

STUDIES OF NORTH AMERICAN
SCORPIONS OF THE GENERA
UROCTONUS AND *VEJOVIS*
(SCORPIONIDA, VEJOVIDAE)

WILLIS J. GERTSCH AND MICHAEL SOLEGLAD

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ABSTRACT

A SYSTEMATIC REVIEW of some American vejovine scorpions is presented with analyses of their characters and relationships. The subfamily Uroctoninae is rejected as a synonym of the Vejovinae. The genus *Uroctonus*, heretofore represented by the single taxon *mordax*, is redefined and the number of species increased to 14. Most of the characters on which the genus *Uroctonus* was formerly based were found to be intergradient to those of *Vejovis*. Although the genus is maintained on the basis of a combination of characters, it seems clear that the species were derived from the same basic stock. The trichobothrial patterns of *Uroctonus* and *Vejovis* are essentially identical and differ strikingly from those of the related genera *Anuroctonus* and *Hadrurus*. The genotype *Uroctonus mordax* ranges from Oregon south into southern California and lives

mostly in mesic, mountainous habitats. Most of the new species occur in California and Baja California but three others are found from southern Arizona to western Texas and Chihuahua. Two of the species, *montereus* and *sequoia*, are unusual in having only a single subdistal tooth present on the outer carina of the movable finger of the chelicera, instead of the normal two of the subfamily. A pale species with small eyes and slender, smooth cauda, *grahami* from Samwell Cave in California, seems to be a cave-adapted type, but its modifications may only indicate an endogean habit. Descriptions of various species of *Vejovis* are also included in the present paper. The identity of *Vejovis minimus* Kraepelin has been established by study of the type material from the Zoologisches Museum in Hamburg, Germany.

INTRODUCTION

HEREIN IS PRESENTED a systematic revision of the scorpion genus *Uroctonus*, an exclusively North American group heretofore represented by the single taxon *mordax*. Since its description by Thorell in 1876, *Uroctonus mordax*, a large black scorpion of California (figs. 1, 2) sometimes attaining 60 mm. in body length, has been one of the most distinctive and famous taxa of the American fauna. In the present paper the genus *Uroctonus* is expanded to 14 species, now constituting a more diverse assemblage, but one still sharing the basic features of the genus. In terms of our present systematic concepts it is clear that most characters assigned to *Uroctonus* are intergradient to those of *Vejovis*, and separation of the two must be achieved by a combination of characters. Widening the limits of the genus has introduced some elements of inexactness, and the precise position of the genus still remains somewhat obscure. This uncertainty earlier resulted in the suggestion that *Uroctonus* was merely one end of a continuous series intergrading to typical *Vejovis* (Gertsch and Allred, 1965, p. 4). However, it now seems clear that the *Uroctonus* complex represents a single development, a series of related species presumably derived from the same basic stock. The presence of so many new species is a reflection of the neglect of scorpion systematics by American students and collectors until recent years.

During the course of this study, various species of uncertain position were described, and these are included in the section under the genus *Vejovis*. Some of these were first assigned to *Uroctonus* and share the general appearance of species of that group.

The species of *Uroctonus* are all nocturnal forms that hide under rocks, fallen trees and other ground objects, and in holes in the ground. *Uroctonus mordax* is often found at entrances to burrows in the banks above streams, and may be able to dig in the fashion of its relative *Anuroctonus phaeodactylus*. Mesic habitats in foothills or mountains are favored locations, and no species occurs in desert or xeric situations. The group is strongly represented in California and Baja California and only three of the 14 species occur outside of these states. One of these three, *apacheanus*, is distributed in isolated mountain ranges from southern Arizona into the Big Bend Region of Texas. The best known species, *Uroctonus mordax*, has a wide distribution from central Oregon to southern California but records outside this area are probably spurious.

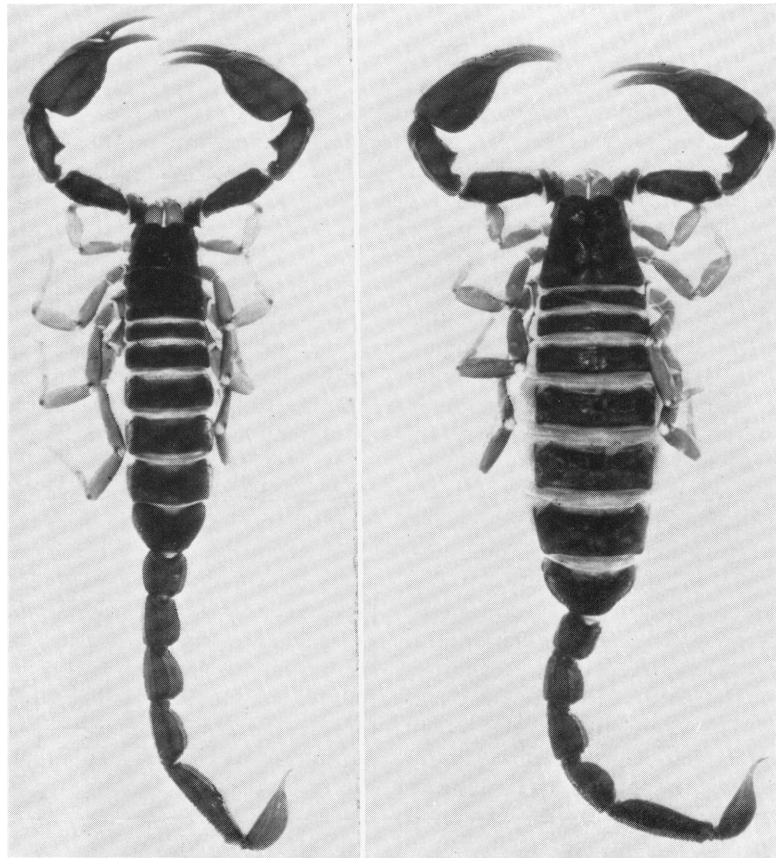
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The present paper is largely based on the rich collections of the American Museum of Natural History in New York and the California Academy of Sciences in San Francisco. We take this

opportunity to express our gratitude for the cooperation of the following individuals and institutions for loans and gifts of material and for other favors during the course of this study: Drs. J. G. Rozen, Jr., J. A. L. Cooke, and C. M. Bogert of the American Museum of Natural History; Dr. Paul Arnaud and Mr. H. B. Leech of the California Academy of Sciences; Dr. Mont A. Cazier and Mr. J. Bigelow of Arizona State University, Tempe; Drs. Otto Kraus and Gisela Rack, Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg, Germany; Mr. C. F. Harbison, Curator Emeritus, San Diego Society of Natural History, San Diego, California; Mr. Vincent Roth of the Southwestern Research Station, Portal, Arizona; Mr. Franklin Ennik, Bureau of Vector Control, State Department of Public Health, Berkeley,

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FIGS. 1, 2. *Uroctonus mordax* Thorell. 1. Male. 2. Female. Both $\times 1\frac{1}{2}$.

SYSTEMATICS

FAMILY VEJOVIDAE

SUBFAMILY VEJOVINAE

GENUS *UROCTONUS* THORELL

Uroctonus THORELL, 1876, p. 11; "1876" [1877], p. 196; "1893" [1894], p. 374. KARSCH, 1879, p. 103. POCOCK, 1893, p. 328; 1902, p. 14. KRAEPELIN, 1894, p. 193; 1899, p. 182. COMSTOCK "1912" [1913], p. 30. EWING, 1928, p. 12. HOFFMANN, 1931, p. 402. WERNER, 1935, pp. 283, 284.

DIAGNOSIS: Carapace slightly longer than broad, narrowed and produced in front into slight to prominent rounded lobes separated by shallow to deep, rounded emargination at middle. Median eyes rather small, set on low tubercle slightly or considerably in advance of middle of carapace; diad of median eyes usually about one-sixth of width of carapace at that point; side eyes three, but third eyes in many cases small or missing. Chelicera with typical vejovine dentition: fixed finger with four teeth on upper margin; movable finger with five teeth on upper margin (one subdistal tooth missing in *montereus* and *sequoia*) and having keel on lower margin entire, crenulate, or toothed. Chela of pedipalp heavy, bearing four principal keels and two or three accessory keels; superior keel usually smooth; inner keels on fixed and movable fingers in straight line, broken into six files and flanked by six to eight supernumerary teeth. Pectines rather small with reduced numbers of elements: middle lamellae, five to 10; pectinal teeth, seven to 12 in females, eight to 13 in males. Cauda with all keels present and usually granulated; inferior median pair of keels always present. Stigmata elongate-oval slits. Tarsi with ventral, pointed apophysis below tarsal claws, and single ventral line of spinules.

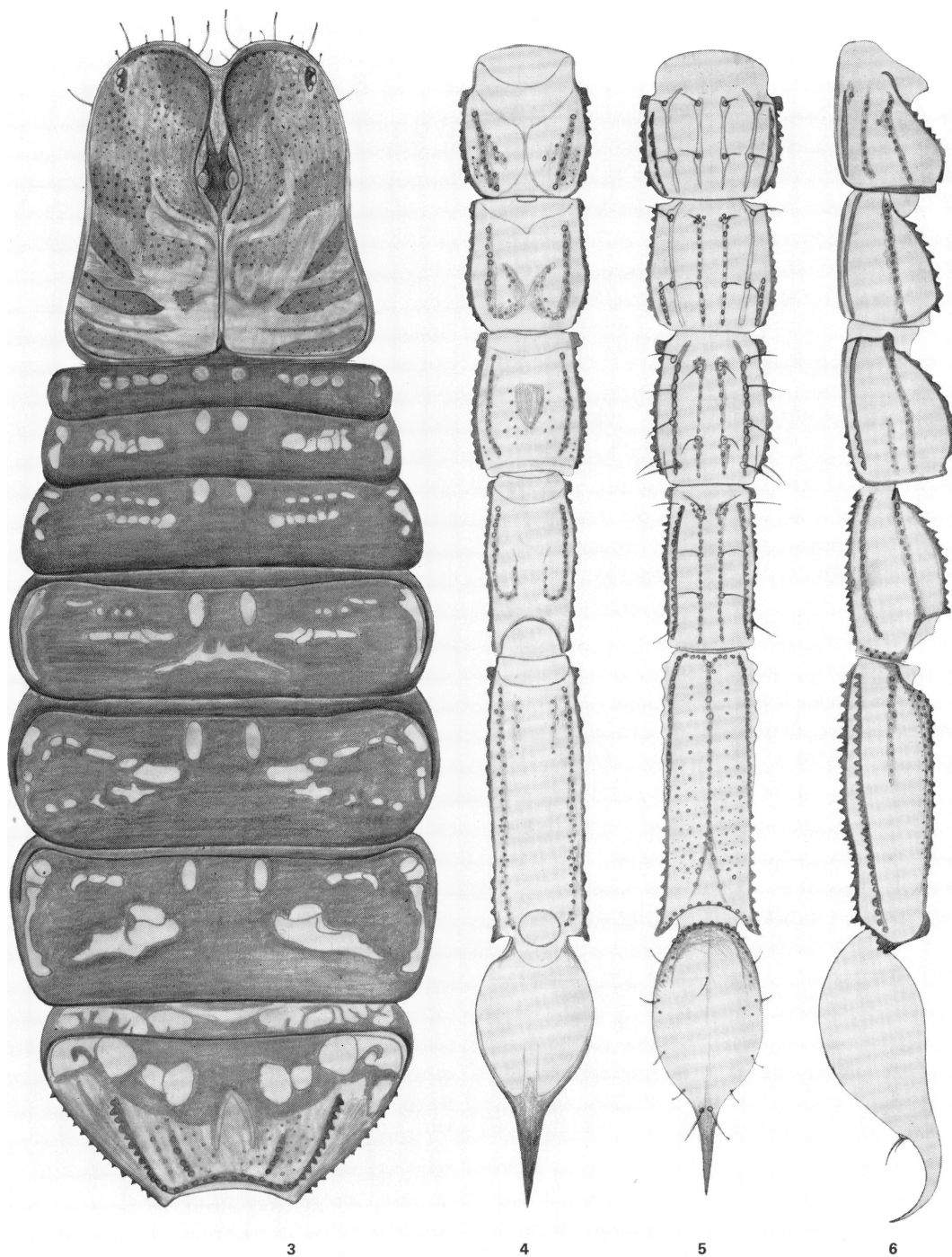
TYPE OF GENUS: *Uroctonus mordax* Thorell.

DISCUSSION: The subfamily Uroctoninae, as first defined by Mello-Leitao (1934, p. 79) and adopted by Werner (1935, p. 281), cannot be maintained on the basis of the cited characters. A prime feature was the number and character of the middle lamellae, said to be few in number and at most six of quadrangular shape. By contrast, the genus *Vejovis* of the subfamily

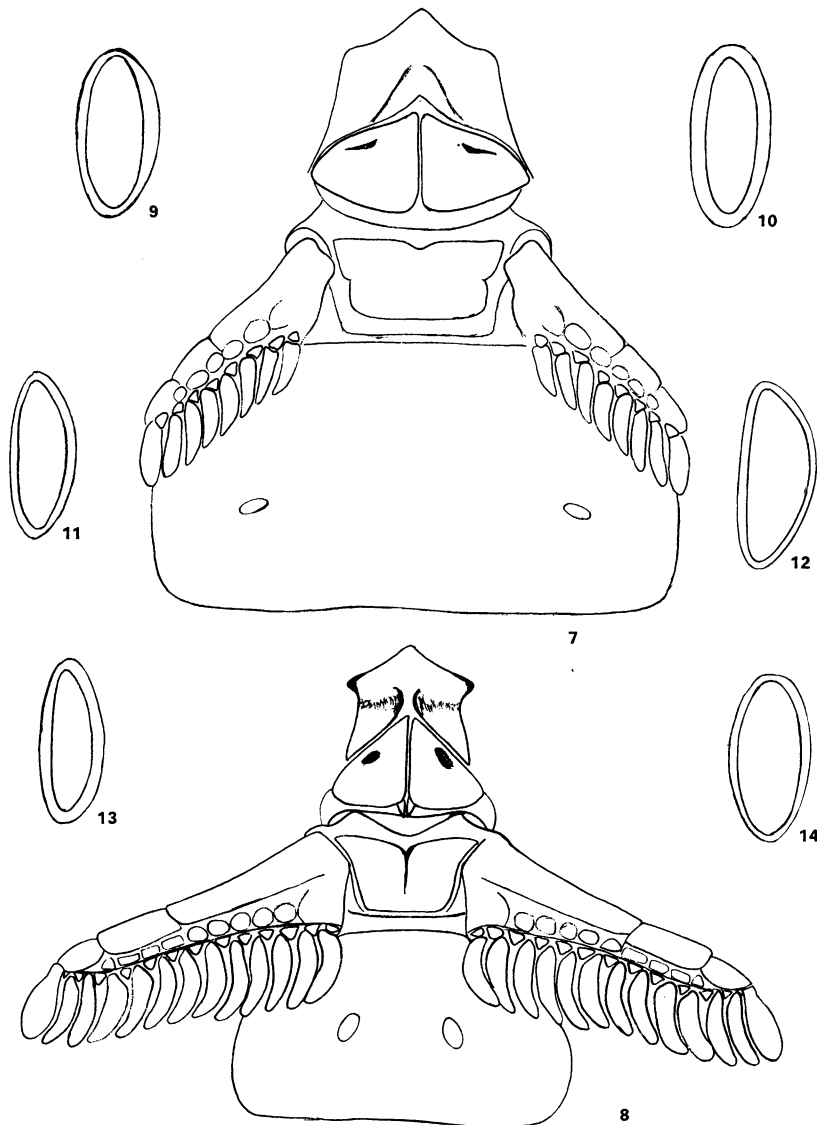
Vejovinae was said to have numerous middle lamellae, at least eight of subspherical shape appearing as little pearls. These differences hold for many but not for all the taxa in each of these groups. One of the genera assigned to the Uroctoninae by Werner, *Paruroctonus*, shared few of the cited characters of the subfamily and was shown by Gertsch and Soleglad (1966) to be closely allied to *Vejovis*. Although it is true that species of *Uroctonus* have fewer middle lamellae and pectinal teeth than do most *Vejovis*, some *Vejovis* on the basis of this character alone fall well within the definition of *Uroctonus*. The second key character, the presence of distinct teeth on the lower margin of the movable finger of the chelicera, has been shown (Gertsch and Allred, 1965, p. 3; Gertsch and Soleglad, 1966, p. 3) to be variable within the group, with closely allied species having entire or toothed margins. It seems desirable to retain *Uroctonus* in the subfamily Vejovinae until a more intensive study of the American vejovids is done on the basis of additional fundamental characters. At present these warrant no special placement.

Some of the characters of *Uroctonus* listed in the generic diagnosis deserve further comment:

In general, the carapace can be described as rather low and relatively smooth, not marked by crests or grooves of great prominence. In *mordax* (fig. 3) and some other species the frontal emargination is a deep, rounded groove. This feature becomes less distinctive in such species as *andreas*, where it is a slight indentation, not much different from that of some species of *Vejovis*. The median tubercle, with two small eyes separated by their long diameter, invariably lies in front of the middle. The degree of forward placement is variable, being least in *mordax* and species with proportionally shorter carapaces and greater in *montereus* and others with narrower carapaces. In *mordax* it lies back about three-sevenths the distance from the front margin; in *montereus* only three-ninths. The size of the eyes and tubercle is also variable: in *mordax* it is about one-sixth of the width of the carapace at that point, whereas in the cave-adapted *grahami* the tubercle is only one-ninth of this width. It can be seen that these features, and others identified with the granulation of the



FIGS. 3-6. *Uroctonus mordax* Thorell, female. 3. Carapace and preabdomen, dorsal view. 4. Cauda, dorsal view. 5. Cauda, ventral view. 6. Cauda, lateral view.

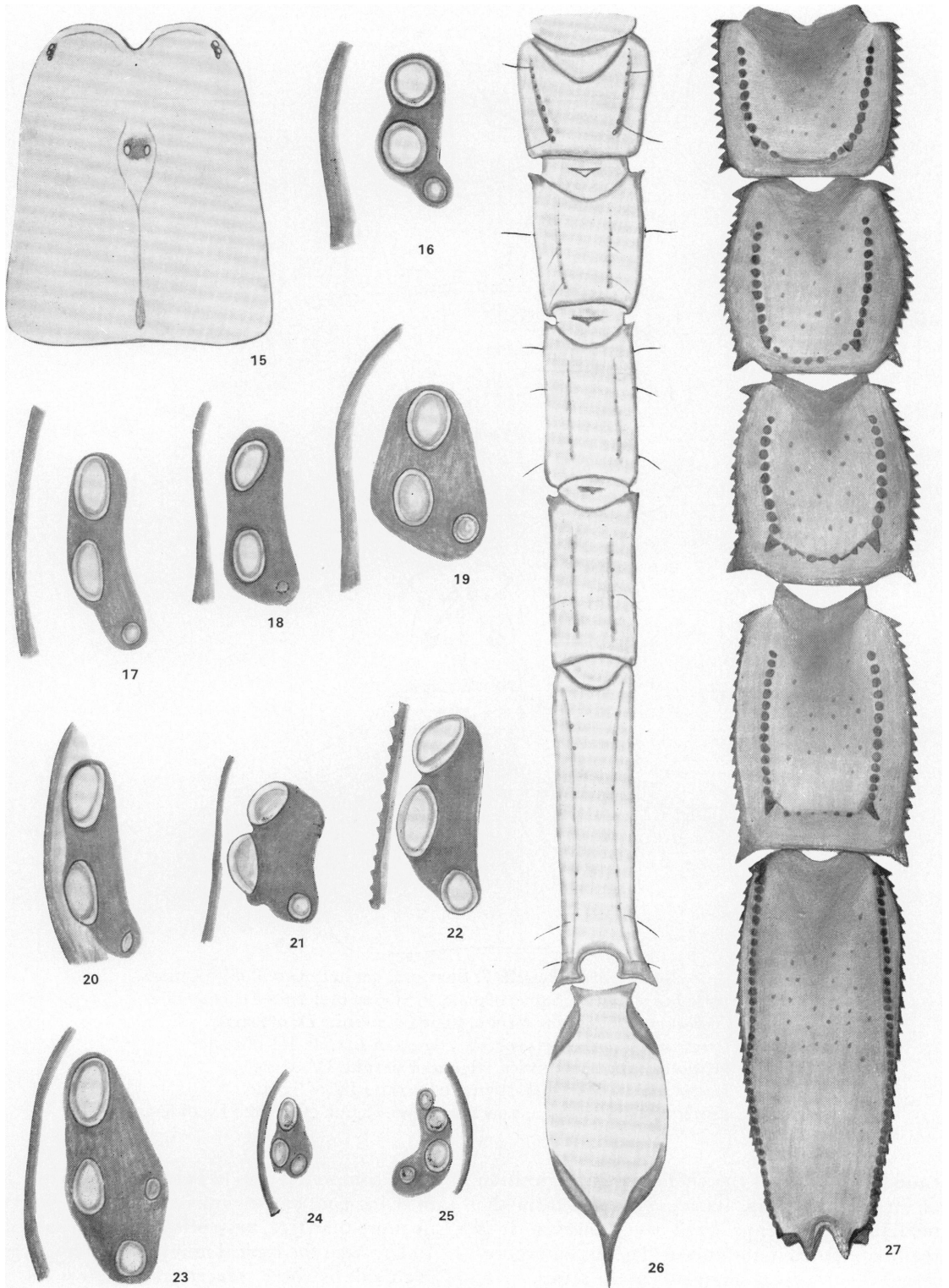


FIGS. 7-9. *Uroctonus mordax* Thorell. 7. Sternum, genital operculum, pectines, and sternite I of female. 8. Same, of male. 9. Stigma of sternite III of female.
 FIG. 10. *Uroctonus montereus*, new species, stigma of sternite IV of female.
 FIG. 11. *Uroctonus williamsi*, new species, stigma of sternite III of male.
 FIG. 12. *Vejovis reddelli*, new species, stigma of sternite IV of male.
 FIG. 13. *Vejovis iviei*, new species, stigma of sternite IV of female.
 FIG. 14. *Vejovis minimus castaneus*, new subspecies, stigma of sternite IV of female.

cauda, armature of the chelicerae, and position of the trichobothria, set *mordax* apart from the median of the genus *Uroctonus*. However, it is readily retained in the enlarged genus and represents a stout species at one side of the series.

The lateral eyes (ocelli) are remnants of the

large compound eyes of Paleozoic scorpions, and in living species are now reduced to a cluster of no more than five, most often three, on each side. In *Uroctonus* the typical number of lateral eyes on each side is three, placed close above the side margin near the frontal corner of the carapace.



The front two are subequal in size and larger than the third eye, which may be of medium development, reduced to a vestige, or entirely absent. Although there is variability in the development of these eyes, which in some cases are reduced or missing only on one side, they tend to be rather constant for the species. The third eye is at most half the diameter of the others and is slightly behind and above the hind eyes as shown for *mordax* (fig. 19). The side eyes have well-marked convex lenses and clear vitreal chambers and are generally easily identified as eyes. When the eye tubercle is heavily pigmented and granulated, some of the rounded granules cause confusion by resembling eyes. In *williamsi* (fig. 20) the third eye is small, of lenticular shape and difficult to see. Two females of *bogerti* (figs. 17, 18) have the third eye present in one and seemingly obsolete in the other. In *grahami* (fig. 16) the small side eyes are drawn closer together but the third eye is well developed. In the related genus *Anuroctonus* (fig. 23) the third eye is quite large and a fourth small eye is present above the second one.

The species of *Vejovis* also have three eyes on each side which typically form a curved row. The two front ones are closer together and the third eye is usually quite large as shown for *reddelli* (fig. 22). In *iviei* (fig. 21) the third eye is smaller and placed above the second to produce what is essentially the pattern of *Uroctonus mordax*. The eyes of *Vejovis gracilis* (figs. 24, 25) are small and the third eye is close to the second; an additional eye is present in front and close to the front eye, and this must be considered an aberrant condition.

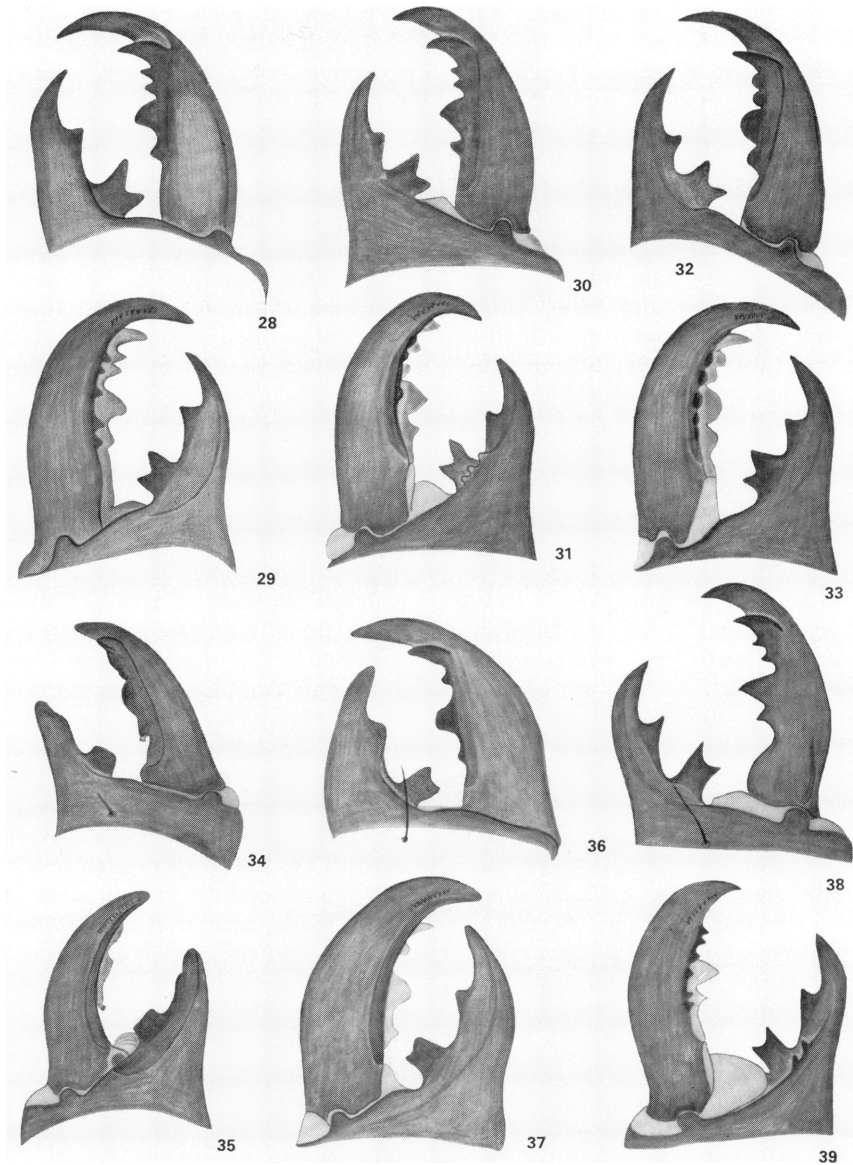
Few scorpions have been closely identified with the cave habitat even though many find its entrance areas and sometimes even its deeper recesses suitable as a temporary habitat. The

discovery of eyeless chactids in Mexican caves (Mitchell, 1968) was a notable event. These scorpions completely lack pigment, show no traces of eyes, and have become strangely modified in some basic characters. It must be presumed that they are troglobites confined to their underground habitats by strong bonds. Lack of eyes and other seeming cave adaptations are not evidence enough to demonstrate that an animal is a troglobite. The blind scorpion of the Pyrenees, *Belisaurus xambeui* Simon, 1879, retains traces of lateral eyes and is known to be an endogean type that lives in caves and in deep soil recesses. Some eyeless spiders live deep in ground detritus and in the galleries of termite nests.

