

## SYSTEMATIC STUDIES ON THE *NITIDULUS* GROUP OF THE GENUS *VAEJOVIS*, WITH DESCRIPTIONS OF SEVEN NEW SPECIES (SCORPIONES, VAEJOVIDAE)

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**Abstract.** New diagnostic characters for the *Vaejovis nitidulus* group are given, and seven new species from México are described: *V. curvidigitus* from Guerrero and Morelos; *V. kochi* from Hidalgo and México; *V. mitchelli* from San Luis Potosí and Querétaro; *V. platnicki* from San Luis Potosí and Tamaulipas; *V. pococki* from San Luis Potosí and Querétaro; *V. rubrimanus* from Nuevo León; and *V. solegladi* from Oaxaca and Puebla. New records are given for *V. nitidulus* Koch, *V. nigrescens* Pocock, *V. intermedius* Borelli, *V. decipiens* Hoffmann, and *V. peninsularis* Williams. Finally, hemispermatophores are described and illustrated for seven species, and preliminary observations on their potential usefulness in species and species group taxonomy are presented.

The *nitidulus* group is a significant and diverse element of the genus *Vaejovis* in mainland México. The group was established by Sissom and Francke (1985), although the precedent for its recognition was set by Hoffmann (1931) in his key to species of *Vaejovis* from México. Sissom and Francke (1985) assigned eleven taxa to this group, including some species previously assigned to other groups. The present treatment identifies some new important characters shared by members of the group, provides description of seven new species, and indicates new records for several previously known species.

The species of the *nitidulus* group occur mainly in the mountainous regions from southwestern United States to central Oaxaca, México. They are generally found on moderate to steep slopes characterized by arid to semiarid vegetation, although some may be found in slopes dominated by pines at higher elevations. There, they may seek refuge in cracks and crevices of near-vertical cliffs or deep in the layers of rock on the surface of the slopes during the daylight hours. They emerge at night shortly after the onset of darkness, but remain on the surface for brief periods. These habits make them difficult to collect by rock-rolling techniques, which is perhaps the main reason they are poorly represented in museum collections. Some species may also be locally rare or exhibit such sporadic surface occurrence that they appear to be rare.

A number of characters shared by members of the group have been further studied since the

diagnosis for the group first appeared (Sissom & Francke 1985). These characters, which are also diagnostic, are as follows: (1) the carapace is obtusely emarginate, with a distinct anteromedian notch; (2) the genital operculi of the female possess a membranous longitudinal connection on the anterior two-thirds to four-fifths; (3) the pectinal teeth of the female are all subequal in size; (4) the cheliceral movable finger bears a well-developed serrula on the ventrodorsal aspect; (5) the ventral spinule row of tarsomere II of the legs is flanked distally by a single pair of spines; (6) the male hemispermatophore bears a two-pronged hook along the ental (= medial) margin of the distal lamina (this hook is positioned on the dorsal face of the blade); (7) the capsular region of the hemispermatophore is well developed, with median, basal, inner, and outer lobes present (sometimes accessory lobes are present as well); and (8) the ental process of the inner hemispermatophoric lobe has a smooth margin (i.e., it does not bear a row of hooklets).

### METHODS

Terminology for general morphology follows that of Stahnke (1970) with the following exceptions: terminology for metasomal and pedipalpal carinae is after Francke (1977) and trichobothrial nomenclature is after Vachon (1974), except that the fourth pedipalpal segment is considered the patella, rather than the tibia, to be consistent with Stahnke's terminology.

Hemispermatophores are described and illus-

trated for seven species for which there was sufficient male material available to allow dissection of one or more specimens. On each specimen, the right hemispermatophore is dissected from the body as described by Lamoral (1979:522, fig. 74), except that upon removal, the paraxial organ is retained intact. In lieu of dissecting the tissues of the paraxial organ away from the hemispermatophore, the entire structure is cleared and viewed in clove oil (Sissom et al. 1990). An advantage gained by this technique is that the hemispermatophore will not be accidentally damaged by further dissection. This is considered important in cases where only one or a few male specimens are known and their hemispermatophores, consequently, are not expendable. A discussion of hemispermatophore morphology is provided in a separate section following the species treatments; the terminology applied to hemispermatophore structures, modified slightly from Lamoral (1979) and Francke (1979), is outlined there.

