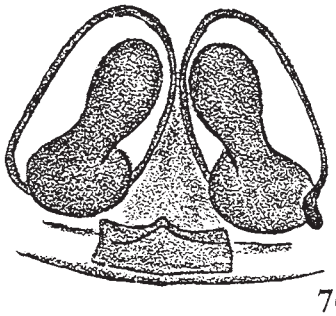
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Figs. 65-76.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 65-66, *travisae*, new species; 67-68, *travisae*, new species; 69-70, *travisae*, new species, aberrant; 71-72, *coryelli*, new species; 73-74, *elliotti*, new species; 75-76, *wartoni*, new species.

lengths: first femur 2 mm, fourth femur 2.3 mm; first and fourth tibiae 2-2-2.

Type-data.—Female holotype from Beck's Sewer Cave, 27 January 1965 (J. Calvert, J. Reddell) (AMNH).

Distribution.—TEXAS: *Travis County*: Cotterell Cave, 18 May 1988 (W. Elliott, J. Reddell, M. Reyes), female and 4 immature. Fossil Garden Cave, 6 June 1990 (J. Reddell, M. Reyes), 1 female, 1 penultimate male, 1 immature. Gallifer Cave, (J. Reddell, M. Reyes), 20 April 1991, 2 females. *Williamson County*: Bev's Grotto, 16 April 1989 (W. Elliott, J. Reddell, M. Reyes), 1 female. Beck's Sewer Cave, 23 January 1965 (J. Reddell, R. Mitchell), 1 female; 27 January 1965 (J. Calvert, J. Reddell), 1 female; 28 February 1987 (J. Reddell, M. Reyes), 1 female, 5 immature. Buttercup River Cave (B. Larsen, W. Russell), 1 female, 1 immature. Good Friday Cave, 7 March 1989 (W. Elliott, M. Reyes), 2 females. McNeil Quarry Cave, 22 July 1963 (J. Reddell, B. Russell), 1 immature. Marigold Cave, 6 August 1988 (J. Reddell, B. Larsen), 1 female, 1 immature; 18 September 1988 (Peter Sprouse), 1 female, 2 immature. Testudo Tube, 29 May 1991 (J. Reddell, M. Reyes), 1 female, 1 immature; 11 May 1991 (J. Reddell, M. Reyes), 12 or more immature. T.W.A.S. A Cave (W. Elliott, J. Reddell, M. Reyes), 15 April 1989, 1 female, 1 immature.

Cicurina coryelli, new species
Figs. 71–72

Diagnosis.—Eyeless troglobite of Tippit Cave, Coryell County, Texas; elongated spermathecum with round sac; index coil narrow lightly procurved band across sac; connecting canal forming close loop partially covering base of spermathecal parts. Male unknown.

Etymology.—Specific name for Coryell County, Texas.

Description.—Female holotype: Length 4.3 mm. Carapace 1.3 mm long, 1 mm wide. Abdomen 3 mm long, 1.6 mm wide. Chelicera: retromargin with 6 teeth. Leg lengths: first femur 1.65 mm long, fourth femur 2.5 mm long; first patella–tibia 1.6 mm long, fourth patella–tibia 2 mm long. Leg spines: ventral spines of first and fourth tibiae 2–2–2.

Type-data.—Female holotype, 2 subadult females from Tippit Cave, Coryell County, Texas, 31 January 1992 (J. Reddell, M. Reyes) (AMNH).

Distribution.—Known only from Tippit Cave. Other records: 9 March 1963 (J. Reddell, D. McKenzie), 1 immature; 24 January 1992 (D. McKenzie, J. Reddell, M. Reyes), 2 females., immature.

Cicurina uvalde, new species
Figs. 101-102

Diagnosis.—Eyeless troglobite of Rambie's Cave, Uvalde County, Texas; oval spermathecum set in oblique position, with large oval sac; index coil heavy straight canal in oblique position; connecting canal forming close loop around spermathecal parts. Male unknown.

Etymology.—Specific name for Uvalde County.

Description.—Female holotype: Length 5.5 mm. Carapace 2.5 mm long, 1.16 mm wide. Abdomen 3 mm long, 1.9 mm wide. Chelicerae: retromargin of fang with 6 or 7 teeth. Leg lengths: first femur 2.2 mm, fourth femur 2.4 mm; first patella-tibia 3 mm, fourth patella-tibia 2.4 mm. Leg spines: first and fourth tibiae with 2-2-2 ventral spines.

Type-data.—Female holotype and 18 immature from Rambie's Cave, 8 miles N of Uvalde, Uvalde County, Texas, 6 April 1963 (J. Reddell, D. McKenzie) (AMNH).

Distribution.—Known only from Rambie's Cave. Other records: 14 August 1976 (J. Reddell, C. Yates, R. Fieseler, D. Pate), 1 female, 4 immature; 4-5 September 1976 (D. Pate, C. Yates), 1 female, 1 immature.

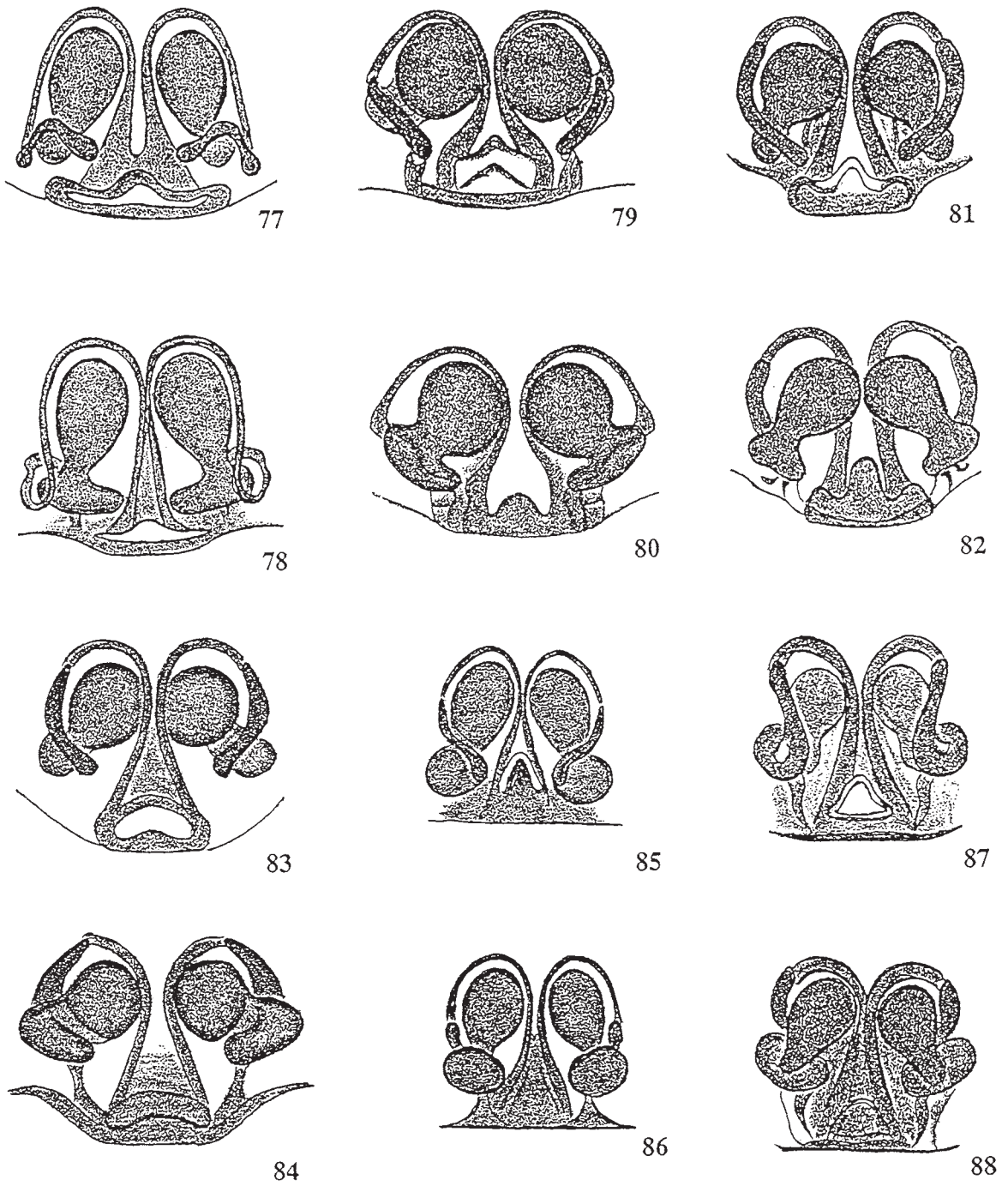
Cicurina watersi, new species
Figs. 103-104

Diagnosis.—Eyeless troglobite of Frio Queen Cave, Uvalde County, Texas; oval spermathecum with rounded sac; index coil transverse, moderately procurved canal across sac; thin connecting canal closely encircling spermathecal parts. Male unknown.

Etymology.—Specific name for the collector, Randy M. Waters.

Description.—Female holotype: Length 4.6 mm. Carapace 2.4 mm long, 1.5 mm wide. Abdomen 2.2 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1.6 mm, fourth femur 1.9 mm; first patella-tibia 2.8 mm, fourth patella-tibia 3 mm. Ventral spines of first and fourth tibiae 2-2-2.

Type-data.—Female holotype and 1 immature from Frio Queen Cave, Uvalde County, Texas, Summer 1983 (Randy M. Waters) (AMNH).



Figs. 77-88.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 77-78, *reddelli*, new species; 79-80, *bandida*, new species; 81-82, *cueva*, new species; 83-84, *russelli*, new species; 85-86, *reyesi*, new species; 87-88, *ubicki*, new species.

Cicurina pablo, new species
Figs. 105-106

Diagnosis.—Eyeless troglobite of Pablo's Cave, Uvalde County, Texas; elongate spermathecum with large rounded sac; index coil heavy transverse canal in oblique position; heavy connecting canal enclosing spermathecal parts. Male unknown.

Etymology.—Specific name for Pablo's Cave, used in apposition.

Description.—Female holotype: Length 5 mm. Carapace 2.5 mm long, 1.8 mm wide. Abdomen 2.5 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 2.3 mm, fourth femur 2.6 mm; first patella-tibia 2.6 mm, fourth patella-tibia 3.2 mm. Ventral spines of first tibia 2-2-1, of fourth tibia 2-2-2.

Type-data.—Female holotype and 4 immature from Pablo's Cave (2 mi. N Burial Cave), 5 April 1963 (J. Reddell, D. McKenzie), in total darkness 50 feet from entrance (AMNH).

Cicurina orellia, new species
Figs. 107-108

Diagnosis.—Eyeless troglobite of Orell Crevice Cave, Real County, Texas; epigynum broader than long; spermathecum elongated with apical ends nearly touching in oblique position; index coil small curved canal across sac; connecting canal forming wide loop around spermathecal parts. Male unknown.

Etymology.—Named for Orell Crevice Cave.

Description.—Female holotype: Length 5.2 mm. Carapace 2.6 mm long, 1.5 mm wide. Abdomen 2.6 mm long, 0.13 mm wide. Chelicerae: retromargin of fang with 5 teeth, three of them enlarged. Leg lengths: first femur 2.4 mm, fourth femur 2.6 mm; first patella-tibia 3 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype and 2 immature from Orell Crevice Cave, 100 yards west of Orell Bat Cave, 18 August 1963 (J. Reddell, D. McKenzie) (AMNH).

Cicurina serena, new species
Figs. 109-110

Diagnosis.—Eyeless troglobite of Picture Cave No. 1, Uvalde County, Texas; oblong spermathecum with rounded sac; index coil thick straight bar; connecting canal closely enclosing spermathecal parts. Male unknown.

Etymology.—Species name for Latin *serenus*, serene.

Description.—Female holotype: Length 3.7 mm. Carapace 1.7 mm long, 1.2 mm wide. Abdomen 2 mm long, 1.4 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1.6 mm, fourth femur 1.8 mm; first patella-tibia 1.6 mm, fourth patella-tibia 12.8 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Picture Cave No. 1, 23 miles NW Uvalde, 3 November 1962 (J. Reddell) (AMNH).

Distribution.—*Uvalde County*: Picture Cave No. 1, 7 March 1965 (J. Reddell), 2 immature. North Well Cave, 2 mi. N of Pablo's Cave, 3 April 1963 (J. Reddell, D. McKenzie), 1 female.

Cicurina selecta, new species
Figs. 111-112

Diagnosis.—Eyeless troglobite of Sandtleben Cave (=Davy Crockett Cave), Uvalde County, Texas; short oval spermathecum with wide sac in oblique position; index coil narrow transverse canal; connecting canal forming loose loop around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *selectus*, to choose.

Description.—Female holotype: Length 4.4 mm. Carapace 2.2 mm long, 1.6 mm wide. Abdomen 2.2 mm long, 1.7 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2 mm, fourth femur 2.4 mm; first patella-tibia 2.8 mm, fourth patella-tibia 3.2 mm. Leg spines: first and fourth tibiae 2-2-2.

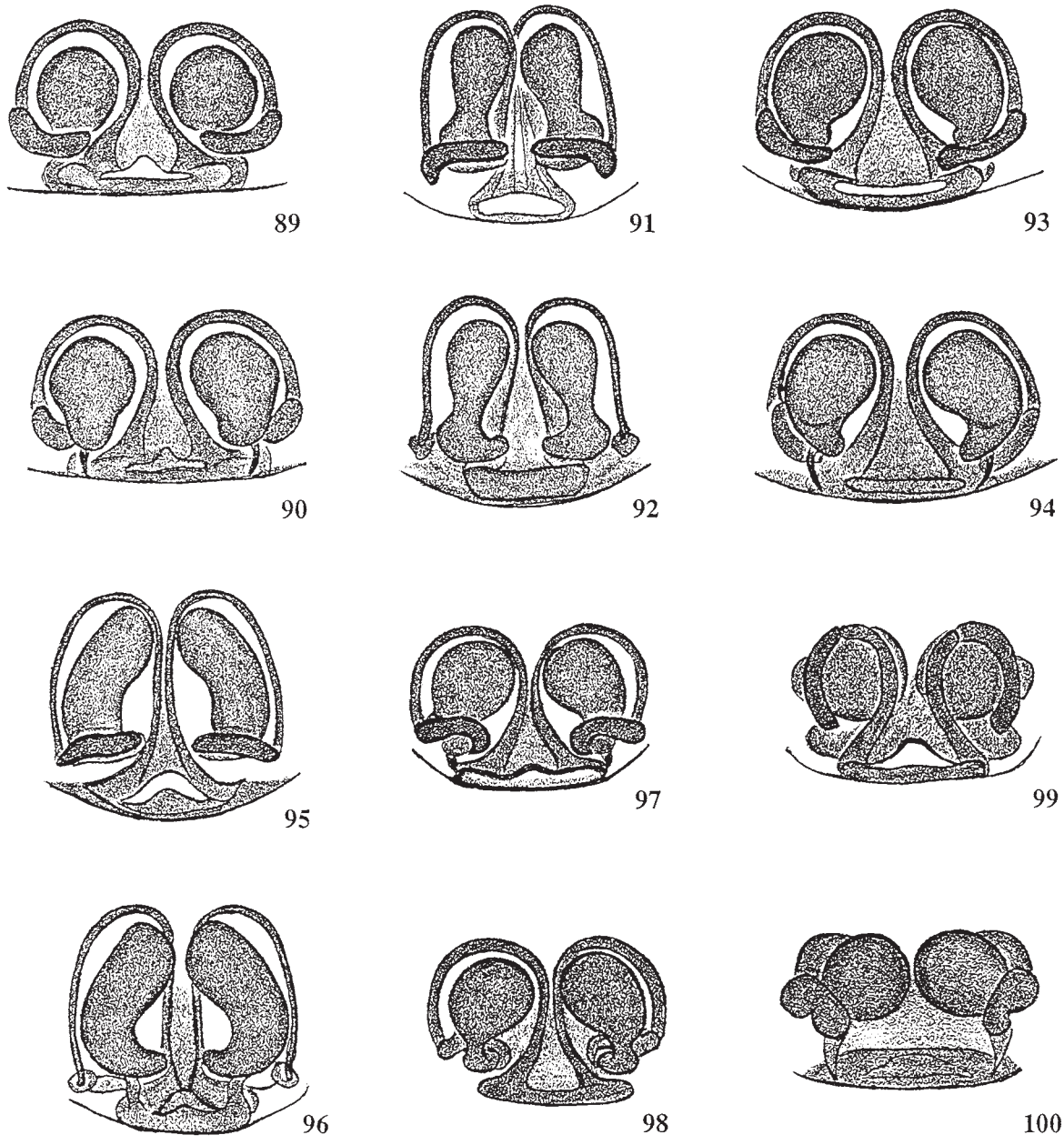
Type-data.—Female holotype from Sandtleben Cave (=Davy Crockett Cave), Uvalde County, Texas, 18 October 1964 (J. Reddell) (AMNH).

Distribution.—Known only from Sandtleben Cave. Other record: 13 August 1965 (J. Fish, J. Reddell), 1 immature.

Cicurina reddelli, new species
Figs. 77-78

Diagnosis.—Eyeless troglobite of Cotterell Cave, Travis County, Texas; long ovate spermathecum with rounded, laterally directed sac; index coil of epigynum an angled procurved loop, and connecting canal of medium size lying outside of spermathecal parts. Male unknown.

Etymology.—Named for James R. Reddell, specialist on Texas caves.



Figs. 89-100.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 89-90, *baronia*, new species; 91-92, *madla*, new species; 93-94, *vespera*, new species; 95-96, *venii*, new species; 97-98, *reclusa*, new species; 99-100, *puentecilla*, new species.

Description.—Female holotype: Length 6.9 mm. Carapace 3.6 mm long, 2.4 mm wide. Abdomen 3.3 mm long, 2 mm wide. Chelicerae: retromargin with 7 teeth, basal 3 large and with 4 denticles. Leg lengths: first femur 3.2 mm, fourth femur 3.6 mm. Leg spines: first and fourth tibiae with 2-2-2 ventral spines.

Type-data.—Female holotype from Cotterell Cave, near Spicewood Springs Road and Mesa Drive, Austin, Travis County, Texas, 11 March 1964 (W. Russell) (AMNH).

Cicurina bandida, new species
Figs. 79-80

Diagnosis.—Eyeless troglobite of Bandit Cave, Travis County, Texas; large round spermathecum with broad oval sac in oblique position; index coil of epigynum short canal at oblique angle across sac; connecting canal heavy tube closely margining spermathecal parts. Male unknown.

Etymology.—Specific name from Spanish *bandido*, bandit, named for Bandit Cave.

Description.—Female holotype: Length 5.6 mm. Carapace 2.6 mm long, 2 mm wide. Abdomen 3 mm long, 2.4 mm wide. Chelicerae: retromargin with 6 teeth. Leg lengths: first femur 2.8 mm, fourth femur 3 mm; first patella-tibia 3.6 mm; fourth patella-tibia 3.9 mm; fourth metatarsus and tarsus 4.6 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Female holotype and 2 immature from Bandit Cave, Rollingwood, Travis County, Texas, 26 May 1966 (J. Reddell, J. Fish) (AMNH).

Distribution.—*Travis County*: Bandit Cave, 27 May 1963 (J. Reddell, B. Frank), 1 female, 7 immature; 20 May 1965 (J. Reddell), 2 immature; 13 September 1988 (W. Elliott), 1 immature. Ireland's Cave, 14 March 1964 (W. Russell), 1 female, 8 immature; 10 April 1964 (W. Russell), 1 immature; 1 March 1986 (Dale L. Pate), 2 immature; 23 January 1989 (J. Reddell, M. Reyes, E. Grimm, M. Grimm), 1 aberrant female, 1 immature.

Cicurina cueva, new species
Figs. 81-82

Diagnosis.—Eyeless troglobite of Cave X, Travis County, Texas; rounded spermathecum with long round sac in oblique position; index coil of epigynum curved canal as long as spermathecum, set in subvertical position; connecting canal lying close to spermathecal parts. Male unknown.

Etymology.—Specific name from Spanish *cueva*, cave.

Description.—Female holotype: Length 5.4 mm. Carapace 2.3 mm long, 1.3 mm wide. Abdomen 2.4 mm long, 1.3 mm wide. Chelicerae: retromargin of fang with 6 teeth, basal three enlarged and well spaced. Leg lengths: first femur 2.1 mm, fourth femur 2.3 mm; first patella-tibia 2.8 mm, fourth patella-tibia 3 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Female holotype from Cave X, Travis County, Texas, September 1962 (B. Bell, S. Woolsey) (AMNH).

Distribution.—*Travis County*: Cave X, 8 March 1963 (D. McKenzie, J. Reddell), 1 female, 2 immature; 14 March 1964 (J. Reddell), 1 immature; October 1970 (J. Reddell), 2 immature. Flint Ridge Cave, August 1989 (M. Grimm), 1 aberrant female, 1 immature; April 1989 (J. Reddell, M. Reyes), 3 immature; 19 June 1989 (M. Grimm, J. Reddell, M. Reyes), 1 female, 3 immature.

Cicurina russelli, new species
Figs. 83-84

Diagnosis.—Eyeless troglobite of Boyett's Cave, Hays County, Texas; ovoid spermathecum with large round twisted sac in oblique position; index coil heavy canal moderately curved to top of spermathecum; connecting canal forming rather close loop around spermathecal parts. Male unknown.

Etymology.—Named for William Russell.

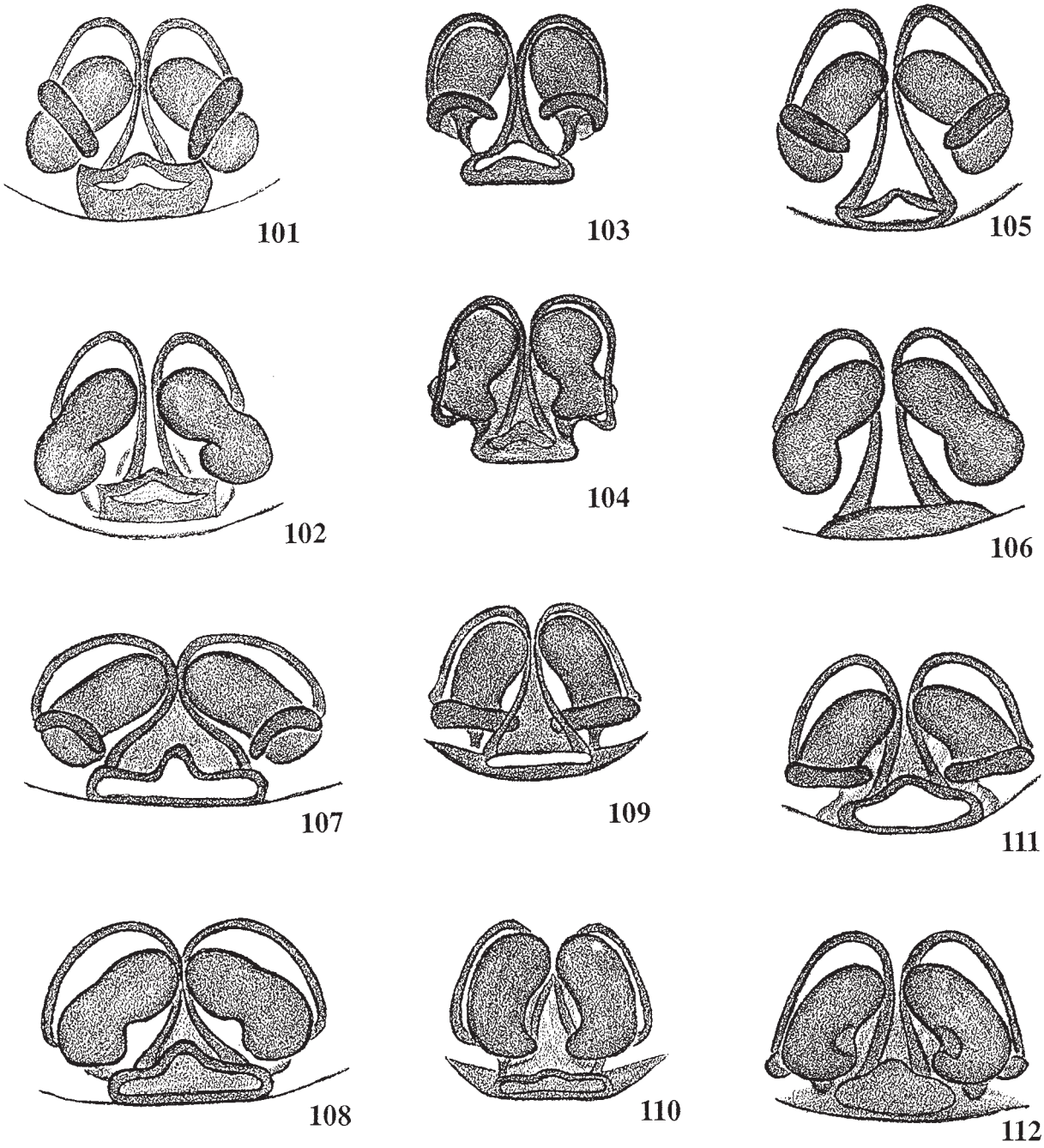
Description.—Female holotype: Length 5.8 mm. Carapace 2.8 mm long, 2.3 mm wide. Abdomen 3 mm long, 2.3 mm wide. Chelicerae: retromargin with 5 stout teeth. Leg lengths: first femur 2.8 mm, fourth femur 3 mm; first patella-tibia 3 mm, fourth patella-tibia 3.6 mm. Leg spines: first tibia 2- 2-2, fourth tibia 2-2-1.

Type-data.—Female holotype and 3 immature from Boyett's Cave, south of Wimberley on Hays-Comal County line, 30 March 1963 (J. Reddell, W. Russell) (AMNH).

Distribution.—Known only from Boyett's Cave. Other records: 19 October 1963 (J. Reddell, J. Porter), 1 immature; 23 June 1978 (W. Elliott, J. Holsinger, T. Poulson, F. Howarth), 2 immature.

Cicurina reyesi, new species
Figs. 85-86

Diagnosis.—Eyeless troglobite of Airman's Cave, Travis County, Texas; ovate spermathecum with rounded sac; index coil thin slightly curved



Figs. 101-112.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 101-102, *uvalde*, new species; 103-104, *watersi*, new species; 105-106, *pablo*, new species; 107-108, *orellia*, new species; 109-110, *serena*, new species; 111-112, *selecta*, new species.

canal in nearly vertical position; thin connecting canal lying just outside of spermathecum.

Etymology.—Named for Marcelino Reyes.

Description.—Female holotype: Length 5 mm. Carapace 2.5 mm long, 1.5 mm wide. Abdomen 2.4 mm long, 1.5 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 2 mm, fourth femur 2.1 mm. Leg spines: first and fourth tibiae with 1-2-2.

Type-data.—Female holotype, damaged male and 5 immature from Airman's Cave, Austin, Travis County, Texas, 3 September 1989 (J. Reddell, M. Reyes) (AMNH).

Distribution.—Known only from Airman's Cave. Other records: 27 September 1975 (A. Grubbs, L. Wilk), 3 immature; 13 March 1982 (S. Robertson, M. Williams), 1 immature; 14 May 1984 (J. Reddell, M. Reyes), 2 immature; 1 June 1984 (J. Reddell, M. Reyes), 5 immature.

Cicurina ubicki, new species
Figs. 87-88

Diagnosis.—Eyeless troglobite of Fern and McGlothlin Caves, Hays County, Texas; ovate spermathecum with heavy oval sac in sublateral position; index coil heavy canal in nearly vertical position; heavy connecting canal closely margining spermathecal parts. Male unknown.

Etymology.—Specific name for Darrell Ubick, collector of many cave spiders.

Description.—Female holotype: Carapace 2.6 mm long, 1.7 mm wide. Abdomen 2.6 mm long, 1.7 mm wide. Chelicera: promargin with 5 teeth. Leg lengths: first femur 2.5 mm, fourth femur 2.7 mm; first patella-tibia 2.6 mm, fourth patella-tibia 3.0 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Female holotype and 2 immature from Fern Cave, Hays County, Texas, 2 September 1989 (D. Ubick, S. Fend, S. Renkes), deposited in AMNH, courtesy of Darrell Ubick.

Distribution.—*Hays County*: Fern Cave, 15 July 1988 (A. Grubbs, J. Evans, L. Schneider), 2 immature. McGlothlin Cave, 26 May 1989 (A. Grubbs, J. Reddell, M. Reyes), 1 female, 2 immature; 3 September 1989 (D. Ubick, S. Fend, S. Renkes), 1 female, 7 immature.

Cicurina baronia, new species
Figs. 89-90, 155-156

Diagnosis.—Eyeless troglobite of Robber Baron Cave, Bexar County, Texas; epigynum wider than long; broader than long spermathecum with rounded sac; index coil heavy procurved bar across sac; heavy connecting canal forming loose loop around spermathecal parts. Male palpus (Figs. 155-156).

Etymology.—Specific name for Robber Baron Cave.

Description.—Female holotype: Length 6 mm. Carapace 2.6 mm long, 1.7 mm wide. Abdomen 3.4 mm long, 2.6 mm wide. Chelicerae: retromargin with 4 teeth. Leg lengths: first femur 2.2 mm, fourth femur 2.25 mm; first patella-tibia 2.4 mm, fourth patella-tibia 2.6 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2 ventral spines.

Male: Length 3 mm. Carapace 1.4 mm long, 1.1 mm wide. Abdomen 1.6 mm long, 1.1 mm wide. Chelicerae: retromargin with 6 teeth. Leg lengths: first femur 1.5 mm, fourth femur 1.6 mm; first patella-tibia 1.4 mm, fourth patella-tibia 1.7 mm. Leg spines: first femur 2-2-2, fourth femur 2-2-2. Male palpus (Figs. 155-156).

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

Distribution.—Known only from Robber Baron Cave. Other records: 9, 11 December 1983 (Scott Harden, Randy Waters), 2 males, 2 immature; 10 March 1982 (A.G. Grubbs, B. Steele, R. Waters), 1 immature; 3 April 1982 (A. Grubbs), 2 females, 8 immature; 6 April 1983 (Randy Waters), 1 immature; 11 December 1982 (Randy Waters), 1 immature; 3 September 1987 (Allan Cobb, George Veni), 3 immature.

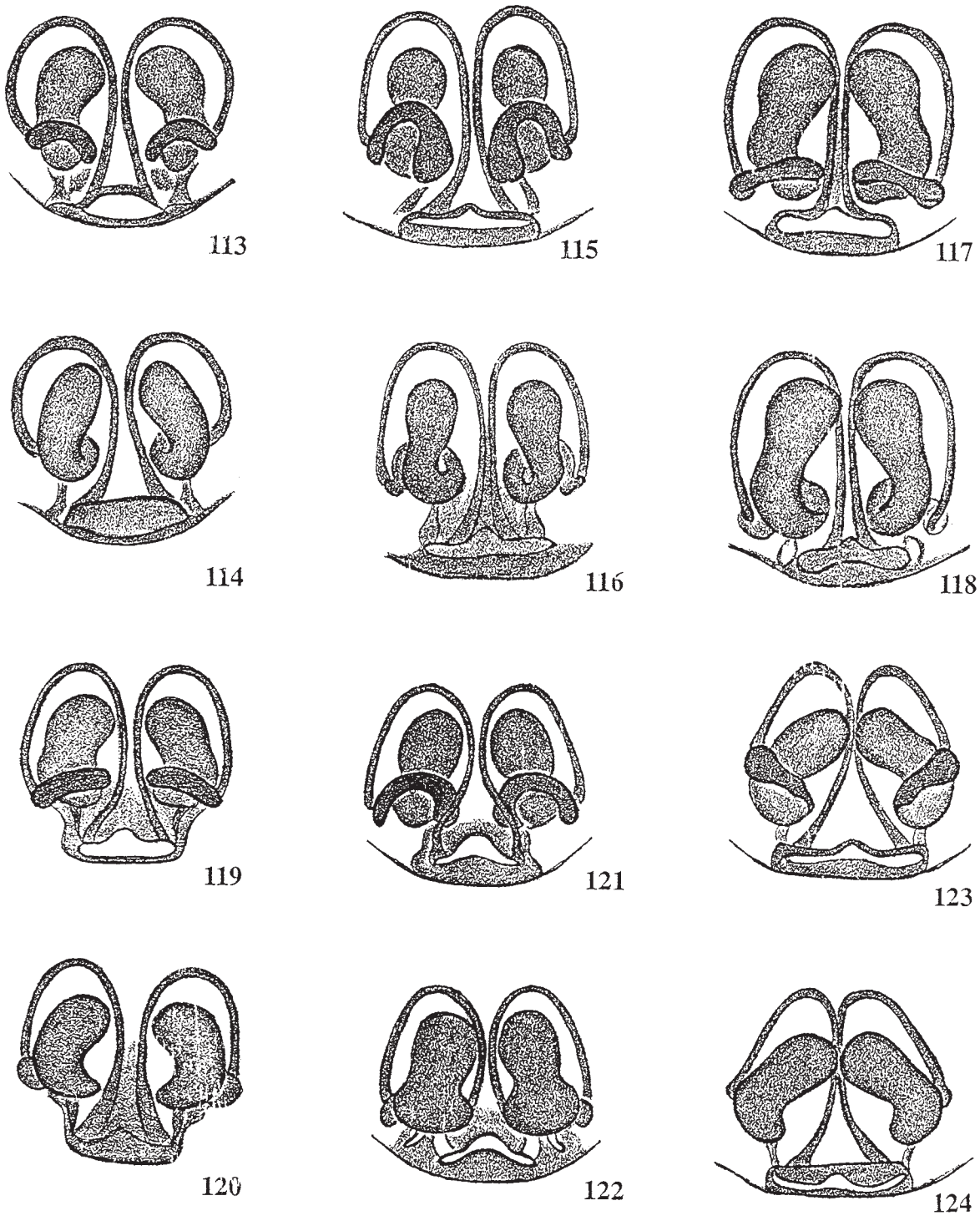
Cicurina madla, new species
Figs. 91-92

Diagnosis.—Eyeless troglobite from Madla's Cave, Bexar County, Texas; elongate spermathecum with rounded sac; index coil straight horizontal bar with downward turn; connecting canal loosely coiled around spermathecal parts. Male unknown.

Etymology.—Specific name for Madla's Cave.

Description.—Female holotype: Length 5.8 mm. Carapace 2.4 mm long, 1.7 mm wide. Abdomen 3.4 mm long, 2 mm wide. Chelicerae: retromargin of fang with 4 teeth. Leg lengths: first femur 2.6 mm, fourth femur 2.8 mm; first patella-tibia 3 mm, fourth patella-tibia 3.3 mm. Leg spines: first tibia 2-2--, fourth tibia 2-2-2.

Type-data.—Female holotype and 5 immature from Madla's Cave, 4 miles NW Helotes, Bexar County, Texas, 4 October 1963 (J. Reddell, D. McKenzie) (AMNH).



Figs. 113-124.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 113-114, *bandera*, new species; 115-116, *obscura*, new species; 117-118, *patei*, new species; 119-120, *sprousei*, new species; 121-122, *stowersi*, new species; 123-124, *pastura*, new species.

Cicurina vespera, new species
Figs. 93-94

Diagnosis.—Eyeless troglobite from Government Canyon Bat Cave, Bexar County, Texas; round spermathecum with small rounded sac; index coil recurved bar across sac; connecting canal forming quite close loop around spermathecal parts. Epigynum broader than long. Male unknown.

Etymology.—Specific name from Latin *vespera*, in the evening.

Description.—Female holotype: Length 2.7 mm. Carapace 1 mm long, 0.45 mm wide. Abdomen 1.7 mm long, 1.2 mm wide. Chelicerae: retromargin with 4 teeth. Leg lengths: first femur 0.8 mm, fourth femur 0.9 mm; first tibia-patella 0.9 mm, fourth patella-tibia 1 mm. Leg spines: first and fourth tibiae 2-2-1.

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

Cicurina venii, new species
Figs. 95-96

Diagnosis.—Eyeless troglobite from Braken Bat Cave, Bexar County, Texas; elongate spermathecum moderately curved inward, with rounded sac; index coil an essentially straight bar across sac; connecting canal forming loose loop around spermathecal parts. Male unknown.

Etymology.—Named for George Veni, student of Texas caves.

Description.—Female holotype: Length 3.4 mm. Carapace 1.7 mm long, 1.3 mm wide. Abdomen 1.7 mm long, 1 mm wide. Chelicerae 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. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Braken Bat Cave, Bexar County, Texas, 22 November 1980 (George Veni) (AMNH).

Cicurina reclusa, new species
Figs. 97-98

Diagnosis.—Eyeless troglobite of Kappelman Salamander Cave, Comal County, Texas; epigynum broader than long; oval spermathecum with small twisted sac; index coil heavy moderately curved canal across sac; connecting canal forming quite tight loop around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *recludere*, a recluse.

Description.—Female holotype: Length 3.9 mm. Carapace 1.8 mm long, 1.2 mm wide. Abdomen 2.1 mm long, 1.4 mm wide. Chelicerae: retromargin of fang with 3 teeth on left, and nodule on right. Leg lengths: First femur 1.5 mm, fourth femur 1.8 mm; first patella-tibia 2 mm, fourth patella-tibia 2.2 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype from Kappelman Salamander Cave, 100 yards NW of Kappelman Cave, Comal County, Texas, 15 March 1964 (W. Russell, J. Reddell) (AMNH).

Distribution.—TEXAS: *Comal County*: Kappelman Cave, 16 mi. NW of New Braunfels, 9 March 1968 (J. Reddell), 1 female. Kappelman Salamander Cave, 14 January 1965 (J. Reddell, T. Raines), penultimate male.

Cicurina puentecilla, new species
Figs. 99-100

Diagnosis.—Eyeless troglobite from Natural Bridge Caverns, Comal County, Texas; epigynum broader than long; round spermathecum with sac in lateral position; index coil heavy slightly curved canal in vertical position; heavy connecting canal running full width of spermathecum. Male unknown.

Etymology.—Specific name from Spanish *puentecilla*, little bridge.

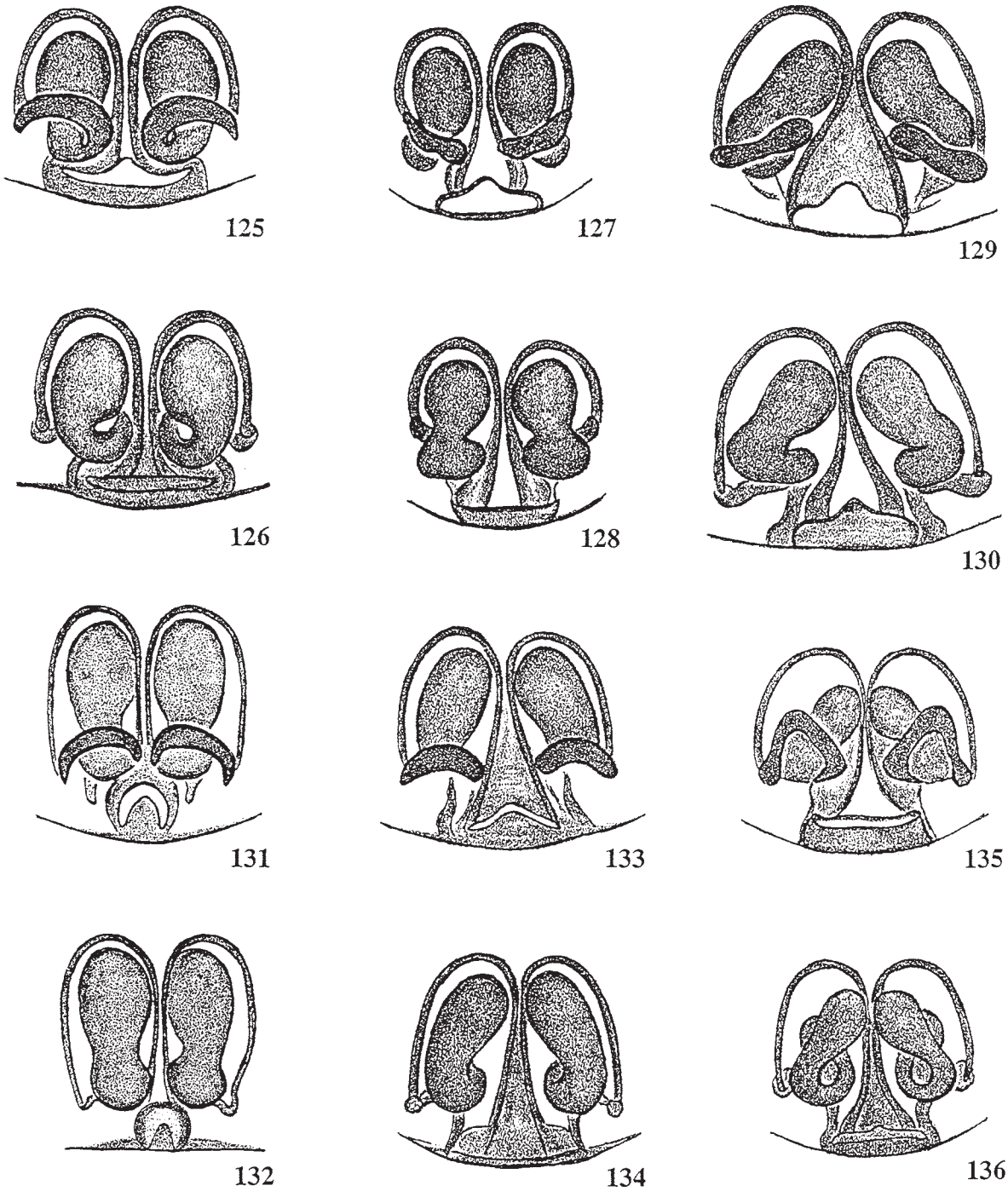
Description.—Female holotype: Length 5.8 mm. Carapace 2.8 mm long, 2 mm wide. Abdomen 3 mm long, 1.8 mm wide. Chelicerae: promargin with 4 widely spaced teeth. Leg lengths: first femur 2.6 mm, fourth femur 3 mm; first patella-tibia 3.8 mm, fourth patella–tibia 4 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype and two immature from Natural Bridge Caverns, Comal County, Texas, 2 September 1978 (A.G. Grubbs) (AMNH).

Distribution.—Known only from Natural Bridge Caverns. Other records: 1 April 1965 (J. Reddell, T. Raines), 2 immature; 23 February 1963 (J. Reddell, D. McKenzie), 2 immature; 23 September 1989 (O. Knox), 1 immature; 1 March 1990 (O. Knox, J. Reddell, M. Reyes), 4 immature.

Cicurina bandera, new species
Figs. 113-114

Diagnosis.—Eyeless troglobite from Fossil Cave, Bandera County, Texas; elongate spermathecum with rounded sac; index coil thick moderately



Figs. 125-136.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 125-126, *machete*, new species; 127-128, *sansaba*, new species; 129-130, *venefica*, new species; 131-132, *caverna*, new species; 133-134, *porteri*, new species; 135-136, *sheari*, new species.

procurved canal across sac; connecting canal widely encircling spermathecal parts. Male unknown.

Etymology.—Named for Bandera County.

Description.—Female holotype: Length 4.7 mm. Carapace 2.3 mm long, 1.6 mm wide. Abdomen 2.4 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 4 or 5 teeth. Leg lengths: first femur 2.2 mm, fourth femur 2.4 mm; first patella-tibia 2.4 mm, fourth patella-tibia 2.8 mm. Leg spines: first tibia 2-2-2, fourth tibia 2-2-1.

Type-data.—Female holotype and 6 immature from Fossil Cave, Bandera County, Texas, 23 July 1966 (J. Reddell, D. McKenzie) (AMNH).

Distribution.—Known only from Fossil Cave. Other record: 21 March 1971 (J. Reddell, T. Mollhagen, S. Wiley), 1 female, 2 immature.

Cicurina obscura, new species
Figs. 115-116

Diagnosis.—Eyeless troglobite from Sutherland Hollow Cave, Bandera County, Texas; ovate spermathecum with larger rounded sac; index canal heavy procurved canal forming deep inverted loop thick on inner side; connecting canal forming wide loop around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *obscurus*, obscure.

Description.—Female holotype: Length about 3 mm. Carapace 1.8 mm long, 1.2 mm wide. Abdomen missing. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2 mm, fourth femur 2.2 mm; first patella-tibia 2.5 mm, fourth patella-tibia 2.6 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype from Sutherland Hollow Cave, Bandera County, Texas, 4 August 1974 (S. Sweet) (AMNH).

Cicurina patei, new species
Figs. 117-118

Diagnosis.—Eyeless troglobite of Fawcett's Cave, Val Verde County, Texas; elongated spermathecum with laterally curved sac; index coil broad essentially straight canal crossing sac; connecting canal widely encircling spermathecal parts. Male unknown.

Etymology.—Named for Dale Pate.

Description.—Female holotype: Length 4.4 mm. Carapace 2 mm long, 1.5 mm wide. Abdomen 2.4 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2.1 mm, fourth femur 2.1 mm; first patella-tibia 2.3 mm, fourth patella-tibia 2.5 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Fawcett's Cave, 36 miles N of Del Rio, Val Verde County, Texas, 8 August 1987 (Dale Pate) (AMNH).

Distribution.—Known only from Fawcett's Cave. Other record: 10 April 1968 (J. Reddell), 1 female, 2 immature in AMNH.

Cicurina sprousei, new species
Figs. 119-120

Diagnosis.—Eyeless troglobite of Station "C" Cave #1, Bandera County, Texas; oval spermathecum with small rounded sac; index coil quite thick procurved canal; connecting canal closely ringing spermathecal parts. Male unknown.

Etymology.—Specific name for Peter Sprouse, student of caves.

Description.—Female holotype: Length 3.85 mm. Carapace 2.6 mm long, 1.6 mm wide. Abdomen 1.25 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1 mm, fourth femur 1.2 mm; first patella-tibia 2.8 mm, fourth patella-tibia 3 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype, 7 immature from Station "C" Cave #1, 15 miles N of Vanderpool, Bandera County, Texas, 4 September 1988 (P. Sprouse) (AMNH).

Distribution.—Known only from Station "C" Cave. Other record: August 1962 (J. Reddell), 2 immature; 30 October 1963 (D. McKenzie), 1 female, 1 immature.

Cicurina stowersi, new species
Figs. 121-122

Diagnosis.—Eyeless troglobite of Stowers Cave, Kerr County, Texas; oval spermathecum with broad rounded sac; index coil thick procurved canal; slender connecting canal forming wide loop around spermathecal parts. Male unknown.

Etymology.—Specific name for Stowers Cave.

Description.—Female holotype: Length 3.3 mm. Carapace 1.6 mm long, 1.1 mm wide. Abdomen 1.7 mm long, 0.8 mm wide. Chelicerae: retromargin of fang with 6 small teeth. Leg lengths: first femur 1.4 mm, fourth femur 1.8 mm; first patella-tibia 2 mm, fourth patella-tibia 2.1 mm. Leg spines: first and fourth tibiae 2-2-0.

Type-data.—Female holotype from Stowers Cave, 24 miles W Kerrville, Kerr County, Texas, 3 May 1969 (Roger Bartholomew) (AMNH).

Distribution.—Known only from Stowers Cave. Other records: 20 March 1965 (J. Reddell), 5 immature; 25 March 1972 (S. Wiley, T. Mollhagen), 1 immature

Cicurina pastura, new species
Figs. 123-124

Diagnosis.—Eyeless troglobite from Water Pond Pasture Cave, Kerr County, Texas; oval spermathecum with rounded sac set in oblique position, with tips nearly touching; index coil thick canal inclined outward; connecting canal loosely enclosing spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *pasture*, pasture.

Description.—Female holotype: Length 4 mm. Carapace 2 mm long, 1.4 mm wide. Abdomen 2 mm long, 1.4 mm wide. Chelicerae: retromargin with 5 teeth. Leg lengths: first femur 1.8 mm, fourth femur 2 mm; first patella-tibia 2.2 mm, fourth patella-tibia 2.5 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Water Pond Pasture Cave, Kerr County, Texas, 16 October 1976 (D. Pate, R. Fieseler, C. Yates) (AMNH).

Cicurina machete, new species
Figs. 125-126

Diagnosis.—Eyeless troglobite of Whiteface Cave, San Saba County, Texas; oval spermathecum with twisted sac; index coil heavy procurved blade-like canal crossing sac; connecting canal heavy loop around spermathecal parts. Male unknown.

Etymology.—Specific name for Spanish *machete*, cutlass, used in apposition.

Description.—Female holotype: Length 4.6 mm. Carapace 2.4 mm long, 1.6 mm wide. Abdomen 2.2 mm long, 1.4 mm wide. Chelicerae: retromargin of fang with 8 teeth. Leg lengths: first femur 2.4 mm, fourth femur 2.8 mm; first patella-tibia 3.2 mm, fourth patella-tibia 3.4 mm. Leg spines: first tibia 2-2-2, fourth tibia 2-2-0.

Type-data.—Female holotype and 4 immature from Whiteface Cave, 30 mi. S Richland Springs, 9 February 1964 (J. Reddell, D. McKenzie, K. Garrett) (AMNH).

Cicurina sansaba, new species
Figs. 127-128, 153-154

Diagnosis.—Eyeless troglobite of Gorman Cave, San Saba County, Texas; elongate spermathecum with broad rounded sac; index coil with transverse canal across sac; heavy connecting canal forming loose loop around spermathecal parts. Male palpus: Figs. 153-154.

Etymology.—Specific name for San Saba County.

Description.—Female holotype: Length 3.65 mm. Carapace 1.65 mm long, 1.15 mm wide. Abdomen 3.5 mm long, 2.2 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1.85 mm, fourth femur 1.95 mm; first patella-tibia 1.3 mm, fourth patella-tibia 3.25 mm. Ventral leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Male: Length 2.7 mm, specimen dried and shriveled. Male palpus (Figs. 153-154): tegulum with three tubules; tarsal process about half width of tarsus; coil of conductor about length of basal process.

Type-data.—Female holotype and 3 immature from Gorman Cave, 6 mi. SW of Bend, San Saba County, Texas, 15 March 1963 (J. Reddell, D. McKenzie) (AMNH).

Distribution.—Known only from Gorman Cave. Other records: 12 June 1978 (J. Reddell), 1 male, 2 females, 2 immature, from Beyond Breakdown; 20 October 1962 (J. Reddell), 1 immature.

Cicurina venefica, new species
Figs. 129-130

Diagnosis.—Eyeless troglobite of Wizard's Well, Terrell County, Texas; elongate spermathecum with rounded sac, set in oblique position with tips nearly touching; index coil large canal in inclined position; connecting canal forming wide coil around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *venefica*, a witch.

Description.—Female holotype: Length 4.6 mm. Carapace 2.3 mm long, 1.6 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 2.2 mm, fourth femur 2.6 mm; first patella-tibia 3 mm, fourth patella-tibia 3.3 mm. Leg spines: first and fourth tibiae with 2-2-0.

Type-data.—Female holotype from Wizard's Well, Terrell County, Texas, 12-13 February 1983 (Eric Short, Randy Waters) (AMNH).

Cicurina caverna, new species
Figs. 131-132

Diagnosis.—Eyeless troglobite of Flemming's Bat Cave, Kimble County, Texas; elongate oval spermathecum with rounded sac; index coil procurved canal crowning sac; slender connecting canal forming loose loop around spermathecal parts. Male unknown.

Etymology.—Specific name from Latin *caverna*, a cavern.

Description.—Female holotype: Length 3 mm. Carapace 2 mm long, 1.4 mm wide. Abdomen 2 mm long, 1.2 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 1.6 mm, fourth femur 1.8 mm; first patella-tibia 1.2 mm, fourth patella-tibia 1.4 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Female holotype and 5 immature from Flemming's Bat Cave, 4 mi. N Telegraph, Kimble County, Texas, 21 February 1964 (W.H. Russell) (AMNH).

Cicurina porteri, new species
Figs. 133-134

Diagnosis.—Eyeless troglobite of Oriente Milestone Molasses Bat Cave, Val Verde County, Texas; elongate spermathecum with rounded sac; index coil heavy procurved canal across sac; connecting canal loosely enclosing spermathecal parts. Male unknown.

Etymology.—Named for John Porter, student of caves.

Description.—Female holotype: Length 4.4 mm. Carapace 2.4 mm long, 1.8 mm wide. Abdomen 2 mm long, 2.4 mm wide. Chelicerae: retromargin of fang with 5 or 6 teeth. Leg lengths: first femur 2.2 mm, fourth femur 2.4 mm; first patella-tibia 2.6 mm, fourth patella-tibia 2.7 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype and 1 immature from Oriente Milestone Molasses Bat Cave, about 20 mi. NE Del Rio, Val Verde County, Texas, 25 January 1964 (J. Reddell, D. McKenzie, J. Porter), under rock beyond bat room (AMNH).

Cicurina sheari, new species
Figs. 135-136

Diagnosis.—Eyeless troglobite of Ramsey Bat Cave, Real County, Texas; small coiled spermathecum and rounded sac in oblique position; index coil heavy recurved canal forming inverted V-shaped figure; connecting canal forming wide loop around spermathecal parts. Male unknown.

Etymology.—Named for William A. Shear, student of spider behavior and evolution.

Description.—Female holotype: Length 4.7 mm. Carapace 2.2 mm long, 1.8 mm wide. Abdomen 2.5 mm long, 1.8 mm wide. Chelicerae: retromargin with 4 large teeth on left chelicera and 6 in scattered row on right chelicera. Leg lengths: first femur 2.2 mm, fourth femur 2.5 mm; first patella-tibia 2.6 mm, fourth patella-tibia 2.8 mm. Leg spines: first tibia 2-2-1, fourth tibia 2-2-2.

Type-data.—Female holotype from Ramsey Bat Cave, Real County, Texas, 2 October 1976 (D. Pate, R. Hemperly, K. Heuss) (AMNH).

Cicurina suttoni, new species
Figs. 137-138, 151-152

Diagnosis.—Eyeless troglobite of Felton Cave, Sutton County, Texas; elongate spermathecum with broadly rounded sac; index coil transverse inwardly turned canal around sac; connecting canal forming a loose loop around spermathecal parts. Male (Figs. 151-152).

Etymology.—Specific name for Sutton County.

Description.—Female holotype: Length 5.8 mm. Carapace 2.6 mm long, 2 mm wide. Abdomen 3.2 mm long, 2 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 2.4 mm, fourth femur 2.5 mm; first patella-tibia 2.4 mm, fourth patella-tibia 2.5 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

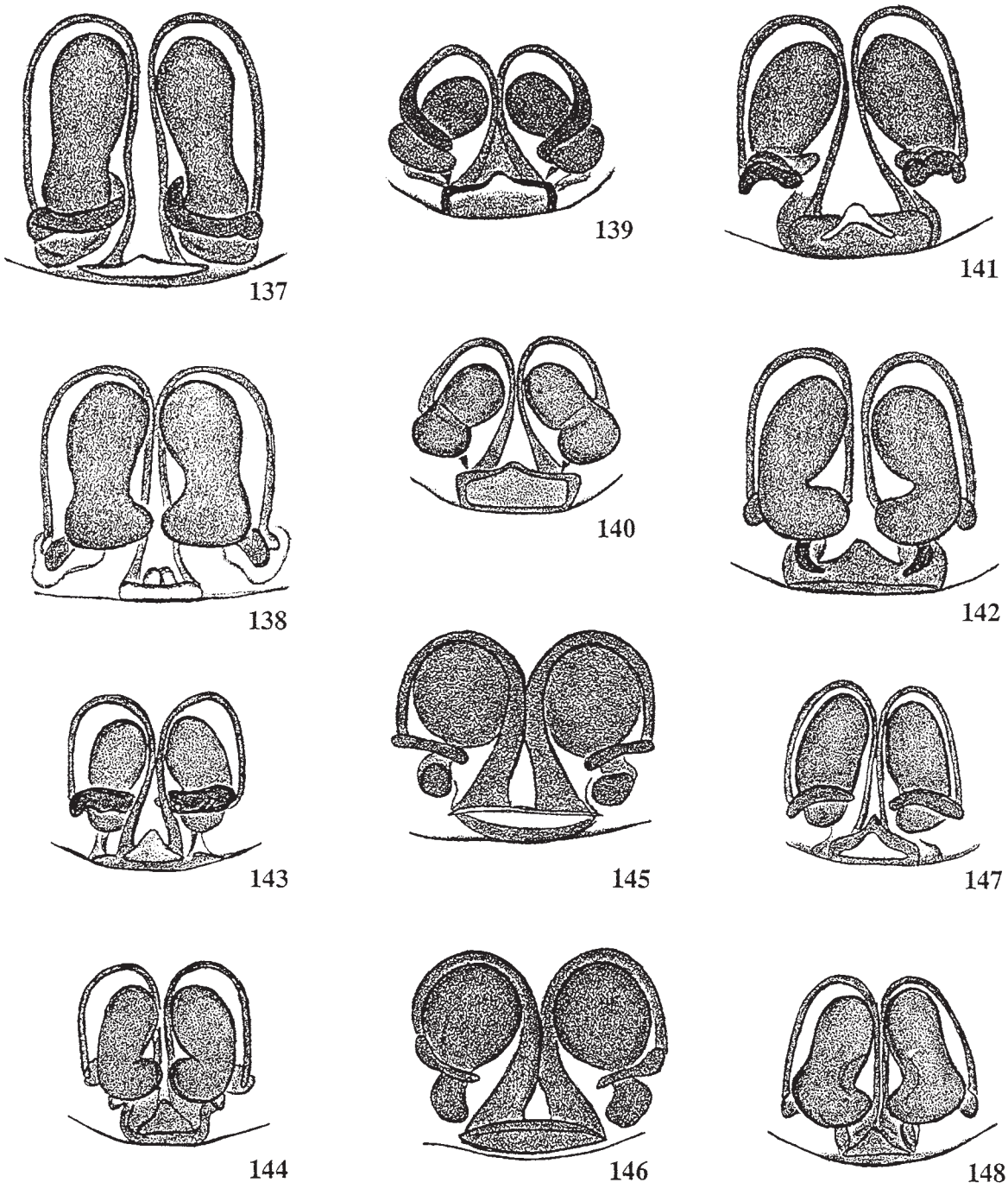
Male: Length 5.4 mm. Carapace 2.6 mm long, 2 mm wide. Abdomen 2.8 mm long, 2 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 2 mm, fourth femur 2.4 mm; first patella-tibia 2.6 mm, fourth patella-tibia 2.8 mm. Male palpus (Figs. 151-152).

Type-data.—Female holotype from Felton Cave, 15 mi. SW Sonora, Sutton County, Texas, 4 July 1964 (J. Reddell), in rotting root 2000 feet from entrance (AMNH).

Distribution.—Known only from Felton Cave. Other records: 4 July 1964 (J. Reddell), 6 immature from near Bat Room, 600 ft. from entrance; 14 October 1928 (O.G. Babcock), 940 feet from entrance, 1 male.

Cicurina mckenziei, new species
Figs. 139-140

Diagnosis.—Eyeless troglobite of Fog Fissure, Bandera County, Texas; rounded spermathecum



Figs. 137-148.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 137-138, *suttoni*, new species; 139-140, *mckenziei*, new species; 141-142, *barri*, new species; 143-144, *rainesi*, new species; 145-146, *wiltoni*, new species; 147-148, *gruta*, new species.

with sac of similar size set in oblique position; index coil heavy canal inclined outward and joined to connecting canal to moderately enclose spermathecal parts. Male unknown.

Etymology.—Named for David McKenzie, student of caves.

Description.—Female holotype: Length 5 mm. Carapace 2.5 mm long, 1.4 mm wide. Abdomen 2.5 mm long, 1.7 mm wide. Chelicerae: retromargin of fang with 5 widely spaced teeth. Leg lengths: first femur 2 mm, fourth femur 2.2 mm; first patella-tibia 2.5 mm, fourth patella-tibia 2.8 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Fog Fissure, 5 mi. N of Vanderpool, Bandera County, Texas, 30 October 1963 (D. McKenzie) (AMNH).

Cicurina barri, new species
Figs. 141-142

Diagnosis.—Eyeless troglobite of Caverns of Sonora (=Mayfield Cave), Sutton County, Texas; oval spermathecum with broadly rounded sac; index coil short recurved canal; heavy connecting canal rather closely looped around spermathecal parts. Male unknown.

Etymology.—Specific name for Thomas Barr, dean of American speleologists.

Description.—Female holotype: Length 5 mm. Carapace 2.4 mm long, 1.4 mm wide. Abdomen 2.6 mm long, 1.4 mm wide. Chelicerae: retromargin with 5 separated teeth. Leg lengths: first femur 2 mm, fourth femur 2.4 mm; first patella-tibia 2.8 mm, fourth patella-tibia 3 mm. Leg spines: first and fourth tibiae 2-2-0.

Type-data.—Female holotype and 1 immature from Caverns of Sonora (=Mayfield Cave), 29 August 1959 (T. Barr) (AMNH).

Cicurina rainesi, new species
Figs. 143-144

Diagnosis.—Eyeless troglobite of 3-Bounce Pit, Edwards County, Texas; oval spermathecum with rounded sac; index coil heavy canal crossing sac; connecting canal forming open loop around spermathecal parts. Male unknown.

Etymology.—Named for Terry Raines, student of caves.

Description.—Female holotype: Length 4.6 mm. Carapace 2.3 mm long, 1.3 mm wide. Abdomen 2.3 mm long, 1.6 mm wide. Chelicerae: retromargin with 7 small teeth. Leg lengths: first femur 1.6 mm, fourth femur 1.8 mm; first patella-tibia 2 mm, fourth patella-tibia 2.2 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-1.

Type-data.—Female holotype from 3-Bounce Pit, Carta Valley, Edwards County, Texas, February 1974 (T. Raines, J. Lewis, R. Fieseler) (AMNH).

Distribution.—Known only from 3-Bounce Pit. Other record: 14 July 1976 (W. Elliott, D. McKenzie), 3 females, 9 immature.

Cicurina gruta, new species
Figs. 147-148

Diagnosis.—Eyeless troglobite of Dunbar Cave, Edwards County, Texas; elongate spermathecum with widely rounded sac; index coil slightly procurved canal across sac; connecting canal forming loose loop around spermathecal parts. Male unknown.

Etymology.—Specific name for Spanish *gruta*, cave.

Description.—Female holotype: Length 4.75 mm. Carapace 2.25 mm long, 1.55 mm wide. Abdomen 2.5 mm long, 1 mm wide. Chelicerae: retromargin of fang with 5 teeth. Leg lengths: first femur 2.2 mm long, 1 mm wide; first patella-tibia 2.8 mm, fourth patella-tibia 2.95 mm. Leg spines: first tibia 1-2-0, fourth tibia 2-2-2.

Type-data.—Female holotype from Dunbar Cave, 20 mi. SW of Rocksprings, Edwards County, Texas, 29 September 1956 (W. McAlister) (AMNH).

Distribution.—Known only from Dunbar Cave. Other record: 30 August 1964 (D. McKenzie, T. Raines), 1 immature.

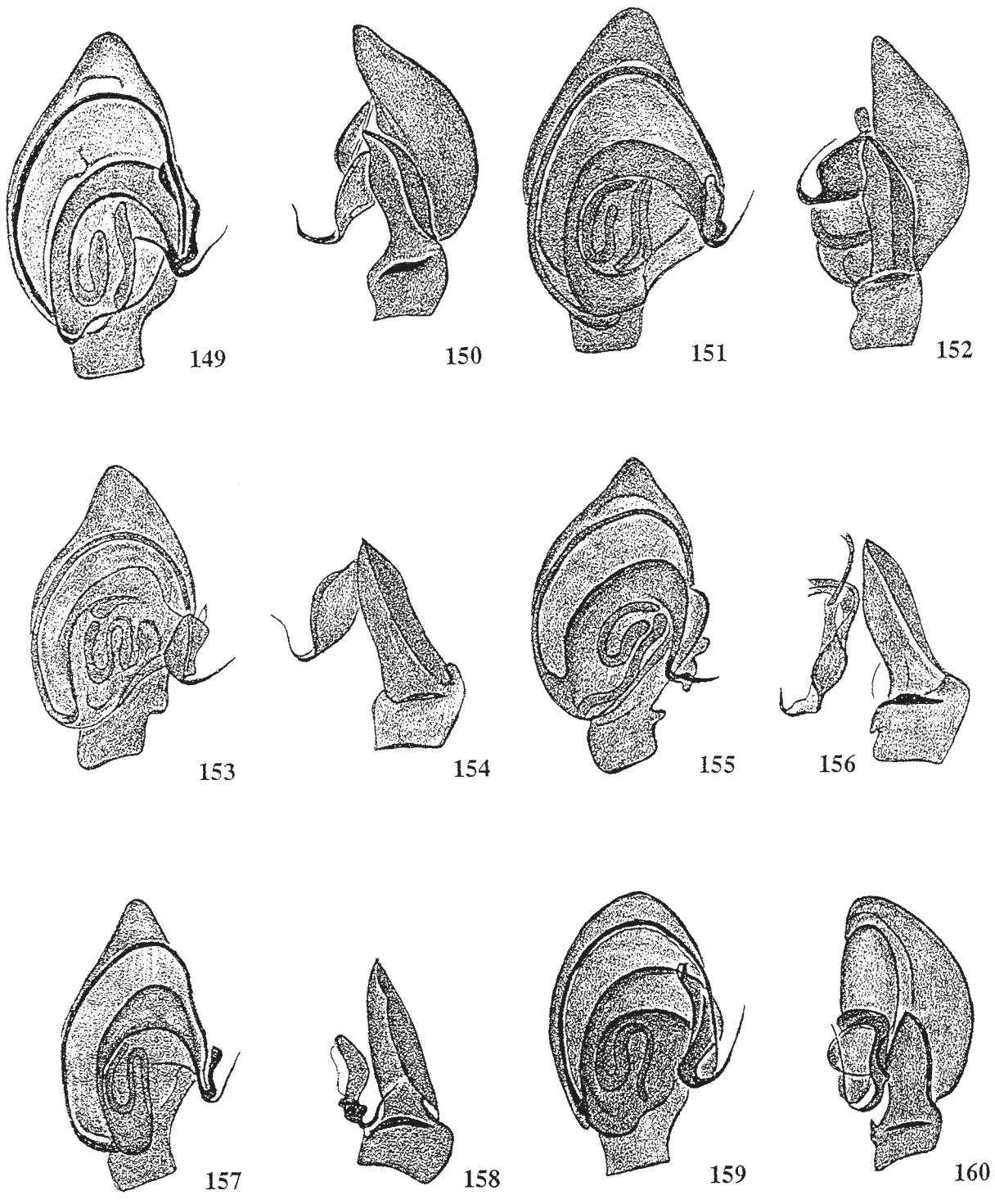
Cicurina medina, new species
Figs. 149-150

Diagnosis.—Eyeless troglobite of Boehme's Cave, Medina County, Texas; conductor of male palpus forming short curved loop as shown in figures. Female unknown.

Etymology.—Named for Medina County.

Description.—Male holotype: Length 3.6 mm. Carapace 1.8 mm long, 1.4 mm wide. Abdomen 1.8 mm long, 1.4 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1 mm, fourth femur 1.1 mm; first patella-tibia 2 mm, fourth patella-tibia 2.4 mm. Leg spines: first and fourth tibiae 2-2-2.

Type-data.—Male holotype from Boehme's Cave, 3 mi. S main dam on Lake Medina, 16



Figs. 149-160.—Ventral and retrolateral views of male palpi of eyeless *Cicurina* (*Cicurella*): 149-150, *medina*, new species; 151-152, *suttoni*; 153-154, *sansaba*, new species; 155-156, *baronia*, new species; 157-158, *menardia*, new species; 159-160, *wiltoni*, new species.

February 1964 (J. Reddell, D. McKenzie, J. Porter) (AMNH).

Cicurina wiltoni, new species
Figs. 145-146, 159-160

Diagnosis.—Eyeless troglobite of Crystal Caverns and nearby cave of Jefferson County, Alabama; large round spermathecum with small oval sac; index coil thin canal crossing small sac; connecting canal closely encircling spermathecal parts. Male palpus (Figs. 159-160).

Etymology.—Specific name for the late Wilton Ivie.

Description.—Female holotype: Length 5 mm. Carapace 2.5 mm long, 1.75 mm wide. Abdomen 2.5 mm long, 1.7 mm wide. Chelicerae: retromargin of fang with 9 teeth. Leg lengths: first femur 2 mm, fourth femur 2.5 mm; first patella-tibia 2.6 mm, fourth patella-tibia 3 mm. Leg spines: first tibia 2-2-0, fourth tibia 2-2-2.

Male: Length 4 mm. Carapace 2 mm long, 1.5 mm wide. Abdomen 2 mm long, 1.5 mm wide. Chelicerae: retromargin with 8 teeth. Leg lengths: first femur 1.8 mm, fourth femur 2 mm; first patella-tibia 2.1 mm, fourth patella-tibia 2.4 mm. Male palpus (Figs. 159-160).

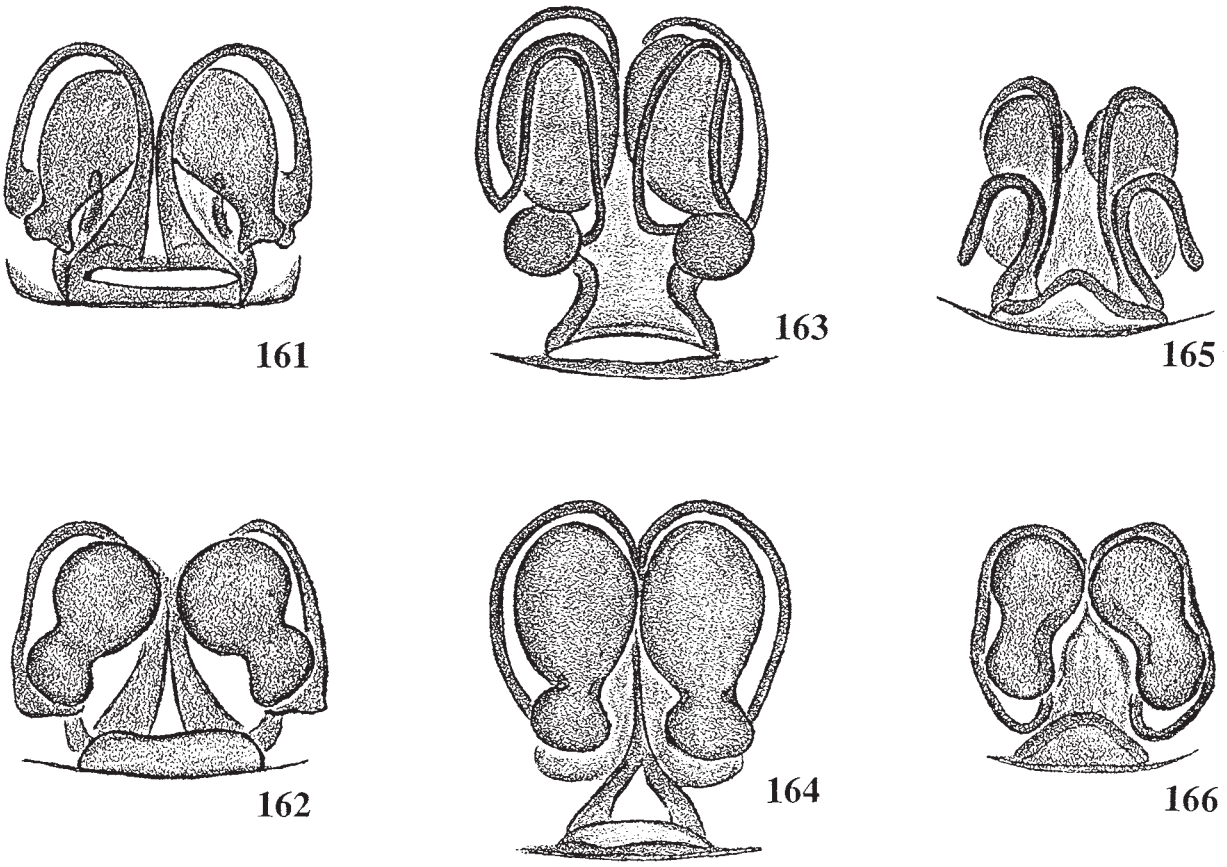
Type-data.—Female holotype from Crystal Caverns, 1 mi. N of Clay, Jefferson County, Alabama, 12 July 1951 (W. B. Jones, J. M. Valentine) (AMNH).

Distribution.—ALABAMA: *Jefferson County*: Crystal Caverns, 29 June 1958 (W.B. Jones, Tom Semnes, T.W. Daniel, Jr.), 1 female, 4 immature; 18 March 1966 (S. Peck), 2 females, 4 immature; 23 July 1965 (S. Peck), 1 male, 2 immature. McClunney-Alabama Caverns, near Clay (H.E. Steeves), 2 females.

Cicurina maya Gertsch
Figs. 161-162

Cicurina maya Gertsch, 1977:127, Fig. 86.

Diagnosis.—Eyeless troglobite from Cueva (Actún) Tucil, Yucatán, México; oval spermathecum in oblique position with small rounded sac, index coil hidden behind sac; connecting canal



Figs. 161-166.—Ventral and dorsal views of epigyna of eyeless *Cicurina* (*Cicurella*): 161-162, *maya* Gertsch; 163-164, *coahuila* Gertsch; 165-166, *leona*, new species.

forming close ring around spermathecal parts. Male unknown.

Etymology.—Named for the Maya people of Yucatán.

Description.—Female holotype: Length 1.6 mm. Carapace 1.6 mm long, 1.08 mm wide. Abdomen 1.9 mm long, 1.1 mm wide. Chelicerae: retromargin with 8 teeth.

Type-data.—Female holotype and subadult male from Cueva (Actún) Tucil, 2 km S Muna, Yucatán, México, 27 March 1973 (J. Reddell) (AMNH).

Cicurina coahuila Gertsch
Figs. 163-164

Cicurina coahuila Gertsch, 1971:110, fig. 108.

Diagnosis.—Eyeless troglobite of Cueva de los Lagos, Coahuila, México; oval spermathecum with small oval sac; index coil thin procurved canal running length of spermathecum; connecting canal loosely encircling large spermathecum. Male unknown.

Etymology.—Named for the State of Coahuila, México.

Description.—Female holotype: Length 3.8 mm. Carapace 1.6 mm long, 1.5 mm wide. Abdomen 2.2 mm long, 1.5 mm wide. Chelicerae: retromargin with 5 teeth.

Type-data.—Female holotype from Cueva de los Lagos, 24 km west of Ciudad Acuña, Coahuila, México, 24 January 1969 (J. Reddell, D. McKenzie, J. Porter) (AMNH).

Cicurina leona, new species
Figs. 165-166

Diagnosis.—Eyeless troglobite of Cueva de Cuchillo, Nuevo León, México; ovate spermathecum with rounded sac; index coil large canal forming prominent loop; thin connecting canal closely draped around spermathecal parts. Male unknown.

Etymology.—Specific name for State of Nuevo León, México.

Description.—Female holotype: Length 3.3 mm. Carapace 1.44 mm long, 1.2 mm wide. Abdomen 1.9 mm long, 1.4 mm wide. Chelicerae: retromargin of fang with 6 teeth. Leg lengths: first femur 1.3 mm, fourth femur 1.4 mm; first patella-tibia 1.5 mm, fourth patella-tibia 1.8 mm. Leg spines: first tibia 2-2-1, fourth tibia 1-2-1.

Type-data.—Female holotype from Cueva de Cuchillo, 2.5 km S Minas Viejas, Nuevo León, México, 22 April 1988 (Peter Sprouse) (AMNH).

Cicurina buwata Chamberlin and Ivie

Cicurina buwata Chamberlin and Ivie, 1940:15, 75, pl. XIII, fig. 94.

Diagnosis.—Eyeless troglobite from cave near Austin, Texas; immature specimen of uncertain sex from uncertain cave habitat, here regarded as a *nomina inquirienda* without specific status.

Description.—Coloration and structural details are offered with drawing (Chamberlin and Ivie, 1940:fig. 94) of the immature specimen in dorsal view. Eyes are entirely absent; measurements and ratios of leg segments are included.

Type-data.—Immature type from cave near Austin, Texas, March 12-18, collector J. H. Comstock (Cornell University).

Cicurina sp.

The following records of immature eyeless *Cicurina* are included to better indicate the range of the group in Texas and to encourage attempts to obtain adult specimens from these caves.