In the present paper several scorpion species are reported from cave habitats. One of these is *Vejovis reddelli*, new species, a large, blackish species (fig. 139) widespread in Texas caves, which is classified as a troglophile. This species shows no physical modification for cave existence and occurs outside of caves in appropriate situations. Another species, presumably also to be regarded as a troglophile, is *Vejovis iviei*, new species, which lives in cave entrances and under rocks and ground detritus outside of caves. A third troglophilic species, *Uroctonus sequoia*, is so far known from three or four specimens taken in caves. The eyes are somewhat smaller than usual and the general coloration paler, but these features should be shared by specimens from outside caves whenever they are found. Two spiders of the genus *Nesticus* living in caves in the same areas of California have similar eye and color modifications but these probably should be regarded as being troglophiles.

A species of *Uroctonus* from Samwell Cave in California, herein described as *grahami*, is of outstanding interest. So far it is known from

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- FIGS. 15, 16. *Uroctonus grahami*, new species. 15. Carapace of female. 16. Left lateral eyes, subdorsal view.
 FIGS. 17, 18. *Uroctonus bogerti*, new species, females. 17. Left lateral eyes of holotype, subdorsal view. 18. Left lateral eyes of another female, subdorsal view.
 FIG. 19. *Uroctonus mordax* Thorell, left lateral eyes of female, sublateral view.
 FIG. 20. *Uroctonus williamsi*, new species, left lateral eyes of female, subdorsal view.
 FIG. 21. *Vejovis iviei*, new species, left lateral eyes of female, subdorsal view.
 FIG. 22. *Vejovis reddelli*, new species, left lateral eyes of female, subdorsal view.
 FIG. 23. *Anuroctonus phaeodactylus* (Wood), left lateral eyes of female, sublateral view.
 FIGS. 24, 25. *Vejovis gracilis*, new species, lateral eyes of female. 24. Left eyes, sublateral view. 25. Right eyes, sublateral view.
 FIG. 26. *Uroctonus grahami*, new species, cauda of female, dorsal view.
 FIG. 27. *Uroctonus rufulus*, new species, caudal segments I-IV of male, dorsal view.



FIGS. 28, 29. *Uroctonus mordax* Thorell, right chelicera of female. 28. Dorsal view. 29. Ventral view.

FIGS. 30, 31. *Uroctonus cazieri*, new species, right chelicera of female. 30. Dorsal view. 31. Ventral view.

FIGS. 32, 33. *Uroctonus grahamsi*, new species, right chelicera of female. 32. Dorsal view. 33. Ventral view.

FIGS. 34, 35. *Uroctonus williamsi*, new species, right chelicera of female. 34. Dorsal view. 35. Ventral view.

FIGS. 36, 37. *Uroctonus montereus*, new species, right chelicera of female. 36. Dorsal view. 37. Ventral view.

FIGS. 38, 39. *Vejovis reddelli*, new species, right chelicera of female. 38. Dorsal view. 39. Ventral view.

three specimens taken inside the cave from deep soil recesses. The coloration is yellowish, and black pigment is found only in the eyes, which are very much reduced in size. The cauda is small and slender and largely devoid of keels. The status of this species remains obscure because of sparsity of material and lack of knowledge of its habits. At the moment it would seem, in spite of the presence of small eyes, to be a species comparable to the European *Belisaurus* and probably endogean in habit. Two essentially eyeless spiders also occur in Samwell Cave in the zone of total darkness.

The stigmata of *Uroctonus* are often described as being short and suboval in shape. Outlines of three species, *mordax* (fig. 9), *montereus* (fig. 10), and *williamsi* (fig. 11) show that the shape is elongate oval. They are also subject to considerable variation on the separate sternites and show differences among the species. In contrast, the stigmata of *Vejovis* are usually described as being long and slitlike. This is true of many species assigned to that genus but also subject to considerable variation. The stigma of *Vejovis reddelli* (fig. 12) is quite flat on one side and shows only small differences from that of *Uroctonus williamsi*. The stigma of *iviei* differs not at all from those in *Uroctonus* species. Such intergradation makes difficult the use of the shape of these external openings as reliable characters.

The chelicerae of *Uroctonus* provide excellent systematic characters and deserve special comment. The nomenclature of Vachon (1963) has become standard for these appendages and he has described the patterns for most families and subfamilies. The formula for *Uroctonus* is largely standard for the subfamily Vejovinae. The fixed finger bears four outer teeth, a distal, subdistal, median, and basal; the median and basal are joined to form a compound tooth with two sharp projections. The lower margin of the fixed finger has a smooth, rounded keel in all *Uroctonus* except *cazieri* where it is armed with three rounded teeth (fig. 31). The movable finger is longer and has an outer and inner series of teeth. The outer carina bears five teeth; a basal, median, two subdistals, and distal. Two subdistal teeth are present in all species of *Uroctonus* except *montereus* (fig. 36) and *sequoia* in which only one subdistal is present. This is presumed to be a derivative character and results from loss of the normal second one. This is an interesting record as up to this time the only vejovid

with such dentition is the genus *Iurus* (placed in its own subfamily Iurinae) of eastern Europe and the Middle East. A constant feature of the lower margin of the movable finger is a row of fine serrulae along the distal part. This margin is variously developed, often completely smooth, in some cases crenulated or denticulate, or provided with strong dark teeth, heretofore a key feature of the untenable subfamily. The armature of this keel has been shown to be subject to wide variation in the subgenus *Paruroctonus* (Gertsch and Soleglad, 1966). One species of *Vejovis* described below, *reddelli*, has stout teeth on this margin, but the several other species assigned to the genus have this carina quite smooth.

Although there seems to be no variation in the tooth formula for each of the *Uroctonus* species, marked variation can be seen in the details of the individual teeth. In obviously immature and medium-sized specimens, the teeth are in general sharply pointed and well developed. In larger and older specimens they are likely to be rounded and less well developed. The female type of *Uroctonus williamsi* (fig. 34) and one of the larger males have all the teeth short, bluntly rounded as if worn down by use to the extent that the number and limits of the individual teeth are not readily apparent. This extreme condition has not been noticed in any of the other species.

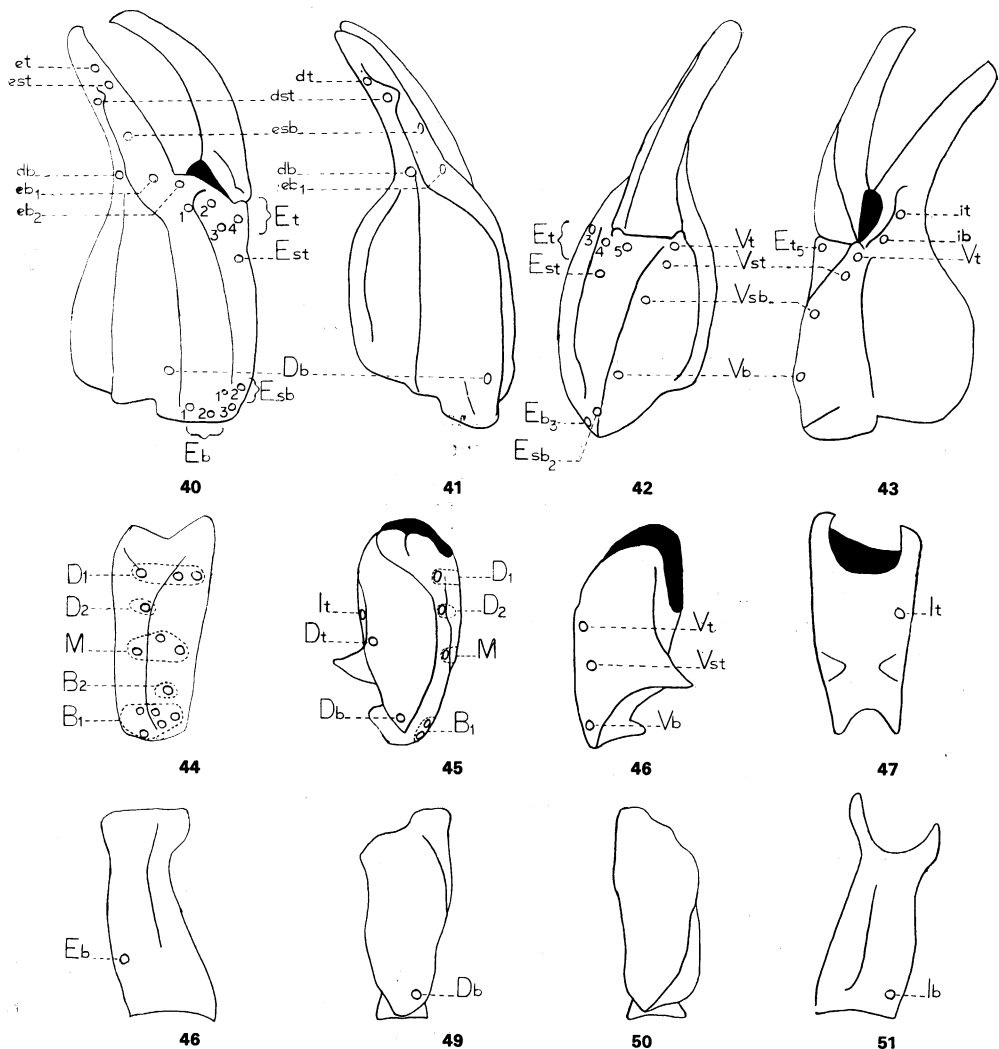
The trichobothrial patterns of scorpions provide additional characters useful in systematics as has been on several occasions shown by Vachon and quite precisely in his 1962 paper on the chactid genus *Euscorpis*. The sensory hairs called trichobothria are thin, willowy setae that extend from large, rimmed alveolae on segments of the pedipalps. They are quite uniformly slender and do not taper as do typical setae. In most species of *Uroctonus* and *Vejovis* the trichobothria with their rounded pores are easily differentiated from the surrounding setation. However, in *Hadrurus* they are short, thin, and not always easy to distinguish from setae projecting from large alveolae. Few American students have mentioned or made much use of the trichobothria as taxonomic characters, so it is appropriate that those of *Uroctonus* and related genera be discussed and evaluated herein.

The nomenclature for the surfaces of the pedipalp and the positions of the trichobothria is essentially that of Vachon. Four views are

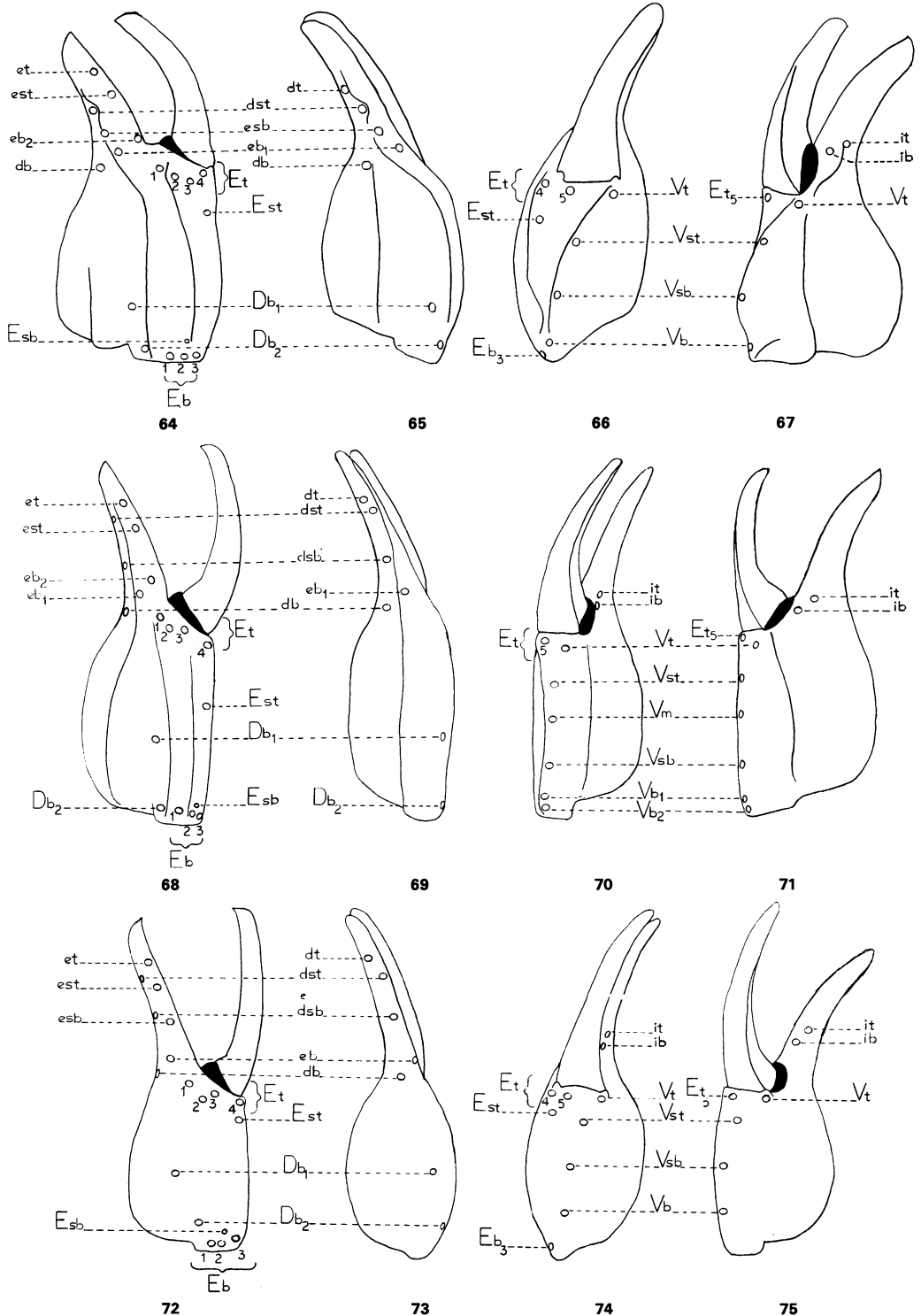
illustrated as follows: exterior, dorsal, ventral, and interior represented by the letters e, d, v, i, or their capitals E, D, V, I. Trichobothria on the fingers of the chela are indicated by lower case letters; those of the tibia, femur, and palm of the chela by capital letters. Each trichobothrium is represented by a circle. The positional labels are based on the relative positions with the following five distinctions: basal (b), subbasal (sb), median (m), terminal (t), and subterminal (st). Because of the irregularity and abundance of the trichobothria on the exterior face of the tibia,

they are considered by groups. Basal, median, and distal groups are distinguished. Some inexactness is inevitable in this nomenclature, especially when determining border areas between dorsal and exterior positions, or in deciding whether a trichobothrium is situated on a finger instead of the palm.

The following trichobothrial pattern of *Uroctonus mordax* (figs. 40–51) features 48 trichobothria. The femur bears three near the base, an external basal, Eb, dorsal basal, Db, and internal basal, Ib. The tibia is provided with 19



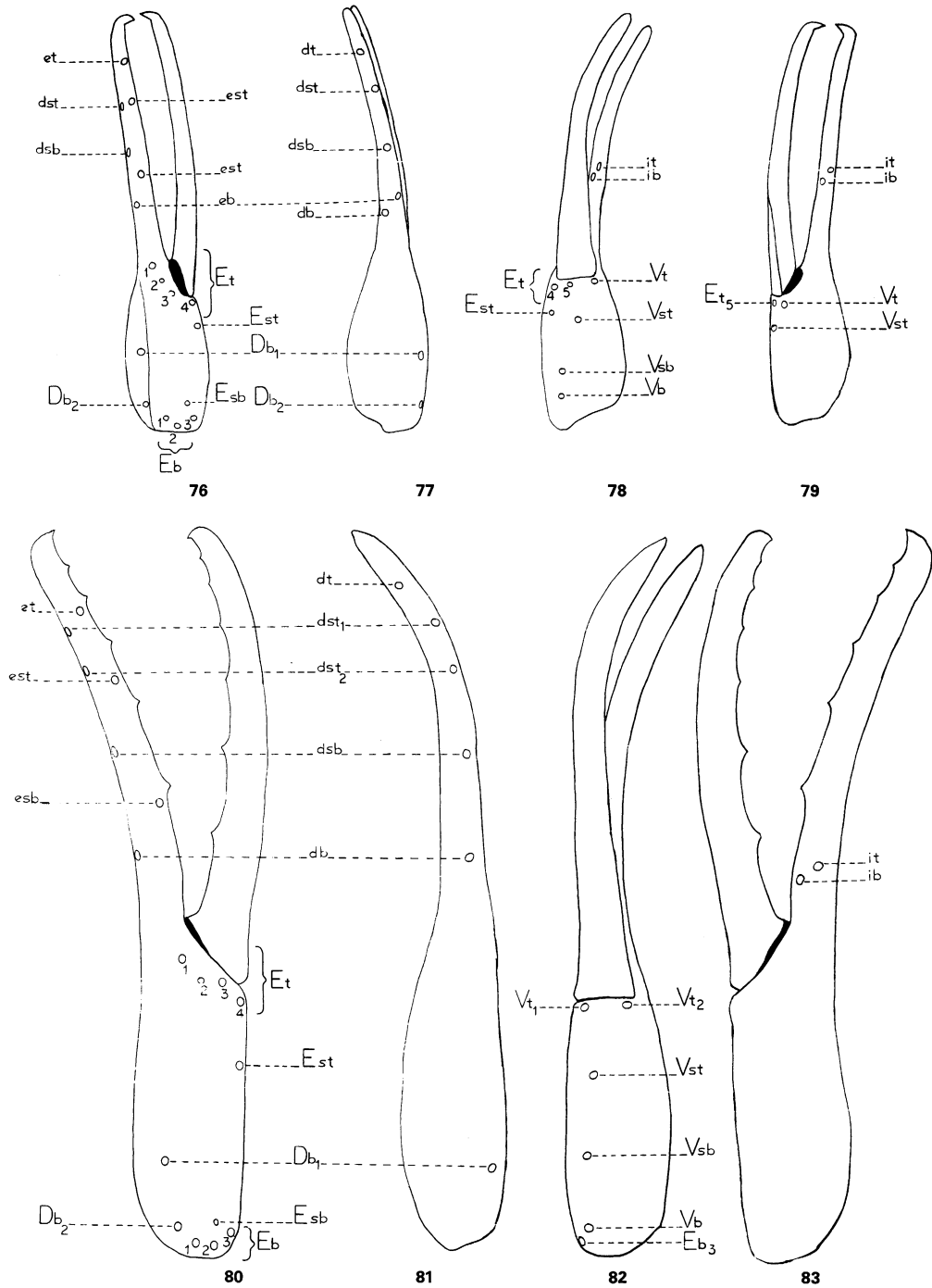
FIGS. 40–51. *Uroctonus mordax* Thorell, trichobothrial pattern of female pedipalp. 40. Chela, exterior view. 41. Chela, dorsal view. 42. Chela, ventral view. 43. Chela, interior view. 44. Tibia, exterior view. 45. Tibia, dorsal view. 46. Tibia, ventral view. 47. Tibia, interior view. 48. Femur, exterior view. 49. Femur, dorsal view. 50. Femur, ventral view. 51. Femur, interior view.



FIGS. 64-67. *Uroctonus huachuca*, new species, trichobothrial pattern of female chela. 64. Exterior view. 65. Dorsal view. 66. Ventral view. 67. Interior view.

FIGS. 68-71. *Uroctonus bogerti*, new species, trichobothrial pattern of female chela. 68. Exterior view. 69. Dorsal view. 70. Ventral view. 71. Interior view.

FIGS. 72-75. *Vejovis spinigerus* Wood, trichobothrial pattern of female chela. 72. Exterior view. 73. Dorsal view. 74. Ventral view. 75. Interior view.



FIGS. 76-79. *Vejovis wupatkiensis* Stahnke, trichobothrial pattern of female chela. 76. Exterior view. 77. Dorsal view. 78. Ventral view. 79. Interior view.

FIGS. 80-83. *Vejovis gracilis*, new species, trichobothrial pattern of female chela. 80. Exterior view. 81. Dorsal view. 82. Ventral view. 83. Interior view.

also clearly longer than the space between Vt and Et5. In *grahami* these distances are subequal in length, with the space between Vt and Vst being possibly shorter. The length comparisons are more noticeable in *mordax* where the distance between Vt and Vst is only one-half of the other. These positional differences are also found in juveniles of *mordax*.

The pattern of *Uroctonus*, featuring four ventral trichobothria on the chelal palm and two internal at the base of the fixed finger, shows only subtle positional differences from patterns of the *Vejovis* species studied herein. In *Vejovis* the two internal trichobothria (ib, it) typically are placed higher on the fixed finger, well removed from the palm juncture. The chela of *Vejovis spinigerus* (figs. 72-75) shows essentially the same pattern as that of *mordax*. The same is true of *wupatkiensis* (figs. 76-79) and *gracilis* (figs. 80-83); in the former the internal trichobothria are far out on the fixed finger, whereas in *gracilis* they are quite near the base.

The trichobothrial patterns of the genera *Anuroctonus* and *Hadrurus* differ from the above by the presence of a long series of trichobothria starting from the juncture of the movable finger on the palm venter and extending the length of the palm. This series is also represented on the ventral face of the tibia and terminates as it approaches the external face. The pattern of *Anuroctonus phaeodactylus* (figs. 84-95) retains the two internal trichobothria on the fixed finger near the palm juncture but has on the palm a closely spaced series of almost 20 ventral trichobothria, instead of four or six.

A third pattern is recognized for *Hadrurus* by the presence of more than two internal trichobothria (except in *aztecus*) and a closely spaced series of nearly 20 ventral ones. The pattern on the pedipalp of *Hadrurus arizonensis* is shown in figures 96-107. The large number of trichobothria on the tibia and chela is not matched by any scorpion known to us. The number and placement of the internal trichobothria appear to be reliable characters for differentiating the various species of *Hadrurus*. In *arizonensis* (fig. 109) they number seven to nine, having mostly eight. Six are found in *hirsutus* (fig. 112) and only four or five, mostly five, are present in *spadix* and *obscurus* (figs. 108, 110). *Hadrurus aztecus*, probably the most isolated species with less than a half dozen specimens in collections, has only two internal trichobothria (fig. 111)

and these are closer to the palm juncture than the corresponding ones of the other species.

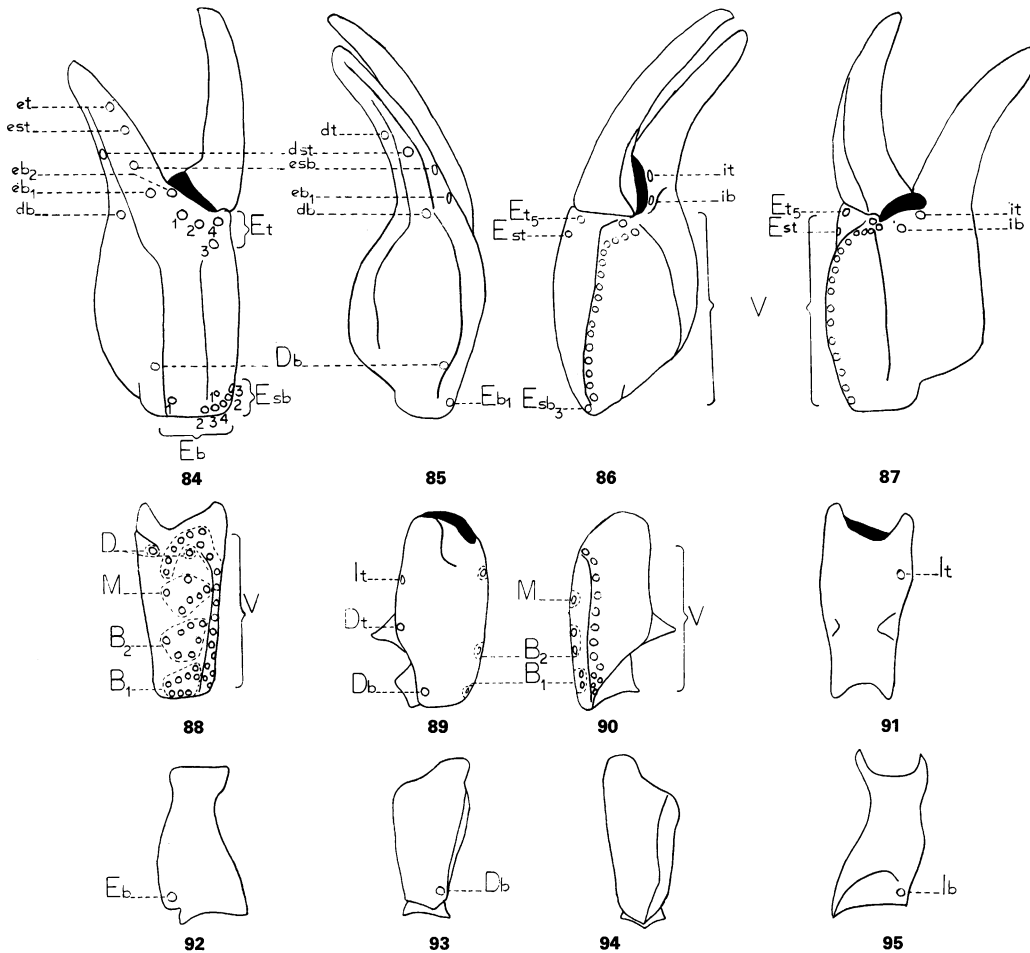
The three trichobothria near the base of the femur of *Uroctonus* are also found in *Vejovis*, *Anuroctonus*, and *Hadrurus*. According to Vachon (1962), they are typical of all members of the families Chactidae, Bothriuridae, Diplocentridae, Scorpionidae, as well as the Vejovidae. The trichobothrium he listed as d2 is here considered to be external in position, our Eb. The number of trichobothria on the tibia and chela is also quite standard for *Uroctonus* and *Vejovis*. In *Anuroctonus* and *Hadrurus* the number is far higher because of many more in the exterior and ventral series on the tibia and in ventral series on the palm of the chela. These genera are readily differentiated from the *Uroctonus-Vejovis* complex by trichobothrial patterns alone. In summary, then, it is clear that these patterns of vejovine scorpions are of systematic importance and supplement the many other characters. They give additional clues for the separation of genera, species and subspecies. At the same time, they are not infallible and probably of no greater importance than other characters.