*Vaejovis curvidigitus*, new species

Figs. 1-10; 71, 72

**Type data.**—Holotype male from Taxco, Guerrero, México (18°33'N:99°36'W), 3 May 1963 (W. J. Gertsch and W. Ivie). Deposited in the American Museum of Natural History, New York.

**Etymology.**—The specific name is derived from the Latin words *curvus*, meaning curved or bent, and *digitus*, meaning finger, which describes the distinct scalloping of the male chela fingers.

**Distribution.**—*Vaejovis curvidigitus* is known from several localities in the state of Morelos and from the Taxco area in northern Guerrero, México.

**Diagnosis.**—Adults 30-40 mm in length. Base color orange brown with distinct dusky markings. Sternite VII with lateral keels weak to moderate, granular. Pectinal tooth count 18-21 in males, 16-18 in females. Metasomal segment III length/width 0.83-0.93 ( $N = 11$ ); V length/width 1.67-1.85 ( $N = 11$ ). Ventrolateral metasomal carinae moderate, granular to finely crenulate; ventral submedian carinae obsolete on I-III, often present, but faint on III and IV. Pedipalp patella with 2 *esb* trichobothria; dorsoexternal carina of patella moderate, weakly crenulate. Pedipalp chela with dorsal marginal and dorsointernal carinae weak, granular; keels of outer palm essentially obsolete. Chela fixed finger with six subrows of denticles; movable finger with six subrows

and seven inner accessory granules; fingers of male distinctly scalloped. Chela length/width 3.40-3.75 in males ( $N = 4$ ), 3.73-4.20 in females ( $N = 7$ ); fixed finger length/carapace length 0.74-0.86 ( $N = 11$ ); femur length/carapace length 0.88-0.95 ( $N = 11$ ).

**Description.**—Based on adults; parenthetical statements refer to females. Measurements are given in Table 1.

**Coloration.**—Base color of carapace, tergites, and metasoma rich to dark orange brown with distinct dusky markings. Tergites with two dark submedian stripes and pale orange center stripe. Distal metasomal segments darker than preceding ones; telson lighter orange brown. Pedipalps yellow brown to light orange brown, contrastingly lighter than body. Legs light yellow brown or orange brown.

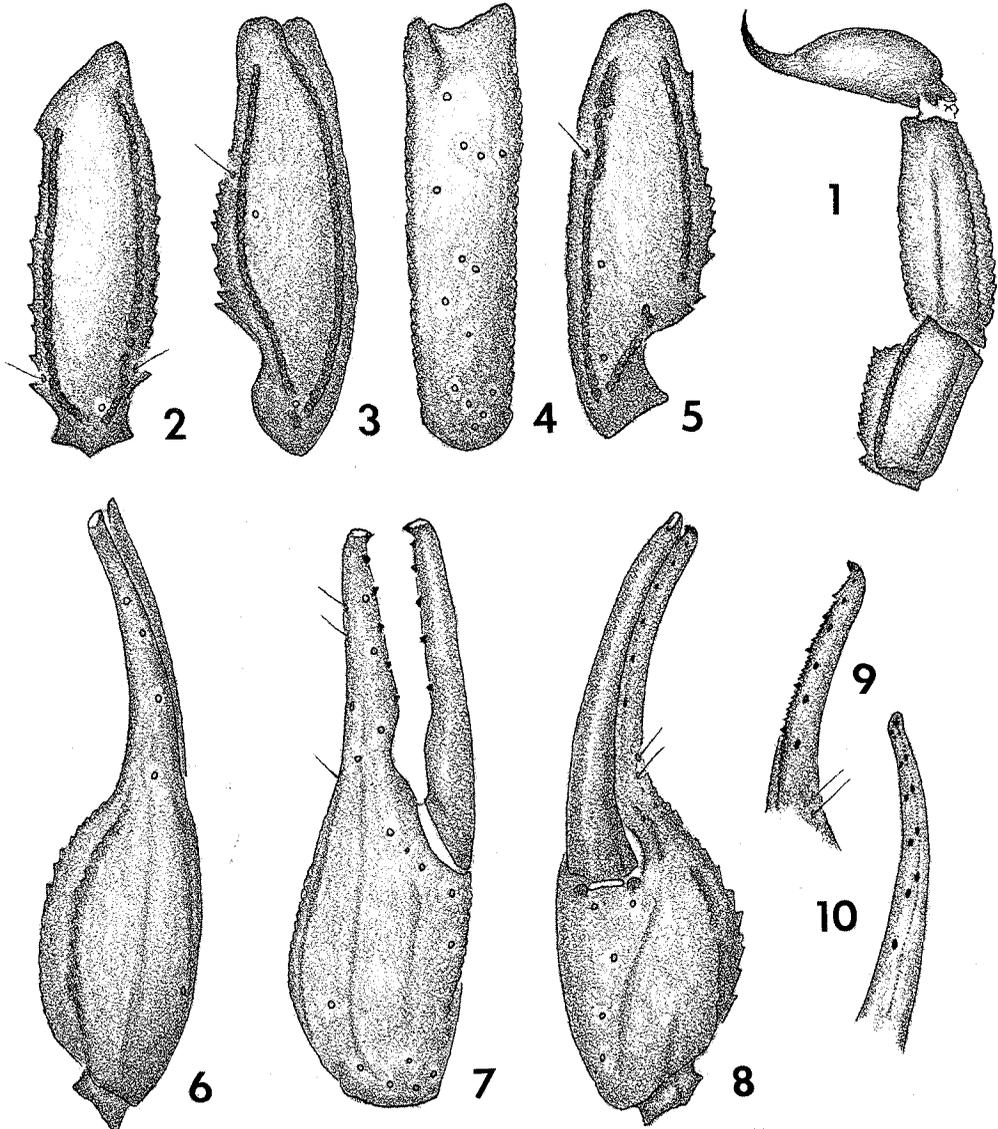
**Prosoma.**—Anterior margin of carapace obtusely emarginate; median notch weak, shallow. Entire carapacial surface finely granular.