Records.—TEXAS: *Bandera County*: Haby Swallow Cave, 21 March 1971 (J. Reddell), 2 immature; Keese Cave, 11 July 1974 (D. McKenzie, W. Elliott), 3 immature. *Bell County*: Adam's Gold Mine, 27 July 1963 (J. Reddell, D. McKenzie), 1 immature. *Bexar County*: Black Cat Cave, 27 January 1987 (J. Reddell, M. Reyes), 1 immature; 8 March 1987 (J. Reddell, M. Reyes), 2 immature; Genesis Cave, June 1985 (R.M. Waters, A. Cobb), 1 immature; Headquarters Cave, 24 April 1966 (B. Russell, D. McKenzie), 2 immature; Helotes Blowhole, 25 December 1982 (R.M. Waters), 4 immature; John Wagner Ranch Cave No. 3 (=Adam Wilson's Cave, Jr.); 23 December 1963 (C. Huebner, O. Knox), 1 immature; 4 October 1963 (J. Reddell, D. McKenzie), 2 immature; Kamikazi Cricket Cave, 19 January 1986 (S.J. Harden), 1 immature; Robber's Cave, 3 September 1987 (A. Cobb, G. Veni), 3 immature; Young Cave No. 1, 6 August 1983 (G. Veni, J. Ivy), 1 immature. *Blanco County*: Forest View Cave, 20 February 1983 (W.R. Elliott), 1 immature. *Comal County*: Double Decker Cave, 5 February 1978 (G. Darilek, D. Montgomery, T. Mills), 1 immature; Lewis Cave, 8 March 1968 (J. Reddell, J. Fish, S. Fowler), 1 immature; Startzville Bat Cave, 1982 (A.G. Grubbs), 1 immature. *Coryell*

County: Diamond Cave, 16 August 1964 (J. Reddell, D. McKenzie), 3 immature. *Edwards County*: Deep Cave, 4 September 1965 (J. Reddell, D. McKenzie), 2 immature; Devil's Sinkhole, 26 October 1963 (J. Reddell, J. Porter), 1 immature; 14 February 1965 (J. Reddell), 2 immature; Dunbar Cave, 30 August 1964 (D. McKenzie, T. Raines), 2 immature; Jacoby Cave, 22 September 1963 (J. Reddell, D. McKenzie), 2 immature; Wyatt Cave, 21 September 1963 (J. Reddell, D. McKenzie), 4 immature. *Hays County*: Boggus Cave, 21 June 1985 (A. Cobb), 3 immature; 16 January 1986 (S.J. Harden), 2 immature; Donaldson Cave, 15 August 1965 (B. Frank, B. Benfer), 1 immature; Grapevine Cave, 6 February 1988 (A.G. Grubbs, L.J. Graves, C. Clayton, M. Bearll), 6 immature; Ladder Cave, 2 September 1989 (J. Reddell, M. Reyes), 2 immature; 26 May 1989 (A. Grubbs, J. Reddell, M. Reyes), 9 immature; McCarty Cave, 1988 (A. Grubbs), 2 immature; Michaelis Cave, January 1990 (A.G. Grubbs, L.J. Graves), 2 immature; Morton's Cave, 9 September 1963 (D. McKenzie, B. Russell), 2 immature. *Kendall County*: Cave-Without-A-Name (=Century Caverns), 30 July 1969 (J. Reddell, D. McKenzie), 1 immature. *Kerr County*: Mingus Swallow Cave, 28 April 1968 (J. Reddell, S. Fowler), 1 immature. *Medina County*: Davenport Cave, 10 July 1966 (J. and J. Reddell), 6 immature; Marguerite Cave, 28 April 1984 (S. Harden), 1 immature; 5 May 1984 (R.M. Waters), 2 immature; Valdina Farms Sinkhole, 12 January 1964 (J. Reddell, D. McKenzie, J. Porter), 2 immature; Weynand Cave, 12 August 1965 (J. Reddell, J. Fish), 6 immature. *Real County*: Cave of the Lakes (=Haby Cave), 30 October 1963 (D. McKenzie), 2 immature; Skeleton Cave, 18 August 1963 (J. Reddell, D. McKenzie), 12 immature. *San Saba County*: Cicurina Cave, 17 February 1963 (J. Reddell, D. McKenzie), 1 immature; Clark's Branch Well Cave, 13 October 1962 (J. Reddell), 1 immature; Harrell's Cave, 9 February 1964 (J. Reddell, D. McKenzie, K. Garrett), 1 immature; Lemon's Cave, 1 September 1963 (J. Reddell, D. McKenzie), 5 immature; Suprise Cave, 15 February 1964 (J. Reddell, D. McKenzie, J. Porter), 2 immature; Unknown Cave, 8 April 1989 (K. Markette), 1 immature; Wedge Cave, 11 June 1978 (J. Reddell, R. Fieseler, E. Kastning), 1 immature. *Travis County*: Backyard Cave, 18 January 1963 (W. Russell), 1 immature; Beckett's Cave, 8 March 1963 (B. Russell), 3 immature; 5 December 1965 (B. Russell), 1 immature; Bee Creek Cave, 2 October 1963 (J. Reddell, D. McKenzie), 9 immature; 7 June 1965 (J. Fish, J. Reddell), 2 immature; Broken Straw Cave, 27 September 1965 (J. Reddell), 3 immature; Dead Dog Cave No. 2, October 1963 (B. Russell), 1 immature; Gallifer Cave, 28 August 1988 (J. Reddell, M. Reyes), 1 penultimate male, 1 immature; Goat Cave, 4 December 1983 (D.L. Pate), 4 immature; Lost Gold Cave, 27 May 1963 (J. Reddell, B. Frank), 3 immature; October 1963 (D. McKenzie), 4 immature; Lunsford Cave, April 1963 (B. Russell), 1 immature; McNeil Bat Cave, 18 January 1963 (W. Russell), 1 immature; Midnight Cave, 6 March 1966 (B. Russell), 1 penultimate male; New Comanche Trail Cave, 11 January 1989 (J. Reddell, M. Reyes), 1 immature; Weldon Cave, 7 January 1965 (B. Russell), 1 immature. *Uvalde County*: Cement Tank Cave, 12 July 1974 (W. Elliott, D. McKenzie, P. Lynn), 4 immature; Dripstone Cave, 13 August 1965 (J. Fish, J. Reddell), 5 immature; 22 March 1983 (R.M. Waters, G.A. Poole), 1 immature; July 1983 (R. Waters, E. Short), 1 immature; Frio Bat Cave, January 1984 (R.M. Waters), 1 immature; Frio King Cave, 8 June 1985 (A. Grubbs, R. Waters, A. Cobb), 1 immature; Grape Hollow Cave, 26 October 1965 (J. Reddell, J. Calvert), 1 immature; Indian Creek Cave, 3 December 1963 (J. Reddell), 1 immature; Moss Pit Cave, 13 May 1989 (M. Warton), 5 immature; Story Cave, 18 October 1964 (J. Reddell, D. McKenzie), 1 immature; Tampke Ranch Cave, 11 February 1966 (J. Reddell, D. McKenzie), 7 immature; 25 July 1974 (W. Elliott, S. Sweet), 2 immature; Whitecotton Bat Cave, 24 April 1966 (J. Reddell, E. Alexander), 1 immature. *Val Verde County*: Emerald Sink, 24 January 1964 (J. Reddell, D. McKenzie, J. Porter), 3 immature; Ladder Cave, 11 August 1963 (J. Reddell, D. McKenzie), 5 immature. *Williamson County*: Bat Well, 4 March 1988 (J. Reddell, M. Reyes), 2 immature; Beck Bat Cave, 24 August 1963 (J. Reddell, B. Russell), 1 immature; Beck Ranch Cave (=Beck's Tin Can Cave), November 1962 (J. Reddell), 2 immature; 12 March 1963 (B. Russell), 1 immature; 23 June 1968 (J. Reddell), 4 immature; 27 February 1972 (J. Reddell), 1 immature; 9 March 1988 (J. Reddell, M. Reyes), 2 immature; Bone Cave, 4 August 1963 (J. Reddell), 1 immature; Cobb Cavern, 31 March 1963 (J. Reddell), 5 immature; Cricket Cave, 30 March 1965 (J. Reddell), 2 immature; Grimace Cave, 16 April 1989 (W. Elliott), 1 immature; Ilex Cave, 1 June 1989 (J. Reddell, M. Reyes, M. Warton), 3 immature; Inner Space Caverns (=Laubach Cave), 9 July 1965 (J. Reddell), 3 immature; 2 November 1968 (W. Elliott), 1 immature; Kamikazi Crack Cave, 16 April 1989 (J. Reddell, M. Reyes), 1 immature; LakeLine Cave, 21 January 1990 (J. Reddell), 1 immature; 7

February 1990 (J. Reddell, M. Reyes), 4 immature; 16 February 1990 (J. Reddell, M. Reyes), 2 immature; Off Campus Cave, 8 April 1989 (W. Elliott, J. Reddell, M. Reyes), 2 immature; Steam Cave, 7 July 1963 (J. Reddell, B. Russell), 2 immature; Three-Mile Cave, 30 March 1965 (J. Reddell), 1 immature; Walsh Ranch Cave, 24 August 1963 (J. Reddell, B. Russell), 1 immature; Williams Cave, 24 August 1963 (J. Reddell, B. Russell), 1 immature; Wolf's Cave, 7 August 1983 (W. Elliott, B. Vinson, D. Pate), penultimate male.

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The research material on which this paper is based has been brought together by friends and colleagues over a period of many years. One of the first students was Wilton Ivie who was responsible for basic work on the cicurine spiders and began study of the *Cicurella* complex until his untimely death. The active field contributors have been speleologists long devoted to systematic study of caves and cave faunas. In this case no better reason for intensive study of cave cicurellas are the spiders themselves which have responded to cave stimuli to produce an unparalleled total of more than fifty completely eyeless taxa within a quite limited geographical area. Caving demands devotion to arduous and often dangerous excursions into many kinds of caves. Among the first Texas cave students were James R. Reddell and Robert W. Mitchell, who have devoted much of their field life to cave research in the United States and Mexico. We salute these and the many other students as assistants during years of caving; many of their names will be found among the described taxa. I am grateful to the following Museum caretakers for loans of types and other valuable specimens, and for the many special favors during this study: Dr. W. G. Reeder, Texas Memorial Museum (TMM), Austin, Texas; Dr. Norman Platnick, American Museum of Natural History (AMNH), New York; Mr. Darrell Ubick, California Academy of Sciences (CAS), San Francisco.

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A NEW AND FIRST TROGLOBITIC SPIDER FROM ARIZONA (*THYMOITES*, THERIDIIDAE)

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ABSTRACT

The first troglobitic spider from Arizona, *Thymoites minero,* new species, is described from Southwestern Cave, Cochise County. This is the first troglobitic *Thymoites* and the first troglobitic species of the Theridiidae in North America.

INTRODUCTION

Arizona has a depauperate cave fauna mainly consisting of troxloxenes and troglophiles (Roth, unpublished; Peck 1980) and a few troglobites. Barr's (1963) definition of troglobites would include only the following blind forms: the isopod *Brackenridgia sphinxensis* Schultz (1984), an amphipod, *Stygobromus arizonensis* Holsinger (1974), a phreatobite, and possibly the collembolan, *Tomocerus* sp., and campodeid, *Haplocampa* sp., the latter two listed by Peck.

Peck presented a list of species taken from caves in the Grand Canyon, used a broadened definition of the term "troglobite," and included a "cave adapted ... low level or relatively unspecialized" spider (*Telema* sp., Telemidae) as a troglobite. Barr would identify this as a troglophile. He describes troglobites as "those obligative cavernicoles —usually distinguished morphologically by regression of pigment and photoreceptors, and frequently by longer, more slender appendages than their epigean congeners.

In the absence of regressive and/or adaptive modifications frequently associated with troglobites, an animal, even though known only from caves, is usually (and probably should be) considered a troglophile." This is the criteria followed in this paper and accordingly some of Peck's "troglobites or disjunct troglobites" must be considered troglophiles or disjunct troglophiles, or, at the most, incipient troglobites.

Undescribed female telemids have a F/C index of 260, (femur I length/carapace length X 100), for an eyeless troglobite, 218 carapace length for an eyed troglophile, and 170 for an epigean species. Peck's *Telema* sp. showed the presence of pigmented eyes, not reduced in size, integument slightly pigmented, and not much longer legs than normal with a F/C index of 195, obviously a troglophile.

This suggests that the new species of *Thymoites* (Theridiidae) is the first spider troglobite known from Arizona. It is unpigmented, has only pale eye spots except for the AME which do not appear functional and are irregularly pigmented and more slender legs with a F/C index of 169 - 197 (males) and 194 - 219 (females) compared with eight epigean species with an index of 94 - 161 (males) and 96-136 (females).

Few Theridiidae are troglobites. *Styposis* have the AME reduced or lost (Levi 1959a, 1964a) but are not cave species.

The 6-eyed *Comaroma* (= *Archerius*) is not a theridiid and its transfer to the Anapidae by Wunderlich (1986) was overlooked by both Peck and Shear (1987) and Merrett and Ashmole (1989). They described the first theridiid troglobites, the blind *Theridion streptipes* (Peck and Shear) from the

Galapagos Islands and one with eye spots from the Azores, *T. pico* (Merrett and Ashmole).

This third species was found in a moist limestone cave, the Southwestern Cave at Bisbee, Arizona. Troglophiles in the habitat included a pale psocid, collembolans, and mycetophilid flies. The spiders were brought to my attention by Ralph Luetcke whose keen interest in the natural history of the area made the find possible. His assistance in guiding our group and helping with collections is hereby gratefully acknowledged. Special thanks go to Dr. Herbert Levi who confirmed the identity of this species and proofed the manuscript and to Dr. Todd Riddell of the U.S. Army for the original drawings.

The females key out to couplet 6 of Levi's (1964b) key but lack the lateral ducts; the males key to couplet 33, however their carapace setae are not transverse but form three longitudinal rows on the pars cephalica.

DESCRIPTION

The following description follow those of Levi (1957) to provide a comparison of species.

Thymoites minero n. sp.
Figs. 1-5

Type-data.—Male holotype, female allotype and 3 male and 7 female paratypes from Southwest Cave in Bisbee, Cochise County, Arizona, Dec. 15, 1983, Vincent and Barbara Roth, Ralph and Suzanne Luetcke, collectors.

The holotype and allotype will be deposited in the Museum of Comparative Zoology, paratypes in the California Academy of Sciences, Texas Memorial Museum, Museum of Natural History, Washington D. C., The American Museum of Natural History, and the author's collection.

Etymology.—The specific name "minero" is Spanish for "one who digs for metals" and is used to honor the miners of Bisbee, Arizona who opened the underground cavities where these spiders occur.

Diagnosis.—This is the only troglobitic *Thymoites*, differing from the epigean species by longer legs, femora I, 1 1/2 to 2 X as long as the carapace, and the tiny colorless (except AME) eyes. The males have three rows of long setae on the pars cephalica (Fig. 2) and the females can be recognized by the knob-like epigynum (Fig. 3) with very short ducts on the spermatheca (Fig. 5).

The epigynum is similar to that of *T. missionensis* (Levi, 1959b) but the copulatory opening is smaller, round and internally the spermatheca bears a short blind (?) duct off the ventral wall. The males do not seem similar to any other *Thymoites*.

The females have relatively longer legs than the males, an unusual feature among spiders but another case was noted in the same genus. One pair of *T. madera* Gertsch and Archer (Levi, 1957) had a F/C index of 95 (male) and 115 (female).

Description.—Pale yellow spiders lacking marks except for irregular dark pigment in the AME.

Carapace high (Fig. 2), equal to length of chelicera exposed below lower edge of clypeus. The clypeus about 2/3 as high as width of AER. Eyes reduced in size, about 0.03 mm diameter, pale, except AME with scattered pigment. Viewed from front, AER slightly procurved to straight; viewed from above PER strongly procurved, PLE advanced one diameter anterior to PME; latter separated slightly more than AME and about half that distance from them. Pars cephalica (Fig. 2) encircled by 15 long (0.25–0.3 mm) curved setae, 4 on each side, 3 on the center line, plus four on the anterior part of the pars thoracica. Chelicerae with large promarginal tooth, none on retromargin. Legs with few large dorsal spines, two on patellae and one near base of tibiae.

Palpus as illustrated (Fig. 1) with median apophysis extending out from edge of bulb. Palpal femur curved, patella continuing the curve almost 180° to parallel the femur. Tibia constricted near base.

Total length of males 1.7–2.0 mm. Measurements of male holotype: total length 1.8 mm; carapace length 0.82 mm; width 0.69 mm. Leg I total length 5.11 mm; first femur 1.64 mm; patella-tibia 1.57 mm; metatarsus 1.31 mm; tarsus 0.59 mm; second patella-tibia 1.29 mm; third 0.90 mm; fourth 1.29 mm.

Female: As in male except setae on carapace much shorter (0.18 –0.26 mm) and few on a median line. Carapace not as high in front, 2/3 the length of the exposed part of the chelicerae, clypeus height about 3/5 the width of the AER.

Epigynum raised posteriorly, knob-like (Figs. 3, 4) with an opening at the tip. Vulva simple (Fig. 5), two large bulbous spermathecae with short ducts.

Total lengths of females, 2.5 mm. Measurements of female allotype: total length 2.5 mm; carapace length 0.85 mm, width 0.72 mm; leg I length 5.47 mm; first femur 1.62 mm; patella-tibia 1.80 mm; metatarsus 1.41 mm; tarsus 0.64 mm; second patella-tibia 1.41 mm; third 1.08 mm; fourth 1.57 mm.

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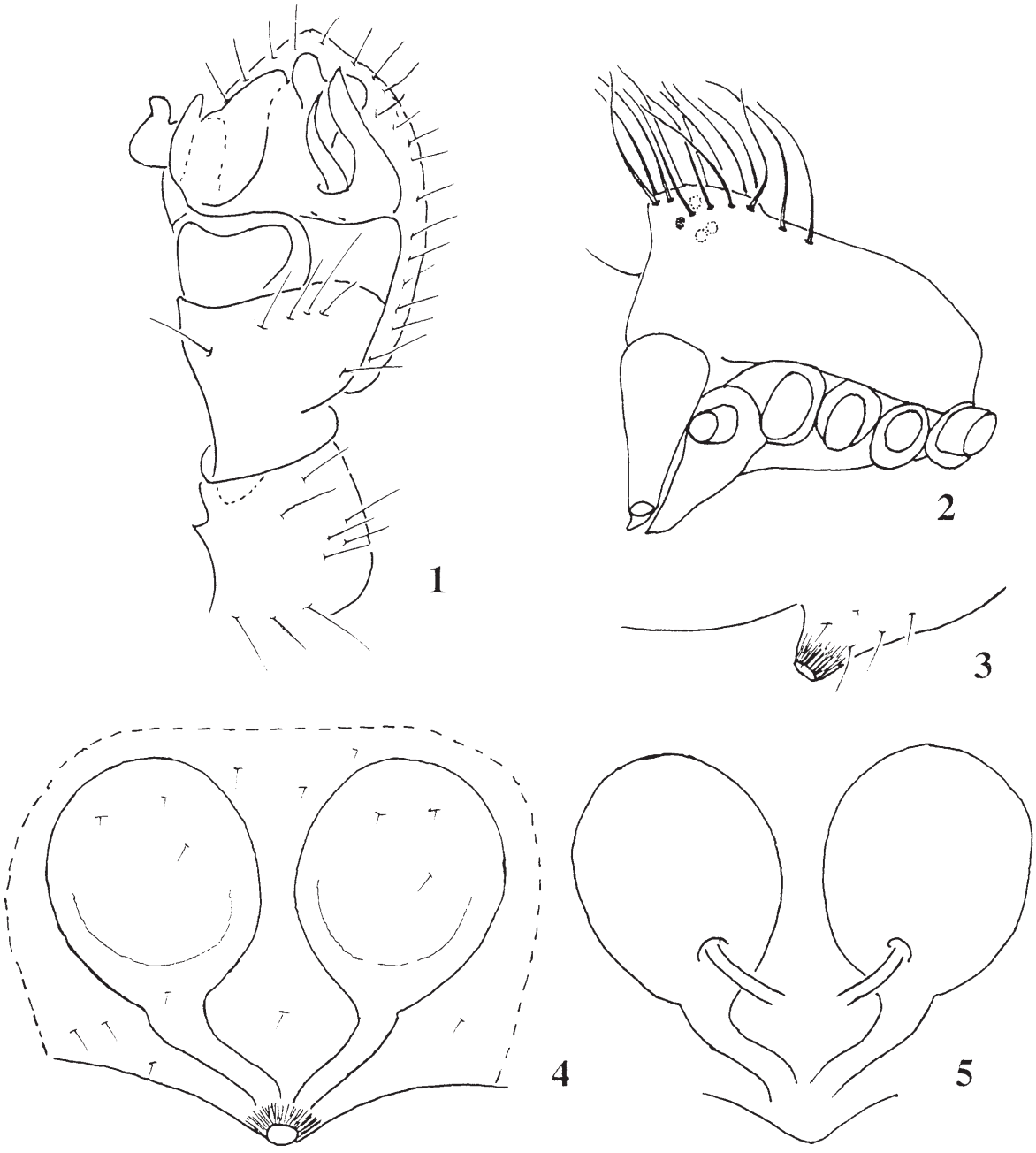

Figs. 1–5.—*Thymoites minero,* new species: 1, left male palpus, ventral view; 2, Male carapace; 3, lateral view of epigynum; 4, epigynum, ventral view; 5, epigynum, dorsal view.

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CAVERNICOLOUS PSEUDOSCORPIONS FROM TEXAS AND NEW MEXICO (ARACHNIDA: PSEUDOSCORPIONIDA)

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ABSTRACT

All known cavernicolous pseudoscorpions from Texas and New Mexico have been reviewed and studied. A key to represented genera is provided. In addition to the 9 identified species previously reported, 17 others are here recorded, including 9 newly described. The new species are: *Tyrannochthonius texanus*, *Tartarocreagris comanche*, *Chitrella welbourni*, *C. major*, *C. elliotti*, *Cheiridium reyesi*, *Apocheiridium reddelli*, *Neoallochernes*(?) *incertus*, and *Dinocheirus cavicolus*. The genus *Tartarocreagris* Curcic is discussed in regard to newly discovered males, and 2 species are transferred therein. Also, the genus *Neoallochernes* Hoff is redefined; a new species, *N. cubanus*, is described from Cuba and *Dinocheirus stercoreus* Turk, from Texas bat caves is reassigned to that genus. In an Addendum, another new species from a cave in Texas is described: *Tartarocreagris intermedia*.

INTRODUCTION

Until now, reports of cavernicolous pseudoscorpions in Texas and New Mexico have been widely scattered in the literature (Turk, 1949; Hoff, 1957; Reddell, 1965, 1970; Barr and Reddell, 1967; Muchmore, 1969, 1976, 1981, 1986). Seven identified species have been reported from 8 caves in Texas and 2 identified species from 2 caves in New Mexico; additional tentatively identified or unidentified pseudoscorpions were known from about 15 other caves in Texas and one in New Mexico. Recent collections, especially by James Reddell and colleagues in Texas and W.C. Welbourn in New Mexico, now allow the addition of 17 species (including 9 newly described below) to the list of those found in caves in the two states.

Unless otherwise noted, the materials upon which this report is based are deposited in the Florida State Collection of Arthropods (FSCA), Gainesville, Florida. Some specimens are housed in the American Museum of Natural History (AMNH), New York, New York; the Canadian National Collection of Insects and Arachnids (CNC), Ottawa, Canada; the J.C. Chamberlin Collection (JCC), Forest Grove, Oregon; the Museum of Comparative Zoology (MCZ), Cambridge, Massachusetts; and the United States National Museum of Natural History (USNM), Washington, D.C.

FAMILY CHTHONIIDAE HANSEN

Genus *Aphrastochthonius* Chamberlin

Aphrastochthonius Chamberlin, 1962:307; Muchmore, 1986:17.

Key to Genera of Cavernicolous Pseudoscorpions in Texas and New Mexico

1. Legs III and IV with more segments (6 beyond coxa) than legs I and II (5 beyond coxa) (family Chthoniidae) 2
   All legs with same number of segments (either 5 or 6 beyond coxa) 4

2. Coxal spines only on coxa of leg I ..... *Apochthonius*
   Coxal spines not confined to leg I 3

3. Coxal spines only on coxa of leg II ..... *Tyrannochthonius*
   Coxal spines on coxae of legs I and II ..... *Aphrastochthonius*

4. Tarsus of each leg divided into 2 parts, each leg with 6 segments beyond coxa 5
   Tarsus of each leg undivided, each leg with 5 segments beyond coxa 9

5. Chelicera with inner margin of movable finger distinctly dentate 6
   Chelicera with inner margin of movable finger essentially smooth (family Garypidae) ..... *Archeolarca*

6. Abdomen with pleural membranes striate (family Syarinidae) ..... *Chitrella*
   Abdomen with pleural membranes granulate 7

7. Trichobothrium *ib* in middle of dorsum of chelal hand, *isb* on base of fixed finger (family Bochicidae) ..... *Leucohya*
   Trichobothrium *ib* on base of fixed chelal finger along with *isb* (family Neobisiidae) 8

8. Movable finger of chelicera with spinneret in form of low elevation ..... *Microbisium*
   Movable finger of chelicera with spinneret in form of long, usually branched galea ..... *Tartarocreagris*

9. Femora of all legs similar, articulations between basifemora and telofemora obsolete (family Cheiridiidae) 10
   Femora of legs I and II quite different from those of legs III and IV, articulations well developed (family Chernetidae) 11

10. Movable finger of palpal chela with 2 trichobothria ..... *Cheiridium*
    Movable finger of palpal chela with only 1 trichobothrium ..... *Apocheiridium*

11. Chelicera with flagellum composed of 3 setae; hand of chelicera with 4 setae ..... *Neoallochernes*
    Chelicera with flagellum composed of 4 setae; hand of chelicera with 5 setae 12

12. Tarsus of leg IV with an acuminate tactile seta ..... *Dinocheirus*
    Tarsus of leg IV without an acuminate tactile seta ..... *Hesperochernes*

Species of *Aphrastochthonius* are known from Alabama, Cuba, Central America, New Mexico, and California. Except for 2 species from Cuba and Chiapas, Mexico, all are cavernicoles.

Aphrastochthonius pachysetus Muchmore

Aphrastochthonius pachysetus Muchmore, 1976: 361, Figs. 1-3.

The holotype female of this species was found in Doc Brito Cave, near White's City, Eddy County, New Mexico. No other representative is known.

Genus *Apochthonius* Chamberlin

Apochthonius Chamberlin, 1929a:66; Muchmore and Benedict, 1976:68.

Apochthonius is distributed over most of the United States and Canada. Representatives are to be found in moist litter, both epigean and hypogean.

Apochthonius magnanimus Hoff

Apochthonius magnanimus Hoff, 1956a:4, Figs. 2-4; Hoff, 1958:6.

A male belonging to *Apochthonius* was collected in Ogle Cave, Carlsbad Caverns National Park, Eddy County, New Mexico, 25 May 1974, by W.C. Welbourn. Though it is a little smaller than the types described by Hoff, it is, no doubt, a representative of *A. magnanimus* (see Welbourn, 1978:31), accidental in the cave.

Genus *Tyrannochthonius* Chamberlin

Tyrannochthonius Chamberlin, 1929a:74; Muchmore, 1986:20.

This genus has a wide distribution in the warmer parts of the world; in North America it is found through the southern United States and into the Caribbean area and Central America (mostly unpublished records). While Chamberlin and Malcolm (1960) made mention of troglobitic forms of *Tyrannochthonius* from Alabama, only 2 named species have been reported from the United States, an epigean form from Florida and a troglobite from Texas. Epigean representatives are found in moist litter.

Tyrannochthonius troglodytes Muchmore

Tyrannochthonius troglodytes Muchmore, 1986:23, Fig. 11.

The holotype and allotype of this species were collected in Rock Slab Cave, on Enchanted Rock, Llano County, Texas. No other representative is known.

Tyrannochthonius texanus, new species
Figs. 1, 2

Tyrannochthonius spp.: Reddell, 1970:403.

Type-data.—Holotype male (WM1078.01001) and allotype female (WM1078.01002) from Tooth Cave, Travis County, Texas, 14 May 1966 (J. Reddell). Paratype female from Ezell's Cave, San Marcos, Hays County, Texas, 7 September 1963 (J. Reddell); paratype male from Deep Cave, Edwards County, Texas, 4 September 1965 (J. Reddell); 2 paratypes (1 male, 1 female) from Wren Cave, Val Verde County, Texas, 9 April 1968 (J. Reddell and T. Mollhagen). All specimens mounted on slides (FSCA).

Diagnosis.—Smaller than *T. troglodytes* (chela length <0.65 mm), with 4 setae on tergites 1-3 and 6 setae on tergites 4-8.

Description.—Male and female similar but female a little larger and stouter. Carapace slightly longer than broad; epistome low and broad (Fig. 1); 4 eyes present, anterior pair corneate, posterior pair flat; chaetotaxy 4-4-4-2-2. Coxal chaetotaxy 2-2-1:3-0(or 1):2-2-CS:2-3:2-3; each coxa II with 6-7 terminally incised coxal spines.

Abdomen typical. Tergal chaetotaxy 4:4:4:6:6:6: 6:6:7:4:T2T:0. Sternal chaetotaxy of holotype male 9:[4-4]:(3)16/6(3):(3)5(3):10:9:9:9:9:9:0:2; that of allotype female 8:(3)6(3):(3)6(3):—.

Chelicera about 3/4 as long as carapace; hand with 5 setae; flagellum apparently of 6 or 7 pinnate setae; dentition of fingers typical; galeal elevation small in both sexes.

Palp relatively short and stout (Fig. 2); femur about 1.05 and chela about 1.6 times as long as carapace. Femur 4.15-4.45, tibia 1.6-1.8, and chela 4.15-4.95 times as long as broad; hand 1.6-1.9 times as long as deep; movable finger 1.62-1.88 times as long as hand. Chelal trichobothriotaxy

typical; one spinelike seta on hand. Fixed chelal finger with 18-23 spaced macrodenticles and 9-12 interspersed microdenticles; movable finger with 7-9 spaced macrodenticles, 5-8 interspersed microdenticles, and 15-18 low, rounded teeth proximally. Sensillum on movable finger proximal to last macrodenticle.

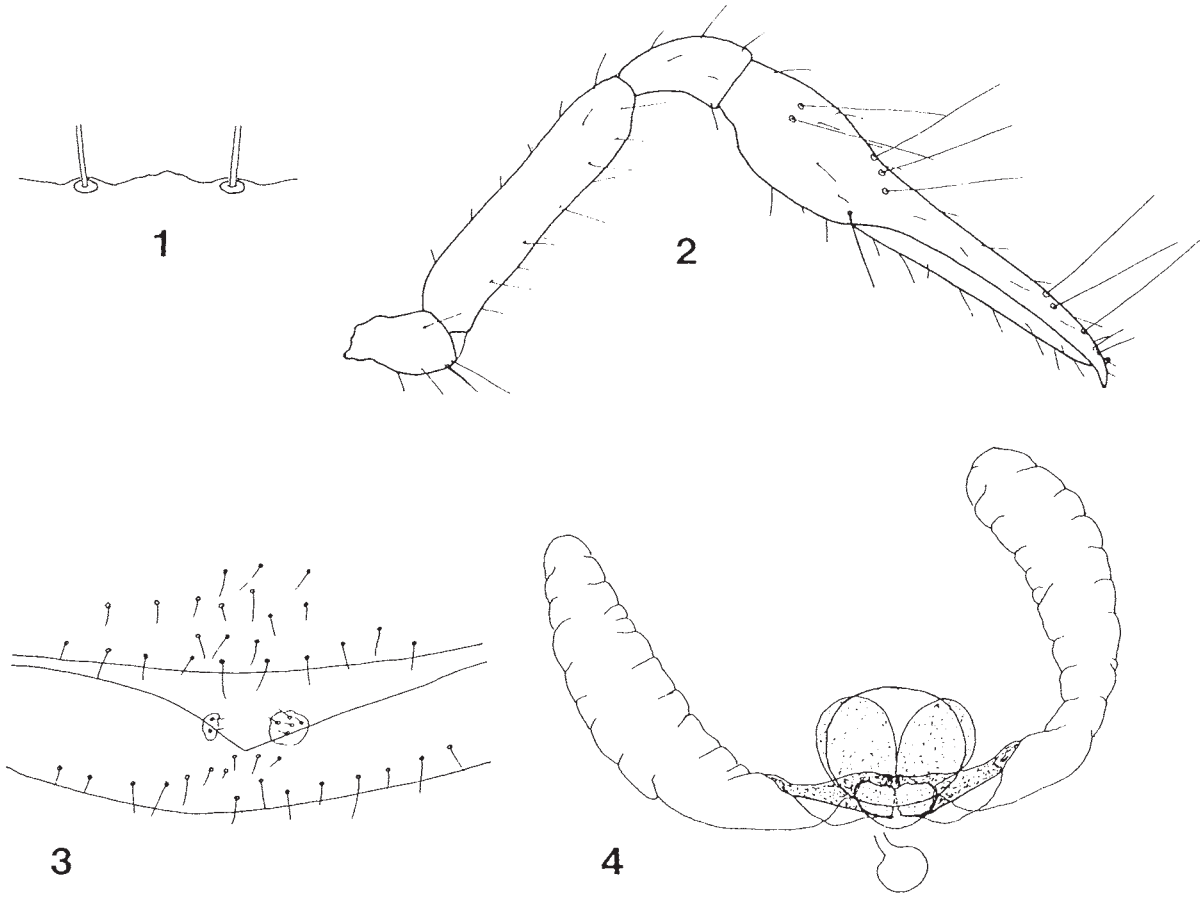
Legs relatively robust; leg IV with entire femur 2.3-2.5 and tibia 4.0-4.3 times as long as deep. Long tactile setae on tibia and both tarsi of leg IV.

Measurements (mm).—Figures given first for holotype followed in parentheses by ranges for the allotype and paratypes. Body length 1.08 (1.08-1.41). Carapace length 0.385 (0.355-0.45). Chelicera 0.285 (0.27-0.34). Palpal femur 0.415 (0.38-0.47) by 0.095 (0.085-0.11); tibia 0.165 (0.165-0.21) by 0.105 (0.095-0.12); chela 0.625 (0.585-0.725) by 0.13 (0.12-0.16); hand 0.255 (0.23-0.26) by 0.135 (0.1260.16); movable finger 0.415 (0.37-0.46) long. Leg IV: entire femur 0.37 (0.34-0.43) by 0.16 (0.15–0.17); tibia 0.265 (0.235-0.31) by 0.06 (0.55-0.75).

Etymology.—The new species is named *texanus* for the state in which it has been found.

Remarks.—This species is very similar to *T. floridensis* Malcolm and Muchmore (1985), but can be differentiated easily from that species by the occurrence of 6 setae on tergite 4 and the lack of a seta on the apical projection of coxa I. Although it has been found only in caves it is not much adapted for cavernicolous existence; the only modification appears to be the slight reduction in development of the posterior eyes. It is at best a troglophile and perhaps only accidental in caves. No epigean representatives of this genus have been reported from Texas, but this fact may be due simply to the paucity of collections of the litter dwelling fauna of the state.

Also at hand are 4 representatives of *Tyrannochthonius* from Arrowhead Cave, Hays County, Texas, 1983 (A.G. Grubbs), which probably belong to this species. Unfortunately, these specimens are so broken and dismembered that they cannot be identified with certainty.



Figs. 1-4.—1-2, *Tyrannochthonius texanus*, new species, holotype male: 1, epistome and flanking setae on carapace; 2, left palp, dorsal view; 3-4, *Tartarocreagris texana* (Muchmore), male from Amber Cave: 3, chaetotaxy of genital opercula; 4, internal genitalia, ventral view.

FAMILY NEOBISIIDAE CHAMBERLIN

Genus *Microbisium* Chamberlin

Microbisium Chamberlin, 1930:20; Nelson, 1984: 341.

This genus is represented in North America by 2 litter-dwelling species, *Microbisium brunneium* (Hagen) and *M. parvulum* (Banks). The latter is widespread through the United States and is occasionally found in caves.

Microbisium parvulum (Banks)

Obisium parvulum Banks, 1895:12.
Microbisium parvulum: Chamberlin, 1930:21; Hoff, 1946:495; Hoff, 1956b:3; Hoff, 1958:9; Nelson, 1984:341.
Microbisium confusum Hoff, 1946:496; Hoff, 1958:9; Nelson, 1975:280.
Microbisium sp.: Reddell, 1970:403.

This species is apparently distributed widely over North and Central America (Nelson, 1984), usually being found in moist ground litter. Occasional specimens have been found in Texas and 4 specimens are here reported from caves: 2 females from Mold Hole, Travis County, 8 June 1966 (J. Reddell); 1 female from Copperhead Cave, San Saba County, 12 June 1978 (J. Reddell and R. Fieseler); and 1 female from the entrance sink of Robber Baron Cave, San Antonio, Bexar County, 21 February 1986 (S.J. Harden).

Genus *Tartarocreagris* Curcic

Tartarocreagris Curcic, 1984:163.

The genus is based on the species *Microcreagris infernalis* Muchmore, 1969, which is known only from a single female specimen. With the addition of 3 more species, our understanding of the genus is increased.

Diagnosis (revised).—A genus of the family Neobisiidae Chamberlin (1930:9). Carapace longer than broad; with epistome small to absent; eyes 4 or absent; chaetotaxy 20-30, with 4 at anterior and 4-6 at posterior margin. Palpal coxa with 3-4 (occasionally 5) apical setae. Middle tergites with 12-15 setae; middle sternites with 15-17 setae (including 2 discal setae on sternites 6-8). Female anterior operculum with 3-4 small setae on each side of midline; posterior operculum with marginal row of 12-15, few sometimes displaced anteriorly near middle. Male anterior operculum with about 24 scattered setae; posterior operculum with 6-12 on face and 12-15 in marginal row. Internal genitalia of male with conspicuous round ventral sac, 2 smaller dorsal sacs, and 2 long, narrow, wrinkled lateral sacs. Cheliceral hand with 6-7 setae; flagellum of 8 serrate setae; galea bifurcate distad of middle, each ramus with 0-2 spinules, smaller in male than in female. Palp with small granulations on medial sides of trochanter, femur, and chelal hand, and occasionally on tibia; chelal fingers with numerous contiguous marginal teeth, the distalmost 10-20 with cusps, the others rounded. Fixed finger of chela with trichobothria *et*, *it* and *est* in distal half and *ist*, *isb*, and *ib* in proximal half; *esb* and *eb* placed laterally on distal part of hand. Subterminal tarsal setae of legs with spine near middle and few spinules near tip (not "furcate," as stated by Curcic, 1984:164).

Distribution.—As presently understood, the genus *Tartarocreagris* is represented only by troglobitic forms in Williamson and Travis Counties, Texas.

Tartarocreagris infernalis (Muchmore)

Microcreagris infernalis Muchmore, 1969:15, fig. 12.
Microcreagris. spp. (in part): Reddell, 1970:403.
Tartarocreagris infernalis (Muchmore): Curcic, 1984:163, figs. 21, 40.

The holotype female of this species was collected from under a rock, several thousand feet from entrance, in Core Hole Cave (Inner Space Cavern) near Georgetown, Williamson County, Texas. No other representative is known.

Microcreagris infernalis was designated the type species of the new genus *Tartarocreagris* by Curcic (1984).

Tartarocreagris texana (Muchmore), NEW COMBINATION
Figs. 3, 4

Microcreagris texana Muchmore, 1969:18, figs. 13, 14; Chambers and Jahrsdoerfer, 1988:36029.
Microcreagris. spp. (in part): Reddell, 1970:403.
Australinocreagris texana (Muchmore): Curcic, 1989:360, figs. 8, 15.

This species was described from the female holotype collected in Tooth Cave, Travis County, Texas.

Recently, in nearby Amber Cave, a male was found which appears conspecific with the holotype.

New record.—One male from Amber Cave, Travis County, Texas, 8 April 1984 (J. Reddell and M. Reyes); mounted on slide (FSCA). As this is the first male known for the genus *Tartarocreagris* Curcic, it is appropriate to provide a short description. Very similar to female in most respects. Carapace with epistome much reduced; no eyes; 23 setae, 4 at anterior and 6 at posterior margin. Palpal coxa with 4 apical setae. Tergal chaetotaxy 8:10:12:11:12:12:13:13:12:10:3:2. Sternal chaetotaxy 24:[2-5]:(5)6/12(5):(5)1/12(5):15:2/15:2/14:2/13:1/12:12:9:2 (Fig. 3). Internal genitalia (Fig. 4) much like those of *Microcreagris phyllisae* Chamberlin (1962:fig. 12), with 2 conspicuous, rounded sacs lying dorsal to a large round ventral sac, and the 2 lateral sacs long, rather narrow, and wrinkled. Cheliceral hand with 7 setae on right and 6 on left; flagellum of 9 serrate setae; galea bifurcated just distad of middle, each ramus in turn bifurcated. Palp with femur 5.75, tibia 4.55, and chela (with pedicel) 6.1 times as long as broad; hand (with pedicel) 2.75 times as long as deep; movable finger 1.34 times as long as hand with pedicel. Fixed finger with 97 and movable finger with 108 marginal teeth of which only the distal 10-15 are cusped. Leg IV with entire femur 5.15 and tibia 8.25 times as long as deep; subterminal tarsal setae with a small median spine and 1-2 spinules toward tip.

Measurements (mm).—Body length 3.96. Carapace length 1.08. Chelicera length 0.68. Palpal trochanter 0.71 by 0.28; femur 1.52 by 0.265; tibia 1.36 by 0.30; chela (without pedicel) 2.47 by 0.435; hand (without pedicel) 0.975 by 0.42; pedicel 0.185 long; movable finger 1.55 long. Leg IV: entire femur 1.18 by 0.23; tibia 1.07 by 0.13.

Remarks.—In his revision of some North American species of *Microcreagris*, Curcic (1984) did not deal with *M. texana*. However, his new genus *Tartarocreagris* is based on *M. infernalis* from Inner Space Cavern, about 25 miles north of Tooth Cave, the type locality of *M. texana*. The holotypes of both *M. infernalis* and *M. texana* are females, which are quite similar to one another in basic morphology, differing only in the degree of attenuation of their appendages and in small details of chaetotaxy. The male from Amber Cave is very like the females except in sex-related characters. It is clear that these specimens are congeneric and *texana* is assigned to *Tartarocreagris*.

The male described above is the first male known in the genus. It is interesting and intriguing that its genitalia are quite similar to those of *Microcreagris phyllisae*, which Curcic has placed in the genus *Saetigerocreagris* (1984:158). Further study will be required to resolve the questions posed by this similarity, as very little has yet been recorded about the genitalia of neobisioid pseudoscorpions.

Curcic (1989:360) has assigned *M. texana* to the genus *Australinocreagris* Curcic (1984), which is based on *M. grahami* Muchmore from Calaveras County, California. I find that assignment untenable because the internal genitalia of the male *texana* are quite different from those of male *grahami*, which lack the conspicuous rounded dorsal sacs (personal observation, to be published elsewhere).

It should be noted that *T. texana* has been declared an endangered species (see Chambers and Jahrsdoerfer, 1988) along with some other invertebrates in Travis and Williamson Counties.

Tartarocreagris reddelli (Muchmore), NEW COMBINATION

Microcreagris reddelli Muchmore, 1969:17, fig. 11.
Microcreagris spp. (in part): Reddell, 1970:403.
Australinocreagris reddelli (Muchmore): Curcic, 1989:360, figs. 7, 16.

This species was described from the holotype female collected in McDonald (Schulze) Cave, Travis County, Texas. More recently, two other specimens referable to this species have been found.

New records.—A topotype male from McDonald Cave, Travis County, Texas, 15 December 1988 (J. Reddell and M. Reyes) and a female from Beck's Ranch Cave, Williamson County, Texas, 23 June 1968 (J. Reddell and R.W. Mitchell); mounted on slides (FSCA). Both the female and the male are very similar to the holotype female in most respects, with the following noteworthy features. While the holotype has 21 setae on the carapace, with 4 at both anterior and posterior margins, the new specimens have 24 (male) and 25 (female) setae, with 4 at anterior and 5 at posterior margins. The holotype has 3 long setae on the apex of each palpal coxa, but each of the new specimens has 4 setae in that position. Anterior genital operculum of female with 8 setae, posterior operculum with 12. Male genitalia much like those of *T. texana*, with 2 rounded sacs lying dorsal to a single ventral sac; chaetotaxy 23:[3-3]:(6)12/14(7): (4)11(4):—. Both of the new specimens have 6 (rather than 7) setae on the hand of the chelicera; galea smaller in male than female, bifurcate in distal half, each ramus with 0-2 spinules. Ratios of palpal segments, male (female):

trochanter 2.5 (2.6), femur 5.55 (5.55), tibia 4.05 (4.0), chela (with pedicel) 5.05 (5.1), hand (with pedicel) 2.2 (2.25), movable finger/hand with pedicel 1.53 (1.43).

Measurements (mm), male (female).—Body length 3.42 (3.08). Carapace length 1.04 (1.08). Chelicera 0.605 (0.67) long. Palpal trochanter 0.63 by 0.25 (0.70 by 0.27); femur 1.39 by 0.25 (1.47 by 0.265); tibia 1.26 by 0.31 (1.325 by 0.33); chela (including pedicel) 2.43 by 0.48 (2.65 by 0.52); hand (including pedicel) 1.00 by 0.45 (1.13 by 0.50); movable finger 1.53 (1.62) long. Leg IV: entire femur 1.10 by 0.225 (1.16 by 0.25); tibia 1.07 by 0.125 (1.10 by 0.13).

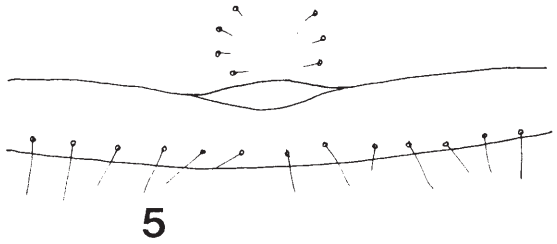
Remarks.—As with *M. texana* Curcic (1989: 360) has assigned this species to the genus *Australinocreagris*. However, the internal genitalia of the male are very similar to those of *texana*, and show that *reddelli* is congeneric with *texana* and not with *grahami*.

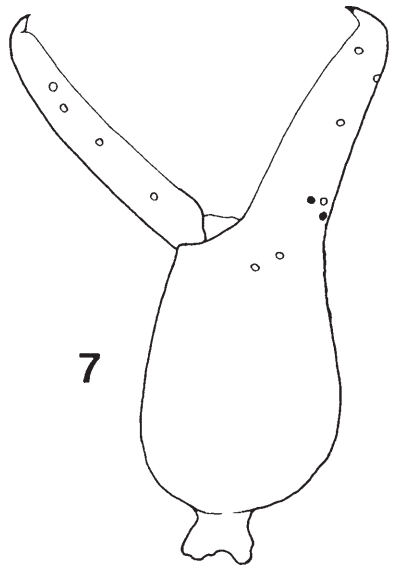
It should be noted that Schulze Cave and McDonald Cave are the same; the preferred name is McDonald Cave.

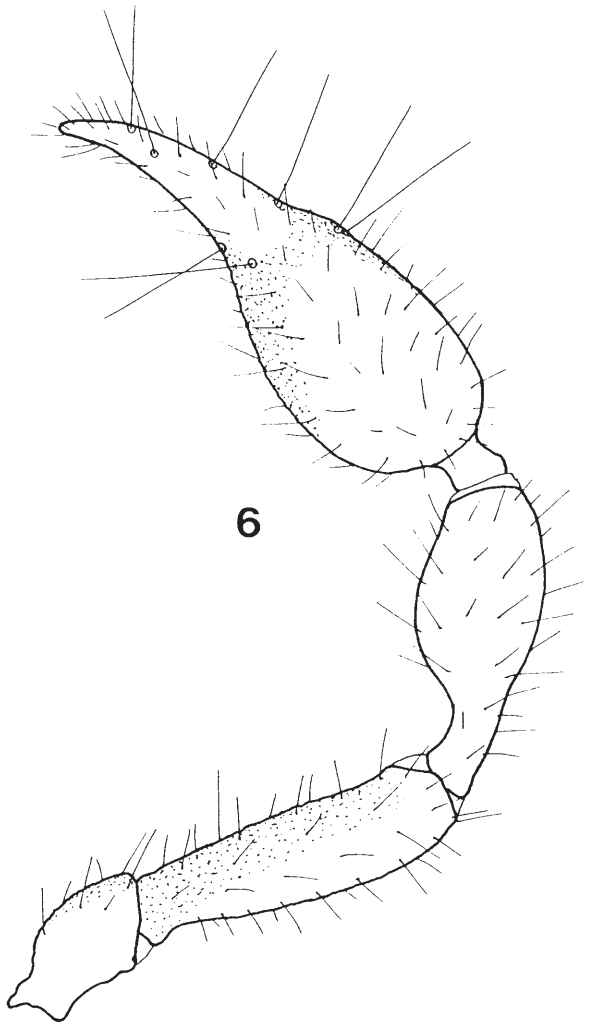
Tartarocreagris comanche, new species
Figs. 5-7

Type-data.—Holotype female (WM7367.01001) from New Comanche Trail Cave, Travis County, Texas, 26 January 1989 (J. Reddell and M. Reyes); mounted on slide (FSCA).

Diagnosis.—A moderate sized species (palpal







Figs. 5-7.—*Tartarocreagris comanche*, new species, holotype female: 5, chaetotaxy of genital opercula; 6, right palp, dorsal view; 7, left chela, lateral view (darkened areoles are underneath).

chela 1.75 mm long), with relatively robust appendages (chela L/B = 3.25), and with poorly developed eyes.

Description of female (male unknown).—Body tan, palps light brown. Carapace longer than broad; with a low, triangular epistome; 4 small, scarcely corneate eyes; about 30 setae, 4 at anterior and 7 at posterior margin. Coxal area typical; palpal coxae with 4 apical setae on right and 5 on left.

Abdomen long ovate. Tergal chaetotaxy 8:13:13: 13:13:16:12:16:12:11:3:2. Anterior genital operculum with 3 or 4 setae on either side of midline, posterior operculum with 13 marginal setae (Fig. 5); each spiracle with 6 or 7 guard setae; sternites with 14-15 marginal setae, and, in addition, sternites 6-8 with 2 setae on face near middle.

Chelicera 0.65 as long as carapace; hand with 7 setae; galea bifurcated near end, each ramus with 2-3 terminal branches; flagellum of 8 pinnate setae.

Palp rather short and heavy (Fig. 6); femur 1.15 and chela 1.67 times as long as carapace. Trochanter 2.0, femur 3.8, tibia 2.7, and chela (including pedicel) 3.25 times as long as broad; hand (including pedicel) 1.55 times as long as deep; depth of hand greater (1.15 times) than breadth; movable finger 0.93 as long as hand with pedicel. Femur and chelal hand at base of fingers moderately granulate, other parts smooth. Trichobothria as shown in Fig. 7. Fixed finger with 44 and movable finger with 55 marginal teeth, only 8-10 at distal end of each finger with cusps.

Legs normal. Leg IV with entire femur 3.95 and tibia 5.75 times as long as deep. Tibia and each tarsus with a tactile seta. Subterminal tarsal setae spinous in distal third.

Measurements (mm).—Body length 3.51. Carapace length 0.96. Chelicera length 0.62. Palpal trochanter 0.56 by 0.28; femur 1.10 by 0.29; tibia 0.97 by 0.36; chela (without pedicel) 1.61 by 0.54; hand (without pedicel) 0.805 by 0.62; pedicel 0.155 long; movable finger 0.895 long. Leg IV: entire femur 0.91 by 0.23; tibia 0.805 by 0.14.

Etymology.—The species is named *comanche* for the cave in which it is found, New Comanche Trail Cave.

Remarks.—*Tartarocreagris comanche* is distinguished from the other known species of the genus by its lesser modification for cave existence; it is smaller and more robust, is darker in color, and has 4 (albeit small) eyes. It is almost like an epigean form, but (in the absence of a non-cave representative of *Tartarocreagris*) compared to *Cryptocreagris laudabilis* (Hoff) it is much lighter and has poorly developed eyes.

In most neobisiid pseudoscorpions the hand of the palpal chela is almost round in cross section or a little flattened in a dorsal-ventral direction, that is, the depth is equal to or less than the breadth. In *T. comanche*, however, the depth of the hand is greater than the breadth, by a significant factor of 1.15. The importance of this unusual construction is unknown, but it may be analogous to the situation in some olpiids (e.g. *Aldabrinus aldabrinus* Chamberlin) and some chernetids (e.g. *Dinocheirus tenoch* Chamberlin) where similar deep chelal hands are developed.

FAMILY BOCHICIDAE CHAMBERLIN

Genus *Leucohya* Chamberlin

Leucohya Chamberlin, 1946:7; Muchmore, 1986: 26.

This genus is represented by only 3 species, from Nuevo León, Mexico, and Texas. All are troglobites.

Leucohya texana Muchmore

Leucohya texana Muchmore, 1986:26, figs. 16-18.

The holotype female of this species was found in Frio Queen Cave, Uvalde County, Texas. No other representative is known.

FAMILY SYARINIDAE CHAMBERLIN

Genus *Chitrella* Beier

Chitrella Beier, 1932a:165; Malcolm and Chamberlin, 1960:2; Muchmore, 1973:183; 1982:218, 219.

Representatives of this genus have been recorded from the states of California, Utah, New Mexico, Colorado, Tennessee, Virginia, and West Virginia. Three of the 7 known species are troglobitic. Epigean forms are found in moist litter.

Chitrella welbourni, new species
Figs. 8-10

Chitrella sp.: Welbourn, 1978:31.

Type-data.—Holotype male (WM3757.01001) and paratype male in Berlese of material from

bottom of entrance pit, Ogle Cave (Ogle Section), Carlsbad Caverns National Park, Eddy County, New Mexico, 2 September 1974 (W.C. Welbourn); allotype female (WM3340.01001) found on damp flowstone in twilight, Ogle Cave (Rainbow Section), CCNP, Eddy County, New Mexico, 27 May 1973 (W.R. Elliott); all mounted on slides (FSCA).

Diagnosis.—Much like *Chitrella transversa* (Banks) but larger (chela length 1.13-1.41 mm rather than 0.78-1.00 mm) and with more slender appendages (chela length/breadth 3.55-3.9 rather than 2.8-3.35).

Description.—Male and female similar, but female distinctly larger. Carapace and palps light brown, other parts lighter. Carapace longer than broad; surface smooth; with 2 indistinct transverse furrows; 4 corneate eyes; about 30 setae, 6 at anterior and 7-8 at posterior margin.

Abdomen long, narrow. Tergal chaetotaxy of holotype 7:10:11:14:13:14:15:15:15:11:7:2; others similar. Sternal chaetotaxy of male like that of *C. transversa* (see Muchmore, 1973:190); that of holotype 14:[1-1]:(3)9/14(4):(3)24(3):0/16:17:18: 17:16:14:4:2; paratype similar but with 4 setae on all stigmatic plates; there is no sensory area on sternite 6; sternites 6-10 with 2 larger setae near middle of row. Anterior sternal chaetotaxy of female 7:(4)16(4):(4)12(4):—; sternites 6-10 with 2 enlarged setae as in male.

Chelicera 0.55-0.6 as long as carapace; hand with 5 setae; flagellum apparently of 5 serrate setae; no spinneret visible.

Palp rather slender (Fig. 8); femur 4.2 (male), 5.05 (female), tibia 2.55-2.7 (male), 3.2 (female), and chela (without pedicel) 3.55-3.75 (male), 3.9 (female) times as long as broad; hand (without pedicel) 1.55-1.6 (male), 1.85 (female) times as long as deep; movable finger 1.35 (male), 1.3 (female) times as long as hand. Surfaces smooth except few small granules on medial sides of femur, tibia, and chelal hand. Trichobothria typical (Fig. 9); *t*, on movable finger, is flattened or lanceolate toward distal end. Fixed finger with 52-65 cusped marginal teeth; movable finger with 52-63 teeth, of which only the distal 10-12 are cusped, the others lower and rounded. Movable finger with a sensillum between trichobothria *st* and *sb*. In addition, movable finger with a low thickening of the dental margin (denticle?) lateral to proximal teeth (4th from proximal end of row in holotype, 6th in allotype) (Fig. 10); this structure not evident in paratype male.

Legs rather slender; leg IV with entire femur 3.25-3.4 and tibia 5.1- 6.0 times as long as deep. A long tactile seta on tibia and basitarsus of leg IV. Subterminal tarsal setae dentate.

Measurements (mm).—Figures given first for holotype male, followed in parentheses by those for paratype male and allotype female. Body length 3.0 (3.0-3.05). Carapace length 0.76 (0.79-0.82). Chelicera 0.41 (0.42-0.48) long. Palpal trochanter 0.36 (0.35-0.49) by 0.19 (0.21-0.21); femur 0.75 (0.76-0.96) by 0.18 (0.18-0.19); tibia 0.63 (0.64-0.80) by 0.235 (0.25-0.25); chela (without pedicel) 1.13 (1.20-1.41) by 0.30 (0.34-0.36); hand (without pedicel) 0.50 (0.52-0.65) by 0.31 (0.33-0.35); pedicel 0.07 (0.075-0.09) long; movable finger 0.68 (0.69-0.83) long. Leg IV: entire femur 0.69 (0.695-0.79) by 0.20 (0.215-0.23); tibia 0.56 (0.585-0.72) by 0.11 (0.115-0.12).

Etymology.—The species is named for W.C. Welbourn, who has collected most of the pseudoscorpion material known from caves in New Mexico.

Remarks.—It is interesting to note that *C. welbourni* is similar to *C. transversa* in not having a specialized sensory area on the 6th sternite of males. On the other hand, 9 specimens of *C. transversa* examined fail to show the lateral thickening (denticle?) of the proximal dental margin as seen in *C. welbourni*.

In *C. welbourni* (and the other species of *Chitrella* treated below) there are 2 transverse furrows on the carapace, rather than one as seen in *C. transversa*; one (equivalent to that in *C. transversa*) is located just posterior to the middle of the carapace, while the second is closer to the posterior margin. As Hoff pointed out (1956b:22), these "furrows" are noticeable more because of underlying thickening of the cuticle than depression of the surface.

Chitrella major, new species
Fig. 11

Type-data.—Holotype female (WM4571.01002) and 2 paratypes (1 female, 1 tritonymph) from Fern Cave, Val Verde County, Texas, 14 April 1973 (T.R. Mollhagen); mounted on slides (FSCA).

Diagnosis.—This is the largest known species of *Chitrella* in the United States (palpal chela > 1.4 mm in length).

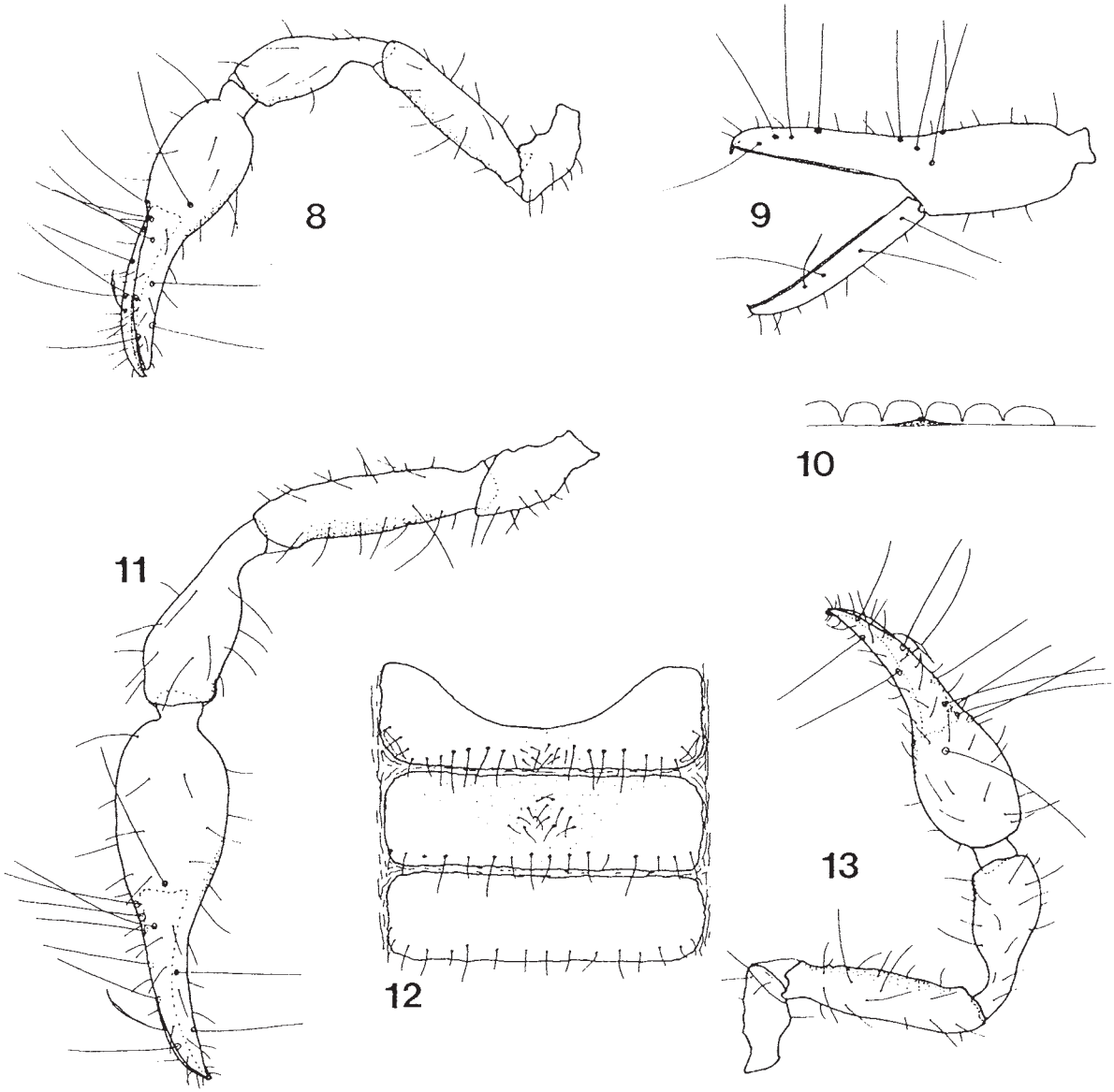
Description of female (male unknown).—Carapace and palps reddish brown, other parts tan. Carapace longer than broad; surface smooth; with 2 distinct transverse furrows; 4 corneate eyes, posterior pair smaller; 38-40 setae, with 7-9 at anterior and 8 at posterior margin

Abdomen long, narrow. Tergal chaetotaxy of holotype 7:11:13:12:14:17:15:15:15:13:11:2. Sternal chaetotaxy of holotype 9:(4)19(4):4)15(4): 18:18:17:18:17:14:4:2; sternites 7-10 with 2 larger setae near middle of row.

Chelicera about 0.55 as long as carapace; hand with 5 acuminate setae; flagellum of 5 denticulate setae; no spinneret visible.

Palp rather slender (Fig. 11); femur 4.25, tibia 2.75-2.8, and chela (without pedicel) 3.1-3.2 times as long as broad; hand (without pedicel 1.6 times as long as deep; movable finger about 1.15 times as long as hand. Surfaces smooth except few small granules on medial sides of femur, tibia and chelal hand. Trichobothria typical; *t* flattened or lanceolate toward distal end. Fixed chelal finger with 56-61 and movable finger with 55-62 marginal teeth. Movable finger with sensillum distad of trichobothrium *sb*; also with a low thickening of the dental margin as seen in *C. welbourni*, near penultimate tooth in holotype and 7th tooth in paratype female (this structure not apparent in tritonymph paratype, but present in tritonymph from H.T. Miers Cave).

Legs rather slender; leg IV with entire femur 3.3 and tibia 5.7-6.0 times as long as deep. A long



Figs. 8-13.—8-10, *Chitrella welbourni*, new species: 8, right palp of holotype male, dorsal view; 9, left chela of allotype female, lateral view (darkened areoles are underneath); 10, most proximal teeth on movable finger of holotype male, showing lateral thickening (denticle?) of finger margin; 11, *Chitrella major*, new species, female: right palp, dorsal view; 12-13, *Chitrella elliotti*, new species, holotype male: 12, sternites 4-6; 13, right palp, dorsal view.

tactile seta on tibia and basitarsus. Subterminal tarsal setae denticulate.

Tritonymph.—Similar to adults but less heavily sclerotized, smaller, and with less slender appendages. Carapace without the transverse furrows so evident in adults; 4 corneate eyes, posterior pair smaller; 6 setae at anterior and 7 at posterior margin. Chelicera with 5 setae on hand and 5 setae in flagellum. Palp with femur 3.65, tibia 2.45, and chela (without pedicel) 3.0 times as long as broad. Fixed chelal finger with 46 and movable finger with 44 marginal teeth; movable finger with sensillum on lateral surface between trichobothria *st* and *b*, closer to *st*; the paratype without a proximal "denticle" on the dental margin. Leg IV with entire femur 3.0 times as long as deep.

In addition to the paratype tritonymph, there is at hand a very similar tritonymph from H.T. Miers Cave, Del Rio, Val Verde County, Texas, 29 January 1984 (P. Sprouse); mounted on slide (FSCA).

Measurements (mm).—Adults: Figures given first for holotype, followed in parentheses by those for paratype. Body length 3.84 (3.83). Carapace length 0.975 (1.00). Chelicera 0.52 (0.54) long. Palpal trochanter 0.56 (0.56) by 0.26 (0.26); femur 1.00 (1.00) by 0.235 (0.235); tibia 0.87 (0.89) by 0.31 (0.325); chela (without pedicel) 1.44 (1.50) by 0.465 (0.47); hand (without pedicel) 0.69 (0.73) by 0.43 (0.45); pedicel 0.11 (0.12) long; movable finger 0.805 (0.815) long. Leg IV: entire femur 0.83 (0.83) by 0.25 (0.25); tibia 0.75 (0.74) by 0.125 (0.13).

Tritonymph: Body length 2.57. Carapace length 0.68. Chelicera 0.37. Palpal trochanter 0.36 by 0.17; femur 0.62 by 0.17; tibia 0.54 by 0.22; chela (without pedicel) 0.955 by 0.32; hand (without pedicel) 0.465 by 0.29; pedicel 0.08 long; movable finger 0.555 long. Leg IV: entire femur 0.55 by 0.185; tibia 0.46 by 0.095.

Etymology.—The species is named *major* for its large size among western U.S. species of *Chitrella*.

Chitrella elliotti, new species
Figs. 12, 13

Type-data.—Holotype male (WM4568.01001) and allotype female (WM4568.01002) from Felton Cave, Sutton County, Texas, 26 October 1974 (W.R. Elliott); mounted on slides (FSCA).

Diagnosis.—Similar to *C. transversa* (Banks) in many respects; intermediate in size between *C. transversa* and *C. major*, with palpal chela about 1.2 mm long.

Description.—Male and female essentially alike. Carapace and palps light brown, other parts lighter. Carapace longer than broad; surface smooth; with 2 distinct transverse "furrows"; 4 corneate eyes; about 36 setae, with 6 at anterior and 8 at posterior margin.

Abdomen long, narrow. Tergal chaetotaxy of holotype 8:12:12:14:14:15:15:14:15:11:7:2; allotype similar. Sternal chaetotaxy of male 7:[1-1]: (3)8/14(3):(4)23(3):13/16:16:18:15:16:14:5:2; no sensory area on sternite 6 (Fig. 12); sternites 7-10 with 2 enlarged setae near middle of row. Anterior sternal chaetotaxy of female 8:(4)19(4):(3)14(4):—; sternites 7-10 with 2 larger setae as in male.

Chelicera about ½ as long as carapace; hand with 5 acuminate setae; flagellum of 5 serrate setae; no spinneret visible.

Palp moderately slender (Fig. 13); femur 3.8-3.9; tibia 2.35-2.5, and chela (without pedicel) 2.85-3.15 times as long as broad; hand (without pedicel) 1.4-1.55 times as long as deep; movable finger 1.17-1.22 times as long as hand. Surfaces smooth, except few small granules on medial sides of femur, tibia and chelal hand. Trichobothria typical; *t*, on movable finger, flattened or lanceolate toward distal end. Fixed finger with 53-56 and movable finger with 54-61 marginal teeth. Sensillum on movable finger between trichobothria *st* and *sb*; no thickening of dental margin (denticle?) such as that seen in *C. welbourni* and *C. major*.

Legs moderately slender; leg IV with entire femur 3.05-3.15 and tibia 4.6-4.85 times as long as deep. A long tactile seta on tibia and basitarsus of leg IV. Subterminal tarsal setae dentate.

Measurements (mm).—Figures given first for holotype male, followed in parentheses by those for allotype female. Body length 2.78 (3.42). Carapace length 0.82 (0.83). Chelicera 0.42 (0.46) long. Palpal trochanter 0.445 (0.48) by 0.21 (0.22); femur 0.82 (0.83) by 0.21 (0.22); tibia 0.70 (0.70) by 0.28 (0.295); chela (without pedicel) 1.20 (1.22) by 0.38 (0.43); hand (without pedicel) 0.555 (0.59) by 0.36 (0.42); pedicel 0.11 long; movable finger 0.68 (0.69) long. Leg IV: entire femur 0.695 (0.70) by 0.22 (0.23); tibia 0.57 (0.58) by 0.12 (0.125).

Etymology.—The new species is named for William R. Elliott, who collected the type specimens and many other interesting pseudoscorpions in the southwestern states.

Chitrella, sp. indet.

A single male was found in Lower Sloth Cave, Guadalupe Mountains National Park, Culberson County, Texas (W.C. Welbourn), which is

mutilated and has important parts missing or broken. From the data available it seems close to *C. welbourni*, with which it may be conspecific. However, a final determination will have to await collection and study of additional material.

Lower Sloth Cave also supports a population of *Archeolarca guadalupensis* (see below).

FAMILY GARYPIDAE HANSEN

Genus *Archeolarca* Hoff and Clawson

Archeolarca Hoff and Clawson, 1952:2.

Five species of *Archeolarca* are known, all from pack rat nests and/or caves in Utah, Oregon, California, Arizona, New Mexico and Texas.

Archeolarca guadalupensis Muchmore

Archeolarca guadalupensis Muchmore, 1981:54, figs. 9, 10.

The 7 types (2 males, 2 females, 2 tritonymphs, 1 deutonymph) were collected in Lower Sloth Cave, Guadalupe Mountains National Park, Culberson County, Texas. No other representative is known.

Archeolarca, sp. indet.

Three nymphs belonging to this genus were collected by Berlese separation of bat guano in Truckett Guano Cave, Valencia County, New Mexico, 11 September 1976, by W.C. Welbourn. It is impossible to determine the specific identification of these immature specimens.

FAMILY CHEIRIDIIDAE CHAMBERLIN

Genus *Cheiridium* Menge

Cheiridium Menge, 1855:36; Hoff, 1952:188.

Four species of *Cheiridium* are presently known from the United States, as discussed below. All are tiny creatures, usually found in rather dry litter.

Cheiridium reyesi, new species
Figs. 14, 15

Type-data.—Holotype female (WM7363.01001) from Cot Cave, Kinney County, Texas, 7 October 1987 (M. Reyes); mounted on slide (FSCA).

Diagnosis.—Similar to *C. firmum* Hoff (1952) from which it can be distinguished by its larger size (palpal chela 0.40 mm long *vs.* 0.33-0.36 mm) and more slender appendages (palpal femur 4.25 times as long as broad *vs.* 3.25-3.5 times).

Description of female (male unknown).—With the general characters of the genus. All parts light brown. Carapace subtriangular, with a median transverse furrow and a shallow depression near posterior margin; surface granulate anterior to transverse furrow, reticulate behind; 2 small, corneate eyes; setae slender, curved, 4 at anterior and 8-10 at posterior margin. Abdomen ovate; tergites divided. About 20 slender curved setae on middle tergites. Chaetotaxy of sternites not observable.

Chelicera about ¼ as long as carapace; setae on hand not discernible; flagellum of 4 setae; galea long, slender, with 2 or 3 small terminal rami.

Palp rather slender (Fig. 14); femur 4.25, tibia 2.65, and chela (without pedicel) 2.85 times as long as broad; hand (without pedicel) 1.55 times as long as deep; movable finger 1.05 times as long as hand. Surfaces heavily granulate, with many arcuate setae with midlateral spinules. Trichobothria as usual in the genus, fixed finger with 7 and movable finger with 2; *et* just proximad of middle of fixed finger, much closer to *est* than to finger tip (Fig. 15). Each finger with 8-10 small marginal teeth, conical or rounded distally, becoming flattened proximally.

Legs rather slender; leg IV with entire femur 5.3 and tibia 4.65 times as long as deep. Articulation between basifemur and telofemur of all legs faintly visible (as in Figs. 17 and 18).

Measurements (mm).—Body length 1.04. Carapace length 0.34, posterior breadth 0.41. Chelicera 0.09 long. Palpal trochanter 0.16 by 0.085; femur 0.32 by 0.075; tibia 0.25 by 0.095; chela (without pedicel) 0.40 by 0.14; hand (without pedicel) 0.20 by 0.13; pedicel 0.03 long; movable finger 0.21 long. Leg IV: entire femur 0.265 by 0.05; tibia 0.21 by 0.045; tarsus 0.185 by 0.03.

Etymology.—The new species is named for Marcelino Reyes who collected the type specimen.

Remarks.—Until now, only 3 species of *Cheiridium* have been reported from the United States: *C. firmum* Hoff (1952), *C. insperatum* Hoff and Clawson (1952), and *C. museorum* (Leach) (see Muchmore, 1972). Of these, *C. museorum* is an immigrant from Europe found in Massachusetts and is larger and has more slender palps than the new species. *C. insperatum* was described from Utah and has subsequently been identified in California (unpublished); it is even larger and has even slenderer palps. *Cheiridium firmum* is recorded only from Illinois, but a specimen from a cave in

Missouri may be conspecific (unpublished); it is smaller and more robust than the new species. *Cheiridium reyesi* is apparently more closely related to the midwestern forms and may be somewhat modified for cavernicolous existence.

It is interesting to note that the articulations between femoral segments are distinctly visible in all legs. This is at variance with the condition in many species of *Cheiridium* and related genera, where the femora appear completely fused, with no visible suture between basifemur and telofemur.

Genus *Apocheiridium* Chamberlin

Apocheiridium Chamberlin, 1924:34; Benedict, 1978:231.

Seven species of *Apocheiridium* have been known from across the United States. As representatives are usually found under the bark of living trees, it is surprising that a new form from Texas is cavernicolous.

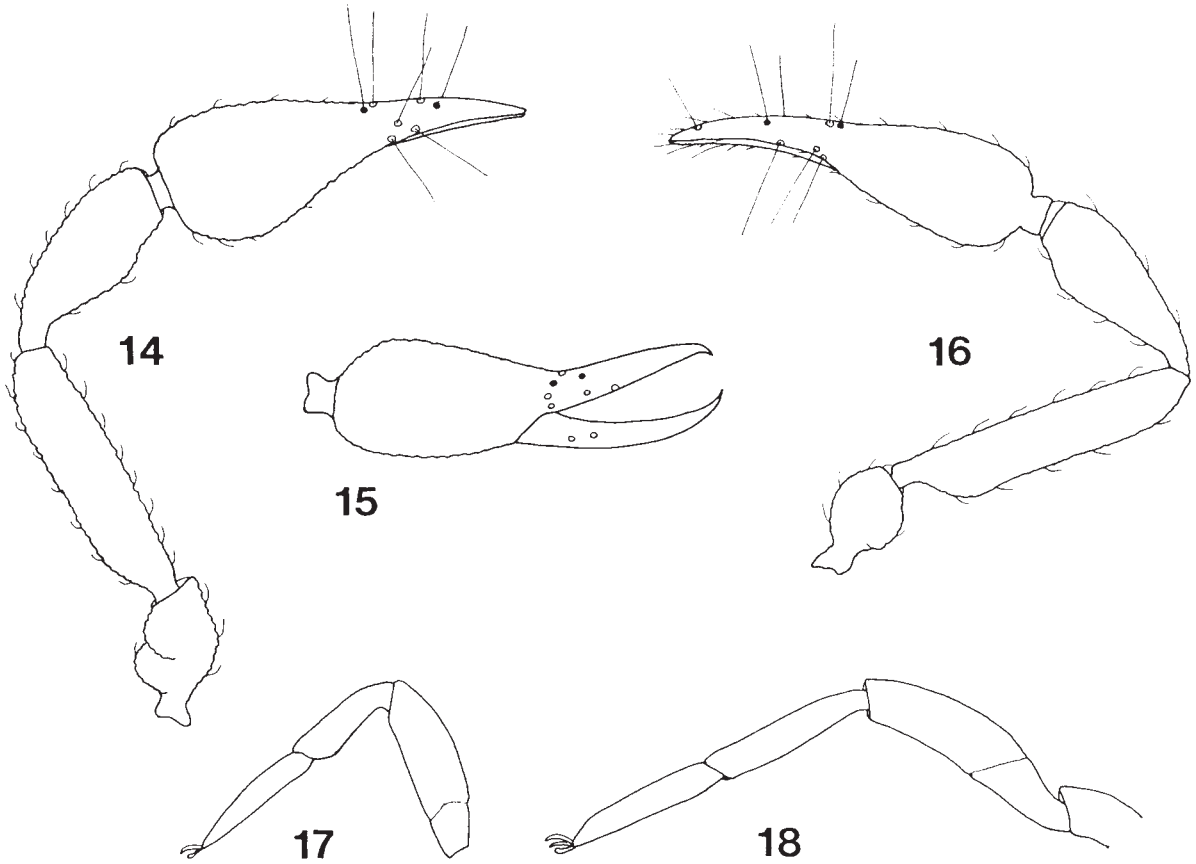
Apocheiridium reddelli, new species
Figs. 16-18

Apocheiridium sp.: Reddell, 1970:402.

Type-data.—Holotype male (WM900.01001) from Devil's Sinkhole, near Rocksprings, Edwards County, Texas, 14 March 1966 (J. Reddell); mounted on slide (FSCA).

Diagnosis.—Similar to *A. stanndardi* Hoff (1952) in general shape, but a little smaller (palpal chela 0.33 mm long), with surfaces much less granulate, and with chelal fingers shorter than hand.

Description of male (female unknown).—With the general characters of the genus (see Benedict, 1978). Carapace and tergites not granulate, but distinctly reticulate; setae small, acuminate. Carapace with shallow, median transverse furrow; 2 prominent corneate eyes; 4 setae at anterior and 12 at posterior margin. Abdomen ovate, 11 segments visible from above; tergites 1-9 divided; tergal chaetotaxy 15:16: 15:16:21:21:19:19:-; sternal



Figs. 14-18.—14–15, *Cheiridium reyesi*, new species, holotype female: 14, left palp, dorsal view; 15, right chela, dorsolateral view (darkened areoles are underneath); 16-18, *Apocheiridium reddelli*, new species, holotype male: 16, right palp, dorsal view; 17, leg I,

chaetotaxy not discernible. Internal genitalia like that shown by Chamberlin (1931:fig. 51D).

Chelicera ¼ as long as carapace; 4 setae on hand; flagellum of 3 unequal setae; galea short, simple.

Palp relatively slender (Fig. 16): femur 5.2, tibia 3.25, and chela (without pedicel) 3.45 times as long as broad; hand (without pedicel) 2.4 times as long as deep; movable finger 0.89 as long as hand. Femur with a small, proximal bulge. Surfaces with sparse, small granules, no large granules. Some setae arcuate and with midlateral spinules. Trichobothria as usual in the genus, 7 on fixed finger and one on movable finger; *et* well distad of middle of fixed finger, much closer to finger tip than to *est*. Marginal teeth on fingers not discernible.

Legs rather slender: leg IV with entire femur 4.5 and tibia 4.5 times as long as deep. Femora of all legs show the articulation between basifemur and telofemur (Figs. 17-18).

Measurements (mm).—Body length 1.15. Carapace length 0.325, posterior breadth 0.35. Chelicera 0.08 long. Palpal trochanter 0.12 by 0.075; femur 0.265 by 0.05; tibia 0.21 by 0.065; chela (without pedicel) 0.33 by 0.095; hand 0.18 by 0.075; pedicel 0.03 long; movable finger 0.16 long. Leg IV: entire femur 0.22 by 0.05; tibia 0.155 by 0.035; tarsus 0.13 by 0.025.

Etymology.—The species is named for James R. Reddell in honor of his great contributions to the study of the cave fauna of Texas.

Remarks.—*Apocheiridium reddelli* appears most closely related to *A. stannardi* Hoff (1952, 1961), which is known from Illinois, Michigan and Colorado. Its lighter color, reduction of granulation, and more slender palps are probably adaptations to the cave habitat. In the reduction of granulation *A. reddelli* resembles *A. inexpectum* Chamberlin from southern California and Baja California, Mexico (see Benedict, 1978); from that tree-dwelling species it is distinguished by its smaller size and the chelal fingers shorter than the hand. Other unusual, but unexplained, characters of *A. reddelli* are the relatively far distal position of trichobothrium *et* and the obvious articulations between the femoral segments of all legs (which can also be seen in *Cheiridium reyesi*, above).

FAMILY CHERNETIDAE CHAMBERLIN

Genus *Neoallochernes* Hoff

Neoallochernes Hoff, 1947:499.
Tejachernes Hoff, 1957:83 (NEW SYNONYMY).