The measurements used in the present paper are, for the most part, conventional for scorpion systematics. They were taken by means of calibrated, crosshatched reticules under a dissecting microscope at low power, mostly 10× and 25× in the belief that they are sufficiently accurate for the intended purpose. The total length is the sum of the lengths of carapace, preabdomen, and cauda, and excludes the telson. The length of the cauda is the sum of the dorsal lengths of the five segments measured separately. The length of the chela is taken as the length of the palm and its fixed finger. The length of the sting (aculeus) on the telson is not fixed by exact limits and is arbitrarily taken at a point near the inconspicuous subaculear nodule.

The following key to both males and females is based on the armature of the chelicerae, proportions of the cauda, telson, and chela, pectinal tooth counts, and on coloration and pattern.

KEY TO THE SPECIES OF *Uroctonus*

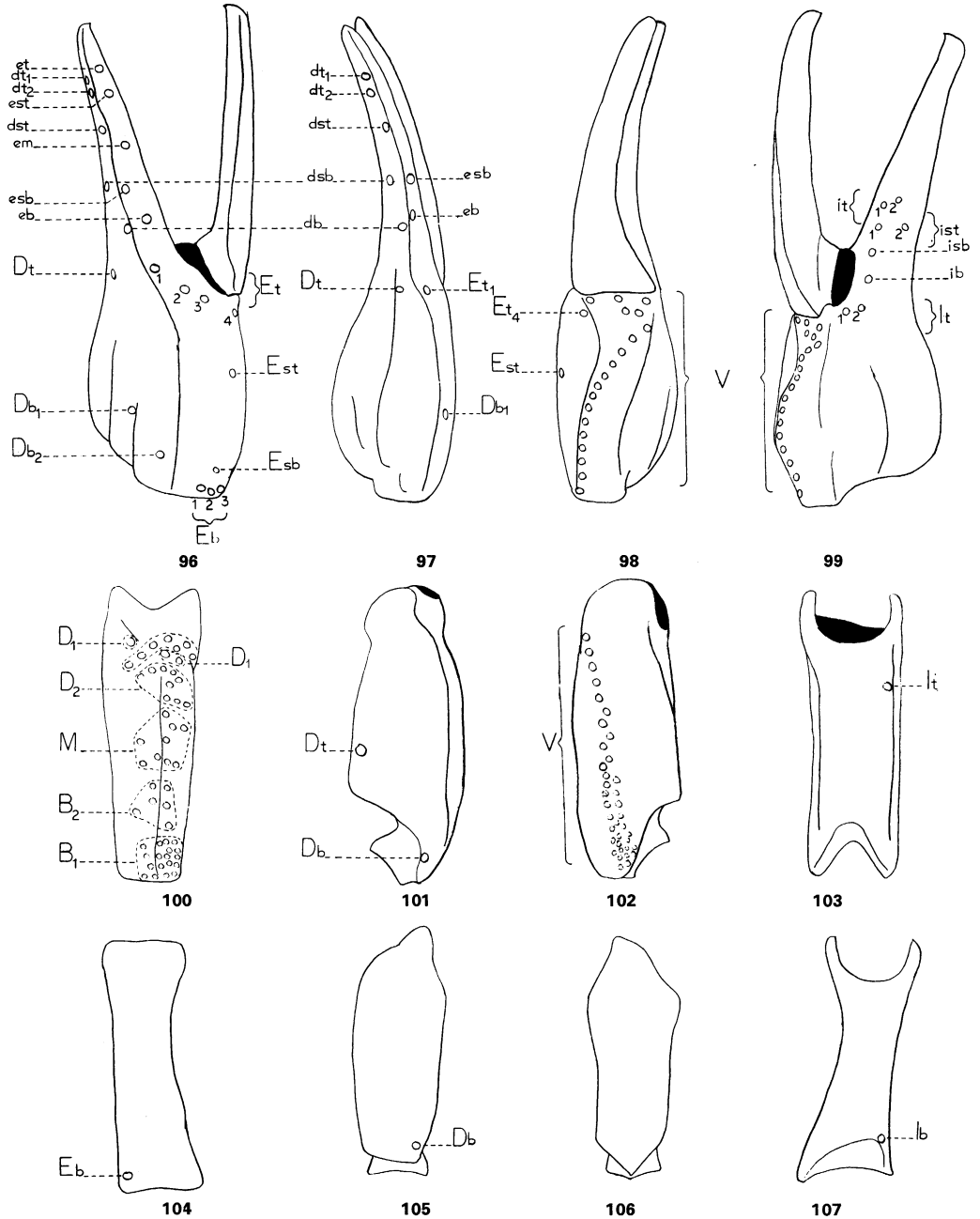
1. Lower margin of movable finger of chelicera with well-formed teeth or sharp denticles . . . 2
Lower margin essentially smooth 5
2. Inferior median keels of caudal segments I and II smooth or obsolete 3



FIGS. 84-95. *Anuroctonus phaeodactylus* (Wood), trichobothrial pattern of female pedipalp. 84. Chela, exterior view. 85. Chela, dorsal view. 86. Chela, ventral view. 87. Chela, interior view. 88. Tibia, exterior view. 89. Tibia, dorsal view. 90. Tibia, ventral view. 91. Tibia, interior view. 92. Femur, exterior view. 93. Femur, dorsal view. 94. Femur, ventral view. 95. Femur, interior view.

- Inferior median keels of caudal segments I and II present and crenulated 4
- 3. Inferior median keels of caudal segments I and II smooth; telson slightly broader than caudal segment V; adults dark mahogany brown *mordax* Thorell
- Inferior median keels of caudal segments I and II obsolete; telson much broader than caudal segment V; yellowish species from Samwell Cave, California *grahami*, new species
- 4. Pectinal tooth count: eight for females, nine for males; telson as wide as caudal segment V; movable finger of pedipalp with six super-numerary teeth; southern Arizona *huachuca*, new species
- Pectinal tooth count: 10 or more for females, 12 or

- more for males; telson broader than caudal segment V; movable finger with seven super-numerary teeth; Baja California *cazieri*, new species
- 5. Movable finger of chelicera with one subdistal tooth 6
- Movable finger with two subdistal teeth 7
- 6. Carapace with mottled dark pattern; three lateral eyes on each side; fixed finger of chela shorter than width of palm *monterius*, new species
- Carapace uniform brown; only two lateral eyes on each side; fixed finger of chela longer than width of palm *sequoia*, new species
- 7. All caudal segments longer than wide 8
- At least caudal segment I wider than long 9

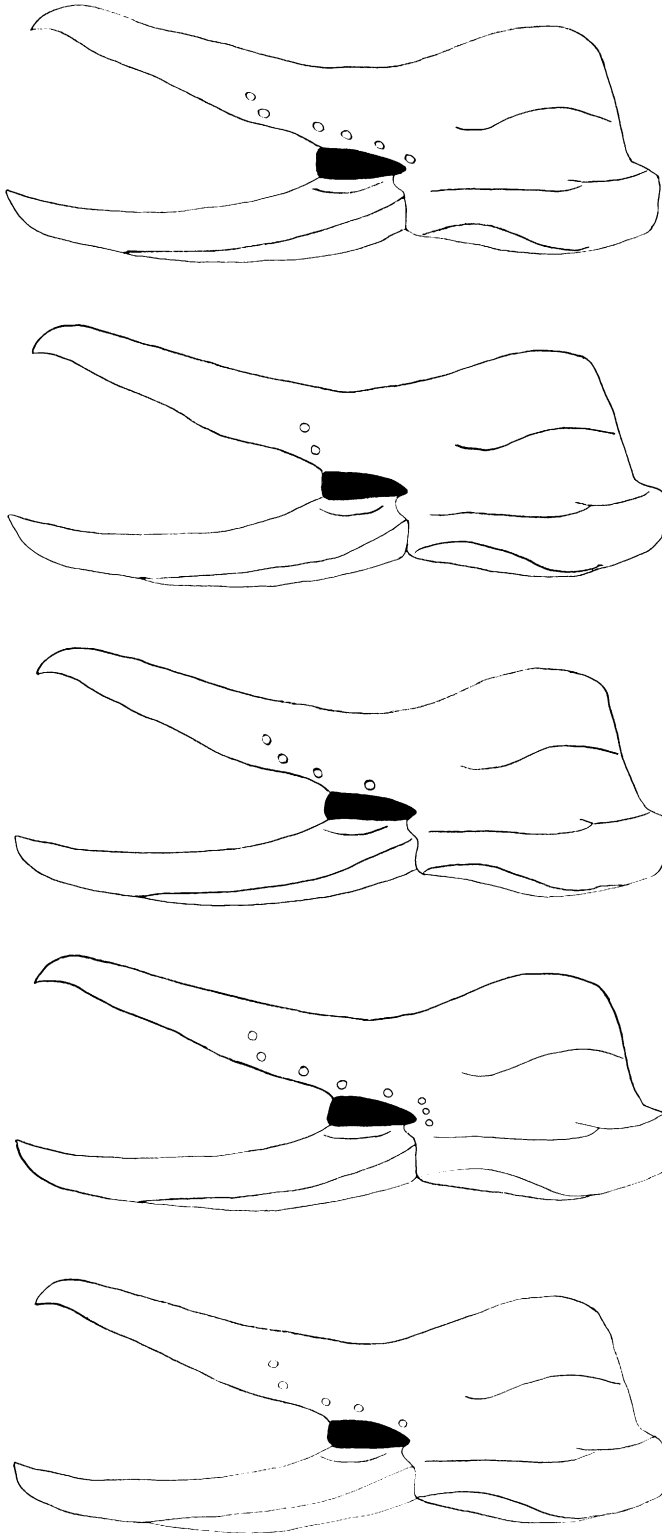


FIGS. 96-107. *Hadrurus arizonensis* Ewing, trichobothrial pattern of female pedipalp. 96. Chela, exterior view. 97. Chela, dorsal view. 98. Chela, ventral view. 99. Chela, interior view. 100. Tibia, exterior view. 101. Tibia, dorsal view. 102. Tibia, ventral view. 103. Tibia, interior view. 104. Femur, exterior view. 105. Femur, dorsal view. 106. Femur, ventral view. 107. Femur, interior view.

8. Chela elongate, with palm twice as long as wide; telson not noticeably inflated at juncture with sting; six ventral trichobothria on palm *bogerti*, new species

Palm of chela not twice so long as wide; telson inflated at juncture with sting; four ventral trichobothria on palm *williamsi*, new species

9. Fixed finger of chela with six and movable finger



108

109

110

111

112

Figs. 108-112. *Hadrurus* species, chelae showing internal trichobothria. 108. *Hadrurus obscurus* Stahnke. 109. *Hadrurus arizonensis* Ewing. 110. *Hadrurus spadix* Stahnke. 111. *Hadrurus aztecus* Pocock. 112. *Hadrurus hirsutus* Wood.

- with seven supernumerary teeth10
 Fixed and movable fingers with six supernumerary teeth *andreas*, new species
10. Telson broader than caudal segment V11
 Telson narrower than caudal segment V12
11. Caudal segment II longer than broad; pectinal tooth count of male 11; carapace granulose; southern California *angelenus*, new species
 Caudal segment II wider than long; pectinal tooth count for female 12, for male 14; carapace essentially smooth; Baja California *lindsayi*, new species
12. Ventral keels of cauda crenulate; carapace finely granulated; caudal segment III wider than long13
 Ventral keels of cauda serrate; carapace coarsely granulated; caudal segment III longer than wide *rufulus*, new species
13. Carapace with mottled pigmentation
 *chicano*, new species
 Carapace essentially of one color
 *apacheanus*, new species

SPECIES OF UNCERTAIN POSITION: *Uroctonus privus* Karsch, 1879, has long been placed as a synonym of *Uroctonus mordax* Thorell. The immature type from the Zoologisches Museum der Humboldt-Universität in Berlin, Germany, has not been seen by us, but Stanley Williams after studying it has assured us that it is not *mordax*. The type locality, "California," undoubtedly has reference to Baja California as preliminary study indicates that *privus* probably came from that fauna.

Uroctonus mordax Thorell

Figures 1-9, 19, 28, 29, 40-51, 113-115, 119, 120, 133, 134

Uroctonus mordax THORELL, 1876, p. 11; "1876" [1877], p. 196; "1893" [1894], p. 374. ПОДОК, 1893, p. 330, pl. 14, fig. 11; 1902, p. 14, pl. 4, figs. 2, 2a-f. KRAEPELIN, 1894, p. 194; 1899, p. 182. BANKS, 1900, p. 424; 1910, pp. 186, 188, fig. 81e. BORELLI, 1908, p. 224. COMSTOCK, "1912" [1913], p. 30, fig. 35; 1940, p. 30, fig. 35. EWING, 1928, p. 15. HOFFMANN, 1931, pp. 402-403. WERNER, 1935, pp. 283, 284. GERTSCH AND ALLRED, 1965, p. 4. PARRISH, 1966, pp. 11, 12, figs.

Vejovis yosemitensis EWING, 1928, p. 11, pl. 2, fig. 3.

DIAGNOSIS: Robust, dark scorpion with heavy pedipalps and following special features: medium to large sized averaging about 40 mm., but in many cases 55 mm. or more in length; carapace quite strongly granulated, with scattered

larger granules; median eyes situated a little in front of middle of carapace; first caudal segment about as broad as long, posterior ones more and more longer than broad; inferior lateral and median keels on caudal segments I and II essentially smooth; pectinal tooth count averaging nine in females, 13 in males; lower margin of movable finger of chelicera with several dark teeth.

COLORATION: General appearance in both sexes (figs. 1, 2) that of reddish, mahogany brown, or blackish species with considerable luster in females, mostly lacking in males, and with scarcely any contrasting markings except whitish conjunctival membranes usually visible on abdomen; younger specimens paler, often dusky or yellowish and with less luster. Carapace, tergites of preabdomen, all of postabdomen, and pedipalpi dark reddish brown, with paler color pattern of spots and bands on preabdomen largely masked by this darker color; sternites of abdomen, walking legs, chelicerae, and pectines pale yellowish brown.

STRUCTURE: Descriptive data (table 1) and illustrations based largely on females from Gurneville, Sonoma County, California. Structure similar in both sexes except as noted below.

Carapace: Dorsal aspect of carapace and preabdomen of female as shown in figure 3. Carapace, 4.5 mm. wide at lateral eyes; anterior margin with deep, rounded emargination at middle, leaving well-rounded lobes on each side; sides and posterior margin straight, with posterior corners rounded; posterior width, 7.7 mm. Entire carapace coriaceous, bare except for few erect bristles, usually bordered by shallow, submarginal trench, and with marginal armature of small granules, with deep depressions near margins opposite median eyes and above posterior corners. Frontal margin of carapace with five to seven principal reddish bristles and smaller ones along edge. Median ocular tubercle elongate oval, of medium height, situated a little in front of middle of carapace, with small anterior groove running forward to revolved margin and narrow, linear posterior median groove running back to revolved margin. Median eyes small, 0.4 mm. in diameter, separated from each other by their diameter. Lateral eyes three (fig. 19) in cluster just above each side margin; third eye smallest, obsolete in some. Entire carapace finely to coarsely granulated over almost entire surface. Frontal lobes

TABLE 1
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus mordax*

	Male	Female	Male	Female
Total length	52.05	53.0	33.25	28.5
Carapace				
Length	7.3	7.55	5.1	4.6
Width at lateral eyes	4.3	4.85	3.1	2.95
Width at caudal edge	7.3	7.8	4.9	4.4
Preabdomen, length	17.5	22.9	12.9	10.5
Postabdomen, length	27.25	22.55	15.25	13.4
Caudal segment I				
Length	3.8	2.15	2.15	1.8
Width	3.5	3.55	2.4	2.25
Caudal segment II				
Length	4.6	3.8	2.4	2.1
Width	3.1	3.1	2.15	1.9
Caudal segment III				
Length	4.85	4.05	2.7	2.3
Width	2.95	2.95	2.05	1.8
Caudal segment IV				
Length	5.4	4.6	2.9	2.6
Width	2.7	2.7	1.9	1.65
Caudal segment V				
Length	8.6	7.95	5.1	4.6
Width	2.5	2.5	1.8	1.6
Telson, length	8.2	7.8	5.1	4.6
Vesicle				
Length	5.4	5.0	3.5	2.95
Width	2.95	2.9	2.15	1.8
Depth	2.7	2.6	1.6	1.5
Sting, length	2.8	2.5	1.7	1.6
Pedipalp, length	26.1	24.4	16.05	15.45
Femur				
Length	6.7	6.2	4.2	3.8
Depth	2.4	2.4	1.8	1.6
Tibia				
Length	6.5	6.2	4.3	3.8
Depth	3.2	3.55	2.15	2.15
Chela, length	12.9	12.0	7.55	7.85
Palm length	6.7	6.7	4.6	4.1
Palm width	5.4	5.65	3.35	3.1
Palm depth	4.3	4.3	2.8	2.5
Fixed finger, length	5.0	5.1	3.8	3.1
Movable finger, length	7.55	7.1	4.7	4.15
Pectines				
Teeth	13/12	11/12	12/12	9/9
Middle lamellae	9/9	7/7	7/7	6/6

and ocular region in many cases rather smooth and polished, but in some with few or numerous coarse granules; lateral wings behind and on sides liberally provided with coarse granules. Granulation of carapace variable, seemingly much coarser in some specimens of same sex.

Males with denser granulation, with more heavy granules and row of these on each side of median groove in front of eyes.

Preabdomen: Of female (fig. 3) broader than that of male, with much broader tergites. All tergites essentially bare, with few erect bristles

mostly on posterior margins; tergites of females quite smooth and shiny as seen under low power, finely and densely granulated under higher power, with only faint traces of median keel still persistent; tergites of male with less luster and uniformly granulated. Tergite VII granulose, with granules along side margins, elevated on each side and there bearing two rather weak keels set with granules, and with many granules flanking them. All sternites smooth and shiny. Stigmata short, oval slits (fig. 9).

Cauda: Dorsal and ventral views as shown in figures 4-6. In both sexes widest at base, gradually but only slightly narrowed to apex. First caudal segment as broad as or slightly broader than long; posterior caudal segments longer than broad as shown in measurement chart (table 1). Dorsal and superior lateral keels of segments I-IV prominent, provided with rows of heavy granules of quite regular size to give serrate appearance, without unusual development of those at posterior ends of series. Lateral keels weak, consisting of row of scattered granules on following segments: running length of segment I, in apical half of segments II and III, in apical third of segment IV, and missing on segment V. Inferior lateral keels of these segments well developed, those of segment I mostly smooth, of segment II mostly smooth but often crenulate in apical third, of segment III crenulated, and lateral keel of segment IV usually granulated to crenulate or serrate condition. Inferior median keels essentially the same. Most keels of segment V prominent; dorsal keels rounded, set with rows of granules, superior lateral keels reduced to row of granules in basal half; inferior lateral keels with serrate granules; single inferior median keel bifid at apex, with serrate granules, with numerous granules in dorsal intercarinal spaces. All segments with a few bristles below and on sides, those on ventral face in quite regular pairs from segments I-V as follows: 3-3-3-4-4, with a few additional single or pairs of shorter ones.

Telson: See figures 133, 134. Sting moderately curved, about half as long as vesicle. Vesicle wider than fifth caudal segment, flattened above, elongate-oval, evenly convex, with a pair of bristles at juncture with sting on inconspicuous subaculear nodule. Telson of male somewhat wider than that of female.

Pectines: Those of female (fig. 7) rather small for size of animal. Median piece twice as broad as

long, with small emargination in front; pectin length one and one-third that of median piece; marginal area composed of three segments, with basal one longer than other two; middle lamellae consisting of seven, mostly rounded pieces; fulcra subtriangular, 10 in number; pectinal teeth, 10, apical one somewhat longer. Teeth in other females, 7-12, with average of nine. Pectines of male (fig. 8) considerably larger; median piece with small emargination in front; pectin length two and one-half times as long as median piece; marginal area like that of female; middle area consisting of nine or 10 rounded pieces; fulcra, 13; teeth, 13, longer and heavier than those of female. Teeth in other males 12 but mostly 13.

Genital operculum: In female (fig. 7) consisting of two rounded, sclerotized valves, separated by deep, linear fissure but free only in posterior third. In male (fig. 8) valves smaller, more pointed in front, free for most of length; genital papillae conspicuous, pointed fingers generally plainly visible, but less developed in young males.

Chelicerae: See figures 28, 29. Basal segment of medium size, with brush of fine, whitish hairs on inner, ventral side. Fixed finger with four teeth on upper margin of which distal tooth is much larger and basal pair forms compound tooth; lower margin with rounded, shiny, indistinct keel. Movable finger with five strong teeth on upper, external side; lower margin with heavy distal tooth and heavy keel bearing five dark, evenly spaced teeth. In other females dentition of keel on lower margin of movable finger variable, rarely smooth, in many cases merely crenulate, with mixed crenulations and dark teeth, or with variable crenulations and dark teeth up to about nine.

Pedipalps: Similar in both sexes, with heavy hands as shown in figures 114, 115. Femur in lateral view two and one-half times as long as broad, flattened on sides, with keels strongly angled and coarsely granulated: intercarinal areas with numerous small granules; frontal face with four sharp granules. Tibia about twice as long as broad, produced below behind middle into two projections, each bearing two spinose granules; all keels distinct and granulated. Chela greatly thickened, flattened above and on sides, rounded below, with four variously developed principal and two or three accessory keels as follows: superior keel prominent, quite smooth,

pitted, flanked by fine granules, lying in middle of hand and running into fixed finger; inner accessory keel weakly developed, evident as finely granulose stripe; outer accessory keel present, smooth, irregularly pitted, somewhat crenulated, running to inner edge of movable finger; inner keel a rounded ridge, bearing rows of heavy granules; outer keel an angled ridge, smooth, crenulated, with some heavy granules; inferior keel rounded, with many granules; inner ventral keel absent. Inner keel of fixed and movable fingers (figs. 119, 120) with small granules forming lightly curved row, faintly scalloped, and indistinctly broken by somewhat larger granules into six files, flanked by large supernumerary teeth, seven on fixed and eight on movable finger; basal file more than twice as long as others.

Walking legs: Legs sparsely provided with reddish bristles. Tarsi with sharp, pointed process at base of paired claws and ventral row of 8–10 spinules. Metatarsi with subdorsal row of spinules and two ventral rows on first three legs, these lacking on fourth leg.

TYPE DATA: Of *Uroctonus mordax* Thorell, presumed female type from California, in Zoologiska Institutionen, Stockholm, Sweden. Of *Vejoavis josemitensis* Ewing, male type from under rocks at the base of Yosemite Falls, Yosemite Valley, California, in the National Museum of Natural History, Smithsonian Institution.

DISTRIBUTION: *Uroctonus mordax*, described from "California" was likely based on a specimen from the San Francisco region. In 1893 Thorell recorded his *mordax* from Guatemala but it is certain that his record was based on falsely labeled specimens. Werner (1935) cited both California and Guatemala. In 1900 Banks gave the distribution as "The West Coast," Hoffmann (1931) stated that in Mexico *mordax* was found only in Baja California but gave no precise locality information. Our studies suggest that the species occurs only in Oregon and California and is largely replaced in southern California and entirely in northern Baja California by distinct taxa.

At present *mordax* is known from eight counties of Oregon and about 30 counties of California as shown by the spot map (fig. 113). This map is intended to show a general distributional pattern with each spot covering one or several collections from the same or nearby localities. In Oregon the species ranges in the humid western

part and nearly reaches the Columbia River in Wasco County. In California the species is common in the coastal area south to Santa Cruz County, in the northern Cascades, and through the Sierras south to Kern and Los Angeles counties. The hypothetical range includes suitable habitats south of the mapped area but at present we have no positive records. Banks's 1900 records for Lakeside (San Diego County) and Santa Rosa Island (Santa Barbara County) are dubious and need verification.