**Mesosoma.**—Median carina on tergite I obsolete; on II-VI weak, granular; tergite VII pentacarinata, with median carina weak, granular and lateral carinae moderate, serrate. Pectinal teeth numbering 18-21 in males, 16-18 in females. Sternites III-VI smooth, sparsely setose; sternite VII with pair of moderate (weak), granular lateral carinae.

**Metasoma.**—Segments I-IV: Dorsolateral carinae strong, crenulate to serrate; distalmost denticles on I-IV distinctly enlarged, spinoid. Lateral supramedian carinae on I-III strong, crenulate; on IV moderate, granular; distalmost denticles on I-III enlarged, spinoid and on IV flared. Lateral inframedian carinae on I complete, strong, crenulate; on II-III present on posterior one-third, strong, crenulate; on IV absent. Ventrolateral carinae on I-IV moderate, granular to finely crenulate. Ventral submedian carinae obsolete on I-III, sometimes faint on IV, granular. Dorsal and lateral intercarinal spaces with scattered granulation. Segment V (Fig. 1): Dorsolateral carinae moderate, crenulate on proximal one-third, granular posteriorly. Lateromedian carinae present on anterior three-fourths, granular. Ventrolateral and ventromedian carinae moderate, crenulate to serrate. Intercarinal spaces with scattered coarse granulation.

**Telson.** (Fig. 1). Ventral surface of vesicle with subtle irregular punctations and granulation; vesicle with 12-16 pairs setae.

**Pedipalp.** Trichobothrial pattern of pedipalps (Figs. 2-9) Type C, orthobothriotaxic (Vachon



Figures 1-10.—Morphology of *Vaejovis curvidigitus*, new species, from southern México: 1, lateral aspect of metasomal segments IV and V, and telson; 2, dorsal aspect of pedipalp femur; 3, dorsal aspect of pedipalp patella; 4, external aspect of pedipalp patella; 5, ventral aspect of pedipalp patella; 6, dorsal aspect of pedipalp chela; 7, external aspect of pedipalp chela; 8, ventral aspect of pedipalp chela; 9, dentition pattern on fixed finger of pedipalp chela; 10, dentition pattern on movable finger of pedipalp chela.