The genus *Neoallochernes* is based on *Chelanops garcianus* Banks, 1909, from Havana, Cuba. Hoff (1947) studied the type collection (in MCZ) consisting, according to him, of 3 females and 1 tritonymph(?); one of the adults was mounted on a slide and designated the lectotype. Redescription of the type species and diagnosis of the genus was based on the mounted lectotype, supplemented by certain data from the 2 other adults. I have had the opportunity to restudy the lectotype and to mount and study the 2 other adult specimens. In most respects, the descriptions by Hoff are found to be accurate; however, a few corrections and additions are provided below.

In addition, there is available from Las Villas, Cuba, a collection of pseudoscorpions which are certainly congeneric with *Chelanops garcianus*. They are described below as *N. cubanus*.

On the basis of new information gained recently, it is now possible to diagnose the genus *Neoallochernes* in up-to-date terms.

Diagnosis (revised).—A genus of the family Chernetidae. Carapace longer than broad; surface strongly granulate; 2 conspicuous transverse furrows; 2 distinct eyespots; setae narrow clavodentate. Abdominal tergites 1-10 and sternites 5-10 divided; tergal surfaces granulate, setae narrow clavodentate to terminally denticulate, no acuminate tactile setae on tergite 11; sternal surfaces smooth, setae mostly acuminate, 11th sternite with 2 (lateral) long, acuminate tactile setae. Anterior operculum of male with group of 40-50 setae, including 4 elongated ones; posterior operculum with 4-8 small, internal guard setae on each side and a marginal row of 10-15 larger setae. Anterior operculum of female with a horseshoe-shaped group of 30-40 setae; posterior operculum with row of 10-15. Internal genitalia of male large and heavily sclerotized (Fig. 19), with large wrinkled lateral sacs. Each spermatheca of female in form of an elongated sac with a small terminal cribriform plate and a short slender tubule leading into a single median chamber with a large ovoid cribriform plate (Fig. 20). Chelicera with 4 setae on hand (*sbs* absent), *bs* moderately long, denticulate, and the others long, acuminate; flagellum of 3 setae, at least the distal 2 denticulate; galea fairly robust but with only a few small rami, smaller in male than female. Palp fairly robust, less so in female than male; surfaces partly granulate; setae strong, narrow clavodentate to denticulate; both chelal fingers with several accessory teeth; venom apparatus well developed in movable finger, with nodus ramosus at or proximad of level of trichobothrium *st*; usually a vestigial venom duct apparent in fixed finger.

Trichobothriotaxy of chela generally typical for chernetids (Fig. 22); movable finger with *t* and *st* close together in distal half and *b* and *sb* close together in proximal half; fixed finger with *ist* a little distad of *est*, which is proximad of middle, and *ib* and *isb* near level of *esb* at base of finger. Legs typical; surfaces of femora granulate to scaly. Tarsus of leg IV with a long, terminally denticulate seta about 3/4 length of segment from proximal end.

Remarks.—*Dinocheirus stercoreus* Turk, the type species of the genus *Tejachernes* Hoff, is, without doubt, a representative of *Neoallochernes* (see below).

Its peculiar combination of characters, especially the unique spermathecae of the female, places *Neoallochernes* well apart from other genera in the Chernetidae, according to our present knowledge. However, further study of the genitalia of the many other relatively unknown American forms can be expected to shed more light on its affinities.

Geographic distribution.—In addition to the representatives from Cuba and Texas treated below, many other specimens belonging to *Neoallochernes* are presently under study. These are from Mexico and several Central American countries.

Neoallochernes garcianus (Banks)

Chelanops garcianus Banks, 1909:147.
Dinocheirus garcianus (Banks): Beier, 1932b:139.
Neoallochernes garcianus (Banks): Hoff, 1947:500, figs. 13, 14.

Types examined.—Lectotype male and 2 paratype males from Havana, Cuba (Baker); lectotype mounted on slide by Hoff and paratypes mounted by me (MCZ).

As mentioned above, Hoff has given a full and mostly accurate account of this species. However, a couple of corrections and additions should be mentioned, based upon my restudy of the type material.

Firstly, the adult specimens, including the lectotype, are all males, rather than females as Hoff stated (1947:500); the genital features are typically male. Thus it is the female which is absent from the type collection, making a characterization of the female genitalia impossible.

Hoff was correct in stating "Tarsus of fourth leg without tactile seta" (1947:499), if "tactile seta" is understood to be an *acuminate* seta larger than the usual investing setae. However, careful examination shows that the lectotype does possess, on the distal end of the fourth tarsus, a conspicuously larger seta which bears a few spinulations near the tip (a "pseudotactile seta").

Hoff reported (1947:500) that the cheliceral flagellum is composed of 3 setae, but he failed to mention the number and nature of the setae on the hand of the chelicera. Reexamination confirms that there are 3 setae in the flagellum in all of the types and shows that the cheliceral hand bears only 4 setae, with *ls*, *is* and *es* long, acuminate, and *bs* shorter and denticulate.

Hoff mentioned (1947:499, 501) that tactile seta (trichobothrium) *ist* is near level of *est*. This is correct, but it should be noted that *ist* is always a little distal to level of *est*, which is proximad of middle of finger.

Neoallochernes cubanus, new species
Figs. 19-22

Type-data.—Holotype male (WM4169.01002), allotype female (WM4169.01008) and about 90 paratypes "en nido de murciélagos *Tadarida minuta* y *T. laticauda* en palma *Copernicia vespertilionum*" at Estero Real, Mayajigua, Las Villas, Cuba, 8 March 1973 (J. de la Cruz). The holotype, allotype and 7 paratypes (4 males, 3 females) mounted on slides; all these and most paratypes in alcohol deposited in the Academia de Ciencias de Cuba, 15 paratypes in alcohol in FSCA.

Diagnosis.—Generally like *N. garcianus* but larger (chela of male 1.04-1.27 mm long, rather than 0.87-0.95) and with more slender appendages (chela of male 2.95-3.25 times as long as broad, rather than 2.65-2.85).

Description.—Male and female generally similar, but female a little smaller and with more slender appendages. Carapace, tergites and palps well sclerotized and light brown in color, other parts thinner, tan. Carapace a little longer than broad; surface strongly granulate; 2 deep transverse furrows; 2 distinct eyespots; setae denticulate to narrow clavodentate. Tergites 1-10 divided; surfaces heavily granulate; setae long clavodentate; chaetotaxy of holotype 18:21:18:20:24:23:20:23:20:16:15:2; no tactile setae on tergite 11. Sternites 5-10 divided; surfaces smooth; setae mostly acuminate; chaetotaxy of holotype (male) 55:[6-8]:(3)10(4):(3)11(1):22:18:18:17:17:12:T3T:2; with 4 long setae among the 55 on the anterior operculum and 2 long, acuminate tactile setae on sternite 11; anterior sternal chaetotaxy of allotype (female) 36:(4)8(2):(3)13(2):20:20:—. Internal genitalia of male (Fig. 19) heavily sclerotized and large, 0.55-0.62 as long as carapace. Each spermatheca of

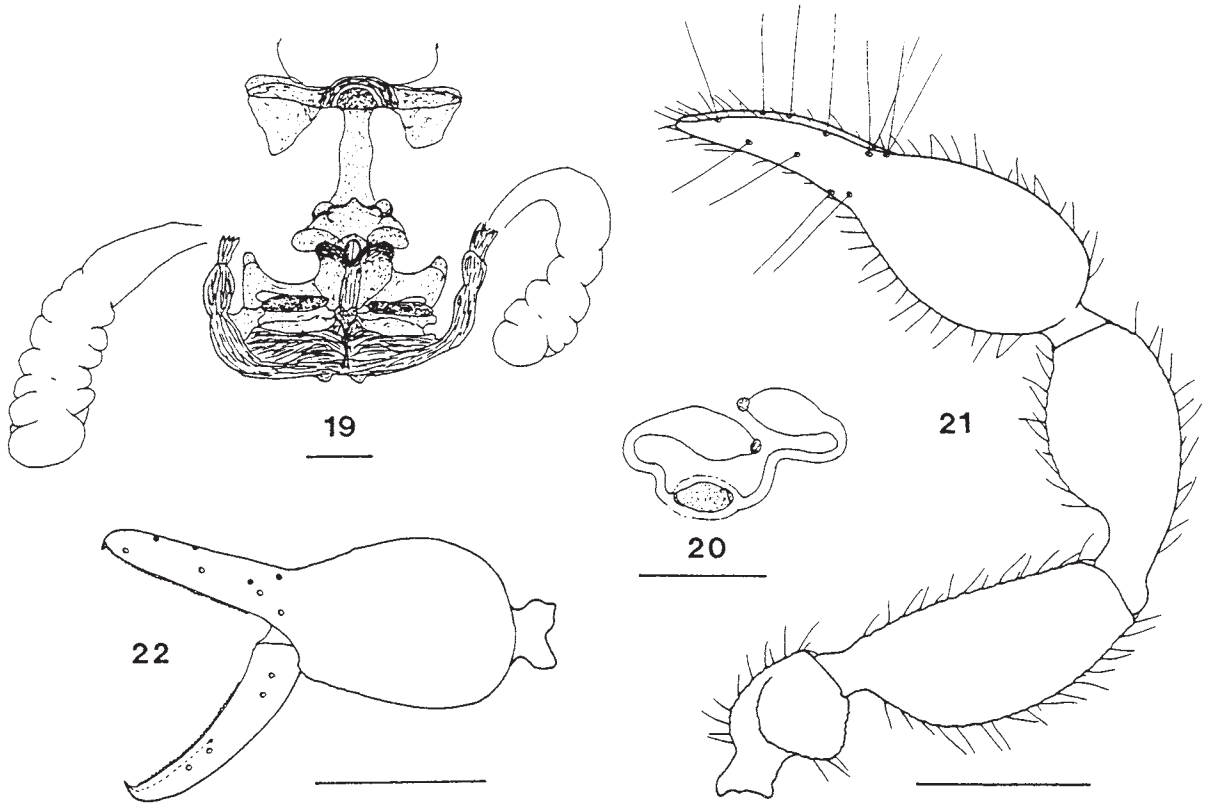
female in form of an elongated sac with a small terminal cribriform plate and a short slender tubule leading into a single median chamber with a large ovoid cribriform plate (Fig. 20).

Chelicera with 4 setae on hand, *bs* denticulate, others long, acuminate; flagellum of 3 setae, at least the distal 2 denticulate; galea fairly robust, but with only a few small rami, smaller in male than in female.

Palp rather robust (Fig. 21), more so in male than in female; trochanter 1.45-1.8, femur 2.55-3.2, tibia 2.1-2.7, and chela (without pedicel) 2.95-3.3 times as long as broad; hand (without pedicel) 1.4-1.7 times as long as deep; movable finger 0.94-1.04 times as long as hand. Surfaces partly granulate; setae strong, narrow clavodentate to denticulate. Trichobothria as shown in Fig. 22; on movable finger *st* close to *t* and *sb* close to *b*, the distances between each pair about equal; on fixed finger *ist* distal to level of *est* near middle of finger and *eb*, *esb*, *ib* and *isb* close together on base of finger, at or proximal to level of last marginal tooth. Each finger with 35-45 cusped marginal teeth and several accessory teeth, internal and external. Movable finger with well developed venedens and venom duct, nodus ramosus at or proximal to level of trichobothrium *st*; fixed finger with short venedens and vestigial venom duct.

Legs rather slender; leg IV with entire femur 3.6-4.1 and tibia 5.3-6.2 times as long as deep. Tarsus of leg IV with a long, denticulate "pseudotactile" seta about 3/4 length of segment from proximal end.

Measurements (mm).—Male (figures given first for holotype, followed in parentheses by ranges for the 4 mounted paratypes). Body length 3.02 (2.38-2.97). Carapace length 0.95 (0.79-0.95). Chelicera length 0.265 (0.245-0.27). Palpal trochanter 0.48 (0.40-0.49) by 0.33 (0.24-0.30); femur 0.93 (0.75-0.90) by 0.37 (0.27-0.35); tibia 0.82 (0.67-0.81) by 0.39 (0.28-0.36); chela (without pedicel) 1.27 (1.04-1.25) by 0.44 (0.33-0.41); hand (without pedicel) 0.66 (0.53-0.67) by 0.48 (0.34-0.44); pedicel 0.08-0.11 long; movable finger length 0.63 (0.54-0.65). Leg IV: entire femur 0.87 (0.71-0.87) by 0.24 (0.19-0.24); tibia 0.71 (0.58-0.71) by 0.13 (0.10-0.13); tarsus 0.52 (0.45-0.525) by 0.085 (0.08-0.085).



Figs. 19-22.—*Neoallochernes cubanus*, new species: 19, internal genitalia of holotype male, ventral view; 20, spermathecae of allotype female; 21, right palp of holotype male, dorsal view; 22, left chela of holotype, lateral view (darkened areoles are underneath). Scale lines = 0.1 mm for Figs. 19 and 20, 0.5 mm for Figs. 21 and 22.

Female (figures given first for allotype, followed in parentheses by ranges for the 3 mounted paratypes). Body length 2.90 (2.88-2.95). Carapace length 0.83 (0.81-0.86). Chelicera length 0.26 (0.245-0.25). Palpal trochanter 0.40 (0.39-0.41) by 0.23 (0.22-0.24); femur 0.73 (0.73-0.74) by 0.24 (0.23-0.24); tibia 0.61 (0.64) by 0.24 (0.24-0.26); chela (without pedicel) 0.98 (1.01) by 0.32 (0.30-0.33); hand (without pedicel) 0.53 (0.53-0.54) by 0.33 (0.32-0.33); pedicel 0.07-0.08 long; movable finger length 0.50 (0.50-0.53). Leg IV: entire femur 0.73 (0.70-0.75) by 0.19 (0.17-0.20); tibia 0.57 (0.60-0.62) by 0.10 (0.10); tarsus 0.42 (0.42-0.45) by 0.075 (0.075-0.08).

Etymology.—The species is named for Cuba, where it has been found.

Remarks.—Though the males of *N. cubanus* are larger and have more slender appendages than the males of *N. garcianus*, they are quite similar to the latter in all qualitative characters. Therefore, it is certain that they are congeneric; and the accompanying females can then illustrate the female characteristics of the genus, particularly the unique spermathecae.

It is interesting to note that the specimens of *N. cubanus* were found in or at (*en*) a roost (*nido*) of the bats *Tadarida minuta* (Miller) and *T. laticaudata* (E. Geoffroy) in a palm, *Copernica vespertilionum* León (see Silva-Taboada and Koopman, 1964). No ecological data are available for the types of *N. garcianus*. All other known specimens of *Neoallochernes*, from southwestern United States and Central America, have been collected in caves. Most of these collections are not accompanied by ecological data, but of those that are all are from bat guano, usually of *Tadarida brasiliensis* (I. Geof. St.-Hilaire).

Neoallochernes stercoreus (Turk), NEW COMBINATION

Dinocheirus stercoreus Turk, 1949:121; Hoff, 1958: 28.

Tejachernes stercoreus (Turk): Hoff, 1957:84, figs. 1-5; Reddell, 1965:167.

Tejachernes sp.: Reddell, 1970:403.

This species was described by Turk (1949) on the basis of 2 poorly prepared specimens from Bracken Cave, Comal County, Texas, and was placed by him in the genus *Dinocheirus*. Hoff (1957), after study of 11 topotypes (3 males, 8 females) and several specimens from Frio Cave, Uvalde County, Texas, recognized that *stercoreus* does not belong in *Dinocheirus* and he erected a new genus, *Tejachernes*, to accommodate it.

The descriptions by Turk and Hoff have characterized the species fairly well, but a few additional data are warranted here, based upon study of the many specimens listed below.

There is much more variation in measurements than Hoff observed (1957:87). On average, males are larger and more robust than females, but there is considerable overlap between the 2 sexes (Table 1).

Though the species is quite variable in size and proportions, even for a chernetid, it is remarkably consistent in qualitative features. The distinctive generic characters are always evident: 3 setae in the cheliceral flagellum; 4 setae on the cheliceral hand, with *bs* denticulate and *es* longer, acuminate; arrangement of trichobothria on palpal chela, movable finger with *t* and *st* close together in distal half and *b* and *sb* close together in proximal half, and fixed finger with *est* proximad of middle (see Hoff, 1957:figs. 2, 5); movable chelal finger with well developed venom apparatus, nodus ramosus usually proximad of trichobothrium *st*, and small, vestigial venom duct in fixed finger; tarsus of leg IV without an acuminate tactile seta but with a prominent denticulate seta about 3/4 length of segment from proximal end; spermathecae of female "relatively short, a little less than the distal one-half of each in form of a weakly swollen, pyriform or cylindrical sac capped by a small cribriform plate," the 2 tubes connected to a central sac with a conspicuous, ovoid cribriform plate (Hoff, 1957:84, figs. 3a-c). In addition, carapace and palps strongly granulate, the carapace with 2 distinct transverse furrows and 2

Table 1.—Ranges of measurements (mm) and proportions of 43 mounted males, 19 mounted females and 5 mounted tritonymphs of *Neoallochernes stercoreus* from 10 caves in Texas. Abbreviations: L=Length, B=Breadth, D=Depth; * indicates length exclusive of pedicel.

	Males	Females	Tritonymphs
Body L	2.05-3.10	2.15-3.05	1.60-2.40
Carapace L	0.73-0.94	0.71-0.90	0.64-0.68
Chelicera L	0.20-0.28	0.20-0.26	0.19-0.21
Palpal femur L	0.56-0.87	0.51-0.69	0.45-0.52
L/B	2.15-2.70	2.60-2.95	2.10-2.20
Palpal tibia L	0.52-0.79	0.46-0.62	0.41-0.47
L/B	1.90-2.25	2.15-2.45	1.95-2.10
Palpal chela L*	0.86-1.23	0.77-0.97	0.69-0.80
L*/B	2.40-3.05	2.75-3.15	2.50-2.90
Chelal hand L*	0.40-0.59	0.37-0.48	0.36-0.41
L*/D	1.09-1.40	1.33-1.50	1.25-1.45
Movable finger L	0.47-0.68	0.43-0.53	0.40-0.44
finger L/hand L*	0.98-1.20	1.03-1.23	1.06-1.14
Leg IV femur L	0.56-0.78	0.50-0.69	0.45-0.49
L/D	3.15-3.60	2.90-3.60	2.80-3.10

eyespots; internal genitalia of male large and heavily sclerotized, with large, wrinkled lateral sacs; 11th sternite with 2 lateral, acuminate tactile setae, 11th tergite lacking such setae.

Tritonymph (based on 5 mounted specimens from Comal, Kinney and Val Verde Counties).—Much like adults but smaller and with more robust appendages (Table 1). Carapace with heavily granulate surface; 2 distinct transverse furrows; 2 small eyespots. Chelicera with flagellum of 3 setae; 4 setae on hand, *bs* denticulate, *es* long acuminate; galea like that of female. Palpal surfaces mostly granulate; chela lacking trichobothria *sb* and *ist*, *t* and *st* close together; *est* proximad of middle of finger; vestigial venom duct in fixed finger. Tarsus of leg IV with rather long, denticulate "pseudotactile" seta about 2/3 length of segment from proximal end.

New records.—TEXAS: *Blanco County*: Davis Blowout Cave, 12 April 1970 (Becker and Howden), 15 males, 2 females, 1 tritonymph (CNC); 3 March 1984 (W.R. Elliott and D. Pate), 5 males, 2 females, 1 nymph; 24 July 1984 (W.R. Elliott), 3 males. *Burnet County*: Beaver Creek Bat Cave, Fall 1977 (W.R. Elliott), 5 males, 1 female; 28 March 1987 (W.R. Elliott), 1 male. *Comal County*: Bracken Bat Cave, 6 mi. N of Bracken, 19 January 1963 (J. Reddell and D. McKenzie), 2 males, 1 tritonymph (JCC); January 1963 (M. Tandy), on guano, 2 males, 2 females, 1 tritonymph (JCC); 5 April 1983 (R.M. Waters), 1 male, 2 tritonymphs; 10 October 1987 (W.R. Elliott), 1 male, 3 females. *Edwards County*: Punkin Cave, 9 April 1965 (D. Dickey and J. Reddell), 6 males, 3 females. *Kendall County*: Two Step Cave, 20 June 1987 (A. Cobb), 1 male, 2 nymphs. *Kerr County*: Stowers Cave, 25 March 1971 (S. Wiley and T. Mollhagen), 1 male, 1 female; date? (R. Bartholomew), 7 males, 2 females, 2 nymphs. *Kinney County*: Cricket Siphon Cave, 27 February 1988 (J. Ivy, M. Ulmer, D. Pearson), 2 males, 2 females; Porcupine Cave, 17 October 1987 (G. Veni and J. Ivy), 1 male; Webb Cave, 10 mi. N of Brackettville (W. Russell), 2 males, 3 females, 1 tritonymph (JCC). *Mason County*: James River Bat Cave, 29 May 1988 (W.R. Elliott), 3 males, 2 females. *Medina County*: Valdina Farms Sinkhole, 12 January 1963, 1 female (JCC); Ney Cave, 21 June 1968 (J. Reddell), in guano of *Tadarida brasiliensis mexicana* (Saussure), 17 males, 5 females, 1 tritonymph; 14 April 1972 (S. Wiley, T. Mollhagen, B. Davis), from bat guano, 9 males, 5 females. *Terrell County*: Adams Cave (=Sorcerer's Cave), 16 September 1978 (G. Veni), 1 female. *Uvalde County*: Frio Bat Cave, 24 January 1970 (B. David and R. McDaniel), 3 males, 10 nymphs; 24 March 1971 (S. Wiley and T. Mollhagen), from bat guano, 3 males, 1 female, 1 tritonymph; January 1984 (R.M. Waters), 15 males, 2 females; 10 March 1984 (S. Harden), 10 males, 1 female. *Val Verde County*: Cave Hollow Cave, 12-13 July 1974 (W.R. Elliott), 3 males, 1 female; Fern Cave, 30 September 1962 (J. Reddell), on guano, 1 tritonymph (JCC); 12 June 1966 (R.W. Mitchell), from guano, 11 males, 30 females, 40 nymphs; 19 July 1968 (R.W. Mitchell), "a small [sic!] sample from guano," largely of *Tadarida brasiliensis*, 200-300 specimens, all stages; 14 April 1973 (T.R. Mollhagen), 1 female; Twin Tree Cave, 12 July 1969 (W. Russell and C. Kunath), 4 males; abandoned railroad tunnel 11 miles W Comstock, largely inhabited by *Tadarida brasiliensis*, 13 April 1968 (J. Reddell and T. Mollhagen), berlese sample of guano, 1 tritonymph.

Remarks.—*Neoallochernes stercoreus* is, without any doubt, congeneric with *N. garcianus* and *N. cubanus*; it shares with those species all of the important generic characters of *Neoallochernes*.

Neoallochernes stercoreus is common in many bat caves in Texas as far west as Terrell County. However, in spite of considerable collecting, it has not been found in the extensive bat caves in Eddy County, New Mexico, where one might expect conditions similar to those in Texas. Perhaps the Carlsbad caves are actually different in some way (temperature, humidity, kinds of bats, kinds of food organisms, etc.), or perhaps *N. stercoreus* has been excluded from these caves by competition with *Dinocheirus astutus*, which is commonly found there.

Neoallochernes(?) *incertus*, new species
Figs. 23, 24

Type-data.—Holotype male (DM181.01001) from "bottom of 100 foot entrance drop" in Lonesome Ridge Deep Pit, Eddy County, New Mexico, 14 April 1963 (B. Bell); mounted on slide (AMNH).

Diagnosis.—Generally similar to males of *N. stercoreus* but, most obviously, with more slender appendages (palpal femur L/B = 3.05, rather than 2.5 or less). More subtle differences include the nature of setae *bs* and *es* on the cheliceral hand and the "tactile seta" on the tarsus of leg IV, and the placement of trichobothria on the chelal fingers, etc., as discussed below.

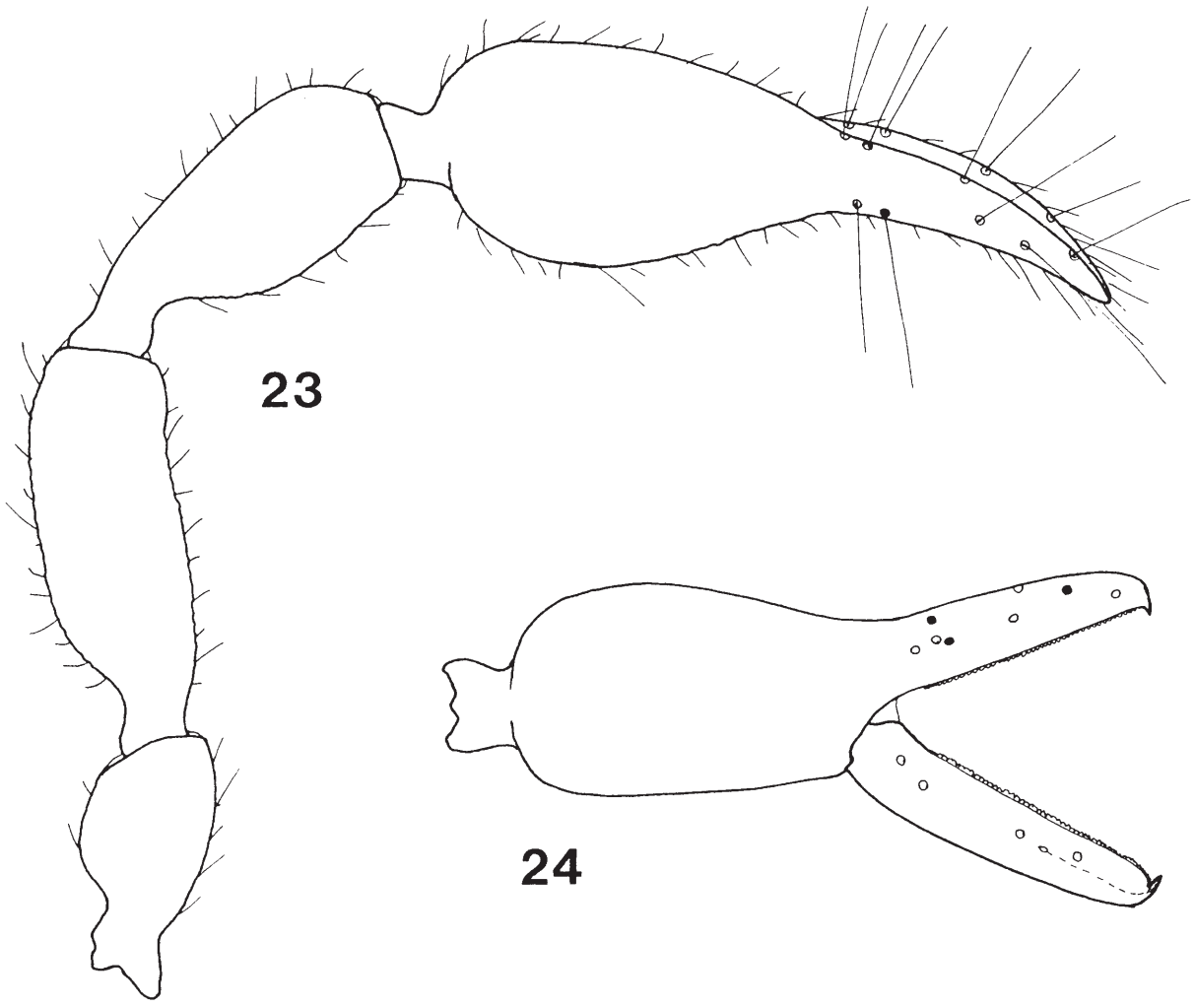
Description.—Rather lightly sclerotized, all parts tan in color. Carapace longer than broad; surface finely granulate, especially laterally; 2 distinct

transverse furrows; eyespots not evident; setae clavodentate. Tergites 1-10 and sternites 4-10 divided; surfaces of tergites finely granulate to scaly, sternites smooth; dorsal setae clavodentate, ventral setae denticulate. Tergal chaetotaxy 15:16:15:18:18:20:18:17:16:14:12:2; sternal chaetotaxy ?:(2)18(2):(2)14(2):22:21:22:21:20:16:12:2; presence of tactile setae on tergite and sternite 11 uncertain, as lateral setae are missing. Genitalia large and heavy but otherwise not describable, as the abdomen has been separated from the cephalothorax in this specimen and the genital region is damaged.

Chelicera with 4 setae on hand, all acuminate, *es* short, less than ½ as long as *bs*; flagellum of 3 setae; both galeae are broken from the movable fingers of this specimen.

Palp (Fig. 23) more slender than that of *N. stercoreus*: trochanter 1.95, femur 3.05, tibia 2.4, and chela (without pedicel) 3.15 times as long as broad; hand (without pedicel) 1.65 times as long as deep; movable finger 1.09 times as long as hand. Surfaces finely granulate, except chelal fingers smooth; most setae short, denticulate. Trichobothria as shown in Fig. 24; on movable finger the distance between *t* and *st* is about 2 times the distance between *b* and *sb*; on fixed finger *est* lies distad of middle, nearly at same level as *ist*; *eb*, *esb*, *ib* and *isb* close together on base of finger, at or distal to level of last marginal tooth. Fixed finger with 45 and movable finger with 47 cusped marginal teeth; each finger with 5-7 internal and external accessory teeth. Venom apparatus well developed in movable finger, with nodus ramosus midway between trichobothria *t* and *st*; only a short venedens and vestigial venom duct in fixed finger.

Legs rather slender; leg IV with entire femur 4.2



Figs. 23-24.—*Neoallochernes*(?) *incertus*, new species, holotype male: 23, left palp, dorsal view; 24, right chela, lateral view (darkened areoles are underneath).

and tibia 5.4 times as long as deep. Tarsus of leg IV with a short, acuminate tactile seta 3/4 length of segment from proximal end.

Measurements (mm).—Body length 2.75. Carapace length 0.805. Chelicera length 0.275. Palpal trochanter 0.435 by 0.225; femur 0.715 by 0.235; tibia 0.62 by 0.26; chela (without pedicel) 1.18 by 0.375; hand (without pedicel) 0.58 by 0.35; pedicel 0.13 long; movable finger length 0.62. Leg IV: entire femur 0.65 by 0.155; tibia 0.54 by 0.10; tarsus 0.43 by 0.08.

Etymology.—The species is named *incertus* because of its uncertain taxonomic position.

Remarks.—This species is tentatively placed in *Neoallochernes* on the basis of these characters: 3 setae in the cheliceral flagellum; only 4 setae on cheliceral hand, *sbs* lacking; location of "tactile seta" on tarsus of leg IV at distal 3/4; and possession of a vestigial venom duct in the fixed chelal finger. However, it differs from others in that genus in several important characters and may well belong to an hitherto undescribed genus. Some differences from other known members of *Neoallochernes* are the following: on the cheliceral hand, seta *bs* is acuminate rather than denticulate and *es* is shorter than *bs* rather than longer; on the tarsus of leg IV the "tactile seta" is acuminate rather than denticulate; on the movable chelal finger, the distance between trichobothria *t* and *st* is twice as great as the distance between *b* and *sb* rather than the 2 distances essentially equal, and the nodus ramosus of the venom dust is midway between *t* and *st* rather than proximad of *st*; on the fixed chelal finger, *est* is distad of the middle rather than proximad, and the group *eb*, *esb*, *ib* and *isb* lies mostly distal to the level of the last marginal tooth rather than proximal to the last tooth; and eyespots are apparently absent rather than present. These differences probably indicate that the new species represents a new genus, but I prefer not to name it now on the basis of a single, damaged male specimen. The differences should be confirmed on additional material and the nature of the genitalia, especially of the female, should be elucidated. At hand are a few specimens from Central America which appear to be congeneric and may allow a proper characterization of the taxon.

Genus *Hesperochernes* Chamberlin

Hesperochernes Chamberlin, 1924b:89; Muchmore, 1974:27.

Representatives of the genus *Hesperochernes* are widely distributed through the temperate and tropical parts of North and Central America. Three species have been reported previously from New Mexico, but only one from Texas (Hoff, 1958). Many of the forms are found in close association with small mammals, especially packrats, and several are recorded from caves, usually on bat guano.

Hesperochernes occidentalis (Hoff and Bolsterli)

Pseudozaona occidentalis Hoff and Bolsterli, 1956:170, figs. 1-3; Hoff, 1958:24.
Hesperochernes occidentalis (Hoff and Bolsterli): Muchmore, 1974:30.

This species was first described from caves in Washington County, Arkansas. It has since been found in many other caves in the Ozark Region of Arkansas, Missouri and Oklahoma (unpublished). There are 2 collections of *H. occidentalis* from Texas, both from Edwards County: 4 specimens (1 male, 2 females, 1 tritonymph) from Wyatt Cave, 2 miles north of Wheat Cave, 21 September 1963 (J. Reddell and D. McKenzie); 3 specimens (1 male, 1 female, 1 tritonymph from nest of *Petrochelidon fulva* (Vieillot) in Dunbar Cave, 22 July 1976 (R. Martin). The species is highly variable in size and proportions and these individuals fit easily into the known ranges of measurements.

Hesperochernes riograndensis Hoff and Clawson

Hesperochernes riograndensis Hoff and Clawson, 1952:19, figs. 11-12; Hoff, 1958:23.

A number of specimens collected from caves in western Texas and eastern New Mexico appear to belong to this species, which has been known previously only from "food storage of a kangaroo rat (*Dipodomys*)" in Socorro County, New Mexico (Hoff and Clawson, 1952:23). Most of them are larger than the types described by Hoff and Clawson, but they have the same general shape and proportions. On the other hand, some of them have some characters similar to those of *H. canadensis* Hoff and *H. utahensis* Hoff and Clawson, both of which have been reported in the southern Rocky Mountain region. Until a comprehensive revision of the western species of *Hesperochernes* is completed, it is impossible to be certain of the identities of most individuals.

Present collections include: 1 female from "below dome 250 feet from entrance" in Blackstone Cave, Terrell County, Texas, 4 June 1963 (J.

Reddell and W. Russell); 1 female from Murphy Wells Cave, Irion County, Texas, 24 February 1974 (R. Ballinger); 3 males from dark zone of Wind Cave (upper level), Eddy County, New Mexico, 31 December 1973 (W.C. Welbourn); 1 female from Helen's Cave, Carlsbad Caverns National Park, Eddy County, New Mexico, 31 August 1974 (W.C. Welbourn); 1 female near bat guano in Endless Cave, Eddy County, New Mexico, 17 February 1975 (W.C. Welbourn); 3 males, 1 female from Three Fingers Cave, Lincoln National Forest, Eddy County, New Mexico, 28 May 1978 (W.C. Welbourn); 1 female in "twilight zone near porcupine lair," Serpentine Root Cave, NW Tinnie, Lincoln County, New Mexico, 27 July 1973 (W.C. Welbourn). All are mounted on slides (FSCA).

Hesperochernes molestus Hoff

Hesperochernes molestus Hoff, 1956c:33, figs. 12-15; Hoff, 1958:24; Hoff, 1959:32.
?*Hesperochernes* sp.: Reddell, 1970:403.

This species has been known previously only from central New Mexico; found in close association with rodents, in nests of *Neotoma* sp., *Dipodomys* sp., and *Perognathus flavus* Baird, and on the hair of *Onychomys leucogaster* (Wied-Neuwied) (Hoff, 1956c:38).

At hand is one collection of 26 specimens (21 males, 4 females, 1 deutonymph) which appear to belong to this species. They were taken from "bat guano in the Bat Room," Four Mile Cave, 4 miles N Del Rio, Val Verde County, Texas, 24 April 1966 (J. Reddell and E. Alexander); 10 adults (6 males, 4 females) mounted on slides (FSCA). They tend to be a little larger on average than the types reported by Hoff from New Mexico, but in general shape and proportions they are much the same.

A single conspecific female was found "attached to the right rear leg of a cranefly" at College Station, Brazos County, Texas, 11 March 1985 (S.W. Taber). This sort of phoretic association may assist, at least in part, in the spread of the species from place to place.

Hesperochernes unicolor (Banks)

Chelanops unicolor Banks, 1908:39.
Hesperochernes unicolor (Banks): Hoff, 1947:511; Hoff and Clawson, 1952:23.

A single female referable to this species was found in Ezell's Cave, Hays County, Texas, 15 August 1978 (J.C. Davis); mounted on slide (FSCA). It is a little larger than 3 females previously reported by Hoff (1947) and Hoff and Clawson (1952), but otherwise fits the description of the species very well. It was obviously accidental in the cave, not at all modified for cave life.

Genus *Dinocheirus* Chamberlin

Dinocheirus Chamberlin, 1929b:171; Muchmore, 1974:31.

Dinocheirus, as presently (imperfectly) understood, is widely distributed in Europe and North and Central America. Five species have been reported previously from New Mexico and 2 from Texas (Hoff, 1958). Representatives are usually found in rich forest litter or in the nests of small mammals; one species has been reported from bat guano in Carlsbad Caverns.

Dinocheirus astutus Hoff

Dinocheirus astutus Hoff, 1956c:44, figs. 18-20; Hoff, 1958:28; Hoff, 1959:27, 33; Barr and Reddell, 1967:259.

Dinocheirus astutus was described by Hoff (1956c) from specimens taken mainly from nests of *Neotoma* sp. in west-central New Mexico. It was subsequently reported (det. Hoff) from the Bat Cave, Carlsbad Caverns, in southeastern New Mexico (Barr and Reddell, 1967). More recent collections have provided many more specimens from Carlsbad Caverns and a single female from Ellis Cave in west-central New Mexico.

Nine males and 10 females from the recent collections have been mounted and studied. In most particulars they agree closely with Hoff's descriptions. However, both males and females tend to be a little larger and have slightly more slender appendages than Hoff's. These differences may be an artifact of different techniques of measurement or may indicate some small adaptations of the cavernicolous forms.

New records.—NEW MEXICO: *Eddy County*: Carlsbad Caverns National Park, Bat Cave, berlese sample of guano of *Tadarida brasiliensis*, 25-27 November 1967 (T. Rossen), about 150 specimens, all stages; berlese samples, 14 February 1974, 27 June 1974, 28 November 1974, 26-27 April 1975 (W.C. Welbourn), about 150 specimens, all stages.

Sandoval County: Ellis Cave, under rock near rodent feces, 3 August 1976 (W.C. Welbourn), 1 female.

Dinocheirus texanus Hoff and Clawson

Dinocheirus texanus Hoff and Clawson, 1952:27, figs. 16-19; Hoff, 1958:28.

This species was described from 2 small collections from nests of *Neotoma micropus* Baird at Laguna Madre, Cameron County, Texas.

Present material consists of a single male from BFS Cave, Uvalde County, Texas, 8 June 1985 (A. Grubbs). This specimen is a little larger than those described by Hoff and Clawson but otherwise is very similar.

Dinocheirus venustus Hoff and Clawson

Dinocheirus venustus Hoff and Clawson, 1952:31, figs. 20-23; Hoff and Bolsterli, 1956:174; Hoff, 1958:28.
?*Acuminochernes* sp.: Reddell, 1970:403.
?*Dinocheirus* sp.: Reddell, 1970:403.

Dinocheirus venustus was originally found in a pack-rat (*Neotoma*) nest at Lawrence, Kansas (Hoff and Clawson, 1952). It was subsequently reported from Iron County, Missouri, with no ecological data (Hoff and Bolsterli, 1956). The present record extend its range far to the west.

The original description by Hoff and Clawson, supplemented by data in Hoff and Bolsterli, characterize the species very well. However, a few pertinent additions and comments may be made here, based on 23 mounted specimens (11 males, 12 females). The new specimens, all from caves in Texas, are on average a bit larger and have somewhat more slender appendages than those reported from Kansas and Missouri. There are 2 distinct transverse furrows on the carapace; no eyes evident. Male anterior genital operculum with 20-32 setae, including 4 long ones; posterior operculum with 19-27 setae on face and 2-3 very small setae on each side of middle of anterior margin; internal genitalia fairly large and heavily sclerotized. Female anterior genital operculum with 15-24 setae, posterior operculum with 11-15; spermathecae are long, slender tubes without any terminal enlargement. Cheliceral hand with 5 setae, *bs* always acuminate, *sbs* usually terminally and subterminally denticulate but sometimes acuminate; flagellum of 4 setae. Palp of male generally heavier than that of female: male femur 2.3-2.75 (female 2.35-3.0), male tibia 2.05-2.35 (female 2.1-2.4), and male chela (without pedicel) 2.05-2.5 (female 2.45-2.75) times as long as broad; male hand (without pedicel) 1.2-1.35 (female 1.4-1.6) times as long as deep; male movable finger 0.95-1.01 (female 0.93-1.00) as long as hand. Male leg IV with entire femur 3.5-3.9 (female 3.65-4.0) and male tibia 4.8-5.5 (female 4.8-5.5) times as long as deep. Tarsus of leg IV with short, acuminate, tactile seta 0.72-0.79 length of segment from proximal end.

Measurements (mm).—Ranges given first for males, followed in parentheses by those for females. Body length 2.42-3.32 (2.77-3.55). Carapace length 0.795-1.00 (0.83-0.96). Palpal femur 0.70-0.89 (0.63-0.86) by 0.275-0.35 (0.265-0.32); tibia 0.57-0.79 (0.59-0.73) by 0.275-0.36 (0.28-0.32); chela (without pedicel) 1.12-1.36 (1.08-1.30) by 0.49-0.615 (0.415-0.495); hand (without pedicel) 0.585-0.76 (0.61-0.70) by 0.485-0.62 (0.415-0.49); pedicel length about 0.10; movable finger length 0.59-0.72 (0.51-0.695). Leg IV: entire femur 0.66-0.80 (0.67-0.79) by 0.175-0.23 (0.175-0.215); tibia 0.55-0.695 (0.565-0.65) by 0.11-0.13 (0.105-0.13).

New records.—TEXAS: *Comal County*: Bracken Bat Cave, 19 January 1963 (J. Reddell and D. McKenzie), 1 female (JCC). *Edwards County*: Deep Cave, ¼ mile E Punkin Cave, 4 September 1965 (J. Reddell and D. McKenzie), on guano in upper levels, 1 female; Devil's Sinkhole, 8 mi. NE Rocksprings, 14 February 1965 (J. Reddell), 1 male, 1 female; 14 March 1966 (J. Reddell), "under rocks on guano and silt below the cave entrance," 1 male, 4 females; 8 March 1968 (J. Reddell), 1 male. *Medina County*: Weynand Cave, 2 August 1965 (J. Reddell and J. Fish), 1 male. *Val Verde County*: Fern Cave, 14 April 1973 (T.R. Mollhagen), 16 males, 12 females, 3 tritonymphs.

Remarks.—Because of the acuminate form of seta *sbs* on the cheliceral hand of some, these specimens were at first thought to belong to the genus *Acuminochernes* (hence the tentative identification of the Deep Cave specimen in Reddell, 1970). Further study, however, has shown their similarity to *Dinocheirus venustus*. The variability in the denticulation of *sbs* here raises a question about the distinctness of *Acuminochernes* and *Dinocheirus*. Additionally, though, the absence of terminal enlargements of the spermathecae sets this taxon apart from both *Dinocheirus* and *Acuminochernes*, where terminal enlargements of spermathecae were considered the rule. These problems further point up the need for a thorough revision of the genera *Dinocheirus*

and *Acuminochernes*, along with the closely related *Hesperochernes* and *Chernes*.

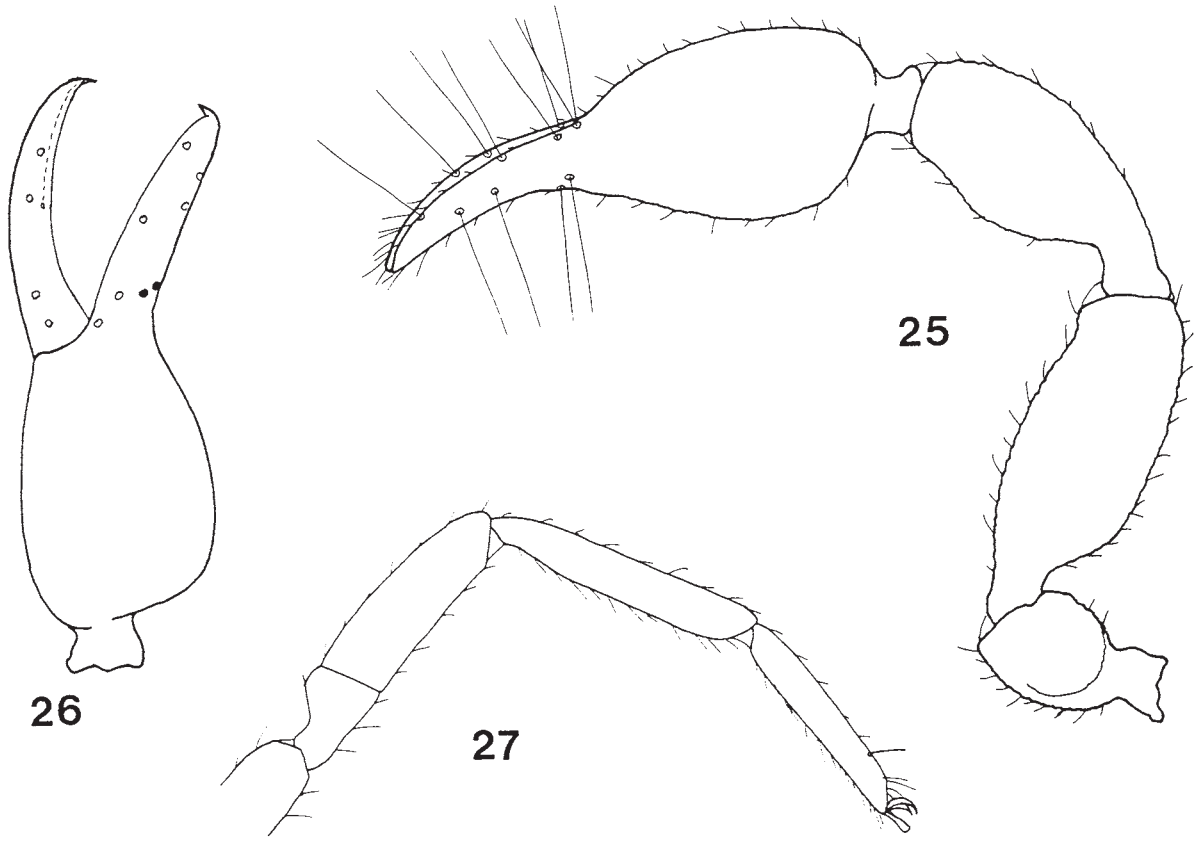
Dinocheirus cavicolus, new species
Figs. 25-27

Type-data.—Holotype male (WM1744.01002), allotype female (WM1744.01005) and 11 paratypes (2 males, 8 females, 1 nymph) in guano of *Myotis velifer* (J.A. Allen), Fawcett's Cave, 36 miles N Del Rio, Val Verde County, Texas, 10 April 1968 (J. Reddell) (FSCA); 2 males, 2 females, same locality, 29 March 1975 (R.W. Mitchell) (FSCA); 1 female, Sumac Pit, Kinney County, Texas, October 1987 (A.G. Grubbs) (FSCA); 2 males, 3 females, 2 nymphs, Rattlesnake Cave, Kinney County, Texas, 3 May 1964 (J. Reddell and D. McKenzie) (JCC). Most adults mounted on slides.

Diagnosis.—Similar to *D. athleticus* Hoff in body size but with more slender appendages, especially the legs (femur of leg IV L/B = 4.5-5.4, rather than 3.3-3.5).

Description.—Male and female generally similar, both sexes quite varied. Carapace light brown, palps brown, other parts much lighter. Carapace longer than broad; surface with low granules, 2 distinct transverse furrows; no eyes; about 75 narrow clavodentate setae, 4 at anterior and 7-9 at posterior margin. Tergites 1-10 and sternites 4-10 divided; cuticle thin and surfaces slightly granulate to smooth; dorsal setae narrow clavodentate, ventral setae acuminate to multidenticulate. Tergal chaetotaxy of holotype male 10:10:9:10:10:12:11:12:12:12:10:2, others generally similar; tergite 11 without acuminate tactile setae. Sternal chaetotaxy of holotype male 20:[2-2]:(3)15(3):(1)8(1):13:12:13:11:12:9:2T2T2:2, other males similar; the 2 acuminate tactile setae of sternite 11 are near the middle. Anterior sternal chaetotaxy of allotype female 17:(3)11(3):(1)6(1):11:12:—, others similar. Internal genitalia of male typical, that of holotype 0.45 as long as carapace. Spermathecae of female are long, thin tubules with expanded, saclike ends.

Chelicera with 5 setae on hand, *sbs* denticulate, others acuminate; flagellum of 4 setae; galea rather slender, with 4-6 small rami.



Figs. 25-27.—*Dinocheirus cavicolus*, new species, holotype male: 25, right palp, dorsal view; 26, left chela, lateral view (darkened areoles are underneath); 27, leg IV, lateral view.

Palp (Fig. 25) rather slender, a little more so in females than in males; trochanter 1.75-2.1, femur 2.6-3.25, tibia 2.3-2.7, and chela (without pedicel) 2.8-3.4 times as long as broad; hand (without pedicel) 1.45-1.75 times as long as deep; movable finger 0.92-1.05 as long as hand. Surfaces finely granulate except chelal fingers smooth; setae mostly short, denticulate. Trichobothria as shown in Fig. 26. Fixed chelal finger with 38-46 cusped marginal teeth; movable finger with 41-50 teeth, similar except proximal 8-10 rounded; each finger with 3-6 accessory teeth, both internal and external. Venom apparatus well developed in movable finger; nodus ramosus usually just distad of trichobothrium *st*, but just proximad of *st* in holotype.

Legs quite slender; leg IV (Fig. 27) with entire femur 4.5-5.4 and tibia 5.7-7.0 times as long as deep. Tarsus of leg IV with a short, acuminate tactile seta about 3/4 length of segment from proximal end.

Measurements (mm).—Figures given first for holotype followed in parentheses by ranges of allotype and mounted paratypes. Body length 2.25 (2.04-2.81). Carapace length 0.805 (0.74-0.88). Chelicera length 0.265 (0.23-0.29). Palpal trochanter 0.39 (0.34-0.445) by 0.22 (0.185-0.245); femur 0.74 (0.67-0.82) by 0.27 (0.27-0.29); tibia 0.665 (0.60-0.725) by 0.285 (0.24-0.29); chela (without pedicel) 1.07 (0.98-1.30) by 0.38 (0.33-0.41); hand (without pedicel) 0.57 (0.50-0.64) by 0.385 (0.33-0.41); pedicel about 0.10 long; movable finger length 0.56 (0.50-0.62). Leg IV: entire femur 0.65 (0.60-0.75) by 0.14 (0.12-0.15); tibia 0.57 (0.51-0.64) by 0.09 (0.08-0.095); tarsus 0.465 (0.40-0.48) by 0.065 (0.06-0.075).

Etymology.—The new species is named *cavicolus* for its habitat in a cave.

Remarks.—*Dinocheirus cavicolus* appears to be modified for cave existence in the same way that *Hesperochernes occidentalis* and *H. mirabilis* are, i.e. by having a thinner cuticle than epigean forms, by having more attenuated appendages, and by reduction in the number of setae on the body.

Dinocheirus, sp. indet.

In the collections from Texas caves are two specimens which cannot be identified with certainty at this time: one tritonymph from Wheat Cave, NW corner of Edwards County, Texas, 21 September 1963 (J. Reddell and D. McKenzie) (JCC); one female from Arrowhead Cave, 3 mi. N San Marcos, Hays County, Texas, 1983 (A.G. Grubbs) (FSCA).

Chernetidae, gen. et sp. indet.

Several unidentifiable nymphs are at hand: one from 400 Foot Cave, Brewster County, Texas, 30 June 1985 (A.G. Grubbs); one from Harrell's Cave, on Pete Sloan Ranch about 2 mi. W Chappell, San Saba County, Texas; 2 from Springdale Ranch Cave, San Saba County, Texas, 22 October 1989 (R.C. Matthews, Jr.); 3 from Secret Valley Cave, Uvalde County, Texas, February 1984 (R.M. Waters).

ACKNOWLEDGMENTS

Many sincere thanks are due to the collectors of the specimens reported herein, and especially to James Reddell, who not only collected most of the material but also strongly encouraged and supported this publication. I am also indebted to C.R. Hignutt for drawing some of the figures. An anonymous reviewer made many comments which have helped to improve the manuscript.

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ADDENDUM

After the manuscript for this paper was completed, some additional cavernicolous pseudoscorpions became available. In order to bring the account up-to-date, this material is treated below.

Tartarocreagris infernalis (Muchmore)

One female, probably referable to this species, was collected in Off Campus Cave, Williamson County, Texas, 8 April 1989, by W. Elliott, J. Reddell and M. Reyes (mounted on slide—FSCA). This specimen differs in several minor respects from, but is generally similar to, the holotype female of the species, which was found in Inner Space Cavern, only about a mile south of Off Campus Cave. In

spite of the differences, it seems best to consider it a representative of *T. infernalis*.

Tartarocreagris intermedia, new species
Figs. 28-29

Type-data.—Holotype male (WM7453.01002) and paratype male from Airman's Cave, Travis County, Texas, 3 September 1989 (J. Reddell and M. Reyes); mounted on slides (FSCA).

Diagnosis.—A moderately large species of the genus (palpal chela 2.1- 2.2 mm long), with rather slender appendages (chela L/B = 3.7-3.8), and with very poorly developed eyes.

Description of male (female unknown).—Palps light brown, carapace tan, other parts lighter. Carapace longer than broad; with a small epistome, triangular or rounded; 4 barely discernible eye spots; 24-26 setae, 4 at anterior and 6-7 at posterior margin. Coxal area typical; palpal coxa with 3 or 4 apical setae.

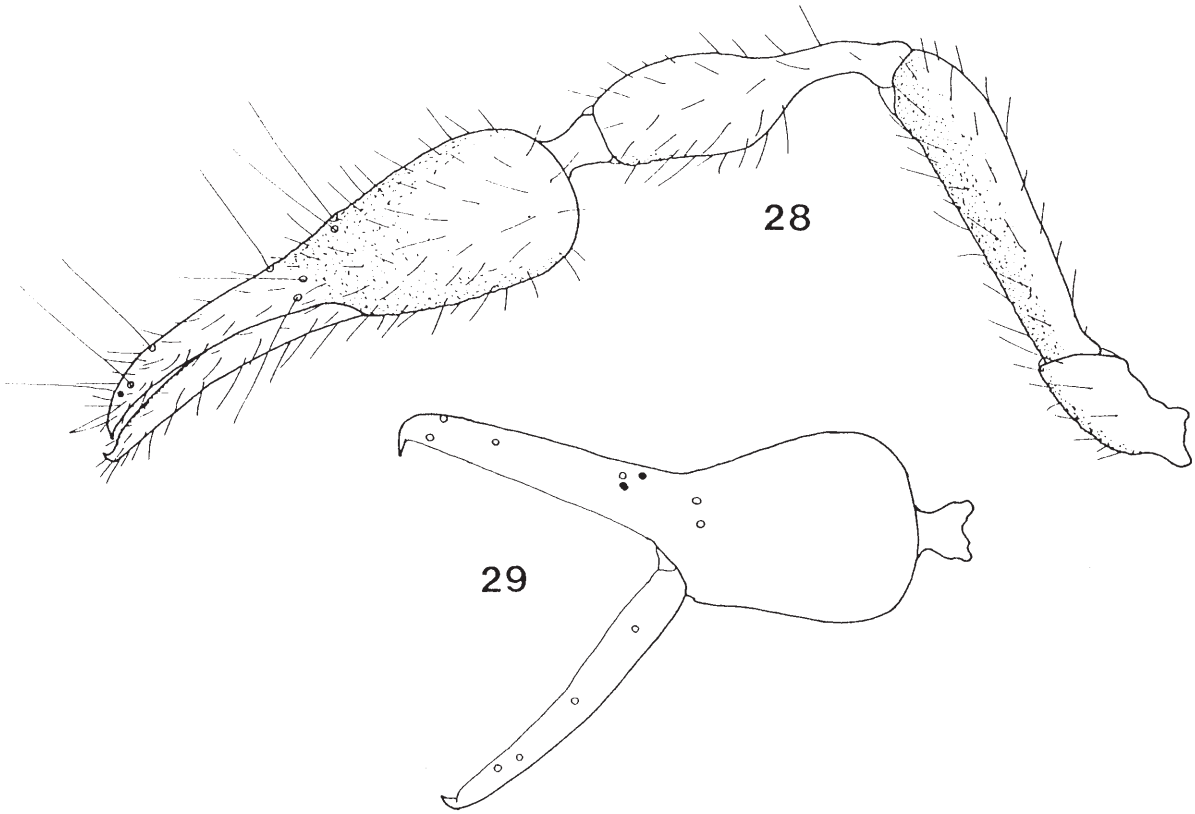
Abdomen long ovate. Tergal chaetotaxy of holotype 8:12:12:13:13:13:14:12:12:11:T2T:3; paratype similar but with 10 setae on 1st tergite and 2 on anal operculum. Sternal chaetotaxy of holotype 25:[4-5]:(6)8/12(6):(6)11(5):14:2/14:2/15:2/15:14:14:T1T2T1T:2; paratype much the same. Internal genitalia much like those of *T. texana* (cf. Fig. 4).

Chelicera 0.6 as long as carapace; hand with 7 setae; galea bifurcated near tip; flagellum of 8 pinnate setae.

Palp rather slender (Fig. 28); femur about 1.3 and chela (including pedicel) 2.15-2.2 times as long as carapace. Trochanter 2.15-2.3, femur 4.25-4.35, tibia 3.15-3.2, and chela (including pedicel) 3.7-3.8 times as long as broad; hand (including pedicel) 1.6-1.65 times as long as deep; movable finger 1.08-1.13 times as long as hand with pedicel. Trochanter, femur and chelal hand lightly granulate. Trichobothria as shown in Fig. 29. Fixed finger with 59-60 and movable finger with 68-70 marginal teeth, only the distal 12-14 with cusps.

Legs rather slender; leg IV with entire femur 4.25-4.35 and tibia 6.8- 7.2 times as long as deep. Tibia and each tarsus with a tactile seta. Subterminal tarsal setae spinous in distal third.

Measurements (mm).—Figures given first for holotype, followed in parentheses by those for paratype. Body length 3.23 (3.51). Carapace length 1.01 (0.96). Chelicera length 0.615 (0.615). Palpal trochanter 0.64 (0.61) by 0.295 (0.265); femur 1.29 (1.26) by 0.295 (0.295); tibia 1.18 (1.13) by 0.37



Figs. 28-29.—*Tartarocreagris intermedia*, new species, holotype male: 28, right palp, dorsal view; 29, left chela, lateral view (darkened areoles are underneath).

(0.36); chela (without pedicel) 2.00 (1.91) by 0.59 (0.555); hand (without pedicel) 0.895 (0.84) by 0.665 (0.635); pedicel 0.19 (0.19) long; movable finger length 1.17 (1.16). Leg IV: entire femur 1.04 (1.02) by 0.245 (0.235); tibia 0.955 (0.96) by 0.14 (0.13).

Etymology.—The new species is named *intermedia* for its morphological characters intermediate between those of *T. comanche* and the other more highly cave-adapted forms.

Remarks.—It is interesting to note that, as in *T. comanche* (above), the depth of the chelal hand of this species is greater than the breadth. As no non-cave species of the genus is yet known, it is impossible to judge whether or not this is a primitive character.

The discovery of yet another species of *Tartarocreagris* in the area of Travis and Williamson Counties emphasizes the fact that much speciation has gone on in the caves here. It is to be expected that further collecting will yield more new species and it is to be hoped that collections in epigean habitats will turn up some "ancestral" surface forms.

This is Publication No. N.S.-59 of the Texas Memorial Museum.

Tartarocreagris, sp. indet.

A lone tritonymph was collected in LakeLine Cave, Williamson County, Texas, 7 February 1990, by M. Reyes and J. Reddell mounted on slide (FSCA). As LakeLine Cave lies about midway between McDonald Cave and Beck Ranch Cave where adults of *Tartarocreagris reddelli* have been found, it is reasonable to believe that this nymph belongs to that species; however, a definite identification is impossible at this time.

Hesperochernes unicolor (Banks)

A male of this species was taken by Berlese separation of leaf litter from the entrance area of LakeLine Cave, Williamson County, Texas, 13 February 1990, by J. Reddell and M. Reyes; mounted on slide (FSCA). This specimen is smaller than, but generally similar to, the female from Ezell's cave mentioned above. Also, it is quite similar to the male from a pack rat nest in Cameron County, Texas, which was tentatively assigned to this species by Hoff and Clawson 1952).

Ubick, D., and T.S. Briggs. 1992. The harvestman family Phalangodidae. 3. Revision of *Texella* Goodnight and Goodnight (Opiliones: Laniatores). Texas Mem. Mus., Speleol. Monogr., 3:155-240.

THE HARVESTMAN FAMILY PHALANGODIDAE. 3. REVISION OF *TEXELLA* GOODNIGHT AND GOODNIGHT (OPILIONES: LANIATORES)

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ABSTRACT

The genus *Texella* is revised and the two previously included species, *T. mulaiki* Goodnight and Goodnight and *T. reddelli* Goodnight and Goodnight, are redescribed. *Sitalcina bifurcata* Briggs is transferred to *Texella* and redescribed. Eighteen species are newly described. All species are diagnosed and illustrated.

A cladistic analysis, using primarily characters of the male genitalia, clusters the species into the *bifurcata* species group (1 species) from southwestern Oregon and northwestern California, the *kokoweef* species group (3 species) from southern California, and the *mulaiki* species group (17 species) from New Mexico and Texas. The highest species diversity (15 species) is along the Balcones Escarpment, Texas.

Sixteen of the 21 species of *Texella* are cavernicoles; of these, five are regarded as troglobites. An analysis of troglomorphic characters shows clinal variation towards increasing troglomorphism in virtually all clades.

Texella appears most closely related to *Banksula* Roewer, from central California, and more distantly to *Phalangodes* Tellkampf, *Bishopella* Roewer, and the other nominal genera from the Appalachian Region.

INTRODUCTION

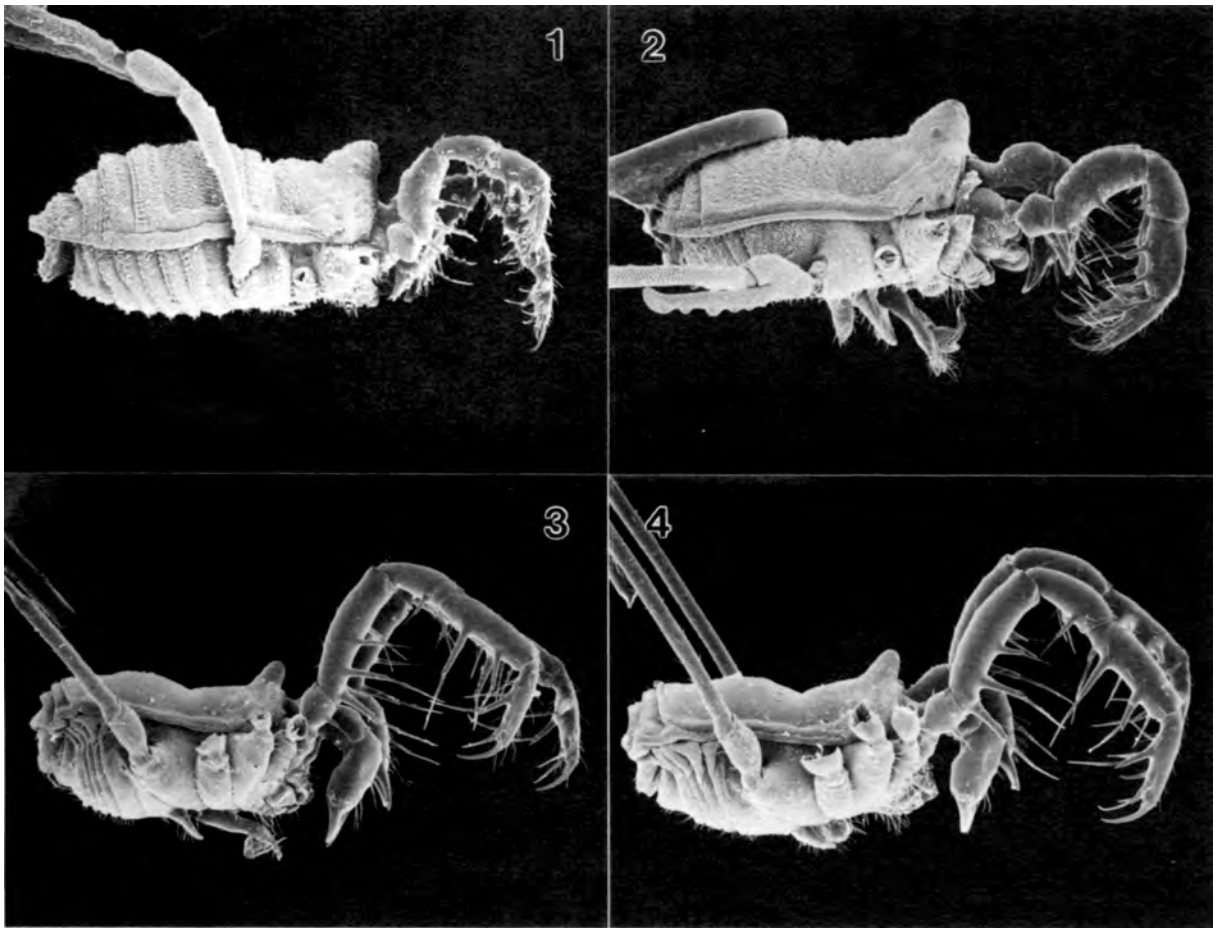
The genus *Texella* was, until quite recently, one of the most poorly known of the Nearctic Phalangodidae. This seems largely the result of the apparent rarity of these harvestmen. In fact, the type species, *Texella mulaiki* Goodnight and Goodnight (1942), was described from a single specimen, which remained the sole representative of the genus for over two decades. The specimen was cloaked in obscurity: its sex was initially misdiagnosed and even the type locality was vague, indicated simply as "Hays County, Texas". However, its strongly troglomorphic appearance [depigmentation, unusually elongated appendages, total loss of eyes, and even the reduction of the eye mound to a slender cone (Figs. 3, 4)] left no doubt of its cave origins. In the degree of its cave adaptations, *T. mulaiki* closely resembled the several cavernicolous phalangodids from the Appalachian region. But on the basis of eye mound placement (on the anterior margin of the scute), which resembled instead the condition in the Californian phalangodids, the genus *Texella* was established.

It was not until more systematic sampling of the Texas karst progressed that additional specimens of *Texella* were discovered. From these, a second species, *T. reddelli* Goodnight and Goodnight (1967), was described. Morphologically, this species stood in sharp contrast to *T. mulaiki*. Although

cavernicolous, it lacked the troglomorphic modifications of the latter, being distinctly pigmented and having well developed eyes, a robust eye mound, and relatively short appendages. Of particular interest were the sexually dimorphic structures; males having both a trochanteral spur, an elongate process on the ventral surface of the fourth trochanter, and a postopercular process, a conical outgrowth just posterior of the genital operculum (Fig. 2). Although similar, but smaller, spurs are known from both a Nearctic *(Sitalcina* Banks) and Palearctic genus (*Scotolemon* Lucas), the postopercular process is unique, as is the combined presence of two dimorphic structures, and was the first clear indication of a derived character defining the genus.

In addition to the topotypes of *T. reddelli*, these collections also included specimens from several other caves along the Balcones Escarpment. All of these specimens were troglomorphically intermediate between the two species. For example, they lacked the retina (unlike *T. reddelli*) but retained at least a vestigial cornea (unlike *T. mulaiki*). On the basis of somatic characters these additional specimens were assigned to the two species: the most troglomorphic to *T. mulaiki*, the others to *T. reddelli*.

Continued sampling of the Texas cave fauna produced additional specimens of *Texella*, spreading the known distribution of the genus over much of the Balcones Escarpment (Mitchell and Reddell, 1971), but turned up no further species. The presence of only two species of *Texella* now seems incongruous. On the one hand, this region is extremely rich in other cavernicolous arachnids; for example, the many species of the spider genera *Neoleptoneta* Brignoli (Gertsch, 1974), *Eidmanella* Roewer (Gertsch, 1984), and *Cicurina* (*Cicurella*) Menge (Gertsch, 1992). Furthermore, the other known phalangodid faunas of the Nearctic region are quite speciose. An unusually rich fauna is known from the Californian region (Briggs, 1968; Briggs and Hom, 1966, 1967; Briggs and Ubick, 1981, 1989; Ubick and Briggs, 1989) and the Appalachian fauna,



Figs. 1-4.—*Texella* spp., lateral views: 1, *T. bifurcata* (Briggs), male topotype; 2, *T. spinoperca,* new species, male paratopotype; 3, *T. mulaiki* Goodnight and Goodnight, male, Fern Cave; 4, *T. mulaiki* Goodnight and Goodnight, female, Fern Cave.

although not recently studied is nonetheless represented by a dozen nominal species (Goodnight and Goodnight, 1942).

The present study, based on the examination of an extensive collection of these relatively rare harvestmen, made available largely through the efforts of James Reddell and field associates, shows that *Texella* is far richer and more complex than previously imagined. In terms of species richness, the 21 species now recognized make *Texella* one of the largest Nearctic phalangodid genera (second in size only to *Calicina* Ubick and Briggs (1989) with 25 species). The high degree of complexity is evident in the pronounced interspecific variation of both somatic and genitalic characters as well as in the patterns of relationship which emerge upon their analysis.

Although this study greatly increases our knowledge of *Texella*, there are probably few to many additional species to be discovered. This is suggested by the high isolation of the species (about two thirds are known from single localities) and the highly disjunct distribution of the species groups. Even along the Balcones Escarpment, by far the most heavily sampled region, many caves and patches of epigean habitat have not been adequately searched. Also, several of the species descriptions are not adequate, being based on only a few specimens (three species are represented by single specimens), and give little or no indication of intraspecific variation. Additionally, several populations of *Texella* are currently known from only female and juvenile specimens and, thus, can not be identified with certainty. Clearly, much basic work remains to be done on this genus and it is hoped that this study encourages biologists, both cavernicole and epigean, to gather the additional material necessary to fill existing gaps and test the various hypotheses presented here.

Another aim of this study is to urge the conservation of *Texella*. There seems little doubt that the biological complexity of *Texella* is a consequence of a high degree of species isolation which is now evident in the widespread pattern of localized endemism. Unfortunately, localized endemicity also may have negative ramifications, namely the increased potential for extinction. This is especially of concern in regions of rapid urbanization, as along the Balcones Escarpment, where development is a potential threat to the many biologically rich caves. At present, only two species of *Texella* (*reddelli* and *reyesi*) are afforded federal protection. However, if restricted distribution is an important prerequisite for listing species, then comparable protection should be afforded all of the remaining species which, with the exception of *T. bifurcata*, have even more restricted ranges.

MATERIALS AND METHODS

This study is based on the examination of about 300 specimens of *Texella*, which (along with related Phalangodidae) were borrowed from the following persons and institutions:

AMNH: American Museum of Natural History, Dr. Norman I. Platnick

CAS (including TSB collection): California Academy of Sciences, Dr. Wojciech J. Pulawski

CDU: Mr. Darrell Ubick collection

MLG: Dr. Marie L. Goodnight collection

NMNH: National Museum of Natural History, Dr. Jonathan Coddington

TMM: Texas Memorial Museum, Mr. James R. Reddell (including the collection formerly at Texas Tech University and made available by Mr. James C. Cokendolpher)

WAS: Dr. William A. Shear collection

Specimens were prepared for study as were those of *Calicina* (Ubick and Briggs, 1989). Measurements were made with ocular reticles in Olympus and Leitz dissecting microscopes, at 80 X, and are believed accurate to about ± 0.03 (and from ± 0.08 to ± 0.12 for leg II, depending on length). Detailed observations and drawings were made with the help of a compound, phase-contrast (Zeiss) microscope equipped with a grid.

Scanning electron micrographs were taken with a Hitachi S-520 Scanning Electron Microscope. Specimen preparation consisted of dehydration (soaking specimens in serial baths from 75% to 100% ethanol), critical point drying (using liquid carbon dioxide), and mounting onto a stub. Specimens were cleaned manually, using eye lash brushes, both before dehydration and upon being mounted. It was eventually discovered that the most effective method of mounting specimens was to glue the fourth legs to a fine wire attached to the stub. This leaves the body unspoiled by the adhesive and permits movement of the specimen into virtually any position. It should be noted that due to photoreduction of the micrographs, the original magnifications given are useful only for facilitating comparison of the images; the actual dimensions can be determined using the accompanying scale bars. All measurements are in millimeters, unless indicated otherwise.

Terminology.—Tubercles. This commonly used term refers to a wide variety of cuticular outgrowths in harvestmen. To avoid unnecessary redundancy, it

is here used in a more restricted sense to include only medium-sized structures (of about 20 μm in basal diameter) having rounded crowns. Included in this definition are the paraocular anterior tubercles (AT), tubercles located on the posterior tergite margins, ventral trochanteral tubercles, and body tubercles scattered over dorsal and ventral surfaces. The smaller tuberculate structures, which constitute the background texture of the phalangodid body cuticle ('microtubercles' of Murphree, 1988), are referred to as 'fine rugosity' (for microtubercles of about 5 μm in diameter) or 'coarse rugosity' (for microtubercles of about 10 μm in diameter). For larger structures, the terms 'eye mound' and 'megaspine' (here used somewhat loosely to refer to both the macroseta and the basal, cuticular process) are used to substitute 'eye tubercle' and 'palpal spine-bearing tubercle', respectively.

Glans Nomenclature. The terminology used for the male genitalia is largely descriptive and novel. Most of the terms used previously for *Calicina* (Ubick and Briggs, 1989) are not repeated here in order to avoid making premature assumptions about homology. Positional adjectives of glans structures, such as "the ventral surface of the stylus," refer to a fully expanded glans where the stylus is apically directed.

Tarsal Count. The tarsal count notation is abbreviated, as in our previous studies, with the number of tarsomeres of legs I through IV listed serially and separated by a "-" (e.g., 3-5-5-5). However, in many individuals of *Texella* the tarsal count is not bilaterally symmetrical and this variation is shown by a "/", with the value for the left leg given first. For example, "3-5-6/5-5" indicates asymmetry in leg III, the left leg having six tarsomeres and the right having five.

Abbreviations:

AS = apical spine
AT = anterior tubercles
BF = basal fold of stylus
BK = basal knob of glans
BS = basal segment of glans
DS = dorsal setae of VPP
GO = genital operculum
LII/SL = leg II/ scute length
LS = lateral setae of VPP
ML = middle lobe of glans
POP = postopercular process
PSL = parastylar lobe(s)
PSL2 = secondary parastylar lobe(s)
PTb = palpal tibia
S = stylus
SA = stylar apophysis
TC = tarsal count
TrIV = trochanter of leg IV
VC = ventral carina of stylus
VP = ventral plate
VPP = ventral plate prong
VS = ventral setae of VPP

MORPHOLOGY

Of the 29 characters used in this analysis the vast majority (20) are from the male genitalia. The morphologically simpler female genitalia were comparably poorer in apparent characters (2). In addition, secondary sexual characters (3) and some somatic characters (4) were found useful.

Male genitalia.—(Figs. 6-7). The penis of *Texella* consists of an inflatable basal sac, a sclerotized truncus, and a distal glans. The ventroapical extension of the truncus, the ventral plate (VP), is deeply bifurcate. The resulting prongs (VPP) are lateral in position and widely separated, permitting the ventral protrusion of the glans. The prongs bear setae arranged on the dorsal, lateral, and ventral surfaces (DS, LS, and VS, respectively). Also on the lateral surface, and somewhat distad of the lateral setae, is a stout cuticular outgrowth, the apical spine (AS).

The glans of *Texella* is robust and appears sigmoid in lateral view. The basal segment (BS) is large, often approaching the apex of the VPP, and, in roughly half of the species, bears on its ventroapical margin a pointed extension, the basal knob (BK). The middle segment is split apically to form two lobes, the parastylar lobes (PSL), and, in some species, an additional pair of lobes, the secondary parastylar lobes (PSL2). The middle lobe (ML) is a thin flap which separates the middle segment of the glans from the apical segment, the stylus (S). The stylus is either simple or has a basal enlargement (the basal fold, BF), a lateral process (the stylar apophysis, SA), and/or a membranous ventral carina (VC).

Of all the Nearctic phalangodid genera, the penis in *Banksula* (Fig. 5) is most similar to that of *Texella*. One obvious difference is the placement of the VPP, which are relatively contiguous and positioned on the ventral margin of the truncus. Also, the glans is considerably simpler than in *Texella*: the glans has only one axis of rotation, the basal segment (BS) is reduced, and the apical elements lack accessory structures (except for a pair of PSL

and stylar outgrowths, present in some species, which may or may not be homologs to the SA).

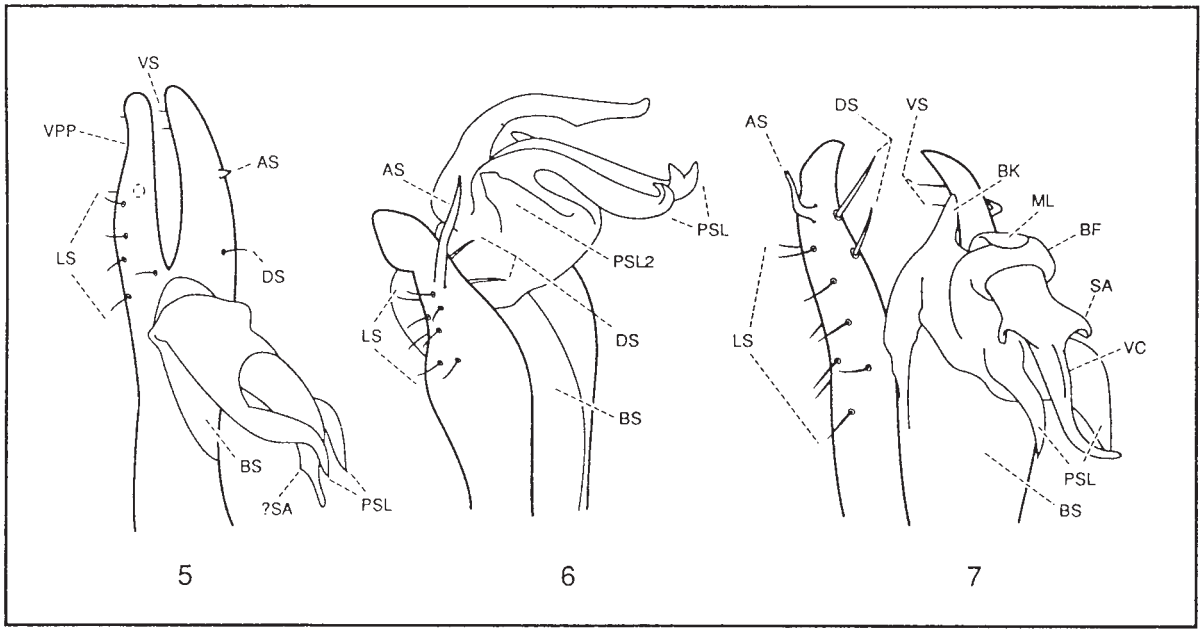
Function: The glans of *Texella* is of the folded type. In its unexpanded form, the stylus and the (deflated) middle segment are pressed against the (deflated) basal segment. During expansion, as simulated by treatment in KOH, the membranous portions of the glans inflate and the distal elements rotate along a dorsoapical arc. There are two axes of rotation: the primary, at the junction of the basal and middle segments, and the secondary at the base of the stylus. With complete expansion the stylus points apically (roughly 180° from the unfolded condition) and the entire glans protrudes ventrally beyond the VPP. At this stage, the stylus is typically separated from the parastylar lobes, which abduct and (in some species) inflate and contort to permit passage of the stylus.