The records below, arranged alphabetically by counties, include only locality information

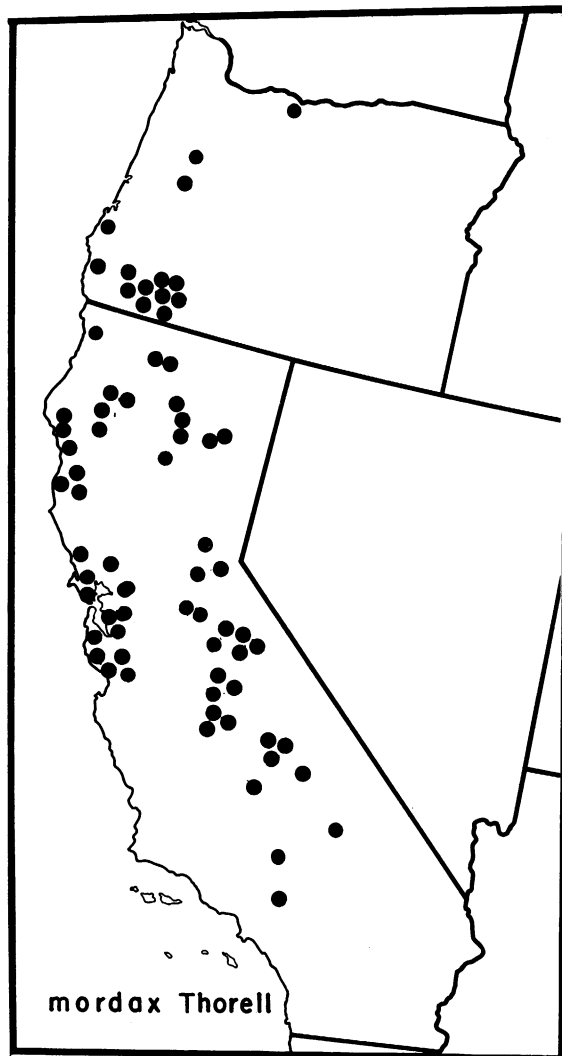
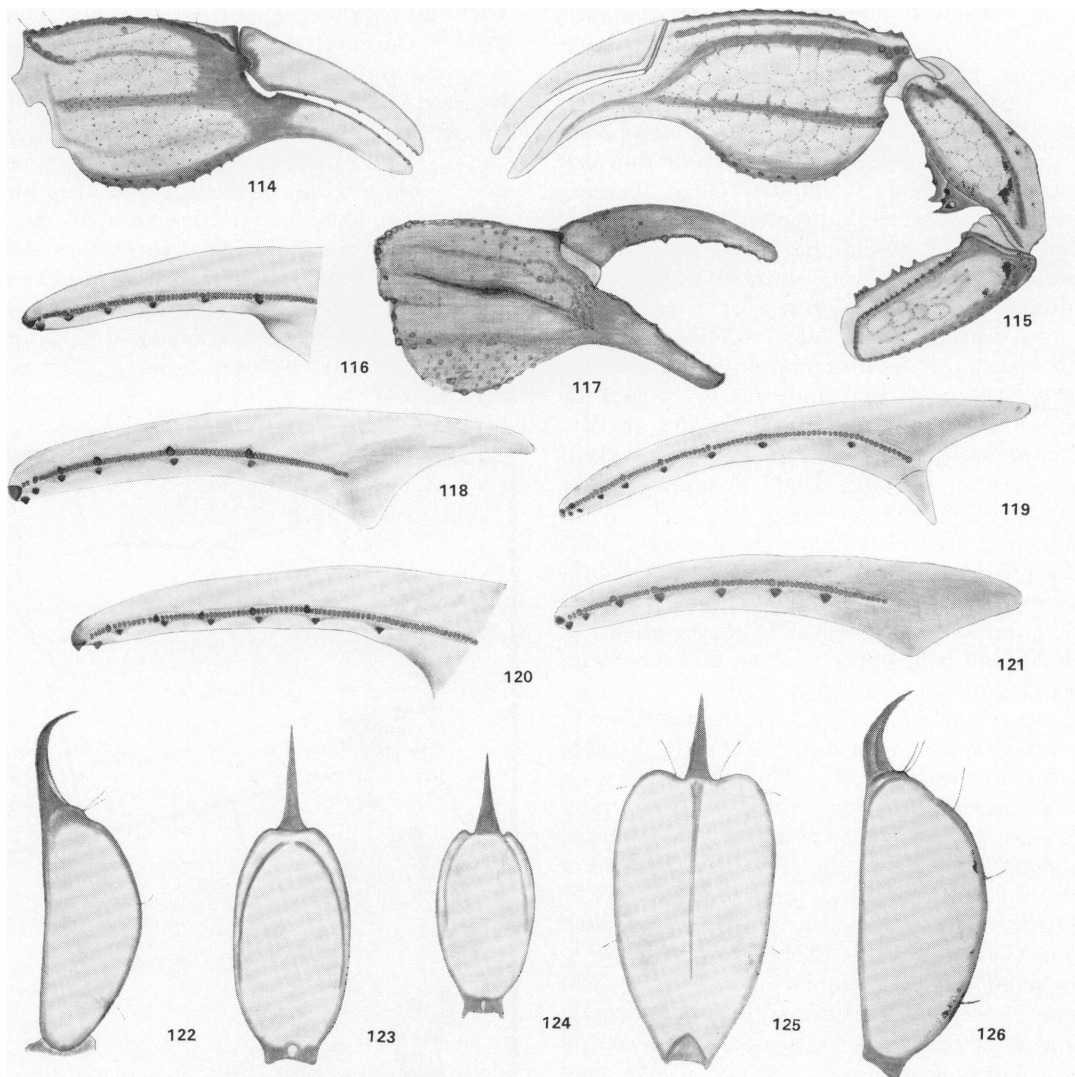


FIG. 113. Distribution map of *Hadrurus mordax* Thorell.



FIGS. 114, 115. *Uroctonus mordax* Thorell, female. 114. Right chela, interior view. 115. Right pedipalp, exterior view.

FIGS. 116-118. *Uroctonus huachuca*, new species, female. 116. Fixed finger of chela, inner view. 117. Left chela, exterior view. 118. Movable finger of chela, inner view.

FIGS. 119, 120. *Uroctonus mordax* Thorell, inner view of fingers of chela. 119. Movable finger. 120. Fixed finger.

FIG. 121. *Uroctonus angelenus*, new species, inner view of fixed finger.

FIGS. 122, 123. *Uroctonus bogerti*, new species, telson of male. 122. Lateral view. 123. Dorsal view.

FIG. 124. *Uroctonus angelenus*, new species, telson of male, dorsal view.

FIGS. 125, 126. *Uroctonus williamsi*, new species, telson of female. 125. Dorsal view. 126. Lateral view.

and ecological data when available. The hundreds of recorded specimens were taken mostly during the warmer months of the year but others were taken during every month except

December and January. Represented during the entire period were males and females and immature specimens in all stages of these perennial scorpions.

RECORDS: *Oregon*: Coos County: Coquille. Curry County: Gold Beach. Grant County: John Day Gorge; 5 mi. E Forest Glen. Jackson County: McAllister Soda Springs, 3000 ft.; Siskiyou Summit, 4500 ft.; Little Applegate River, 2300 ft.; Rogue River, near Military Bridge at Camp White; Butte Falls; Quenton; 2 mi. W Selma; 3.2 mi. S Ruch, under log chips and loose bark of pine stumps. Josephine County: Grants Pass; Sunny Valley. Lane County: Eugene; top of Spencer Butte, 2050 ft, Eugene. Linn County: Lebanon (Borelli, 1908). Wasco County: 8 mi. W Rowena, under volcanic rocks. *California*: Alameda County: Oakland; foothills above Fremont; Strawberry Canyon, Berkeley; Regional Park, along Welch Creek, 725 ft. Sunol Valley; Mines Road, San Antonio Valley. Calaveras County: Near Shaw's Cave, 1.6 mi. NW Murphys, under rocks in dry creek area of live oak and pine; Calaveras Big Trees; Dorrington. Contra Costa County: Lafayette; El Cerrito; Mt. Diablo: 9 mi. NW Clayton, 950 ft; 11 mi. SW Clayton, 1250 ft; 13 mi. S Clayton, on east facing slope in oak woodland on loamy soil. Del Norte County: Gasquet; junction of Dunn Creek and East Fork. Eldorado County: Kyburz; Crystal Cave, Somerset; Snowline Camp; Pollock Pines. Fresno County: Shaver Lake; Cedar Grove, Kings Canyon National Park; 3 mi. N Pinehurst. Humboldt County: Miranda; Richardson Redwood Grove; 2 mi. S Weott, in redwoods; Willow Creek and 10 mi. W. Inyo County: Olancho. Kern County: Green Mountain, 6200 ft; Paradise Valley, Tehachapi Mountains, under bark of dead pine. Lassen County: Manzanita Lake, 5800 ft.; Lassen National Park. Los Angeles County: Tanbark Flat, San Gabriel Mountains. Madera County: Northfork; Nelden Grove. Marin County: Kent Lake; Mill Valley, in chaparral zone and among redwoods; Inverness; Novato; $\frac{1}{2}$ mi. S of mouth of Bear Valley, Point Reyes National Seashore; Mt. Tamalpais State Park: Bootjack Camp, 2500 ft., 5 mi. N Fairfax, Matt Trail, under rocks; Lily Lake, 2 mi. E Alpine Reservoir, 800 ft. in redwood ravine under logs. Mariposa County: Yosemite Falls, Yosemite National Park; 14 mi. N Oakhurst, 5100 ft.; 3 mi. NW Fish Camp, 6000 ft; 4 mi. S of Miami Ranger Station. Mendocino County: Percy and 5 mi. N, under rocks and ground debris; 5 mi. E Anchor Bay; Longvale; 2 mi. W Novarro, from road cuts in redwood forest; Mendocino; Men-

docino Woodlands Camps, 9 mi. E and 12.8 mi. NE Mendocino, 80 to 150 ft., under rocks in redwood forest; 9 mi. S Albion. Napa County: Samuel Springs; 5 mi. N Pope Valley, 1200 ft., under rocks in manzanita; NW St. Helens, 280 ft., under rocks in chaparral community; Rattlesnake Spring, S of Lake Berryessa under rock in digger pine area; west side of Lake Berryessa, 2 mi. S Spanish Flat, 550 ft.; White Sulphur Springs, 2 mi. S Calistoga, under bark of fallen tree; 0.6 mi. N Robert L. Stevenson State Park, under bark of wet log. Placer County: Auburn. San Diego County: Lakeside (Banks, 1900), a dubious record, not mapped. Santa Barbara County: Santa Rosa Island (Banks, 1900), a dubious record, not mapped. San Mateo County: Redwood City. Santa Clara County: Arroyo Mocho, Mt. Hamilton; Alum Rock Park; Gilroy Hot Springs; Scott's Valley; Loch Lomond Reservoir; 10 mi. S of Holy City; 5 mi. S of Redmond Estates, on Loma Prieta road, in Douglas fir area. Santa Cruz County: Ben Lomond; near Sarasota; Big Basin State Park. Shasta County: Hazel Creek; Montgomery Creek, Shingletown; Bear Creek, near Whitmore; Old Shasta; Hat Creek; Barney. Solano County: Cerada Ranch, S Cordelia. Sonoma County: Gurneville and 1 mi. S; Agua Caliente Park; 6 mi. W Geyserville, along Skaggs Springs Road, 2675 ft. Tehama County: 25 mi. E Covelo, 5300 ft. Trinity County: Del Loma; 2 mi. E Hayfork Summit; Butter Creek, 12 mi. SE Hampon, 3400 ft. Tulare County: Springville; 2 mi. E California Hot Springs; Soda Creek, Moorehouse Creek, and McIntire Creek near Camp Nelson; 6 mi. W, 10 mi. W Johnsondale, and Kern River at Johnsondale; Sequoia National Park; crest of Redwood Mountain, near main camp headquarters, and near Ash Mountain. Tuolumne County: 4 mi. W Pinecrest; Strawberry; Long Barn; Yosemite National Park: Rocky Point, valley floor and base of El Capitan, Wawona Campgrounds, Bridalveil Falls moraine and Ski-Hill valley floor.

Uroctonus huachuca, new species

Figures 64-67, 116-118

DIAGNOSIS: Smaller, more slender scorpion resembling *mordax* in general appearance but differing in following features: average size

about 30 mm., some female specimens 40 mm. long; median eye tubercle placed well in front of middle of carapace; pectinal tooth count averaging eight for females and nine for males; fingers of chela stouter and proportionally shorter in comparison with palm; lower margin of movable finger of chelicera crenulate, with a few pale teeth but lacking dark ones; inferior lateral and median keels of basal segments of cauda granulated.

ETYMOLOGY: This species is named for the Huachuca Mountains of Arizona.

COLORATION: Base color in most cases paler than that of *mordax*, varying from tan to dark reddish brown. Mature specimens with carinae of pedipalps and cauda darkly pigmented in contrast to lighter body color. Legs and telson light yellow. Juveniles entirely pale yellow until subadult stages.

STRUCTURE: Similar to that of *mordax* in basic features unless otherwise indicated. Descriptive data and measurements (see table 2) based largely on specimens from Carr Canyon, Huachuca Mountains, Arizona. Structure similar in both sexes unless otherwise noted.

Carapace: Finely granulated over most of surface; ocular triangle mostly devoid of heavy granulation; lateral wings with somewhat heavier granulation; frontal margin with six short setae. Frontal emargination well rounded. Ocular tubercle far in advance of middle of carapace. Median eyes small, 0.22 mm., separated by about their diameter. Lateral eyes three; posterior eye smallest, in many cases missing.

Preabdomen: Basal tergites relatively smooth, very finely granulated; apical ones with more larger granules; tergite VII with well-developed pair of keels on each side, each keel provided with about 10 large, rounded granules, and intercarinal spaces with small, inconspicuous granules.

Cauda: First caudal segment of female distinctly broader than long; second segment about as broad as long. First caudal segment of male about as broad as long; second segment longer than broad. All keels prominent and distinctly granulated to give serrated appearance in lateral view; single inferior median keel of segment V not at all or only weakly bifid at apex; intercarinal spaces of segment V lacking heavy granules.

Telson: Similar to that of *mordax*; vesicle about

as wide as caudal segment V; sting about half as long as vesicle.

Pectines: Like those of *mordax* but with fewer elements. Middle lamellae, five in both sexes; pectinal teeth, eight in females, nine (or rarely eight) in males; outer pectinal tooth distinctly larger than others.

Chelicerae: Like those of *mordax* except as follows: keel on lower margin of movable finger smooth, lightly crenulated, or with few pale nodules; with row of delicate serrulae on lower edge of tip of movable finger.

Pedipalps: All keels on femur and tibia granulated. Frontal spurs on tibia prominent with one granule per spur, but not so sharp as those of *mordax*. Chela (fig. 117) stout, with movable finger as long as palm; superior keel prominent, quite smooth; granulation and position of keels like those of *mordax*. Six inner flanking teeth on fixed and movable fingers (figs. 116, 118). For trichobothrial pattern see figures 64-67.

Walking legs: With basic spination of *mordax* but setae fewer and stouter; single row of spines on venter of tarsus with row of evenly spaced, short setae on each side.

TYPE DATA: Female holotype, and three other females, from Madera Canyon, Santa Rita Mountains, Santa Cruz County, Arizona, June 7, 1952 (W. J. Gertsch) in collection of the American Museum of Natural History.

DISTRIBUTION: Known only from the Santa Rita and Huachuca mountains of southern Arizona.

RECORDS: *Arizona:* Santa Cruz County: Santa Rita Mountains: Madera Canyon, July 21-26, 1954 (W. A. McDonald), two males and one female, all subadult; August 17-20, 1955 (W. A. McDonald), male; June 7, 1952 (W. J. Gertsch), female. Roundup Camp, Madera Canyon, March 23, 1960 (W. J. Gertsch, W. Ivie, R. Schrammel), subadult male and female; May 20, 1963 (W. J. Gertsch, W. Ivie), subadult female. Cochise County: Huachuca Mountains: Upper Carr Canyon, 7500 ft., August 6-10, 1952 (H. B. Leech, J. W. Green), two males. Carr Peak trail, 7000 ft., September 20, 1969 (J. Burkhart), two males, six females, one with 70 young, from under rocky slabs in deep pine needles. One-half mi. E campground, Ree's Road, 14 mi. S Sierra Vista, 7500 ft., June 5, 1969 (M. A. Cazier, J. Bigelow), male from rocky outcrop. Deep in Miller's Canyon, July 22-24, 1958 (M. E. Sologlad, D. S. Doug-

lass), four males, four females, male and female juveniles, from under rocks in very damp, dark earth.

***Uroctonus apacheanus*, new species**

DIAGNOSIS: Smaller, more slender, more granulated scorpion than *huachuca*, readily distinguished by following features: average length about 25 mm., with some females attaining 35 mm.; median eye tubercle placed well in front of middle of carapace; frontal emargination on carapace less deep than that of *huachuca*; pectinal tooth count averaging 10 for females, 11 for males; lower margin of movable finger of chelicera essentially smooth; chela smaller than that of *huachuca*, with hand less inflated.

ETYMOLOGY: Named for the Apache Indians who lived in and ranged widely throughout the area where this species occurs.

COLORATION: Similar to that of *huachuca*, quite uniform tan to dark reddish brown, with all carinae darker.

STRUCTURE: Similar to *huachuca* in basic features unless otherwise indicated. Descriptive data and measurements (table 2) based largely on specimens from Portal, Cochise County, Arizona. Structure similar in both sexes except as noted.

Carapace: In both sexes densely provided with medium-sized granules; frontal margin with six short setae. Frontal emargination shallowly rounded. Ocular tubercle far in advance of middle of carapace. Median eyes small, 0.19 mm., separated by full diameter. Lateral eyes typically three in number; posterior eye smallest, often missing.

Preabdomen: All segments liberally provided with medium-sized granules, most numerous in males; tergite VII with prominent keels, each one with about 15 large, rounded granules, and intercarinal spaces with numerous large granules.

Cauda: First and second caudal segments of both sexes distinctly broader than long; third segment about as broad as long. All keels prominent, distinctly granulated to give serrated appearance in lateral view, with distal granule in each series raised on sharp point; single inferior median keel of segment V distinct to apex; intercarinal spaces on segment V with many heavy granules above and on sides.

Telson: Similar to that of *huachuca*: vesicle

somewhat narrower than fifth caudal segment, smooth above, lightly granulated below and around sides, especially near base; sting about half as long as vesicle.

Pectines: Like those of *huachuca* but with more elements. Middle lamellae, six in females, seven in males; pectinal teeth, nine or 10 in females, 10 or 11 in males; outer tooth larger than others.

Chelicerae: Keel on lower margin of movable finger essentially smooth, in few cases slightly crenulated, but without development of distinct denticles.

Pedipalps: Chela of medium stoutness, with movable finger somewhat shorter than palm; palm narrower, not inflated on inner side. Superior carina prominent, crenulate to lightly granulated; all other carinae granulated. Inner flanking teeth of fixed finger, six, of movable finger, seven.

Walking legs: With basic spination of *huachuca*, with relatively short spines; single row of spinules on venter of tarsus not flanked by short setae.

TYPE DATA: Female holotype from the Southwestern Research Station grounds, 5400 ft., 5 mi. SW Portal, Cochise County, Arizona, July 1, 1967 (V. Roth), in the collection of the American Museum of Natural History.

DISTRIBUTION: Mountains of southern Arizona, New Mexico, and western Texas.

RECORDS: *Arizona:* Cochise County: Chiricahua Mountains: Southwestern Research Station, 5400 ft., 5 mi. W Portal, June–August (V. Roth, W. J. Gertsch, E. Ordway, etc.), many males, females, immatures. Portal, March–August (W. J. Gertsch), males, females. Paradise road, 3 mi. W Portal, March 23, 1969 (J. Bigelow), female, with young. Two mi. W Portal, July 23, 1969 (J. Bigelow), female. South Fork of Cave Creek, 5000 ft., July 22, 1969 (M. A. Cazier, J. Bigelow), female. Thirteen to 16 mi. W Portal on Rustler Park road, July 31, 1965 (S. C. Williams), males, females, immatures, under flat rocks in clearings on sloping hillsides, pine and pine-oak communities. Rustler Park to 1½ mi. N, 8200 to 8600 ft., July 22, 1969 (M. A. Cazier, J. Bigelow), males, females, immatures, along road cuts, rock outcrops and cliffs. Onion Saddle to 3 mi. SE, 6500 ft. to 7600 ft., July 21, 1969 (M. A. Cazier, J. Bigelow), males, females, immatures, along road cuts. *Graham County:* Dry camp, Mt. Graham, near Safford, July 14, 1956 (W. J. Gertsch, V. Roth). *Pima County:* Molino Basin, Santa Catalina

TABLE 2
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus huachuca* AND *apacheanus*

	Male <i>huachuca</i>	Female <i>huachuca</i>	Male <i>apacheanus</i>	Female <i>apacheanus</i>
Total length	38.7	35.7	22.8	20.8
Carapace				
Length	5.3	5.5	3.5	3.9
Width at lateral eyes	2.8	3.0	1.8	2.0
Width at caudal edge	5.1	5.2	3.2	3.4
Preabdomen, length	13.0	12.6	7.9	6.3
Postabdomen, length	20.4	17.6	11.4	10.6
Caudal segment I				
Length	2.8	2.4	1.4	1.4
Width	2.8	2.8	2.0	2.0
Caudal segment II				
Length	3.1	2.8	1.7	1.6
Width	2.8	2.6	1.9	1.7
Caudal segment III				
Length	3.5	2.9	1.8	1.7
Width	2.6	2.5	1.8	1.8
Caudal segment IV				
Length	4.3	3.6	2.4	2.2
Width	2.4	2.3	1.8	1.7
Caudal segment V				
Length	6.7	5.9	4.1	3.7
Width	2.4	2.1	1.7	1.7
Telson, length	6.5	5.7	4.3	3.9
Vesicle				
Length	4.6	3.9	2.8	2.8
Width	2.4	2.4	1.5	1.5
Depth	2.0	2.0	1.2	1.2
Spine, length	1.9	1.7	1.5	1.2
Pedipalp, length	18.0	18.1	12.2	12.4
Femur				
Length	4.7	4.7	3.2	3.2
Depth	1.7	1.7	1.2	1.2
Tibia				
Length	4.9	5.0	3.3	3.3
Depth	2.0	2.0	1.3	1.5
Chela, length	8.4	8.4	5.7	5.9
Palm length	4.7	4.7	3.2	3.2
Palm width	3.9	3.8	2.4	2.5
Palm depth	2.7	2.7	1.95	1.9
Fixed finger, length	3.5	3.5	2.4	2.4
Movable finger, length	4.7	4.6	3.2	3.2
Pectines				
Teeth	9/9	8/8	11/10	10/10
Middle lamellae	9/5	8/5	7/7	6/6

Mountains, July 24, 1965 (W. J. Gertsch), female. Brown Canyon, Baboquivari Mountains, July 19, 1959 (V. Roth), three females, immatures; April 22, 1961 (W. J. Gertsch), females. Santa Cruz County: 1½ mi. SW Pena Blanca Lake, September 2, 1967 (R. S. Funk),

female. South end of Pena Blanca Lake, March 21, 1967 (V. Lee), two males, seven females, under rocks in oak woodland. Sycamore Canyon, Atascosa Mountains, March 21, 1967 (V. Lee), female, under rock in oak-grassland; June 21, 1969 (M. A. Cazier, J. Bigelow), male, fe-

male. Madera Canyon, Santa Rita Mountains, August 22, 1966 (S. C. Williams), female with second instar young from under rock; March 22, 1967 (V. Lee), female, under stone in pinion woodland; August 22, 1966 (S. C. Williams), male, female, under rocks above stream; August 16, 1942 (C. M. Bogert), two females. $7\frac{1}{2}$ mi. NE Patagonia, October 21, 1965 (W. Minckley), female. *New Mexico*: Eddy County: Whites City, October 5, 1961 (W. J. Gertsch), four immature. *Texas*: Val Verde County: Painted Rock Railroad cut, on west bank of Amestad Reservoir, 1000 ft., September 6, 1969 (M. A. Cazier, J. Bigelow), male. Jeff Davis County: Elbow Canyon Creek, 5800 ft., Davis Mountains, 21 mi. NW Fort Davis, August 26, 1967 (W. J. Gertsch, R. Hastings), two males, female, immature. Brewster County: The Basin, 6000 ft., Chisos Mountains, Big Bend National Park, August 25, 1967 (W. J. Gertsch, R. Hastings), three males, female, immatures, under rocks and ground debris in arroyo.

Uroctonus chicano, new species

DIAGNOSIS: Close relative of *apacheanus*, distinguished by following features: median eye tubercle placed well in front of middle of carapace but closer to center, 36 in *chicano*, 32 in *apacheanus*; carapace with distinct dark mottling; chela heavier, with shorter fingers, chela length over fixed finger length 2.62 in *chicano*, 2.35 in *apacheanus*.

ETYMOLOGY: A vernacular name of the Southwest for various Mexican peoples.

COLORATION: Base color orange-tan with darker mottling on carapace and terga. Eye tubercles black. Keels on cauda and pedipalpi and aculeus dark brown. Walking legs yellow with dusky markings on all segments except tarsi.

STRUCTURE: Similar to that of *apacheanus* except as noted. Descriptive data and measurements as given in table 3.

Carapace: Surface covered with small granules, most noticeable on pigmented areas; frontal margin with six suberect setae. Frontal emargination deep, broadly rounded. Ocular tubercle well in advance of middle of carapace. Median eyes small, 0.17 mm., separated by their diameter. Lateral eyes three; posterior eye small, set above principal pair.

Preabdomen: Posterior half of first six tergites finely granulated; tergite VII with both pairs of

keels well developed and serrate. First four sternites smooth; fifth sternite rough with fine granulation; keels essentially obsolete.

Cauda: Dorsal and dorsal lateral keels on segments I-IV serrate; inferior lateral keels of these segments serrate, and inferior median keels irregularly serrate. Lateral keels present on segments as follows: irregular serrate row on I, on posterior half of II, on posterior third of III, and essentially obsolete on IV except for scattered granules in intercarinal spaces. Keels on segment V as follows: dorsal keel crenulate; lateral keel irregular on anterior three-fourths; inferior lateral and single median keel serrate; intercarinal spaces essentially smooth, with some scattered granulation.

Telson: Sting sharply curved, delimited from vesicle by slight basal swelling; vesicle with about six pairs of setae on ventral surface.

Pectines: Like those of *apacheanus*; middle lamellae, five; pectinal teeth, nine.

Chelicerae: With normal dentition; lower margin of movable finger smooth except for line of serrulae.

Pedipalps: All keels on femur and tibia granulated. Femur two and one-half times as long as wide; tibia twice as long. Superior keel on chela smooth anteriorly, becoming rough posteriorly; outer accessory keel irregular, weak anteriorly; outer keel with rounded granules posteriorly; inner ventral keel essentially obsolete; inferior keel with rounded, irregular granules; inner secondary keel with large granules posteriorly; inner accessory keel smooth anteriorly but granulated posteriorly. Supernumerary teeth on fixed finger, six, on movable finger, seven. Trichobothria ib and it positioned directly above articular membrane.

Walking legs: Single ventral row of spinules on venter of tarsus small and delicate, flanked by three pairs of delicate setae.

TYPE DATA: Female holotype from 1 mi. E La Saucedá, Chihuahua, Mexico, 7000 ft., July 21, 1947 (W. J. Gertsch), in collection of the American Museum of Natural History.

DISTRIBUTION: Known only from above specimens.

Uroctonus bogerti, new species

Figures 17, 18, 68-71, 122, 123

DIAGNOSIS: Medium-sized scorpion with long, thin cauda and heavy, elongated pedipalps,

with basic characters of *mordax* except as follows: mature females about 45 mm. in length; median eye tubercle situated well in front of middle of carapace; pectinal tooth count of female 12, of male 14; lower margin of movable finger of chelicera essentially smooth; palm of chela

large, twice as long as wide; inferior lateral and median keels of basal segments of cauda granulated, with crenulated margins.