1974). Femur (Fig. 2): carinae granulose; internal face with about 12-15 medium-sized granules; dorsal face with scattered coarse granulation. Patella (Figs. 3-5): dorsointernal and ventrointernal carinae strong, crenulate; dorsoexternal and ventroexternal carinae moderate, crenulate; inner face with moderate basal tubercle and an oblique keel of 8-10 large granules; dorsal face without con-

spicuous granulation; external face moderately coarsely granular. Chela (Figs. 6-10) with dorsal marginal, dorsointernal, ventrointernal, and ventroexternal carinae weak, granular; digital carina vestigial, smooth on distal portion of manus; other carinae obsolete. Dentate margin of chela fixed finger with primary denticle row divided into six subrows by five enlarged denticles; six

Table 1.—Measurements in mm and pectinal tooth counts of new species of *Vaejovis*: *V. curvidigitus*, *V. kochi*, *V. mitchelli*, and *V. pococki*.

	<i>V. curvidigitus</i>		<i>V. kochi</i>		<i>V. mitchelli</i>		<i>V. pococki</i>	
	Holotype male	Paratype female	Holotype male	Paratype female	Holotype male	Paratype female	Holotype female	Paratype male
Total length	32.2	32.8	48.4	46.9	56.3	68.5	52.5	40.6
Carapace length	4.2	4.4	5.7	5.8	6.7	8.5	6.5	5.0
Mesosoma length	9.4	10.8	14.3	15.1	15.8	21.7	16.9	12.1
Metasoma length	14.2	13.4	21.7	19.3	26.4	29.6	22.5	18.2
I length	1.8	1.7	2.8	2.4	3.4	3.9	3.0	2.4
I width	2.5	2.5	3.8	3.7	3.6	4.6	3.8	3.0
II length	2.1	2.0	3.3	2.9	4.1	4.6	3.4	2.8
II width	2.6	2.6	3.9	3.5	3.6	4.5	3.6	2.9
III length	2.4	2.2	3.5	3.2	4.4	4.9	3.8	3.1
III width	2.6	2.5	3.9	3.6	3.4	4.4	3.6	2.9
IV length	3.4	3.1	5.0	4.5	6.2	6.7	5.1	4.3
IV width	2.6	2.5	3.9	3.6	3.4	4.2	3.5	2.9
V length	4.5	4.4	7.1	6.3	8.3	9.5	7.2	5.6
V width	2.5	2.5	3.7	3.6	3.4	4.0	3.5	2.8
Telson length	4.4	4.2	6.7	6.7	7.4	8.7	6.6	5.3
Vesicle length	2.3	2.6	4.5	4.2	4.8	5.8	4.0	3.4
Vesicle width	1.8	1.7	2.8	2.6	2.4	3.0	2.8	2.2
Vesicle depth	1.3	1.1	2.2	2.0	2.0	2.7	2.0	1.6
Aculeus length	2.1	1.6	2.2	2.5	2.5	2.9	2.6	1.9
Pedipalp length	14.2	14.7	21.1	20.0	25.9	31.3	22.8	18.0
Femur length	3.8	3.9	5.7	5.3	7.0	8.4	6.0	4.8
Femur width	1.1	1.2	1.6	1.5	1.6	2.2	1.7	1.4
Patella length	4.0	4.1	5.9	5.7	7.4	9.0	6.3	5.0
Patella width	1.2	1.3	1.8	1.8	1.8	2.4	2.0	1.6
Chela length	6.4	6.7	9.5	9.0	11.5	13.9	10.5	8.1
Chela width	1.7	1.6	2.6	2.3	2.2	2.4	2.2	2.2
Chela depth	1.9	1.8	3.0	2.6	2.7	2.8	2.5	2.4
Mov. fing. length	4.0	4.3	5.9	5.8	7.5	9.2	7.0	5.1
Fix. fing. length	3.1	3.5	4.7	4.7	6.4	7.8	5.7	4.0
Pectinal teeth (l/r)	19-19	16-17	22-22	20-20	28-28	25-26	21-21	21-20

inner accessory granules (Fig. 9). Dentate margin of chela movable finger with primary denticle row divided into six subrows by five enlarged denticles; seven inner accessory granules (Fig. 10). Fingers of male with distinct scalloping (Fig. 7).

*Hemispermatophore*: (Figs. 71, 72). Distal lamina relatively short, slender (laminar length/width = 6.63,  $N = 1$ ), and slightly curved; inner lobe of capsule long, tapered; median and basal lobes small, rounded.