It is worth noting that, in virtually all instances of unexpanded and partially expanded glandes observed, the parastylar lobes are in intimate contact with the stylus. It appears that the PSL lock the S in position. Three types of these apparent lock mechanisms were found: 1) PSL-S. In this, the most common type of lock, the PSL adduct, pinching the S (Figs. 68, 87, 96). 2) PSL-SA. In this type, found only in species of the *spinoperca* infragroup, the PSL grip the attenuated prongs of the SA (Fig. 180). 3) SA-PSL. In this type, found only in the *reddelli* infragroup, the clip-like SA grip the basal portions of the PSL (Figs. 120, 145).

Female genitalia.—The ovipositor in *Texella*, as in other Nearctic Phalangodidae, is structurally relatively simple (Fig. 18). The cuticle is conspicuously wrinkled (with longitudinal folds on the ventral and dorsal surfaces and transverse folds along the lateral surfaces) and sculptured (with minute tubercles and spines, often arranged in linear serrations). The apical surface bears a pair of cuticular projections (= apical teeth) and 7 (rarely 6) pairs of setae, arranged as in Fig. 20.

The ovipositor of *Banksula* resembles that of *Texella* but lacks apical teeth (at least in the three species closely examined: *B. grahami* Briggs, *melones* Briggs, and *rudolphi* Briggs and Ubick).

One noteworthy observation is the presence of a hyperexpanded ovipositor (Figs. 152-155) which differs from the typical form in having an additional apical segment terminating in four lobes. This hyperexpanded state, most likely being the condition assumed during egg laying, was also observed by us in a few specimens of *Bishopella* sp. and *"Sitalcina" cockerelli* Goodnight and Goodnight but was not recorded by Martens, Hoheisel, and Götze (1981) in their study of opilionid ovipositor morphology. However, thanks to the detailed drawings



Figs. 5-7.—Phalangodid penes, dorsolateral views: 5, *Banksula galilei* Briggs; 6, *Texella bifurcata* (Briggs); 7. *Texella reyesi*, new species. Styli shaded. Abbreviations: AS = apical spine, BF = basal fold of stylus, BK = basal knob of glans, BS = basal segment of glans, DS = dorsal setae, LS = lateral setae, ML = middle lobe of glans, PSL = parastylar lobes, PSL2 = secondary parastylar lobes, SA = stylar apophysis, VC = ventral carina of stylus, VPP = ventral plate prong, VS = ventral setae.

of ovipositor sections presented in that study, it is possible to conclude that the hyperexpanded segment is actually the everted vagina (ibid, figs. 30-33) and that the openings to the seminal receptacles are to be found at the bases of the apical lobes.

Sexual dimorphisms.—The most conspicuous sexual dimorphism is the male trochanteral spur, a large, robust process located ventroapically on the fourth trochanter (Figs. 24, 25). In several species this structure is reduced in size (Figs. 91, 192), in only one (*T. mulaiki*) it is completely absent (Fig. 104), and in another (*T. bifurcata*) it is represented by one to three small, rounded tubercles (Fig. 11). (The female homolog of the spur is represented by one to two small tubercles, for example in Fig. 17.) Similar, although smaller, trochanteral spurs are present in some species of *Sitalcina* and the European *Scotolemon* Lucas.

The second conspicuous dimorphic structure, the postopercular process (POP), appears to be unique to *Texella*. The POP is a conical cuticular outgrowth located immediately behind the genital operculum and is found in most members of the *mulaiki* species group (Figs. 132, 133). There appears to be no female counterpart to this unusual structure [although one aberrant female of *T. reyesi* does possess both a vestigial POP and spur (Figs. 130, 134, 135)].

Another interesting dimorphism is found in the females of the *spinoperca* infragroup. In these species the genital operculum is modified apically; bearing 1-2 pairs of short spines (Figs. 171, 173, 182, 183, 194). Males lack these spines, except for *T. spinoperca* where some males have homologs represented by short, blunt tubercles (Fig. 181). Similar apical tubercles are found in both sexes of *T. jungi* and *shoshone* (Figs. 64, 71).

Finally, in one species, *T. jungi*, the number of paraocular AT appears to be sexually dimorphic: males have 6-7 pairs, females 2-3 pairs (Figs. 60-62).

Somatic characters.—The somatic characters used in the analysis were: the number and arrangement of anterior tubercles, the tarsal count, and the number of palpal megaspines. Most of these and other somatic characters are discussed in the section on Troglomorphy.

PHYLOGENY

The character numbers in the following discussion correspond to those listed in Table 1.

SISTER GROUP

1) Ventral plate (VP) bifurcation. Three clades of Nearctic harvestmen have deeply bifurcate ventral plates: *Phalangodes* and the nominal genera of the Appalachian region [henceforth referred to as *Phalangodes* (et al.); Briggs, 1974: fig. 7], *Banksula* (Fig. 5), and *Texella* (Figs. 6, 7). In the remaining genera, which includes *Calicina*, the probable plesiomorphic sister of all Nearctic Phalangodidae, the VP is entire, suggesting that a bifurcate VP is derived.

We are not sufficiently familiar with the European phalangodids, the probable closest relatives of the Nearctic fauna, to fully include them in the discussion. However, we have examined specimens and/or published illustrations of representatives of all Mediterranean genera, with the exception of *Lola* Kratochvil and *Paralola* Kratochvil, and none has a bifurcate VP. However, an apically notched VP occurs in some (but not all) species of *Scotolemon* (*doriae*, Martens, 1978, and *terricola*, Brignoli, 1968) and *Ausobskya* (*athos*, Martens 1972). The notch is only about ¼ the length of the VP and is, therefore, quite distinct from the bifurcate condition in the Nearctic genera. Even assuming homology, the notch appears to be plesiomorphic relative to the bifurcation and so would not alter the monophyly of the Nearctic clade.

2) Apical spine (AS). The AS appears to be present only in, and is considered a synapomorphy for, *Banksula* and *Texella* (Figs. 5-7).

3) Ventral plate prong (VPP) position. In *Banksula* the VPP are located ventrally, as is the VP of other Californian genera, suggesting that the lateral position of the VPP in *Texella* and *Phalangodes* (et al.) is derived.

The sister group of *Texella* cannot be established with much certainty at this time. However, taking into consideration the relative merit of characters 2 and 3, the shared presence of a unique structure (AS) appears to offer the stronger argument in support of a sister relationship with *Banksula*. Additional characters will obviously be necessary to resolve this issue. On the other hand, there seems little doubt that, of the three clades, *Banksula* is the most plesiomorphic. In addition to the placement of the VPP, several other character states of *Banksula* are best interpreted as plesiomorphies: VP bifurcation narrow; AS short, apically unmodified; VP setae short and slender; glans folding simple; glans with few accessory structures; and glans basal segment small. By contrast, *Phalangodes* (et al.) is clearly and strongly derived. For example, the VPP

in *Phalangodes* (et al.) is thick and swollen, whereas in *Texella*, *Banksula*, and the ventral plate of all remaining genera is thin and platelike. Furthermore, *Phalangodes* (et al.) seems to be autapomorphic in several additional characters of generic significance, such as: width of VPP (wide, virtually surrounding glans); size of glans (strongly reduced); folding mechanism of glans (basal segment expands accordion-like); form of glans lobes (thin, scale-like, reduced); movement of glans lobes (presumably stationary); placement of ovipositor setae (on protruding lobes); position of eye mound (posteriorly removed from anterior margin).

MONOPHYLY

4) VP bifurcation width. In *Banksula*, the VP bifurcation (i.e., distance between VP prongs) is narrow, less than the width of a single prong, and does not permit the ventral protrusion of the glans. In *Texella*, the VP bifurcation is wide, greater (usually much greater) than the width of a single prong, and permits the protrusion of the glans ventrally beyond the VP. Given the probably plesiomorphic state of the *Banksula* VPP position, it seems likely that the transformation series for the ventral plate is: VP entire-VP narrowly bifurcate-VP widely bifurcate. In this case a wide bifurcation would be autapomorphic for *Texella*.

5) Glans shape. With the exception of *Calicina*, all Nearctic phalangodids have folded glandes. In most genera the glans unfolds along a single axis (appearing V-shaped in lateral view; see Fig. 5), whereas in *Texella* there are two axes (the glans appearing W-shaped, or sigmoid, in lateral view; as in Figs. 6, 7). On the basis of uniqueness and greater complexity, the sigmoid glans is considered derived.

6) Ovipositor teeth. The ovipositor in virtually all species of *Texella* has a pair of apical teeth, which appear to be derived. Apical teeth are lacking in *Banksula*, *Sitalcina*, *Microcina*, and the several species of *Phalangodes* (et al.) examined. The presence of apical teeth in a few species (5) of *Calicina* is most parsimoniously interpreted as a parallelism. Apical teeth are absent in *T. kokoweef*, *diplospina*, and in all members of the *mulaiki* infragroup; this is interpreted as a reversal and an additional synapomorphy for the *mulaiki* infragroup.

7) Apical spine (AS) length. In *Banksula* the AS is short, being less than two thirds the width of the VPP; in *Texella* the AS length/VPP width ratio ranges from 1.1 to 2.9. The longer AS length is considered a synapomorphy for *Texella*. Here, the AS is longest in *T. bifurcata* (AS/VPP = 2.5-2.9), of moderate length in *T. kokoweef*, *longistyla*, *reyesi*, and the *spinoperca* infragroup (1.5-2.5), and shortest in the remaining species (1.1-1.5).

SUBGROUPS

The *bifurcata* group

8) VPP apex. In *T. bifurcata* the VPP apex is strongly bent so that the ventral margin appears notched (Fig. 15); in other *Texella* and all *Banksula* the VPP apex is straight or, at best, only moderately bent. The widespread occurrence of the latter state suggests plesiomorphy.

9) Ovipositor shape. In *T. bifurcata* the ovipositor is bent basally (Fig. 18); it is straight for the other *Texella* and *Banksula* examined (i.e., those with fully extruded ovipositors). A more complete survey will be necessary to resolve this character, although the data so far suggest that a bent ovipositor is another potential autapomorphy for *T. bifurcata*.

10) Male trochanteral spur. Another possible synapomorphy for *Texella* is the male trochanteral spur (provisionally assuming a parallelism for the spur in some species of *Sitalcina* and *Scotolemon*, which will be explored in a later study). In most species the spur is moderate to quite large. Spur reduction is most evident in the *mulaiki* infragroup, being completely absent in *T. mulaiki* (Fig. 104) and reduced to vestiges in the other species (Fig. 91). Strongly reduced spurs are also found in *T. bilobata*, *fendi*, and *homi*; all species with relatively derived genitalia, suggesting that spur reduction is secondary. This leaves a single species, *T. bifurcata*, where the spur is represented by 1-3 tubercles. These tubercles are smooth and rounded (Fig. 11) and appear quite different from small spurs, which have a textured cuticle (as do typical spurs) and are generally more elongate (Fig. 192).

The phylogenetic implications of this character distribution are somewhat ambiguous. One possibility is that the trochanteral spur is a synapomorphy for the genus, with the tubercles of *T. bifurcata* representing extremely reduced spurs. However, given their morphological simplicity, it appears more likely that the tubercles in *T. bifurcata* are primitively simple. In this case, a well developed spur would be a synapomorphy for all of the remaining species of *Texella* (i.e., the *kokoweef* plus *mulaiki* species groups).

11) Anterior tubercle (AT) number. The greatest number of AT, $\geq$ 9 pairs, is found in *T. bifurcata* (Fig. 9). Moderately high numbers (5-8

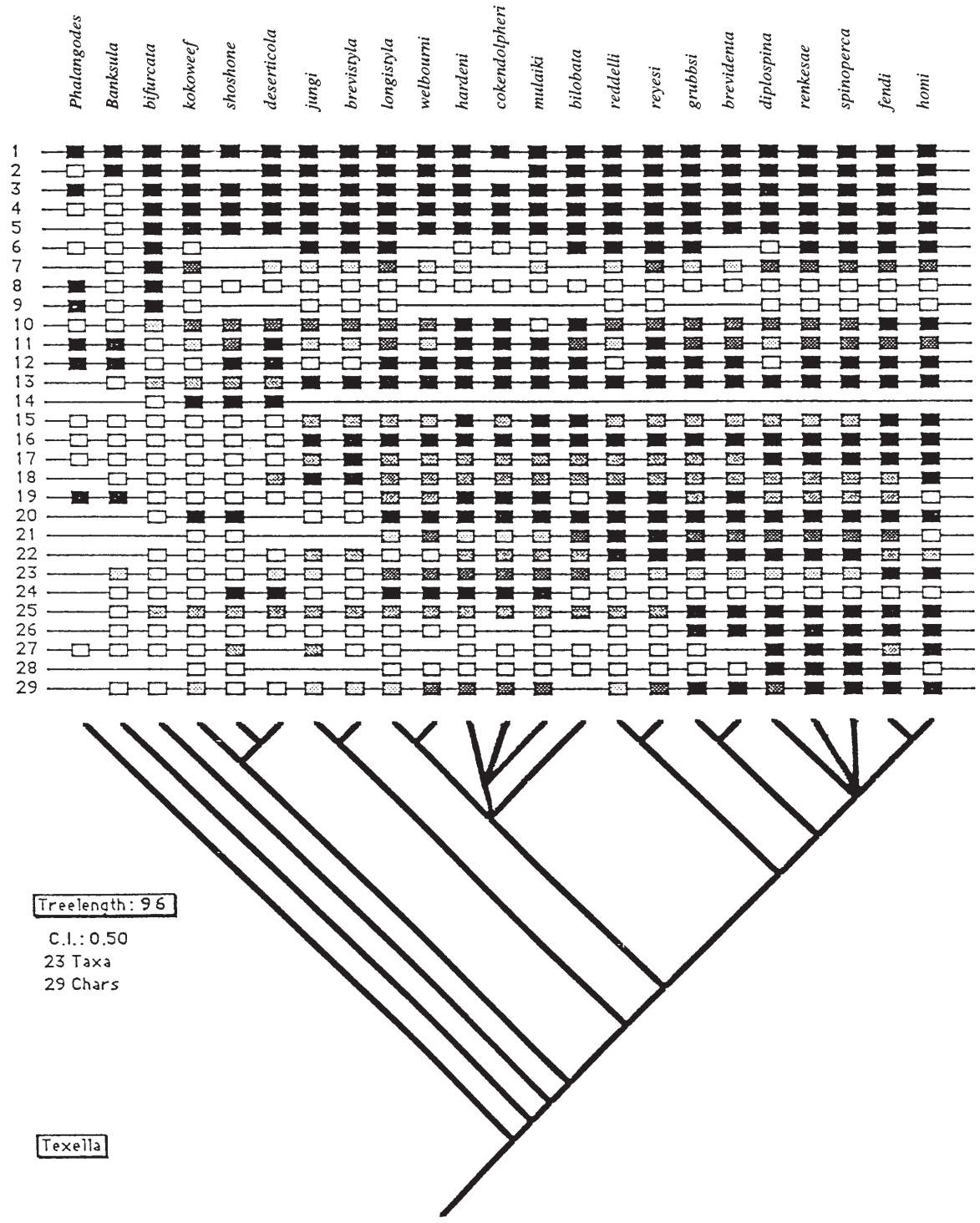


Table 1.—Character table with cladogram of possible relationships in *Texella*. Characters and polarities discussed in text.

pairs) are found in six species: *T. kokoweef* (Fig. 22), *brevistyla* (Fig. 48), *T. jungi* (males only, Fig. 62), *welbourni*, *reddelli* (Figs. 118, 119; although some individuals have only 4 pairs), and *diplospina* (Fig. 166). The wide distribution, across the entire cladogram, of the multituberculate state suggests plesiomorphy. This in turn suggests that the highest number of AT represents the most plesiomorphic condition.

12) AT rows. A biserial arrangement of AT is found in species with high numbers of AT (≥ 5 pairs). Outgroup comparison cannot be used with *Banksula* or *Phalangodes* (et al.) where the AT are absent (or represented by 1-2 tiny tubercles). However, the 6-8 pairs of AT present in *Calicina mariposa* are arranged in a single row. This suggests that the biserial arrangement is a synapomorphy for *Texella*. Within *Texella*, the loss of the biserial condition would be derived.

13) Secondary parastylar lobes (PSL2). The PSL2 are found only in the *bifurcata* and *kokoweef* groups and because of their uniqueness may be considered to be synapomorpic for them. However, there appears to be some evidence which suggests that the PSL2 are plesiomorphic within *Texella*. First, there is a trend of reduction of the PSL2 in the *kokoweef* group, the largest PSL2 being found in *T. kokoweef* (Fig. 15) and the smallest in *deserticola*, where they appear to be reduced to mere vestiges (Fig. 45). Also, in virtually all species of *Texella* the lateral faces of the middle segment bear rather prominent folds (for example Figs. 53, 96, 106, 136, 163, 177, 181, 187). It seems at least possible that these folds represent vestigial PSL2. If this is the case, the PSL2 would most parsimoniously be interpreted as a synapomorphy for the entire genus (and the loss of prominent PSL2 as another synapomorphy for the *mulaiki* group).

The several characters discussed above suggest a unique position of *T. bifurcata* and the likelihood that this species represents the plesiomorphic sister group of the remaining *Texella*.

The *kokoweef* group

14) PSL2 direction. In *T. bifurcata*, the PSL2 point along the mesal axis of the glans (towards the ventral surface of the stylus; Fig. 15); in the *kokoweef* group the PSL2 point along the longitudinal axis (towards the tip of the stylus; Fig. 27, 41, 45). Using *T. bifurcata* as the outgroup, the longitudinal alignment is taken to be a synapomorphy for the *kokoweef* group.

The *mulaiki* group

15) Postopercular process (POP). The POP is absent in the *bifurcata* and *kokoweef* species groups but is found in virtually all members of the *T. mulaiki* group, for which it is considered a synapomorphy. In some species (of the *mulaiki* and *spinoperca* infragroups) the POP is absent (Fig. 104) and in others (of the *brevistyla* subgroup and of the *reddelli* and *mulaiki* infragroups) it may be reduced in size (Figs. 50, 92). This structure also exhibits variable development intraspecifically. In the species with the largest available series, *T. reyesi*, the POP may vary from being extremely large to small (Fig. 132, 133), even within a single cave population, and (along with the trochanteral spur) appears to vary allometrically.

16) Basal fold of stylus (BF). The BF is found only in members of the *T. mulaiki* species group (Figs. 53, 68, 77, 83, 87, 96, 107, 116, 120, 136, 161, 164, 169, 177, 181, 187, 201), where it is considered to be derived.

17) Basal knob (BK). The BK is absent in *Banksula* and the *T. bifurcata* and *kokoweef* species groups and is, therefore, a synapomorphy for the *T. mulaiki* species group (Figs. 66, 77, 83, 86, 95, 107, 114, 121, 136, 161, 163). Its absence from *T. brevistyla* (Fig. 76) and the *T. spinoperca* infragroup (Figs. 174, 180, 188, 198) is regarded as a secondary loss.

The *brevistyla* and *mulaiki* subgroups

18) Stylus length. In the *T. bifurcata* and *kokoweef* species groups (except in *T. deserticola*) and most species of *Banksula* the stylus is subequal in length to the PSL. Thus, both a longer stylus (as in *T. deserticola* (Fig. 45) and the *mulaiki* subgroup (Figs. 77, 83, 96, 107, 138, 161, 163, 168, 175, 180) and an extremely short one [in the *brevistyla* subgroup (Figs. 53, 75) and in *T. homi* (Fig. 201)] can be considered derived.

19) Tarsal count (TC). The lowest TC, 3-5-4-5, is found in all members of the *bifurcata* and *kokoweef* groups and the *brevistyla* subgroup. A TC of 3-5-5-5 or more is found in all remaining species (except *T. bilobata* and *homi*). Given the presence of additional plesiomorphies in the former group, the higher tarsal count is presumed to be derived. However, an increased TC is clearly a troglomorphic character, best demonstrated by the clinal variation in the *reddelli* infragroup which is discussed

later. Evidence that an increased TC is not strictly troglomorphic comes from: 1) cave species with TC = 3-5-4-5 (*T. kokoweef*, *shoshone*, *brevistyla*, and the cavernicole specimen of *T. bifurcata*); and 2) epigean species with TC = 3-5-5-5 (*T. fendi* and the epigean population of *T. longistyla*). A TC of 3-5-5-5 is therefore regarded as a synapomorphy for the *mulaiki* subgroup (with a reversal in *T. bilobata* and *T. homi*), with further increases in TC being related to cave adaptation.

20) Stylar apophysis (SA). The SA is absent in *bifurcata* (Fig. 14) but appears to be represented in the other Californian species (except possibly *deserticola*) as a weakly developed laterobasal carina (Figs. 28, 41). The SA is absent in the two species of the *brevistyla* subgroup (Figs. 54, 75), but is well developed in the remaining species of the *mulaiki* group, where it is typically produced into a tooth-like process (Figs. 78, 84, 87, 96, 107, 117, 121, 136, 161, 164, 168, 176, 180, 187, 201). It is not clear whether the SA is a synapomorphy for the *kokoweef* group plus the *mulaiki* group (with a reversal in the *brevistyla* subgroup) or whether the SA is independently derived (autapomorphic) in the two clades. Given the structural differences between the two types of SA, the latter possibility seems more plausible.

21) Stylar apophysis shape. The simplest form of the SA is found in *T. kokoweef* and *T. shoshone* (Figs. 28, 41). A more prominent SA, which bears a tooth (reduced to a tubercle in *T. hardeni*, Fig. 88), seems to be synapomorphic for the *mulaiki* subgroup. In the *mulaiki* infragroup (Figs. 96, 107) and *T. longistyla* (Fig. 78) the SA consists of a basal tooth and a lateral carina. The absence of a carina in the remaining species may be derived. Long, attenuated SA teeth are a synapomorphy for the *spinoperca* infragroup (Figs. 168, 176, 180, 187); here the unique SA in *homi*, consisting of a rectangular lateral carina, appears to be autapomorphic (Fig. 201). A triangular, apically scrolled SA (which clips onto the PSL) is a synapomorphy for the *reddelli* infragroup (Figs. 121, 136-147).

22) Stylus shape. The stylus is compressed in the *bifurcata* group (Fig. 14), the *kokoweef* group (Figs. 26, 42, 45), and the *longistyla* infragroup (Figs. 78, 84). If this compressed state is plesiomorphic, then the tubular stylus in the *brevistyla* subgroup (Figs. 53, 54, 74, 75), the *mulaiki* infragroup (Figs. 86, 87, 95, 96, 107, 108), the *bilobata* infragroup (Figs. 116, 117), *T. fendi* (Fig. 187) and *T. homi* (Fig. 201) could be considered derived, as could the apically spatulate stylus in the *reddelli* subgroup (Figs. 121, 141, 147, 161, 164, 168, 176, 180).

23) Parastylar lobe (PSL) shape. The PSL of *Banksula* are claw-like: curved and tapering to a point (Fig. 5). Similar PSL are found in many species of *Texella*, including *T. deserticola* (Fig. 45), *jungi* (Fig. 67) and most species of the *reddelli* subgroup (Figs. 120, 136, 161, 163, 169, 177, 180) and suggest plesiomorphy. However, in *T. bifurcata* (Fig. 15), the remaining two species of the *kokoweef* group (Figs. 27, 41), and *T. brevistyla* (Fig. 53) the PSL are attenuated and ribbon-like, suggesting that this is the plesiomorphic condition. The PSL in the *longistyla* and *mulaiki* infragroups are lobe-like (a robust, rectangular lobe with folds; Figs. 77, 83, 86, 94, 108) and appear derived. The three additional forms of PSL in *Texella* [spiral in *brevistyla* (Fig. 53), hooked claw in *bilobata* (Fig. 116), and vermiform in *fendi* and *homi* (Figs. 187, 198)] are regarded as autapomorphies.

24) Mesal megaspines of palpal tibia. In *Banksula* and most species of *Texella* the palpal tibia has three mesal megaspines (Fig. 10). The presence of only two megaspines in the *longistyla* and *mulaiki* infragroups (Fig. 97) seems to be synapomorphic. The presence of two megaspines in *deserticola* and *shoshone* is regarded as a parallelism (autapomorphic for the two species).

25) Ventral plate (VP) setal length. The lateral setae of the VP are short in *Banksula* and of moderate length in all species of *Texella* (Figs. 15, 42-47, 74-79, 81, 86, 94, 106, 120, 136) except the *brevidenta* and *spinoperca* infragroups, where they are distinctly longer (Figs. 160-165, 169, 177, 181, 186, 200).

26) Apical spine (AS) tip. The apical spine is simple or bifurcate (Figs. 15, 29, 47, 63, 76, 79, 82, 87, 123, 148, 149, 151) [or, rarely, trifurcate in *T. mulaiki* (Fig. 102) and some specimens of *T. reyesi* (Fig. 150)] in all species except the *brevidenta* and *spinoperca* infragroups, where it is polyfurcate to plumose and considered a synapomorphy (Figs. 160-165, 170, 172, 179, 191, 198-200).

27) Genital opercular (GO) spines. The apical margin of the GO is unmodified in most species. In the *spinoperca* infragroup the apical margin of the female GO bears a pair of spines (Figs. 173, 183) [2 pairs in *T. diplospina* (Fig. 171) and a pair of blunt tubercles in *T. fendi* (Fig. 194)] which are considered synapomorphic. A few additional species have a pair of apical tubercles: males and females of *T. jungi* (Figs. 64, 71) and *T. shoshone* (Fig. 38) and some males of *T. spinoperca* (Fig. 181). The presence of these modifications in the more distantly

related species is probably best interpreted as a parallelism.

28) Stylar apophysis (SA) origin. The SA of most species originates laterally on the stylus (Figs. 77, 84, 88, 96, 107, 116, 120, 136, 164). In the *spinoperca* infragroup (except *T. homi*, Fig. 201) the SA is clearly in a more ventral position (Figs. 169, 177, 180, 187), which is considered derived.

29) Ventral plate setae number. The lowest number of < 15 setae per prong is found in *Banksula* and the species of the *bifurcata* and *kokoweef* groups (Figs. 5, 6, 15, 27, 41, 42-47); the highest (> 25), apparently derived, in the *brevidenta* and *spinoperca* infragroups (Figs. 160-164, 169, 177, 181, 188, 200).

The character transformations were studied with the help of MacClade (Maddison and Maddison, 1987). The preferred tree (Table 1) has a length of 96 steps and a character index of 0.50.

Some ambiguities exist within the *mulaiki* species group. The relationships within the *mulaiki* subgroup are uncertain as two characters, 23 (PSL shape) and 24 (palpal megaspines), cluster the *mulaiki* and *longistyla* infragroups whereas a third (22, S shape) clusters the *mulaiki* and *bilobata* infragroups. This problem may be resolved as additional and fresh material of *T. bilobata* becomes available to permit more detailed examination of that unusual species. The relationships of the three species in the *mulaiki* infragroup are likewise unresolved. However, the form of the SA varies among the three species (see discussion under the infragroup) and the most strongly developed SA tooth in *T. mulaiki* may be plesiomorphic. Finally, the *spinoperca* infragroup, with the exception of the synapomorphies for *T. fendi* and *homi* (10, reduced TrIV spur; 15, absence of POP; 22, tubular S; 23, attenuated PSL) is unresolved. However, the high number (11) and biserial arrangement (12) of the AT in *T. diplospina* suggests plesiomorphy.

BIOGEOGRAPHY

The species of *Texella* are strongly allopatric in their distribution and closely resemble the western Nearctic phalangodid genera recently studied. The *bifurcata* and *kokoweef* groups are Californian and occur at the extreme parts of the state, both spatially and ecologically (Map 1). Markedly disjunct is the *mulaiki* group (Maps 2, 5) which occurs in SE New Mexico and adjacent Texas (*longistyla* infragroup) and central Texas (all remaining species). With one exception, all species are geographically isolated, as are all higher level clusters, from infragroup to species group. This high degree of disjunction immediately suggests a vicariant model of speciation. The presumed barriers, and their relative appearance, are immediately evident (Map 3). Given our phylogenetic interpretation, the initial barriers would have been in what is now California: the first barrier separating *Texella* from *Banksula* (currently restricted to caves of the central Sierran foothills; see map in Briggs and Ubick, 1981); the second separating *T. bifurcata* from the *kokoweef* group; the third separating the Californian species from the *mulaiki* group. All subsequent barriers would have been in Texas, the fourth isolating the *brevistyla* subgroup and the fifth separating the *mulaiki* and *reddelli* subgroups.

Of some interest, but of uncertain significance, is the fact that the relatively plesiomorphic elements (*Banksula* and *T. bifurcata*) occur on presumed exotic terranes, whereas the relatively apomorphic elements (all remaining *Texella*) occur on the North American Plate (Silberling et al., 1984).

However, some dispersal is nonetheless required to arrive at the present distribution, as indicated by the single instance of sympatry: that of *T. mulaiki* with *diplospina* and *renkesae*. Interestingly, the former species is the most troglomorphic, whereas the others (especially *T. diplospina*) are the least troglomorphic of all cavernicolous *Texella*. Given the presumably lower dispersal potential of troglobites, the simplest hypothesis requires the dispersal of the two species of the *spinoperca* infragroup into the range of *T. mulaiki*.

TROGLOMORPHY

Over two thirds of the species of *Texella* occur in caves and, as expected, show at least some morphological modification to that environment. The several troglomorphic characters identified in *Texella* (most of which are given in Table 2) appear to represent four basic types:

1) Appendage elongation. The most apparent troglomorphy is leg elongation. To remove the effects of body size on leg length the ratio of leg II length (the longest leg) to the scute length (which exhibits less intraspecific variation than the total body length) was used. The lowest LII/SL values are found in epigean species (2.3-3.1, except for 3.4 in *T. deserticola*); the longest in the *mulaiki* infragroup (LII/SL = 9.9-15.3), *T. reyesi* (4.3-8.7), and *T. welbourni* (4.6), the species here considered troglobites. Intermediate leg lengths occur in all remaining (cavernicolous) species (3.2-4.3) except for *T. brevistyla* and *diplospina* which have shorter

Map 1.—Map of western North America showing distribution of *Texella bifurcata* (dots), *T. deserticola* (circle), *T. shoshone* (solid triangle), and *T. kokoweef* (open triangle).

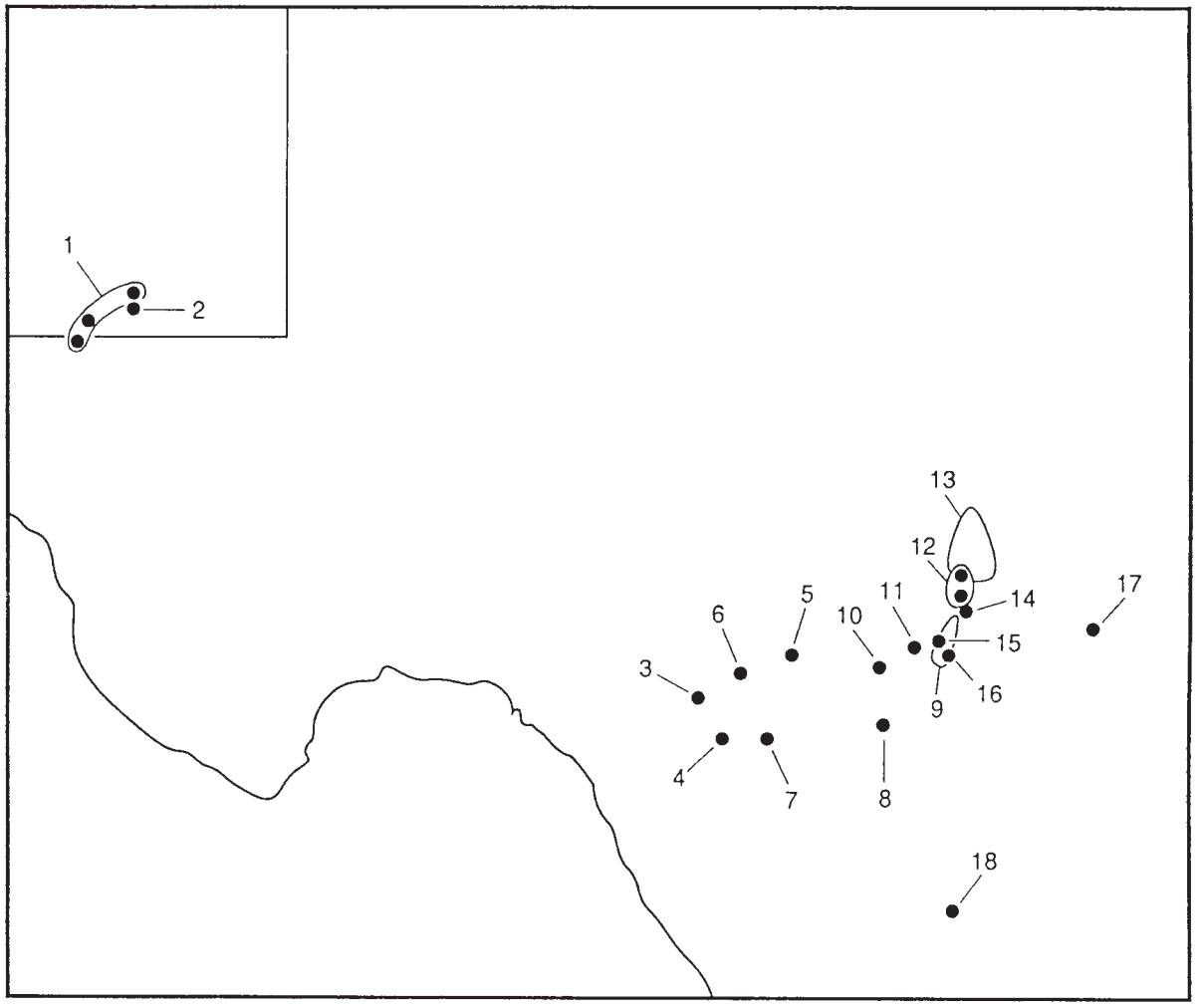
legs than expected (2.6-3.2). This character is the most sensitive indicator of troglomorphy, apparently discriminating between epigean and cavernicolous populations of the same species. In *T. bifurcata*, the cavernicolous specimen has a higher LII/SL value (3.3) than the epigean specimens (2.6-3.1) and in *T. longistyla*, the epigean specimen has a lower LII/SL value (2.8) than the cavernicole specimens (3.5-3.6).

Another character, related to leg length, is the tarsal count (TC). As discussed earlier, a low TC (3-5-4-5) appears to be plesiomorphic in *Texella* and an increased TC (3-5-5-5) is most parsimoniously interpreted as a synapomorphy for the *mulaiki* subgroup. However, further increases in the number of tarsomeres appear to be troglomorphic. In four species of troglobites, the *mulaiki* infragroup and *T. reyesi*, the TC is distinctly higher (as well as being polymorphic); the remaining troglobite, *T. welbourni*, shows no increase in TC.

Also related to appendage elongation is the attenuation of palpal elements, including palpal megaspines, present only in the most troglomorphic species, the *mulaiki* infragroup.

2) Eye reduction. All epigean species and most cavernicoles have well developed eyes. The five troglobitic species lack a retina; four of these also lack all traces of a cornea. In *T. reyesi* the condition of the cornea varies from being well developed to completely absent. Retinal loss thus precedes corneal loss as appears to be the case in all other Phalangodidae.

The reduction of the eye mound seems to be the final step in this transformation series (at least in



Map 2.—Map of western Texas and southeastern New Mexico showing distribution of the species of the *Texella mulaiki* group. Numbers: 1, *T. longistyla*; 2, *T. welbourni*; 3, *T. jungi*; 4, *T. brevistyla*; 5, *T. bilobata*; 6, *T. hardeni* (Haby Salamander Cave, only); 7, Marguerite Cave; 8, *T. cokendolpheri* (Robber Baron Cave, only); 9, *T. mulaiki*; 10, *T. brevidenta*; 11, *T. grubbsi*; 12, *T. reddelli*; 13, *T. reyesi*; 14, *T. spinoperca*; 15, *T. diplospina*; 16, *T. renkesi*; 17, *T. fendi*; 18, *T. homi*.

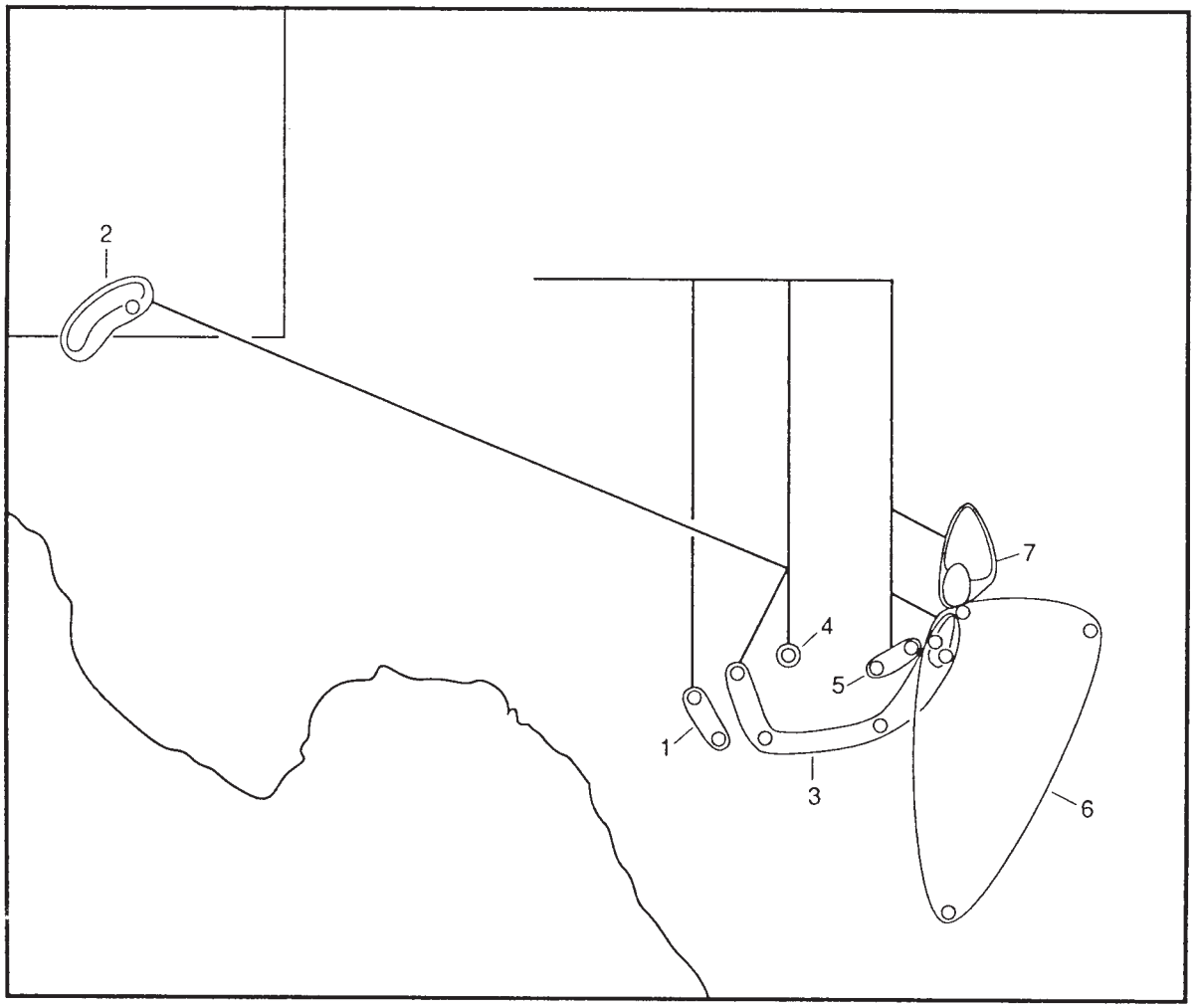
Texella). This is found in the three most troglomorphic species, the *mulaiki* infragroup, and is most extreme in *T. mulaiki*.

3) Reduction of protuberances. Troglobitic species are noticeably smoother in appearance than other *Texella* as a result of an overall reduction of body sculpturing and other protuberances. The body surfaces are almost completely devoid of tubercles (including anterior tubercles). The cuticular microtubercles are small, giving a fine rugosity. Sexually dimorphic structures, female TrIV tubercle, male TrIV spur, and POP, are reduced in size or completely lost.

4) Depigmentation. A loss of pigmentation is most apparent in the troglobitic species.

It is possible to arrange the species of *Texella* on the basis of increasing troglomorphy. The least troglomorphic are the epigean species. Of these *T. deserticola*, with the highest LII/SL ratio and some reduction of anterior tubercles and depigmentation, would be most troglomorphic. Of intermediate troglomorphy are the troglophiles, cavernicolous species having well developed eyes. In this group *T. brevistyla* and *diplospina* have the lowest LII/SL ratios and a relatively high number of anterior tubercles. The troglobitic species range from the moderately modified, *T. welbourni* and *reyesi*, to the extremely modified, the *mulaiki* infragroup.

The fact that troglomorphy appears to be derived, using *T. bifurcata* as outgroup, suggests the use of these characters in phylogenetic analysis. Using the most obvious gaps in the troglomorphic character spectrum, three potential clades can be identified: all cavernicolous species (cave habitation and LII/SL



Map 3.—Distribution and area cladogram of the subgroups and infragroups of the *Texella mulaiki* species group. Numbers: 1, *brevistyla* subgroup; 2, *longistyla* infragroup; 3, *mulaiki* infragroup; 4, *bilobata* infragroup; 5, *brevidenta* infragroup; 6, *spinoperca* infragroup; and 7, *reddelli* infragroup.

≥ 3.3 are synapomorphic); all troglobitic species (eye loss and LII/SL ≥ 4.3 are synapomorphic); and the *mulaiki* infragroup (reduction of eye mound, LII/SL ≥ 9.9, etc. are synapomorphic). The fact that only the last group appears to be monophyletic suggests that troglomorphic characters are primarily adaptive.

Indeed, it appears most probable that troglomorphy evolved several times in *Texella*. For example, the *kokoweef* group includes two troglophilic (*T. kokoweef* and *shoshone*) and one epigean species (*T. deserticola*). Since *T. shoshone* appears to be more closely related to *deserticola*, it would seem most parsimonious that troglomorphy evolved once in the species group and was subsequently lost in *deserticola*. This may be further supported by the fact that *deserticola*, as noted above, is the most troglomorphic of the epigean species. However, one weakness in this argument is that it fails to take into account the relative time frame of phylogenetic and troglomorphic characters. In all probability the speciation events in this group, judging by the morphological distinctness of the species and the basal position of the group, must be old. If the degree of troglomorphy is a function of time, then the presumed antiquity of these species should be reflected in their troglomorphic characters, which is not the case (the species, especially *kokoweef*, are not strongly troglomorphic). Thus, an equally, if not more, parsimonious argument would be that the cavernicolous habit and subsequent troglomorphic modification is a more recent event, and one which occurred independently in the two species. Using similar reasoning, it could be argued that troglomorphy evolved independently at least seven times in the *mulaiki* species group.

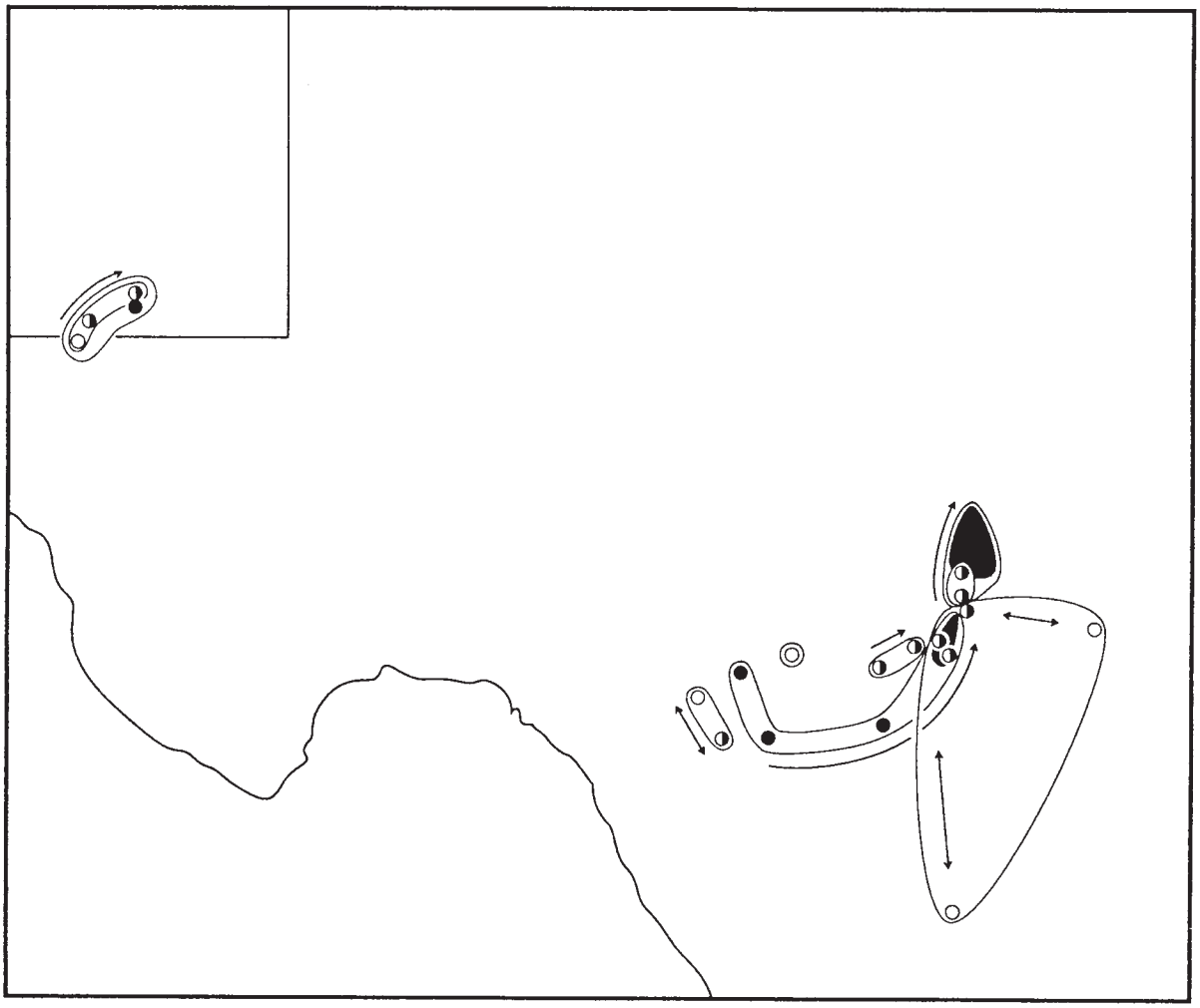
Furthermore, and of possible use in understanding the evolutionary patterns in *Texella*, is the clinal variation in troglomorphic characters. This is

species	LII/SL(N)	tarsal count	ret/cor	ant tubs	TrlV f	TrlV m	POP
bifurcata (E)	2.6-3.1(22)	3-5-4-5	+/+	9-12prs	0-2 tubs	1-3 tubs	-
bifurcata	3.3(1)	3-5-4-5	+/+				
kokoweef	3.3-3.8(6)	3-5-4-5	+/+	4-8prs	2 tubs	long	-
shoshone	3.9-4.2(3)	3-5-4-5	+/+	2prs	1 tub	long	-
deserticola (E)	3.4(1)	3-5-4-5	+\+	2prs	?	long	-
jungi (E)	2.3-2.7(6)	3-5-4-5	+/+	2-6prs	1 tub	long	large
brevistyla	2.6-3.2(11)	3-5-4-5	+/+	8prs	2 tubs	long	md-lg
longistyla (E)	2.8(1)	3-5-5-5	+/+	2prs	?	long	med
longistyla	3.5-3.6(4)	3-5-5-5	+/+	2-3prs	1 tub	long	med
welbourni	4.6(1)	3-5-5-5	-/-	5prs	?	short	small
hardeni	9.9-11.6(3)	3-6/8-4-5	-/-	1pr	none	tiny	none
Marguerite Cave	9.4-11.2(2)	3-6/7-4-5	-/-	0pr	1 tub	?	?
watersi	11.1-12.9(5)	4-6/8-5-5	-/-	1pr	none	tiny	small
mulaiki	12.5-15.3(18)	4-5/8-5/6-5/6	-/-	0-1pr	none	none	none
bilobata (E)	2.6-2.8(3)	3-5-4-5	+/+	2prs	1 tub	short	none
reddelli	3.8-4.2(7)	3-5-5-6	+/+	4-5prs	2 tubs	long	large
reyesi	4.3-8.7(71)	3/4-4/8-5/6-5/8	-/±	0-2prs	0-1 tub	md-lg	sm-lg
brevidenta	3.3(1)	3-5-5-6	+/+	4prs	?	long	med
grubbsi	3.6-3.7(4)	3-5-5-5	+/+	2prs	2 tubs	long	md-lg
diplospina	2.6-3.1(9)	3-5-5-5/6	+/+	4-6prs	1 tub	long	md-lg
renkesae	3.2-3.4(5)	3-5-5-5	+/+	4prs	1 tub	long	md-lg
spinoperca	3.4-4.3(13)	3-5-5-5	+/+	3-4prs	1 tub	long	large
fendi (E)	2.5-2.7(8)	3-5-5-5	+/+	2-4prs	1 tub	short	none
homi (E)	2.5-2.9(4)	3-5-4-5	+/+	3prs	1 tub	short	none

Table 2.—Table of troglomorphic characters. Abbreviations: E = epigean species or populations; LII/SL = leg II/ scute length; N = number of specimens measured; ret = retina; cor = cornea; ant tubs = number of paraocular anterior tubercles; pr(s) = pair(s); TrIV = trochanter IV; f = female; m = male; tub(s) = tubercle(s); lg = long, large; md, med = medium-sized; sm = small.

evident in virtually all (nonmonotypic) clades. In the *kokoweef* group, the direction of least to most troglomorphic goes from *T. deserticola* to *shoshone*. A clearly defined cline is not evident in the *brevistyla* subgroup. Although the cavernicolous *T. brevistyla* has a slightly higher LII/SL ratio, *T. jungi* has a more reduced AT and female TrIV tubercle count. In the *longistyla* infragroup, troglomorphy proceeds from the epigean population of *T. longistyla* to the troglobitic *T. welbourni*. In the *mulaiki* infragroup, the direction is from *T. hardeni* and the species from Marguerite Cave to *mulaiki*. In the *reddelli* infragroup, the highest troglomorphy is in the northernmost populations of *T. reyesi*. In the *brevidenta* infragroup, *T. grubbsi* is clearly the more troglomorphic of the two species. Finally, the situation in the *spinoperca* infragroup is somewhat more complex. Although the cavernicolous species clearly form a cline (from *diplospina* to *spinoperca*, the most troglomorphic), the position of the epigean species is not clear. Contrary to expectation, these species appear more troglomorphic than the cavernicolous species in some characters (Table 2).

Finally, of biogeographic interest is the spatial distribution of troglomorphy. The resulting pattern (Map 4) is unusually orderly. First, there appears to be a directionality in troglomorphism. In virtually all clades, the least and the most troglomorphic harvestmen are at opposite ends of the clade's distribution. Second, and what seems quite remarkable is that, in virtually all clades, the most troglomorphic element is at the N to NE part of the distribution. The apparent nonrandomness of these patterns begs for an explanation. Hopefully one will come as the distribution patterns of the rich Nearctic cavernicole fauna, especially that of central Texas, become better known.



Map 4.—Distribution of troglomorphy in the *Texella mulaiki* species group. Symbols: open circle = epigean species (and epigean population of *T. longistyla*); black dot = troglobitic species; mixed symbol = troglophilic species (and troglophilic populations of *T. longistyla*). Arrows give the direction towards increasing troglomorphy; double arrows indicate ambiguity in polarity.

TAXONOMY

TEXELLA Goodnight and Goodnight

Texella Goodnight and Goodnight, 1942:10 (type species by monotypy and original designation *Texella mulaiki* Goodnight and Goodnight 1942).

Diagnosis.—Species of *Texella* may be distinguished from those of *Banksula* in lacking spiniferous tubercles dorsally on the palpal femora, from *Calicina* and *Microcina* in having tubercles or spurs ventrally on the fourth trochanters, and from *Phalangodes* and other nominate genera from the eastern Nearctic in having the eye mound situated on the anterior margin of the scute. The presence of three mesal megaspines on the palpal tibia and/or the absence of a retina will distinguish most species of *Texella* from those of *Sitalcina*.

Males of *Texella* may be distinguished from all other Nearctic phalangodid genera by the following combination of genitalic characters: ventral plate with bifurcation wider than glans, ventral plate with well developed apical spine, and glans double folded, appearing sigmoid in lateral view. Most females may be distinguished from those of other genera in having ovipositors with transverse wrinkles and a pair of apical teeth.

Description.—Total body length 1.2-2.7; scute length 0.8-1.7. Body color from yellowish white to brownish orange, appendages relatively paler. Body cuticle with uniform layer of hemispherical to ovoid microtubercles, appearing smooth (microtubercles about 5 μm in diameter) to rugose (about 10 μm) at normal magnifications, and scattered patches of larger tubercles (from about 20 μm), which may be elongate, scale-like, and setiferous; setation light to moderate, most pronounced on the abdomen. Scute with eye mound at anterior margin; thoracic region set off dorsally by transverse grooves and laterally (at insertion of leg III) by pronounced constriction; abdominal region typically with five transverse rows of coarse tubercles representing fused tergites I-V. Eye mound roughly conical, reduced in troglomorphic species, rugosity smooth to coarse; eyes well developed, reduced, or absent. Anterior tubercles present or absent. Ozopores well developed, on anteriolateral margin, with distinct posterior channel. Tergites VI-VIII free, typically with median, transverse rows of coarse tubercles interspersed with short setae. Venter textured similarly as scute but more densely setose. Coxae with coarse tuberculation typically on ventral surfaces, retrolaterally on coxae II, and prolaterally on coxae IV; endites mesoapically situated on palpal coxae, coxae I, and coxae II; anteriorly directed spur on ventral surface of palpal coxae. Genital operculum between coxae IV, roughly semicircular, may be armed apically with 1-2 pairs of spines or tubercles. Large to small conical, cuticular outgrowth (= postopercular process) immediately behind genital operculum present in males of most species. Sternites typically with transverse rows of tubercles; sternite I with spiracle near distal part of coxa IV; sternites II-V free; sternites VI-VII fused. Anal operculum coarsely tuberculate and setose.

Chelicerae with smooth cuticle, basal segment with dorsoapical swelling, apical segments dorsally setose. Palpi with smooth cuticle of appressed scales, apically setose, typically robust but conspicuously attenuated in highly troglomorphic species; megaspine number and distribution: trochanter: 1-2 ventral (small); femur: 3 ecto(ventro)-basal, 1-2 mesoapical; patella: 1 ectal, 1-2 mesal; tibia: 2 ectal, 2-3 mesal; tarsus: 2 ectal, 2 mesal. Legs with cuticle of apically rebordered scales giving honeycomb appearance; calcanei and tarsi smooth; lightly to moderately setose; leg II longest, leg formula (longest to shortest) II-IV-I-III; leg II length / scute length = 2-15; tarsal counts typically 3-5-4-5, 3-5-5-5, and 3-5-5-6, but up to 4-8-6-8 in highly troglomorphic species; tarsal claws single on legs I and II, paired on legs III and IV; legs of juveniles with posterior claws on onychium and enclosing arolium. Trochanter IV with ventral tubercles (females, some males) or elongate process (=spur) (most males); spur generally slightly curved, ventrally with smooth knobs, apically bent or enlarged.

Penis without muscles, composed of basal sac, truncus, and apical glans. Ventral plate bifurcate; incision at least as wide as glans width; each prong with a rigid, cuticular, apical spine and movable setae; setae arranged in dorsal, lateral, and ventral series. Glans double folded, appearing sigmoid in lateral view, expansion along two axes of rotation: 1) junction of basal and middle segment and 2) junction of apical segment and stylus; basal segment typically with ventroapical extension (= basal knob); middle segment with a pair of distal lobes (parastylar lobes), occasionally with a pair of secondary parastylar lobes; stylus apical, may bear a pair of basolateral processes (stylar apophyses) and ventral carina. Ovipositor bent or straight; cuticle wrinkled, with longitudinal and transverse folds; microsculpturing of small, thin spines, serrations, or rounded tubercles, rarely smooth; apex with dorsoventral slit, typically with a pair of teeth; setal

Key to the species of *Texella*

Males

1. POP absent (Figs. 1, 3, 104) 2
   POP present (Figs. 2, 50, 64, 92, 132, 133) 10

2. Trochanter IV with ventral spur longer than trochanter (Figs. 24, 37). Distribution California 3
   Trochanter IV with spur (or tubercles) shorter than trochanter (Figs. 11, 192) or absent (Fig. 104). Distribution California and Texas 5

3. Glans with well developed PSL2; S subequal to PSL (Figs. 27, 39). Cavernicole 4
   Glans with tiny PSL2. S distinctly longer than PSL (Fig. 45). Epigean ..... *deserticola* n. sp.

4. PSL2 robust; VPP wide (Fig. 27). Palpal tibia with three mesal megaspines. Scute with 4–8 pairs of AT (Fig. 22) ..... *kokoweef* n. sp.
   PSL2 slender; VPP narrow (Fig. 39). Palpal tibia with two mesal megaspines. Scute with 2-3 pairs of AT (Fig. 34) ..... *shoshone* n. sp.

5. Eyes well developed. TC = 3-5-4-5 or 3-5-5-5. LII/SL = 2.5-2.9 (rarely to 3.3). Epigean (rarely troglophilic) 6
   Eyes absent, lacking retinae and corneae. TC higher. LII/SL = 9.9-15.3. Cavernicole (troglobitic) 9

6. Trochanter IV with 1-3 ventral tubercles (Fig. 11). Glans with 2 pairs of PSL (Fig. 15). SA absent (Fig. 14). Distribution NW California and SW Oregon ..... *bifurcata* (Briggs)
   Trochanter IV with short, ventral spur (Fig. 192). Glans with 1 pair PSL. SA present. Distribution central Texas 7

7. TC = 3-5-5-5. Both PSL and SA attenuated (Fig. 187) ..... *fendi* n. sp.
   TC = 3-5-4-5. SA and sometimes PSL not attenuated 8

8. BK present, bilobed; PSL hooked (Figs. 113-117) ..... *bilobata* n. sp.
   BK absent; PSL attenuated (Figs. 198-201) ..... *homi* n. sp.

9. Trochanter IV lacking spur or tubercle (Fig. 104). Tarsus I with four tarsomeres ..... *mulaiki* Goodnight and Goodnight
   Trochanter IV with tiny ventral spur. Tarsus I with three tarsomeres ..... *hardeni* n. sp.

10. Eyes well developed 11
    Eyes reduced, lacking at least retinae 19

11. TC = 3-5-4-5. S shorter than PSL (Figs. 74-76) 12
    TC = 3-5-5-5 or 3-5-5-6. S longer than PSL 13

12. PSL short, claw-shaped (Figs. 67, 74). Scute with 3-6 pairs of AT (Figs. 60-62). Epigean ..... *jungi* n. sp.
    PSL long, spiraled (Figs. 52-55, 76). Scute with 7-8 pairs of AT (Fig. 48). Cavernicole ..... *brevistyla* n. sp.

13. S compressed (Figs. 77, 78). Distribution Eddy County, New Mexico, and Culberson County, Texas ..... *longistyla* n. sp.
    S spatulate apically (Figs. 121, 164, 168, 176, 180). Distribution central Texas 14

14. BK absent (Figs. 177, 180). SA with moderately to extremely long prongs (Figs. 168, 176, 180) 15
BK present (Figs. 121, 160-163). SA with short prongs (Fig. 164) or clip-like (Fig. 120) 17

15. Scute with 3-4 pairs of AT (Fig. 178). LII/SL = 3.4-4.3. Distribution Travis County, Texas ..... *spinoperca* n. sp.
Scute with 4-6 pairs of AT (Fig. 166). LII/SL = 2.6-3.4. Distribution Hays County, Texas 16

16. SA originating medially on S (Fig. 168) ..... *diplospina* n. sp.
SA originating basally on S (Fig. 176) ..... *renkesae* n. sp.

17. SA clip-like (Fig. 120). LII/SL = 3.8-5.2 ..... *reddelli* Goodnight and Goodnight
SA with a pair of short, blunt prongs (Fig. 164). LII/SL = 3.3-3.7 18

18. TC = 3-5-5-6. 4 pairs of AT. LII/SL = 3.3 ..... *brevidenta* n. sp.
TC = 3-5-5-5. 2 pairs of AT. LII/SL = 3.6-3.7 ..... *grubbsi* n. sp.

19. SA clip-like (Fig. 136). POP medium to long (Figs. 132, 133). LII/SL = 4.3-8.7 ..... *reyesi* n.sp.
SA with prongs (Figs. 84, 96). POP small to medium sized 20

20. POP small (Fig. 92). LII/SL = 9.9-11.6 ..... *cokendolpheri* n. sp.
POP medium sized. LII/SL = 4.6 ..... *welbourni* n. sp.

Females

(not known for *T. deserticola, welbourni,* and *brevidenta*)

1. TC = 3-5-4-5 2
TC = 3-5-5-5, or higher 8

2. Scute with at least 4 pairs of AT (Fig. 16) 3
Scute with at most 3 pairs of AT (Fig. 61) 5

3. Ovipositor bent, with a pair of large apical teeth (Figs. 18, 19). Distribution NW California to SW Oregon ..... *bifurcata* (Briggs)
Ovipositor straight; apical teeth small or absent (Figs. 30, 56) 4

4. LII/SL = 3.3-3.8. Ovipositor lacking apical teeth. Distribution S California ..... *kokoweef* n. sp.
LII/SL = 2.6-3.2. Ovipositor with small apical teeth. Distribution Texas ..... *brevistyla* n. sp.

5. Genital operculum apically unmodified ..... *bilobata* n. sp.
Genital operculum with a pair of apical tubercles or spines 6

6. Palpal tibia with 2 mesal megaspines. Distribution California ..... *shoshone* n.sp.
Palpal tibia with 3 mesal megaspines. Distribution Texas 7

7. Genital operculum with a pair of apical tubercles (Fig. 71) ..... *jungi* n. sp.
Genital operculum with a pair of apical spines ..... *homi* n. sp.

8. Palpal tibia with two mesal megaspines 9
Palpal tibia with three mesal megaspines 12

9. Retina present. LII/SL = 2.8-3.6 ..... *longistyla* n. sp.
Retina absent. LII/SL = 10-15 10

10. Tarsus I with three tarsomeres. LII/SL = 10-12 ..... *hardeni* n. sp.
Tarsus I with four tarsomeres 11

11. Palpal patella with one mesal megaspine. Eye mound with several prominent conical tubercles (Fig. 90). LII/SL = 11-13 ..... *cokendolpheri* n. sp.
Palpal patella with two mesal megaspines. Eye mound lacking prominent tubercles (Fig. 101). LII/SL = 12-15 ..... *mulaiki* Goodnight and Goodnight

12. Genital operculum with spines or tubercles on anterior margin 13
Genital operculum with anterior margin entire 16

13. Genital operculum with 1 pair of apical tubercles (Fig. 194). Epigean ..... *fendi* n. sp.
Genital operculum with 1-2 pairs of apical spines. Cavernicolous 14

14. Genital operculum with 2 pairs of apical spines (Fig. 171) ..... *diplospina* n. sp.
Genital operculum with 1 pair of apical spines (Fig. 183) 15

15. LII/SL = 3.2-3.4. Distribution Hays County, Texas ..... *renkesae* n. sp.
LII/SL = 3.4-4.3. Distribution Travis County, Texas ..... *spinoperca* n. sp.

16. Retina absent ..... *reyesi* n. sp.
Retina present 17

17. TC = 3-5-5-5. LII/SL = 3.6-3.7 ..... *grubbsi* n. sp.
TC = 3-5-5-6. LII/SL = 3.8-4.9 ..... *reddelli* Goodnight and Goodnight

pattern: 4 pairs lateral, 1 pair ventral, subapical, and 2 pairs dorsal, subapical; subapical setae located in cuticular folds. Hyperexpanded ovipositor with four apical valves and a patch of small basolateral spines.

Range.—Known from southwestern Oregon to southern California and southern New Mexico to central Texas.

Texella Goodnight and Goodnight

The *bifurcata* Group

Diagnosis.—The presence of at least 9 pairs of AT (Fig. 9) separates this group from the others. The males may be further distinguished by the following combination of characters: ventral surface of TrIV with tubercles, lacking spur (Fig. 11); POP absent (Fig. 1); PSL2 present, mesally directed; S compressed, basally unmodified, lacking SA; PSL long, ribbon-like, apically bifurcate; apex of VPP with ventral notch; AS long (2.5 times VP width) (Figs. 6, 12-15). The females appear to be unique in having a bent ovipositor (Fig. 18).

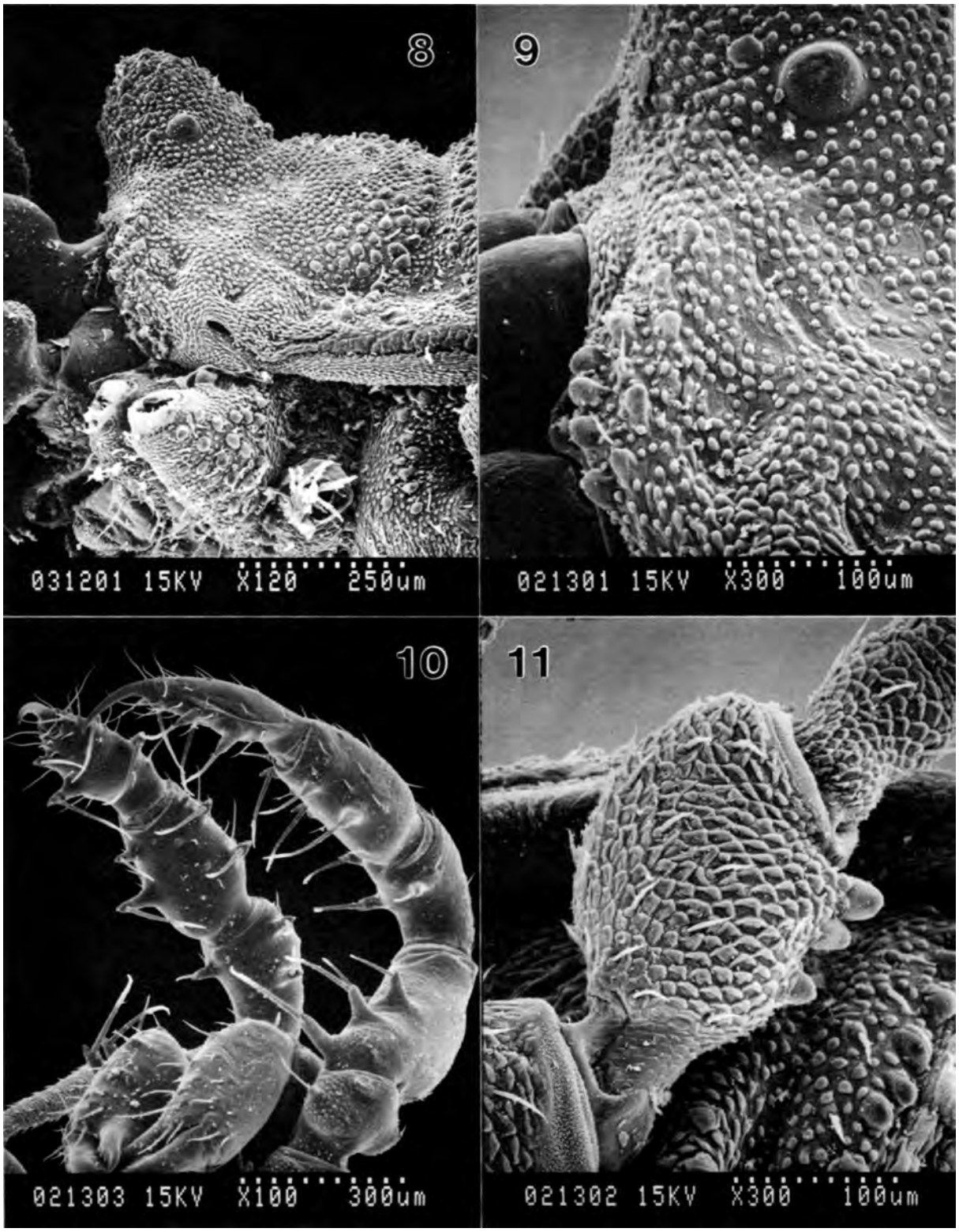
Range.—Known from southwestern Oregon and northwestern California.

Texella bifurcata (Briggs), **New Combination**

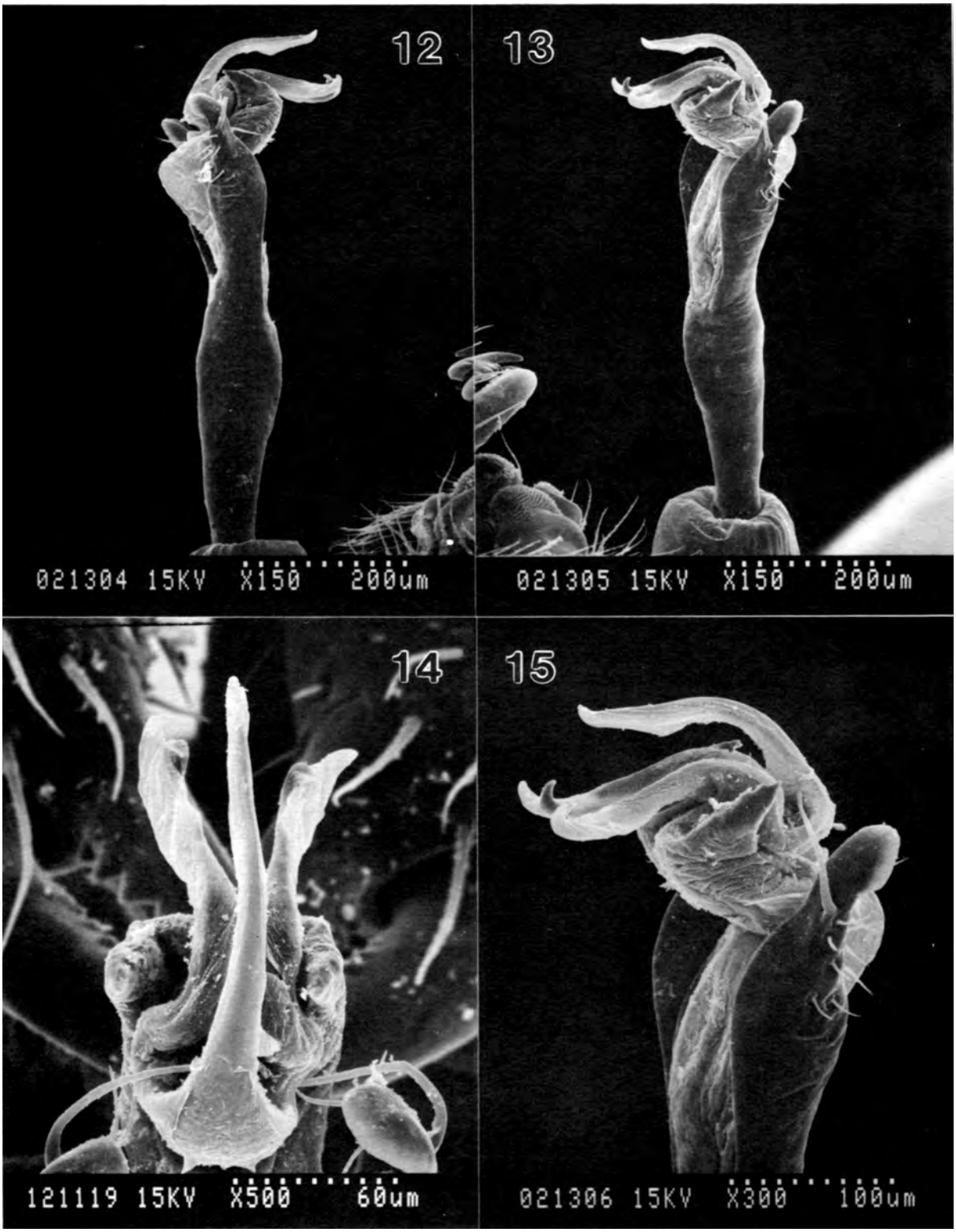
Figs. 1, 6, 8-21

Sitalcina bifurcata Briggs, 1968:29, figs. 31, 61, 92, and 105 (male holotype from near west entrance of Castle Crags State Park, Shasta County, California, in CAS, examined).

Diagnosis.—Males of this species are most easily distinguished from other *Texella* by the presence of transversely (rather than longitudinally) directed PSL2 (Figs. 6, 15). Females have an ovipositor, possibly unique in the genus, which is bent (rather than straight) when fully extended (Fig. 18). Also, *T. bifurcata* differs from other species in the higher number of AT (9-12 pairs, compared to 8-0 pairs in other *Texella*) which are arranged in two rows (a biserial arrangement is also found in *T. kokoweef*, *jungi*, *brevistyla*, *reddelli*, and *diplospina*) (Fig. 9).



Figs. 8-11.—*Texella bifurcata* (Briggs), male topotype: 8, anterior half of body, lateral view; 9, enlargement of previous image showing cornea and anterior tubercles; 10, palpi and chelicerae, ventrolateral view; 11, trochanter IV, lateral view.



Figs. 12-15.—*Texella bifurcata* (Briggs), male topotype: 12, penis, ventrolateral view; 13, 15, penis, dorsolateral view; 14, penis, apical view.

Description.—Total body length, 1.51-2.10. Scute length, 1.00-1.31. Leg II length, 2.92-4.03. Leg II/Scute length, 2.60-3.27. (N=23).

Color orange to brownish orange. Body coarsely rugose; tubercles present on eye mound, dorsal and lateral surfaces of pars thoracica, tergite margins, and ventral and lateral faces of coxae. Carapace with 9-12 pairs of anterior tubercles arranged in double rows. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.72. Scute length, 1.18; width, 1.26. Eye mound length, 0.31; width, 0.26. Leg II length, 3.31. TrIV with three tubercles. POP absent.

Penis (Figs. 12-15): VPP with apex strongly bent; 2 dorsal, 8 lateral, and 4 ventral setae; AS long, evenly curved, with small, subapical tooth. Glans with BK absent; ML apparently present, small; PSL long, ribbon-like, apically bifurcate; PSL2 present, transversely directed. S long, compressed; lacking BF and SA.

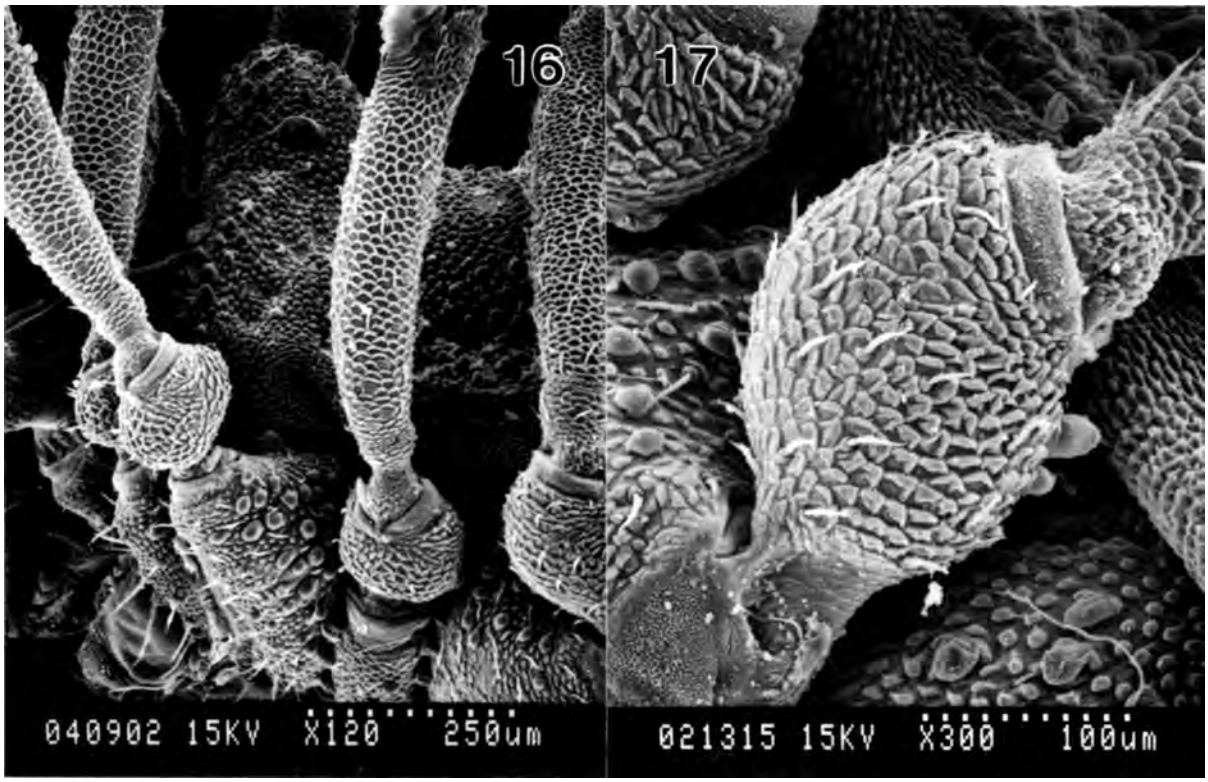
Female (allotype): Total body length, 1.67. Scute length, 1.15; width, 1.31. Eye mound length, 0.30; width, 0.27. Leg II length, 3.13. Trochanter IV with ventral tubercle.

Ovipositor (Figs. 18-21): cuticle intricately folded; dorsal surface sparsely set with small spines; ventral with microtubercles;1 pair apical teeth present; setal pattern typical.