ETYMOLOGY: This species is dedicated to Dr. Charles M. Bogert, Curator Emeritus of the American Museum of Natural History, who has

TABLE 3
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus chicano* AND *bogerti*

	Female <i>chicano</i>	Female <i>bogerti</i>	Male <i>bogerti</i>	Female <i>bogerti</i>
Total length	18.6	45.1	38.6	45.2
Carapace				
Length	3.2	7.4	6.2	6.8
Width at lateral eyes	1.7	3.7	3.1	3.5
Width at caudal edge	2.8	6.5	5.3	5.8
Preabdomen, length	6.4	15.0	12.5	16.7
Postabdomen, length	9.0	22.7	19.9	21.7
Caudal segment I				
Length	1.2	3.2	2.7	2.8
Width	1.6	3.0	2.3	2.5
Caudal segment II				
Length	1.3	3.6	3.2	3.5
Width	1.6	2.7	2.2	2.3
Caudal segment III				
Length	1.5	4.1	3.5	3.7
Width	1.6	2.5	2.1	2.2
Caudal segment IV				
Length	1.9	5.0	4.3	4.7
Width	1.5	2.3	1.8	2.1
Caudal segment V				
Length	3.1	6.8	6.2	7.0
Width	1.5	2.2	1.8	2.1
Telson, length	3.2	7.0	5.4	6.8
Vesicle				
Length	2.0	4.5	3.6	4.6
Width	1.4	2.3	1.8	2.0
Depth	1.1	1.9	1.5	1.8
Spine, length	1.2	1.9	1.8	1.9
Pedipalp, length	9.4	26.3	22.8	24.8
Femur				
Length	2.3	6.8	5.7	6.3
Depth	.95	2.3	1.6	2.0
Tibia				
Length	2.6	6.7	5.6	6.3
Depth	1.2	2.7	2.1	2.5
Chela, length	4.5	12.8	11.5	12.2
Palm length	2.6	7.7	6.3	7.3
Palm width	2.0	4.2	3.4	4.1
Palm depth	1.8	2.7	2.4	3.0
Fixed finger, length	1.8	5.0	4.0	4.6
Movable finger, length	2.5	6.7	5.2	6.3
Pectines				
Number of teeth	9/9	12/11	14/13	12/12
Number of middle lamellae	5	6-8	7-8	6

found many new and interesting arachnids in Mexico and the western United States.

COLORATION: Base color of mature specimens dusky reddish brown; legs, sternites of preabdomen, chelicerae, and telson yellowish.

STRUCTURE: Similar to that of *mordax* and in both sexes unless otherwise indicated. For measurements, see table 3.

Carapace: Carapace thickly covered with quite coarse granules over most of surface, those of interocular triangle smaller and heavy row on each side margining this area; frontal margin with six short spines. Frontal emargination deep and rounded. Ocular tubercle of average size, placed well in front of middle, the eyes at this point about one-third distance between front and posterior margin. Median eyes small, 0.3 mm.; separated by nearly their diameter. Lateral eyes (figs. 17, 18) two or three; third eye obsolete in some adult specimens, still present in immature.

Preabdomen: All tergites finely to coarsely granulated, mostly on caudal half; tergite VII with prominent, long keels, of which middle pair is finely granulated and side pair provided with about 30 coarse granules; intercarinal spaces of tergite VII with numerous small and large granules.

Cauda: All caudal segments longer than broad; caudal segment V as long as carapace. All keels prominent, distinctly but finely granulated to give crenulate to serrate appearance in lateral view; single inferior median keel of segment V weakly bifid in holotype, not so in other mature female; intercarinal spaces of segment V with little granulation.

Telson: See figures 122, 123. Vesicle about as wide as caudal segment V, elongate oval, less than half as deep as long, smooth above, lightly granulated below and on sides; sting moderately curved, less than half as long as vesicle.

Pectines: Like those of *mordax* but with more elements. Middle lamellae, eight in female, 10 in male; pectinal teeth, 12 in females, 14 in males; outer pectinal tooth larger than others; median piece with shallow, V-shaped emargination in front.

Chelicerae: Keel on lower margin of movable finger smooth.

Pedipalps: All keels of femur and tibia granulated. Frontal spurs on tibia small, single, rounded projections bearing stout spine. Chela stout, elongated, with palm almost twice as long

as broad; movable finger shorter than palm; position of keels like those of *mordax*; superior keel with numerous granules, distinctly crenulate; all other keels finely granulated and intercarinal spaces with few granules. Trichobothrial pattern as shown in figures 68-71.

Walking legs: With basic spination of *mordax* but spinules minute and spines of small size; single row of spinules on venter of tarsus with irregular row of few fine spines on each side.

TYPE DATA: Female holotype from Snow Creek, San Jacinto Mountains, Riverside County, California, April 27, 1938 (C. M. Bogert), in the collection of the American Museum of Natural History.

DISTRIBUTION: Riverside and San Diego counties of California.

RECORDS: *California:* Riverside County: White-water Canyon, May 27, 1968, female. Palm Canyon, March 27, 1960 (W. J. Gertsch), male, immature female. San Diego County: Mt. Palomar, 3500 ft., June 30, 1956 (W. J. Gertsch, V. Roth), immature female. San Bernardino County: Mountain Home Creek, August 13, 1959 (W. J. Gertsch, V. Roth), immature female.

Uroctonus williamsi, new species

Figures 11, 20, 34, 35, 125, 126

DIAGNOSIS: Large, dusky brown, heavily granulated species similar to *mordax* except as follows: average size about 45 mm. with largest female 54 mm. long; median eye tubercle lying in front of middle of carapace; pectinal tooth count 11 for females, 13 for males; lower margin of movable finger of chelicera smooth; inferior lateral and median keels of basal segments of cauda prominent and granulated; keels on chela crenulate to heavily granulated; vesicle of sting considerably inflated at apex.

ETYMOLOGY: This species is dedicated to Dr. Stanley C. Williams, San Francisco State College, who has made numerous contributions to knowledge of American scorpions.

COLORATION: Of fully adult specimens as follows: carapace dark reddish brown, with granules on keels and eye tubercles blackish; preabdomen and cauda dusky brown; pedipalps dark reddish brown, quite shiny, with keels and fingers blackish; legs, sternites of preabdomen, chelicerae, and telson, except dark

sting, yellowish. Immature specimens yellowish, with reddish brown pedipalps.

STRUCTURE: Similar in both sexes to that of *mordax* in basic features unless otherwise indicated. For measurements, see table 4.

Carapace: Entire surface covered thickly with large, round granules; coriaceous, with median grooves and posterior side depressions prominent and bordered by submarginal trench; frontal lobes with six stiff bristles. Frontal emargination a deep, rounded notch. Median eyes situated back about three-eighths of distance from front to posterior margin. Median eyes small, 0.34 mm., separated by full diameter. Lateral eyes (fig. 20) three, two large ones close together overhanging side margin; third eye small, inconspicuous, placed above second eye.

Preabdomen: All tergites quite coarsely granulated, except along basal strip, with heaviest granules along posterior edges; distinct traces of median keels present as rows of heavier granules on midline of tergites I-VI. Tergite VII granulose, with dorsal and lateral keels prominent, each set with heavy, rounded granules, and with many large granules in intercarinal spaces. Sternites smooth, shiny; sternite V with sides granulose and development of weak carinae in males, these much reduced in females. Shape of stigma of male as shown in figure 11.

Cauda: In both sexes widest at base and slightly narrowed at segment V. All caudal segments longer than wide; segment V, slightly longer than carapace. Keels on all surfaces prominent and granulated to give serrated appearance in lateral view; dorsal and superior lateral keels showing no prominent development of apical granules at posterior ends of series. Bristles on cauda short; three principal ventral pairs on all segments.

Telson: See figures 125, 126. Vesicle suboval, broader than fifth caudal segment, flattened above and inflated behind near sting, smooth above but with fine granulation below and on sides, provided with a few short bristles. Sting one-third as long as vesicle.

Pectines: Those of female: median piece twice as broad as long, with shallow, V-shaped indentation on frontal margin; pectin length less than twice that of median piece (40/23); middle lamellae, seven or eight; pectinal teeth, 11. Those of male with smaller, deeply indented median piece, which is about twice as long as

pectin (70/38); middle lamellae, six; pectinal teeth, 13.

Genital opercula: Like those of *mordax*.

Chelicerae: See figures 34, 35. Basic pattern like that of *mordax* but teeth short, rounded; lower margin of movable finger a smooth keel.

Pedipalps: In both sexes like those of *mordax* except as follows: frontal spurs on tibia of medium size, with prominent, pointed granules on each side bearing short seta; all keels on chela prominent, all granulated; superior keel finely crenulated as seen in lateral view; intercarinal spaces finely granulated above, smoother below.

Walking legs: Setation like that of *mordax*; tarsus with three thin spines on each side of ventral line of spinules.

TYPE DATA: Female holotype, and three males and three immature females, from Mission Gorge, 1 mi. W Padre Dam, 100 ft., San Diego County, California, July 7, 1969 (S. C. Williams, V. F. Lee), in collection of California Academy of Sciences.

DISTRIBUTION: San Diego County, California.

OTHER RECORDS: *California:* San Diego County: Mission Gorge, March 31, 1940 (Earl Brown), female in San Diego Museum; Wild Cat Canyon, August 9, 1962 (S. C. Williams), female probably this species from pit trap in burned area.

Uroctonus angelus, new species

Figures 121, 124

DIAGNOSIS: Medium-sized, reddish brown species similar to *williamsi*, distinguished by following combination of characters: total length of male 30.8 mm., median ocular tubercle situated well in front of middle of carapace; pectinal tooth count of male 11; lower margin of movable finger of chelicera smooth; inferior lateral and median keels of cauda granulated; vesicle of sting lightly inflated at apex.

ETYMOLOGY: Specific name from Latin *angelus*, angel.

COLORATION: Dusky to reddish brown scorpion with underside of preabdomen, legs, chelicerae, and telson yellowish.

STRUCTURE: Like that of *williamsi* except as indicated. For measurements, see table 4.

Carapace: Entire surfaces granulated; frontal lobes with six short bristles. Frontal emargination a quite deep, rounded notch. Median eyes

TABLE 4
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus williamsi* AND *angelenus*

	Female <i>williamsi</i>	Male <i>williamsi</i>	Female <i>williamsi</i>	Male <i>angelenus</i>
Total length	54.1	50.3	29.4	30.8
Carapace				
Length	8.2	7.2	5.3	4.6
Width at lateral eyes	4.2	3.7	2.8	2.3
Width at caudal edge	7.5	6.3	5.3	4.2
Preabdomen, length	20.0	17.7	8.5	10.0
Postabdomen, length	25.9	25.4	15.6	16.2
Caudal segment I				
Length	3.5	3.2	2.2	2.2
Width	3.0	3.0	2.2	2.1
Caudal segment II				
Length	4.1	4.0	2.5	2.5
Width	2.9	2.7	2.0	2.0
Caudal segment III				
Length	4.3	4.3	2.6	2.8
Width	2.8	2.6	1.9	1.8
Caudal segment IV				
Length	5.5	5.4	3.3	3.5
Width	2.5	2.5	1.8	1.7
Caudal segment V				
Length	8.5	8.5	5.0	5.2
Width	2.5	2.5	1.8	1.7
Telson, length	8.2	7.5	5.0	5.3
Vesicle				
Length	6.0	5.3	3.2	3.0
Width	3.0	3.0	1.8	1.9
Depth	2.7	2.4	1.3	1.5
Spine, length	2.0	1.7	1.5	1.4
Pedipalp, length				
Femur				
Length	7.2	6.8	4.6	3.8
Depth	2.2	2.2	1.7	1.3
Tibia				
Length	7.0	6.3	4.5	4.0
Depth	3.0	2.7	1.8	1.5
Chela, length	14.5	12.5	8.5	7.5
Palm length	8.7	8.0	5.5	4.7
Palm width	5.0	4.5	3.0	3.8
Palm depth	3.9	3.3	2.2	1.8
Fixed finger, length	5.6	5.1	3.4	2.8
Movable finger, length	7.7	6.8	4.5	3.8
Pectines				
Number of teeth	11	13/13	12	11/11
Number of middle lamellae	8	6	—	7 or 8

small, 0.19 mm., separated by their diameter. Lateral eyes two; third eye obsolete.

Preabdomen: All tergites granulated, those in front finely, posterior ones more coarsely, with largest granules along posterior edges; scarcely any traces of median keels apparent. Tergite

VII with well-developed median and lateral keels and numerous granules in intercarinal spaces. Sternites I-IV smooth; sternite V lightly granulose on each side and with weak lateral keel represented by row of small granules.

Cauda: First caudal segment about as broad

as long; succeeding one progressively longer than broad; segment V slightly longer than carapace. Keels on all surfaces prominent and granulated.

Telson: See figure 124. Vesicle elongate oval, broader than fifth caudal segment, flattened above, and weakly inflated in front of sting, mostly smooth but with light, round granulation below and on sides. Sting less than half as long as vesicle.

Pectines: Middle lamellae, seven or eight; pectinal tooth count, 11.

Chelicerae: Teeth sharper and more distinctly formed than those of *williamsi*; lower margin of movable finger smooth.

Pedipalps: All keels prominent, more finely granulated than those of *williamsi*; superior keel lightly crenulated in lateral view. Inner view of fixed finger as shown in figure 121.

Walking legs: Setation like that of *mordax*; ventral line of spinules on tarsi flanked by three or four spines on each side.

TYPE DATA: Male holotype from Malibu, Los Angeles County, California, June 14, 1954 (W. J. Gertsch, V. Roth), in collection of the American Museum of Natural History.

OTHER RECORDS: *California*: Los Angeles County: Malibu, May 27, 1950, male in San Diego Natural History Museum.

Uroctonus cazieri, new species

Figures 30, 31, 131, 132

DIAGNOSIS: Medium-sized, smooth, brownish scorpion similar to *huachuca*, distinguished by following features: total length of male 26.3 mm., of larger female 31.6 mm.; median ocular tubercle situated well in front of middle of carapace; pectinal tooth count of females 12, of males 13; chela stout, with short fingers, and keels weak and mostly smooth; lower margin of movable finger of chelicera crenulate, with about five weakly rounded lobes; all of chelicera crenulate, with about five weakly rounded lobes; all keels on cauda crenulated or granulated; vesicle lightly inflated in front of sting.

ETYMOLOGY: This distinctive scorpion is dedicated to Dr. Mont A. Cazier of Arizona State University, Tempe, Arizona, who through the years has collected many hundreds of scorpions from arid regions of the United States and Mexico.

COLORATION: Base color of adults light yellowish brown, of immature specimens much paler. Carapace dusky in front half with faint mottled darker pattern; eye tubercles black. Cauda somewhat darker brown, with keels reddish or black. Chela also darker, with dark reddish fingers and reddish keels. Sternites of preabdomen pale yellow; pectines whitish. Vesicle of sting yellow; sting dark red.

STRUCTURE: Similar in both sexes to those of *huachuca* in all basic features, unless otherwise indicated. For measurements, see table 6.

Carapace: See figure 131. Carapace quite smooth over most of surface, shiny, with few, weak, inconspicuous granules in posterior median groove and along sides behind ocular triangle; frontal lobes with six reddish bristles, irregularly spaced in holotype. Frontal emargination widely rounded indentation. Ocular tubercle situated back one-third distance between front and posterior margin. Median ocular tubercle small, smooth; median eyes small, 0.2 mm., separated by diameter. Lateral eyes, three; third eye smallest.

Preabdomen: All tergites quite smooth, shiny, posterior ones with weak granulation, especially along hind margins. Tergite VII with dorsal and lateral keels fairly well developed, each provided with about 10 rounded granules giving crenate appearance in side view; intercarinal spaces with few weak granules.

Telson: See figure 132. Vesicle oval, broader than fifth caudal segment, flattened and smooth above, lightly inflated behind in front of sting, with smooth granulation on sides and below, provided with few short hairs. Sting about half as long as vesicle.

Pectines: Of female, median piece twice as broad as long, with wide, shallowly V-shaped emargination on front margin; pectin more than twice as long as median piece (58/23); middle lamellae, eight or nine; pectinal count, 11. Of males, shorter, emarginated median piece and much longer pectin (52/21); middle lamellae, seven or eight; pectinal teeth, 13.

Chelicerae: See figures 30, 31. With basic pattern of *mordax* group; keel on lower margin of movable finger with irregular crenations, without distinctive dark teeth; keel on fixed finger with three pale teeth near base.

Pedipalps: Keels on femur prominent, armed with rounded granules to give mostly crenulate appearance in lateral view; those on tibia less

TABLE 5
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus rufulus* AND *montereus*

	Female <i>rufulus</i>	Male <i>rufulus</i>	Female <i>montereus</i>	Male <i>montereus</i>
Total length	26.9	25.7	30.8	30.8
Carapace				
Length	4.0	4.2	4.65	4.4
Width at lateral eyes	2.0	2.1	2.5	2.4
Width at caudal edge	3.7	3.7	4.85	4.1
Preabdomen, length	12.2	7.5	11.3	10.6
Postabdomen, length	10.7	14.0	14.85	15.1
Caudal segment I				
Length	1.5	1.8	1.9	2.0
Width	1.9	2.2	2.6	2.5
Caudal segment II				
Length	1.6	2.1	2.2	2.25
Width	1.8	2.1	2.4	2.3
Caudal segment III				
Length	1.7	2.3	2.4	2.5
Width	1.8	2.1	2.3	2.15
Caudal Segment IV				
Length	2.2	3.0	3.05	3.05
Width	1.8	2.0	2.2	2.2
Caudal segment V				
Length	3.7	4.8	5.3	5.3
Width	1.7	2.0	2.0	1.95
Telson, length	4.1	5.0	5.4	5.4
Vesicle				
Length	2.5	3.5	3.8	4.0
Width	1.8	1.8	2.3	2.15
Depth	1.5	1.6	1.9	1.65
Spine, length	1.3	1.6	1.5	1.35
Pedipalp, length	12.0	14.5	15.45	13.95
Femur				
Length	3.0	3.5	3.75	3.35
Depth	1.2	1.25	1.4	1.35
Tibia				
Length	3.8	3.7	4.15	3.95
Depth	1.4	1.9	1.65	1.6
Chela, length	5.2	7.3	7.55	6.65
Palm length	3.7	4.5	3.95	3.6
Palm width	2.5	3.0	3.5	3.5
Palm depth	2.0	2.2	2.5	2.4
Fixed finger, length	2.5	2.7	2.85	2.7
Movable finger, length	3.3	3.7	4.35	4.1
Pectines				
Number of teeth	9/9	11/11	10/9	10/10
Number of middle lamellae	5	7	6/5	6/6

developed, quite smooth, crenulated; frontal spurs on tibia rounded, with single granule set with long reddish seta. Chela very stout, with movable finger shorter than palm, quite smooth, with most carinae weak and smooth; inner side

of palm and area below set with weak, rounded granules; superior carina weakly developed, smooth except for alveolae of weak setae. Keels on fixed and movable fingers with single line of minute denticles, broken into six files by six

larger teeth, and flanked by six heavier, triangular teeth.

Walking legs: Legs with sparse covering of reddish bristles and weak spines, with basic features of those of *huachuca*. Venter of tarsus with two or three fine spines on each side of median line of spinules.

TYPE DATA: Female holotype from Mission San Borjas, 1500 ft., Baja California Norte, Mexico, June 20, 1968 (S. C. Williams, M. A. Cazier, etc.) in collection of California Academy of Sciences.

DISTRIBUTION: Known only from type locality.

OTHER RECORDS: *Mexico*: Baja California Norte: Mission San Borjas, 1500 ft., June 20, 1968 (S. C. Williams, M. A. Cazier) male and female, subadult female and two males, three immatures.

Uroctonus rufulus, new species

Figures 27, 129, 130

DIAGNOSIS: Medium-sized, brownish scorpion allied to *cazieri*, distinguished by following features: total length of female 26.9 mm., of male 25.7 mm.; male roughly granulated but female quite smooth; median ocular tubercle well in front of middle of carapace; pectinal teeth, nine for female, 11 for male; chela large in male, well granulated, with fixed finger not so long as palm width; chela of medium size in female, with fixed finger as long as palm width; lower margins of fixed and movable fingers of chelicerae smooth, without trace of denticles; all keels on cauda prominent, granulated, bluntly serrated in side view.

ETYMOLOGY: Specific name from Latin *rufus*, reddish.

COLORATION: Like that of *cazieri*, yellowish brown, with faint, dusky mottling present on carapace and preabdomen, the latter also with pair of dark, oval spots on each tergite forming median band running into posterior one; keels on cauda and pedipalps reddish brown.

STRUCTURE: Similar to that of *cazieri* but cauda thinner and pedipalps proportionally smaller. For measurements, see table 5.

Carapace: Of male: Of entire surface covered with quite heavy, round granules; frontal lobes with six reddish bristles. Frontal emargination a shallow, rounded indentation; median eye tubercle low, with few rounded granules, situated three-eighths distance from front to posterior

margin. Median eyes small, 0.2 mm., separated by nearly their diameter. Lateral eyes, three, but posterior eye minute or obsolete. Carapace of female (fig. 129) with inconspicuous granules over most of surface.

Preabdomen: Tergites of male with dull luster, finely granulated throughout, with heavier granules along posterior margins and on each side, most numerous in posterior tergites. Tergite VII with prominent median and lateral pairs of keels, each armed with about a dozen heavy, rounded granules; intercarinal spaces with numerous granules. Sternites quite smooth; sternite V with weak traces of lateral keels. Tergites of female smooth in appearance, seen to be finely granulated under high power, with keels less strongly developed.

Cauda: Of male (fig. 27) with first segment broader than long; second segment as long as broad; posterior segments longer than broad; fifth caudal segment longer than carapace. All keels prominent, with serrate granules; apical granules on dorsal and lateral keels forming distinct, sharp spurs; intercarinal spaces on dorsum of all segments with scattered granules, on venter largely lacking except on segment V. Cauda of female with first three segments broader than long.

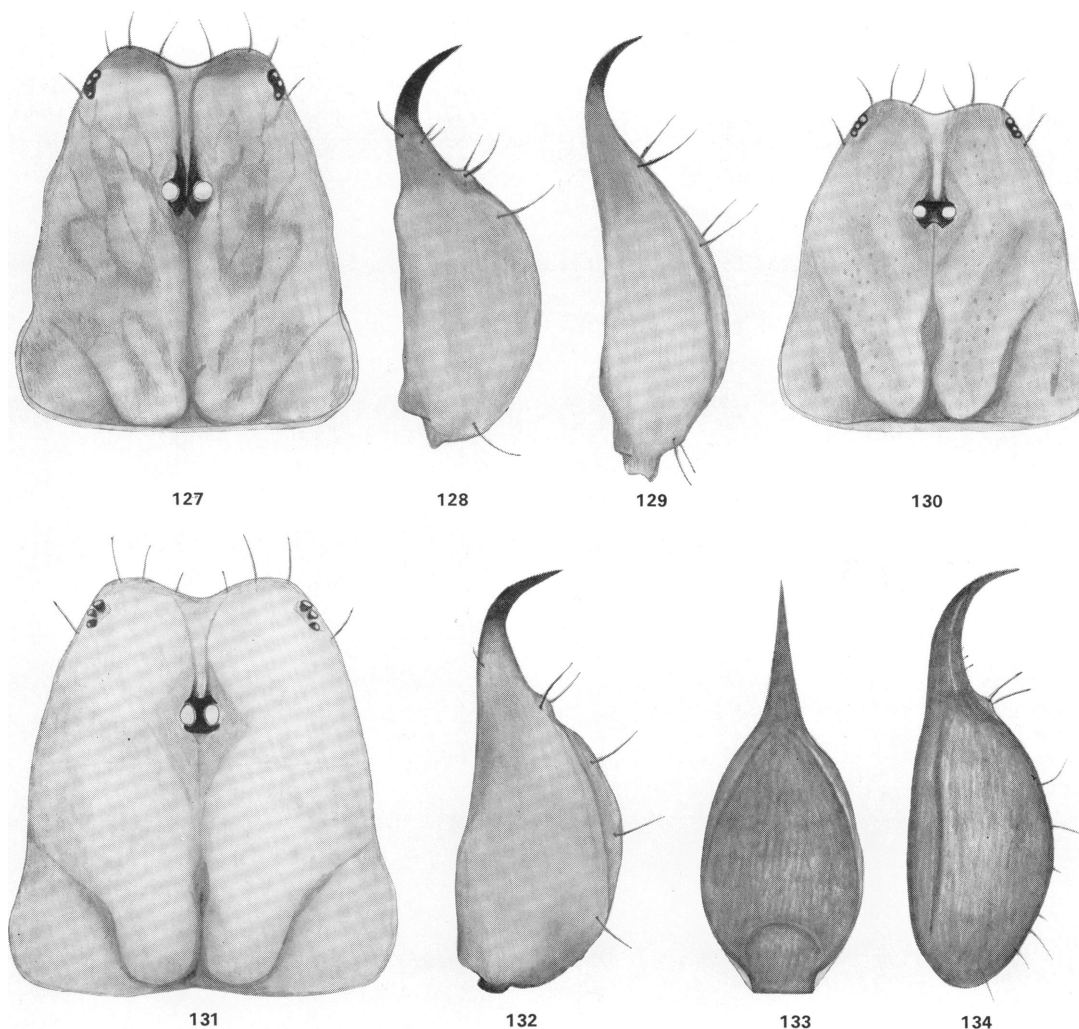
Telson: See figure 130. Vesicle elongate oval, slightly narrower than caudal segment V, smooth above, with small granules below and on sides. Sting almost half as long as vesicle.

Pectines: Those of female with median piece twice as wide as long, with very shallow emargination in front; pectin twice as long as median piece; middle lamellae, five; pectinal teeth, nine. Those of male with number of middle lamellae, seven, and pectinal teeth, 11.

Chelicerae: With basic pattern of group; lower margin of movable finger smooth; lower margin of fixed finger without trace of denticles or distinct teeth.

Pedipalps: Of male like those of *cazieri* but with heavier granulation; chela with superior keel smooth, pitted, flanked by rounded granules; lateral keels more granulose, crenulate in lateral view. Keel of denticles on fixed and movable fingers of chela with six and seven supernumerary teeth respectively. Chela of female smaller.

Walking legs: Like those of *cazieri*: venter of tarsus with three fine spines on each side of median line of spinules.



FIGS. 127, 128. *Uroctonus lindsayi*, new species, female. 127. Carapace. 128. Telson, lateral view. FIGS. 129, 130. *Uroctonus rufulus*, new species, female. 129. Telson, lateral view. 130. Carapace. FIGS. 131, 132. *Uroctonus cazieri*, new species, female. 131. Carapace. 132. Telson, lateral view. FIGS. 133, 134. *Uroctonus mordax* Thorell, female telson. 133. Dorsal view. 134. Lateral view.

TYPE DATA: Male holotype from Punta Banda, Baja California Norte, 200 ft., April 4, 1969 (S. Williams), in collection of California Academy of Sciences.

DISTRIBUTION: Baja California Norte.

RECORDS: *Mexico:* Baja California Norte; 11 mi. E Puerto Santo Tomas, at altitude of 150 ft., July 11, 1969 (S. C. Williams, V. F. Lee), female. Punta Banda, 100 ft., July 10, 1969 (S. C. Williams, V. F. Lee), male, female.

Uroctonus lindsayi, new species

Figures 127, 128

DIAGNOSIS: Medium-sized, smooth, brown scorpion allied to *cazieri*, distinguished by following list of characters: total length of larger female 33.2 mm., of male 27.1 mm.; median ocular tubercle situated well in front of middle of carapace; pectinal tooth count of female 12, of male 14; chela stout, smooth, with fixed

TABLE 6
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus cazieri* AND *lindsayi*

	Female <i>cazieri</i>	Male <i>cazieri</i>	Female <i>lindsayi</i>	Male <i>lindsayi</i>
Total length	31.6	26.3	33.2	27.1
Carapace				
Length	5.2	4.2	4.8	4.5
Width at lateral eyes	2.8	2.3	2.0	2.4
Width at caudal edge	4.7	3.9	4.3	4.0
Preabdomen, length	11.3	9.5	14.4	8.0
Postabdomen, length	15.1	12.6	14.0	14.6
Caudal segment I				
Length	2.2	1.7	1.8	1.8
Width	2.5	2.3	2.5	2.5
Caudal segment II				
Length	2.3	2.0	2.1	2.3
Width	2.5	2.3	2.3	2.4
Caudal segment III				
Length	2.4	2.0	2.3	2.5
Width	2.4	2.2	2.3	2.3
Caudal segment IV				
Length	3.1	2.6	3.0	3.2
Width	2.3	2.0	2.2	2.2
Caudal segment V				
Length	5.1	4.3	4.8	4.8
Width	2.3	2.0	2.1	2.1
Telson, length	5.3	4.3	5.0	4.8
Vesicle				
Length	3.5	2.8	3.3	3.2
Width	2.5	2.0	2.3	2.2
Depth	2.0	1.5	1.9	1.8
Spine, length	1.8	1.6	1.6	1.5
Pedipalp, length			15.4	14.5
Femur				
Length	4.5	3.7	3.7	3.5
Depth	1.6	1.3	1.4	1.3
Tibia				
Length	4.6	4.0	4.3	4.0
Depth	1.7	1.4	1.5	1.4
Chela, length	8.3	6.6	7.4	7.0
Palm length	5.0	4.0	4.8	4.3
Palm width	3.5	2.7	3.2	3.0
Palm depth	2.3	2.5	2.2	2.3
Fixed finger, length	3.3	2.5	2.8	2.5
Movable finger, length	4.5	3.5	3.8	3.6
Pectines				
Number of teeth	12/12	13/13	12/12	14/14
Number of middle lamellae	8 or 9	7 or 8	8	10

finger shorter than palm width; lower margins of fixed and movable fingers of chelicera essentially smooth; all keels on cauda prominent, granulated, crenulate to serrulate in lateral view.

ETYMOLOGY: This species is dedicated to Dr. George Lindsay, Director of the California

Academy of Sciences, San Francisco, California, who has headed many expeditions into western Mexico and contributed much new knowledge of the plants and animals of Baja California.

COLORATION: Base color tan to quite bright reddish brown. Carapace reddish brown, shiny,

with faint dusky, mottled pattern including dusky marginal band. Preabdomen yellowish, with dusky shadings on sides and faint, narrow, median stripe enclosing pair of dusky, subintegumental spots on each tergite. Sternites and pectines pale yellow. Cauda and pedipalps bright reddish brown, with keels dusky red. Telson yellowish brown.

STRUCTURE: Similar in both sexes to those of *cazieri* unless otherwise indicated. For measurements, see table 6.

Carapace: Of female (fig. 127) smooth over entire surface, with few granules visible even under medium power; of male scattered, inconspicuous granules over most of surface; six weak bristles on frontal margin in both sexes. Frontal emargination a quite wide, rounded indentation. Median ocular tubercle small, smooth, situated about one-third distance from front to posterior margin. Median eyes small, 0.21 mm., separated by full diameter. Lateral eyes, three, well developed; posterior eye smallest, lying above principal pair.

Preabdomen: All tergites smooth in female, lightly granulated along posterior edges; those of male lightly granulated over much of surface and with larger granules on posterior margins. Tergite V of female with weak median and lateral keels bearing about a dozen rounded granules and with few granules in intercarinal spaces; those of male better developed, with more conspicuous granules, and with numerous small granules in intercarinal spaces. All sternites quite smooth; sternite V of female with inconspicuous cluster of pale granules at site of obsolete lateral keel, of male weak keel bearing few pale granules.

Cauda: First and second segments broader than long, posterior ones longer than broad; fifth caudal segment about as long as carapace. All keels prominent, granulated to give crenulated appearance in lateral view; distal granules on dorsal and lateral keels rounded on moderately developed spur; intercarinal spaces mostly smooth, with few scattered granules, most numerous on venter of segment V.

Telson: See figure 128. Vesicle oval, slightly broader than caudal segment V, lightly inflated behind, with weak, rounded granules on sides and below. Sting about half as long as vesicle.

Pectines: Like those of *cazieri*; number of middle lamellae, eight in females, 10 in males; pectinal teeth, 12 in females, 14 in males.

Chelicerae: With basic pattern of *mordax* group; keels on lower margins of fixed and movable fingers smooth.

Pedipalps: Like those of *cazieri*; chela stout, smooth, shining, with weakly developed, smooth dorsal keels, with granules developed on inner, outer, and inferior keels to give denticulate appearance in lateral view.

Walking legs: Like those of *cazieri*, tarsus with three weak spines on each side flanking middle row of spinules.

TYPE DATA: Female holotype from Sierra Laguna, Baja California Sur, Mexico, March 14, 1965 (R. C. Banks), in collection of San Diego Museum of Natural History.

OTHER RECORDS: *Mexico:* Baja California Sur: Sierra Laguna, March 14, 1965 (R. C. Banks), female from under log; May 26, 1965 (Banks, Sloan), male, under rocks and oak litter.

Uroctonus andreas, new species

DIAGNOSIS: Small, golden brown, densely granulose scorpion with basic features of genus but distinctive in following characters: one of our smallest species, with length variation in adults from about 15 mm. to 22 mm., females larger; median eye tubercle far in front of middle of carapace; pectinal tooth count of females seven to nine, of males eight to 10; lower margin of movable finger of chelicerae smooth; inferior lateral and median keels of caudal segments I-II granulated; caudal segment IV distinctively longer than wide.

ETYMOLOGY: Named for Andreas Canyon, the type locality.

COLORATION: Base color golden-orange to dusky orange-brown with faint traces of darker pattern present on carapace and preabdomen in some specimens, mostly with few contrasting markings; eye tubercles and tip of sting black; pedipalp and cauda with some dusky shadings. Legs yellow.

STRUCTURE: Features like those of *mordax* unless otherwise indicated. Males smaller than females, similar to females except as noted. For measurements, see table 7.

Carapace: Most of surface, with dense covering of rounded granules; interocular area of female with sparse granulation; frontal margin with six long setae. Frontal emargination a shallow indentation. Ocular tubercle far in front of middle of carapace, situated about one-

TABLE 7
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus andreas*

	Female	Male	Female	Male
Total length	18.45	17.6	15.8	16.5
Carapace				
Length	2.7	2.7	2.5	2.7
Width at lateral eyes	1.4	1.3	1.2	1.3
Width at caudal edge	2.4	2.2	2.2	2.4
Preabdomen, length	7.8	6.5	6.1	5.0
Postabdomen, length	7.95	8.4	7.2	8.8
Caudal segment I				
Length	1.1	1.2	0.9	1.2
Width	1.45	1.5	1.4	1.6
Caudal segment II				
Length	1.25	1.3	1.1	1.4
Width	1.45	1.5	1.4	1.7
Caudal segment III				
Length	1.3	1.4	1.2	1.5
Width	1.4	1.5	1.3	1.7
Caudal segment IV				
Length	1.6	1.7	1.5	1.8
Width	1.35	1.5	1.3	1.6
Caudal segment V				
Length	2.7	2.8	2.8	2.9
Width	1.35	1.45	1.3	1.5
Telson, length	2.8	3.1	2.6	3.0
Vesicle				
Length	2.15	2.2	1.8	2.0
Width	1.25	1.1	1.3	1.5
Depth	0.9	0.9	1.0	1.1
Sting, length	0.65	0.8	0.8	1.0
Pedipalp, length	8.3	8.2	7.5	7.9
Femur				
Length	1.9	2.0	1.8	1.9
Depth	0.8	0.75	0.8	0.8
Tibia				
Length	2.5	2.2	2.1	2.2
Depth	0.9	0.8	0.8	0.9
Chela, length	3.9	4.0	3.6	3.8
Palm length	2.15	2.6	2.0	2.8
Palm width	1.45	1.6	1.3	1.8
Palm depth	1.35	1.45	1.2	1.6
Fixed finger, length	1.35	1.3	1.3	1.2
Movable finger, length	2.0	1.8	1.9	1.8
Pectines				
Number of teeth	9/8	10/9	8/7	8/8
Number of middle lamellae	5/5	4/5	4	4

third distance from front to posterior margin. Median eyes small, about 0.15 mm., separated by full diameter. Lateral eyes three or two; posterior eye small, often missing.

Preabdomen: All tergites finely to quite coarsely granulated, more so in males, posterior ones with heavier granules; tergite VII with

well-developed dorsal and superior lateral keels, provided with numerous pointed granules, and with numerous rounded granules in intercarinal space.

Cauda: Segments I-III broader than long; segment IV distinctly longer than broad; segment V twice as long as broad. All keels on

cauda prominent and distinctly granulated. Placement of ventral setae on basal segments: 2-3-3-3.

Telson: Vesicle covered below and on sides with large, rounded granules, smooth above, slightly inflated on sides. Sting short, curved, about one-third as long as vesicle.

Pectines: Like those of *mordax* in basic features. Median piece about twice as broad as long, with shallow indentation on front margin. Middle lamellae, five or six. Pectinal teeth, seven to nine in females, nine or 10 in males; outer tooth slightly larger.

Chelicera: With standard dentition of genus. Lower margin of movable finger smooth.

Pedipalps: Chela of medium stoutness, with short fingers; fixed finger shorter than width of palm. Keels of femur and tibia well granulated; fine granulation in intercarinal spaces; frontal spurs on tibia small. Superior keel smooth but ventral keels roughened, with irregular rows of granules. Keels on movable and fixed fingers flanked by six supernumerary teeth.

Walking legs: With few thin setae and shorter spines; line of spinules on venter of tarsus with two or three setae on each side.

TYPE DATA: Female holotype from Andreas Canyon, off Palm Canyon, 4 mi. S Palm Springs, Riverside County, California, March 26, 1960 (W. J. Gertsch, W. Ivie, R. Schrammel), in the American Museum of Natural History.

DISTRIBUTION: Riverside and San Diego counties, California, and adjacent Baja California, Mexico.

RECORDS: *California*: San Diego County: Mission Gorge, 1 mi. W Padre Dam, 100 ft., July 7, 1969 (S. C. Williams, V. F. Lee), male, female; 1 mi. E San Ysidro, near sea level, December 31, 1966 (S. C. Williams), male from under rock on chaparral hillside; 25 mi. E San Diego, off highway 8, August 23, 1970 (M. Soleglad), males, females; 1 mi. N Santee, September, 18, 1970 (C. S. and M. E. Soleglad, J. and J. Springer), two females. Riverside County: Andreas Canyon, off Palm Canyon, 4 mi. S Palm Springs, March 26, 1940 (W. J. Gertsch, W. Ivie, R. Schrammel), three males, 15 females, some not fully mature. *Baja California*: 1 mi. W La Rumarosa, 4800 ft., July 17, 1969 (S. C. Williams), male, 6 mi. N La Mission, 200 ft., July 14, 1969 (S. C. Williams), male, female; 16 mi E Ensenada, 2000 ft., July 15, 1969 (S. C. Williams), female; 11 mi. SE Ojos

Negros, 3500 ft., July 15, 1969 (S. C. Williams, V. F. Lee), female. Sierra Juarez: 9 mi. N Rancho El Topo, 5000 ft., July 16, 1969, female; 5 mi. N Rancho El Topo, 5200 ft., male; 6 mi. N Rancho El Topo, July 16, 1969, female (all S. C. Williams, V. F. Lee).

Uroctonus montereus, new species

Figures 10, 36, 37

DIAGNOSIS: Smaller, paler scorpion than *mordax*, distinguished by following features: average size about 30 mm. for adult specimens, with largest female 36 mm. in length; median eye tubercle placed well in front of middle of carapace; pectinal tooth count for females nine and 10, for males 10; lower margin of movable finger of chelicera essentially smooth; upper margin of movable finger with only four stout teeth, lacking one subdistal tooth; fixed finger of chela much shorter than width of palm; inferior lateral and median keels of basal segments of cauda crenulate or granulated.

ETYMOLOGY: Specific name based on that of Monterey County.

COLORATION: Base color uniform tan to dusky or bright reddish brown depending on age and preservation, masking distinct pattern of dark bands and spots clearly defined in subadult specimens. Legs, chelicerae, most of venter, and often telson yellowish.

STRUCTURE: Similar to that of *mordax* in basic features and similar in both sexes unless otherwise noted. Measurements given in table 5.

Carapace: Finely granulated over most of surface, giving quite smooth appearance, with relatively few larger granules; frontal margin with six setae of medium length. Frontal emargination shallowly rounded. Ocular tubercle of average size, placed far in advance of middle of carapace. Median eyes small, 0.18 mm., separated by more than full diameter. Lateral eyes three; posterior eye small and well separated from anterior ones.

Preabdomen: Tergites densely and finely granulose, with quite smooth appearance; tergite VII with two fairly well-developed keels on each side, each provided with 12 to 16 rounded granules, and with several heavy granules in intercarinal spaces. Fourth stigma of female as shown in figure 10.

Cauda: First and second caudal segments in both sexes broader than long; segment three

TABLE 8
MEASUREMENTS (IN MILLIMETERS) OF *Uroctonus grahami* AND *sequoia*

	Female <i>grahami</i>	Female <i>grahami</i>	Female <i>sequoia</i>	Male <i>sequoia</i>
Total length	33.9	26.5	35.4	25.8
Carapace				
Length	5.0	3.7	5.0	3.8
Width at lateral eyes	3.0	2.1	2.8	1.8
Width at caudal edge	4.5	3.5	4.9	3.0
Preabdomen, length	15.5	12.0	12.4	9.5
Postabdomen, length	13.4	10.8	18.0	12.5
Caudal segment I				
Length	2.2	1.5	2.7	1.8
Width	2.2	1.5	2.7	1.8
Caudal segment II				
Length	2.2	1.7	2.8	1.9
Width	1.7	1.2	2.5	1.7
Caudal segment III				
Length	2.5	1.8	3.0	2.1
Width	1.6	1.2	2.3	1.7
Caudal segment IV				
Length	2.8	2.2	3.5	2.5
Width	1.4	1.1	2.2	1.6
Caudal segment V				
Length	4.7	3.6	6.0	4.2
Width	1.4	1.1	2.1	2.0
Telson, length	4.7	3.7	6.0	4.2
Vesicle				
Length	3.3	2.4	3.8	2.7
Width	1.7	1.3	2.3	1.6
Depth	1.5	1.1	1.8	1.3
Sting, length	1.3	1.2	1.7	1.2
Pedipalp, length	18.8	14.7	18.4	12.0
Femur				
Length	4.5	3.5	4.5	3.0
Depth	1.6	1.3	1.6	1.1
Tibia				
Length	4.5	3.5	4.7	3.2
Depth	1.9	1.5	1.7	1.2
Chela, length	9.3	7.7	9.2	5.8
Palm length	5.7	4.3	5.2	3.4
Palm width	3.1	2.3	3.4	2.25
Palm depth	2.6	1.9	2.7	1.75
Fixed finger, length	3.5	3.0	3.7	2.5
Movable finger, length	4.6	3.9	4.7	3.2
Pectines				
Number of teeth	9/9	10/11	9/10	9/9
Number of middle lamellae	7/8	9/9	5	5

about as broad as long. All keels quite prominent and granulated to give crenulate or serrate appearance in lateral view; single inferior median keel on segment V terminating near apex; intercarinal spaces on segment V without conspicuous granulation.

Telson: Similar to that of *mordax*; vesicle as wide as caudal segment V, smooth above, weakly granulated on sides and below; sting short, less than half as long as vesicle.

Pectines: Like those of *mordax*. Middle lamellae, five or six in females, six in males; pec-

tinal teeth, nine or 10 in females, 10 in males; outer pectinal tooth larger than others.

Chelicerae: Like those of *mordax* except as follows: keel on lower margin of movable finger essentially smooth, without development of crenules or denticles; upper margin of movable finger with four stout teeth, a basal, median, and distal tooth, and single stout subdistal tooth, instead of two found in all other species of genus. See figures 36, 37.

Pedipalps: Chela stout, with short, thick fixed finger much shorter than width of palm; movable finger shorter than length of palm; superior keel quite smooth, slightly pitted as seen in lateral view.

Walking legs: Like those of *mordax* with relatively few short setae; single row of spinules on venter of tarsus with row of four short, stout setae on each side.

TYPE DATA: Female holotype from Red Hill, Hastings Natural History Reservation, Monterey County, California, February 3, 1951 (J. Linsdale), in the American Museum of Natural History.

DISTRIBUTION: Monterey, Santa Clara, and San Mateo counties of California.

RECORDS: *California*: Santa Clara County: Clayton Road, June 10, 1963 (S. Smoker), subadult female. San Mateo County: 0.8 mi. NW Crystal Springs Dam, February 19, 1966 (V. Lee), two females, one juvenile from under serpentine and chert rocks (S. C. Williams collection); $\frac{3}{4}$ mi. N Crystal Springs Dam, January 23, 1966 (K. Hom), male, female, juvenile from under rocks near spring. Monterey County, Hastings Natural History Reservation: Red Hill, March 23, 1945, male, three subadult; February 3, 1951, male, eight subadult, March 23, 1945, female (all J. Linsdale). Four mi SE Nacimiento Summit Campground, Los Padres National Forest, August 8, 1970 (W. E. Azevedo, V. F. Lee), male.

Uroctonus sequoia, new species

DIAGNOSIS: Reddish brown, average-sized species related to *montereus*, distinguished by following features: carapace uniform tan in color, without pattern of dark bands and spots; two small lateral eyes on each side; dentition of chelicera like that of *montereus*, lacking one subdistal tooth; pedipalps proportionally longer and heavier, with longer fingers of which fixed finger is longer than width of palm.

ETYMOLOGY: Named for Sequoia National Park; specific name in apposition with masculine generic name.

COLORATION: Base color of mature female tan to reddish brown. Carapace and preabdomen without contrasting pattern except for black eye tubercles and dusky margins of sclerites. Pedipalps brown with keels and fingers reddish brown. Chelicerae and underside of preabdomen yellowish. Tip of sting red.

STRUCTURE: Similar to that of *mordax* unless otherwise noted. For measurements see table 8.

Carapace: That of female about as broad as long, wide in front, of immature male longer than broad. Front with shallow, curved emargination; frontal lobes gently rounded, armed with three bristles. Carapace low, gently convex, with crests and grooves inconspicuous, covered uniformly with small granules over most of surface, with pair of bristles behind median eyes and single one behind side eyes, otherwise quite bare. Median eye tubercle smooth, weakly elevated, situated well in front of middle of carapace, its width equal to less than one-sixth of carapace width at that point. Median eyes small, 0.25 mm., separated by little more than their diameter. Lateral eyes two; third eye obsolete.

Preabdomen: All tergites finely granulated as seen under medium power, with heavier granules on posterior portions. Tergite VII with well-marked keels set with rows of small crenate to serrate granules. Sternites smooth, with rows of small bristles; sternite V with crenate side margins and pair of weak ventral keels with rounded granules.

Cauda: First caudal segment as broad as long, succeeding ones slightly to considerably longer than broad. All keels prominent, granulated to give crenate or serrate appearance in lateral view; single inferior median keel on segment V bifid near apex; intercarinal spaces with scattered round granules.

Telson: Vesicle much wider than caudal segment V, smooth above, with faint granulation on sides; sting short, less than half as long as vesicle.

Pectines: Median piece about twice as wide as long, with slight, rounded emargination in front. Middle lamellae, five in both sexes; pectinal teeth, nine or 10 in females, nine in young male; outer pectinal tooth of female oval, not much longer than others.

Chelicerae: Like those of *mordax* except as follows: keel on lower margin of movable finger essentially smooth, with only faint traces of crenulation; upper margin of movable finger with four stout teeth, a small basal, large triangular median, single broad subdistal and longer curved distal tooth; one subdistal aborted as in denture of *montereus*.

Pedipalps: Chela stout, with fixed finger longer than width of palm; movable finger shorter than length of palm; superior and other dorsal keels smooth except for few granules at base; inner and inferior keels rounded, provided with irregular row of heavy granules. Fixed and movable fingers with six supernumerary teeth.

Walking legs: Single row of fine spinules beneath tarsi flanked by three stout setae on each side.

TYPE DATA: Female holotype, and immature female, from Clough Cave, Sequoia National Park, Tulare County, California, May 14, 1966 (T. S. Briggs), from under rocks in ladder room, in the collection of the American Museum of Natural History.

DISTRIBUTION: Known only from the type locality.

OTHER RECORDS: *California*: Tulare County: Clough Cave, Sequoia National Park, November 26, 1965 (V. Lee), young male from under limestone chip (S. C. Williams collection).

Uroctonus grahami, new species

Figures 15, 16, 26, 32, 33, 52-63

DIAGNOSIS: Cave-adapted representative of genus with characters modified and obliterated but otherwise closely allied to *mordax* and relatives, distinguished by following features: size of females from 26 to 34 mm.; median eye tubercle situated about two-fifths of distance from front margin to posterior edge; pectinal tooth count from nine to 11 in females; lower margin of movable finger of chelicera with distinct, pale crenulations; cauda thin, weak, with keels largely obliterated and mostly unarmed.

ETYMOLOGY: This derivative species is dedicated to Dr. Richard Graham of Upsala College, East Orange, New Jersey, friend and collecting companion of the first author, who has contributed much to the knowledge of cave fauna of California.

COLORATION: Base color of sclerites and

appendages yellow to golden-brown with few contrasting markings; conjunctival membranes whitish; median and lateral eye tubercles blackish; fingers of chela slightly reddish; sting reddish; articulation spots at ends of femora and tibiae of legs brown; setae reddish.

STRUCTURE: Similar to that of *mordax* in basic features unless otherwise noted. For measurements see table 8.

Carapace: Dorsal aspect of carapace as shown in figure 15. Frontal emargination deep, rounded; frontal lobes moderately round and provided with six principal bristles. Carapace essentially smooth, with only traces of granulation, with usual keels, grooves, and depressions softened or obliterated; bare except for weak bristles in pairs behind eyes to caudal margin and those on anterior margin. Median eye tubercle smooth, weakly elevated, situated well in front of middle of carapace. Median eyes reduced in size, about 0.7 mm., separated from each other by two diameters. Lateral eyes (fig. 16) three, close together just above side margin; third eye smallest.

Preabdomen: All tergites smooth, shiny, bare except for a few inconspicuous bristles along posterior margins. Tergite VII largely smooth, with keels nearly obsolete; median keel scarcely apparent, provided with cluster of few pale granules; lateral keel short, weak, with series of about seven weak granules. Sternites smooth, shining, provided with rows of scattered bristles. Stigmata tiny, elongated slits.

Cauda: Dorsal view as shown in figure 26. Slender, widest in front, considerably narrowed behind. First caudal segment as broad as long; succeeding ones slightly to much longer than broad. Keels of all caudal segments weakly developed or essentially obsolete; dorsal keels rounded and weak on all segments; superior lateral keels better developed, slightly angled and bearing scattered granules; inferior lateral and median keels essentially obsolete on segments I-IV; single inferior median keel and lateral keels on segment V better developed, slightly angled and armed with rows of pointed granules. Bristles on cauda relatively long, present in rows along developed and obsolete keels, those on ventral face in quite regular pairs from segments I-V as follows: 3-3-3-3-4, with additional shorter pairs and singles lying in the files.

Telson: See figure 26. Sting slender, evenly

curved, less than half as long as vesicle. Vesicle smooth on all surfaces, about twice as long as width, much wider than segment V of cauda, set with scattered bristles.

Pectines: Median piece broader than long, with small emargination in front; pectin length 1.3 times that of median piece; pectinal teeth of medium size, nine to 11 in two females.

Genital operculum: Like that of *mordax*.

Chelicerae: See figures 32, 33. Dentition typical of group; lower margin of movable finger with several large, pale, irregular crenulations.

Pedipalps: All segments quite smooth, with weak keels and reduced granulation. Frontal spurs at base of tibia small, sharply pointed. Chela stout, elongated; both fingers shorter than palm. All keels reduced, mostly smooth; superior keels smooth, shining; inner keel rounded, provided with band of about 15 pointed granules. Trichobothrial pattern as shown in figures 52-63.

Walking legs: With basic pattern of *mordax*; row of spinules on tarsi flanked by three or four thin setae on each side.

TYPE DATA: Female holotype from Samwell Cave, Shasta County, California, June 27, 1960 (Richard Graham), in the collection of the American Museum of Natural History; taken in damp floor at 8 foot depth in back end of main entrance, while excavating for fossils.

DISTRIBUTION: Known only from type locality.

OTHER RECORDS: *California*: Shasta County: Samwell Cave, July 18, 1959 (R. E. Graham), female from under stone on mud substrata inside lower entrance, in twilight zone, temperature 53° F.; June 5, 1957 (R. de Saussure), juvenile in crawlway at entrance, at midnight.

GENUS *VEJOVIS* KOCH

Vaejovis KOCH, 1836, p. 51. POCOCK, 1902, p. 8. EWING, 1928, p. 9.

Vejovis: THORELL, 1876, p. 10 (emendation). KRAEPELIN, 1894, p. 198; 1899, p. 183. COMSTOCK, "1912" [1913], p. 31; 1940, p. 31. HOFFMANN, 1931, p. 346. GERTSCH AND ALLRED, 1956, p. 346. GERTSCH AND SOLEGLAD, 1966, p. 3.