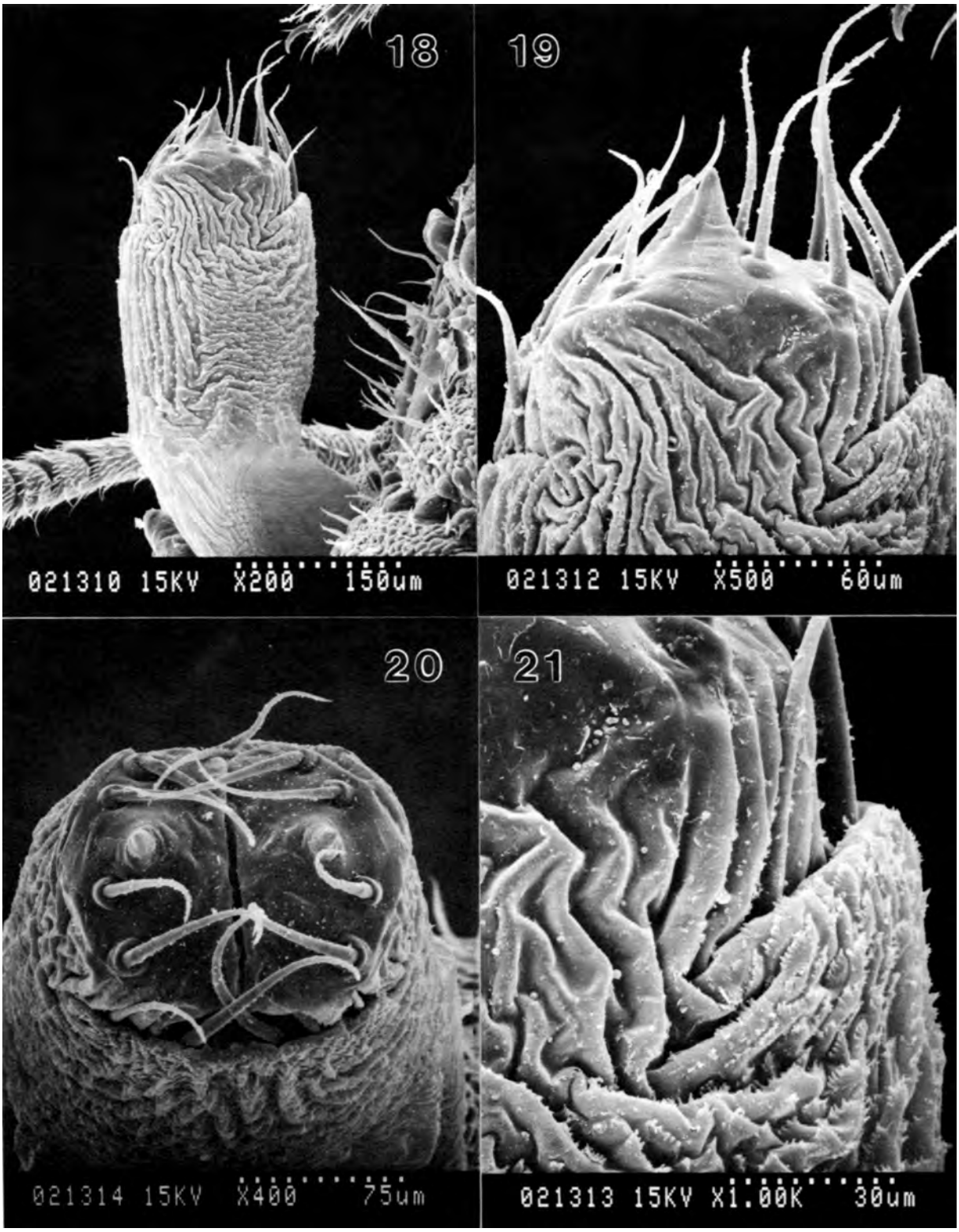
Variation.—Slight differences were detected in the male genitalia. The tip of the stylus varies in shape and the subapical prongs of the PSL vary slightly in size and curvature.

The number of ventral tubercles on Tr IV varies, even within a single population. Typically, males have two tubercles, the apical being twice the length and diameter of the basal, and females have a single small tubercle. Some males were found with one (five out of 26 specimens examined) or three (5/26) tubercles, as well as some females with zero (2/11) or two (3/11). Males from Round Mountain have one or two tubercles, all small. In the Oregon populations, males have only the single, apical tubercle (which is of moderate size) and the females lack them altogether.

The individuals from Oregon are also paler and somewhat smaller than those from California, having: SL = 1.00-1.10 (N = 5), compared to SL = 1.13-1.31 for remaining epigean specimens measured (N = 18); SW = 1.08-1.15 (1.18-1.41 for the remaining specimens); LIIL = 2.92-3.10 (3.13-3.59 for the remaining specimens). The single Oregon



Figs. 16-17.—*Texella bifurcata* (Briggs), female topotype: 16, anterior half of body, lateral view; 17, trochanter IV, lateral view.



Figs. 18-21.—*Texella bifurcata* (Briggs), female topotype: 18, ovipositor, lateral view; 19, ovipositor tip, lateral view; 20, ovipositor, apical view; 21, ovipositor, enlarged view of dorsolateral surface.

male examined closely has fewer setae on the VP prongs, 3 ventral and 6 or 7 lateral, but does not appear to differ from the Californian males in glans characters.

The single female from a cave locality (Shasta Lake Caverns) has distinctly longer appendages. Its LII/SL = 3.27; for all remaining individuals examined (N = 22) the LII/SL ratio ranges from 2.60-3.10 (mean = 2.79). This specimen is also slightly less pigmented but otherwise, including the tarsal count, resembles those from surface habitats.

Natural History.—Collected from beneath rocks and logs and in duff in coniferous and riparian forests. One specimen is from a cave.

Material Examined.—UNITED STATES: **California**: *Shasta Co.*: near west entrance Castle Crags State Park, 6 May 1967, under granite, pine woodland (T. Briggs, K. Hom, and A. Jung, CAS), 13 males (including type), 5 females; 5 mi SW Round Mountain, 7 May 1967, under limestone, pine woodland (T. Briggs and A. Jung, CAS), 6 males, 3 females; Clear Creek Camp, Shasta National Forest, 5 Aug. 1967, under rotten log, riparian woodland (T. Briggs, CAS), 1 male, 2 females; Shasta Lake Caverns, 16 mi NNE Redding, 10 Apr. 1979 (D. Rudolph, B. Martin, and S. Winterath, CAS), 1 female; N of Hazel Creek, 26 June 1954 (R. Schuster and B. Adelson, AMNH), 2 males, 6 females; 10 mi S Dunsmuir, 2 July 1954 (R. Schuster and E. Gilbert, AMNH), 1 male; Squaw Creek, 122.40, 15 July 1937 (R. Chamberlin, AMNH), 1 male. *Del Norte Co.*: 0.3 mi SE east entrance Jedediah Smith State Park, 25 June 1966 (A. Jung and K. Hom, CAS), 1 male. **Oregon**: *Jackson Co.*: 15 mi SW Ruch, Upper Applegate Road, T40S R3W sec 8, 1800', 13 Nov. 1971, berlese duff, debris, moss, bark (E. Benedict, WAS), 1 male, 1 female; 6 mi S Ruch, Upper Applegate Grange, T39S R3W sec 15, 1600', 13 Nov. 1971, berlese mixed duff, litter (E. Benedict, WAS), 1 male, 2 females.

Distribution.—Known from northwestern California and adjacent regions of Oregon (Map 1).

The *kokoweef* Group

Diagnosis.—Males of this group differ from those of the other two groups by the following combination of characters: TrIV with well developed spur (Figs. 24, 25, 37); POP absent; BK absent; BF absent; PSL2 medium sized to small, longitudinally directed (Figs. 26-29, 38-47). Females (only those of *T. kokoweef* clearly observed) have a straight ovipositor which lacks apical teeth (Figs. 30, 32, 33).

Texella kokoweef, new species
Figs. 22-33, 42, 43.

Diagnosis.—Males of this species differ from all other *Texella* by the combined presence of a unique TrIV spur which is apically T-shaped (Figs. 24, 25) and a VPP which has a long, pointed AS (Figs. 26-29).

Type.—Male holotype from Kokoweef Crystal Cave, San Bernardino County, California (30 Dec. 1968; T. Briggs, B. Lum, and G. Leung), deposited in CAS.

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

Description.—Total body length, 1.67-1.82. Scute Length, 1.21-1.31. Leg II length, 3.97-4.72. Leg II/Scute length, 3.28-3.84. (N = 6).

Color light brownish orange. Body coarsely rugose; tubercles present on eye mound, on the pars thoracica, tergite margins, and coxae. Carapace with 4-8 pairs of AT arranged in two, poorly defined rows. Eye mound a broadly rounded cone, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-4-5.

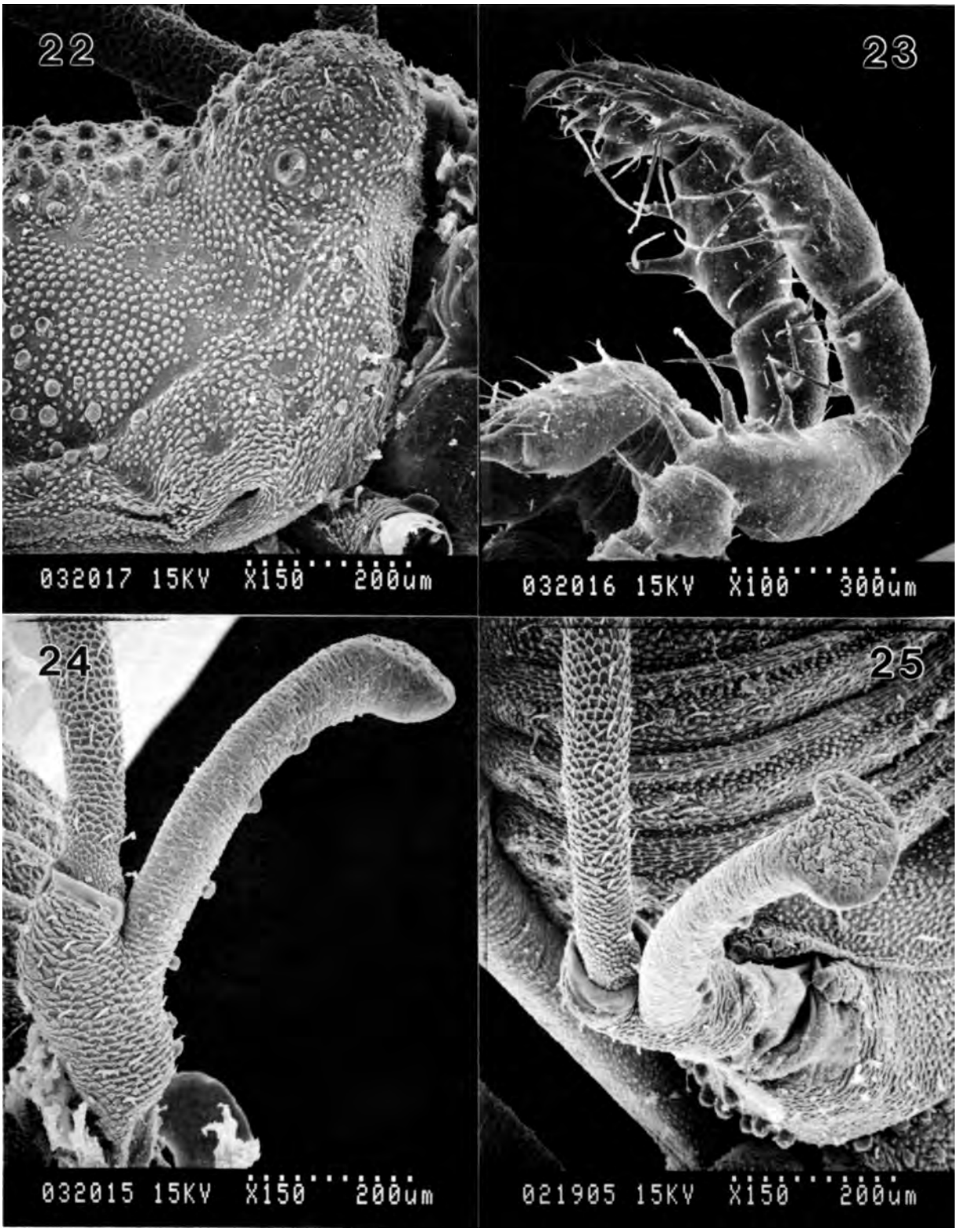
Male (holotype): Total body length, 1.67. Scute length, 1.26; width, 1.23. Eye mound length, 0.31; width, 0.31. Leg II length, 4.49. TrIV spur robust, curved, apically enlarged (T-shaped); length, 0.54. POP absent.

Penis (Figs. 26-29, 42, 43): VPP with 3 dorsal, 10 lateral, 4 ventral setae; AS long, pointed, slightly curved. Glans: BK absent; ML small but distinct; PSL long, ribbon-like, with subapical ectal tooth; PSL2 well developed, apically directed. S long, compressed, apically bent; BF absent; SA represented by laterobasal carina.

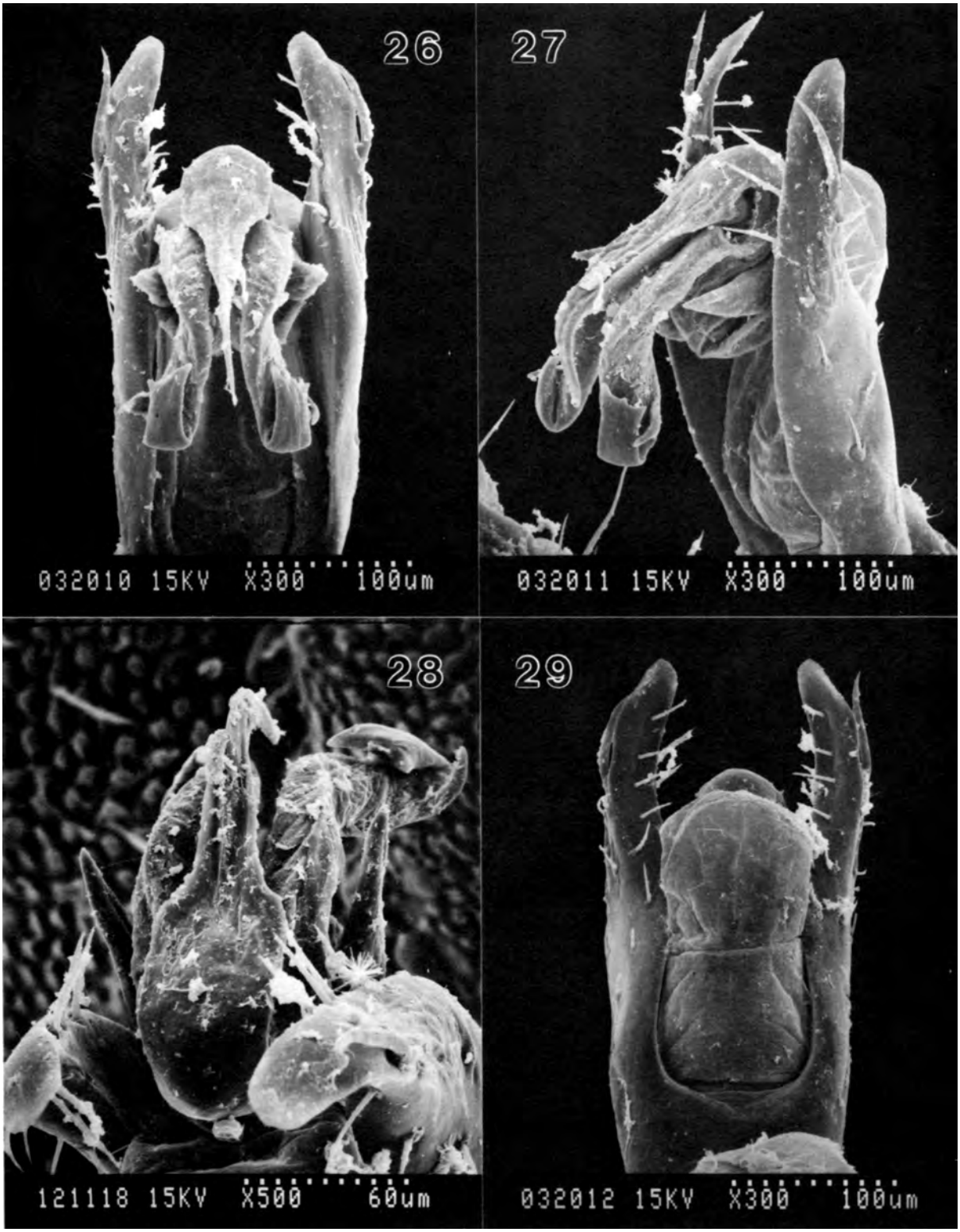
Female (paratopotype): Total body length, 1.82. Scute length, 1.21; width, 1.33. Eye mound length, 0.26; width, 0.27. Leg II length, 3.97. TrIV with two ventral tubercles.

Ovipositor (Figs. 30, 32, 33): cuticle intricately folded; surface sculpturing of minute serrations, sparse ventrally; apical teeth absent; setal pattern: 1 pair ventral, 2 pairs dorsal, 4 pairs lateral.

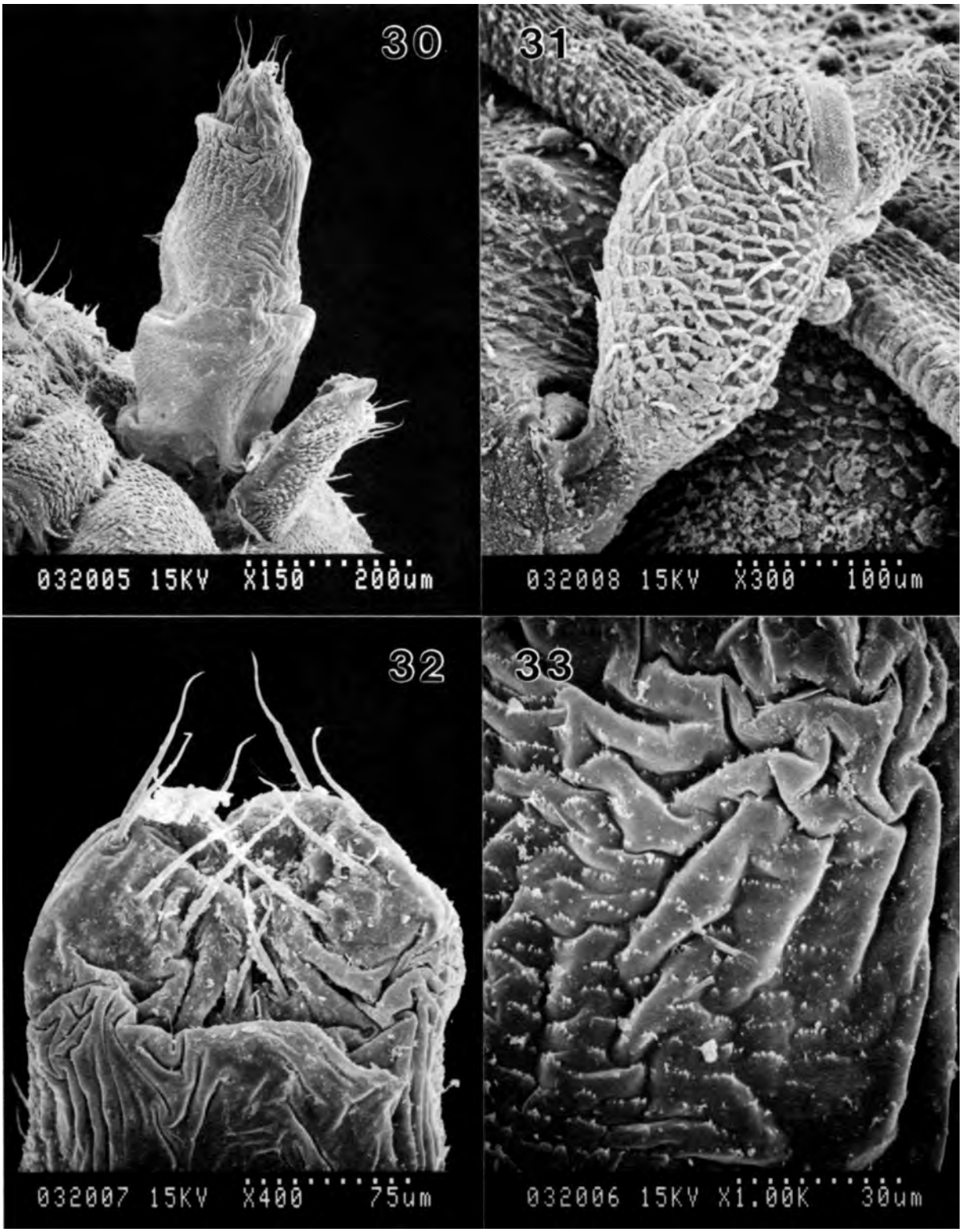
Note.—The glans of *T. kokoweef* shows dramatic changes following treatment with KOH. Unlike the strictly positional changes observed in the majority of other species so treated, the glans structures in this species are also altered in appearance. Specifically, the PSL are both inflated, especially in the



Figs. 22-25.—*Texella kokoweef,* new species, male paratopotype: 22, anterior half of body, lateral view; 23, palpi and chelicerae, sublateral view; 24, trochanter IV spur, lateral view; 25, trochanter IV spur, apical view showing enlarged tip.



Figs. 26-29.—*Texella kokoweef,* new species, male paratopotype: 26, penis, dorsal view; 27, penis, dorsolateral view; 28, penis, apical view; 29, penis, ventral view.



Figs. 30-33.—*Texella kokoweef,* new species, female paratopotype: 30, ovipositor, lateral view; 31, trochanter IV, lateral view; 32, ovipositor, subapical view; 33, ovipositor, enlarged view of lateral surface.

apical region which loses the apical fold, and twisted, with the lateral prongs becoming mesal (compare Figs. 26-29 to 42 and 43). Similar changes, but of a lesser magnitude, occur to the PSL of *T. shoshone.*

Natural History.—Specimens were collected beneath decaying wood debris, along with several additional invertebrates. Given the isolation of Kokoweef Crystal Cave, it is likely that much of the fauna is endemic. At present, a species of spider, *Usofila* n. sp. (Telemidae), is known only from this cave (Gertsch, personal communication).

Other Material Examined (Paratypes).— UNITED STATES: **California**: *San Bernardino Co.*: Kokoweef Crystal Cave, 30 Dec. 1968 (T. Briggs, B. Lum, and G. Leung, CAS), 7 males, 1 female; 1 Apr. 1972 (T. Briggs and D. Ubick, CDU, AMNH), 2 males, 1 female.

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

Texella shoshone, new species
Figs. 34-41, 44.

Diagnosis.—Males of this species may be distinguished from all others in the group by the following combination of characters: VPP thin, parallel-sided; AS apparently absent; PSL2 slender; and GO with 2 pairs of apical tubercles (also found in females) (Figs. 38-41, 44). This species is also distinct somatically in having the body surface studded with large tubercles; especially prominent on the tergite margins and anal operculum (Figs. 34-35).

Type.—Male holotype from Shoshone Cave, Inyo County, California (29 Dec. 1971; T. Briggs), deposited in CAS.

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

Description.—Total body length, 1.40-1.49. Scute length, 0.90-1.05. Leg II length, 3.82-4.23. Leg II/Scute length, 3.86-4.24. (N = 3).

Color yellowish orange. Body coarsely rugose; large tubercles on eye mound, pars thoracica, coxae, and especially tergite margins and anal operculum. Carapace with 2 pairs of large anterior tubercles. Eye mound rounded, dorsally flattened, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 1 mesal; tibia, 2 mesal. Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.49. Scute length, 1.05; width, 1.08. Eye mound length, 0.23; width, 0.23. Leg II length, 4.05. TrIV spur relatively straight; length, 0.25. POP absent. GO with 2 pairs of apical tubercles.

Penis (Figs. 38-41): VPP slender, parallel sided, apically pointed; with 2 dorsal, 6 lateral, and 4 ventral setae; AS apparently absent. Glans: BK absent; ML absent or possibly represented by two lateral lobes; PSL long, ribbon-like, apically folded; PSL2 slender, apically directed. S long, compressed, relatively straight; SA represented by basolateral carina; BF absent.

Female (paratopotype): (The single available specimen was badly damaged during dissection.) Similar to males in size and general appearance. GO with two pairs of prominent apical tubercles. Ovipositor withdrawn, apical setae visible. Tr IV with one ventral tubercle.

Note.—The PSL apparently inflate during glans expansion (see note in *T. kokoweef* and compare Figs. 38-41 to 44).

Natural History.—This species is known only from Shoshone Cave. This cave has a thermal spring, which maintains conditions at about 25°C and 100% humidity. The habitat and cave conditions are more thoroughly described by Briggs and Hom (1972). Shoshone Cave is located in a saltbush desert and has a rich fauna which, as a result of its isolation, is high in endemicity. In addition to *T. shoshone*, the fauna includes an endemic shizomid [*Hubbardia shoshonensis* (Briggs and Hom, 1972)], milliped (*Colactis briggsi* Shear 1974), cricket (*Ceuthophilus* n. sp.), and carabid (*Rhadine* n. sp.).

Other Material Examined (Paratypes).— UNITED STATES: **California**: *Inyo Co.*: Shoshone Cave, 29 Dec. 1971 (T. Briggs, CAS), 3 males, 1 female.

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

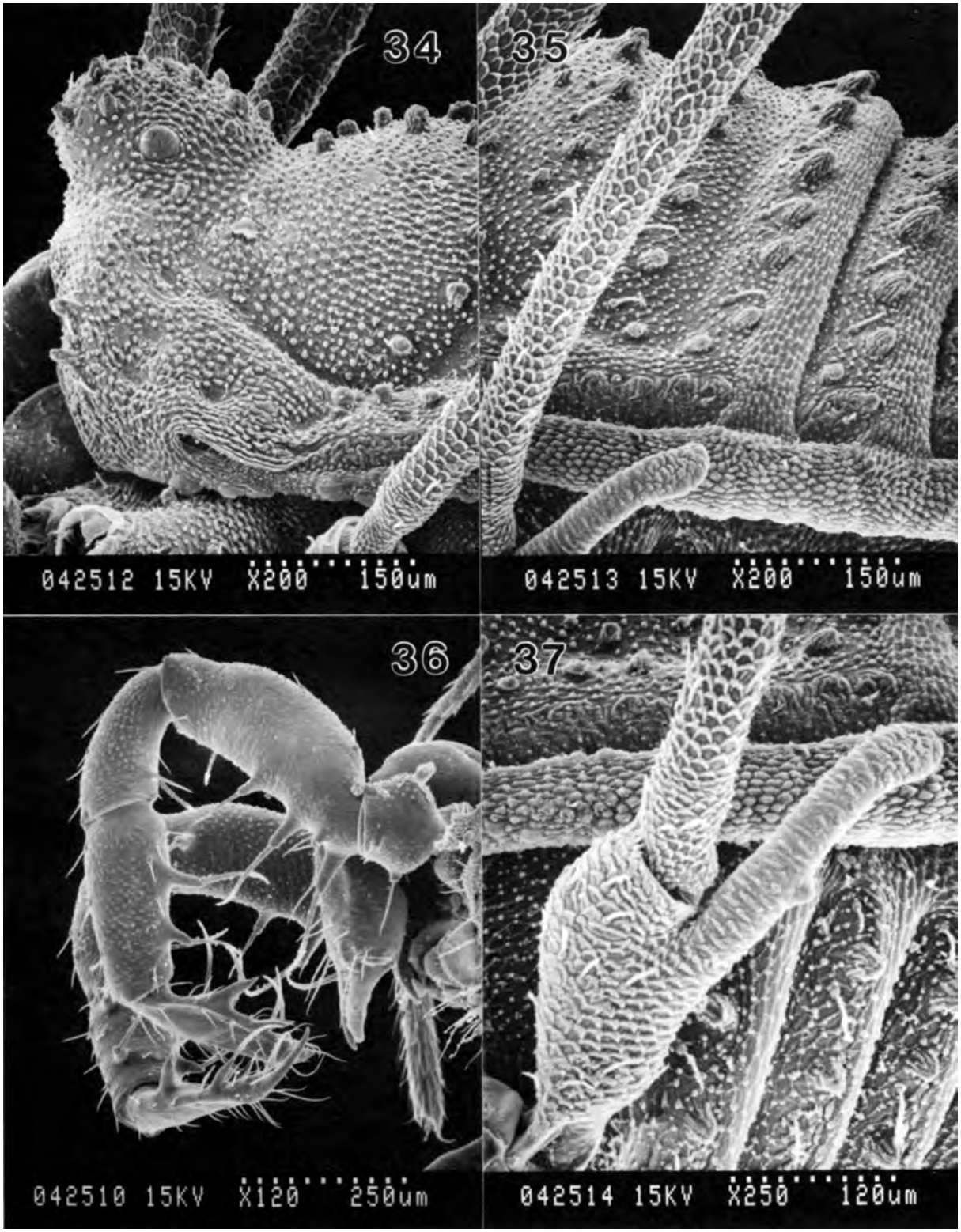
Texella deserticola, new species
Figs. 45-47.

Diagnosis.—This species may be distinguished from the males of other species in the group by the combined presence of a medium-sized AS, short claw-like PSL, and strongly reduced PSL2 (Figs. 45-47).

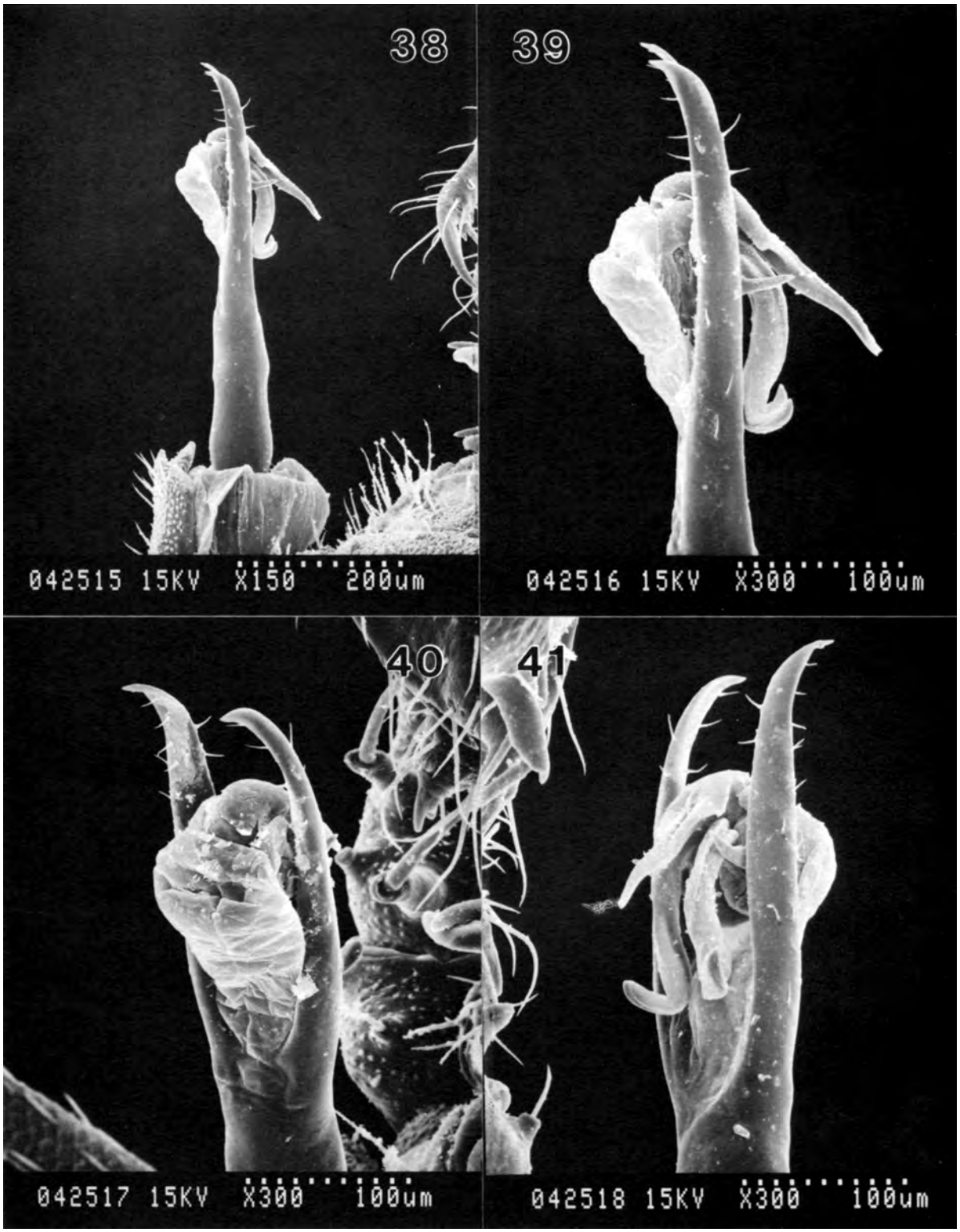
Type.—Male holotype from Whitewater Canyon, Riverside County, California (8 Apr. 1979; D. Ubick), deposited in CAS.

Etymology.—The species name is Latin for "dweller of the desert".

Description.—Male (holotype): Total body length, 1.33. Scute length, 0.92; width, 0.85. Eyemound length, 0.21; width, 0.23. Leg II length, 3.13. LII/SL = 3.40.



Figs. 34-37.—*Texella shoshone*, new species, male paratopotype: 34, anterior half of body, lateral view; 35, middorsal section of body, lateral view showing prominent tubercles on tergite margins; 36, palpi and chelicerae, lateral view; 37, trochanter IV spur, lateral view.



Figs. 38-41.—*Texella shoshone,* new species, male paratopotype: 38-39, penis, lateral view; 40, penis, ventrolateral view; 41, penis, dorsolateral view.

Color yellowish orange. Body coarsely rugose; tubercles on eye mound, pars thoracica, tergite margins, coxae, etc. Carapace with 2 pairs of AT. Eye mound low, rounded; eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 2 mesal. Tarsal count: 3-5-4-5. Tr IV spur relatively straight, length, 0.21. POP absent.

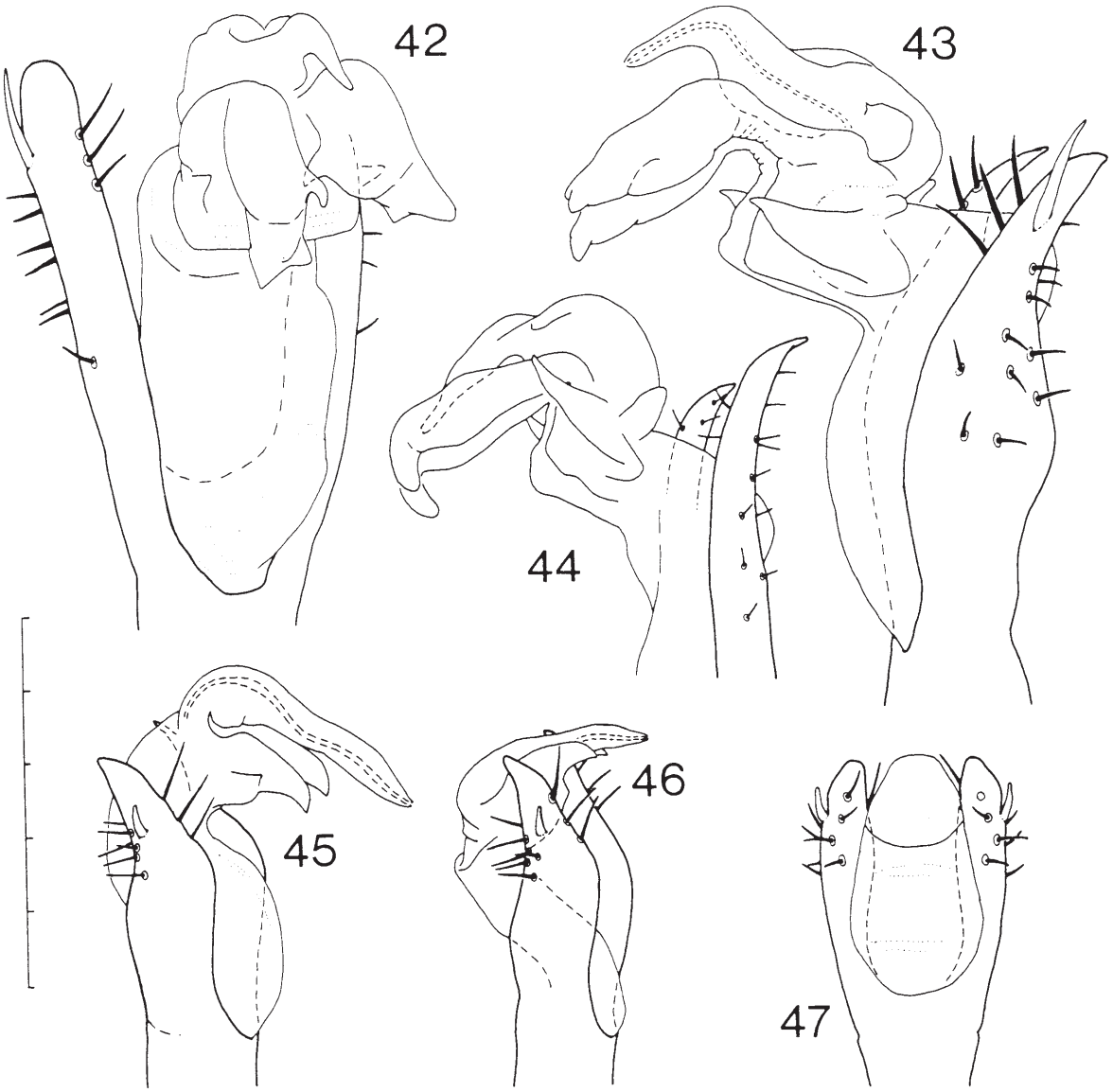
Penis (Figs. 45-47): VPP apically pointed; with 3 dorsal, 4? lateral, and 2 ventral setae; AS medium-sized, stout. Glans: BK absent; ML apparently absent; PSL short, claw-like; PSL2 vestigial, apically directed. S compressed; SA apparently represented by small, laterobasal carina; BF absent.

Female: Unknown.

Note.—The single specimen available for study was unusually resistant in having its genitalia extracted and, unfortunately, was badly damaged in the process.

Natural History.—The holotype was collected under a rock (?granite) in a mesic southern chaparral community along the canyon slope. A subsequent visit to the locality, on 2 April 1985, failed to produce additional specimens.

Other Material Examined.—None.



Figs. 42-47.—*Texella* species, male genitalia: 42-43, *T. kokoweef*, new species, paratopotype: 42, penis, subventral view, expanded with KOH; 43, penis, lateral view. 44, *T. shoshone*, new species, paratopotype: Penis, lateral view, expanded with KOH. 45-47, *T. deserticola*, new species, holotype: 45, penis, lateral view, expanded; 46, penis, lateral view, partially expanded; 47, penis, ventral view. Scale bar = 0.25 mm.

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

The *mulaiki* Group

Diagnosis.—The following combination of male characters distinguishes the members of this group: POP present (secondarily lost in *T. mulaiki, hardeni, bilobata, fendi,* and *homi*), glans penis with BK (lost in *T. brevistyla* and the *spinoperca* infragroup), and stylus with BF (small in *T. brevistyla*) (Figs. 7, 132, 133). No characters have been found which distinguish females.

Range.—Known from southern New Mexico to central Texas (Maps 2-4).

The *brevistyla* Subgroup

Diagnosis.—The combination of S shorter than PSL, and the absence of a SA (Figs. 52-55, 66-69, 74-76) distinguishes males of these species from all other *Texella.*

Range.—Known from western central Texas (Maps 3, 4).

Texella brevistyla, new species
Figs. 48-59, 76.

Diagnosis.—Males of this species are distinguished from other *Texella* by the following combination of characters: VPP apically convergent; PSL long, attenuated, spiraled; S short, tube-like; BF present; SA absent; BK absent (Figs. 52-55, 76).

Type.—Male holotype from Crom Cave, Uvalde County, Texas (Summer 1983; R. Waters), deposited in CAS.

Etymology.—The specific name refers to the short stylus characteristic of this species.

Description.—Total body length, 1.56-2.18. Scute length, 1.18-1.44. Leg II length, 3.54-4.03. Leg II/Scute length, 2.58-3.17. (N = 11).

Color orange to brownish orange. Body of medium rugosity; tubercles on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 8 pairs of AT arranged in two rows. Eye mound broadly conical, eyes well developed, cervical groove prominent. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.85. Scute length, 1.38; width, 1.44. Eye mound length, 0.41; width, 0.41. Leg II length, 3.56. TrIV spur robust, apically bent; length, 0.51. POP length, 0.26.

Penis (Figs. 52-55, 76): VPP apically converging; with 2 dorsal, 10 lateral, and 4 ventral setae; AS short, curved. Glans: BK absent; ML present, of moderate size; PSL elongate, tapering apically, spiraled. S short, tubular; BF present, reduced; SA absent.

Female (paratopotype): Total body length, 1.64. Scute length, 1.28; width, 1.33. Eye mound length, 0.32; width, 0.31. Leg II length, 3.54. TrIV with two ventral tubercles.

Ovipositor (Figs. 56, 58, 59): cuticle intricately folded; dorsal surface sparsely set with microserrations, ventral smooth; 1 pair of small apical teeth present; setal pattern: 1 pair dorsal, 4 pairs lateral, 1 pair ventral.

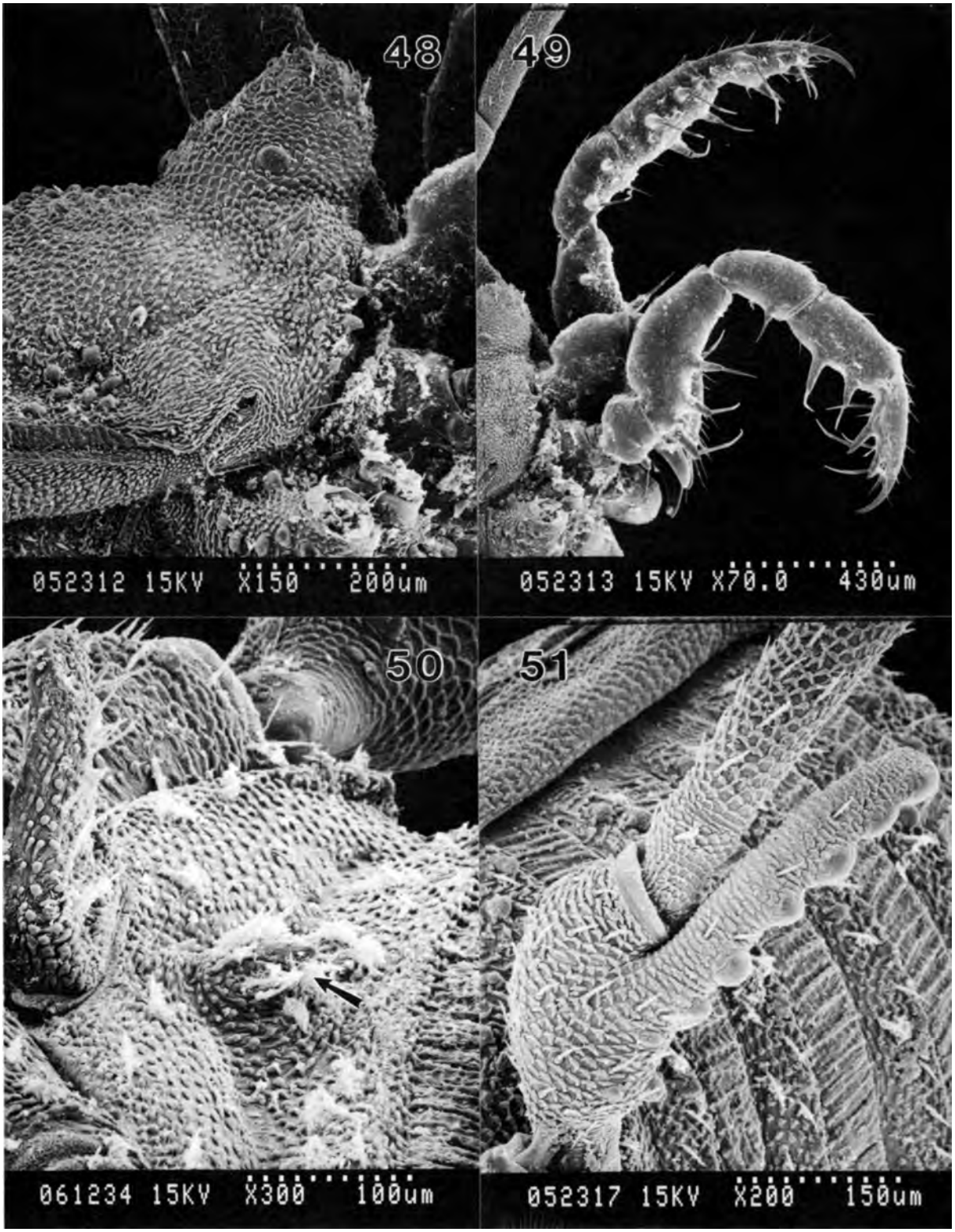
Variation.—The cervical groove is more prominent in specimens from Crom Cave. One male (SEM) has a short TrIV spur (L = 0.35) and a strongly reduced POP (L = 0.05) (Figs. 50, 51); in the remaining males (6) these structures are uniformly large (about 0.50 and 0.30 respectively). The aberrant male is distinctly smaller than the others (scute length = 1.18 compared to 1.31-1.44 for the others). One male from BFS Cave (SEM) lacks an apical spine (Figs. 52-55) which, like the tip of one prong, may be broken. The ovipositor of the female from BFS Cave (SEM) lacks a pair of apical teeth (Figs. 56, 58) which are present, although small, in all three females from Crom Cave.

Note.—The PSL are spiral-shaped and enclose the S in the unexpanded and partially expanded glans. With more complete expansion the PSL separate and become somewhat unspiraled (as in Fig. 53).

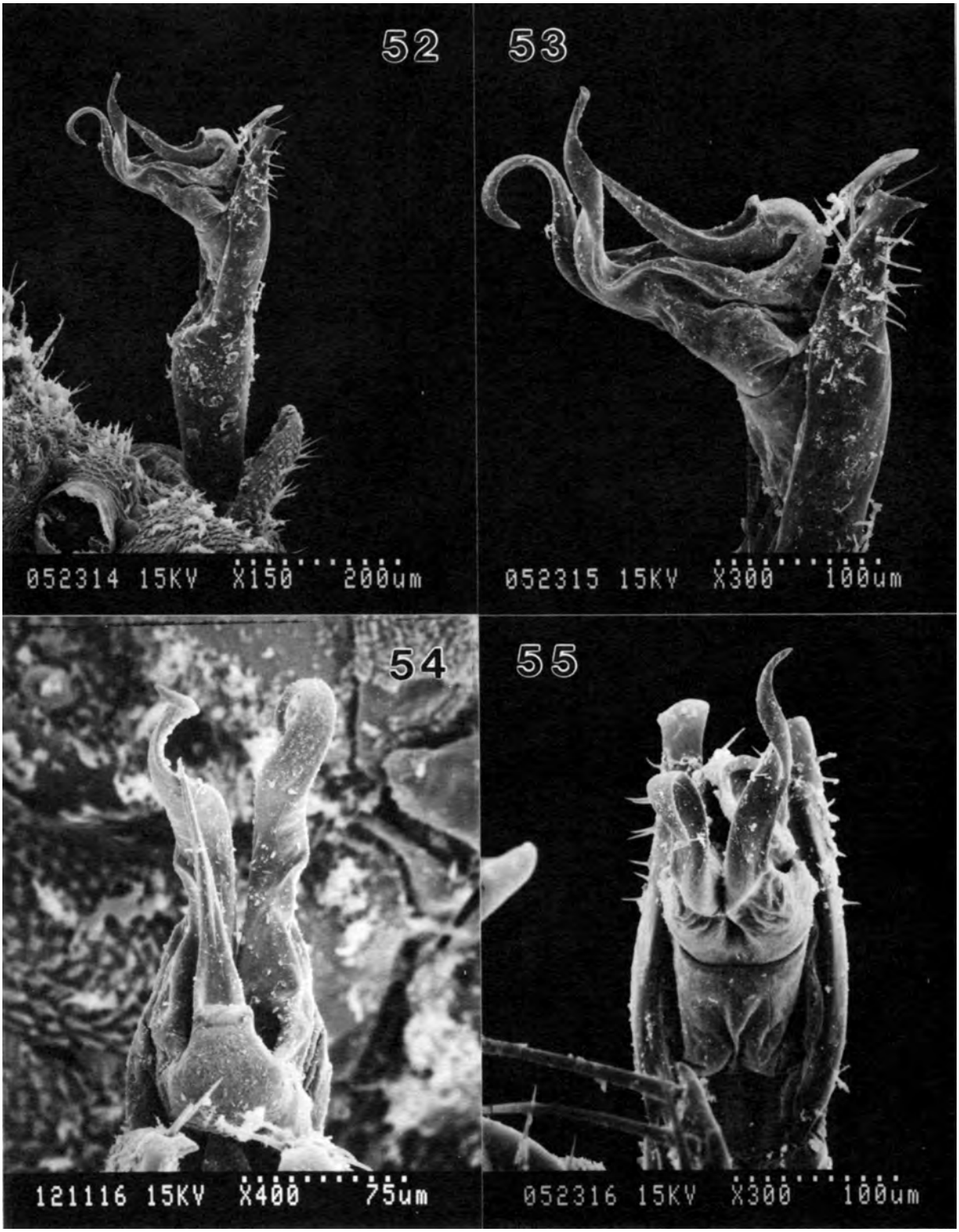
Natural History.—One female (Crom Cave) has what appears to be two large eggs (one visible through the somewhat transparent sternites and the second revealed through dissection). The presumed eggs are quite large (0.36 x 0.46), much larger than the genital opening (0.18 x 0.23), and occupy much of the abdominal cavity. We have seen specimens of another laniatorid harvestman, *Hoplobunus* species (Gonyleptoidea), from a nearby cave, Frio Queen Cave.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Uvalde Co.*: Crom Cave, Summer 1983 (R. Waters, TMM, CDU), 3 females; BFS Cave, 8 June 1989 (A. Grubbs, "A. C.", and R. Waters, TMM, CAS, CDU), 6 males, 1 female.

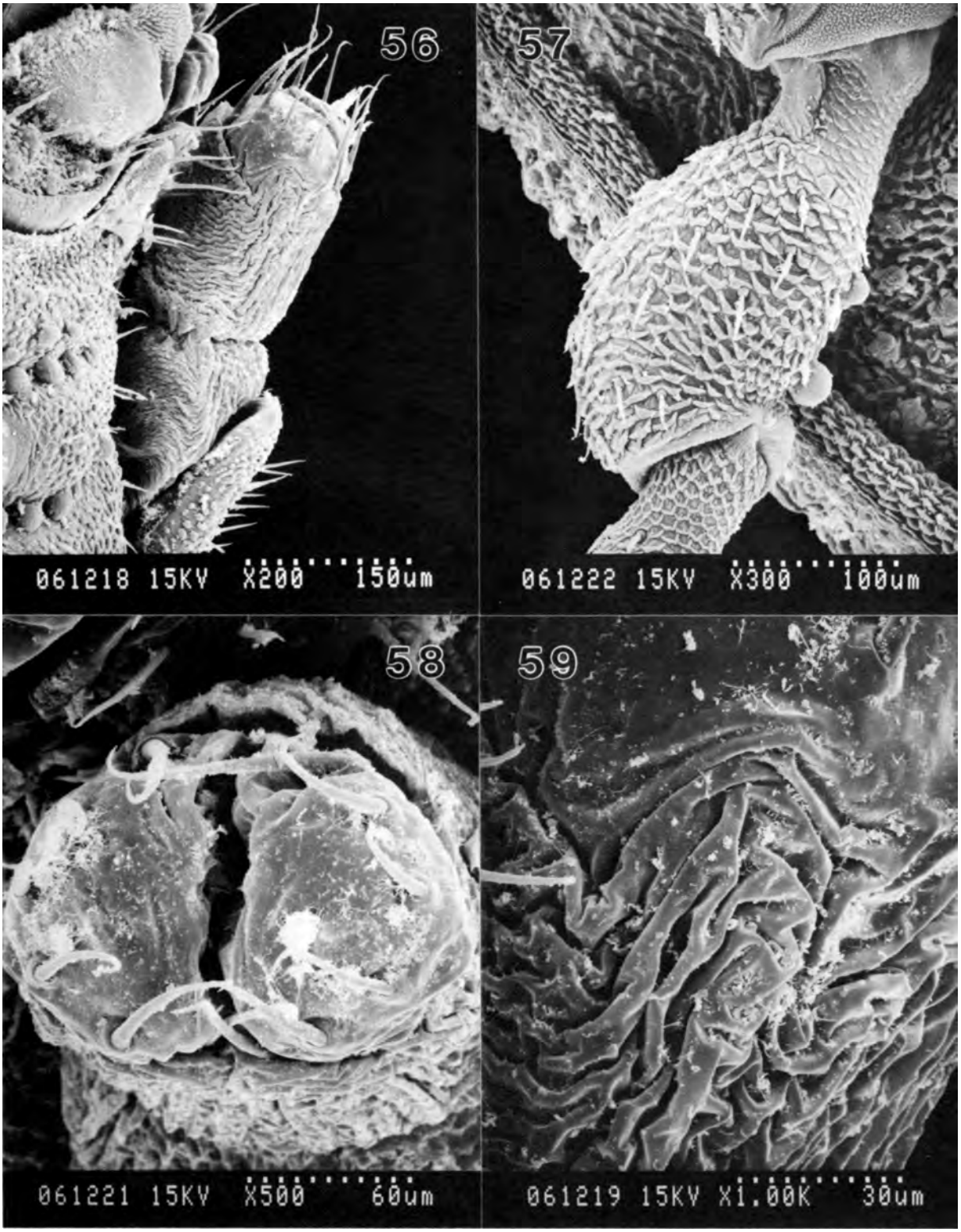
Distribution.—Known only from Crom and BFS caves, Uvalde County, Texas (Maps 2-4).



Figs. 48-51.—*Texella brevistyla,* new species, male paratype from BFS Cave: 48, anterior half of body, lateral view; 49, palpi, lateral view; 50, subventral view of body showing genital operculum and reduced postopercular process (indicated by arrow); 51, trochanter IV spur, lateral view.



Figs. 52-55.—*Texella brevistyla,* new species, male paratype from BFS Cave: 52-53, penis, lateral view; 54, penis, apical view; 55, penis, dorsal view.



Figs. 56-59.—*Texella brevistyla,* new species, female paratype from BFS Cave: 56, ovipositor, lateral view; 57, trochanter IV, lateral view; 58, ovipositor, apical view; 59, ovipositor, enlarged view of lateral surface.

Texella jungi, new species
Figs. 60-75.

Diagnosis.—Males of this species are distinguished from other *Texella* by the following combination of characters: VPP apically divergent; PSL claw-like; S shorter than PSL, apically tubular; SA absent (Figs. 66-69, 74, 75).

Type.—Male holotype from 7.1 mi E Campwood, Real County, Texas (23 Sep. 1971; A. Jung) deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr Albert K. S. Jung, the sole collector of this species.

Description.—Total body length, 1.54-1.92. Scute length, 1.03-1.36. Leg II length, 2.47-3.13. Leg II/Scute length, 2.30-2.66. (N = 6).

Color yellowish orange. Body finely rugose; tubercles sparse, most pronounced on dorsum from eye mound to scute posterior and intercoxal regions, inconspicuous on tergite and sternite margins. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 2 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.92. Scute length, 1.36; width, 1.23. Eye mound length, 0.37; width, 0.33. Leg II length, 3.13. TrIV spur robust, apically enlarged, bent; length, 0.51. POP length, 0.26. Carapace with 5-6 pairs of AT, arranged in two rows.

Penis (Figs. 63, 64, 66-69, 74, 75): VPP apically diverging; with 2 dorsal, 13 lateral, 3 ventral setae; AS moderate sized, elbowed, apically pointed. Glans: BK conical; ML inconspicuous; PSL claw-like. S short, tubular; BF well developed; SA absent.

Female (paratopotype): Total body length, 1.59. Scute length, 1.03; width, 1.03. Eye mound length, 0.23; width, 0.26. Leg II length, 2.47. TrIV with one ventral tubercle. Carapace with 2-3 pairs of AT.

Ovipositor (Figs. 70-73): cuticle intricately folded; surface smooth, lacking microspinations; 1 pair apical teeth present; setal pattern: 1 pair ventral, 4 pairs lateral, 2 pairs dorsal.

Variation.—The two male paratypes are smaller than the holotype (scute lengths 1.08 and 1.05) and have shorter TrIV spurs (0.33 each) and POP (0.13 and 0.08).

Note.—This is the only species which has a sexually dimorphic number of anterior tubercles (Figs. 60-62).

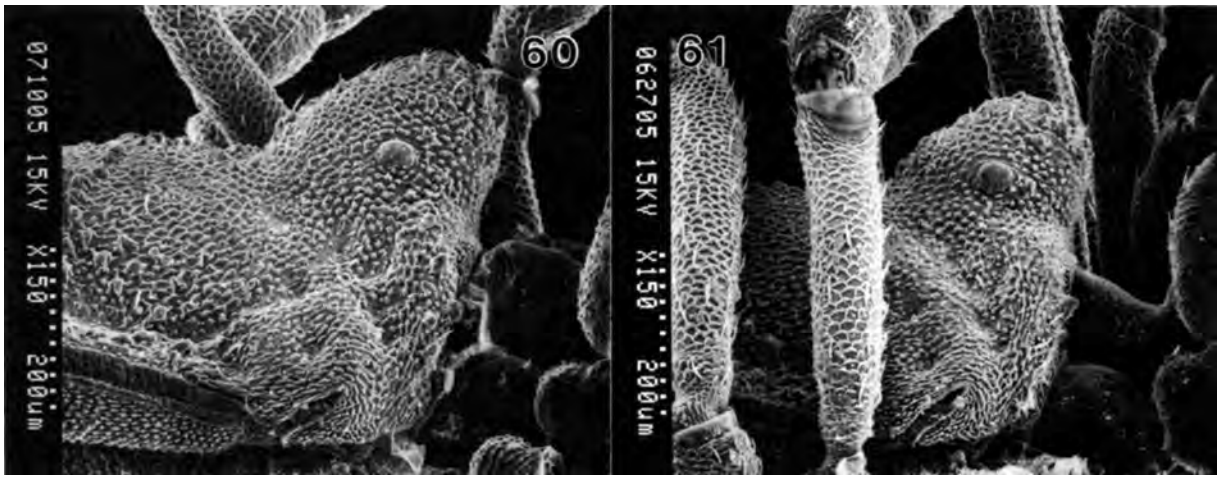
Natural History.—This epigean species has been collected in oak-juniper woodland.

Other Material Examined (Paratypes).—UNITED STATES: **Texas**: *Real Co.*: 7.1 mi E Campwood, 23 Sep. 1971, in oak-juniper woodland (A. Jung, CAS), 2 males, 3 females.

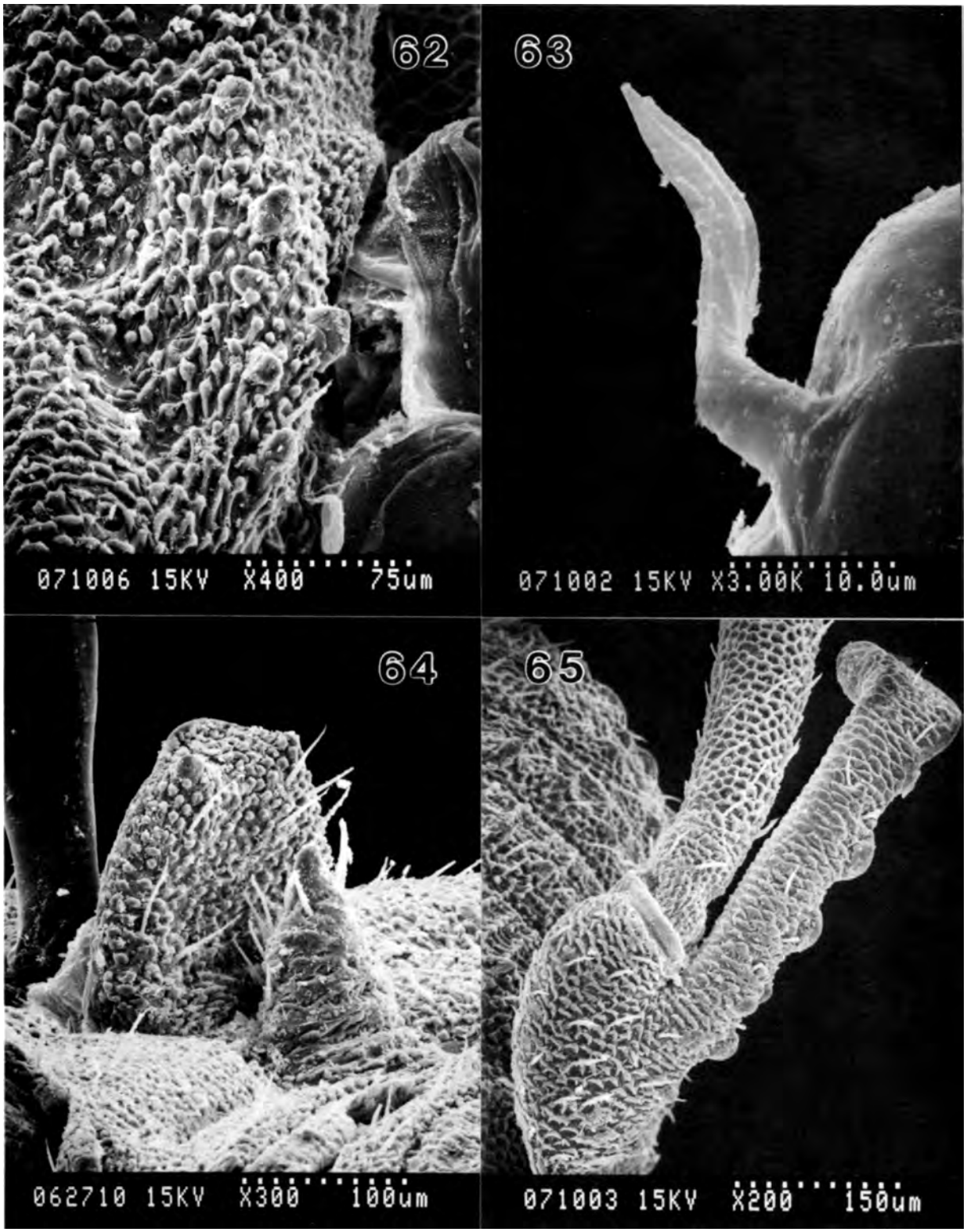
Distribution.—Known only from Real County, Texas (Maps 2-4).

The *mulaiki* Subgroup

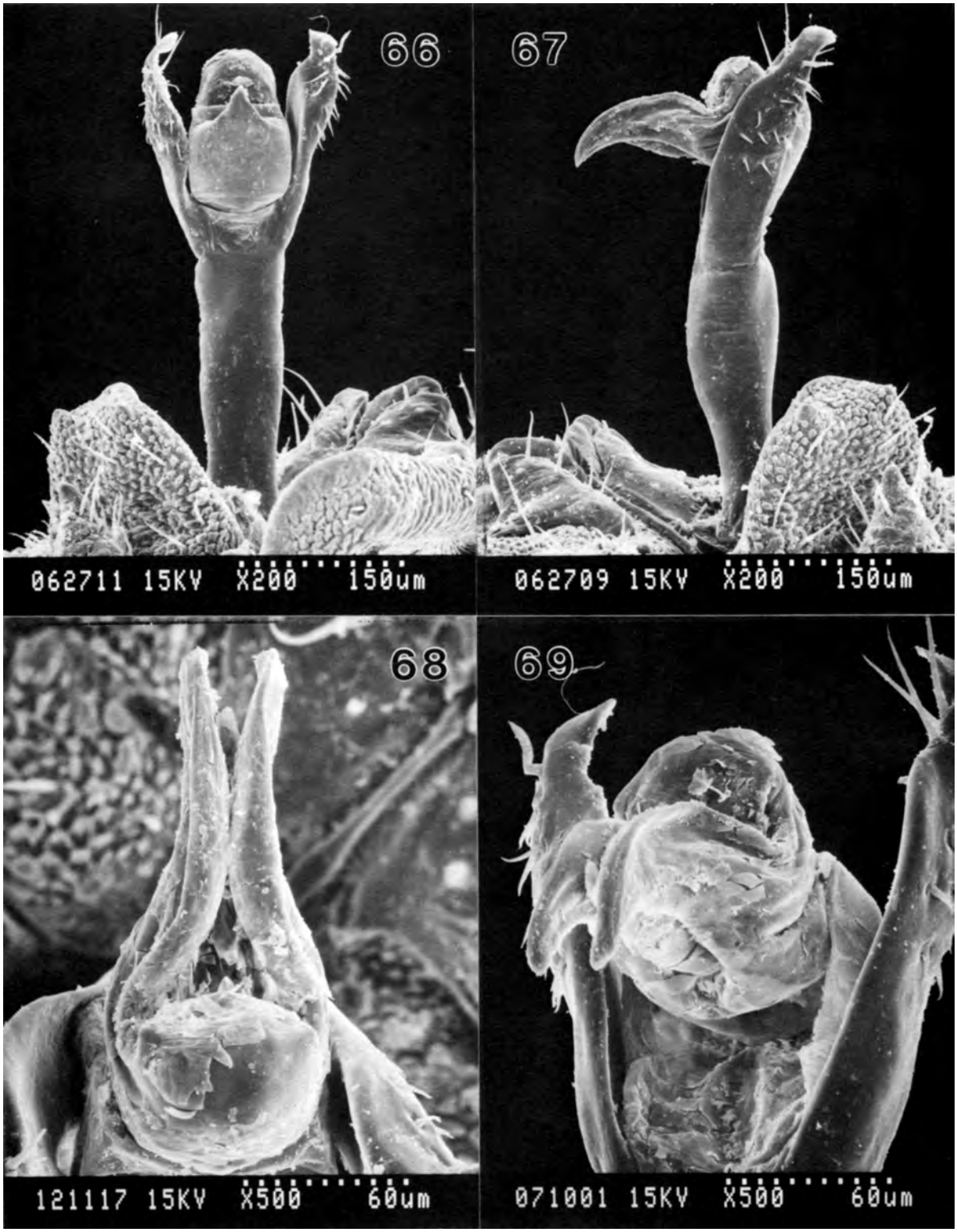
Diagnosis.—Males of this subgroup are distinguished from other *Texella* by the following combination of characters: PSL subrectangular in shape (except in *T. bilobata*), somewhat folded, shorter



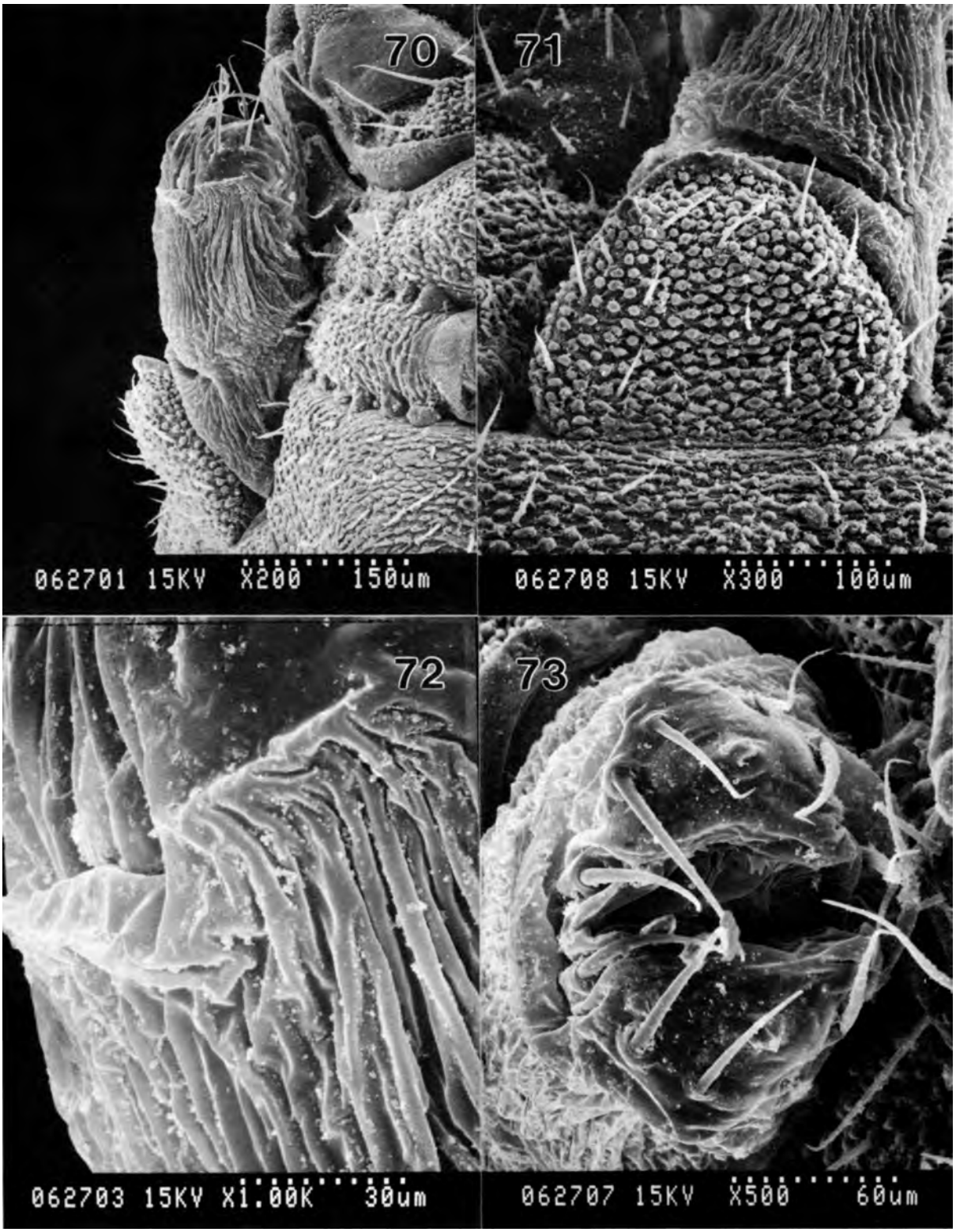
Figs. 60-61.—*Texella jungi*, new species, paratopotypes: 60, male, anterior half of body, lateral view; 61, female, anterior half of body, lateral view.



Figs. 62-65.—*Texella jungi,* new species, male paratopotype: 62, anterior part of scute, lateral view, showing anterior tubercles; 63, apical spine of penis, dorsal view; 64, subventral view of body, showing postopercular process and genital operculum with apical tubercles; 65, trochanter IV spur, lateral view.



Figs. 66-69.—*Texella jungi,* new species, male paratopotype: 66, penis, ventral view; 67, penis, lateral view; 68, penis, apical view; 69, penis, dorsolateral view of glans.



Figs. 70-73.—*Texella jungi,* new species, female paratopotype: 70, ovipositor, lateral view; 71, genital operculum, ventral view, showing apical tubercles; 72, ovipositor, enlarged view of lateral surface; 73, ovipositor, apical view.

than S; SA with laterobasal carina (except in *T. welbourni* and *bilobata*) and tooth (except in *T. hardeni*); apical portion of S tubular or compressed.

Range.—Known from southern New Mexico to central Texas (Maps 2-4).

The *longistyla* Infragroup

Diagnosis.—Males of this infragroup are distinguished from other *Texella* by the following combination of characters: TC = 3-5-5-5; PTb with 2 mesal megaspines; S compressed; SA prongs well developed, parallel sided, blunt (Figs. 77-84).

Range.—Known from southern New Mexico and adjacent Texas (Maps 2-4).

Texella longistyla, new species
Figs. 77-79.

Diagnosis.—Males of this species are distinguished from other *Texella* by the following combination of characters: PTb with two mesal megaspines; S long, compressed; SA with lateral carina and laterobasal prongs (Figs. 77-79).

Type.—Male holotype from Musk Ox Cave, Carlsbad Caverns National Park, Eddy County, New Mexico (7 Aug. 1976; W. Welbourn), deposited in CAS.

Etymology.—The specific name refers to the long stylus characteristic of this species.

Description.—(cavernicole)—Total body length, 1.51-1.59. Scute length, 1.05-1.08. Leg II length, 3.64-3.92. Leg II/Scute length, 3.47-3.63. (N = 4) (epigean)—Total body length, 1.67. Scute length, 1.05. Leg II length, 2.95. Leg II/Scute length, 2.81. (N = 1).

Color yellowish white (yellowish orange in epigean specimen). Body coarsely rugose; tubercles moderate on eye mound (dense in epigean specimen), sparse on pars thoracica, moderate on tergite margins and coxae. Carapace with 2 or 3 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 2 mesal. Tarsal count: 3-5-5-5.

Male (holotype): Total body length, 1.59. Scute length, 1.10; width, 1.08. Eye mound length, 0.28; width, 0.29. Leg II length, 3.82. TrIV spur length, 0.36. POP length, 0.10.

Penis (Figs. 77-79): VPP with 2 dorsal, 11 lateral, and 4 ventral setae; AS stout, pointed, geniculate. Glans: BK triangular, narrow; ML rectangular, wide; PSL quadrate, folded. S long, compressed; BF present; SA with basolateral prong (long, rounded apically) and mediolateral carina (evenly rounded).

Female (paratype, Doc Brito Cave): Total body length, 1.51. Scute length, 1.08; width, 1.10. Eye mound length, 0.26; width, 0.31. Leg II length, 3.92. TrIV with one ventral tubercle.

Ovipositor: cuticle intricately folded, surface apparently smooth; 1 pair of apical teeth present; setal pattern: 2 pairs dorsal, 4 lateral, 1 ventral.

Variation.—The paratype male from Musk Ox Cave, although subequal in size to the holotype, has longer TrIV spurs (0.49) and POP (0.18).

Natural History.—The specimen from Texas was collected beneath a large decaying prickly pear cactus, under conditions of high moisture, in an oak-juniper forest adjacent to a mesic riparian woodland.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Culberson Co.*: Guadalupe Mountains National Park, McKittrick Canyon, 7 Sep. 1989 (D. Ubick, CDU), 1 male. **New Mexico**: *Eddy Co.*: Carlsbad Caverns National Park, Musk Ox Cave, 5200', 27 Mar. 1976 (W. Welbourn, TMM), 1 male, 1 female; Doc Brito Cave, 3500', 25 May 1975 (W. Welbourn, MLG), 1 female.

Distribution.—Known only from Culberson County, Texas, and Eddy County, New Mexico (Maps 2-4).

Texella welbourni, new species
Figs. 80-84.

Diagnosis.—The single male representing this species is distinguished from other *Texella* by the following combination of characters: eyes absent (lacking both retina and cornea); TC = 3-5-5-5; SA with a pair of long laterobasal prongs, lacking carina; S long, compressed (Figs. 80-84).

Type.—Male holotype from Jurnigan Cave (3500'), Eddy County, New Mexico (16 Feb. 1974; W. Welbourn), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr W. Calvin Welbourn, collector of this and other species of *Texella*.

Description.—Male (holotype): Total body length, 1.69. Scute length, 1.23; width, 1.10. Eye mound length, 0.31; width, 0.31. Leg II length, 5.62. Leg II/Scute length, 4.57. TrIV spur length, 0.08. POP length, 0.05.

Color yellowish white. Body moderately rugose; tubercles sparse on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 5 pairs of AT. Eye mound broadly conical, eyes absent (lacking retina and cornea). Palpal megaspines:

trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 2 mesal. Tarsal count: 3-5-5-5.

Penis (Figs. 80-84): VPP apically rounded, with 2 dorsal, 17 lateral, and 4 ventral setae; AS stout, curved, pointed. Glans: BK present; ML present; PSL subquadrate, intricately folded. S long, compressed; BF present; SA represented by a pair of laterobasal prongs (long, parallel-sided, apically rounded), lacking lateral carinae.

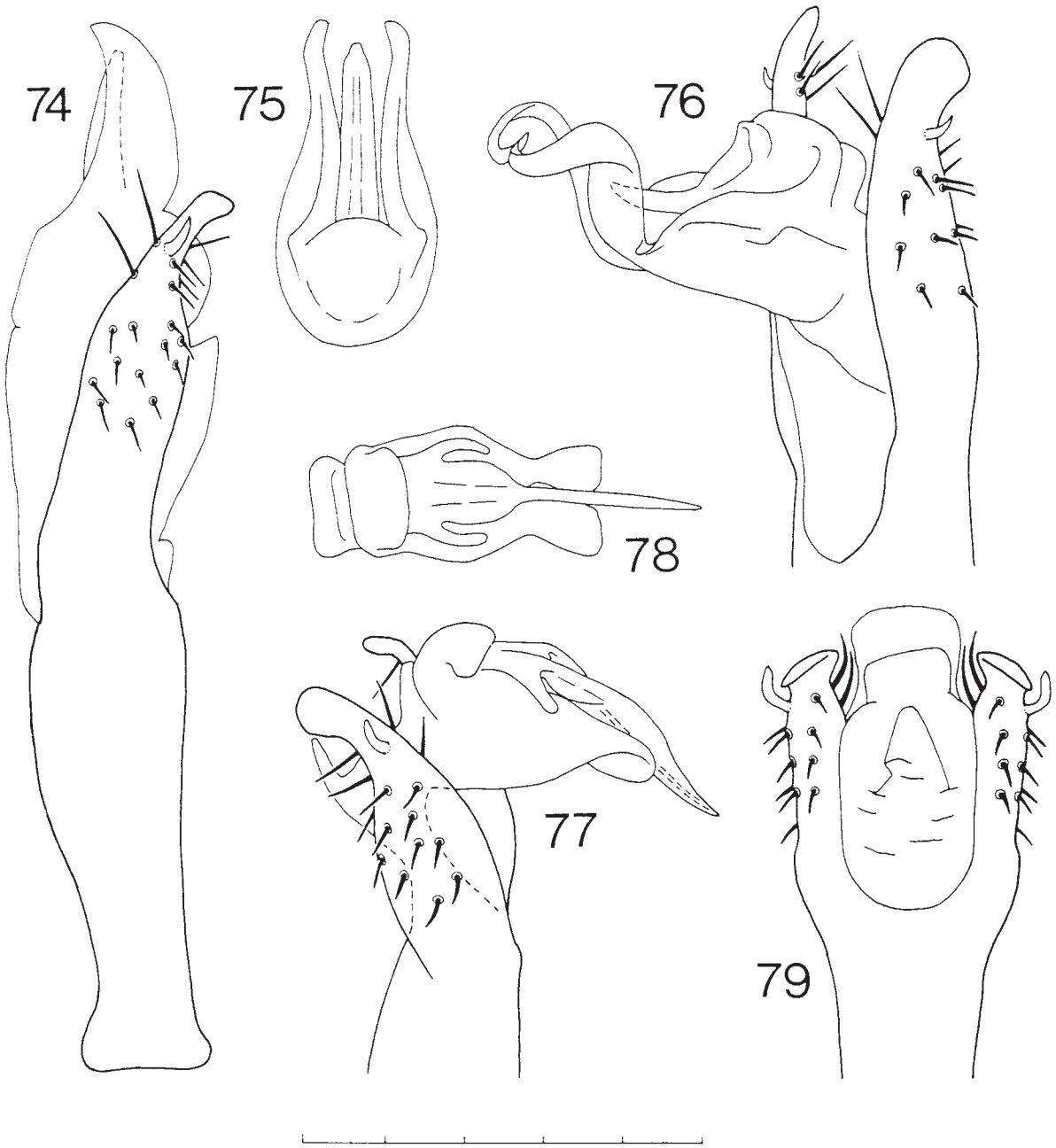
Female: Unknown.