DISCUSSION: During the above revisional study of *Uroctonus* several species were mistakenly placed in that genus and then later assigned to *Vejovis*. Descriptions of these and others of unusual interest are given below. The large, ex-

clusively American genus *Vejovis* is composed of a number of species groups sharing basic characters but also presenting wide variation in appearance. The trichobothrial patterns of the species studied are identical in the various species groups and essentially the same as those of *Uroctonus*. They provide additional evidence of the close relationship of the two genera.

Among the species described in the following pages are some of special interest. The name *Vejovis reddelli*, new species, is made available for the large, blackish species widespread in Texas caves. A very distinct new species, *Vejovis gracilis*, from Cueva de Atoyac in Veracruz, Mexico, shows some cave adaptations but its exact status is uncertain. The identity of *Vejovis minimus* Kraepelin has been established by study of the types from the Zoologisches Museum in Hamburg, Germany. It is the nominate subspecies of a polytypic species with representatives from southern California and the adjacent Channel Islands.

Vejovis iviei, new species

Figures 13, 21, 150

DIAGNOSIS: Small, brown, granulated scorpion with appearance of *Uroctonus* group but presenting several important differences: average size of males about 25 mm., of females about 30 mm., median eye tubercle situated well in front of middle of carapace; pectinal tooth count for females 10, for males 11; lower margin of movable finger of chelicera essentially smooth; inferior lateral and median keels on basal segments of cauda prominent and granulated; chela with inner ventral keel well developed.

ETYMOLOGY: This distinctive species is dedicated to a recently deceased friend and colleague, Mr. Wilton Ivie, whose works on spiders have been of paramount importance to American arachnology.

COLORATION: Base color dark reddish brown, with legs, chelicerae, and underside of preabdomen dusky to yellowish. Carapace and preabdomen with more or less distinct, reticulate pattern of lines and spots; preabdomen with narrow central longitudinal yellowish band, bordered by dusky stripe of granulation, from base to cauda, visible in some specimens.

STRUCTURE: Similar to that of *reddelli* in basic features unless otherwise indicated. Descriptive data and measurements (table 9) based largely

TABLE 9
MEASUREMENTS (IN MILLIMETERS) OF *Vejovis reddelli* AND *iviei*

	Female <i>reddelli</i>	Male <i>reddelli</i>	Female <i>iviei</i>	Male <i>iviei</i>
Total length	55.5	45.6	31.5	27.5
Carapace				
Length	8.0	6.8	4.9	4.1
Width at lateral eyes	4.4	4.0	2.5	2.2
Width at caudal edge	6.8	6.1	4.7	3.5
Preabdomen, length	21.0	13.0	10.5	9.0
Postabdomen, length	26.5	25.8	16.1	14.4
Caudal segment I				
Length	3.6	3.6	2.5	2.0
Width	4.0	3.6	2.8	2.3
Caudal segment II				
Length	4.0	4.0	2.5	2.3
Width	3.6	3.3	2.5	2.3
Caudal segment III				
Length	4.4	4.3	2.8	2.5
Width	3.55	3.2	2.5	2.25
Caudal segment IV				
Length	5.6	5.4	3.0	3.0
Width	3.3	2.8	2.5	2.2
Caudal segment V				
Length	8.9	8.5	5.3	4.6
Width	3.1	2.8	2.3	2.1
Telson, length	8.7	8.0	5.5	4.8
Vesicle				
Length	6.2	5.5	3.4	3.0
Width	3.55	3.1	2.2	1.75
Depth	2.9	2.6	1.6	1.4
Sting, length	2.5	2.5	1.7	1.7
Pedipalp, length	29.2	26.7	16.4	13.4
Femur				
Length	7.6	6.7	4.1	3.3
Depth	2.4	1.95	1.5	1.2
Tibia				
Length	7.6	6.8	4.5	3.7
Depth	2.7	2.4	1.8	1.4
Chela, length	14.2	13.2	7.8	6.4
Palm length	7.6	7.1	4.3	3.7
Palm width	4.5	4.45	2.8	2.25
Palm depth	3.6	3.3	2.6	1.9
Mixed finger, length	6.7	6.0	3.6	2.8
Movable finger, length	8.3	7.6	4.6	3.1
Pectines				
Number of teeth	15/16	19/18	10/10	11/11
Number of middle lamellae	11	12	5	6

on specimens from Shasta County. Structure similar in both sexes except as noted.

Carapace: Finely granulated over most of surface, less so in interocular triangle, with largest granules on side wings flanking median ocular tubercle; frontal margin with six princi-

pal setae of medium length. Frontal emargination small, rounded indentation. Ocular tubercle of average size, situated back of front about three-eighths of distance to posterior margin. Median eyes small, 0.22 in female, separated by less than full diameter. Lateral

eyes (fig. 21) three; posterior eye smallest, set back and above the contiguous pair.

Preabdomen: Tergites densely and finely granulose, more so in males; dorsal keels readily discernible on all tergites of males, on posterior ones forming weak granular crests; these keels barely visible in females, segment VII with well-developed, granular median and lateral crests, each with about 15 small granules, and with numerous small granules in intercarinal spaces. Shape of stigma IV of female as shown in figure 13.

Cauda: First and second caudal segments wider than long; third segment about as broad as long. All keels prominent and granulated; last granule in files on dorsal keels produced into small projection; single median keel on segment V undivided at apex; intercarinal spaces without conspicuous granulation.

Telson: See figure 150. Vesicle narrower than caudal segment V, elongate oval, smooth above, with dorsal and lateral crenulations or weak granules; sting half as long as vesicle.

Pectines: Median piece with deep, shallow, V-shaped emargination in front; middle lamellae, six or seven in both sexes; pectinal teeth, nine or 10 in females, 11 in males; outer pectinal teeth enlarged.

Chelicerae: Keel on lower margin of movable finger essentially smooth, with few weak crenulations.

Pedipalps: All keels on femur and pedipalp with rounded granules. Frontal spurs weak, rounded projections bearing single enlarged granule on each side. Chela rather small with carina moderately well developed and intercarinal spaces smooth; superior carina and accessory carinae mostly smooth; outer keel lightly crenulated; inferior carina essentially smooth; inner ventral carina well developed, lightly granulated.

Walking legs: Single row of spinules on venter of tarsus flanked by three bristles on each side.

TYPE DATA: Female holotype from San Juan, Nevada County, California: September 15, 1963 (Jean and Wilton Ivie), in the collection of the American Museum of Natural History.

DISTRIBUTION: Foothills and mountains of northern California.

RECORDS: *California*: Sierra County: The Cups, Sierra City, September 6, 1959 (W. J. Gertsch, V. Roth), male, female. Trinity County: Little French Creek, 2 mi. E Del Loma,

April 6, 1960 (W. J. Gertsch, W. Ivie, R. Schrammel), male, female. Placer County: Clipper Gap, March 26, 1966 (K. Hom), female; $\frac{1}{2}$ mi. S Clipper Gap, May 30, 1966 (V. Lee), female from under rock in digger pine-live oak area. Butte County: Pulga, Feather River, August 3, 1953 (W. J. and J. W. Gertsch), female; Chico, February 19, 1970 (L. Tabor, F. Wiard), two males, three females. Eldorado County: 3 mi. N Placerville, September 3, 1959 (W. J. Gertsch, V. Roth), male; near Crystal Consumes Cave, April 30, 1966 (V. Lee) female under branch in pine-grassland; Crystal Cave, Somerset, October 21, 1961 (W. R. Catron, T. Seeno), male from 500 yards into cave under limestone rocks. Plumas County: Near Soda Springs Cave, 10 mi. N Quincy, September 5, 1961 (W. J. Gertsch, W. Ivie), one immature. Yuba County: Camptonville, September 7, 1959 (W. J. Gertsch, V. Roth), two males. Shasta County: Delta, N end of Shasta Lake, September 3, 1959 (W. J. Gertsch, V. Roth), female. Entrance of Potter Creek Cave, September 3, 1959 (W. J. Gertsch, V. Roth), male, female; April 12, 1960 (W. J. Gertsch, W. Ivie), two males. Entrance of Samwell Cave, April 2, 1960 (W. J. Gertsch, W. Ivie, R. Schrammel), female; July 29, 1960 (R. Graham), male. Napa County: 0.6 mi. N Robert L. Stevenson State Park (7 mi. N Calistoga on Highway 29), April 20, 1968 (E. Bergmark), female from under bark of log in mixed conifer community; west side of Lake Berryessa, November 11, 1969 (V. F. Lee), two females. Sonoma County: 6 mi. W Geyserville, near Skaggs Spring Road, February 25, 1968 (S. C. Williams, W. K. Fox), three males, nine females, two immatures, under rocks and logs on hillside overlooking stream, 2675 ft.; 5 mi. W of Geyserville, January 26, 1968 (J. S. Dunn), male, female, immature, under logs on hillside; 22.9 mi. E of Stewart's Point, along Skaggs Spring road, 2675 ft., February 25, 1968 (S. C. Williams), two females, under logs. Mendocino County: Eel River Camp, 13 mi. E Covelo, August 19, 1969 (M. Bentzien), female.

Vejovis reddelli, new species

Figures 12, 22, 38, 39, 135

Vejovis sp.: REDDELL, 1965, p. 167.

DIAGNOSIS: Large, dark scorpion resembling *mexicanus* and related species of Mexico, readily

distinguished by following features: all segments of cauda with ventral keels granulated; first caudal segment slightly broader than long in females, as long as broad in males, succeeding segments usually longer than broad in both sexes; keels on chela rather weakly developed and granulated; keel on lower margin of movable finger of chelicera with several dark teeth; pectinal teeth of females 15-16, of males 18-19.

ETYMOLOGY: Named for Mr. James Reddell, student of caves and cave faunas, who has done extensive exploration of Texas and Mexican caves.

COLORATION: General appearance in both sexes that of large, reddish to mahogany brown, or blackish scorpion, with tan walking legs and chelicerae. Underside mostly tan, with pectines yellowish. Young specimens paler, with dusky pattern.

STRUCTURE: Dorsal view of male as shown in figure 135. Similar in both sexes, except for smaller size of males. Measurements as given in table 9.

Carapace: Coriaceous, with medium-sized granules in females, concentrated in posterior half and larger ones in males. Area around median eye tubercle and interocular triangle quite smooth in females, rugulose and with heavier granules in males. Frontal margin with rather deep-rounded indentation and set with six long setae; this margin in males revolved to form rugose ridge armed with row of granules. Median eyes about 0.32 mm., separated by more than their diameter, on rather prominent tubercle; eye tubercle about one-fifth width of carapace at that point and situated in front of middle point of length. Lateral eyes (fig. 22) three; posterior eye only slightly smallest.

Preabdomen: Tergites I-II essentially smooth at base, with small granules along posterior edges; tergites III-VI smooth at base but with posterior half or more of each with scattered granules; tergite VII with scattered granules and prominent serrate keels. Stigma of sternite IV of male as shown in figure 12.

Cauda: Dorsal and superior lateral keels sharply serrate, each terminating in sharp, erect spine. Lateral keels serrate on caudal segment I, present and serrate on posterior quarter of segment II, serrate on posterior fifth of segment III, and absent on segment IV. Inferior lateral keels serrate on segments I-IV. Inferior median keels unevenly smooth on segment I, weakly

serrate on segment II, serrate on segments III-IV. Intercarinal spaces essentially devoid of granulations. Dorsal keels on segment V with uneven patches of weakly serrate granules; lateral keels weak on anterior half, formed by small, pointed granules; inferior lateral keels strongly serrate; single median keel with serrate granules. Ventral setae count of segments I-V, 3-3-3-3-4.

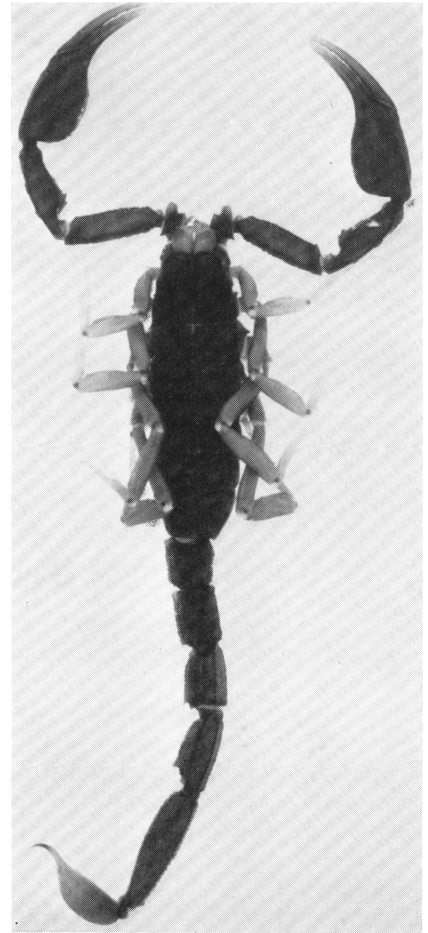


FIG. 135. *Vejovis reddelli*, new species, male, dorsal view.

Telson: Vesicle wider than fifth caudal segment in both sexes. Sting about half as long as vesicle, rather abruptly curved at apex, with inconspicuous nodule and two projecting setae at base.

Pectines: Median piece about two-thirds as long as wide, with shallow emargination in front.

Median lamellae circular, eight to 12 in both sexes. Pectinal teeth short in females, longer and angular in males; counts of females 15–16, of males 18–19.

Chelicerae: See figures 38, 39. Fixed finger of standard vejovid form with respect to count and position; two or three teeth or nodules present on inconspicuous ventral carina. Movable finger with normal five strong teeth on upper margin; lower margin with heavy distal tooth and keel bearing four or five strong, sharp or rounded, dark teeth. Serrulae present on lower edge of movable finger.

Pedipalps: Similar in both sexes with heavy hands and long fingers. Femur with all keels sharply serrate. Tibia with inner keels serrate, outer keels crenulate, and raised portion on inner face set with two blunt spines. Chela with all keels weakly defined and with no sharply marked ridges. Granulation of superior keel quite smooth, with uneven, rounded granules; inner accessory keel smooth; outer accessory keel barely distinguishable, covered with minute granules; inner keel rounded, with heavy, uneven granules. Inferior keel rounded, with medium-sized granules; inner ventral keel obsolete; inner accessory keel weakly granulated. Six files of fine teeth on inner carinae of fingers, flanked by six supernumerary teeth on fixed and seven on movable finger.

Walking legs: Tarsi with median line of ventral spinules flanked by four or five setae on each side.

TYPE DATA: Female holotype from Pablo's Cave, Uvalde County, Texas, April 5, 1963 (J. Reddell, D. McKenzie), found in first room of cave in darkness about 50 feet from entrance, deposited in the American Museum of Natural History.

DISTRIBUTION: Texas. Reddell (1965, p. 167) listed 22 caves in 10 counties where specimens have been taken and classified the species as a "common troglophile in caves throughout the state." Specimens from Texas caves previously referred to *Vejovis mexicanus* and *crassimanus* probably are this species. The species also occurs outside of cave habitats as shown by some of the following records.

RECORDS: *Texas*: Bandera County: Fog Fissure, 5 mi. N Vanderpool, October 30, 1963 (D. McKenzie), female. Bexar County: 1 mi. N Helotes, July 2, 1959 (J. F. Lawrence), male; Government Canyon Bat Cave, 5 mi. SW

Helotes, August 11, 1965 (J. Reddell, J. Fish), male; Madla's Ranch Cave, 3 mi. N Helotes, July 6, 1959 (J. F. Lawrence, J. Reid), male; Adam Wilson's Cave, 4 mi. N Helotes, October 4, 1963 (J. Reddell, D. McKenzie), juvenile. Burnet County: Pie Cave, $\frac{3}{4}$ mi. N Longhorn Caverns, July 24, 1963 (W. Russell), immature. Comal County: New Braunfels, May 28, 1918, female; Brehmer Cave, New Braunfels, September 11, 1940 (W. Jellison, G. Kohls), six males, six females. Edwards County: Deep Cave, $\frac{1}{4}$ mi. E Punkin Cave, September 4, 1965 (J. Reddell, D. McKenzie), male, two females from walls of upper room; September 4, 1965 (D. Dickey), two immatures; Jacoby Cave, about 10 mi. W Telegraph, just south of Kimble County line, September 22, 1963 (J. Reddell, D. McKenzie), young female. Hays County: Ezell's Cave, San Marcos, September 7, 1963 (J. Reddell, D. McKenzie, R. Ballinger), male; Donaldson Cave, August 15, 1965 (B. Frank, B. Banfer), male. Kendall County: Near Century Caverns, 11 mi. NE Boerne, March 20, 1964 (W. Russell), female from under rock near cave entrance. Kerr County: Between Hunt and Leakey, December 30, 1956 (W. McAlister, K. Baker), young female; 6 mi. NW Hunt, December 29, 1956 (W. McAlister, K. Baker), female. Kimble County: Fleming Bat Cave, 2 mi. N Telegraph, September 3, 1967 (J. Goodbar), female, with 21 young. Real County: Orell Crevice Cave, 100 yards W Orell Bat Cave, August 18, 1963 (J. Reddell, D. McKenzie), immature on wall; Skeleton Cave, 5 mi. N Leakey, August 18, 1963 (J. Reddell, D. McKenzie), male, young female from under rocks in entrance room. Travis County: Beckett's Cave, 1 mi. S Oak Hill, December 5, 1965 (W. Russell), female; Cotterrell Cave, 7 mi. N Austin, March 10, 1967 (E. E. Remington), two males; Bee Creek Cave, west of Tom Miller Dam in Austin, October 2, 1963 (J. Reddell, D. McKenzie), young female; Ken Harrell Cave, 10 mi. N Austin, March 27, 1963 (W. Russell), three immatures; Broken Straw Cave, Austin, March 10, 1967 (E. E. Remington), male; Bandit Cave, Austin, March 8, 1968 (J. Reddell, J. Fish), male; Goat Cave, 8 mi. SW Austin, March, 1968 (J. Reddell, J. Fish); Kretschmarr Cave, 15 mi. NW Austin, March 2, 1963 (J. Reddell, D. McKenzie), one immature from second room, 30 ft. from entrance; Cave X, 6 mi. S Austin (J. Reddell), young male, March 8, 1963 (J. Reddell, D.

McKenzie), female; Tooth Cave, 15 mi. NW Austin, October, 1963 (W. Russell), female, February 25, 1963 (D. McKenzie, W. Russell), male, August 5, 1963 (J. Reddell), immature from under rocks; 2 mi. W Austin, April 2, 1958 (W. McAlister), female; Bull Creek, 8 mi. NW Austin, August 22, 1968 (B. Vogel). Zilker Park, Austin, April 1, 1956 (W. McAlister, J. Boyd), male. Uvalde County: North Well Cave, April 5, 1963 (J. Reddell, D. McKenzie), two young males from anteroom and main cave room; McNair Cave, October 26, 1965 (J. Reddell, J. Fish, J. Calvert), female; Tampke Ranch Cave, February 11, 1966 (J. Reddell, D. McKenzie), male. Val Verde County: 6 mi. N Del Rio, April 10, 1968 (J. Reddell), two immatures. Williamson County: Williams Cave, 2 mi. NW Georgetown, August 24, 1968 (J. Reddell, W. Russell), immature; Steam Cave, 2 mi. S Georgetown, July 7, 1963 (J. Reddell, W. Russell), male from wall in darkness; Cave 31, October, 1964, male; Inner Space Caverns, 2 mi. S Georgetown, December 22, 1968 (W. Elliott), male; Core Hole Cave, 1 mi. S Georgetown, November 3, 1963 (J. Reddell, D. McKenzie, J. Porter), two males; Steam Cave, 2 mi. S Georgetown, January 6, 1963 (J. Reddell, T. Phillips), three immatures.

Vejovis minimus Kraepelin

DISCUSSION: Kraepelin (1911) based the name *minimus* on three examples of a small scorpion from San Pedro, California, and compared it with what were then the only presumed relatives, *Vejovis carolinus* of the southeastern United States and *Vejovis pusillus* of Mexico. The structure of *minimus* seems to ally it more closely with *Vejovis baueri* Gertsch (1958, p. 6) and various undescribed species of Baja California, and also to species of the *wupatkiensis* complex of the southwestern United States and adjacent Mexico. The principal feature of *minimus* is the very short, wide cauda, with three basal segments broader than long, and the fourth segment as broad as long. This character is shared by specimens from San Diego County, the mainland and southern Channel Islands of Los Angeles County, and the northern Channel Islands of Santa Barbara and Ventura counties. Specimens from each of these centers show differences that have prompted us to regard the complex

as being derived from the same stock and representing a single polytypic species.

DIAGNOSIS: Small, granulated species with thick cauda about three times as long as carapace; frontal emargination shallow; median eyes situated in front of middle of carapace about one-third of distance back; lower margin of movable finger of chelicera smooth; segments I-III of cauda much broader than long, segment IV as broad as long, all about equal in width instead of segments III-IV being much broader in *baueri*; all keels on cauda granulated.

Vejovis minimus minimus Kraepelin

Figures 136, 137, 144

Vejovis minimus KRAEPELIN, 1911, p. 83. EWING, 1928, p. 11.

DIAGNOSIS: Average size about 19 mm., with largest female 21.6 mm. long; coloration quite uniform brown; fixed finger of chela about equal to palm width, movable finger somewhat less than palm length; apical teeth on fingers of chela not noticeably enlarged; movable finger with six supernumerary teeth.

COLORATION: Quite uniform medium to dark reddish brown, with keels darker; eye tubercles and tip of sting blackish.

STRUCTURE: Similar in both sexes unless otherwise noted. Measurements as given in table 10.

Carapace: Anterior margin with shallowly rounded emargination in front, with six principal setae, three on each lobe. Carapace coriaceous, covered over most of surface with rounded granules, these less numerous in eye triangle. Median eyes small, about 0.02 mm., separated by almost their diameter; median eye tubercle about one-sixth or one-seventh of carapace width at that point. Lateral eyes three; posterior eye smaller than front pair, in some cases obsolete.

Preabdomen: All tergites granulated, lightly as in front half but with heavier, rounded granules on posterior edges. Tergite VII granulose, with dorsal and submedian keels well developed, set with row of rounded granules. Sternites quite smooth; sternite V with scattered granules on sides.

Cauda: In both sexes (fig. 144) short, thick, not much narrowed behind. First three segments much broader than long; fourth segment

TABLE 10
MEASUREMENTS (IN MILLIMETERS) OF *Vejois minimus* AND *castaneus*

	Lectotype <i>minimus</i>	Male <i>minimus</i>	Female <i>minimus</i>	Female <i>castaneus</i>
Total length	19.6	18.5	21.6	30.8
Carapace				
Length	3.3	3.2	3.8	5.2
Width at lateral eyes	1.7	1.7	2.0	2.7
Width at caudal edge	3.0	3.0	3.8	4.8
Preabdomen, length	7.0	5.2	6.7	11.2
Postabdomen, length	9.3	10.1	11.1	14.4
Caudal segment I				
Length	1.2	1.4	1.6	2.0
Width	1.9	2.0	2.3	3.3
Caudal segment II				
Length	1.5	1.6	1.7	2.3
Width	2.0	2.0	2.3	3.4
Caudal segment III				
Length	1.5	1.7	1.8	2.5
Width	2.0	2.1	2.3	3.4
Caudal segment IV				
Length	2.0	2.1	2.4	3.1
Width	2.0	2.1	2.3	3.3
Caudal segment V				
Length	3.1	3.3	3.6	4.5
Width	2.0	2.0	2.3	3.3
Telson, length	3.7	3.6	4.3	5.2
Vesicle				
Length	2.1	2.2	2.5	3.3
Width	1.5	1.5	1.7	2.6
Depth	1.2	1.1	1.3	1.8
Sting, length	1.3	1.3	1.3	1.6
Pedipalp, length	10.0	9.6	12.2	16.1
Femur				
Length	2.5	2.2	2.8	4.0
Depth	1.0	0.9	1.2	1.6
Tibia				
Length	2.7	2.7	3.3	4.2
Depth	1.2	1.1	1.3	1.8
Chela, length	4.8	4.7	6.1	7.9
Palm length	2.9	2.7	3.3	4.7
Palm width	1.9	1.9	2.3	3.2
Palm depth	1.7	1.8	2.2	2.7
Fixed finger, length	2.0	1.7	2.3	3.2
Movable finger, length	2.7	2.4	3.2	4.5
Pectines				
Number of teeth	10/10	10/10	9/9	10/10
Number of middle lamellae	6	8	6	6

as broad as long; fifth segment longer than broad but about as wide at base as width of preceding segments. Dorsal and lateral keels of segments I-IV prominent, provided with heavy, rounded granules to give crenulate to serrate appearance, those at posterior ends of series

slightly larger; these keels of segment V less developed, rounded, with fewer heavy granules. Intercarinal spaces above with numerous small granules. All ventral keels well developed and coarsely granulated; intercarinal spaces with small granules, many on segment V. Cauda with

few bristles; those on venter in rows of three on most segments.

Telson: Vesicle much narrower than fifth caudal segment, elongate-oval, smooth and flat above, rounded and granulated below, with rows of inconspicuous bristles. Sting moderately curved, about three-fifths as long as vesicle in both sexes. See figure 137.

Pectines: Median piece twice as broad as long, with short, triangular emargination in front, its breadth somewhat more than half of greatest length of pectin. Middle lamellae of females five or six, of males seven or eight. Pectinal teeth of females nine or 10, of males 10 or 11.

Chelicerae: Dentition typical of genus. Keel on lower margin of movable finger smooth.

Pedipalps: Similar in both sexes, with heavy hands resembling those of species of *Uroctonus*. Femur and tibia of medium size, with keels prominent and provided with rounded granules. Chela robust for size of scorpion, with all keels prominent; superior and outer accessory keels smooth, with a few pits; inner accessory, lateral and all ventral keels granulated, giving inside view crenulate or irregularly serrate lines. Inner keel of fixed and movable fingers with six files of granules flanked by six supernumerary teeth; apical file on movable finger short. Tips on fingers not much curved inward and apical teeth of medium development (fig. 136).

Walking legs: Typical for genus, with basal segments finely granulated. Tarsi with ventral line of spinules flanked by fine inconspicuous setae.

TYPE DATA: Female lectotype and male and female paratypes from San Pedro, Los Angeles County, California, in the Zoologisches Museum, Universitat Hamburg, Hamburg, Germany.

DISTRIBUTION: Mainland and southern Channel Islands, Los Angeles County, California.

RECORDS: *California:* Los Angeles County: Avalon, Santa Catalina Island, July 24, 1961 (V. and B. Roth), male; San Clemente Island: April 10, 1923 (P. Needham), two males, three females, November 17, 1962 (D. Sanchez), male from Indian midden, August 11, 1968 (D. G. Marqua), female from Nots Pier area, February, 1969 (T. Cooke), eight males.

***Vejovis minimus castaneus*, new subspecies**

Figures 14, 141-143

DIAGNOSIS: Length of subadult female 23.6

mm., of mature female 30.8 mm.; color quite uniform brown; tips of fingers of chela curved inward and apical teeth enlarged; movable finger with seven supernumerary teeth; telson proportionally broader than that of *minimus minimus*.

ETYMOLOGY: From the Latin *castanea*, chestnut, in reference to the dark brown coloration.

COLORATION: Like that of *minimus minimus*.

STRUCTURE: In close agreement with that of *minimus minimus* except as noted below. For measurements, see table 10.

Carapace: Median eyes 0.2 mm.; median eye tubercle a little less than one-seventh of carapace width at that point. Lateral eyes two; posterior eye obsolete or nearly so.

Preabdomen: Stigma of sternite IV of female as shown in figure 14.

Cauda: Caudal segment IV slightly broader than long; caudal segment V only 1.3 times as long as broad. Cauda as shown in figure 141.

Telson: Vesicle broad, somewhat narrower than width of caudal segment V. See figures 142, 143.

Pedipalps: Inner keels of fixed and movable fingers with six files of granules and six spaced teeth, flanked by six supernumerary teeth on fixed, and seven on movable, fingers. Tips of fingers curved inward to form weak claw and apical teeth quite large.

TYPE DATA: Female holotype from Santee, San Diego County, California, January 28, 1965 (Marion Keafer), from house, in San Diego Natural History Museum.

DISTRIBUTION: San Diego County, California.

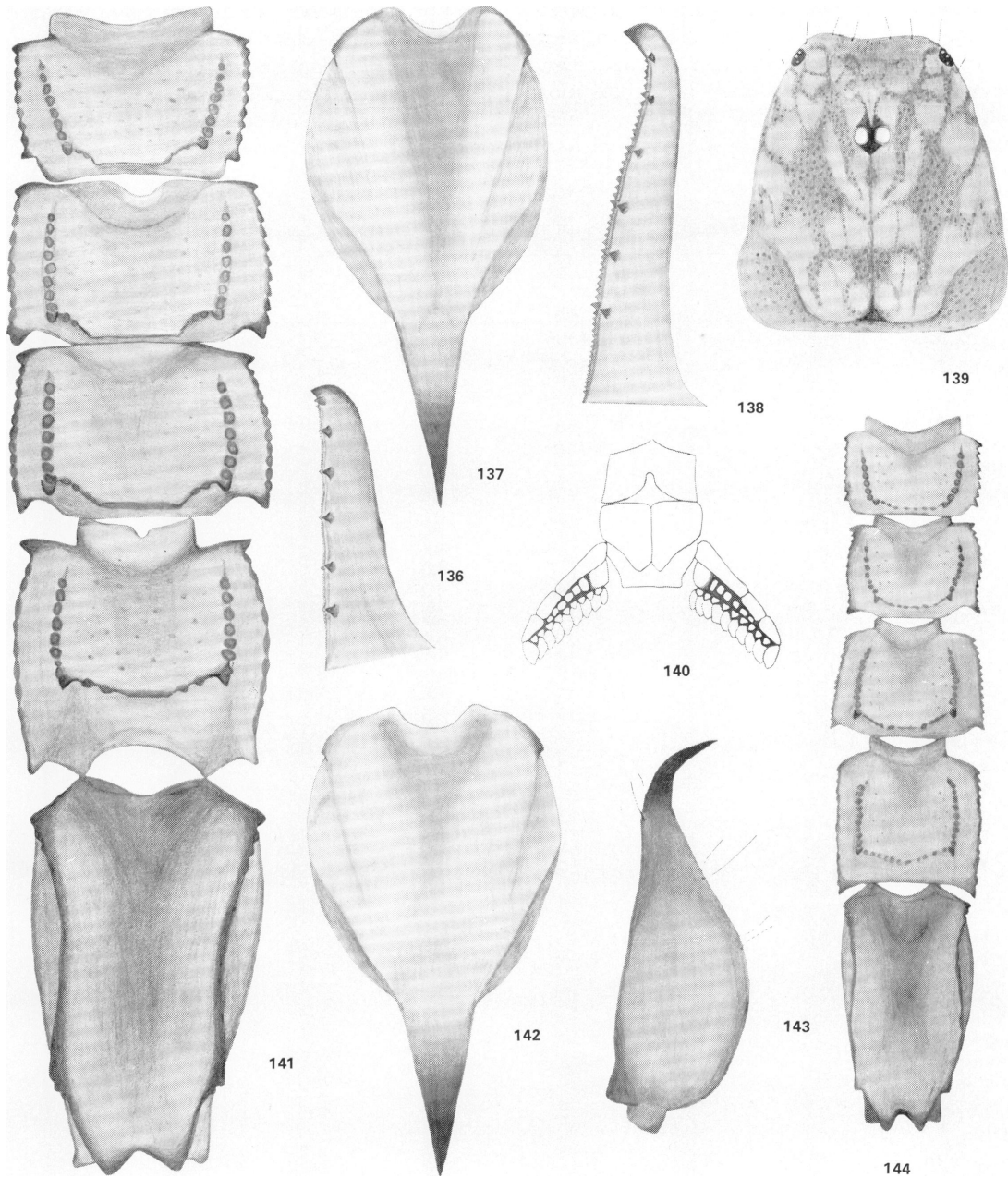
OTHER RECORD: *California:* San Diego County: Vista, April, 1965 (Mrs. Philip Sampson), female.

***Vejovis minimus thompsoni*, new subspecies**

Figures 138-140

DIAGNOSIS: Average size about 22 mm., with largest female 27.8 mm. long; color pattern mottled, with black spots on venter of cauda; length of fixed finger exceeding palm length; movable finger about equal to palm length in males, much longer in females; tips of fingers turned inward to form opposable claws; movable finger with seven supernumerary teeth.

ETYMOLOGY: This species is named for Mr. Melvin Thompson of the Whittier Narrows Nature Center, El Monte, California.



FIGS. 136, 137. *Vejovis minimus minimus* Kraepelin, male. 136. Fixed finger of right chela, ventral view. 137. Telson, dorsal view.

FIGS. 138-140. *Vejovis minimus thompsoni*, new subspecies, female. 138. Fixed finger of right chela, ventral view. 139. Carapace. 140. Sternum, genital operculum and pectines.

FIGS. 141-145. *Vejovis minimus castaneus*, new subspecies, female. 141. Segments I-V of cauda. 142. Telson, dorsal view. 143. Telson, lateral view.

FIG. 144. *Vejovis minimus minimus* Kraepelin, female, segments I-V of Cauda.

COLORATION: Base color pale yellowish to dark reddish brown, darkest in adults, with legs and venter of preabdomen paler. Carapace and preabdomen with brown lines and spots more or less completely marking the surface, with usually distinct pale median longitudinal band

on preabdomen. Cauda and appendages mottled in brown, with keels dark brown; venter of cauda with series of blackish spots along dark keels.

STRUCTURE: In close agreement with that of *minimus minimus* except as noted below. For measurements, see table 11.

TABLE 11
MEASUREMENTS (IN MILLIMETERS) OF *Vejevís thompsoni* AND *gracilis*

	Male <i>thompsoni</i>	Female <i>thompsoni</i>	Female <i>thompsoni</i>	Female <i>gracilis</i>
Total length	22.8	27.8	24.1	16.1
Carapace				
Length	3.6	4.0	3.6	2.3
Width at lateral eyes	1.8	2.1	1.8	1.2
Width at caudal edge	3.5	3.8	3.7	1.9
Preabdomen, length	7.7	12.0	9.5	5.5
Postabdomen, length	11.5	11.8	11.0	8.3
Caudal segment I				
Length	1.6	1.7	1.5	1.1
Width	2.3	2.5	2.2	0.9
Caudal segment II				
Length	1.7	1.7	1.7	1.3
Width	2.3	2.5	2.2	0.8
Caudal segment III				
Length	1.8	1.8	1.8	1.5
Width	2.3	2.5	2.3	0.8
Caudal segment IV				
Length	2.4	2.6	2.3	1.8
Width	2.4	2.6	2.3	0.7
Caudal segment V				
Length	4.0	4.0	3.7	2.6
Width	2.4	2.6	2.3	0.7
Telson, length	4.0	4.5	4.2	2.5
Vesicle				
Length	2.7	2.5	2.5	1.8
Width	1.5	1.7	1.6	0.7
Depth	1.2	1.3	1.2	0.6
Sting, length	1.4	1.3	1.2	0.7
Pedipalp, length	11.7	12.6	11.4	9.3
Femur				
Length	2.7	3.0	2.6	2.5
Depth	1.1	1.2	1.1	0.5
Tibia				
Length	3.3	3.3	3.1	2.8
Depth	1.2	1.3	1.3	0.6
Chela, length	5.7	6.3	5.7	4.0
Palm length	3.3	3.3	3.0	1.9
Palm width	2.3	2.5	2.0	0.6
Palm depth	1.9	2.1	1.7	0.6
Fixed finger, length	2.5	3.1	2.7	2.2
Movable finger, length	3.3	4.0	3.0	2.5
Pectines				
Number of teeth	10/11	10/10	10/10	21/21
Number of middle lamellae	6	6	7	16

Carapace: As shown in figure 139. Median eyes 0.22 mm.; median eye tubercle one-sixth of width of carapace at that point. Lateral eyes three; posterior eye small, rarely obsolete.

Pectines: Of female as shown in figure 140. Pectinal tooth counts of female 10, of males 10 or 11.

Cauda: Fourth caudal segment as broad as long; fifth caudal segment about 1.5 as long as broad.

Telson: Vesicle half width of fifth caudal segment.

Pedipalps: Inner keels on fingers flanked by six supernumerary teeth on fixed and seven on movable finger. Tips of fingers curved inward to form conspicuous opposable claws (fig. 138).

TYPE DATA: Female holotype from Anacapa Island, Ventura County, California, April 11, 1968 (M. Thompson), in the American Museum of Natural History.

DISTRIBUTION: Northern Channel Islands of Ventura and Santa Barbara counties of California.

RECORDS: *California*: Ventura County: Anacapa Island: April 11, 1968 (M. Thompson), male, immature; July 18, 1968 (M. Thompson), female. Santa Barbara County: Santa Cruz Island: August 17, 1968 (M. Thompson), male; August 20, 1968 (M. Thompson), male; no further data, female in San Diego Museum of Natural History; Prisoner's Harbor, March 14, 1969 (J. T. Doyen), male, two females from under bark; Canada de la Cuesta, March 15, 1969 (J. Powell), female from under oak bark; Santa Rosa Island, female in San Diego Museum of Natural History.

Vejovis gracilis, new species

Figures 24, 25, 80-83, 147-149

DIAGNOSIS: Small, slender scorpion related to *Vejovis wupatkiensis* and related species of southwestern United States, readily differentiated by following features: sternum large, as long as broad, much larger than genital operculum; third lateral eye on each side reduced to small vestige; ventral row of spinules on tarsi weakly developed, mostly absent except near base of segments; telson more than three times as long as greatest width.

The pale coloration, weak sclerotization, elongated appendages, and few evident setae on all parts of the body may be adaptations of this

scorpion to its cave habitat or may only reflect its immature status. The number of teeth in the pectines, 21, suggests a much larger scorpion. Until more material becomes available, the exact status of this species must remain obscure.

ETYMOLOGY: Specific name from the Latin *gracilis*, slender or graceful.

COLORATION: Base color of body and appendages pale yellowish. Carapace with dusky, mottled pattern and eyes and eye tubercles black. Pedipalps and walking legs with pale red articulation spots, and tip of sting reddish.

STRUCTURE: Typical for its section of the genus. For measurements, see table 11.

Carapace: As shown in figure 148, flat and elongate, noticeably longer than wide in ratio 4/3.2. Frontal margin with gradually curving, weak indentation. All of carapace essentially devoid of granulation, with areas of pattern minutely pitted, lacking setae except for single pair on tubercle behind median eyes. Median eyes small, 0.12 mm., separated by diameter, on short, flat tubercle lying well in advance of middle of carapace; eye tubercle one-fifth width of carapace at that point. Two well-developed lateral eyes (figs. 24, 25) on each side; third lateral eye present but reduced to small vestige.

Preabdomen: Tergites appearing smooth under low power but posterior portions densely granulate under higher power. Tergite V with pair of weak keels; tergite VII with two pairs of delicately serrate keels. All sternites smooth, with short slitlike stigmata.

Cauda: All segments longer than wide; all keels delicately crenulate; lateral keels present only on first caudal segment; intercarinal spaces smooth.

Telson: As shown in figure 149. Vesicle distinctly elongated with medium-sized sting; pair of erect, long setae at juncture of vesicle and sting, originating from a very weak subaculear nodule.

Pectines: Median piece two-thirds as long as broad, with deep V-shaped emargination in front. Pectines well developed, with 21 long, thin teeth; distal tooth suboval. Middle lamellae circular, 16 in number.

Genital operculum: Composed of two transverse plates, considerably smaller than very large, subpentagonal sternum; outside corners of each plate pointed, in effect like triangles lying on their sides.

Chelicerae: Lower edge smooth, with delicate growth of serrulae. Fixed and movable fingers with standard dentition of genus. Apical tooth of lower edge noticeably longer than dorsal counterpart.

Pedipalps: All segments slender, mostly devoid of granulation and setae. Femur five times as long as deep, a little longer than carapace, with all keels smooth. Inner spur of tibia obsolete except for two tiny granules at basal end. Chela (fig. 147) long, slender, with all keels essentially obsolete giving smooth, rounded effect to palm. Inner edges of fingers moderately scalloped and apical tips large and pointed. Fixed finger with six and movable finger with seven supernumerary teeth. Trichobothrial pattern as shown in figures 80–83.

Walking legs: Spinules of ventral row on tarsi very small or absent, present mostly near base of segment, flanked by three or four setae on each side.

TYPE DATA: Female holotype from Cueva de Atoyac, Atoyac, Veracruz, Mexico, August 6–9, 1969 (S. and J. Peck), in the American Museum of Natural History.

Vejovis vaquero, new species

DIAGNOSIS: Small scorpion not fully mature with general appearance of *chicano* but deviating from *Uroctonus* standard in various features: frontal margin with weak indentation; chela of medium robustness, lacking inner ventral carina; three lateral eyes in straight line, posterior one well developed.

ETYMOLOGY: Specific name based on Spanish word for cowboy.

COLORATION: Base color light tan with darker brown mottling. Carapace and tergites of postabdomen with reticulated brown pattern. Walking legs and femur and tibia of chela with brown streaks and spotting. Keels on chela and cauda outlined in medium brown. Vesicle of telson with three wide brown stripes below. Chelicerae, pectines, and underside of preabdomen pale yellow.

STRUCTURE: Similar in both sexes unless otherwise noted. Measurements as given in table 12.

Carapace: Frontal margin with shallow indentation, armed with six evenly spaced setae. Mottled areas with sparse covering of inconspicuous granules. Median eyes small, 0.15 mm., separated by little more than diameter; median

eye tubercle about one-sixth of width of carapace at that point, lying well in advance of middle of carapace. Lateral eyes three; posterior eye well developed, placed in line with larger front pair.

Preabdomen: Tergites I–VI with scattered fine granules mostly on posterior portions and along these margins. Tergite VII covered with larger granules and with both pairs of keels serrate. Sternites smooth, with transverse rows of weak setae; sternite V with weak set of keels on posterior edge.

Cauda: First three caudal segments broader than long; fourth and fifth segments longer than broad. Dorsal and superior lateral keels of segments I–IV strongly serrate. Lateral keels serrate on segment I, serrate on posterior third of II and posterior fifth of III, obsolete on IV. Inferior lateral and median keels serrate. Dorsal keels on segment V crenulate; lateral keels present and serrate on anterior half; inferior lateral keels serrate and with loose granulation in adjoining spaces; inferior median keels serrate but irregularly as at posterior end. Ventral setae distribution on segments I–V: 2–3–3–3–3.

Telson: Vesicle narrower than caudal segment V. Sting half as long as vesicle, evenly curved.

Pectines: Median piece about five-eighths as long as broad, with deep triangular indentation. Both sexes with seven middle lamellae and 11 teeth on pectines.

Chelicerae: With typical *Vejovis* dentition: ventral carina of movable finger with few weak crenulations, essentially smooth.

Pedipalps: Keels on femur and tibia crenulate; inner spine on tibia weak. Chela of medium size with short fingers and with keels relatively smooth except for weak crenulation or evenly spaced granulation. Inner ventral keel obsolete. Fixed and movable fingers of chela with six and seven supernumerary teeth respectively. Trichobothrial pattern standard; ib and it above membrane, characteristic of *Uroctonus*.

Walking legs: Median row of spinules beneath tarsi flanked by two pairs of fine setae.

TYPE DATA: Female holotype and male from Arroyo del Alamo, Sierra del Nido, Chihuahua, Mexico (latitude 106°50'N, longitude 29°20'W), October 14, 1969 (V. Roth), in the American Museum of Natural History.

DISTRIBUTION: Known only from above specimens.

Vejovis waueri, new species

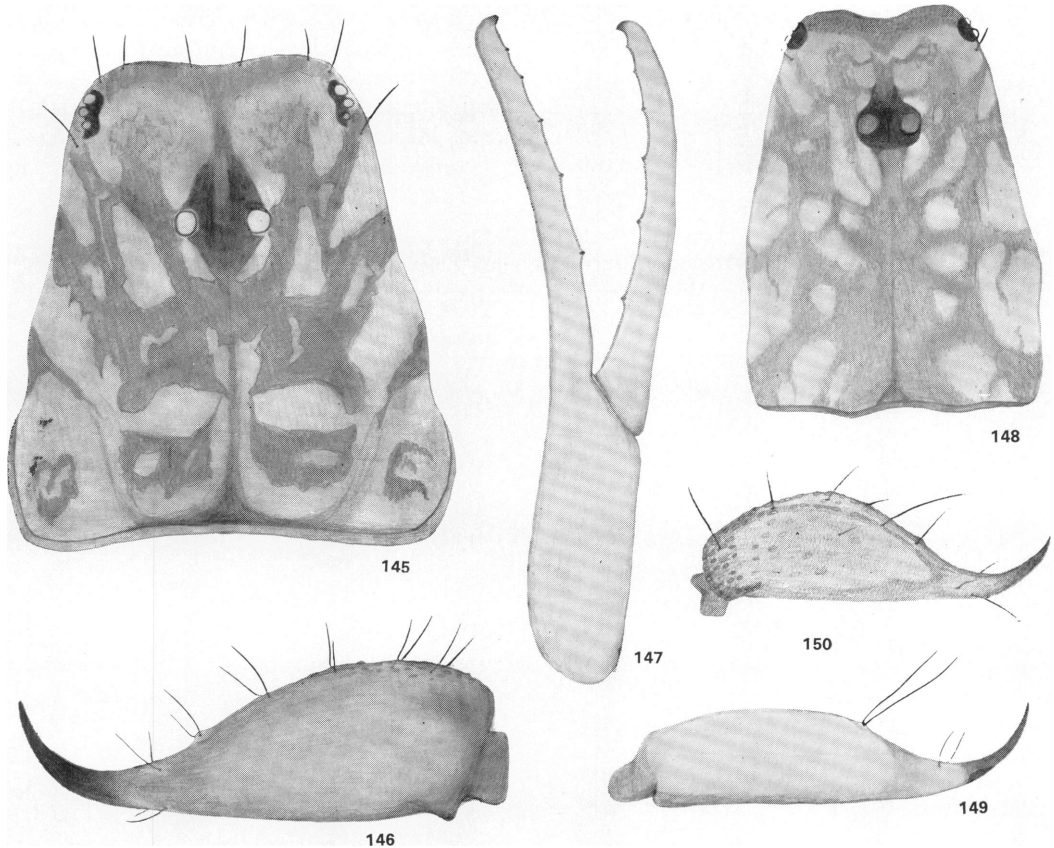
Figures 145, 146

Vejovis bilineatus: GERTSCH, 1939, p. 18 (not *bilineatus* Pocock).

DIAGNOSIS: Small, polished, sparsely granu-

lated species of *spinigerus* group, close relative of *Vejovis bilineatus* Pocock but distinct in following features: largest female 24.8 mm. long; all dorsal and lateral keels of caudal segments I-IV serrate, instead of only those on segments I-II; pectinal tooth count of females 12-13, mostly 12,TABLE 12
MEASUREMENTS (IN MILLIMETERS) OF *Vejovis waueri* AND *vaquero*

	Female <i>waueri</i>	Female <i>waueri</i>	Female <i>vaquero</i>	Male <i>vaquero</i>
Total length	17.9	24.8	20.8	15.4
Carapace				
Length	2.6	3.3	3.0	2.5
Width at lateral eyes	1.3	1.9	1.6	1.3
Width at caudal edge	2.6	3.2	2.8	2.3
Preabdomen, length	7.0	9.5	9.1	5.8
Postabdomen, length	8.3	12.0	8.7	7.1
Caudal segment I				
Length	1.1	1.8	1.2	0.9
Width	1.7	2.2	1.8	1.4
Caudal segment II				
Length	1.3	1.8	1.3	1.1
Width	1.7	2.2	1.7	1.3
Caudal segment III				
Length	1.4	1.9	1.4	1.2
Width	1.7	2.2	1.6	1.3
Caudal segment IV				
Length	1.9	2.6	1.8	1.4
Width	1.6	2.1	1.6	1.3
Caudal segment V				
Length	2.6	3.6	3.0	2.5
Width	1.5	2.1	1.5	1.3
Telson, length	2.6	3.3	3.0	2.4
Vesicle				
Length	1.6	1.8	2.0	1.8
Width	1.1	1.5	1.3	1.1
Depth	0.8	1.2	1.0	0.8
Sting, length	1.0	1.3	1.0	0.6
Pedipalp, length	7.5	9.2	8.8	7.4
Femur				
Length	1.9	2.3	2.2	1.9
Depth	0.7	0.8	0.9	0.8
Tibia				
Length	2.3	2.7	2.5	2.0
Depth	0.9	1.1	1.1	0.8
Chela, length	3.4	4.2	4.1	3.5
Palm length	1.5	2.3	2.3	1.8
Palm width	1.0	1.1	1.5	1.3
Palm depth	0.8	1.0	1.5	1.1
Fixed finger, length	1.5	1.8	1.6	1.4
Movable finger, length	1.6	2.2	2.2	1.9
Pectines				
Teeth	12/12	12/12	11/11	11/11
Middle lamellae	8/8	8/8	8/8	8/8



FIGS. 145, 146. *Vejovis waueri*, new species, female. 145. Carapace. 146. Telson, lateral view.
 FIGS. 147-149. *Vejovis gracilis*, new species, female. 147. Right chela, lateral view. 148. Carapace. 149.
 Telson, lateral view.
 FIG. 150. *Vejovis iviei*, new species, telson of female, lateral view.

more numerous in *bilineatus*, 13-16, mostly 15; chelae and caudal segment V of conspicuous dark brown color.

ETYMOLOGY: This pretty species named for Mr. Roland H. Wauer, Chief Park Naturalist of the Big Bend National Park of Texas.

COLORATION: Base color orange or tan, masked by dark brown or blackish markings. Carapace uniformly mottled with dark pattern. Chelae and caudal segment V dark brown in strong contrast to rest of body. Preabdomen with dark maculations on sides, leaving distinct median pale stripe. Tibia of pedipalp faintly marked with dusky pattern but lighter than dark chela. Patellae of walking legs and dorsal areas of cauda marked with irregular dusky patterns. Inferior lateral and inferior median keels of cauda outlined with brown pigment to form

dark stripes but these coalesced to cover venters of segments IV and V. Vesicle of telson orange; sting dark brown.

STRUCTURE: Based entirely on female specimens. Measurements as given in table 12.

Carapace: Smooth and highly polished, without granulation. Frontal margin with slight indentation; median furrow of slight development. Median eye tubercle situated well in front of middle of carapace (1.6/3.0). Lateral eyes three, all well developed; front eye largest. For details, see figure 145.

Preabdomen: All sclerites highly polished, essentially devoid of granulation. Tergite VII with usual two pairs of keels, weakly and irregularly serrate. All sternites smooth except posterior third of sternite V which is minutely pitted but lacks keels. Stigma short slits.

Cauda: Short, of medium thickness; first three segments wider than long. Lateral keels serrate on cauda as follows: full length of I, posterior half of II, weakly on posterior quarter of III, and entirely absent on IV. Inferior lateral and inferior median keels essentially obsolete on segments I-IV, except for scattered granules on inferior lateral keels of IV. Dorsal keels of segment V covered with rounded granules; lateral keels weak and granulate on anterior half; inferior lateral and single median keels serrate. Intercarinal spaces on venter of caudal segment V with numerous serrate granules.

Telson: Vesicle polished, quite flat above, with weak subaculear nodule, much narrower than caudal segment V, with weak granulation below and on sides. Sting short, well curved, about half as long as vesicle. See figure 146.

Pectines: Median piece large, with prominent V-shaped emargination in front. Median lamellae subcircular, eight in number. Pectinal teeth short; counts of females 12-13, mostly 12.

Chelicerae: Dentition typical and with row of delicate serrulae on lower edge of movable finger. Lower margin of movable finger smooth.

Pedipalps: All segments with polished luster. Femur with serrate upper keels. Tibia with smooth keels. All keels of chela obsolete or nearly so, present as rounded elevations. Fixed finger with six, and movable finger with seven, supernumerary teeth; inner edges of fingers straight.

Walking legs: Tarsi with median line of ventral spinules, flanked by few lateral setae.

TYPE DATA: Female holotype, and three other females, from The Basin, Chisos Mountains, Big Bend National Park, Brewster County, Texas, September 28, 1950 (W. J. Gertsch) from beneath stones in shaded arroyo.

DISTRIBUTION: Southern Texas and Mexico.

RECORDS: *Texas*: Blackstone Ranch, 19 mi. S Sheffield, Terrell County, June 17, 1959 (W. H. McAlister), four females. *Nuevo Leon*: Near Bustamente, December 26, 1963 (W. Russell), female from under rock; 4 mi. S Bustamente, March 26, 1964 (W. Russell), female from under rock; 3 mi. S Bustamente, February 21, 1964 (J. Reddell), female from under rock. *Sonora*: Rio Cuchujaqui, east of Alamos, January 14, 1968 (V. Roth), two females.

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