Other Material Examined.—None.

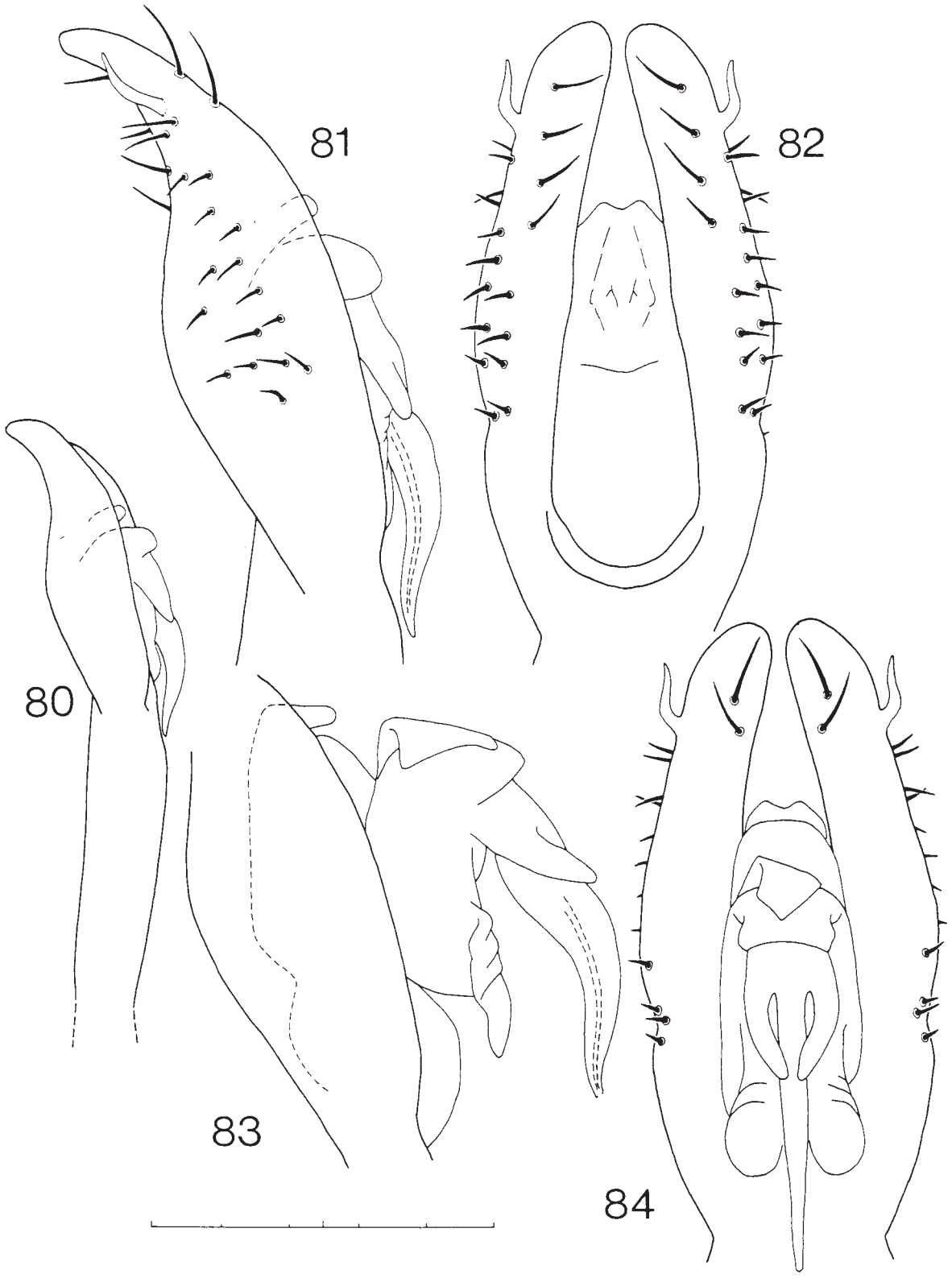
Distribution.—Known only from Jurnigan Cave, Eddy County, New Mexico (Maps 2-4).

The *mulaiki* Infragroup

Diagnosis.—Members of this infragroup are distinguished from other *Texella* by the following,



Figs. 74-79.—*Texella* species, male genitalia, paratopotypes: 74-75, *T. jungi,* new species: 74, penis, lateral view, with fully expanded glans; 75, penis, ventral surface of glans. 76, *T. brevistyla,* new species: Penis, sublateral view. 77-79, *T. longistyla,* new species: 77, penis, lateral view; 78, penis, ventral surface of glans; 79, penis, ventral view. Scale bar = 0.25 mm.



Figs. 80-84.—*Texella welbourni*, new species, male holotype: 80-81, penis, lateral view, unexpanded; 82, penis, ventral view; 83, penis, lateral view, with partially expanded glans; 84, penis, dorsal view, with partially expanded glans. Scale bar = 0.50 mm for Fig. 80 and 0.25 mm for the others.

primarily troglomorphic, characters: eyes absent; 0-1 pairs of AT; PTb with 2 mesal megaspines; LII/SL ≥ 9.4; TC ≥ 3-6-4-5 or 4-5-5-5. Males are further distinguished by the following genitalic characters: PSL subrectangular, folded; SA with laterobasal carina bearing a short prong or tubercle; apical half of S a straight tube (Figs. 85-88, 93-96, 102, 105-108).

Species.—The three species show increasing troglomorphism from *T. hardeni* to *T. cokendolpheri* to *T. mulaiki*. This cline is also reflected in two genitalic characters associated with the SA. In *T. hardeni*, the SA has the largest carina and shortest teeth; these states are reversed in *T. mulaiki* and intermediate in *T. cokendolpheri*. As pronged SA are found in virtually all species of the subgroup, and carinae absent in many, the loss of the prongs (Figs. 87, 88) seems to be derived.

Range.—Known only from central Texas (Maps 3, 4).

Texella hardeni, new species
Figs. 85-88.

Diagnosis.—This strongly troglomorphic species is most closely related to *T. mulaiki* and *T. cokendolpheri* from which it may be distinguished by its somewhat lower TC (leg I with only three tarsomeres) and shorter legs (LII/SL = 9.9-11.6) and by its glans characters: PSL with dorsoapical spine, SA prong reduced to a short knob (Figs. 87, 88).

Type.—Male holotype from Haby Salamander Cave, Bandera County, Texas (31 Oct. 1984; S. Harden and J. Ivy), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr S. J. Harden, one of the collectors of the holotype.

Description.—Total body length, 1.23-1.67. Scute length, 0.95-1.18. Leg II length, 11.0-11.9. Leg II/Scute length, 9.9-11.6. (N = 3).

Color pale orange, appendages lighter. Body finely rugose; with several pointed tubercles anteriorly on eye mound; with few tubercles on pars thoracica; with tergite margins smooth; with coxa I bearing row of setate tubercles, coxae 2-4 smooth. Carapace with 1 pair of small AT. Eye mound a narrowed cone, somewhat cylindrical, retina and cornea absent. Palpal megaspines: trochanter, two ventral; femur, one (female) or two (male) mesoapical; patella, two mesal; tibia, two mesal. Tarsal count: 3-6 to 8-4-5.

Male (holotype): Total body length, 1.67. Scute length, 1.18; width, 1.08. Eye mound length, 0.26; width, 0.26. Leg II length, 11.72. TrIV with vestigial spur, length, 0.02. POP absent.

Penis (Figs. 85-88): VPP with 2 dorsal, 16 lateral, and 6 ventral setae; lateral setae short, dorsal and ventral setae long; AS short, apically entire. Glans: BK conical; ML not evident; PSL subquadrate, folded, with dorsoapical prong. S with apical half straight, lacking ornamentation; BF present; SA with a broad lateral expansion and an apical knob.

Female (paratopotype): Total body length, 1.46. Scute length, 1.13; width, 1.03. Eye mound length, 0.23; width, 0.21. Leg II length, 11.92. TrIV lacking ventral tubercle.

Ovipositor lacking apical teeth.

Natural History.—All populations occur sympatrically with *Hoplobunus* species (Gonyleptoidea).

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Bandera Co.*: Haby Salamander Cave, 31 Oct. 1984 (S. Harden and J. Ivy, TMM), 1 female; 20 July 1986 (S. Harden, TMM), 1 female; Station "C" Cave, 4 Sep. 1988 (P. Sprouse, TMM), 1 juvenile. *Kerr Co.*: Stowers Cave, 20 Mar. 1965 (J. Reddell, TMM), 1 juvenile.

Distribution.—Known definitely only from Haby Salamander Cave, Bandera County, Texas (Maps 2-4).

Note.—The juvenile specimens from Station "C" Cave and Stowers Cave are assigned to this species only tentatively.

Texella cokendolpheri, new species
Figs. 89-100.

Diagnosis.—This strongly troglomorphic species is most closely related to *T. mulaiki* and *T. hardeni* from which it may be distinguished by its glans characters: PSL lacking dorsoapical spine and SA with lateral prong and apically serrated carina (Figs. 93-96).

Type.—Male holotype from Robber Baron Cave, San Antonio, Bexar County, Texas (3 Apr. 1982; A. Grubbs), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr James C. Cokendolpher, who first recognized this species as new.

Description.—Total body length, 1.28-1.67. Scute length, 1.05-1.28. Leg II length, 13.1-13.6. Leg II/Scute length, 11.1-12.9. (N = 5).

Color pale orange. Body finely rugose; with several pointed tubercles anteriorly on eye mound; with few tubercles on pars thoracica; with tergite margins smooth; with coxa I bearing row of setate tubercles, coxae 2-4 smooth. Carapace with 1 pair of AT. Eye mound a narrowed cone, somewhat

cylindrical, retina and cornea absent. Palpal megaspines: trochanter, one ventral; femur, one mesoapical; patella, one mesal; tibia, two mesal. Tarsal count: 4-6 to 8-5-5.

Male (holotype): Total body length, 1.28. Scute length, 1.05; width, 0.92. Eye mound length, 0.20; width, 0.20. Leg II length, 13.4. TrIV spur vestigial, length, 0.02. POP length, 0.06.

Penis (Figs. 93-96): VPP with medium-sized setae laterally, long setae ventrally and dorsally; with 2 dorsal, 13 lateral, and 4 ventral setae. Glans: BK small; ML small; PSL ventrally notched. S with apical half straight, tube-like; BF well developed; SA with lateral tooth and serrate carina.

Female (paratopotype): Total body length, 1.33. Scute length, 1.18; width, 1.05. Eye mound length, 0.18; width, 0.20. Leg II length, 13.1. TrIV lacking ventral tubercle.

Ovipositor (Figs. 98, 100): cuticle intricately folded, lacking microspines or tubercles; apical teeth absent.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Bexar Co.*: Robber Baron Cave, 10 Mar. 1982 (A. Grubbs, B. Steele, and R. Waters, TMM, CAS), 2 females; 6 Apr. 1983 (R. Waters, CAS), 1 male; Jan 1984 (R. Waters, TMM), 1 female; John Wagner Ranch Cave No. 3, 25 Jan. 1985 (S. Harden, TMM), 1 juvenile.

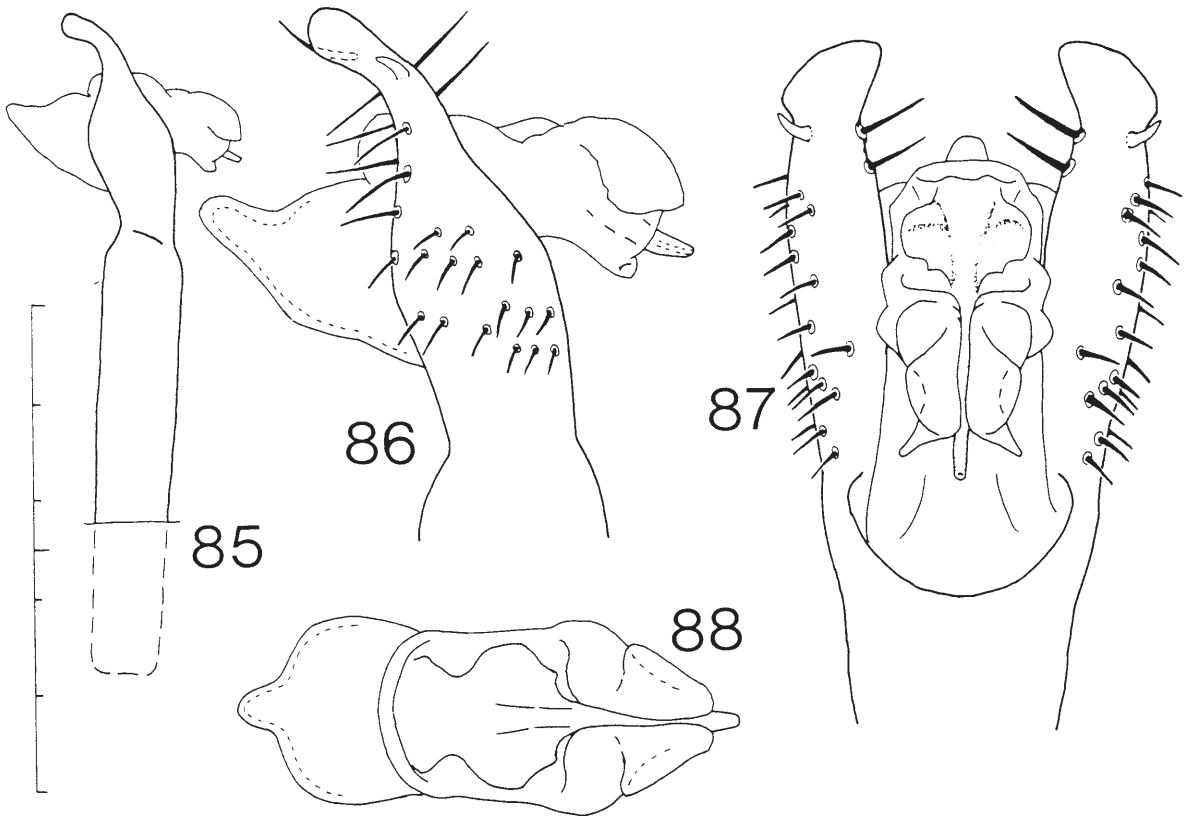
Distribution.—Known from cave(s) in Bexar County, Texas (Maps 2-4).

Note.—The juvenile specimen from John Wagner Ranch Cave No. 3 is assigned to this species only tentatively.

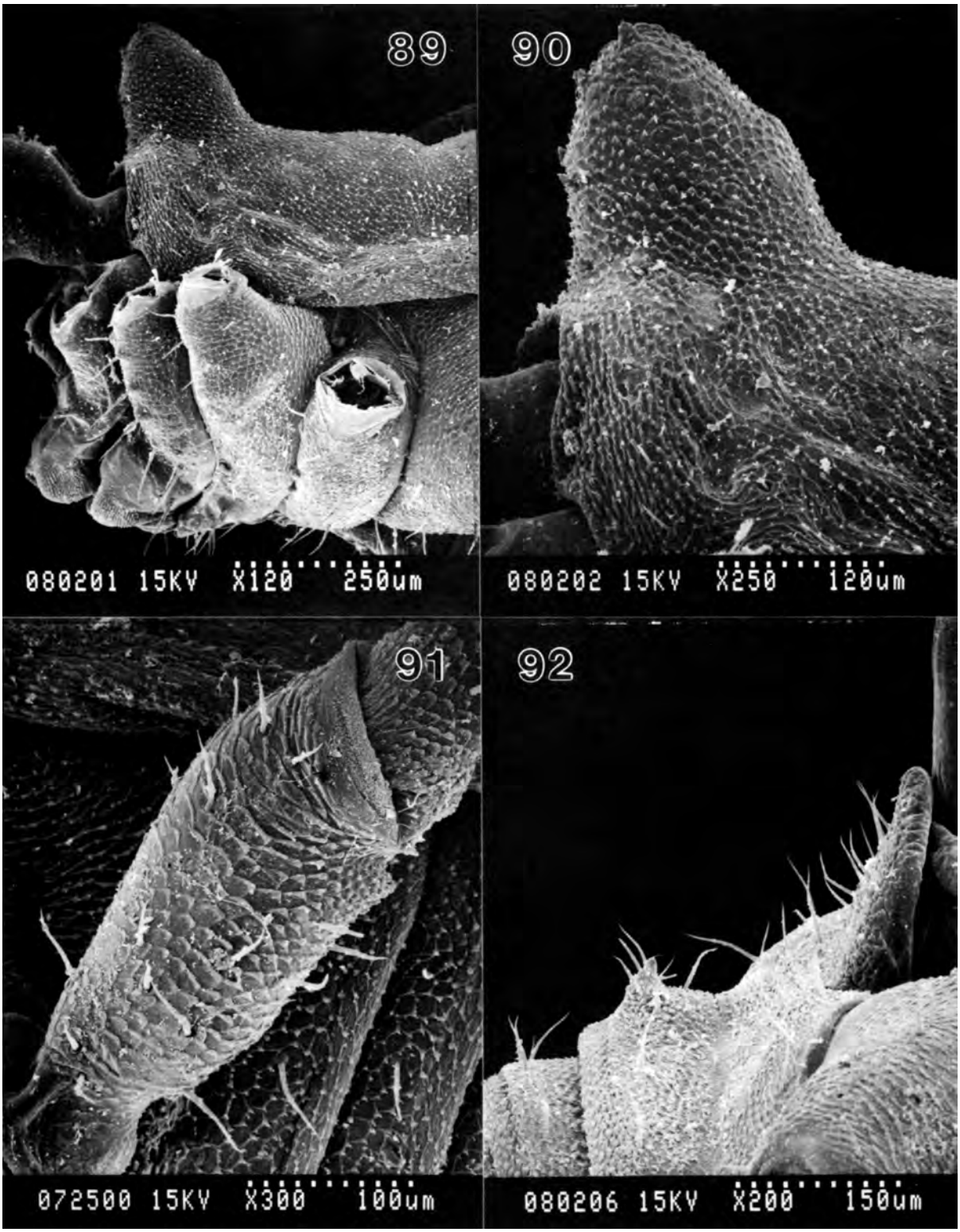
Texella mulaiki Goodnight and Goodnight
Figs. 3, 4, 101-112.

Texella mulaiki Goodnight and Goodnight, 1942:10 (female holotype from Hays County, Texas, in AMNH, examined). Goodnight and Goodnight, 1967:6. Reddell, 1965:177. Mitchell and Reddell, 1971:46. Davis, 1979:34.

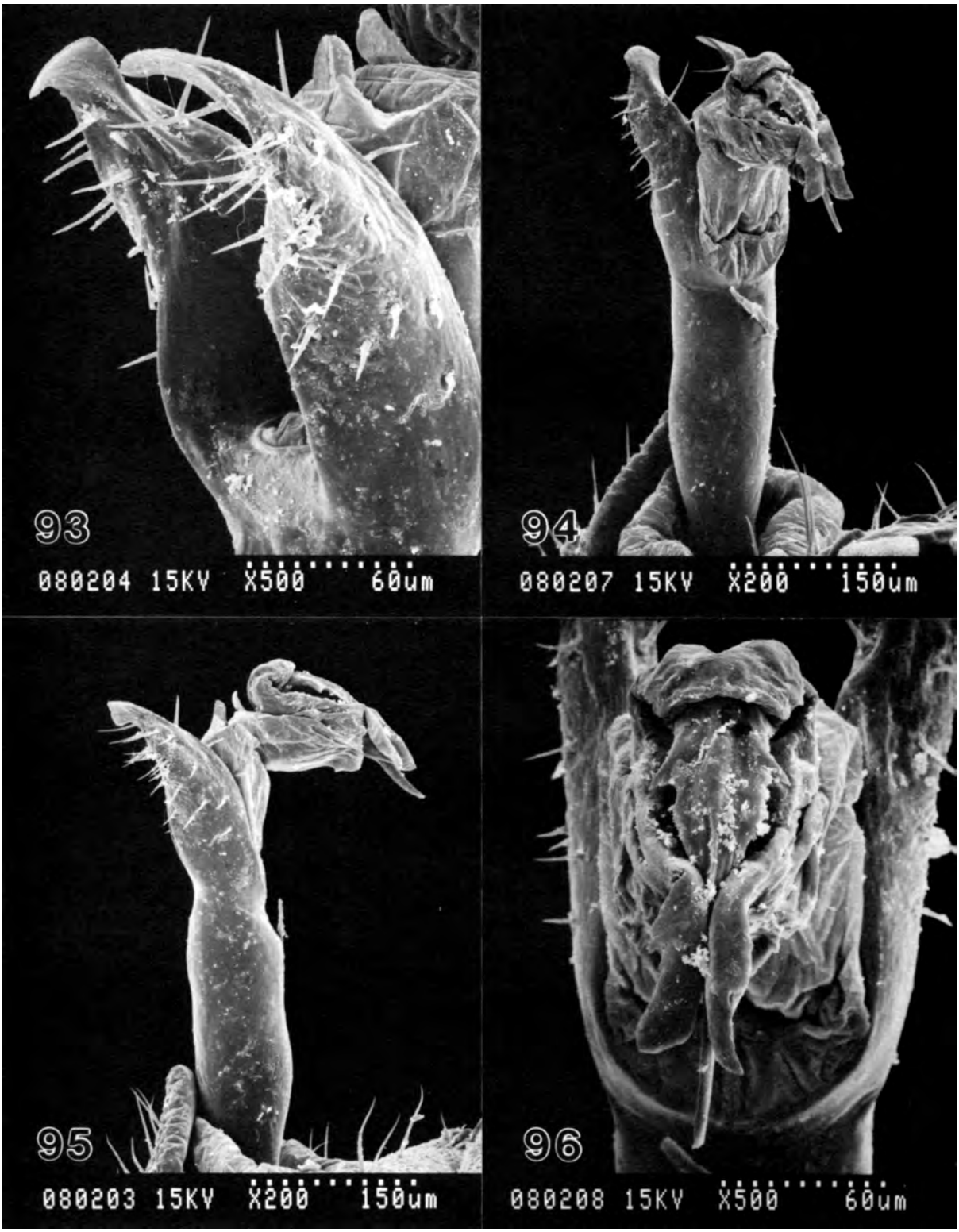
Diagnosis.—This strongly troglomorphic species is most closely related to *T. cokendolpheri* and *T. hardeni* from which it may be distinguished by its glans characters: PSL lacking dorsoapical spine and



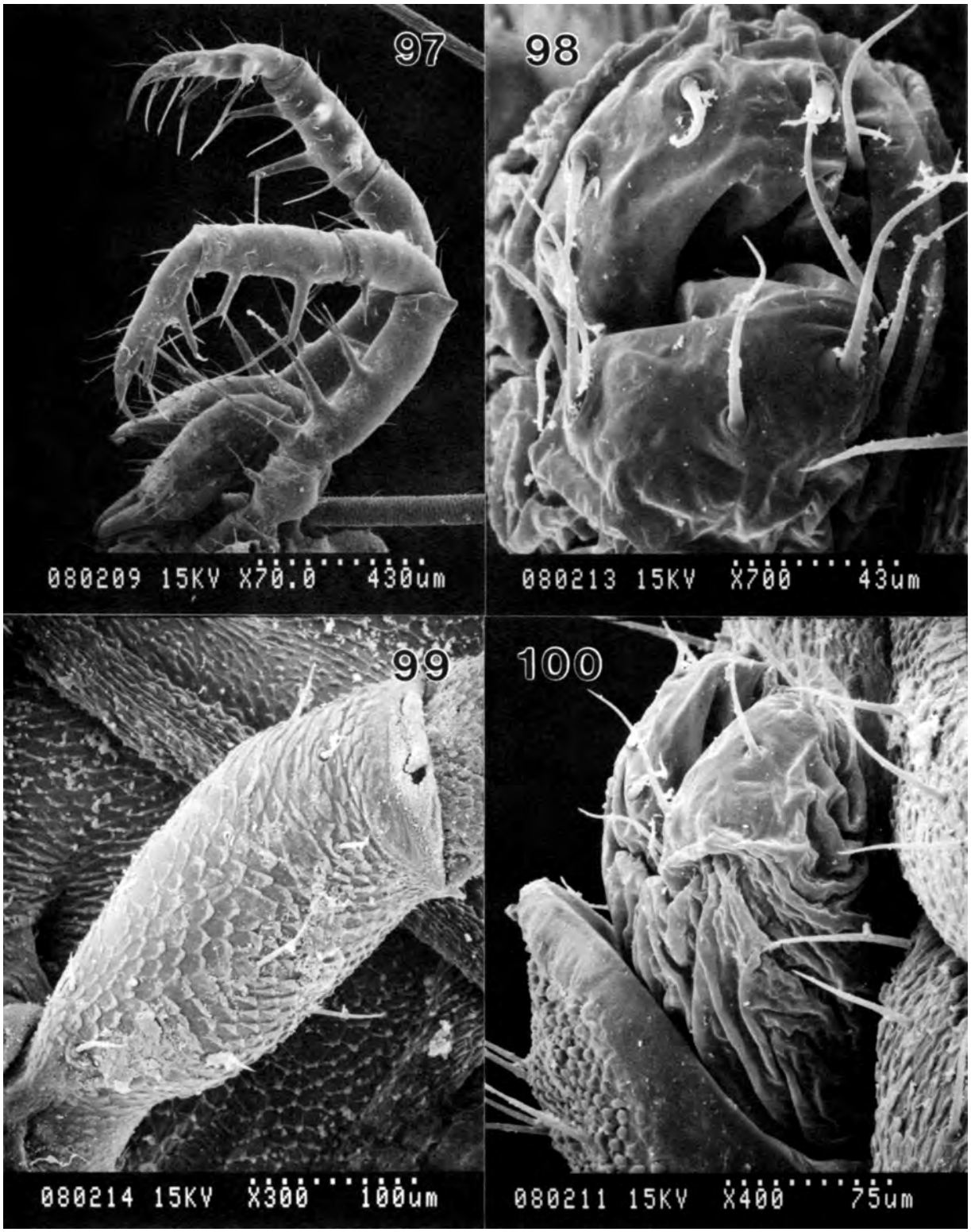
Figs. 85-88.—*Texella hardeni*, new species, male holotype: 85-86, penis, lateral view; 87, penis, dorsal view; 88, glans, ventral surface. Scale bar = 0.50 mm for Fig. 85 and 0.25 mm for the others.



Figs. 89-92.—*Texella cokendolpheri,* new species, male paratopotype: 89, anterior half of body, lateral view; 90, eye mound, lateral view; 91, trochanter IV, lateral view, showing reduced spur; 92, genital region, lateral view, showing operculum and reduced postopercular process.



Figs. 93-96.—*Texella cokendolpheri,* new species, male paratopotype: 93, penis, ventrolateral view; 94, penis, dorsolateral view; 95, penis, lateral view; 96, penis, dorsal view.



Figs. 97-100.—*Texella cokendolpheri*, new species, female paratopotype: 97, palpi and chelicerae, lateral view; 98, ovipositor, apical view; 99, trochanter IV, lateral view; 100, ovipositor, sublateral view.

SA with well developed prong and reduced carina (Figs. 105-108).

Description.—Total body length, 1.49-2.21. Scute length, 1.31-1.49. Leg II length, 12.5-19.8. Leg II/Scute length, 12.5-15.3. (N = 20).

Color of body yellowish orange, appendages yellowish white. Body finely rugose; tubercles absent from eye mound, pars thoracica, tergite margins, and coxae II-IV; coxa I with row of setate tubercles. Carapace without, or with 1 pair of very small, AT. Eye mound conical, reduced; retina and cornea absent. Palpal megaspines: trochanter, one ventral; femur, two mesoapical; patella, two mesal; tibia, two mesal. Tarsal count: 4-5 to 8-5 (or 6)-6 (or 5).

Male (Fern Cave): Total body length, 1.62. Scute length, 1.41; width, 1.31. Eye mound length, 0.18; width, 0.23. Leg II length, 19.7. TrIV spur absent. POP absent (Fig. 104).

Penis (Figs. 102, 105-108): VPP with 2 dorsal, 16 lateral, and 4 ventral setae; lateral setae medium-sized, dorsal and ventral setae long; AS short, curved, with trifurcate apex. Glans: BK a long flap; ML broad with truncate apex; PSL a rounded lobe lacking ventral notch and dorsal spine. S with apical half straight and thin; BF well developed; SA with lateral prongs and reduced carina, lacking serrations.

Female (Fern Cave): Total body length, 1,69. Scute length, 1.44; width, 1.36. Eye mound length, 0.21; width, 0.26. Leg II length, 18.5. TrIV lacking ventral tubercle.

Ovipositor (Figs. 101, 109-112): cuticle intricately folded; lacking microspines or tubercles; apical teeth absent.

Variation.—The tarsal count is rather variable, especially in the tarsomere number of leg II where almost half of the specimens show variation from the typical number of -7-: one specimen has -5-, one -5/6- (-5- on the left leg, -6- on the right), one -6/7-, three -7/8-, and two -8-. In addition, two specimens have counts of -5/6-, one on leg III the other on leg IV.

The LII/SL varies from 12.5 to 15.3. The shortest leg lengths tend to occur in the southern populations (Boggus and Ezell's Caves); the longest in the northern population (Flint Ridge Cave).

Natural History.—*T. mulaiki* occurs sympatrically with *T. renkesae* and *T. diplospina* but occupies relatively deeper portions of the respective caves. These harvestmen appear to be relatively uncommon, at least in Ezell's Cave where a 15-month faunal survey turned up only 7 specimens. On the other hand, we found a comparable number of specimens during a few hours of collecting in Fern Cave. That same study also suggests that they are attracted to baits (6 specimens found at baited rocks) and seem to prefer cheese (4 specimens) (Davis, 1979).

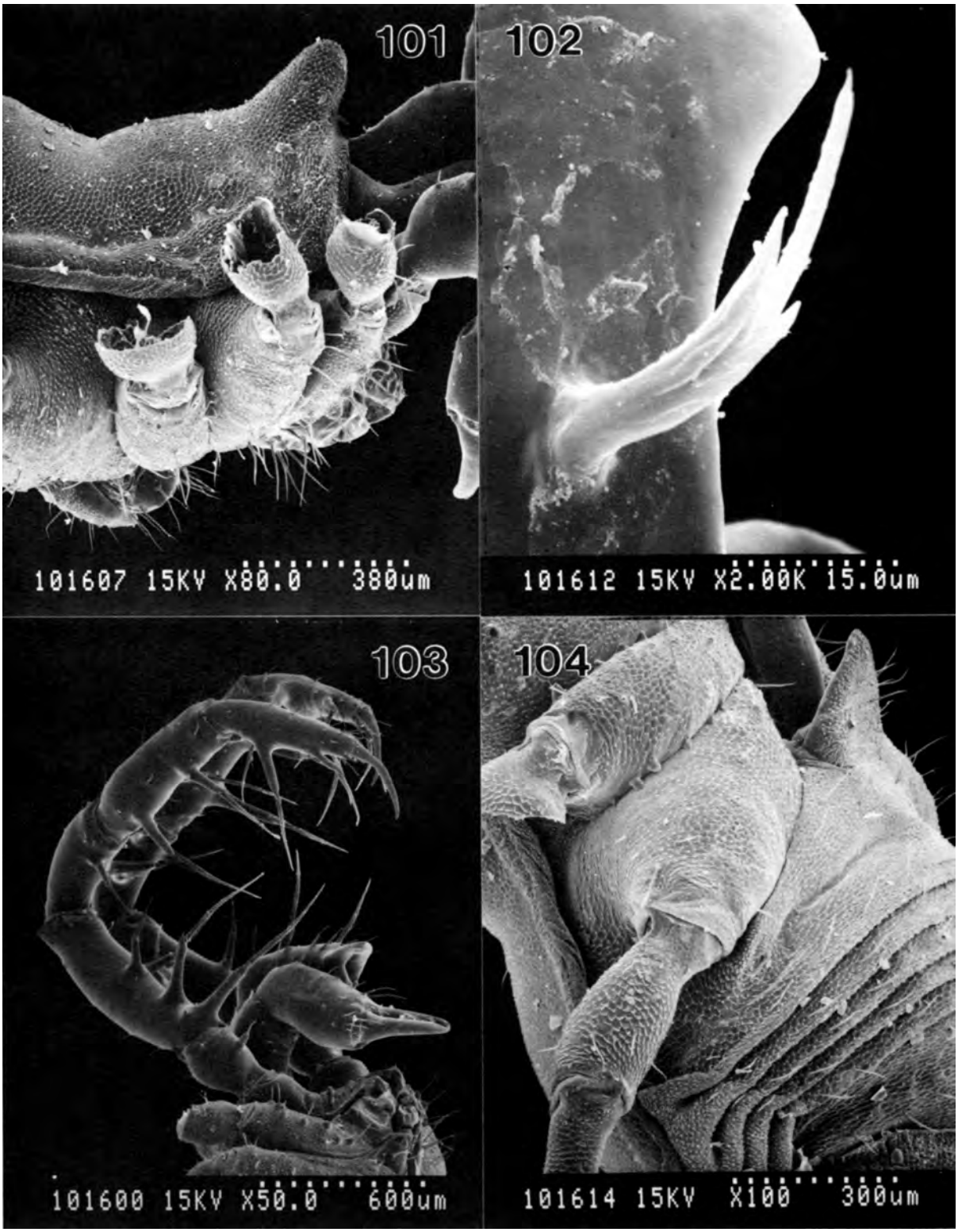
Material Examined.—UNITED STATES: **Texas**: *Hays Co.*: [no specific locality], 15 Apr. 1939 (S. Mulaik, AMNH), 1 female (type); San Marcos, Ezell's Cave, 30 Apr. 1978 (J. Davis, WAS), 2 females; 2 July 1978 (J. Davis, WAS), 1 female; Boggus Cave, 16 Jan. 1988 (S. Harden, TMM), 2 females; McCarty Cave, 1988 [no specific date] (A. Grubbs, TMM), 1 juvenile; McGlothlin Sink, 26 May 1989 (A. Grubbs, J. Reddell, and M. Reyes, TMM), 1 juvenile; 3 Sep. 1989 (D. Ubick, S. Fend, and S. Renkes, CDU), 1 male, 3 juveniles; 11 mi W San Marcos, Fern Cave, 15 July 1988 (A. Grubbs, J. Evans, and L. Schneider, TMM), 1 female; 26 May 1989 (A. Grubbs, J. Reddell, and M. Reyes, TMM), 1 female; 2 Sep. 1989 (D. Ubick, S. Fend, S. Renkes, and A. Grubbs, CDU, CAS), 3 males, 3 females; Ladder Cave, lower level, 2 Sep. 1989 (D. Ubick, S. Fend, S. Renkes, J. Reddell, and M. Reyes, CDU), 1 female; 5 mi W Kyle, Michaelis Cave, Jan. 1990 (A. Grubbs and L. Graves, TMM), 1 male. *Travis Co.*: Flint Ridge Cave, 8-9 June 1984 (D. Pate, TMM), 1 juvenile; Apr. 1989 (M. Grimm, TMM), 1 male; Apr. 1989 (J. Reddell and M. Reyes, TMM), 1 juvenile; 25 Nov. 1989 (M. Grimm, AMNH), 1 female, 1 juvenile; Slaughter Creek Cave, 24 Feb./3 Mar. 1990 (W. Russell, TMM), 1 male; Whirlpool Cave, 8 Jun. 1980 (S. Robertson, TMM), 1 juvenile.

Distribution.—Known from the caves of Central Texas, Hays and Travis Counties (Maps 2-5).

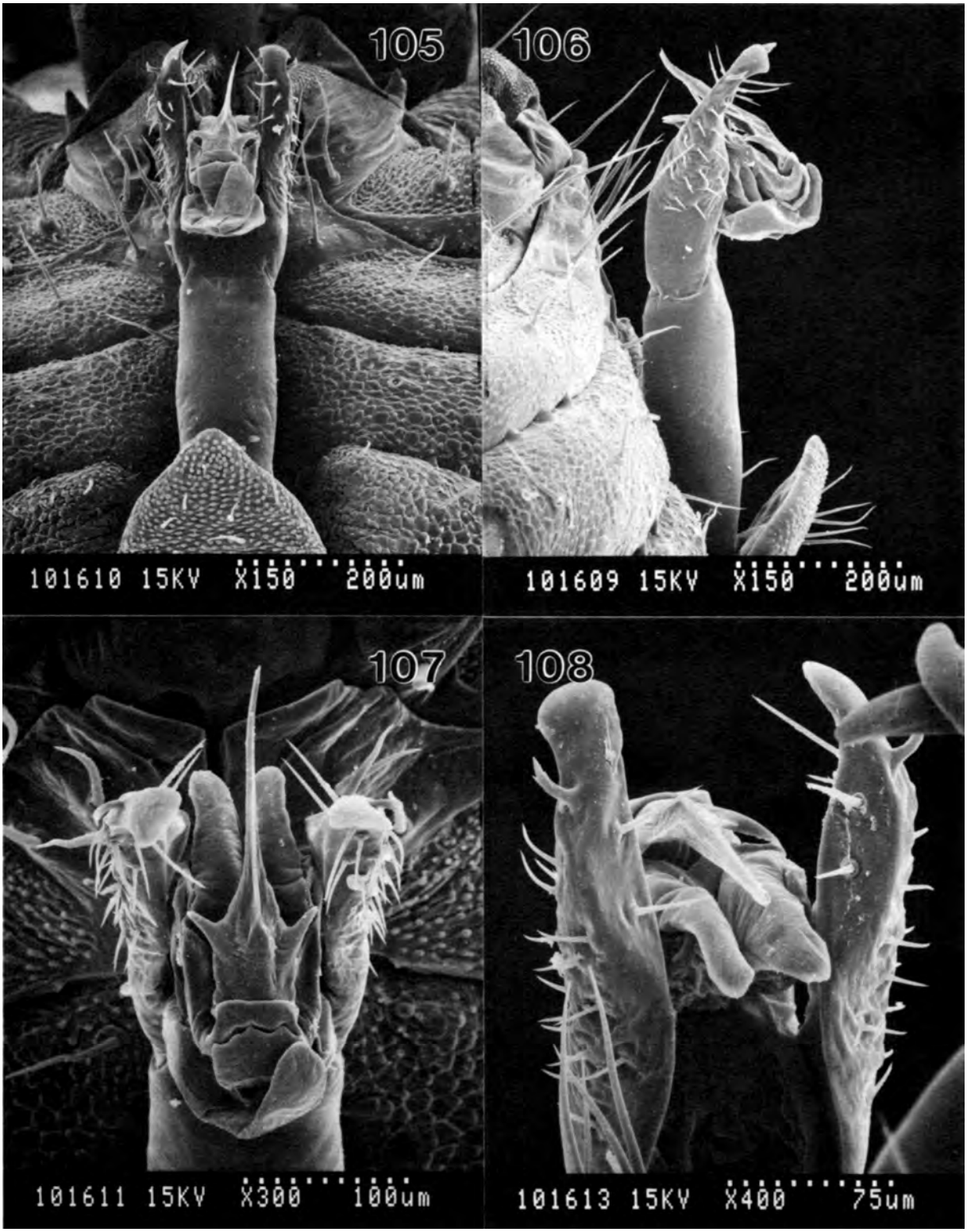
Notes.—The sex of the holotype was originally stated as male but, as was subsequently corrected (Goodnight and Goodnight, 1967:7), is in fact a female. All other specimens previously assigned to this species actually represent a new, and not very closely related, species (*T. reyesi*).

The type locality, although not specifically indicated on the locality label, is probably Ezell's Cave, a popularly visited cave at the time S. Mulaik collected the holotype (J. Reddell, personal communication). This is supported by the fact that the three recently collected female specimens from Ezell's Cave closely resemble the holotype.

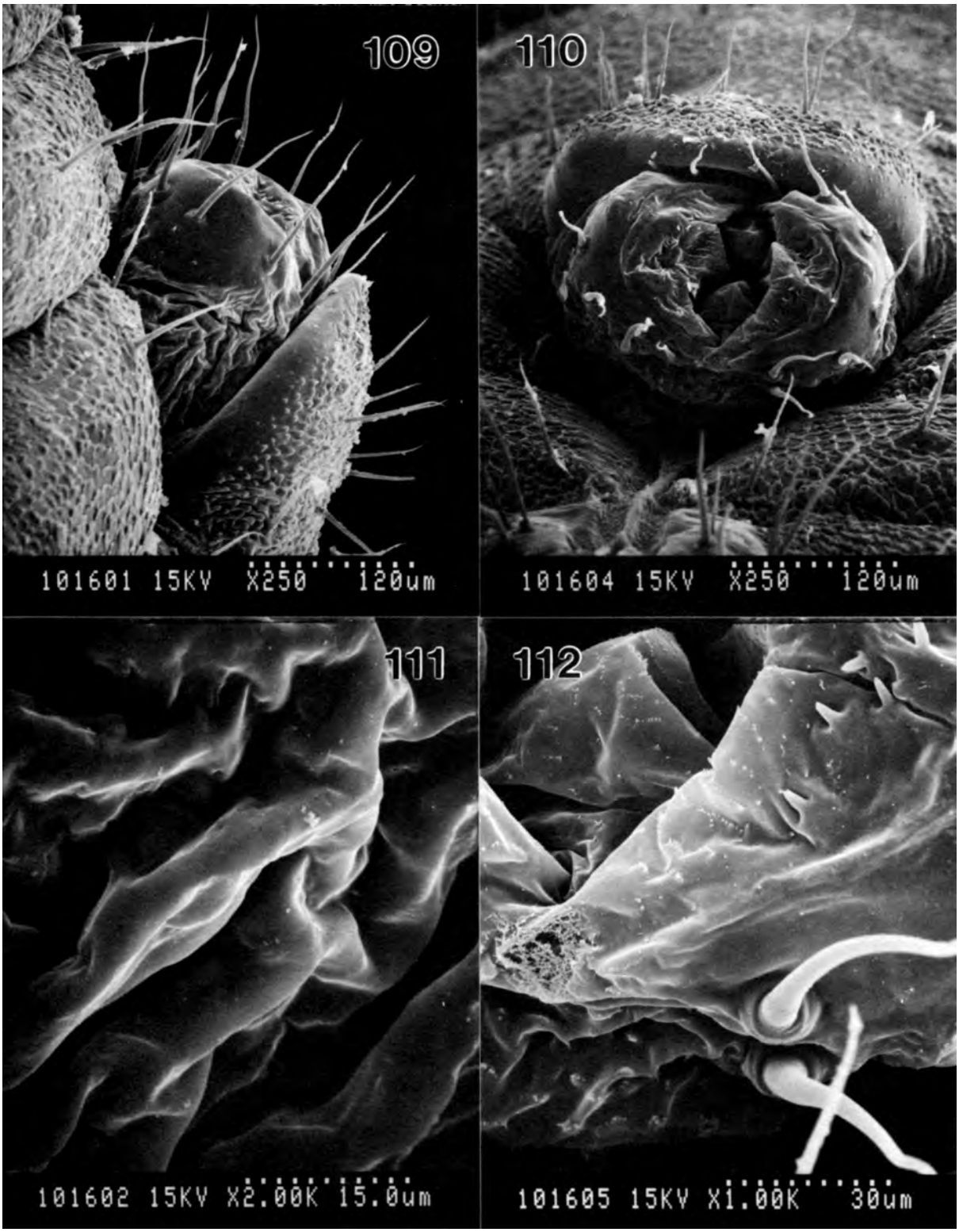
The present interpretation of *T. mulaiki* must be considered preliminary until male specimens from Ezell's Cave become available and are shown to be conspecific with the known males. Even more tentative is the inclusion of the two populations at the extreme ends of the distribution, from Whirlpool



Figs. 101-104.—*Texella mulaiki* Goodnight and Goodnight, Fern Cave: 101, 103, female: 101, anterior half of body, lateral view; 103, palpi and chelicerae, lateral view. 102, 104, male: 102, apical spine of penis, ventral view; 104, subventral view of body showing absence of trochanter IV spur and postopercular process.



Figs. 105-108.—*Texella mulaiki* Goodnight and Goodnight, male from Fern Cave: 105, penis, ventral view; 106, penis, lateral view; 107, penis, apical view; 108, penis, subdorsal view.



Figs. 109-112.—*Texella mulaiki* Goodnight and Goodnight, female from Fern Cave: 109, ovipositor, lateral view; 110, ovipositor, apical view; 111, ovipositor, enlarged view of lateral surface; 112, ovipositor, enlarged view of apical region.

and McCarty Caves, which are known only from juveniles.

Texella sp.

Note.—Two females from Marguerite Cave resemble those from Haby Salamander Cave (*T. hardeni*) and Robber Baron Cave (*T. cokendolpheri*) but differ in possessing a tubercle ventrally on TrIV. On the basis of this and, especially, their isolation, these specimens probably represent a new species. The positive identification of this population will await the discovery of a male.

Material Examined.—UNITED STATES: **Texas**: *Medina Co.*: Marguerite Cave, 28 Apr. 1984 (S. Harden, TMM), 1 female; 5 May 1984 (R. Waters, TMM), 1 female.

The *bilobata* Infragroup

Diagnosis.—Males of the single known species comprising this infragroup may be distinguished from other *Texella* by the following combination of characters: epigean; TC = 3-5-4-5; BK large, bilobed; PSL intricately folded, apically hooked; SA with lateromedial prong, lacking carina; apical half of S tubular (Figs. 113-117).

Range.—Known only from Kerr Co., Texas (Maps 3, 4).

Texella bilobata, new species
Figs. 113-117.

Diagnosis.—As for infragroup.

Type.—Male holotype from Raven Ranch, Kerr County, Texas (Dec. 1939; S. and D. Mulaik), deposited in AMNH.

Etymology.—The specific name is a reference to the bilobed basal knob of the glans, unique to this species.

Description.—Total body length, 1.23-1.41. Scute length, 0.84-0.97. Leg II length, 2.41-2.44. Leg II/Scute length, 2.62-2.80. (N = 3).

Color brownish orange. Body coarsely rugose; tubercles scattered on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 2 pairs AT. Eye mound broadly conical, retina and cornea present. Palpal megaspines: trochanter, one ventral; femur, one mesoapical; patella, two mesal; tibia, three mesal (mesoapical small). Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.23. Scute length, 0.92; width, 0.92. Eye mound length, 0.23; width, 0.23. Leg II length, 2.41. TrIV spur length, 0.05. POP absent.

Penis (Figs. 113-117): VPP with 2 dorsal, 3 lateral, and 2? ventral setae; lateral setae short, dorsal and ventral setae medium to long; AS apparently broken, base distinct, large. Glans: BK bifurcate, large; ML broad; PSL complex, with apical hook. S with apical third straight, tube-like; BF present; SA with lateral prong, lacking carina.

Female (paratopotype): Total body length, 1.41. Scute length, 0.97; width, 1.03. Eye mound length, 0.21; width, 0.26. Leg II missing. TrIV with ventral tubercle.

Ovipositor damaged; apical teeth present.

Note.—The available specimens are old and extremely brittle; all have somewhat damaged genitalia. In both males the apical spine appears to be broken and is represented by a clearly visible and quite large basal portion.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Kerr Co.*: Raven Ranch, Dec. 1939 (S. and D. Mulaik, AMNH), 1 male, 1 female.

Distribution.—Known only from the type locality (Maps 2-4).

The *reddelli* Subgroup

Diagnosis.—The males of this subgroup are distinguished from all other *Texella* by the following combination of characters: PSL claw-like (except in *T. fendi* and *T. homi*); SA produced into a scroll or prong (except in *T. homi*); apical half of S spatulate (except *T. fendi* and *T. homi*).

Range.—Known only from central Texas (Maps 3, 4).

The *reddelli* Infragroup

Diagnosis.—The males of this infragroup are distinguished from all other *Texella* by the following combination of characters: S apically spatulate; SA scrolled, clips onto the PSL (Fig. 7).

Distribution.—Known only from the caves of Travis and Williamson Counties, Texas (Maps 3-5).

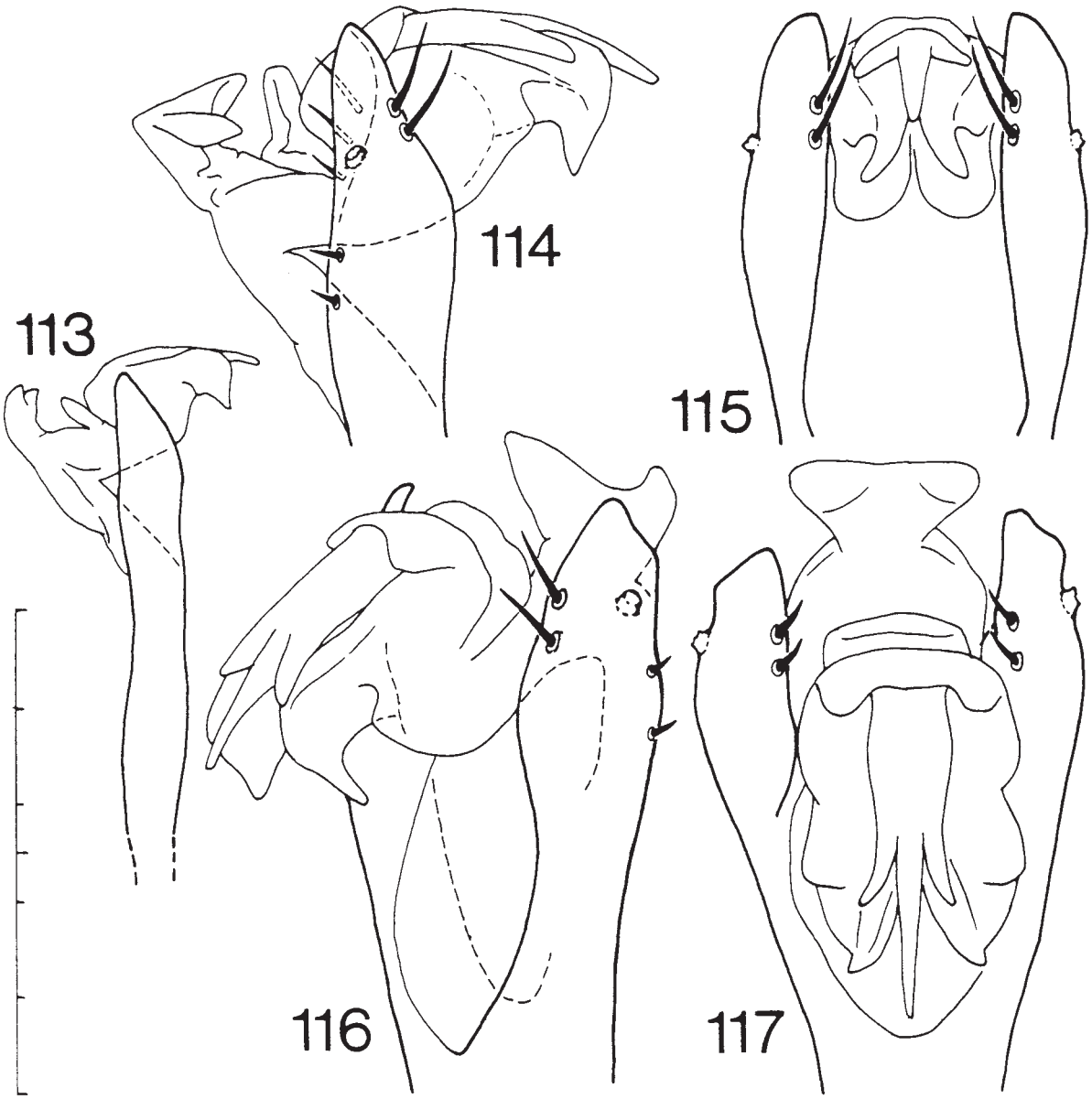
Texella reddelli Goodnight and Goodnight
Figs. 118-123.

Texella reddelli Goodnight and Goodnight, 1967:7 (male holotype from Bee Creek Cave, Austin, Travis County, Texas, in AMNH, examined).

Diagnosis.—This species is most easily distinguished from *T. reyesi* by its somatic characters. *T. reddelli* is only slightly troglomorphic and has well developed eyes, relatively shorter legs (LII/SL = 3.8-5.2), and a higher number of AT (3-5 pairs; Figs. 118, 119). *T. reyesi* lacks retinae, has longer legs (LII/SL = 4.3-8.7), and has a lower number of AT (virtually all specimens with 2-0 pairs; Figs. 124, 125, 127).

The only genitalic differences so far detected are the relative lengths of the AS [shorter in *T. reddelli* (Fig. 123) than in *T. reyesi* (Figs. 148-151)] and the number of setae on the VPP [10 lateral setae in *T. reddelli* (Figs. 120, 121); 12-20 in *T. reyesi* (Figs. 7, 136-147)]. The two species are clearly very closely related and, using the standards of genitalic distinctness applied to other *Texella* species, may even be considered conspecific. However, given that the two groups can be distinguished, they are treated here as species. A comparison of most of these characters is given in Table 3.

Description.—Total body length, 1.90-2.18. Scute length, 1.21-1.66. Leg II length, 4.92-7.59. Leg II/Scute length, 3.81-5.20. (N = 16).



Figs. 113-117.—*Texella bilobata,* new species, male holotype: 113-114, penis, lateral view; 115, penis, ventral view; 116, penis, sublateral view; 117, penis, dorsal view. Scale bar = 0.50 mm for Fig. 113 and 0.25 mm for the others.

Color orange. Body of medium rugosity, sparsely tuberculate. Carapace with 3-5 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-6, rarely 3-5-5-5 or 3-6/5-5-5.

Male (holotype): Total body length, 1.90. Scute length, 1.44; width, 1.44. Eye mound length, 0.36; width, 0.38. Leg II length, 6.00. TrIV spur long, apically bent, length, 0.67. POP length, 0.44.

Penis (Figs. 120, 121): VPP with 2 dorsal, 10 lateral, and 3 ventral setae; AS curved, apically pointed. Glans: BK slender; ML present; PSL claw-like. S spatulate; BF present; SA scrolled, clips onto PSL.

Female (paratopotype): Total body length, 1.97. Scute length, 1.41; width, 1.44. Eye mound length, 0.33; width, 0.33. Leg II length, 5.44. TrIV with two ventral tubercles.

Ovipositor: cuticle intricately folded; 1 pair of apical teeth present; setal pattern typical.

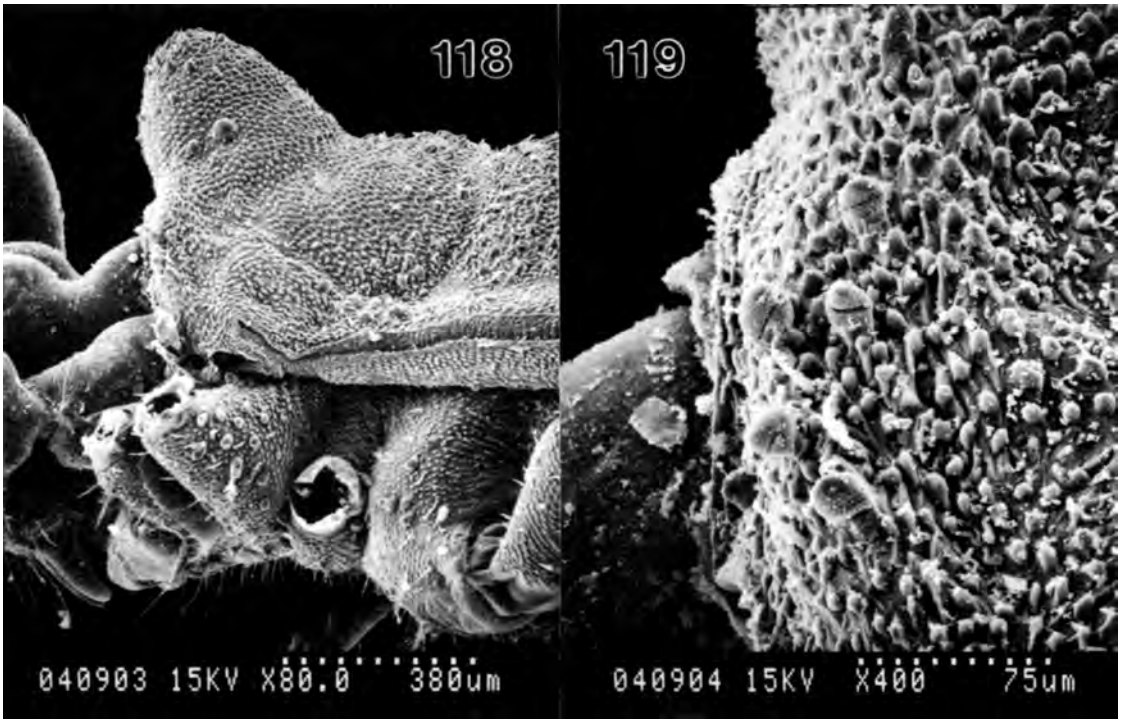
Variation.—The TrIV spur of the seven known males varies in length from 0.51-0.77. The specimens from Bee Creek Cave and Cave Y have 4-5 pairs of AT, those from Bandit Cave and Jester Estates Cave have 3 pairs. All known specimens of *T. reddelli* have a TC of 3-5-5-6, except for the two females from Cave Y, one having a TC of 3-5-5-5 and the other 3-6/5-5-5. The specimens from Jester Estates Cave have slightly longer legs (LII/SL = 4.0-5.2) than the others (LII/SL = 3.8-4.3).

These last two characters suggest a cline with the least troglomorphic individuals (Cave Y) in the southernmost, and the most troglomorphic (Jester Estates Cave) in the northernmost, part of the range.

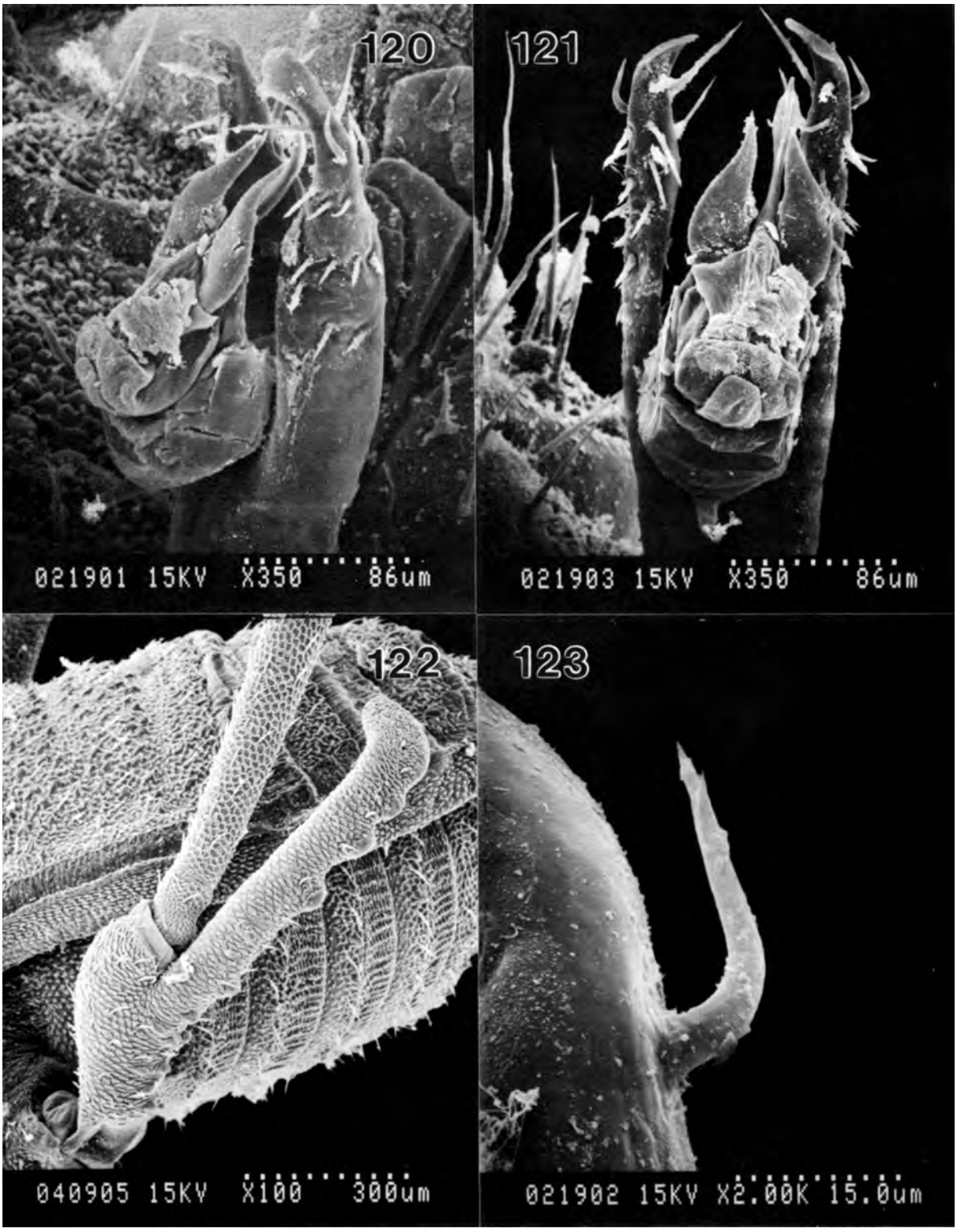
Natural History.—"In Jester Estates Cave this species was collected on the underside of small rocks. One specimen was taken in dim twilight at the bottom of the 8 ft. entrance drop. The remaining specimens were in darkness." (J. Reddell, personal communication)

Material Examined.—UNITED STATES: **Texas**: *Travis Co.*: Cave Y, 4 June 1990 (J. Reddell and M. Reyes, TMM), 1 female; 14 June 1990 (J. Reddell and M. Reyes, TMM), 1 female; Bandit Cave, 17 May 1965 (T. Barr, MLG), 1 female; Bee Creek Cave, 2 Oct. 1963 (J. Reddell and D. McKenzie, AMNH, CAS), 2 males (including type), 2 females; 4 Oct. 1975 (A. Grubbs, M. Cossey, and T. Byrd, TMM), 1 male, 3 females; 7 June 1965 (J. Fish and J. Reddell, MLG), 1 female; Jester Estates Cave, 4 June 1990 (J. Reddell and M. Reyes, TMM), 1 female; 10 June 1990 (J. Reddell and M. Reyes, TMM, CDU), 4 males, 2 females.

Distribution.—Known only from caves in central Travis County, Texas (Maps 2-5).



Figs. 118-119.—*Texella reddelli* Goodnight and Goodnight, male topotype: 118, anterior half of body, lateral view; 119, enlarged view of previous image showing anterior tubercles.



Figs. 120-123.—*Texella reddelli* Goodnight and Goodnight, male topotype: 120, penis, sublateral view; 121, penis, ventral view; 122, trochanter IV spur, lateral view; 123, apical spine of penis, dorsal view.

Notes.—The type locality was erroneously published (Goodnight and Goodnight, 1967) as "Pine Creek Cave."

Males will be necessary to verify the inclusion of specimens from Cave Y and Bandit Cave in this species. However, the females resemble those from Bee Creek Cave and Jester Estates Cave in overall appearance and clearly lack the apomorphies of the other two species in the immediate vicinity, *T. spinoperca* and *T. mulaiki*.

Texella reyesi, new species
Figs. 7, 124-159.

Texella mulaiki Goodnight and Goodnight, 1942. Goodnight and Goodnight, 1967:6 (in part, specimens from Cotterell, Beck Ranch, and Man-With-A-Spear Caves only).

Texella reddelli Goodnight and Goodnight, 1967:7 (in part, specimens from Tooth, Weldon, and Bone Caves only): Mitchell and Reddell, 1971: 46.

Diagnosis.—See discussion under *T. reddelli* and Table 3.

Type.—Male holotype from Bone Cave, Williamson County, Texas (4 June 1989; W. Elliott, J. Reddell, M. Reyes), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr. Marcelino Reyes, collector of this and many other species of *Texella*.

Description.—Total body length, 1.41-2.67. Scute length, 1.26-1.69. Leg II length, 6.10-11.79. Leg II/Scute length, 4.30-8.68. (N = 85).

Color pale orange. Body finely rugose; few small tubercles on eye mound, pars thoracica, and coxae; tergite margins smooth. Carapace with 0-2 pairs of anterior tubercles. Eye mound broadly conical, retina absent, cornea well developed, reduced, or absent. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count from 3-5-5-5 to 4-7-6-8.

Male (holotype): Total body length, 1.59. Scute length, 1.28; width, 1.31. Eye mound length, 0.26; width, 0.28. Leg II length, 9.60. TrIV spur straight; length, 0.56. POP length, 0.26.

Penis (Figs. 145-147): VPP rounded apically; with 2 dorsal, 17 lateral, and 4 ventral setae; AS bent, apically pointed, length 0.05. Glans: BK narrowly conical; ML long; PSL claw shaped. S long, curved, ventrally carinate, apically spatulate; BF well developed; SA laterally scrolled, clips onto PSL.

(paratype, Tooth Cave): Total body length, 2.13. Scute length, 1.46; width, 1.54. Eye mound length, 0.34; width, 0.38. Leg II length, 6.67. TrIV spur bent; length, 0.59. POP length, 0.36.

Penis (Figs. 7, 136, 138, 148): Similar to holotype except for the following: VPP with 12 lateral setae; AS slightly shorter (0.04), apically bifurcate.

Female: (paratopotype) Total body length, 1.92. Scute length, 1.33; width, 1.33. Eye mound length, 0.26; width, 0.28. Leg II length, 9.64. TrIV with tiny ventral tubercle.

Ovipositor: cuticle intricately folded; surface sparsely covered with tiny microspines; 1 pair apical teeth present; setal pattern: 2 pairs dorsal, 4 lateral, 1 ventral.

Juvenile: Color white to yellowish white; integument apparently unsclerotized. Tarsal count of middle instars 2-2-3-3 and 2-2-3-4; tarsomeres of earlier instars not discernable. Six immature specimens have short trochanteral spurs; one of these, presumably a penultimate, also has a short POP.

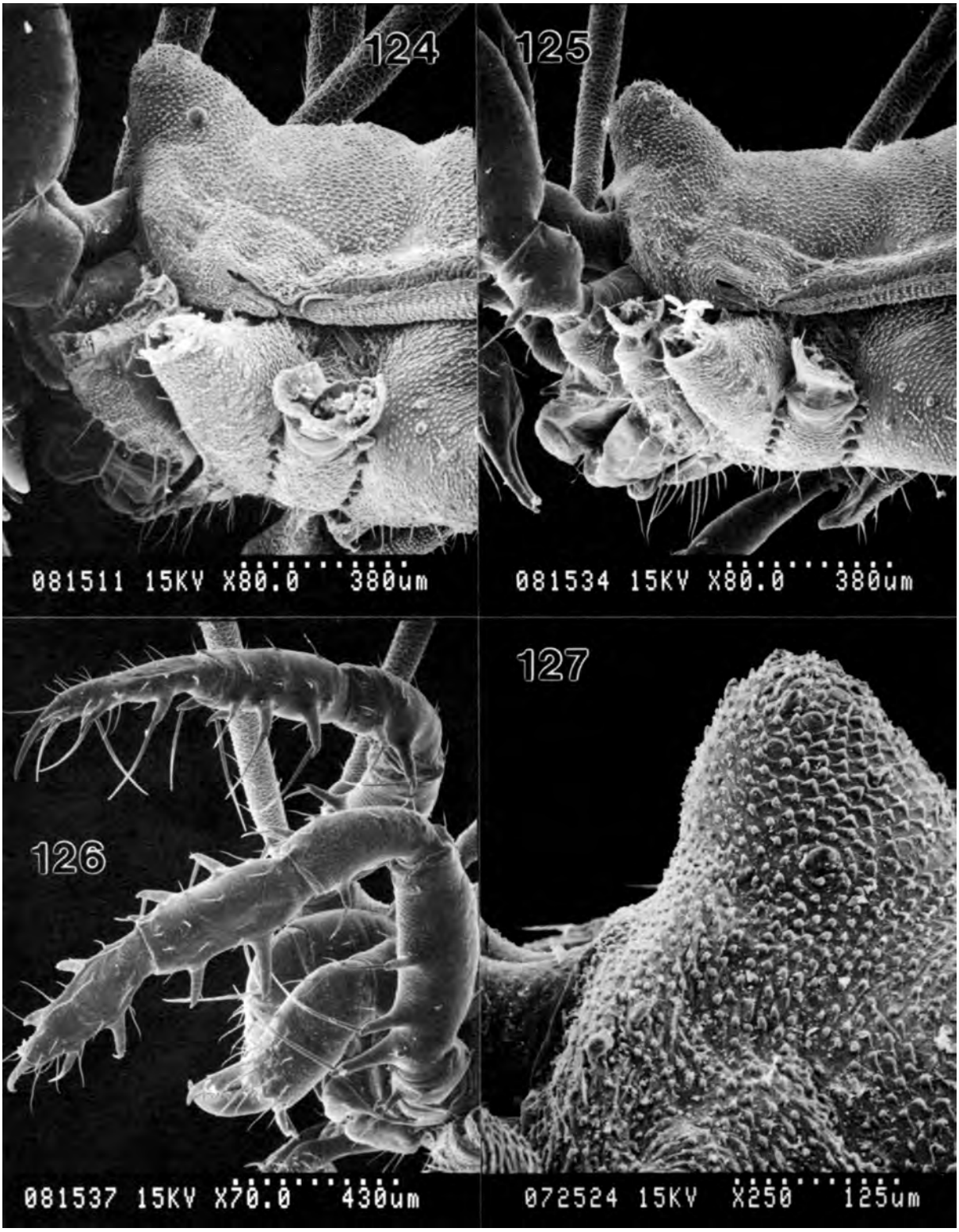
Variation.—This species is extremely polymorphic, most notably in troglomorphic characters. The characters examined are presented in Table 3. A cline is apparent, with the more troglomorphic individuals occurring at the northern end of the distribution.

The size of sexually dimorphic structures appears to vary with body size: the TrIV spur (Figs. 128, 129) varies from 0.35-0.82; the POP (Figs. 132, 133) varies from 0.09-0.51.

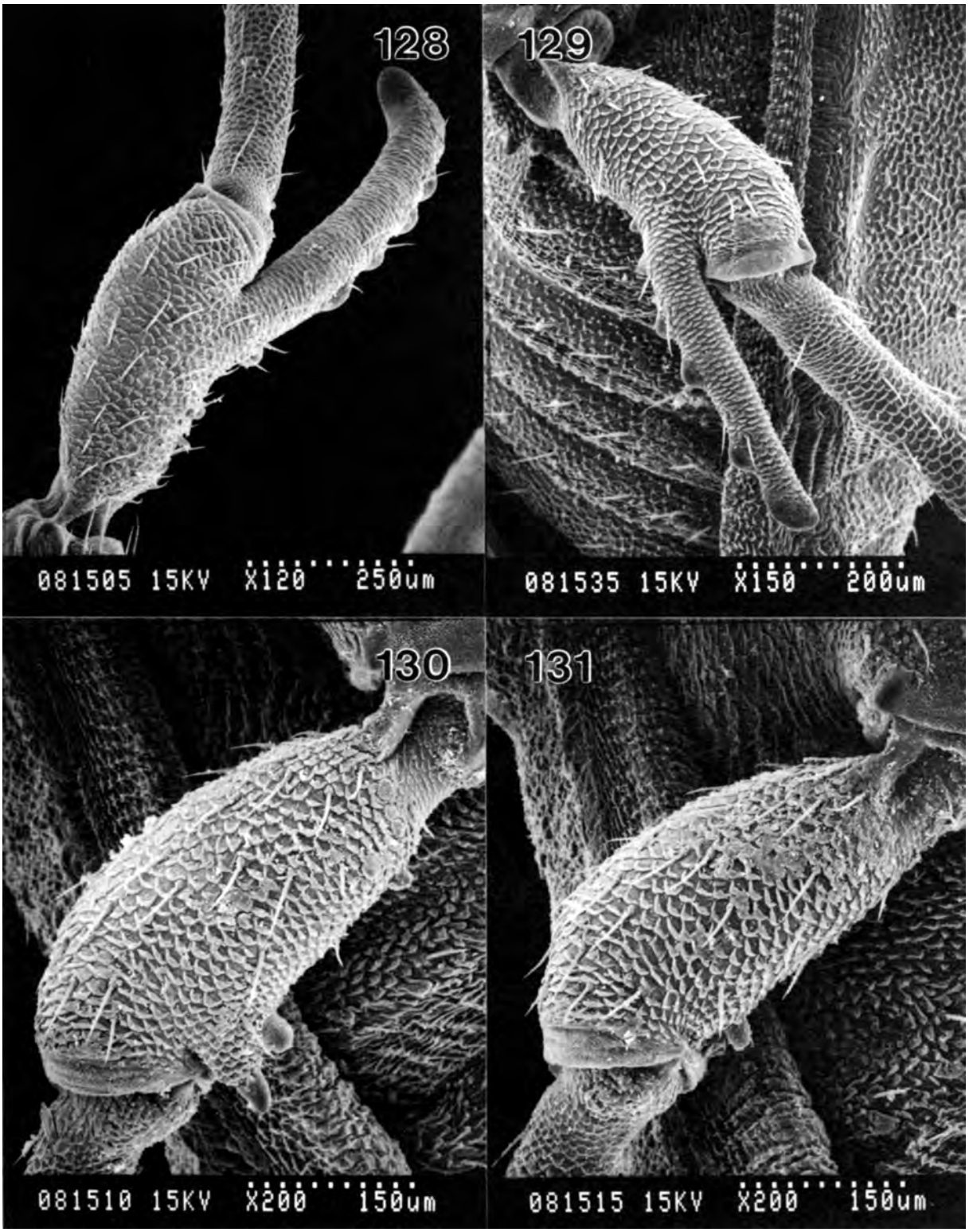
A female from Tooth Cave (Figs. 152-155) is unique in having a hyperexpanded ovipositor (see discussion under morphology). A specimen from Cotterell Cave, the second largest female specimen, is aberrant in having both a tiny POP (Figs. 134, 135) and a short TrIV spur (Fig. 130). A similar (although smaller) TrIV spur is present on a female from Beck Ranch Cave.

Natural History.—"Most specimens of this species have been taken on the underside of rocks lightly buried in soil. In all instances they have been found only in the more remote parts of the caves. None have been found in twilight, with the exception of the single juvenile from New Comanche Trail Cave. This specimen was found on the talus slope below the entrance the day after a heavy rain had saturated the surface of the slope." (J. Reddell, personal communication)

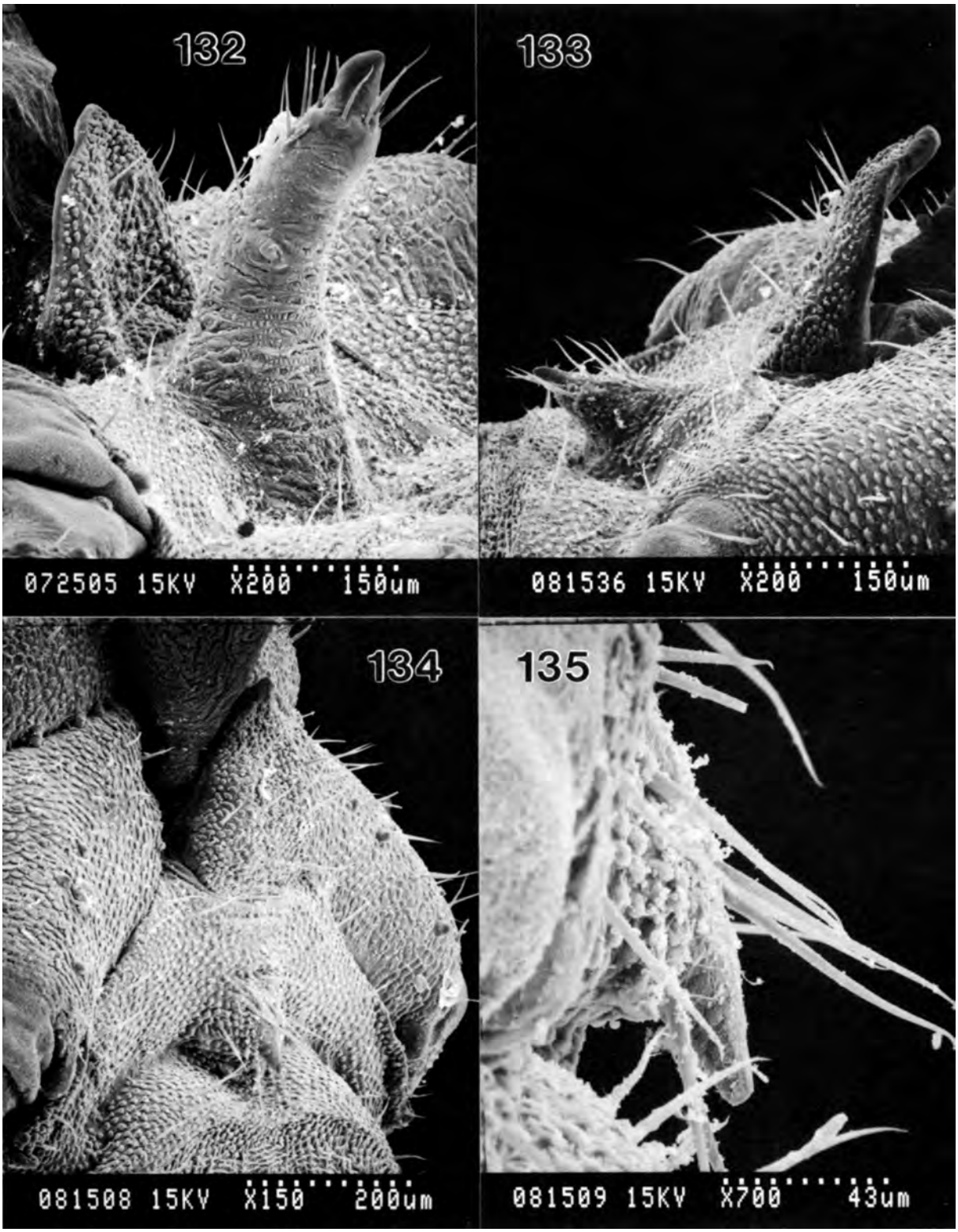
Other Material Examined (paratypes).— UNITED STATES: **Texas**: *Travis Co.*: 14 mi NW Austin, McDonald Cave, 18 May 1984 (D. Pate, J. Reddell, and M. Reyes, TMM), 1 female; 29 May



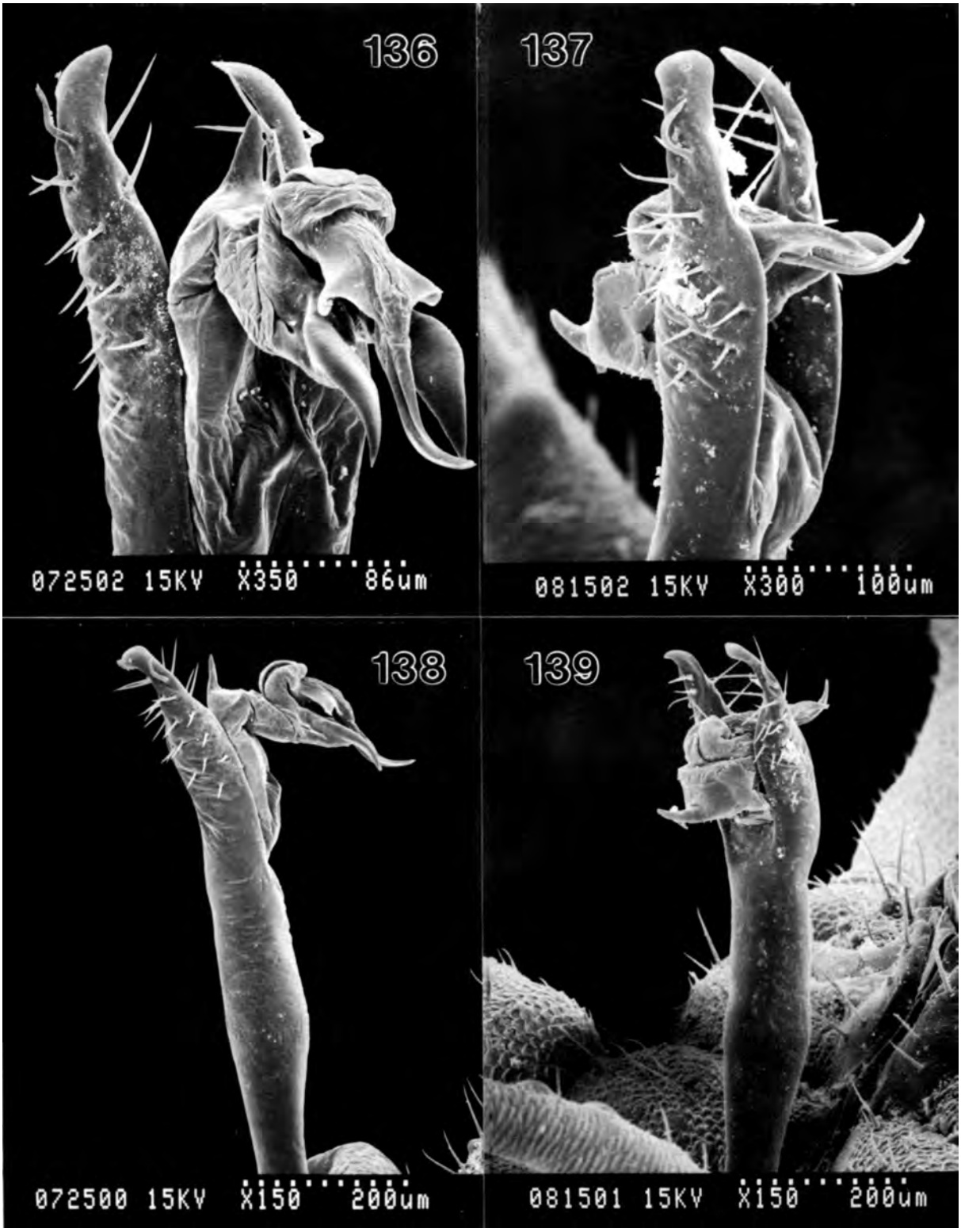
Figs. 124-127.—*Texella reyesi,* new species, paratypes: 124, female (Cotterell Cave), anterior half of body, lateral view. 125-127, males: 125, anterior half of body, lateral view (Bone Cave); 126, palpi and chelicerae, sublateral view (Bone Cave); 127, eye mound, lateral view showing reduced cornea (Inner Space Caverns).



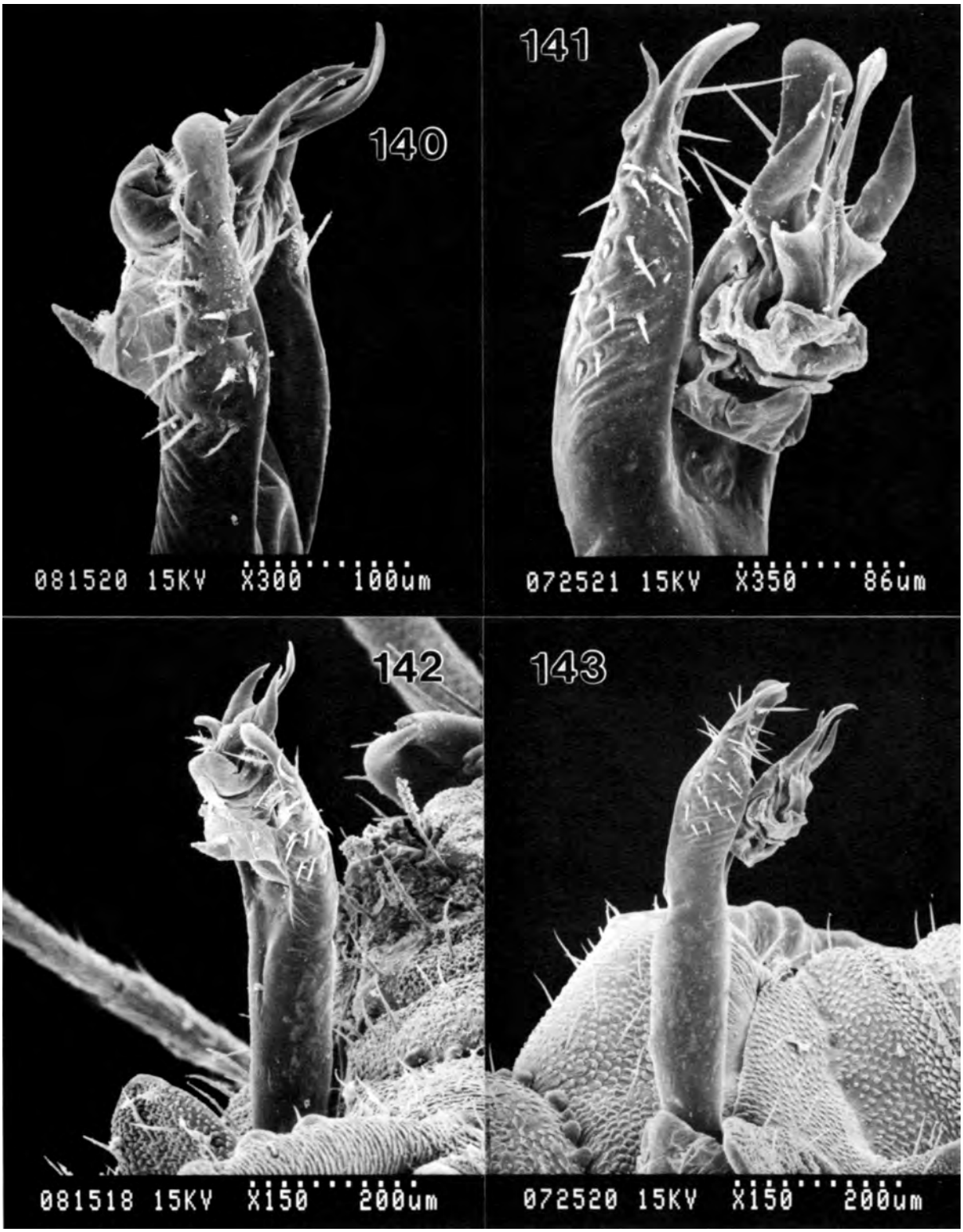
Figs. 128-131.—*Texella reyesi,* new species, paratypes: 128-129, males: 128, trochanter IV, lateral view showing curved spur (Cotterell Cave); 129, trochanter IV, lateral view showing straight spur (Bone Cave). 130-131, females: 130, trochanter IV, lateral view showing aberrant development of short spur (Cotterell Cave); 131, trochanter IV, lateral view showing typical development of small tubercle (Cotterell Cave).



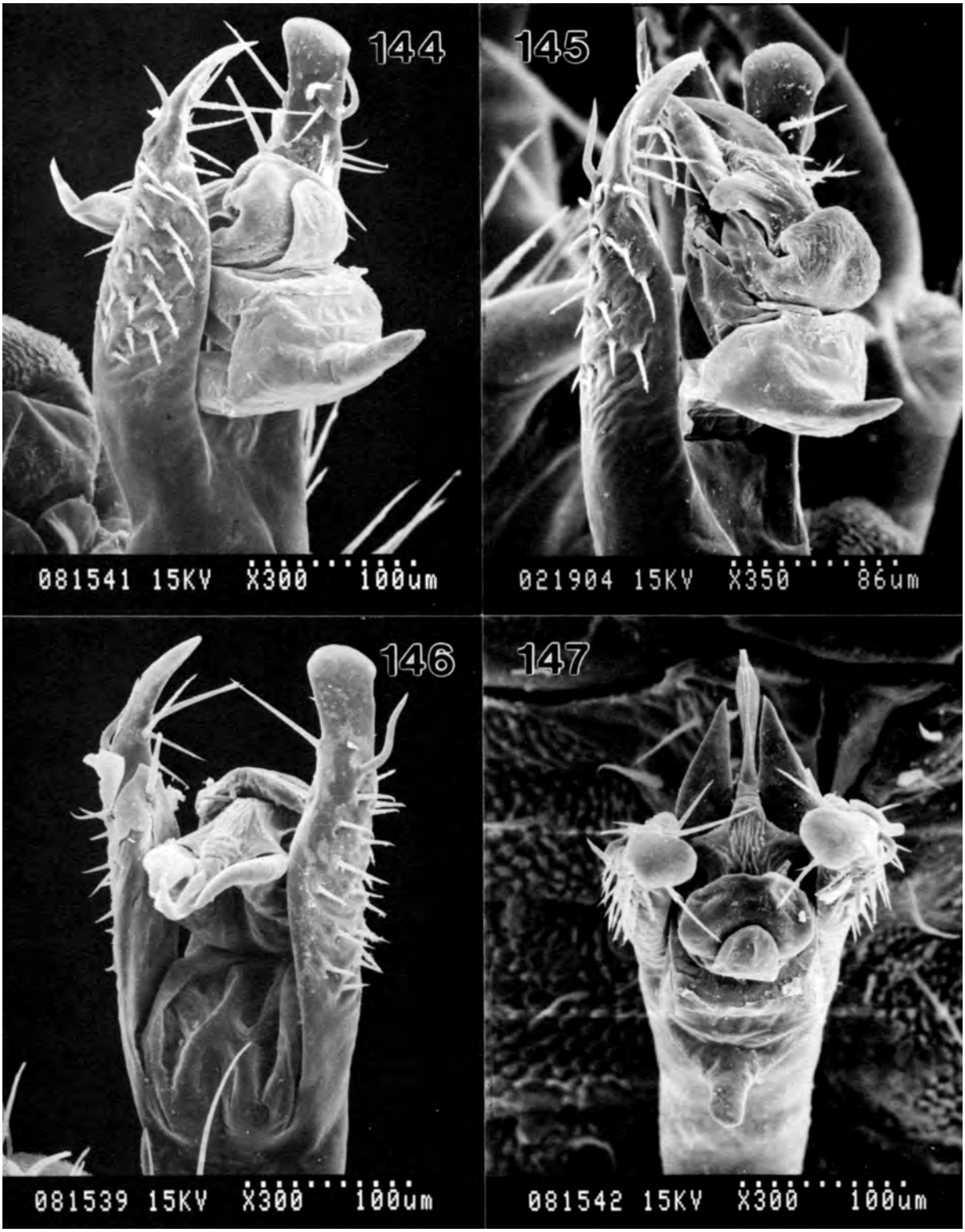
Figs. 132-135.—*Texella reyesi,* new species, paratypes: 132-133, males: 132, genital region, ventrolateral view showing well developed postopercular process (Tooth Cave); 133, genital region, ventrolateral view showing reduced postopercular process (Bone Cave). 134-135.,Ffmale (Cotterell Cave): 134, genital region, ventrolateral view showing aberrant development of small postopercular process; 135, enlarged view of postopercular process, lateral view (same specimen).



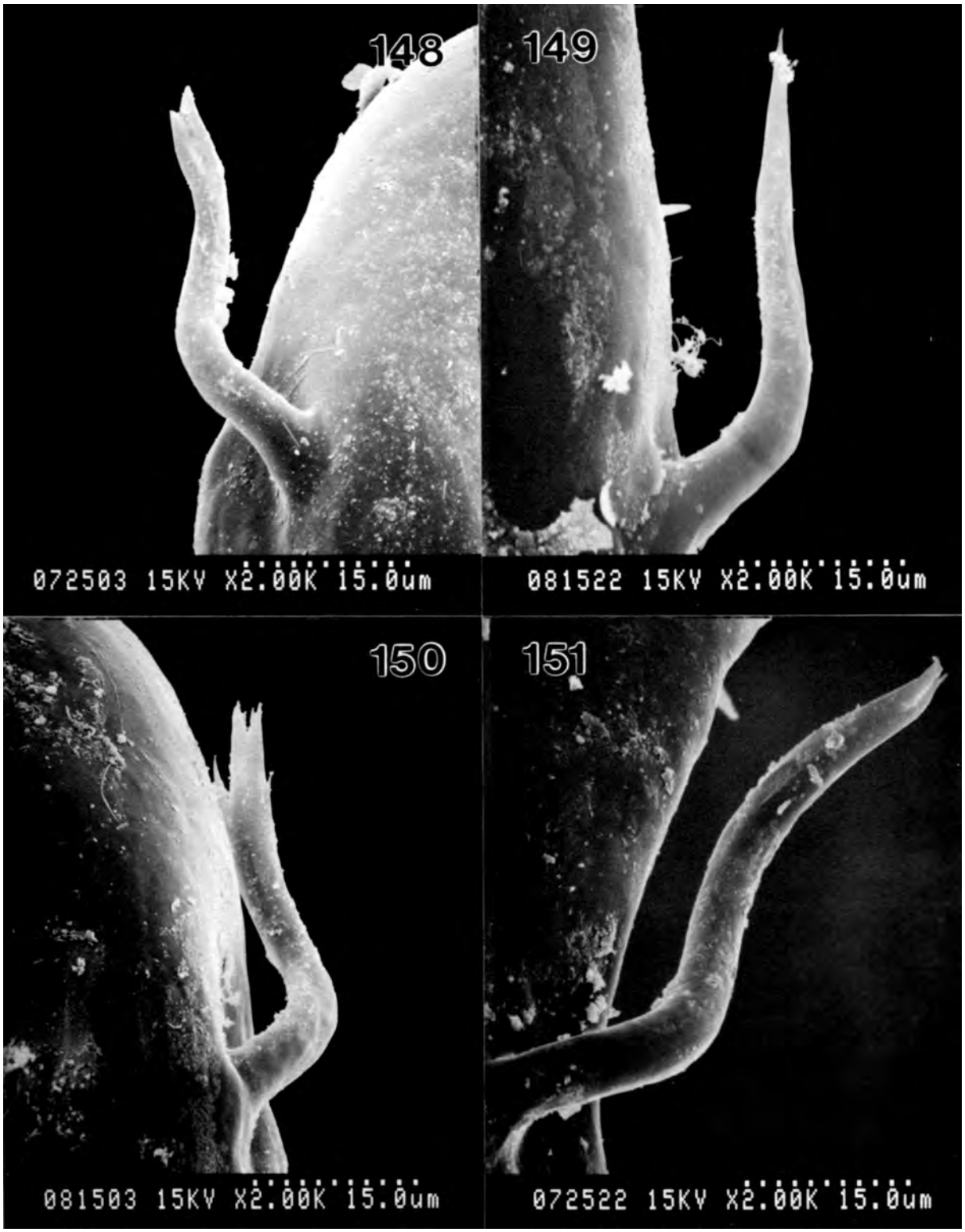
Figs. 136-139.—*Texella reyesi,* new species, male paratypes: 136, 138, penis showing slightly expanded glans (Tooth Cave): 136, dorsolateral view; 138, lateral view. 137, 139, penis showing more fully expanded glans (Cotterell Cave): 137, sublateral view; 139, ventrolateral view.



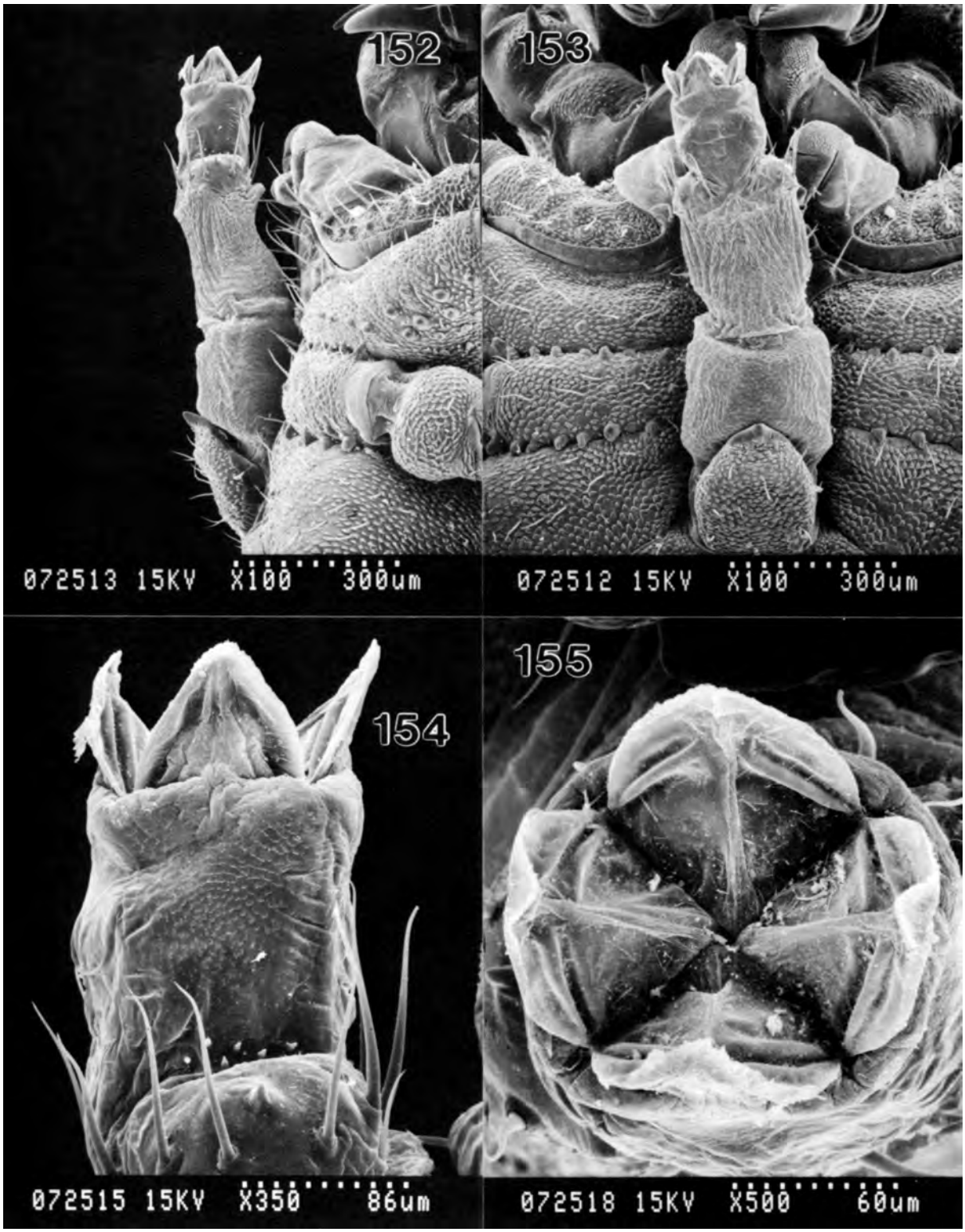
Figs. 140-143.—*Texella reyesi,* new species, male paratypes: 140, 142, penis showing even more fully expanded glans (Beck Ranch Cave): 140, subventral view; 142, ventrolateral view. 141, 143, penis showing completely expanded glans (Inner Space Caverns): 141, ventrolateral view; 143, lateral view.



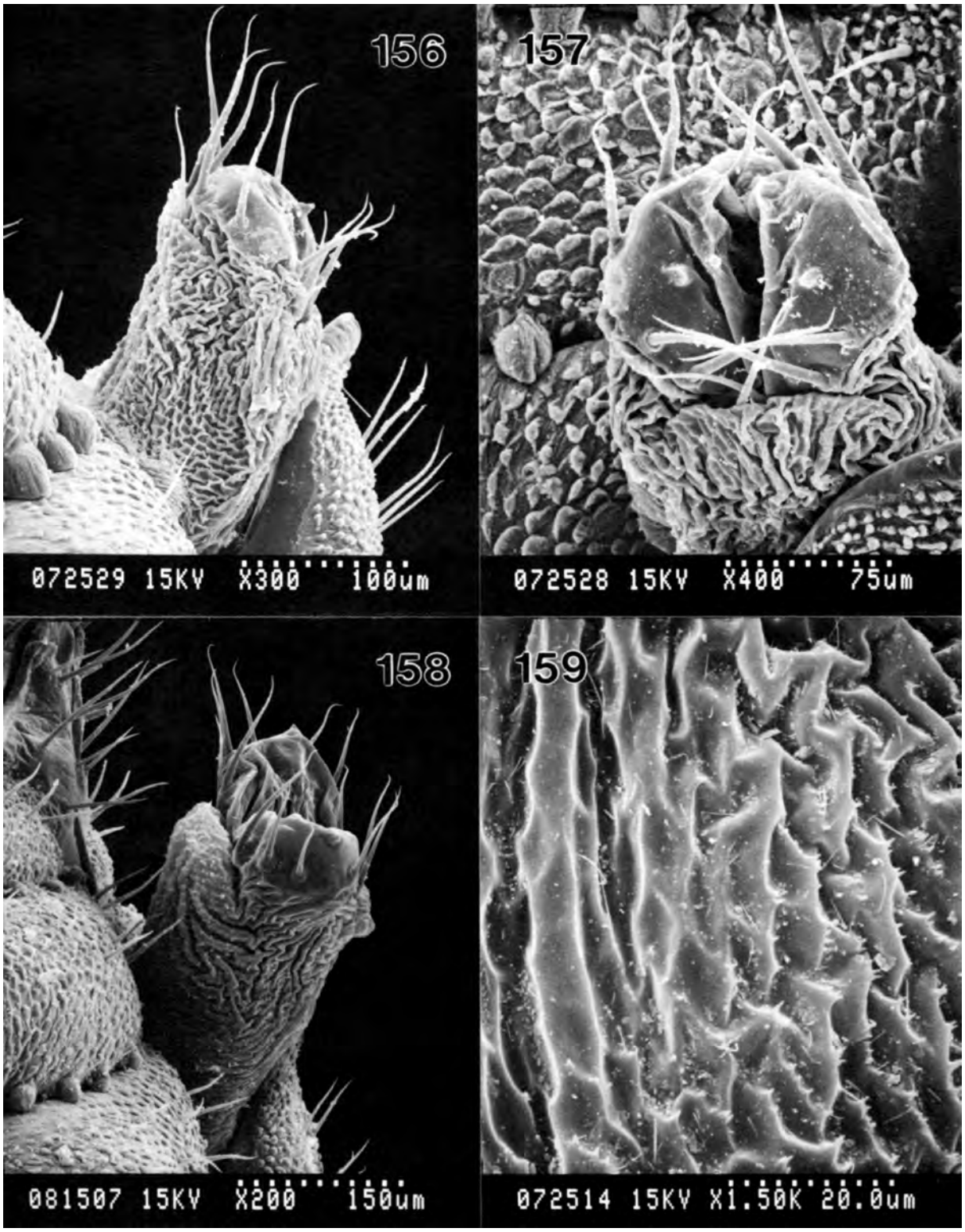
Figs. 144-147.—*Texella reyesi,* new species, male paratypes: 144-145, penis, ventrolateral view: 144, partially expanded glans (Off Campus Cave); 145, more fully expanded glans (Bone Cave). 146, penis, dorsal view (Bone Cave); 147, penis, apical view (Bone Cave).



Figs. 148-151.—*Texella reyesi*, new species, male paratypes, apical spines of penes: 148, Tooth Cave; 149, Beck Ranch Cave; 150, Cotterell Cave; 151, Inner Space Cave.



Figs. 152-155.—*Texella reyesi,* new species, female paratype (Tooth Cave) showing hyperexpanded ovipositor: 152, lateral view; 153, ventral view; 154, hyperexpanded segment, lateral view; 155, apical view.



Figs. 156-159.—*Texella reyesi,* new species, female paratypes showing typically expanded ovipositors: 156, 158, lateral view: 156, Inner Space Caverns; 158, Cotterell Cave. 157, apical view (Inner Space Caverns). 159, enlarged view of lateral surface (Tooth Cave).

1989 (W. Elliott, J. Reddell, and M. Reyes, TMM), 2 males, 1 female; 12 mi NW Austin, Root Cave, 12 July 1984 (J. Reddell and M. Reyes, TMM), 3 juveniles; 11 mi NW Austin, Tooth Cave, no date (no collector, WAS), 1 juvenile; 2 Feb. 1963 (J. Reddell and D. McKenzie, AMNH), 4 damaged specimens; 16 May 1965 (T. Barr, R. Mitchell, and Andrews, MLG, CAS, CDU), 5 males, 5 females; 14 May 1966 (J. Reddell, MLG, CAS), 5 damaged specimens; 19 Aug. 1970 (R. Mitchell, MLG), 1 female, 1 juvenile; 6 Apr. 1986 (J. Reddell and M. Reyes, TMM), 1 male; 21 Feb. 1988 (J. Reddell, TMM), 1 female; Gallifer Cave, 28 Aug. 1988 (J. Reddell and M. Reyes, TMM), 1 male; New Comanche Trail Cave, 26 Jan. 1989 (J. Reddell and M. Reyes, TMM), 2 juveniles; Cotterell Cave, 11 Mar. 1964 (B. Russell, AMNH), 2 females; 18 May 1989 (W. Elliott, J. Reddell, and M. Reyes, TMM, CAS, CDU), 6 males, 6 females, 1 juvenile; Millwood, Hole in the Road (cave), 27 Oct. 1985 (W. Elliott, TMM), 1 juvenile; Cold Cave, 8 Apr. 1990 (J. Reddell and M. Reyes, TMM), 1 female, 1 juvenile; Beer Bottle Cave, 3 May 1990 (W. Russell, TMM), 1 male, 1 female; McNeil Bat Cave, 2 Mar. 1986 (J. Reddell and M. Reyes, TMM), 2 females; Weldon Cave, 11 June 1990 (J. Reddell and M. Reyes, TMM), 1 male, 1 female, 1 juvenile; No Rent Cave, 6 June 1990 (J. Reddell and M. Reyes, TMM), 1 female, 1 juvenile; 11 June 1990 (J. Reddell and M. Reyes, TMM), 1 juvenile; Fossil Garden Cave, 27 June 1990 (J. Reddell and M. Reyes, TMM), 1 male. *Williamson Co.*: Lakeline Cave, 21 Jan. 1990 (J. Reddell, TMM), 1 female; 16 Feb. 1990, (J. Reddell and M. Reyes, CDU), 1 male, 1 female; Beck Sewer Cave, 23 Jan. 1965 (R. Mitchell and J. Reddell, MLG), 1 male; Beck Ranch Cave, 23 June 1968 (J. Reddell, MLG), 1 male, 3 damaged specimens; 9 Mar. 1988 (J. Reddell and M. Reyes, TMM, CAS), 3 males, 1 female; 24 Mar. 1989 (J. Reddell and M. Reyes, TMM), 1 female; Brown's Cave, 23 Apr. 1989 (W. Elliott, J. Reddell, and M. Reyes, TMM), 2 females; Bone Cave, 4 June 1989 (W. Elliott, J. Reddell, and M. Reyes, TMM, CAS), 1 male, 4 females, 2 juveniles; 4 Aug. 1963 (J. Reddell, AMNH), 1 male, 2 females; Man-With-A-Spear Cave, 24 Aug. 1963 [?] (J. Reddell and B. Russell, AMNH), 3 males, 4 females; 2 Sep. 1990 (D. Allen and W. Elliott, TMM), 1 female; Inner Space Caverns (=Laubach Cave), 9 July 1965 (J. Reddell, MLG), 1 male, 1 female; 22 Dec. 1968-5 Jan. 1969, (W. Elliott, MLG, CAS, CDU), 4 males, 3 females; 6 May 1979 (no collector, WAS), 1 juvenile; Steam Cave, 19 May 1985 (J. Reddell and M. Reyes, TMM), 1 female; Off Campus Cave, 31 Aug. 1985 (D. McKenzie, TMM), 1 juvenile; 8 Apr. 1989 (W. Elliott, J. Reddell, and M. Reyes, TMM, CAS), 2 males, 2 females, 1 juvenile; Sore-ped Cave, 28 Apr. 1990 (B. Larsen, TMM), 1 male; 28 Apr. 1990 (P. Sprouse, TMM), 2 females; 28 July 1990 (B. Larsen, J. Reddell, and M. Reyes, TMM), 1 male, 2 females.

Distribution.—Known from caves in Travis and Williamson Counties, Texas (Maps 2-5).

Note.—The populations from Hole in the Road, Cold Cave, No Rent Cave, Root Cave, New Comanche Trail Cave, and Brown's Cave are known only from females or juveniles and are assigned to this species somewhat tentatively. Beck's Tin Can Cave of Goodnight and Goodnight (1967) is actually Beck Ranch Cave.

The *brevidenta* Infragroup

Diagnosis.—The males of this infragroup may be distinguished from other *Texella* by the following combination of characters: AS with apical brush; VPP with 4 dorsal setae; SA with short, blunt, laterobasal prong; S apically spatulate.

Range.—Known only from central Texas (Maps 3, 4).

Texella brevidenta, new species
Fig. 161.

Diagnosis.—*Texella brevidenta* may be distinguished from the other species in its infragroup by the following combination of genitalic characters: penis large, basal knob robust, length shorter than basal diameter, and apical spine distally broad, with several points (Fig. 161).

Type.—Male holotype from Honey Creek Cave, Comal County, Texas (15 May 1982; K. Menking, R. Waters, S. Harden), deposited in CAS.

Etymology.—The specific name refers to the form of the AS, represented by a pair of short teeth.

Description.—Male (holotype): Total body length, 1.95. Scute length, 1.36; width, 1.54. Eye mound length, 0.34; width, 0.33. Leg II length, 4.44. Leg II/Scute length 3.26. TrIV spur length, 0.51. POP length, 0.26.

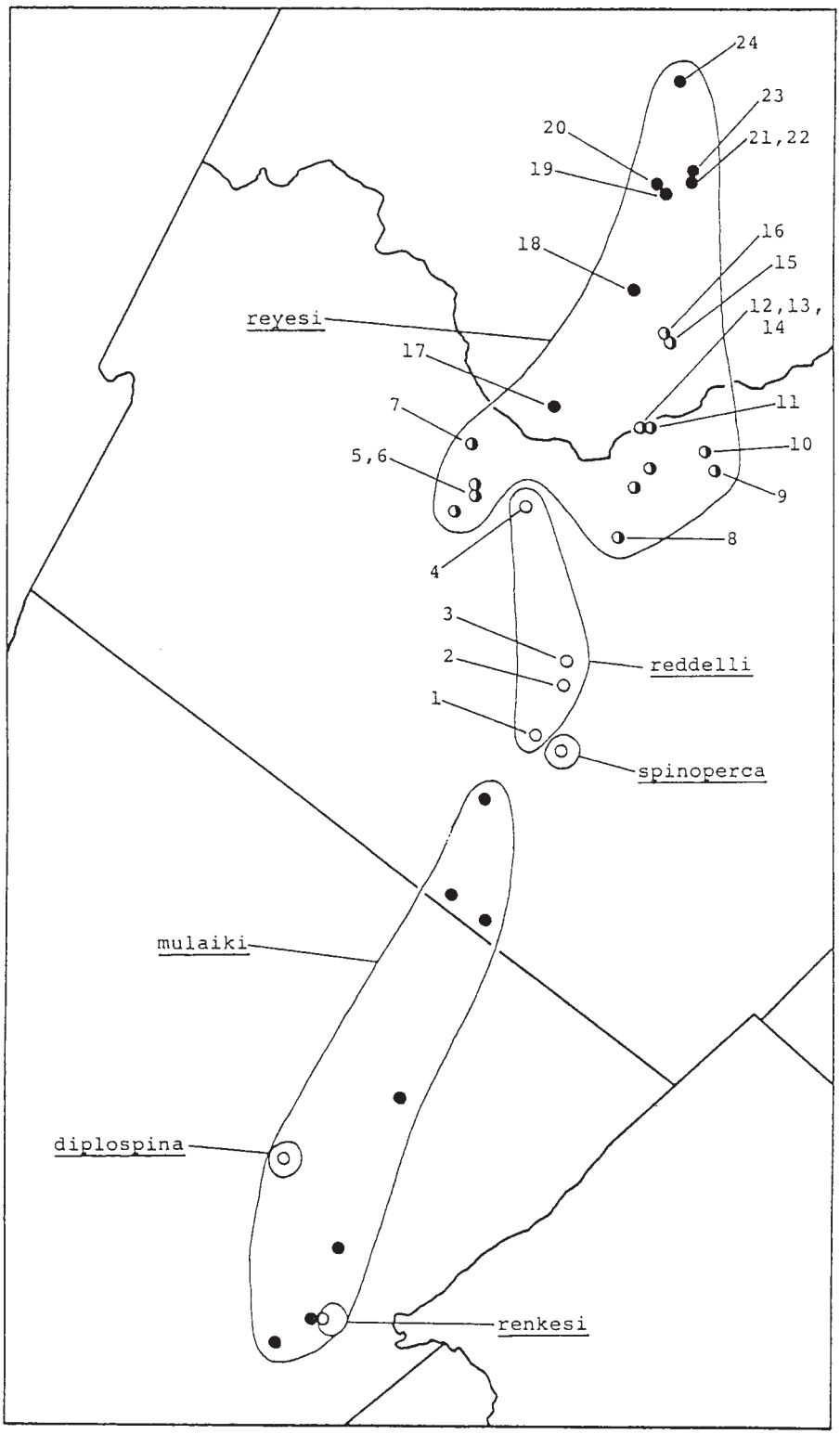
Color pale orange, abdomen dusky posteriorly, legs dusky. Body coarsely rugose; tubercles on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 4 pairs AT. Eye mound a robust, rounded cone; eyes well developed. Palpal megaspines: trochanter, 2 ventral, small; femur, 1

Table 3.—Partial character table for the reddelli infragroup. Abbreviations: # = number of cave as plotted on Map 5; m = male; f = female; * = specimens prepared for SEM; SL = scute length; LII/SL = leg II/ scute length; AT = anterior tubercles; pr(s) = pair(s); TrSL = male trochanteral spur length (and number of female Trochanter IV tubercles); TrSS = male trochanteral spur shape; str = straight; POPL = postopercular process length; ret = retina; cor = cornea; ASL = apical spine (of penis) length; LS# = number of lateral setae on the ventral plate prong (of penis). Notes: Alternate values for tarsomere and tubercle numbers are indicated with the left side given first (eg., "6/7" = left leg with 6 tarsomeres, right with 7); a"?" = missing appendage. A "±" = more or less; with regard to the cornea, a ± indicates that the cornea is strongly reduced, often barely discernable.

#	locality	sex	SL	LII/SL	tarsal count	AT	TrSL	TrSS	POPL	ret	cor	ASL	LS
1	Cave Y	f	1.21	4.07	3-5-5-5	5 prs	2 tubs			+	+		
			1.21	4.26	3-6/5-5-5	5 prs	2 tubs			+	+		
2	Bandit	f	1.36	3.81	3-5-5-6	3/2 prs	2/1 tubs			+	+		
3	Bee Creek	m	1.56	4.09	3-5-5-6	4 prs	0.74	bent	broken	+	+		10
		*	1.51	4.04	3-5-5-6	5 prs	0.62	bent	0.41	+	+	0.034	10
			1.44	4.17	3-5-5-6	4 prs	0.67	bent	0.44	+	+		
		f	1.54	3.92	3-5-5-6	4 prs	2 tubs			+	+		
			1.41	3.86	3-5-5-6	4 prs	2 tubs			+	+		
			1.38	3.92	3-5-5-6	4 prs	2 tubs			+	+		
4	Jester Estates	m	1.66	4.37	3-5-5-6	3 prs	0.77	bent	0.51	+	+		
			1.49	4.23	3-5-5-6	3 prs	0.64	bent	0.44	+	+		
			1.46	5.20	3-5-5-6	3/4 prs	0.77	bent	0.46	+	+	0.04	±8
			1.31	4.11	3-5-5-6	3 prs	0.51	bent	0.23	+	+		
		f	1.54	4.03	3-5-5-6	2/3 prs	2 tubs			+	+		
			1.33	4.77	3-5-5-6	3 prs	1 tub			+	+		
			1.30	4.87	3-5-5-6	3 prs	1 tub			+	+		
5	Tooth	m	1.64	4.44	3-5-5-6	3 prs	0.69	±bent	0.42	-	+		
			1.62	4.60	3-6-5-6	1 pr	0.62	±bent	0.36	-	+		
		*	1.54	5.39	3-5-5-6	2 prs	0.62	±bent	0.41	-	+	0.040	12
			1.54	4.75	3-5-5-6	?1 pr	0.64	±bent	0.41	-	+		
			1.46	4.57	3-6/5-5-6	2 prs	0.59	±str	0.36	-	+		
			1.41	5.27	3-5-5-6/7	1 pr	0.51	±str	0.29	-	+		
		f	1.54	4.30	3-5-5-6	1 pr	1 tub			-	+		
			1.51	4.36	3-5-5-6	1/2 prs	1 tub			-	+		
		*	1.46	4.99	3-5-5-6	2 prs	1 tub			-	+		
			1.44	4.92	3-5-5-6	2 prs	1 tub			-	+		
			1.36	5.15	3-6-5-6	2 prs	1 tub			-	+		
			1.36	4.48	3-6-5-7	2 prs	1 tub			-	+		
6	Gallifer	m	1.46	5.07	3-6/5-5-6/7	2 prs	0.51	±bent	0.36	-	+		
7	McDonald	m	1.46	5.25	3/2-5-5-6	1/2 prs	0.54	±str	0.33	-	+		
			1.41	5.20	3-5-5-6	1 pr	0.51	±str	0.28	-	+		
		f	1.49	4.66	3-5-5-6	1 pr	1 tub			-	+		
			1.41	5.21	3-5/6-5-5/6	1 pr	1 tub			-	+		
8	Cotterell	m	1.69	5.15	4-5-5-6	2 prs	0.82	bent	0.51	-	+		
			1.59	5.97	4-6/7-5-6	2 prs	0.74	bent	0.51	-	+		
			1.56	5.31	4-6/7-5-6	2 prs	0.72	bent	0.46	-	+		
		*	1.51	7.13	4-7/6-5-6	3 prs	0.62	bent	0.33	-	+	0.040	13
			1.44	6.60	4-6-5-6/7	2 prs	0.46	±bent	0.31	-	+		
			1.38	6.81	4-7-5-6	2 prs	0.49	±bent	0.26	-	+		
		f	1.54	6.43	4-6/7-5-6/7	2 prs	1 tub			-	+		
		*	1.51	6.20	4-7-5-7	2 prs	0.08		0.09	-	+		
		*	1.41	6.45	4-7-5-7	2 prs	1 tub			-	+		
			1.41	6.43	4-7-5-6/7	2 prs	1 tub			-	+		
			1.38	7.17	4-7/6-5-6	1 pr	1 tub			-	+		
			1.36	7.13	4-6-5-6/7	2 prs	0.06			-	+		
			1.33	7.37	4-6-5/6-7	2 prs	1 tub			-	+		
			1.31	6.03	4 6/7 5 6	2 prs	1 tub			-	+		
9	Cold	f	1.46	6.02	4-6-5-6	2 prs	1 tub			-	+		
10	Beer Bottle	m	1.69	6.04	4-6-5/?-7/6	2 prs	0.76	bent	0.47	-	+		
		f	1.31	6.36	4-?/6-5-6	2 prs	1 tub			-	+		

Table 3.—Continued.

#	locality	sex	SL	LII/SL	tarsal count	AT	TrSL	TrSS	POPL	ret	cor	ASL	LS
11	McNeil Bat	f	1.62	5.86	4-5/6-5-6/7	2 prs	1 tub			-	+		
			1.41	6.13	4-6-5-6	2 prs	1 tub			-	+		
12	Weldon	m	1.46	6.85	4-?/7-5-6/7	2 prs	0.59	±bent	0.37	-	+		
		f	1.38	6.76	4-6-5-7	1 pr	0 tub			-	+		
13	No Rent	f	1.36	6.81	4-7-5-6/7	1 pr	0 tub			-	+		
14	Fossil Garden	m	1.49	6.76	3-6-5-7/6	0 pr	0.55	±bent	0.31	-	+		
15	Beck Sewer	m	1.36	6.82	3/4-5-?-6	2 prs	0.49	bent	0.10	-	+		
16	Beck Ranch	m	1.51	5.86	4-6-5-6	2 prs	0.62	bent	0.38	-	+		
		*	1.46	6.08	4/3-6/5-5-6	3-4 prs	0.59	bent	0.31	-	+	0.050	12
			1.36	6.54	4/3-5-5-6	2 prs	0.56	bent	0.36	-	+		
		f*	1.41	6.36	4-5-5-6	2 prs	1 tub lg			-	+		
			1.36	6.43	4/2-5/4-5-6	2 prs	0 tub			-	+		
17	LakeLine	m	1.41	7.51	3-6-5-5	1 pr	0.46	str	0.21	-	+	0.050	12
		f	1.36	7.11	3-5-5-6	1 pr	1 tub sm			-	±		
			1.36	6.73	3-5-5-6	1 pr	0 tub			-	-		
18	Brown's	f	1.28	7.66	4-6-5-6	1 pr	1 tub sm			-	-		
			1.28	7.58	4-6-5-7	1 pr	0 tub			-	-		
10	Bone	m	1.41	7.20	4-7/6-5/?-7	1 pr	0.72	str	0.38	-	-		
			1.28	7.50	3-6-5/6-7/8	1 pr	0.56	str	0.26	-	±		
		*	1.28	7.13	4/?-6/8-5/?-7	0 pr	0.39	str	0.11	-	±	0.050	17
		f	1.44	7.48	4-8/7-6-6/7	1 pr	0 tub			-	-		
			1.42	7.02	4-6-6-8	0 pr	0 tub			-	-		
			1.33	7.25	4-6-6/5-7	0 pr	1 tub sm			-	-		
		*	1.31	7.21	4-6-5-7	1 pr	0 tub			-	±		
			1.31	7.18	4-6-5-7/6	0 pr	0 tub			-	-		
			1.28	6.89	4-6-5-7	0 pr	1 tub sm			-	-		
20	ManWSpear	m	1.36	7.94	4-6-5-6	1 pr	0.36	str	0.10	-	+	0.050	12
			1.33	7.38	4-6/7-5-6	2 prs	0.46	str	0.12	-	+		
			1.33	-	4-?-5-6	1 pr	0.35	str	0.15	-	+		12
		f	1.38	7.02	4-6-5-7	2 prs	0 tub			-	-		
			1.38	7.01	4-6/7-5-6	2 prs	0 tub			-	±		
			1.33	7.02	4-6-5-7	1 pr	0 tub			-	±		
			1.31	7.28	4-6/7-5-6	1 pr	1 tub			-	±		
			1.26	8.10	4-6/7-5-5	2 prs	1 tub			-	±		
21	Inner Space	m	1.54	7.08	4-7-5-7/8	1 pr	0.66	±str	0.36	-	±		
			1.33	8.68	4-7/8-5-7/8	1 pr	0.54	±str	0.18	-	-		
			1.33	7.89	4-7-5-7/8	0 pr	0.64	±str	0.28	-	±		
			1.33	7.74	4-6-5-7	1 pr	0.46	str	0.21	-	±		
		*	1.31	7.28	4-6/7-5-7/8	2 prs	0.48	str	0.09	-	-	0.060	17
		f	1.54	7.29	4/5-6-?-7	1 pr				-	±		
			1.54	6.34	4-6-5-7	0 pr	1 tub			-	±		
			1.46	7.12	4-7-5/6-?	0 pr	0 tub			-	-		
		*	1.46	-	4-?-5-7	0 pr	0 tub			-	±		
22	Steam	f	1.44	6.81	4-5-6-7	1 pr	0 tub			-	±		
23	Off Campus	m*	1.49	7.91	4-5/7-6-7/8	1-2 pr	0.64	±bent	0.33	-	-	0.060	20
			1.38	7.47	4-7/6-6-8	1-2 pr	0.56	±bent	0.28	-	-		
		f	1.36	7.72	4-6-5-7	1 pr	1 tub sm			-	-		
		*	1.33	7.17	3-6-5-7	1 pr	1 tub sm			-	-		
24	Sore-ped	m	1.38	7.45	4-?/6-6/5-7/8	0 pr	0.49	±str	0.15	-	-		
			1.36	7.15	3-6-5-7/6	0 pr	0.59	±str	0.29	-	-		
		f	1.41	6.82	3-6-5-6/7	1/0 pr	1 tub			-	-		
			1.33	7.29	3-6-5-7/6	0 pr	1 tub			-	-		



Map 5.—Map of the Balcones Escarpment, central Texas, showing caves where *Texella* species have been collected. Degree of troglomorphy indicated by symbols: open circle = troglophiles (eyes well developed); black dot = troglobites with partial to complete loss of cornea; mixed symbol = troglobites with well developed corneas. The numbers show the caves from which adults of the *reddelli* infragroup are known (see Table 3). (Although not indicated on the map, *T. mulaiki* also occurs sympatrically with *T. diplospina* and *T. renkesi*.)

mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-6.

Penis (Fig. 161): VPP apically rounded, somewhat expanded along mid-dorsal margin; with 4 dorsal, 22? lateral, and 7 ventral setae; AS medium sized, apically broad, brushy. Glans: BK robust, length shorter than basal diameter; ML broad; PSL claw-like. S straight, apically spatulate, with ventral carina; BF well developed; SA represented by a pair of short lateral prongs.

Female: Unknown.

Natural History.—This species occurs sympatrically with another laniatorid, *Hoplobunus* species (Gonyleptoidea). The collection data reads: "Mosquito net placed in stream".

Other Material Examined.—None.

Distribution.—Known only from Honey Creek Cave, Comal County, Texas (Maps 2-4).

Texella grubbsi, new species
Figs. 160, 162-165.

Diagnosis.—Males of *Texella grubbsi* may be distinguished from all other *Texella* by the large, robust basal knob distinctly longer than the basal diameter (Fig. 160).

Type.—Male holotype from Burnett Ranch Cave, 7 mi W Wimberly, Hays County, Texas ("1982"; A. Grubbs), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr. Andy G. Grubbs, collector of this and numerous other species of *Texella*.

Description.—Total body length, 1.62-1.82. Scute length, 1.21-1.31. Leg II length, 4.51-4.67. Leg II/Scute length, 3.56-3.73. (N = 4).

Color brownish orange. Body coarsely rugose; tubercles on eye mound, pars thoracica, and coxae; tergite margins smooth. Carapace with 2 pairs AT. Eye mound a robust, rounded cone; eyes well developed. Palpal megaspines: trochanter, 2 ventral, small; femur, 2 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-5.

Male (holotype): Total body length, 1.82. Scute length, 1.31; width, 1.38. Eye mound length, 0.36; width, 0.36. Leg II length, 4.67. TrIV spur large, apically bent, length, 0.59. POP length, 0.26.

Penis (Figs. 160, 162-165): VPP apically rounded; with 4 dorsal, 18 lateral, and 5 ventral setae; setae long on apical half of prong; AS of moderate length, slightly curved, with apical brush. Glans: BK large, conical; ML broad; PSL claw-like. S long, slightly bent, ventrally carinate, apically spatulate; BF present; SA represented by two, short, basolateral prongs.

Female (paratopotype): Total body length, 1.62. Scute length, 1.23; width, 1.33. Eye mound length, 0.31; width, 0.31. Leg II length, 4.51. TrIV with two ventral tubercles.

Ovipositor: cuticle intricately folded; dorsal surface lacking apparent microspines; 1 pair apical teeth present; setal pattern: 1 pair dorsal, 4 lateral, 1 ventral.

Variation.—The TrIV spur varies in length from 0.46-0.59, and the POP from 0.23-0.26, in the three available males.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Hays Co.*: Burnett Ranch Cave, 7 mi W Wimberly, "1982" (A. Grubbs, TMM, CAS), 2 males, 1 female.

Distribution.—Known only from Burnett Ranch Cave, Hays County, Texas (Maps 2-4).

The *spinoperca* Infragroup

Diagnosis.—The females of this infragroup are distinguished from all other *Texella*, except *T. shoshone* and *jungi*, by the presence of 1-2 pairs of spines or tubercles on the anterior margin of the genital operculum (Figs. 171, 173, 182, 183, 194, 197). The males are distinguished from all other *Texella* by the following combination of characters: VPP with dorsal margin expanded; VPP setae long; AS apically polyfurcate to plumose; BK absent; SA apically produced into long prongs (except in *T. homi*); S apically spatulate (except *T. fendi* and *homi*) (Figs. 168, 169-170, 174-181, 186-191, 198-201).

Range.—Known only from eastern central Texas (Maps 3, 4).

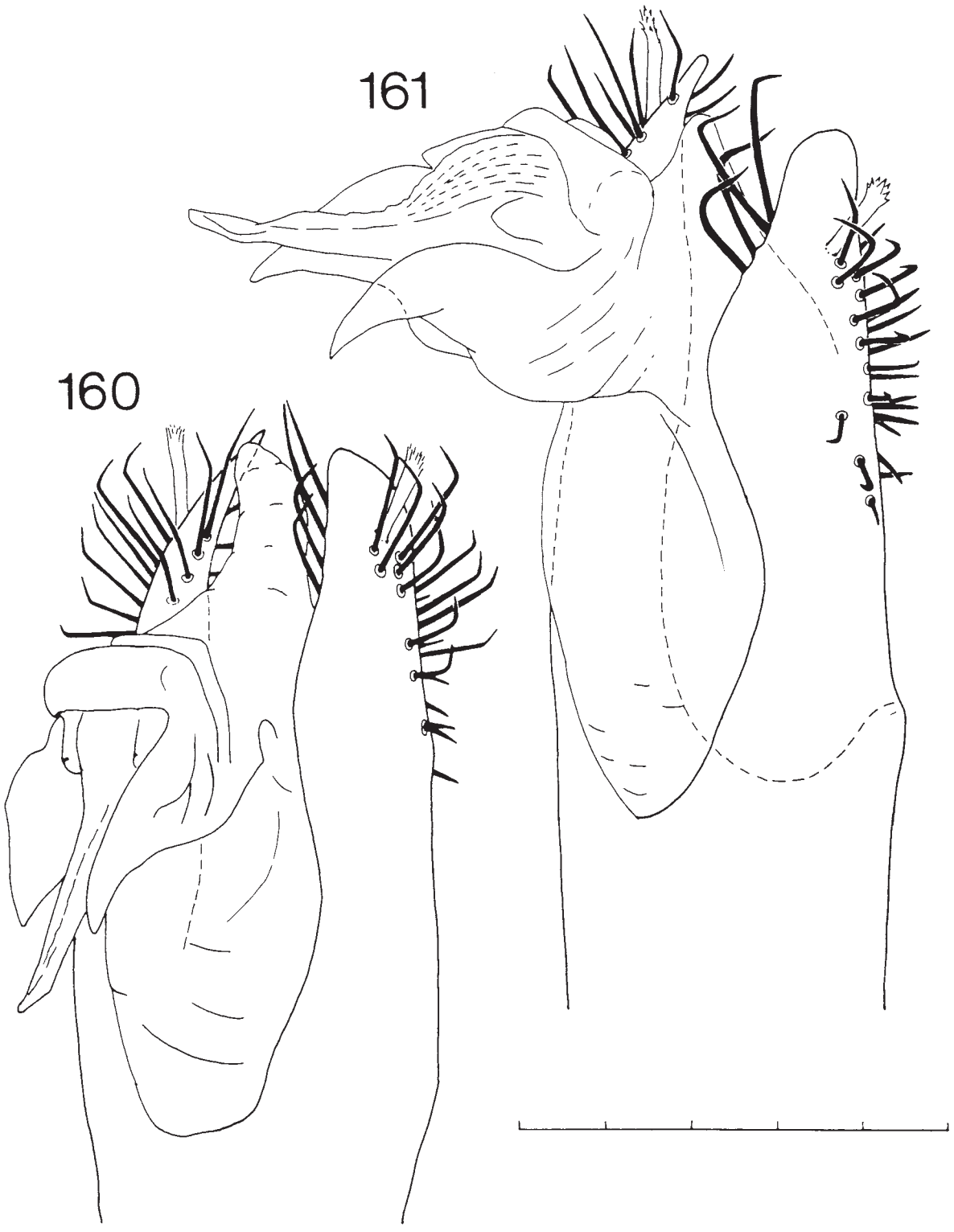
Texella diplospina, new species
Figs. 166-171.

Diagnosis.—Males of this species are distinguished from others in the infragroup by the following combination of characters: GO lacking apical tubercles; VPP with three dorsal setae; SA prongs originating medioventrally on stylus; S narrowly spatulate (Figs. 168-170). Females differ from those of other *Texella* in having 2 pairs of apical spines on the GO (Fig. 171).

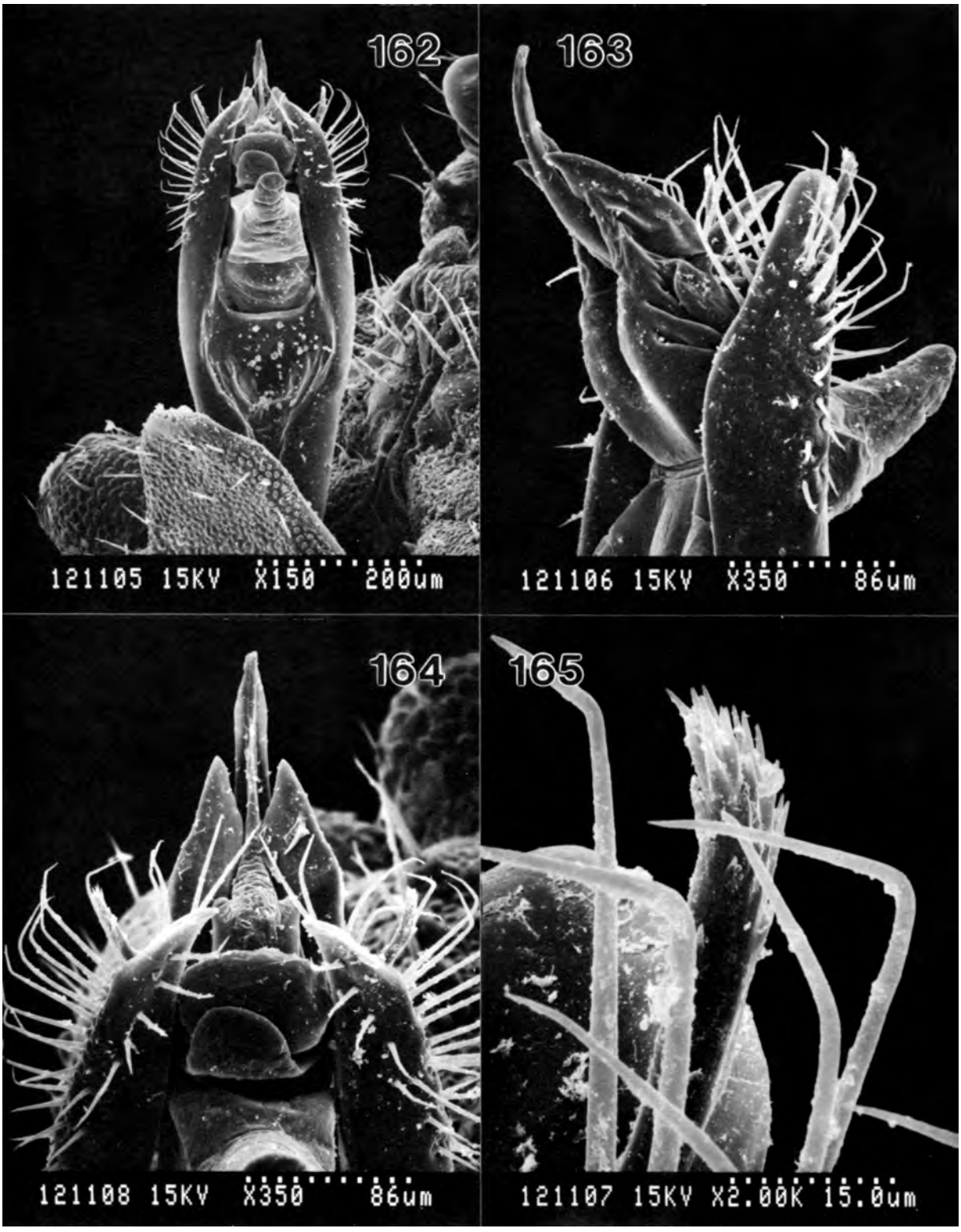
Type.—Male holotype from Ladder Cave, Hays County, Texas (2 Sep. 1989; D. Ubick, S. Fend, S. Renkes), deposited in CAS.

Etymology.—The specific name refers to the 2 pairs of apical spines on the female genital opercula.

Description.—Total body length, 1.41-1.74.



Figs. 160-161.—*Texella* species, male holotypes: 160, *T. grubbsi,* new species: Penis, dorsolateral view. 161, *T. brevidenta,* new species: Penis, dorsolateral view. Scale bar = 0.25 mm.



Figs. 162-165.—*Texella grubbsi,* new species, male paratopotype: 162, penis, ventral view; 163, penis, sublateral view; 164, penis, apical view; 165, apical spine of penis, lateral view.

Scute length, 1.13-1.23. Leg II length, 3.23-3.67. Leg II/Scute length, 2.63-3.09. (N = 9).

Color brownish orange. Body rugosity medium; tubercles on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 4-6 pairs of AT; arranged in two, poorly defined rows. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-5; two specimens have six tarsomeres on the fourth right tarsi.

Male (holotype): Total body length, 1.54. Scute length, 1.15; width, 1.15. Eye mound length, 0.28; width, 0.31. Leg II length, 3.46. TrIV spur length, 0.36. POP length, 0.26.

Penis (Figs. 168-170): VPP apically rounded, dorsally expanded; with 3 dorsal, 16 lateral, and 5 ventral setae; AS evenly curved, apically polyfurcate. Glans: BK absent; ML not apparent; PSL claw-like. S long, slightly sigmoid, apically spatulate, ventroapically with slight groove, ventrobasally with longitudinal carina; BF present; SA represented by two prongs originating medioventrally on the stylus.

Female (paratopotype): Total body length, 1.67. Scute length, 1.23; width, 1.21. Eye mound length, 0.28; width, 0.28. Leg II length, 3.67. TrIV with ventral tubercle. GO with two pairs of apical spines.

Ovipositor (Fig. 171): cuticle intricately folded; surface lacking microspination; apical teeth apparently absent; setal pattern: 1 pair dorsal, 4 pairs lateral, 1 pair ventral.

Variation.—The second male, although similar in size to the holotype, has a shorter POP, 0.15 in length.

Natural History.—This species has been collected under rocks near the cave entrance (including dark and twilight regions), whereas the sympatric *T. mulaiki* occupies the deeper zones.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Hays Co.*: Ladder Cave, 26 May 1989 (A. Grubbs, J. Reddell, and M. Reyes, TMM, CAS), 1 male, 2 females; 2 Sep. 1989 (J. Reddell and M. Reyes, TMM), 4 females, 1 juvenile (D. Ubick, S. Fend, and S. Renkes, CDU), 1 female, 1 juvenile.

Distribution.—Known only from Ladder Cave, Hays County, Texas (Maps 2-5).

Texella renkesae, new species
Figs. 172-177.

Texella sp. Davis, 1979:33.

Diagnosis.—Males of this species are distinguished from others in the infragroup by the following combination of characters: GO lacking apical tubercles; VPP with two dorsal setae; SA prongs basally fused; S broadly spatulate, with ventrobasal groove (Figs. 172, 174-177).

Type.—Male holotype from Ezell's Cave, Hays County, Texas (2 Sep. 1989; D. Ubick, S. Fend, S. Renkes), deposited in CAS.

Etymology.—The specific name is a matronym in honor of Ms Saelon Renkes one of the collectors of the holotype.

Description.—Total body length, 1.54-1.92. Scute length, 1.15-1.31. Leg II length, 3.92-4.46. Leg II/Scute length, 3.21-3.41. (N = 5).

Color brownish orange. Body of moderate rugosity; tubercles sparse on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 4 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-5.

Male (holotype): Total body length, 1.72. Scute length, 1.15; width, 1.15. Eye mound length, 0.26; width, 0.28. Leg II length, 3.92. TrIV spur length, 0.33. POP length, 0.12.

Penis (Figs. 172, 174-177): VPP apically pointed, dorsal margin expanded; with 2 dorsal, 18 lateral, and 6 ventral setae; AS slightly curved, apically polyfurcate. Glans: BK absent; ML not evident; PSL claw-like. S long, slightly sinuate, apically spatulate, ventrobasally grooved; BF present; SA represented by a pair of long, pointed, basally fused, prongs.

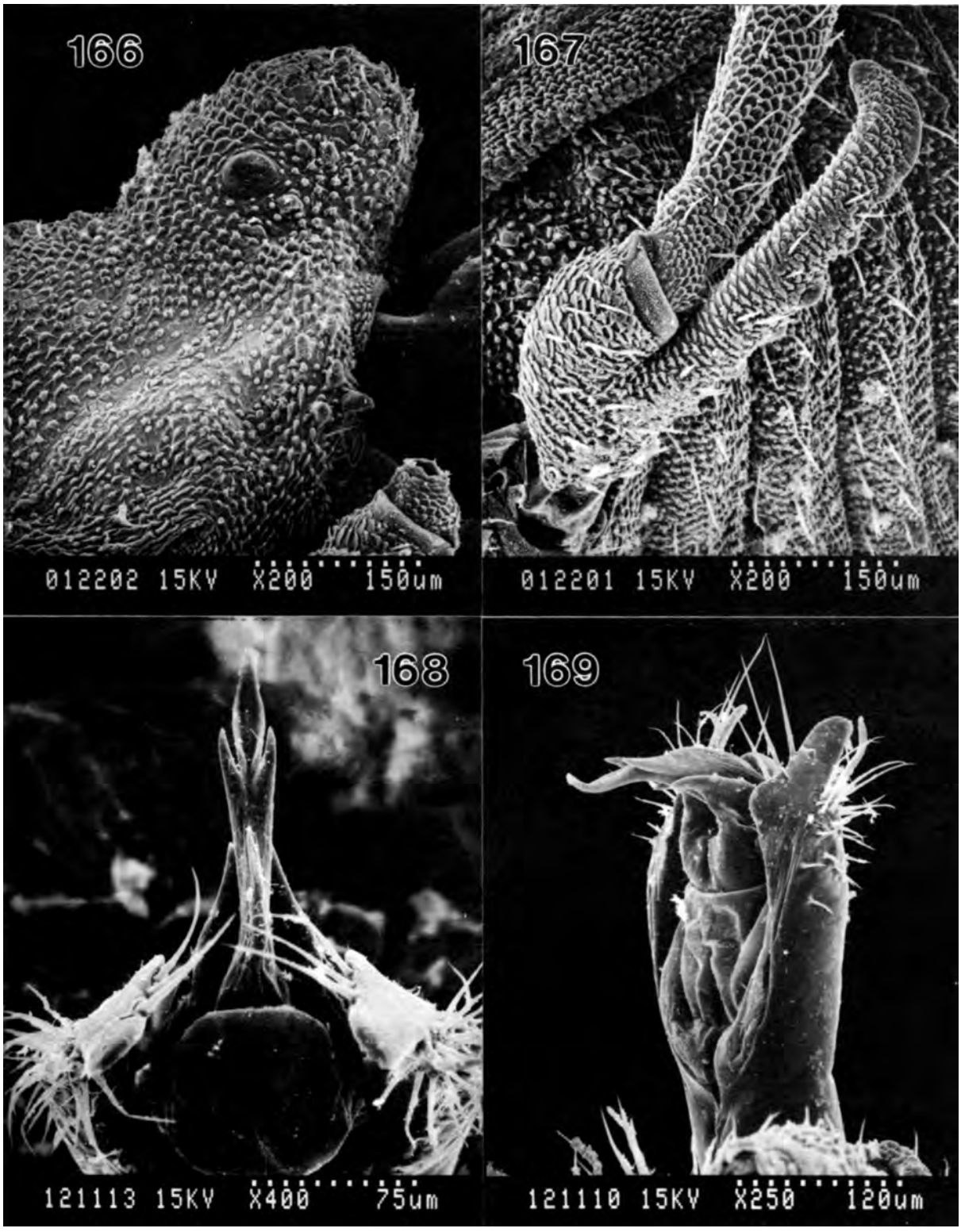
Female (paratopotype): Total body length, 1.79. Scute length, 1.31; width, 1.33. Eye mound length, 0.27; width, 0.31. Leg II length, 4.21. TrIV with ventral tubercle. GO with a pair of apical spines.

Ovipositor (Fig. 173): cuticle intricately folded, surface lacking microspination; 1 pair apical teeth present; setal pattern 1 pair dorsal, 4 pairs lateral, 1 pair ventral.

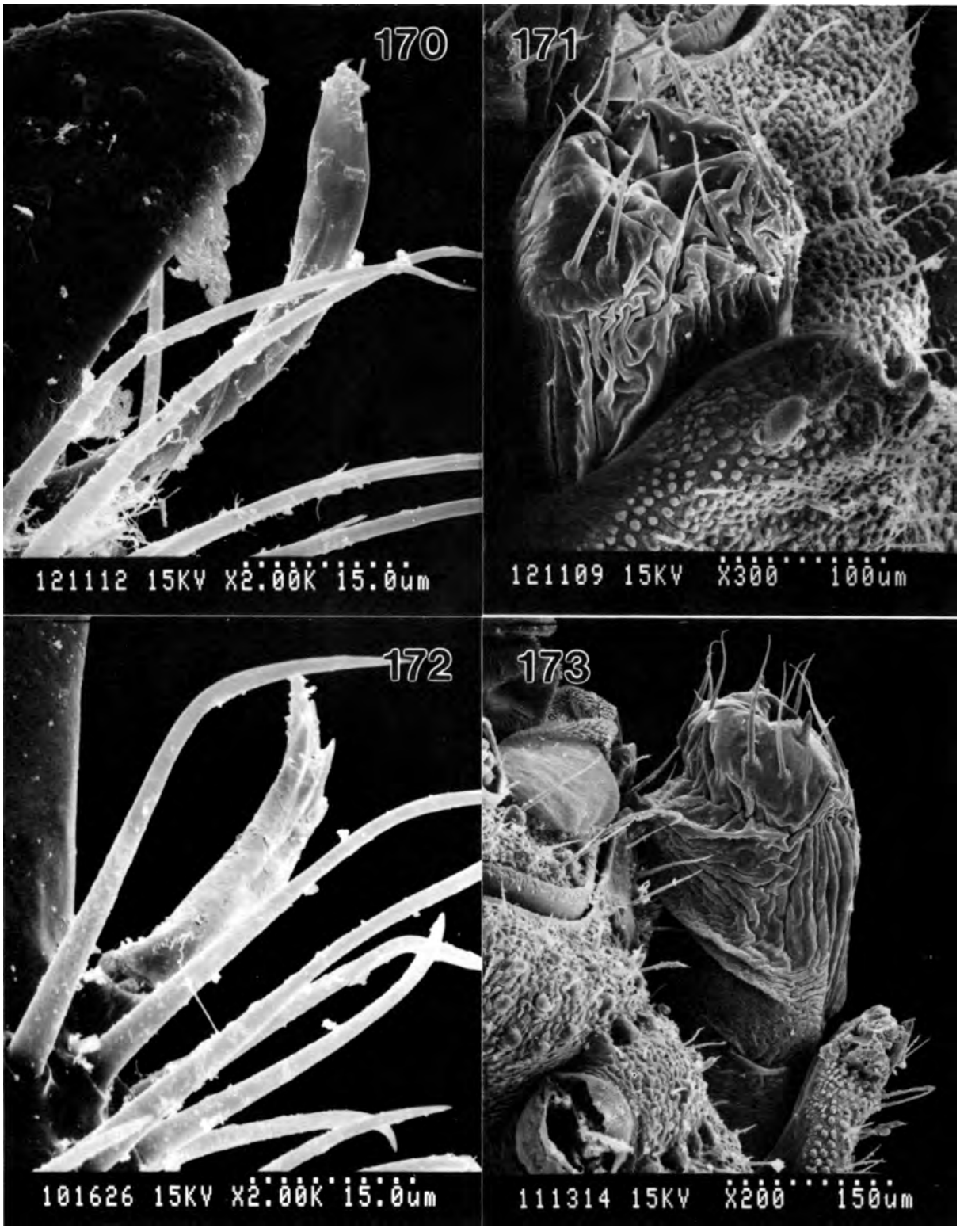
Variation.—The TrIV spur varies in length from 0.33-0.54, the POP from 0.12-0.38, in the three available males.

Natural History.—This species has been collected under rocks near the cave entrance (including dark and twilight regions), whereas the sympatric *T. mulaiki* occupies the deeper zones. One male was collected beneath a rock baited with cheese (Davis, 1979).

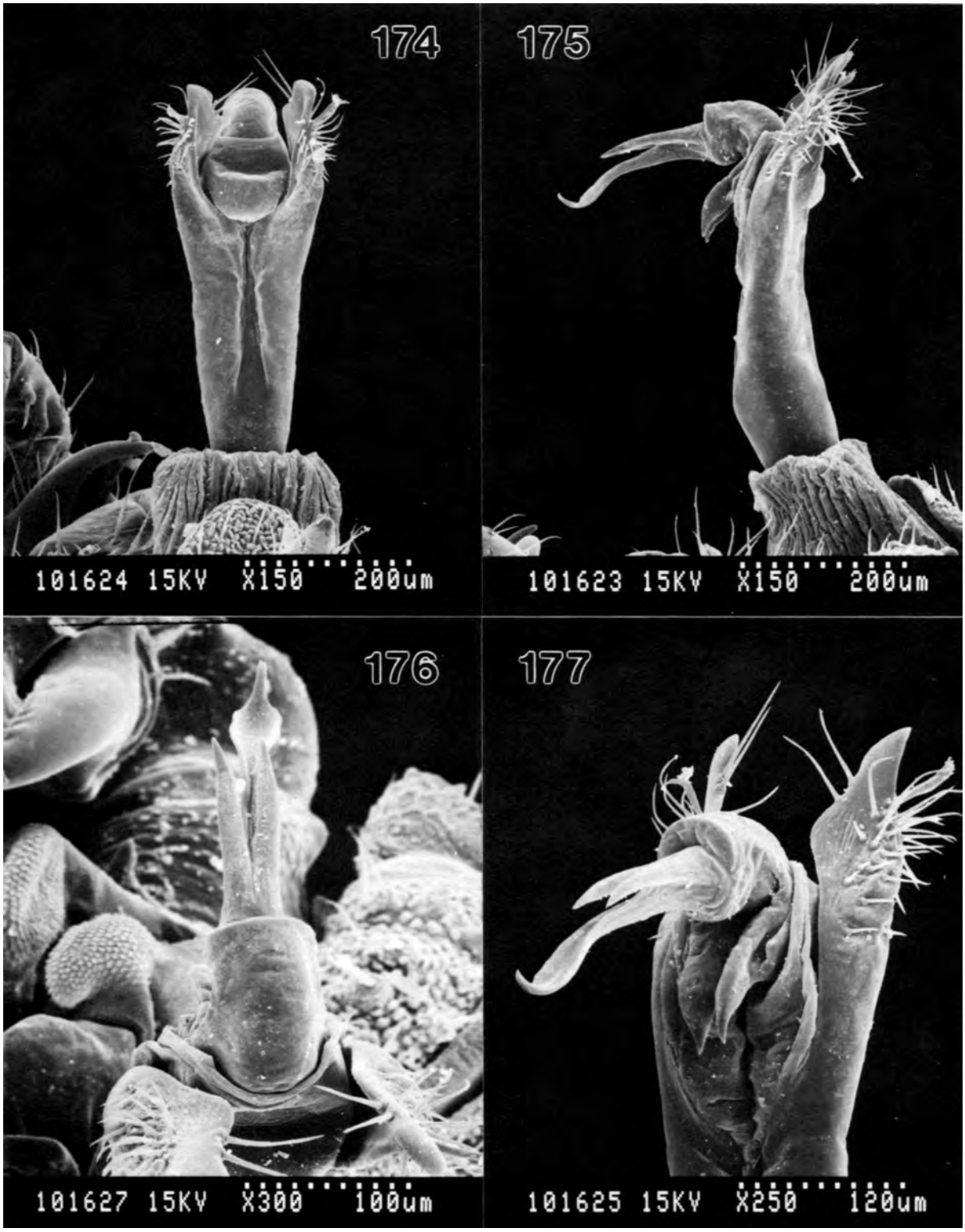
Other Material Examined (Paratypes).— UNITED STATES: **Texas**: *Hays Co.*: Ezell's Cave, 15 Aug. 1978 (J. Davis, WAS), 1 male; 2 Sep. 1989



Figs. 166-169.—*Texella diplospina,* new species, male paratopotype: 166, eye mound, lateral view; 167, trochanter IV spur, lateral view; 168, penis, apical view; 169, penis, dorsolateral view.



Figs. 170-173.—*Texella* species, paratopotypes: 170-171, *T. diplospina,* new species: 170, male, apical spine of penis, sublateral view; 171, female, ovipositor, subapical view. 172-173, *T. renkesae,* new species: 172, male, apical spine of penis, sublateral view; 173, female, ovipositor, lateral view.



Figs. 174-177.—*Texella renkesae,* male paratopotype: 174, penis, ventral view; 175, penis, lateral view; 176, penis, apical view; 177, penis, dorsolateral view.

(J. Reddell and M. Reyes, CAS, CDU), 1 male, 2 females, 1 juvenile.

Distribution.—Known only from Ezell's Cave, Hays County, Texas (Maps 2-5).

Texella spinoperca, new species
Figs. 2, 178-183.

Diagnosis.—Males of this species are distinguished from others in the infragroup by the following combination of characters: VPP with three dorsal setae; SA prongs long and narrow, originating basoventrally on stylus; S broadly spatulate, lacking ventral groove or carina; GO sometimes with apical tubercles (Figs. 179-181).

Type.—Male holotype from Airman's Cave, Austin, Travis County, Texas (3 Sep. 1989; D. Ubick, J. Reddell, and M. Reyes), deposited in CAS.

Etymology.—The specific name is a reference to the apical spines on the female genital opercula.

Description.—Total body length, 1.36-2.08. Scute length, 1.13-1.36. Leg II length, 4.59-5.23. Leg II/Scute length, 3.38-4.30. (N = 13).

Color pale orange. Body rugosity moderate; tubercles on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 3 or 4 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-5; one female has 6 tarsomeres on the fourth right tarsus and one male has six tarsomeres on the fourth left tarsus.

Male (holotype): Total body length, 1.74. Scute length, 1.23; width, 1.28. Eye mound length, 0.28; width, 0.31. Leg II length, 4.87. TrIV spur length, 0.49. POP length, 0.21.

Penis (Figs. 2, 178-181): VPP apically rounded, dorsally expanded; with 3 dorsal, 14 lateral, and 8 ventral setae; AS slightly curved, apically polyfurcate. Glans: BK absent; ML not evident; PSL claw-like. S long, apically broadly spatulate, ventrally lacking carina or distinct groove; BF present; SA represented by two, slender prongs originating basoventrally on the S.

Female (paratopotype): Total body length, 1.79. Scute length, 1.33; width, 1.41. Eye mound length, 0.28; width, 0.31. Leg II length, 4.67. TrIV with one ventral tubercle. GO with a pair of apical spines.

Ovipositor (Figs. 182, 183): cuticle intricately folded; surface smooth, lacking microspination; 1 pair apical teeth present; setal pattern: 2 pairs dorsal, 4 pairs lateral, 1 pair ventral.

Variation.—There is some variation in the size of TrIV spurs (0.46-0.54 long) and POP (0.21-0.33) in the seven males measured. Three males have a pair of apical tubercles on the GO (Figs. 178, 181), the right one missing in one specimen, which are smaller and blunter than those found in females.

Natural History.—A large series of 10 individuals was recently collected under rocks in a small, narrow room (dark zone). Because of a scarcity of rocks, most undersurfaces were examined few to several times (being carefully replaced in their original position after each search) over a period of about 1.5 hours. It is worth noting that only 2 specimens were collected on the initial examination; the remainder came from rocks which had been previously checked two or more times. As the rocks in this cave were situated on a loose, crumbly soil it appears that the harvestmen migrated up from the soil stratum to the rock undersurface during the period of our collecting. This sudden appearance of harvestmen is noteworthy, especially if it resulted from the disturbances to the environment (vibrations, movement of soil, etc.) caused by our collecting. Another possibility, and likewise interesting, is that the migration represented an endogenous rhythm of these harvestmen.

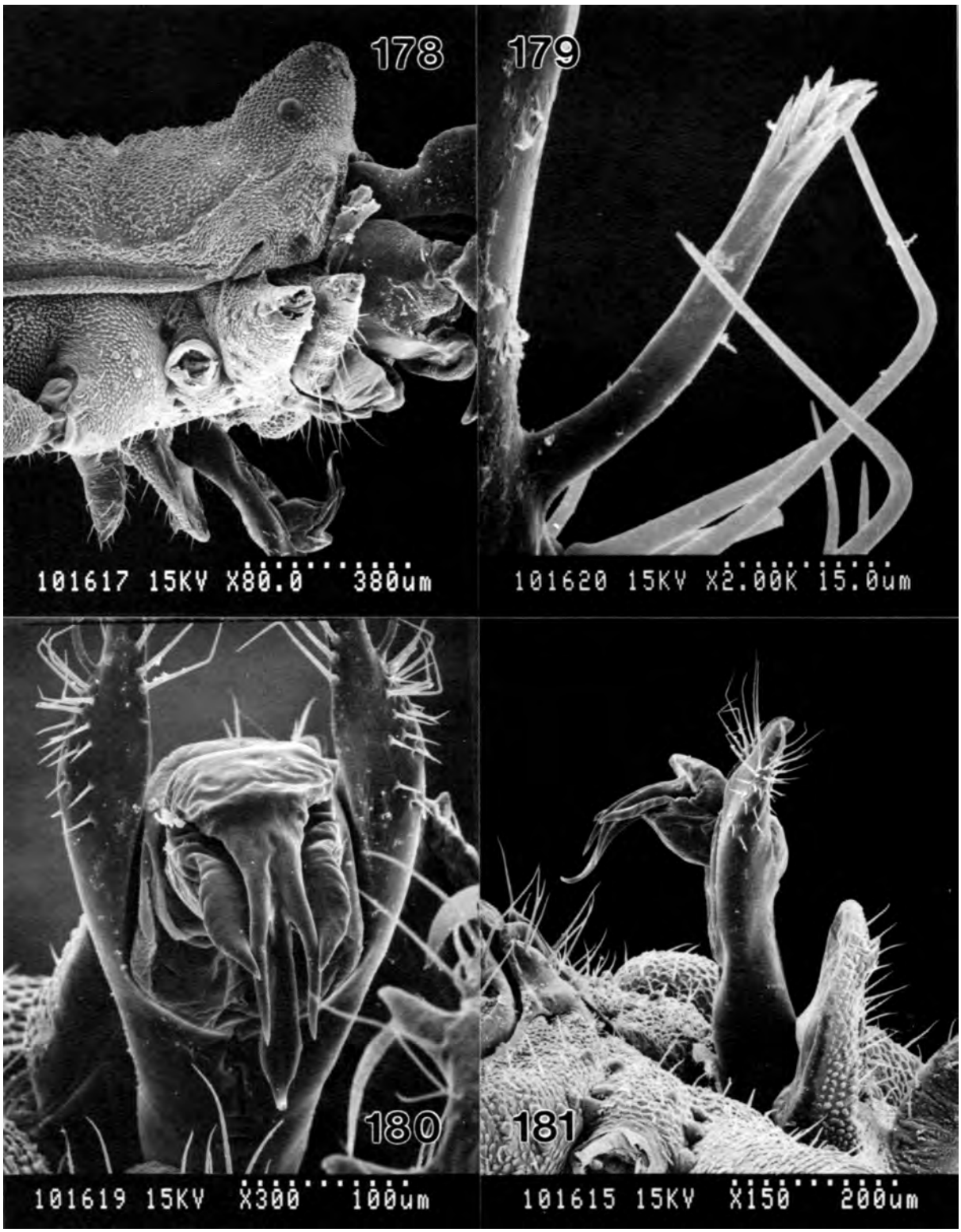
Other Material Examined (Paratypes).—UNITED STATES: **Texas**: Travis Co.: Airman's Cave, 3 Sep. 1989 (D. Ubick, J. Reddell, M. Reyes, TMM, CAS, CDU), 6 males, 3 females; 1 June 1984 (J. Reddell and M. Reyes, TMM), 1 male; 27 Sep. 1975 (A. Grubbs and L. Wilk, TMM), 2 females.

Distribution.—Known only from Airman's Cave, Travis County, Texas (Maps 2-5).

Texella fendi, new species
Figs. 184-197.

Diagnosis.—Males of this species are distinguished from others in the infragroup by the following combination of characters: TrIV spur reduced; POP absent; GO lacking apical spines; VPP lacking dorsal setae; SA prongs long and narrow, originating basoventrally on stylus; PSL attenuated; S tube-like, lacking ventral groove or carina (Figs. 186-189). Females are unique in the infragroup in having a genital operculum with a pair of apical tubercles, rather than spines (Figs. 194, 197).

Type.—Male holotype from 9 mi N La Grange,



Figs. 178-181.—*Texella spinoperca,* new species, male paratopotype: 178, anterior half of body, lateral view; 179, apical spine of penis, lateral view; 180, penis, subdorsal view; 181, penis, lateral view.

Fayette County, Texas (1 Sep. 1989; D. Ubick, S. Fend, S. Renkes), deposited in AMNH.

Etymology.—The specific name is a patronym in honor of Mr. Steven Fend, one of the collectors of the holotype.

Description.—Total body length, 1.59-2.00. Scute length, 1.21-1.41. Leg II length, 3.28-3.69. Leg II/Scute length, 2.54-2.71. (N=9)

Color brownish orange. Body moderately rugose; tubercles small and sparse on eye mound and pars thoracica, large and dense on tergite margins (both free and fused), sternite margins, and coxae. Carapace with 2-4 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-5-5.

Male (holotype): Total body length, 1.72. Scute length, 1.38; width, 1.36. Eye mound length, 0.33; width, 0.36. Leg II length, 3.62. TrIV spur length, 0.10. POP absent.

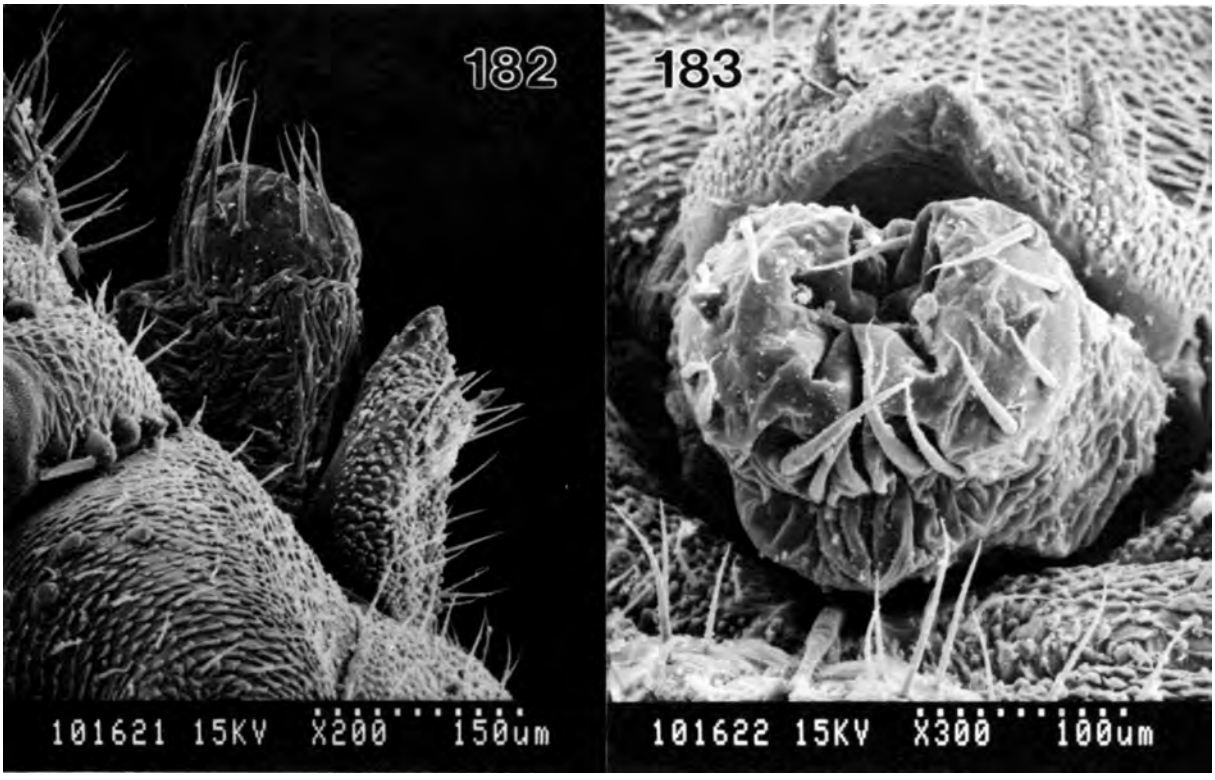
Penis (Figs. 186-191): VPP apically pointed, dorsal margin expanded; with 0 dorsal, 17 lateral, and 9 ventral setae; AS long, straight, apically polyfurcate. Glans: BK absent; ML broad, rounded; PSL attenuated. S long, tube-like, lacking ventral modifications; BF present; SA represented by a pair of long prongs originating basoventrally on the S.

Female (paratopotype): Total body length, 1.92. Scute length, 1.36; width, 1.38. Eye mound length, 0.33; width, 0.33. Leg II length, 3.67. TrIV with one or two ventral tubercles. GO with 1 pair of apical tubercles.

Ovipositor (Figs. 194-197): cuticle intricately folded; dorsal and ventral surfaces with tiny serrations; 1 pair of apical teeth present; setal pattern: 1 pair dorsal, 4 pairs lateral, 1 pair ventral.

Natural History.—The type locality is a pine forest with oaks. At the time of the collection the surface conditions were somewhat xeric. The specimens were collected beneath imbedded limestone boulders; one specimen was on the rock undersurface, the others in the loose sandy soil immediately below the rocks. The harvestmen occurred roughly 0.2-0.3 m below the surface of the ground, in cool and relatively mesic conditions.

Other Material Examined (Paratypes).— UNITED STATES: **Texas**: Fayette Co.: 11 mi N La Grange, 18 July 1966 (J. and W. Ivie, AMNH, CAS), 3 males, 2 females; 9 mi N La Grange, 1 Sep. 1989 (D. Ubick, S. Fend, and S. Renkes, CDU), 1 male, 2 females.



Figs. 182-183.—*Texella spinoperca*, new species, female paratopotype: 182, ovipositor, lateral view; 183, ovipositor and genital operculum, apical view.

Distribution.—Known only from Fayette County, Texas (Maps 2-4).

Texella homi, new species
Figs. 198-201.

Diagnosis.—Males of this species are distinguished from others in the infragroup by the following combination of characters: TrIV spur reduced; POP absent; GO lacking apical spines; VPP lacking dorsal setae; PSL attenuated; SA represented by a laterobasal carina; S short, tube-like, lacking ventral carina (Figs. 198-201).

Type.—Male holotype from 13.3 mi SE Oakville, Live Oak County, Texas (14 Aug. 1966; T. Briggs and K. Hom), deposited in CAS.

Etymology.—The specific name is a patronym in honor of Mr. Kevin Hom, one of the collectors of this species.

Description.—Total body length, 1.59-1.80. Scute length, 1.13-1.23. Leg II length, 3.05-3.33. Leg II/Scute length, 2.48-2.90. (N = 4).

Color brown. Body moderately rugose; tubercles sparse on eye mound, pars thoracica, tergite margins, and coxae. Carapace with 3 pairs of AT. Eye mound broadly conical, eyes well developed. Palpal megaspines: trochanter, 1 ventral; femur, 1 mesoapical; patella, 2 mesal; tibia, 3 mesal. Tarsal count: 3-5-4-5.

Male (holotype): Total body length, 1.67. Scute length, 1.15; width, 1.13. Eye mound length, 0.26; width, 0.28. Leg II length, 3.33. TrIV spur length, 0.03. POP absent.

Penis (Figs. 198-201): VPP apically pointed, dorsal margin expanded; with 0 dorsal, 19 lateral, and 7 ventral setae; AS long, robust, curved, apical half densely plumose. Glans: BK absent; ML rectangular; PSL attenuated. S short, apically tube-like; BF present; SA represented by laterobasal carina.

Female (paratopotype): Total body length, 1.80. Scute length, 1.18; width, 1.18. Eye mound length, 0.31; width, 0.31. Leg II length, 3.28. TrIV with ventral tubercle. GO with 1 pair of apical spines.

Ovipositor: cuticle intricately folded; dorsal surface with few scattered microtubercles, ventral surface smooth; 1 pair apical teeth present; setal pattern: 1 pair dorsal, 4 pairs lateral, 1 pair ventral.

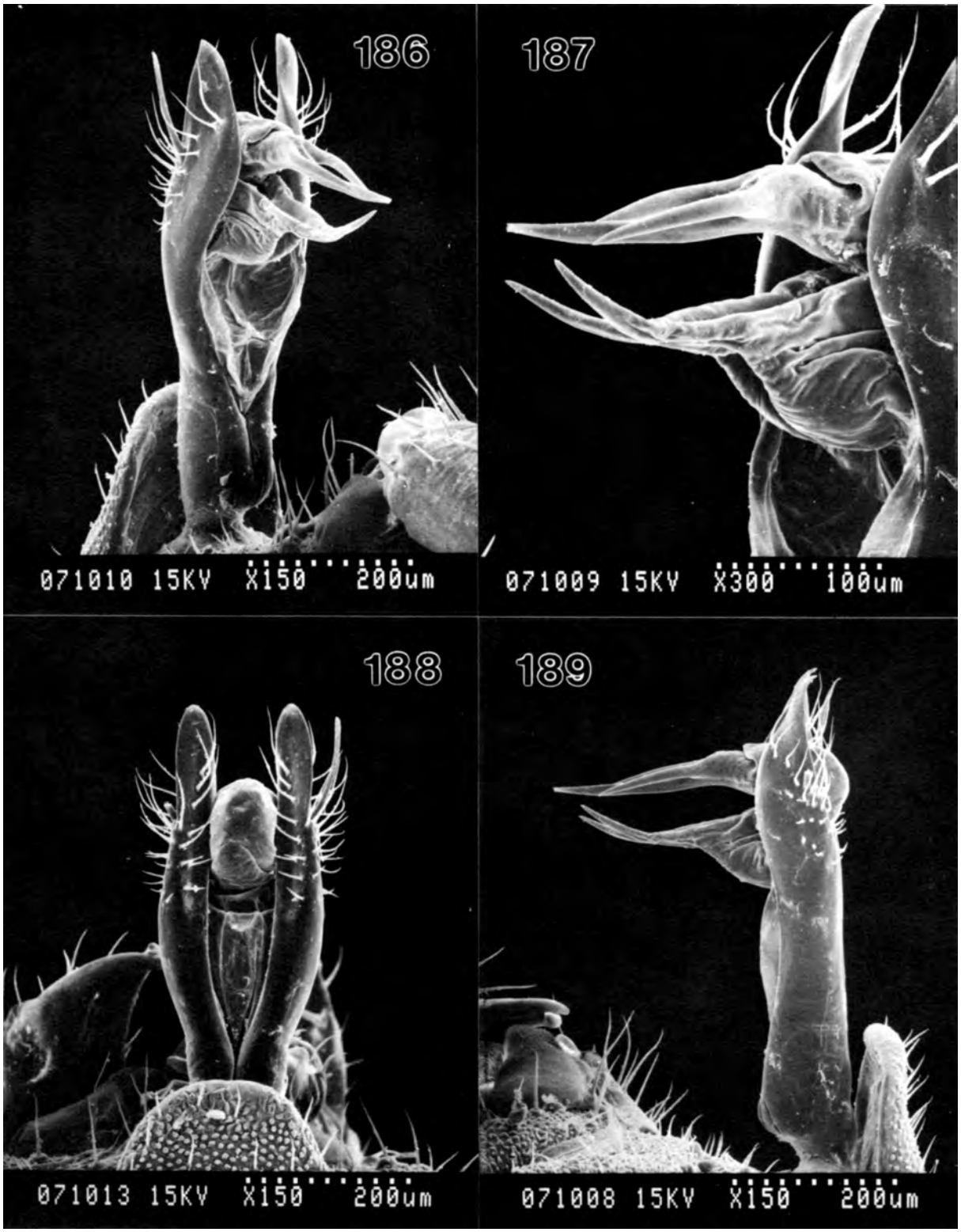
Variation.—The second female has asymmetrical apical spination on the GO: one spine on the left side, two on the right.

Note.—The brown color of the specimens is probably the result of prolonged storage in Oudemans' Fluid (see discussion in Ubick and Briggs, 1989:96); it is expected that the natural color of these harvestmen is brownish orange.**Other**

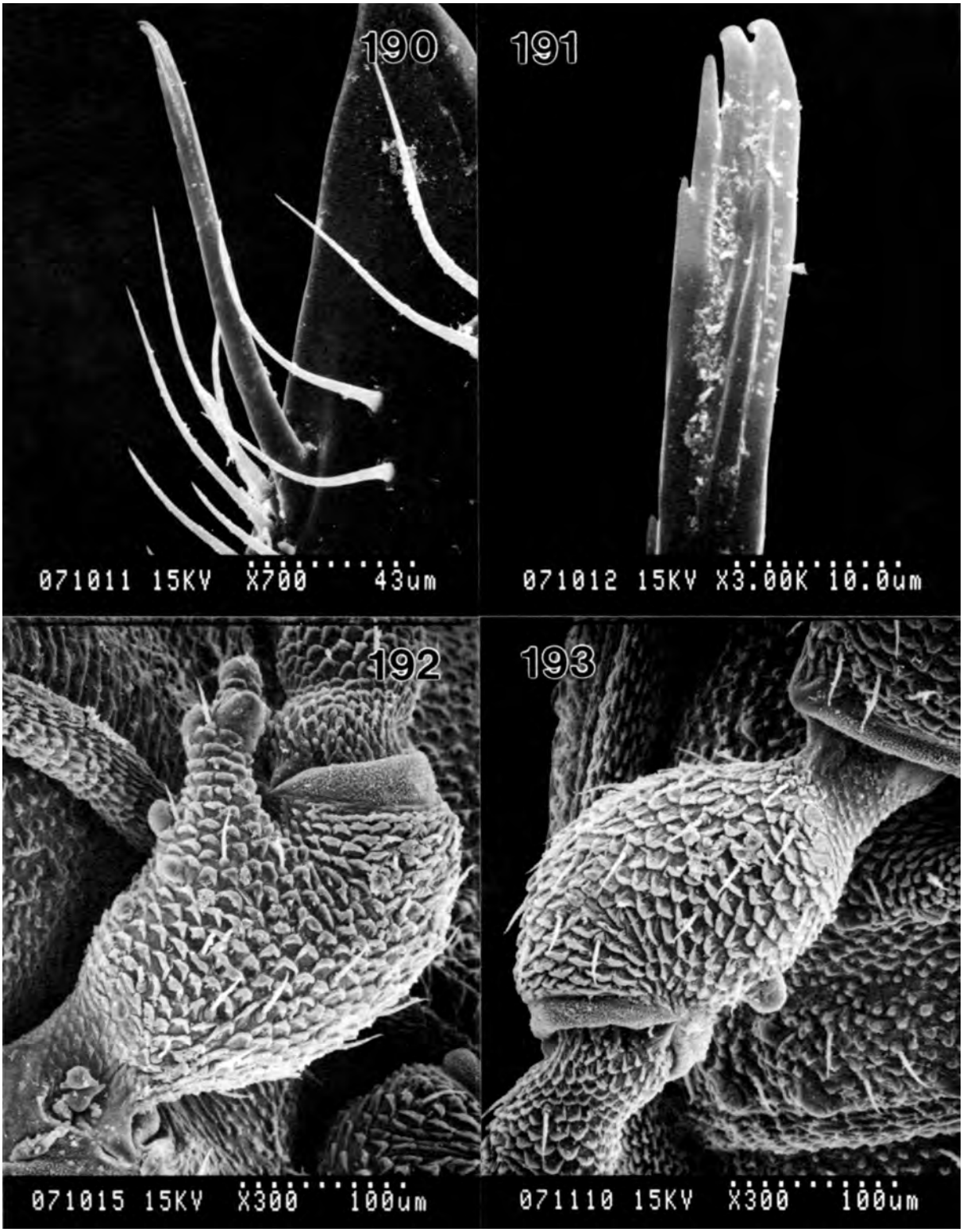
Material Examined (Paratypes).—UNIT-ED STATES: **Texas**: Live Oak Co.: 13.3 mi SE Oakville, 14 Aug. 1966 (T. Briggs and K. Hom, CAS), 1 male, 2 females.

Distribution.—Known only from the type locality (Maps 2-4).

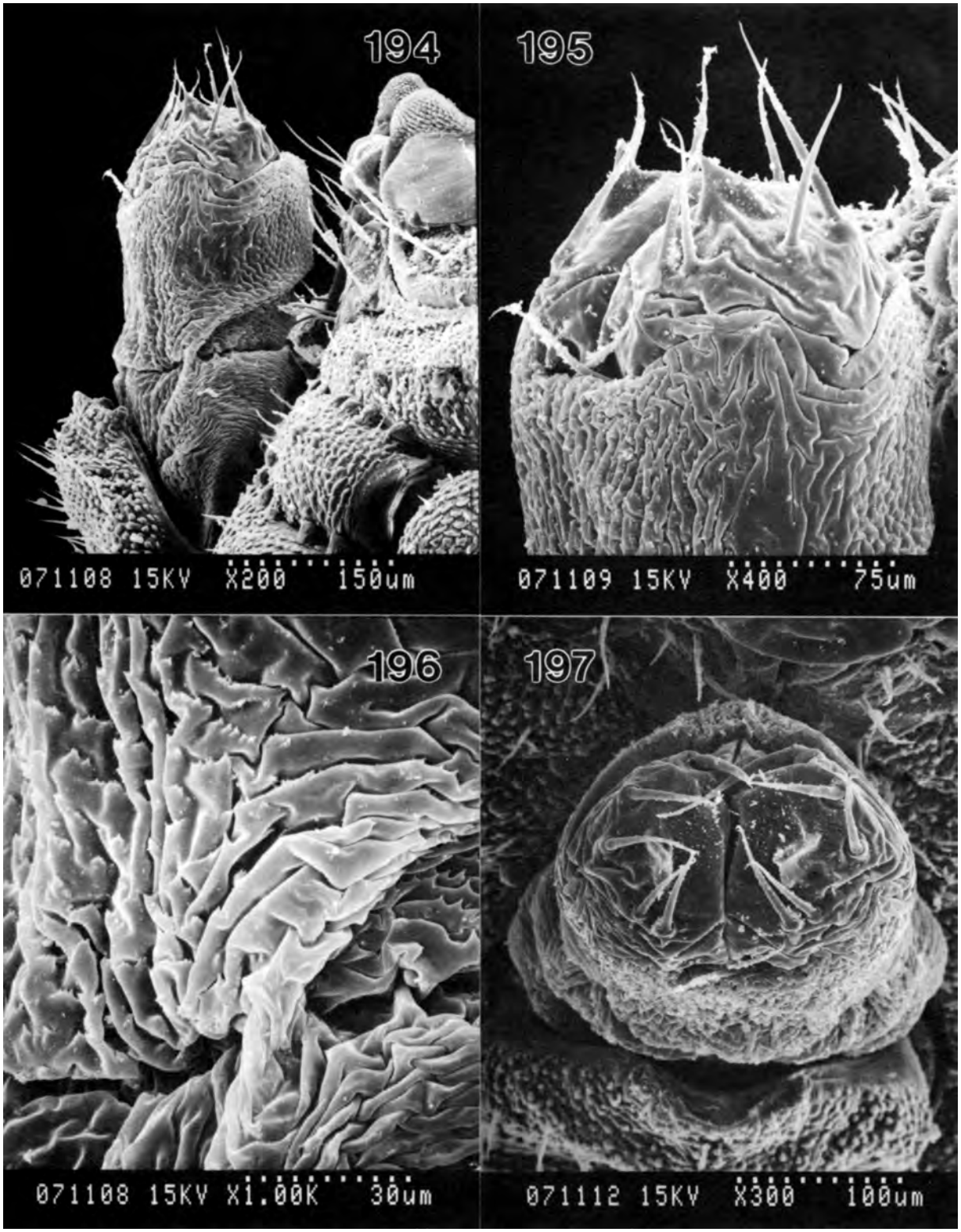
Figs. 184-185.—*Texella fendi*, new species, male paratype: 184. anterior half of body, lateral view; 185, palpi, lateral view.



Figs. 186-189.—*Texella fendi,* new species, male paratype: 186, penis, subdorsal view; 187, penis, sublateral view; 188, penis, ventral view; 189, penis, lateral view.



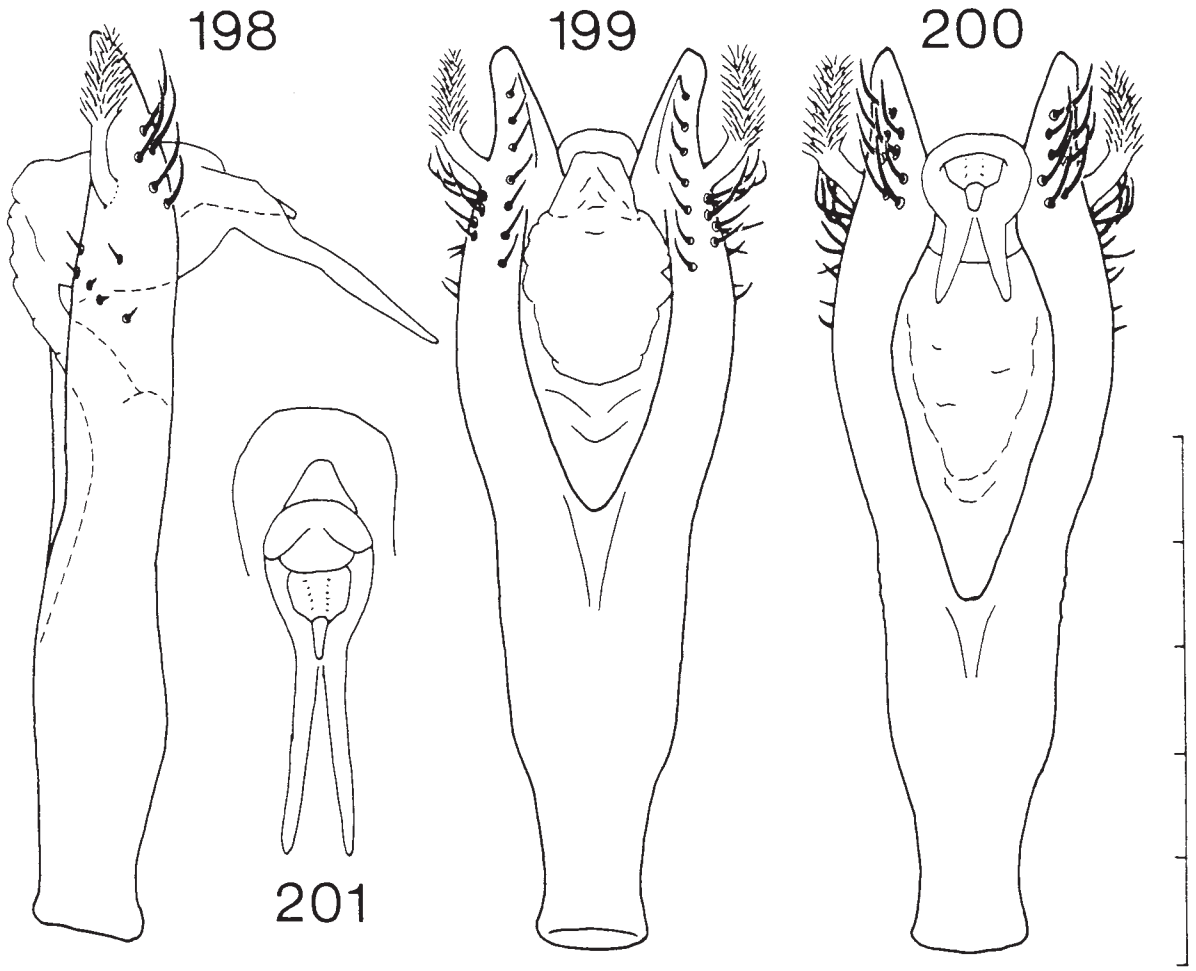
Figs. 190-193.—*Texella fendi,* new species, paratypes: 190-192, male: 190, apical spine of penis, dorsal view; 191, apical spine of penis, lateral view of tip; 192, trochanter IV spur, lateral view. 193, female, trochanter IV spur, lateral view.



Figs. 194-197.—*Texella fendi,* new species, female paratype: 194-195, ovipositor, lateral view; 196, ovipositor, enlarged view of lateral surface; 197, ovipositor, apical view.

CLASSIFICATION

Texella
- *bifurcata* group
  - *bifurcata* (Briggs)
- *kokoweef* group
  - *kokoweef* n. sp.
  - *shoshone* n. sp.
  - *deserticola* n. sp.
- *mulaiki* group
  - *brevistyla* subgroup
    - *jungi* n. sp.
    - *brevistyla* n. sp.
  - *mulaiki* subgroup
    - longistyla infragroup
      - *longistyla* n. sp.
      - *welbourni* n. sp.
    - *mulaiki* infragroup
      - *hardeni* n. sp.
      - *cokendolpheri* n. sp.
      - *mulaiki* Goodnight and Goodnight
    - *bilobata* infragroup
      - *bilobata* n. sp.
  - *reddelli* subgroup
    - *reddelli* infragroup
      - *reddelli* Goodnight and Goodnight
      - *reyesi* n. sp.
    - *brevidenta* infragroup
      - *brevidenta* n. sp.
      - *grubbsi* n. sp.
    - *spinoperca* infragroup
      - *diplospina* n. sp.
      - *renkesae* n. sp.
      - *spinoperca* n. sp.
      - *fendi* n. sp.
      - *homi* n. sp.



Figs. 198-201.—*Texella homi,* new species, male paratopotype: 198, penis, lateral view; 199, penis, ventral view; 200, penis, dorsal view; 201, glans, ventral surface. Scale bar = 0.50 mm.

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THE PSELAPHIDAE (COLEOPTERA) OF TEXAS CAVES

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ABSTRACT

Twelve species of Pselaphidae have been found in Texas caves. Five species are true cavernicoles and are restricted to caves in central Texas: *Batrisodes grubbsi* n. sp., *B. reyesi* n. sp., *B. texanus* n. sp., *B. venyivi* n. sp., and *Texamaurops reddelli* Barr & Steeves. Seven other species are probably found only near cave entrances, in litter washed into caves, or in debris brought in by rodents: *B. uncicornis* (Casey), *B. clypeonotus* (Brendel), *B. globosus* (LeConte), *Cylindrarctus bicornis* Chandler, *Tmesiphorus costalis* LeConte, *Hamotus electrae* Park, and *Trimioarcus musamator* n. sp. *Batrisodes clypeonotus* is associated with the ant, *Camponotus americanus* Mayr, based on many collections from Oklahoma. Two new synonymies have been discovered concerning these species: *B. schneiderensis* Park is a junior synonym of *B. uncicornis* (Casey), and *B. tridens* Casey is a junior synonym of *B. clypeonotus* (Brendel).

INTRODUCTION

Pselaphids have been recorded from caves since 1855 when *Machaerites spelaeus* Miller was described from a cave at Struge, Yugoslavia. Since then the European pselaphid cave fauna has been extensively documented by a number of authors, while the North American fauna has been treated only recently (Park, 1951, 1956, 1960). The first pselaphid described from a Texas cave was *Batrisodes schneiderensis* Park (1960), based on a single female from Schneider Ranch Cave in Kendall County. Four years later a second species was added, *Texamaurops reddelli* Barr and Steeves (1963), based on a single female from Kretschmarr Cave in Travis County. In the only other paper dealing with pselaphids from Texas caves, Barr (1974) figured the aedeagus of a specimen from Inner Space Caverns believed to be the male of *T. reddelli*, but is here recognized as a new species, *Batrisodes texanus*. *Texamaurops reddelli* is now a registered endangered species listed as the "Kretschmarr Cave mold beetle" (Chambers and Jahrsdoerfer, 1988).

Twelve species are listed from Texas caves in this paper. Five species appear to be true cavernicoles based on their reduced eyes and longer than typical legs and antennae, and are only known from the karst region of the Edwards Plateau in central Texas: *Batrisodes grubbsi* n. sp., *Batrisodes reyesi* n. sp., *Batrisodes texanus* n. sp., *Batrisodes venyivi* n. sp., and *Texamaurops reddelli*. The other seven species are free-living or myrmecophilous, including three species of *Batrisodes*: the myrmecophile *clypeonotus* (Brendel), the free-living troglophile *uncicornis* (Casey) (=*schneiderensis* Park), and *globosus* (LeConte). The free-living *Hamotus electrae* Park was described from Veracruz, Mexico, and is here recorded for the first time in the United States from Texas in caves and at ultra-violet light. *Tmesiphorus costalis* LeConte has been collected with ants

and in several leaf litters, and has been previously recorded from a cave (Park, 1960:100). A specimen of *Cylindrarctus bicornis* Chandler was found in a cave, but is presumed to be associated with leaf litters, based on the common association of the other species in the genus. *Trimioarcus musamator* n. sp. has reduced eyes, but is most likely an inhabitant of rodent nests or deep leaf litter since no other species in its tribe, the Euplectini, is known to be cavernicolous. In summary, five species are troglobites, one a myrmecophile, one a troglophile, and the other five species are probably only found in caves near their entrances or in litter piles washed in or brought in by rodents.

All measurements are in millimeters. The collections where specimens are deposited are indicated by the following codons: ANSP, Academy of Natural Sciences, Philadelphia; DSC, collection of author; FMNH, Field Museum of Natural History, Chicago; JAW, John A. Wagner collection, Evanston, Illinois; TMMC, Texas Memorial Museum Collection, Austin; USNM, National Museum of Natural History, Washington, D.C. The types of all previously described species were examined, and the holotypes of species described here are to be placed in the Field Museum of Natural History, Chicago. Illustrations and descriptions were based on whole and disarticulated specimens in temporary mounts on slides, and checked against whole specimens mounted on points.

SYSTEMATICS

1. *Batrisodes (Babnormodes) uncicornis* (Casey) (Figs. 1-2)

Batrisus uncicornis Casey, 1897:576. Type locality: New York City, New York. Male holotype (USNM).

Batrisodes schneiderensis Park, 1960:75. Type locality: Schneider Cave, Texas. Holotype female (FMNH). NEW SYNONYMY.

Description.—Length 2.32-2.64. Males with head transversely excavate anterior to antennal bases, frons lacking projections, largely covered dorsally by rounded angulate projection of vertex, dense setae projecting ventrally from anterior margin of vertex between antennal bases, vertex coarsely punctate especially on anterior half, lateral carinae strong basally but fading before reaching antennal bases, median carina distinct but not strong and extending anteriorly to line between nude vertexal foveae, eyes with about 32 facets; first antennomere (scape) not enlarged but conspicuously punctate on antero-ventral margin, antennomere IX protruding laterally as a lamina, IX less than twice as wide as long, X with large fovea occupying over half of ventral surface, XI with large ventral tubercle at base.

Pronotum with large scattered punctures particularly anteriorly, median longitudinal sulcus extending to near apex; elytra with three basal foveae and subhumeral fovea; sternite VI vaguely impressed longitudinally; protibiae flattened near apex and densely setate on medial margin, mesotibiae excavate on mesal margin in apical third, thick setae along posterior edge of excavation, second mesotarsomere sinuate ventrally near base.

Females with coarse punctures on head and pronotum; eyes with about 17 facets, lacking modifications of head, antennae, and legs; sternite VI rounded.

Male from Schneider Ranch Cave: antennae 1.10, metafemora 0.84, metatibiae 0.80, metatarsi 0.37.

Specimens examined.—43: TEXAS: *Burnet County*: Resurrection Well, VII- 2-1989, M. Grimm (1). *Hays County*: Anaqua Cave, VI-21-1985, A. Grubbs (2); Ezell's Cave, I-16-1979, J. C. Davis, cave area (2); Fern Cave, V-26-1989, A. Grubbs, J. Reddell, M. Reyes (5); Ladder Cave, IX-2-1989, D. Ubick, S. Fend, S. Renkes (1); McGlothlin Sink, V-26-1989, A. Grubbs, J. Reddell, M. Reyes (1). *Comal County*: Klar's Cave, III-12-1988, S. Spence, G. Veni (1). *Kendall County*: The Crack, V-28-1990, D. Pate (1); Schwarz Cave, IX-12-1987, J. Ivy, G. Veni (1); Schneider Cave, VIII-30-1959, T. C. Barr, Jr., H. M. Koepke (type of *schneiderensis*); same locality, IX-8-1963, J. Reddell, D. McKenzie (4). *Llano County*: Enchanted Rock Cave, IV-14-1985, J. Reddell, M. Reyes (1); Freshman Mountain Cave, IV-9-1989, W. Elliott, J. Reddell, M. Reyes (2). *Travis County*: Bandit Cave, V-17-1965, T. C. Barr (1); Cave X, III-30-1974, W. Elliott, W. Russell, S. & R. Fieseler, C. Rogers (1); Ireland's Cave, I-23-1989, J. Reddell, M. Reyes, E. Grimm, M. Grimm (10); LaCrosse Cave, V-8-1990, J. Reddell, M. Reyes (2); Pickle Pit, V-21-1990, J. Reddell, M. Reyes, L. Sherrod (2). *Williamson County*: Beck Ranch Cave (=Beck's Cave), III-24-1989, J. Reddell, M. Reyes (1); same locality, V-16-1965, T. C. Barr (3). Specimens in collections of: DSC, FMNH, JAW, and TMMC.

Comments.—*Batrisodes uncicornis* is a widespread species whose range extends from Massachusetts and Florida to Texas. Habitat information has been associated with only a few specimens, and

Key to Species

1. Abdominal segments II-IV with acute lateral margins 2
Abdominal segments II-IV lacking lateral margins, abdomen round in cross section (Fig. 1) (Batrisinae, Batrisini) 5

2.(1) Last segment of maxillary palpi laterally angulate, previous two segments with spine on outer face (Fig. 21) (Pselaphinae, Tmesiphorini ..... 10. *Tmesiphorus costalis*
Apical segment of maxillary palpi elongate, lacking lateral angulation or spines on previous segments (Figs. 20, 22) 3

3.(2) Last segment of maxillary palpi elongate, penultimate segment angulate on mesal margin (Fig. 20) (Goniacerinae, Tychini ..... 9. *Cylindrarctus bicornis*
Last segment of maxillary palpi enlarged, penultimate segment much smaller (Figs. 22, 24) 4

4.(3) Antennal club of last three segments, penultimate antennomere longer than wide, last segment of maxillary palpus with longitudinal groove on inner margin (Fig. 22) (Pselaphinae, Tyrini)..... 11. *Hamotus electrae*
Antennal club of last two segments, penultimate antennomere much wider than long, last segment of maxillary palpus lacking any groove (Fig. 24) (Euplectinae, Euplectini)..... 12. *Trimioarcus musamator*, n. sp.

5.(1) Apex of metatibiae lacking elongate pencil of appressed setae (Fig. 18); all antennomeres more than twice as long as wide (Fig. 17) ..... 8. *Texamaurops reddelli*
Apex of metatibiae with elongate pencil of appressed setae (Fig. 11); with antennomere VIII distinctly less than twice as long as wide except *texanus* with VIII twice as long as wide (Figs. 3, 9) (*Batrisodes*) 6

6.(5) Eyes distinct, with 10 to 50 facets grouped together..... 7
Eyes apparently absent, possibly up to 10 disassociated pale granules in area where eyes should be 9

7.(6) Vertex of head and anterior portion of pronotum coarsely punctate; males with anterior margin of vertex angulate (Fig. 1); females with vertex coarsely punctate..... 1. *Batrisodes uncicornis*
Basal half of vertex and anterior portion of pronotum not coarsely punctate; males with anterior margin of vertex truncate to broadly rounded (Figs. 3, 15); females with vertex at most coarsely punctate on antennal tubercles, area between vertexal foveae smooth or sparsely granulate..... 8

8.(7) Males with anterior margin of vertex broadly rounded, penultimate antennomere with small fovea at base (Fig. 15); females with large eyes of more than 40 facets..... 7. *Batrisodes globosus*
Males with anterior margin of vertex broadly truncate, penultimate antennomere lacking basal fovea (Fig. 3); females with small eyes of approximately 15 facets ..... 2. *Batrisodes clypeonotus*

9.(6) Antennomeres III-VIII twice as long as wide; sides of head in eye region gently curved (Fig. 9) ..... 5. *Batrisodes texanus* n. sp.
At least antennomere VIII less than twice as long as wide; lateral margins of head slightly angulate and bearing granules where eyes should be (Figs. 7, 13) 10

10.(9) Head lacking lateral and medial vertexal carinae (Fig. 13), vertex smooth ..... 6. *Batrisodes venyivi* n.sp.
Head with at least lateral carinae extending anteriorly from base (Figs. 5, 7), vertex in apical half distinctly punctate or rugulose 11

11.(10) Apical half of vertex roughened (females) or coarsely punctate (males), with faint lateral vertexal carinae, lacking median vertexal carina; males with anterior margin of vertex broadly truncate, first antennomere not modified (Fig. 5) ..... 3. *Batrisodes grubbsi* n.sp.
Apical half of vertex smooth (females) to transversely rugulose (males), with median and lateral vertexal carinae sharply defined; males with anterior margin of vertex broadly bisinuate, first antennomere angulate ventrally (Fig. 7) ..... 4. *Batrisodes reyesi* n. sp.

these have been collected in sawdust, under pine bark, and under stones. This species has not been previously noted as a troglophile, and it is interesting that in surface habitats this species is always collected in quite short series. The longest series I have seen is from Ireland's Cave.

James R. Reddell (pers. comm.) has supplied the following collection information. "It has been found below rocks in moist sinkhole-type caves in association with troglobitic millipedes and other species, but also occurs in total darkness. Most specimens have been found on the underside of rocks lightly buried in silt. A specimen from Beck Ranch Cave was found crawling on moist flowstone more than 200 meters from the cave entrance."

Park (1960) described a single female from Schneider Cave as a new species, *schneiderensis*. Several series from Texas caves contain both sexes, and it is obvious that the type of *schneiderensis* is a typical female of *uncicornis*. *Batrisodes uncicornis* has been placed close to *riparius* (Say) based on the very similar male antennal characters (Park, 1947). The modifications of the legs are also similar, as is the general structure of the head. The punctation of the head is coarser in *uncicornis*, and the apical angle of the vertex is only slightly depressed, while in *riparius* the punctation is not coarse on the pronotum and basal portion of the vertex, and the apical portion of the vertex is strongly deflexed between the antennal bases. Females of *uncicornis* may be confused with those of *globosus* (LeConte), but may be separated by the head being more completely and coarsely punctate.

2. *Batrisodes (Excavodes) clypeonotus* (Brendel) (Figs. 3-4)

Batrisus clypeonotus Brendel, 1893:280, pl. IV. Type locality: Ponchatoula, Louisiana. Male holotype (ANSP).

Batrisodes tridens Casey, 1908:263. Type locality: St. Louis, Missouri. Male holotype (USNM). NEW SYNONYMY.

Description.—Length 2.28-2.68. Males with head transversely excavate just anterior to antennal bases, frons with acute medial and lateral tubercles, medial tubercle with short posterolaterally directed setae, lateral tubercles glabrous, vertex sharply angled ventrally between antennal bases, this area set with short obvious setae arising from small distinct punctures, vertexal apex with small median trilobed projection bearing two small tufts of setae, basal portion of vertex smoother, sparsely setate with setae arising from isolated granules, vertexal foveae nude, lateral vertexal carinae weak and extending to antennal bases, median carina weak and extending to middle of vertex, eyes with 12 (Texas) to 40 (Missouri) facets grouped in crescentic pattern; first antennomere (scape) enlarged, impressed at center of anterior face, densely and minutely punctate in impression, antennomere X globose, slightly wider than last antennomere and lacking a ventral fovea.

Pronotum with median longitudinal sulcus extending to near apex, disc sparsely punctate; elytra with three basal foveae and subhumeral fovea;

sternite VI slightly impressed at base with disc rounded; second mesotarsomeres straight.

Females with frons and anterior half of vertex minutely rugose, small eyes with 10-16 facets, lacking modifications of head and antennae, sternite VI broadly rounded.

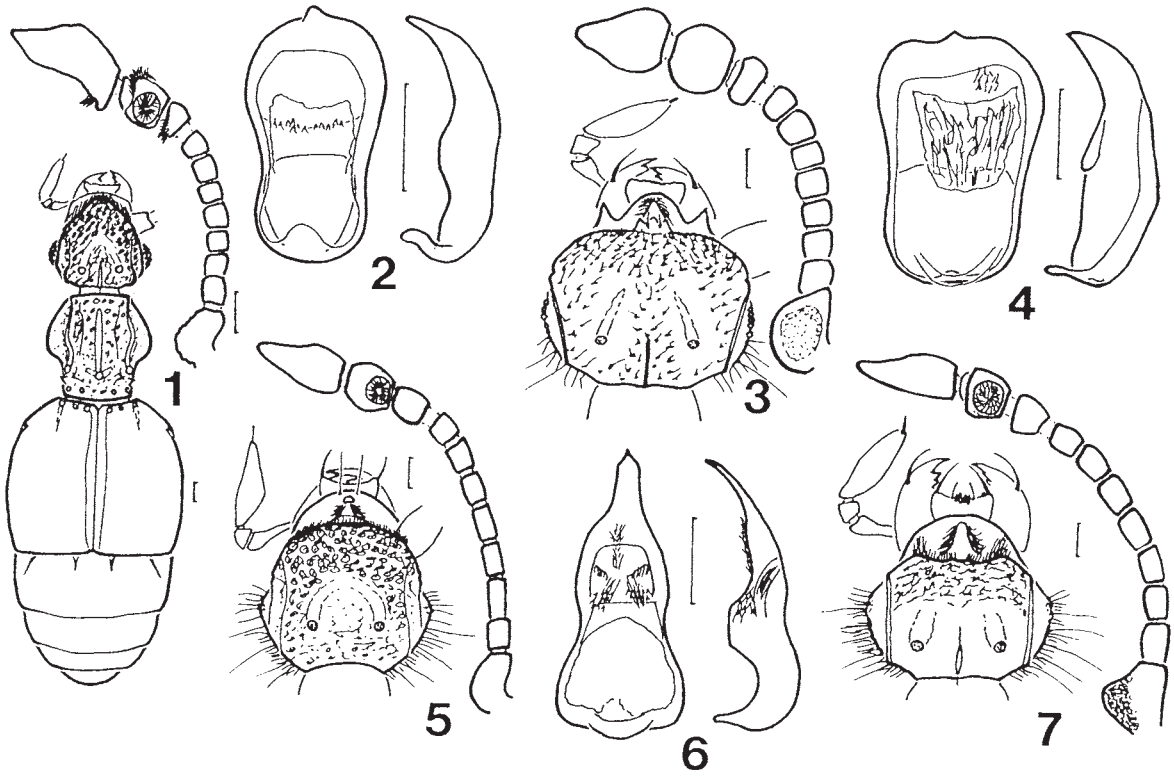
Male from Powell's Cave, Texas: antennae 1.08, metafemora 0.80, metatibiae 0.77, metatarsi 0.45.

Specimen examined.—TEXAS: *Menard County*: Powell's Cave, IV-11-1989, E. Shoud, third crevice (TMMC).

Comments.—This species has been poorly known since its description, and during preparation of this paper was found to be the senior synonym of *tridens* Casey. Park (1956:84) examined a specimen he placed as this species from northern Alabama, and found a minute fovea of antennomere X. A slide preparation of a specimen from Oklahoma did not reveal any trace of a fovea, and a fovea is not obvious in any of the specimens from several localities mounted on points. Park (1956) believed that *clypeonotus* represented an undescribed subgenus, but it appears typical of *Excavodes* to me. This species is now known from Missouri to Alabama and Texas. The largest series have been generated by collecting specimens with their ant host, *Camponotus americanus* Mayr. Whether this species is an obligate myrmecophile is not known, but the reduced number of eye facets indicates that *clypeonotus* has adapted to a subterranean life.

3. *Batrisodes (Excavodes) grubbsi* n. sp.
(Figs. 5-6)

Description.—Length 2.32-2.48. Male head with transverse excavation anterior to antennal bases, clypeus with erect blunt tubercle, tubercle densely setate along postero-lateral margin, vertex broadly truncate in dorsal view, in anterior view vertex projecting ventrally to medial point that is slightly angled anteriorly near apex, vertexal apex densely setate into transverse excavation, vertex coarsely punctate, smoothly roughened in area between vertexal foveae, median carina faint, lateral carinae low but distinct and extending to just anterior to eyes, eyes consisting of approximately 8 granules



Figs. 1-7.—*Batrisodes* spp.: 1, *B. uncicornis*, habitus of male and anterior view, right antenna; 2, *B. uncicornis*, dorsal and right lateral view, aedeagus; 3, *B. clypeonotus*, head and anterior view, right antenna of male; 4, *B. clypeonotus*, dorsal and right lateral view, aedeagus; 5, *B. grubbsi*, head and anterior view, right antenna of male; 6, *B. grubbsi*, dorsal and right lateral view, aedeagus; 7, *B. reyesi*, head and anterior view, right antenna of male. Scale line equals 0.1. Apical three segments of male antennae presented in ventral view.

indicating facet remnants; antennomere X with large fovea covering ventral half.

Pronotum with median longitudinal sulcus faint in basal half of disc, disc sparsely and minutely punctate; elytra with 3 basal foveae and subhumeral fovea; sternite VI with lateral setate tubercles at apex, disc between tubercles flat; second mesotarsomeres straight.

Females lacking modifications of head, antennae, and sixth sternite; frons and anterior half of vertex coarsely punctate, posterior half of vertex smoothly roughened.

Holotype male: antennae 1.40, metafemora 0.96, metatibiae 1.00, metatarsi 0.48.

Specimens examined.—6: TEXAS: HOLOTYPE male, *Hays County*, Grapevine Cave, VII-1-1990, A. Grubbs, J. Reddell, M. Reyes (FMNH). PARATYPES, all same locality: 1 female, eutopotypical (TMMC); 2 males, 1 female, VI-10-1990, A. Grubbs, L. Davis, J. Elliott (DSC, TMMC); 1 female, VII-9-1990, A. G. Grubbs (DSC). The specimens collected on June 10 are teneral.

Etymology.—The species is named for the principal collector of the series, Andrew Grubbs.

Comments.—The type series was collected under washed-in leaf litter at the litter-clay floor interface from the terminal room of Grapevine Cave in total darkness (James R. Reddell, pers. comm.). The male modifications of the head are generally similar to those of *clypeonotus*, but differ in the form of the vertexal apex, lack of lateral clypeal spines, and in the form of antennomeres I and X. The male antennae, median clypeal spine, and form of the aedeagus are also similar to those of *venyivi*, but may be readily separated by the truncate vertexal apex and coarse punctation on the anterior half of the vertex.

4. *Batrisodes (Excavodes) reyesi*, n. sp.
(Figs. 7-8)

Description.—Length 2.36-2.44. Males with head transversely excavate just anterior to antennal bases, frontal horn prominent and with dense short setae directed posterolaterally, anterior margin of clypeus broadly rounded, anterior half of vertex with obscure transverse rugules and smooth on posterior half, anterior margin of vertex weakly biemarginate over transverse excavation, short setae along margin longest near lateral edges, strong lateral carinae of vertex extending anteriorly to antennal bases, median carina extending from base to just anterior to line between nude vertexal foveae, eyes represented by a number of small scattered facet rudiments appearing as granules; first antennomere (scape) angulate on ventral margin, densely and minutely punctate in lower half, antennomere X with large fovea occupying over half of ventral surface.

Pronotum smooth, with median longitudinal sulcus extending to near pronotal apex; elytra with three basal foveae and subhumeral fovea; metasternum at middle with small deep circular impression just anterior to metacoxae; sternite VI medially impressed with tuberculate raised areas laterally, line of thickened setae extending from tubercles to middle; second mesotarsomeres straight.

Females lack modifications of head, antennae, and sternite VI; vertex depressed between antennal bases and smoothly rugulose; metasternal impression present.

Male holotype: antennae 1.52, metafemora 1.04, metatibiae 1.05, metatarsi 0.44.

Specimens examined.—13: HOLOTYPE male, Texas, *Burnet County*, Fenceline Sink, IV-17-1990, J. Reddell, M. Reyes (FMNH). PARATYPES: 1 female, eutopotypical (TMMC); 1 male, same locality, V-27-1989, M. Reyes (DSC); 1 male, Snake Pit Sink, XI-20-1990, J. Reddell, M. Reyes, underside of rock loosely buried in silt (TMMC). *Travis County*: 1 female, Armadillo Ranch Sink, IX-23-1990, J. Reddell, M. Reyes, C. Sexton, from crack in rotten wood (DSC); 3 females, Yellow Berry Cave, XII-111990, J. Reddell, M. Reyes (DSC, TMMC); 2 males, 3 females, Moss Pit, III-5-1991, J. Reddell, M. Reyes, underside of rocks deeply buried in silt (DSC, TMMC). The two specimens collected in April are teneral.

Etymology.—The name is derived from Marcelino Reyes, the principal collector of the type series.

Comments.—*Batrisodes reyesi* was found on the underside of rocks deeply buried in silt at the bottom of the entrance drop of Fenceline Sink, associated with troglobitic spiders, *Cicurina* (*Cicurella*) species, and millipedes, *Speodesmus* species; in Yellow Berry Cave beneath rocks at the bottom of the second drop in total darkness; and in Moss Pit on the underside of rocks deeply buried in silt at cave bottom in association with blind isopods of the family Trichoniscidae (James R. Reddell, pers. comm.).

The general form of the modified vertex and first antennomeres are similar to those of *clypeonotus* (Brendel), a myrmecophile with reduced eyes. The males of *reyesi* are easily distinguished by the relatively flat vertex, the stronger lateral and median

vertexal carinae, and the laterally tuberculate sternite VI.

5. *Batrisodes (Excavodes) texanus* n. sp. (Figs. 9-12)

Description.—Length 2.60-2.88. Male head with vague transverse impression anterior to antennal bases, impression shallow and medianly angulate, vertex smooth and sparsely setate, antennal tubercles prominent with a few coarse punctures dorsally, sides of head smoothly curved and flat with a few granules present where eyes should be, lateral carinae extending sinuately from head base of outer angle of antennal tubercles, median carina extending anteriorly to point between nude vertexal foveae; antennomeres all elongate, X nearly twice as wide as IX and narrowing in apical half, with large nude fovea covering one-third of surface in ventral view.

Pronotum with median longitudinal sulcus shallow on disc; elytra with three basal foveae and subhumeral fovea; second mesotarsomeres straight.

Females lacking transverse sulcus anterior to antennal bases, vertex merging smoothly with frons, antennomere X barely wider and longer than IX.

Male holotype: antenna 1.63, metafemur, 1.32, mesofemur 1.32, metatarsi lost.

Specimens examined.—4: TEXAS: *Williamson County*: HOLOTYPE male, Inner Space Caverns (=Laubach's Cave), V-23-1965, W. Russell (FMNH). PARATYPES (all females): same locality, VIII-1968, W. Elliott (DSC); Off Campus Cave, IV-8- 1989, W. Elliott, J. Reddell, M. Reyes (DSC); Coffin Cave, 10 mi. NW Georgetown, XI-3-1963, J. Reddell (TMMC).

Etymology.—The name is derived from its known occurrence restricted to Texas.

Comments.—*Batrisodes texanus* was found in Off Campus Cave on the underside of a rock lightly buried in silty clay in total darkness (James R. Reddell, pers. comm.). Since this species was included as the Coffin Cave population of *Texamaurops reddelli* when *reddelli* was listed as an endangered species (Chambers and Jahrsdoerfer, 1988), *texanus* should also be considered endangered under federal law although no specific ruling has yet been published (Steve Chambers, pers. comm. to James R. Reddell).

This species possesses elongate legs and antennae, and is superficially similar to *T. reddelli*. The lack of any ocular projection, and the presence of the pencil of setae at the apex of the metatibiae readily separate the two taxa. The aedeagus of this species was figured by Barr (1974) as *T. reddelli*. *Batrisodes texanus* is placed in the subgenus *Excavodes* due to the modified head anterior to the antennae and the straight mesotarsomeres of the male.

6. *Batrisodes (Excavodes) venyivi* n. sp. (Figs. 13-14)

Description.—Length 2.24. Males with head transversely excavate just anterior to antennal bases, frontal horn prominent with short dense setae directed posterolaterally, anterior margin of clypeus angulate, anterior margin of vertex rounded with shallow medial emargination, margin anterior to antennal bases depressed, vertex smooth and lacking lateral and medial basal carinae; first antennomere (scape) not modified, antennomere X with fovea occupying one-fourth of face in ventral view.

Pronotum smooth, with median longitudinal sulcus barely attaining middle of disk; elytra with three basal foveae, lacking subhumeral fovea; sternite VI lightly impressed medially, smoothly granulate in impression; second mesotarsomeres straight.

Female unknown.

Male holotype: antennae 1.05, metafemora 0.76, metatibiae 0.80, metatarsi 0.44.

Specimen examined.—TEXAS: *Bexar County*: HOLOTYPE male, Helotes Hilltop Cave, IX-29-1984, J. Ivy, G. Veni (FMNH).

Etymology.—The name is formed by combination of the names of the collectors.

Comments.—It is not close to any other species of *Excavodes* that I have seen. It is easily distinguished by the lack of vertexal carinae, smooth vertex, and lack of a subhumeral fovea on the elytra.

7. *Batrisodes (Excavodes) globosus* (LeConte) (Figs. 15, 16)

Batrisus globosus LeConte, 1849:100. Type localities: Pennsylvania and Georgia. Syntypes male and female (MCZC).

Description.—Length 2.36-2.48. Males with head transversely excavated anterior to antennal bases, frons with acute medial tubercle bearing four small recurved setae at apex and longer laterally directed sinuate setae toward base, frontal tubercle nearly obscured in dorsal view by broadly rounded projecting vertexal lobe, ventral margin of vertexal lobe with small group of setae projecting ventrally lateral to frontal tubercle, vertex coarsely punctate in anterior third, generally smooth in posterior portion with setae arising from small granules,

lateral carinae strong and extending to antennal bases, medial carina distinct and extending from cervix over moderately swollen vertex to point anterior to nude vertexal foveae, eyes with approximately 45 facets; antennomere X large and globose, wider than XI, X with small ventral fovea near base.

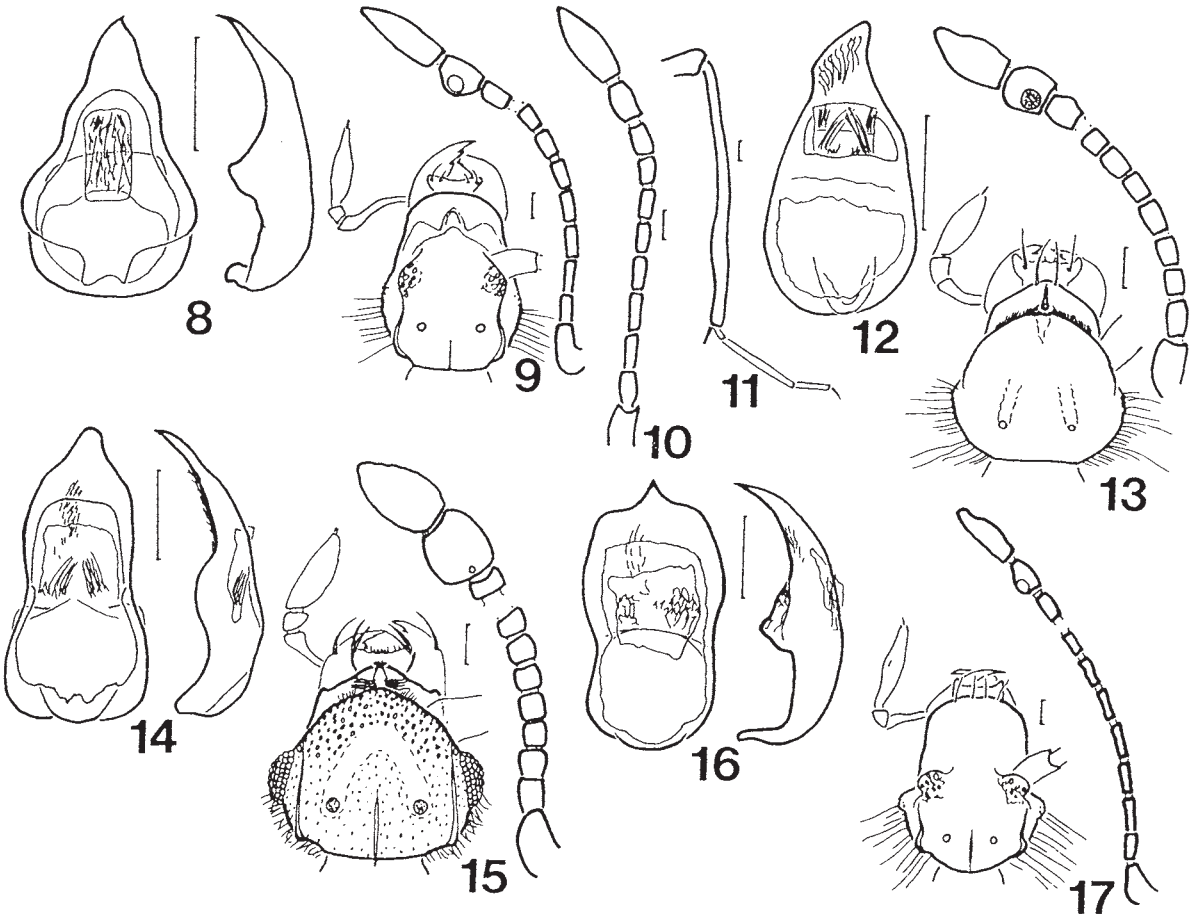
Pronotum sparsely punctate, median longitudinal sulcus extending to near apex; elytra with three basal foveae and subhumeral fovea; sternite VI slightly flattened medially; second mesotarsomeres straight.

Females with coarse punctures only on antennal tubercles and posteriorly to near vertexal foveae, eyes with approximately 42 facets; lacking modifications of head and antennae, sternite VI barely rounded at middle.

Male from Simons Squirm-Around Cave: antennae 1.12, metafemora 0.79, metatibiae 0.76, metatarsi 0.40.

Specimens examined.—5: TEXAS: *Burnet County*: 1 male, Simons Squirm-Around Cave, XI-20-1990, J. Reddell, M. Reyes, underside of rock loosely buried in soil (TMMC); 1 female, Road Side Sink No. 1, XI-20-1990, J. Reddell, underside of rock loosely buried in soil (TMMC); 1 male, Persimon Sink, I-17-1991, J. Reddell, M. Reyes (DSC); 1 male, Simons Pretty Pit, I-17-1991, J. Reddell (DSC); 1 female, Snake Pit Sink, II-8-1991, G. Veni (TMMC).

Comments.—*Batrisodes globosus* is found throughout eastern North America, with isolated records from Colorado, Washington, and Alberta. It



Figs. 8-17.—8-16, *Batrisodes* spp.: 8, *B. reyesi*, dorsal and right lateral view, aedeagus; 9, *B. texanus*, head and anterior view, right antenna of male; 10, *B. texanus*, lateral view, right antenna of female; 11, *B. texanus*, posterior view, right metatibia of male; 12, *B. texanus*, dorsal view, aedeagus; 13, *B. venyivi*, head and anterior view, right antenna of male; 14, *B. venyivi*, dorsal and right lateral view, aedeagus; 15, *B. globosus*, head and anterior view, right antenna of male; 16, *B. globosus*, dorsal and right lateral view, aedeagus. Apical three segments of male antennae of *Batrisodes* spp. presented in ventral view. 17, *Texamaurops reddelli*, head and anterior view, right antenna of female. Scale line equals 0.1.

is associated with rotten woods (Chandler, 1987, and many collection records), and may be found with ants in the northern half of its range (Park, 1960). Park (1960) noted one population that was found in a cave in Alabama.

Male *globosus* may be separated from *uncicornis* by the more broadly rounded anterior margin of the vertex, and by the form of the apical segments of the antennae. Females lack coarse punctures between the vertexal fovea on the head, and also on the pronotum, while in *uncicornis* coarse punctures will be found in both areas.

8. *Texamaurops reddelli* Barr and Steeves (Figs. 17-19)

Texamaurops reddelli Barr and Steeves, 1963:118. Type locality: Kretschmarr Cave, Travis Co., Texas. Holotype female (FMNH).

Description.—Length 2.72-3.08. Male with vertex smoothly merging into elongate frons, area sparsely setate with prominent antennal tubercles, base of vertex with median and lateral carinae distinct but not prominent, lateral carinae reaching apex of antennal tubercles, median extending to point anterior to nude vertexal foveae, all antennomeres elongate, X with large nude fovea on ventral surface near base, antennomere swollen in basal half, eye area a rounded angulation with approximately 6 granules that appear to be vestigial eye facets.

Pronotum with median longitudinal sulcus faint, extending to near pronotal apex; elytra with 2 basal foveae and subhumeral fovea; metasternum at middle with group of long sparse setae; metatibiae lacking apical pencil of setae, sternite VI laterally with rounded tumuli bearing long setae that are directed laterally.

Females with lateral margins of antennomere X straight, lacking ventral fovea, sternite VI broadly rounded.

Male from Stovepipe Cave: antennae 2.12, metafemora 1.56, metatibiae 1.72, metatarsi 0.80.

Specimens examined.—6: TEXAS: *Travis County*: Holotype female, Kretschmarr Cave, 15 mi. NW Austin, III-2-1963, J. R. Reddell, D. McKenzie (FMNH); 1 female, same locality, 1968, R. W. Mitchell (FMNH); 1 female, Tooth Cave, V-3-1964, J. R. Reddell (TMMC); 1 female, same locality, V-14-1966, J. R. Reddell (FMNH); 1 female, Amber Cave, IV-8-1984, J. Reddell, M. Reyes (DSC); 1 male, Stovepipe Cave, X-25-1990, L. Sherrod, under rock lightly buried in silty clay in small side room in total darkness (DSC).

Comments.—*Texamaurops reddelli* has only been found in four closely situated caves on the underside of rocks lightly buried in silt in total darkness (James R. Reddell, pers. comm.), and has been placed on the US. List of Endangered Species (Chambers and Jahrsdoerfer, 1988). It has elongate legs and antennae with reduced eyes, and is clearly a troglobite. The holotype and the single male are different from all the other specimens in possessing only two basal foveae on each elytron. The other four specimens, including one from the type locality, have three equal foveae at the elytral base. All other features appear to be similar and these four specimens are placed as *reddelli*.

Barr and Steeves (1963) initially believed that this genus might be best placed in the Amauropsini, a European tribe whose members are all troglobites. Barr later (1974) figured the aedeagus of a purported male, which clearly indicated the placement of *Texamaurops* in the Batrisini since the morphology of the aedeagus in members of the two tribes is quite different (Jeannel, 1948). The male specimen in question has proven to be a new species of *Batrisodes* convergent with *Texamaurops* in appearance, but discovery of a true male of *Texamaurops* confirms the placement in the Batrisini since the aedeagus is similar in form to those of members of *Batrisodes*. The absence of the metatibial pencil of setae is shared by members of *Batriasymmodes* Park, a group with a number of troglobitic species in the eastern United States, and some members of this group also have a fovea on antennomere X. However, the aedeagal form of this genus is consistently different from members of *Batriasymmodes*, and based on the form of the aedeagus and antennal characters *Texamaurops* is probably best considered a lineage derived from *Batrisodes* that has lost the metatibial pencil of setae.

Texamaurops reddelli is superficially similar to *texanus* by the greatly elongate antennae and legs, as well as body size. However, *reddelli* possesses a distinct rounded angulate knob where the eyes should be, and the metatibiae lack an apical pencil of setae.

9. *Cylindrarctus bicornis* Chandler (Fig. 20)

Cylindrarctus bicornis Chandler, 1988:135. Type locality: Texas (probably Bosque County). Holotype male (USNM).

Description.—Length 2.20. Males with antennal tubercles on head close, forming a broad tubercle constricted at base, vertexal foveae a distance of one ocular facet from eyes, eyes with about eight large facets, maxillary palpi with last three segments elongate, together nearly as long as antennae, penultimate segment angulate near base on mesal margin.

Pronotum lacking any sulci, with small median and lateral antebasal foveae. Elytra with two basal foveae, lacking subhumeral fovea. Metasternum with short longitudinal carina extending anteriorly from near inner margins of each metacoxa; sternites II-VI broadly flattened at middle; protrochanters with prominent spine, metatrochanters with elongate broad flange extending ventrally.

Females are unknown.

Male specimen from Gorman Cave, Texas: antenna 1.19, metafemur 0.76, metatibia 0.79, metatarsus, 0.47.

Specimen examined.—Texas: *San Saba County*, Gorman Cave, 6 mi. SE Bend on Colorado River, III-15-1963, J. R. Reddell (DSC).

Comments.—*Cylindrarctus bicornis* was taken from washed-in organic debris in total darkness several hundred meters from the cave entrance (James R. Reddell, pers. comm.). This is the second known specimen of this species. The other specimen, the holotype, was produced by Belfrage from "Texas," where he had collected most extensively at Clifton and Norse in Bosque County. The other members of the genus are most commonly encountered in moist litter near water, and *bicornis* will probably only be found in caves at their entrances since it lacks any obvious cave adapted features. *Cylindrarctus bicornis* is readily separated from the other cave pselaphids by the elongate last three segments of the maxillary palpi that together are nearly equal to the antennae in length.

10. *Tmesiphorus costalis* LeConte (Fig. 21)

Tmesiphorus costalis LeConte, 1849:77. Type locality: Pennsylvania. Holotype male (MCZC).

Description.—Length 3.08-3.52. Males with head and pronotum coarsely punctate, antennomere IX cylindrical and three times length of VIII, with longitudinal groove on outer face, X slightly shorter than IX and flattened ventrally with anterodistal angle tuberculate, XI excavate in basal third on ventral surface; maxillary palpi with apical segment triangular, previous two segments with lateral spine.

Pronotal disc rounded; elytra with two basal foveae, lacking subhumeral fovea; abdomen with sternites II-III lightly flattened at middle.

Females with apical antennomeres narrower, lacking modifications; abdominal sternites broadly rounded.

Male specimen from Puberty Pit, Texas: antennae 1.68, metafemora 1.04, metatibiae 1.20, metatarsi 0.48.

Specimens examined.—TEXAS: *Burnet County*: Simon Says Sink, XI-12-1990, J. Reddell, M. Reyes, berlese litter (2, TMMC); Snake Pit Sink, XI-20-1990, J. Reddell, M. Reyes, underside of rock loosely buried in silt (2, DSC); Simons Squirm-Around Cave, XI-20-1990, J. Reddell, M. Reyes, underside of rocks loosely buried in silt (4, DSC); Shin Oak Sink, I-17-1991, J. Reddell, M. Reyes (4,, DSC). *San Saba County*: Puberty Pit, IV-21-1990, D. Allen, W. Elliott, B. Fralia (1, TMMC). *Travis County*: Big Oak Cave, X-17-1990, J. Reddell, M. Reyes, on underside of rock in darkness (1, TMMC); Twin Dig Pit, XII-11-1990, J. Reddell, berlese rodent nests at lowest point of cave in total darkness (1, TMMC).

Comments.—This species has been collected in various leaf litters, under bark, with the ant *Aphaenogaster fulva* Roger (Park, 1933), and one specimen has been found in a cave (Park, 1960). *Tmesiphorus costalis* and the other Nearctic species in the genus, *carinatus* (Say), are easily recognized by the form of the maxillary palpi, and the coarsely punctate head and pronotum. *Tmesiphorus costalis* is larger than *carinatus*, the latter being easily distinguished from *costalis* by a median longitudinal carina on the first visible abdominal tergite.

11. *Hamotus (Hamotoides) electrae* Park (Figs. 22-23)

Hamotus electrae Park, 1942:327. Type locality: San Juan, Veracruz, MEXICO. Holotype male (FMNH).

Description.—Length 3.20-3.40. Males with antennomeres IV-VIII transverse, IX twice as long as VIII, IX slightly shorter than X, both IX and X slightly longer than wide; last segment of maxillary palpus enlarged, twice as long as wide, with longitudinal sulcus on mesal margin.

Pronotum with distinct transverse antebasal sulcus, width about half that of median antebasal fovea; elytra with two basal foveae, lacking subhumeral fovea; protrochanters carinate ventrally, a few specimens with small denticle on carina, profemora with

small ventral carina near base, protibiae with small tooth on mesal margin at point about two-thirds of length, mesotrochanters vaguely carinate on ventral margin, metasternum deeply and transversely impressed in apical two-thirds, posterior margin raised as flanges at mesal margins of metacoxae; abdominal sternites II-VI widely impressed.

Females lack modifications of legs and metasternum; abdominal sternites broadly rounded.

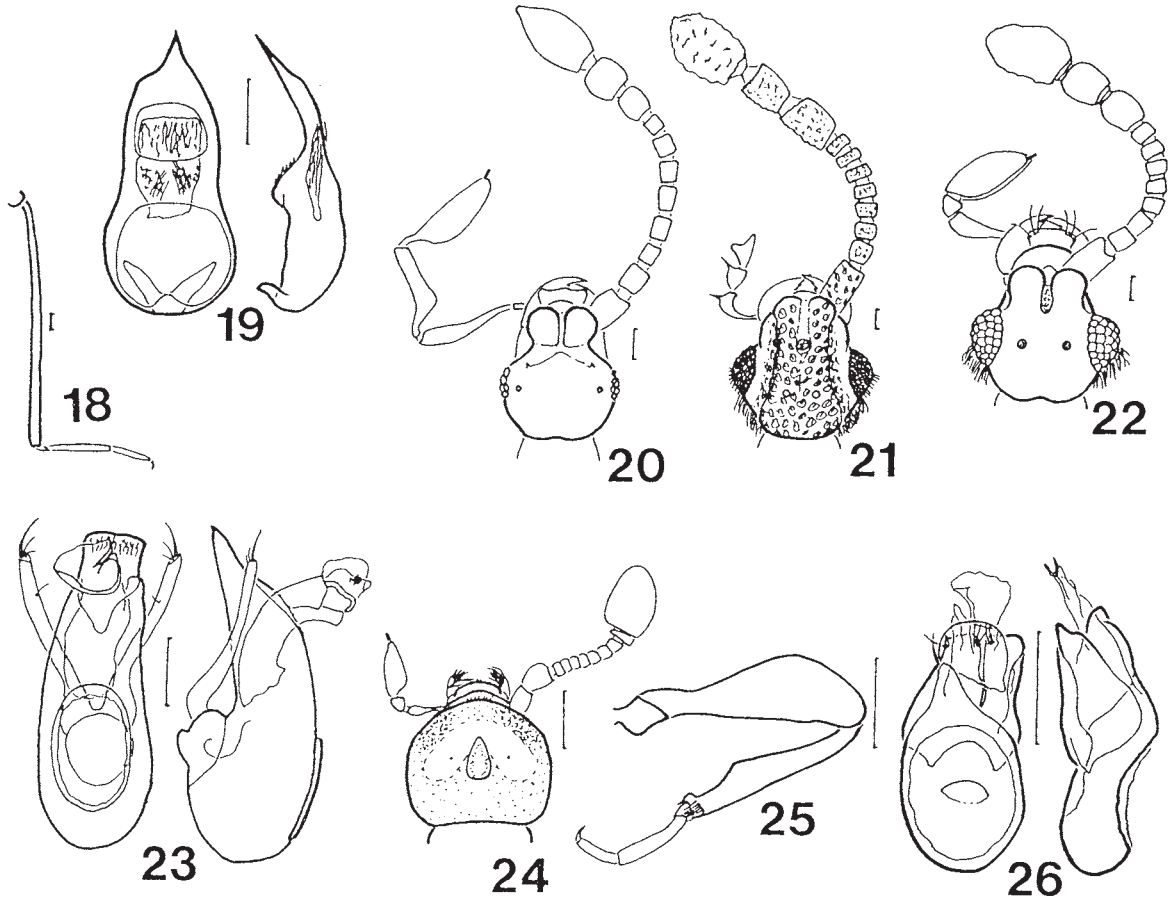
Male specimen from Porcupine Cave, Texas: antennae 1.44, metafemora 1.00, metatibiae 1.08, metatarsi 0.54.

Specimens examined.—3: TEXAS: *Kinney County*, Porcupine Cave, X-17-1987, G. Veni, J. Ivy (DSC and TMMC). Five other specimens were collected at Bentsen-Rio Grande St. Pk., VI-10-1975, by Robert Turnbow at ultraviolet light (DSC and RHT).

Comments.—This species was previously known only from the holotype male collected in Veracruz, Mexico (Park, 1942). It is apparently a free-living species, and will probably only be found when associated with caves at their entrances. Park (1942) placed this species in Group XII of *Hamotus*, where the other four North American species are placed. The males of *electrae* are readily distinguished from all other *Hamotus* (*Hamotoides*) species by the transverse impression of the metasternum, and the metasternal laminae projecting posteriorly near the mesal margins of the metacoxae in males.

Trimioarcus musamator n. sp.
(Figs. 24-26)

Description.—Length 1.16-1.24. Male head with vertex extended and flattened laterally, eyes not



Figs. 18-26.—18-19, *Texamaurops reddelli*: 18, posterior view, right metatibia of female; 19, dorsal and right lateral view, aedeagus. 20, *Cylindrarctus bicornis*, dorsal view, male head. 21, *Tmesiphorus costalis*, dorsal view, male head. 22-23, *Hamotus electrae*: 22, dorsal view, male head; 23, dorsal and right lateral view, aedeagus. 24-26, *Trimioarcus musamator*: 24, dorsal view, male head; 25 posterior view, male right middle leg; 26, dorsal and right lateral view, aedeagus. Scale line equals 0.1.

visible in dorsal view, with median elongate tubercle pointed at apex and rounded at base, top of tubercle narrowly rounded, area immediately anterior and lateral to tubercle shallowly impressed and impunctate, minute vertexal foveae lateral to middle of tubercle, anterior margin of vertex broadly rounded, eyes with 13 facets, genal process lateral to maxillary base bearing three setae, antennal club of apical two antennomeres.

Pronotum with biarcuate transverse antebasal sulcus, median antebasal fovea indistinct, distinct lateral antebasal foveae nude, large procoxal foveae meeting internally; elytra with 2 basal foveae; with small lateral mesosternal foveae, otherwise sternal foveae similar to those in figure by Grigarick and Schuster (1980) for *Trimioarcus incisiurus* Park; profemora with 7-8 sensory pits on ventral margin, mesotrochanters with broadly rounded angulation on ventral margin, mesotibiae gradually expanded to past middle on mesal margin, abruptly constricted to apex, apex with angulate spine; only abdominal tergite I with basal longitudinal carinae; sternite VI broadly impressed at middle, penial plate with setae on apical half.

Females with vertex smoothly rounded laterally and eyes easily visible, eyes with 13 facets, vertexal foveae nude; legs lacking modifications; disc of sternite VI broadly rounded.

Holotype male: antenna 0.33 long, metafemora 0.29 long, metatibia 0.30 long, aedeagus 0.22 long.

Specimens examined.—7: TEXAS: *Travis County*: HOLOTYPE male, Twin Dig Pit, XII-11-1990, J. Reddell, berlese rodent nests (FMNH). PARATYPES: 3 females, eutopotypical (DSC, TMMC); 1 male, 2 females, Moss Pit, III-5-1991, J. Reddell, M. Reyes, berlese litter from entrance pit bottom (DSC, TMMC).

Etymology.—The name was suggested by the collection from rodent nests.

Comments.—This species was found in rodent nests in total darkness at the lowest point in Twin Dig Pit, and in litter from the bottom of the entrance pit of Moss Pit (J. R. Reddell, pers. comm.). *Trimioarcus* Park (1952) was created to hold the new species, *incisiurus* Park, from Monterrey, Mexico. A second species, *pajarito*, was recently described from southern Arizona (Chandler, 1985). *Trimioarcus musamator* is closest to *incisiurus* by the broadly expanded head vertex with a median protuberance, and the eyes not visible in dorsal view in the males. The two species differ in the form of the vertexal tubercle; and in *musamator* the small eyes are of equal size with about 13 facets in both sexes, and the middle legs modified in the male. This species looks very much like a member of *Trimiomelba* LeConte, and would be readily placed in this genus except for the presence of lateral mesocoxal foveae and procoxal foveae.

The reduction in eye size is probably a response of this species to its exploitation of rodent nests or deep leaf litter, rather than a response to the lack of light in caves. No other members of the tribe Euplectini are known to be cavernicolous, while a number of species in a variety of genera in this tribe have reduced eyes and are found in deep leaf litter or tree holes.

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INDEX OF NEW TAXA

CRUSTACEA
AMPHIPODA
Artesiidae

Hadziidae

Sebiidae

ISOPODA
Cirolanidae

ARACHNIDA
SCHIZOMIDA
Protoschizomidae

ARANEAE
Dictynidae

Neobisiidae

Syarinidae

Cheiridiidae

Chernetidae

OPILIONIDA

Phalangodidae

INSECTA

COLEOPTERA

Pselaphidae