**Variation.**—Variation in pectinal tooth counts is as follows: in males, one comb with 18 teeth, four with 19, two with 20, and one with 21; in females, six combs with 16 teeth, three with 17, and three with 18 (the teeth of one female could not be counted). Morphometric variation is summarized in the diagnosis. Some of the specimens

from Morelos are darker brown than the majority of the specimens examined. This is almost certainly due to strong discoloration from poor preservation.

**Comparisons.**—*Vaejovis curvidigitus* is similar to *V. kochi* and *V. nigrescens*. From *V. kochi* it may be easily distinguished by its smaller body size, lower pectinal tooth counts, and the possession of two, rather than three, patellar *esb* trichobothria. Further, the ventrolateral and ventral submedian carinae of metasomal segments I-IV are considerably more reduced in *V. kochi*; the keels of segment V are likewise reduced in that species.

From *V. nigrescens*, *V. curvidigitus* may be distinguished by its (1) more prominent scallop in the male chela fingers; (2) its smaller body size; (3) more robust pedipalp chelae; (4) its pro-

portionately shorter, thicker metasomal segments, with segment III wider than long; (5) the presence of crenulate, rather than smooth, ventrolateral carinae on the metasoma; (6) the frequent presence of faint ventral submedian carinae on metasomal segments III and IV; and (7) the presence of a distinct pattern of dusky markings on the tergites of the adult.

**Specimens examined.**—MEXICO: *Guerrero*: Taxco, 18°33'N:99°36'W, 3 May 1963 (W. J. Gertsch and W. Ivie), 1 male holotype (AMNH), October 1945 (L. Isaacs), 1 female paratype (AMNH), 22 August 1976 (E. S. Ross), 1 female paratype (CAS). *Morelos*: Cuernavaca, September 1946 (H. Field), 3 male paratypes (FMNH), November 1949 (N. L. H. Krauss), 1 female paratype (USNM), Tepoztlán, 1946-1947 (H. Field), 4 female paratypes (FMNH).

*Vaejovis kochi*, new species

Figs. 11-20

*Vaejovis nitidulus nigrescens*, Hoffmann 1937:204 (?).  
*Vaejovis nitidulus nigrescens*, Díaz Nájera 1964:24; 1975:25.

**Type data.**—Holotype male (RS-4036) from Progreso, Hidalgo, México, 5 July 1963 (L. Maz-zotti). Deposited in the Muséum National d'Histoire Naturelle, Paris.

**Etymology.**—The specific name is a patronym honoring Carl Ludwig Koch for his contributions to arachnology in the 1800's.

**Distribution.**—Known from southeastern Hidalgo and northeastern Distrito Federal, México.

**Diagnosis.**—Adults 45-50 mm in length. Base color brown, lacking conspicuous dusky markings. Sternite VII with lateral keels weak, smooth. Pectinal tooth count 22 in males, 19-21 in females. Metasomal segment III length/width 0.89-0.92 ( $N = 3$ ); V length/width 1.7-1.9 ( $N = 3$ ). Ventrolateral carinae on I-III weak, smooth; on IV essentially obsolete. Ventral submedian carinae on I-IV obsolete. Keels of segment V obsolete to weak. Pedipalps: patella with 3 *esb* trichobothria; fixed finger of chela with primary denticle row divided into six subrows; movable finger with six subrows and seven inner accessory granules. Male chela palm somewhat rounded, external and dorsal carinae obsolete; fingers distinctly scalloped. Chela length/width ratio 3.52-3.65 in males ( $N = 2$ ), 3.91 in female ( $N = 1$ ); fixed finger length/carapace length 0.81-0.85 ( $N = 3$ ); femur length/carapace length 0.91-1.00 ( $N = 3$ ).

**Description.**—Based on adults; parenthetical

statements refer to females. Measurements appear in Table 1.

**Coloration:** Carapace and tergites brown, lacking noticeable dusky markings. Metasomal segments I-III orange brown; IV-V more reddish brown, especially laterally and ventrally. Telson reddish brown with dark brown aculeus. Pedipalp femur yellow brown; patella yellow brown basally, orange brown distally. Chela more or less uniformly reddish to orange brown, slightly darker at base of fingers. Legs yellowish or light yellow brown.

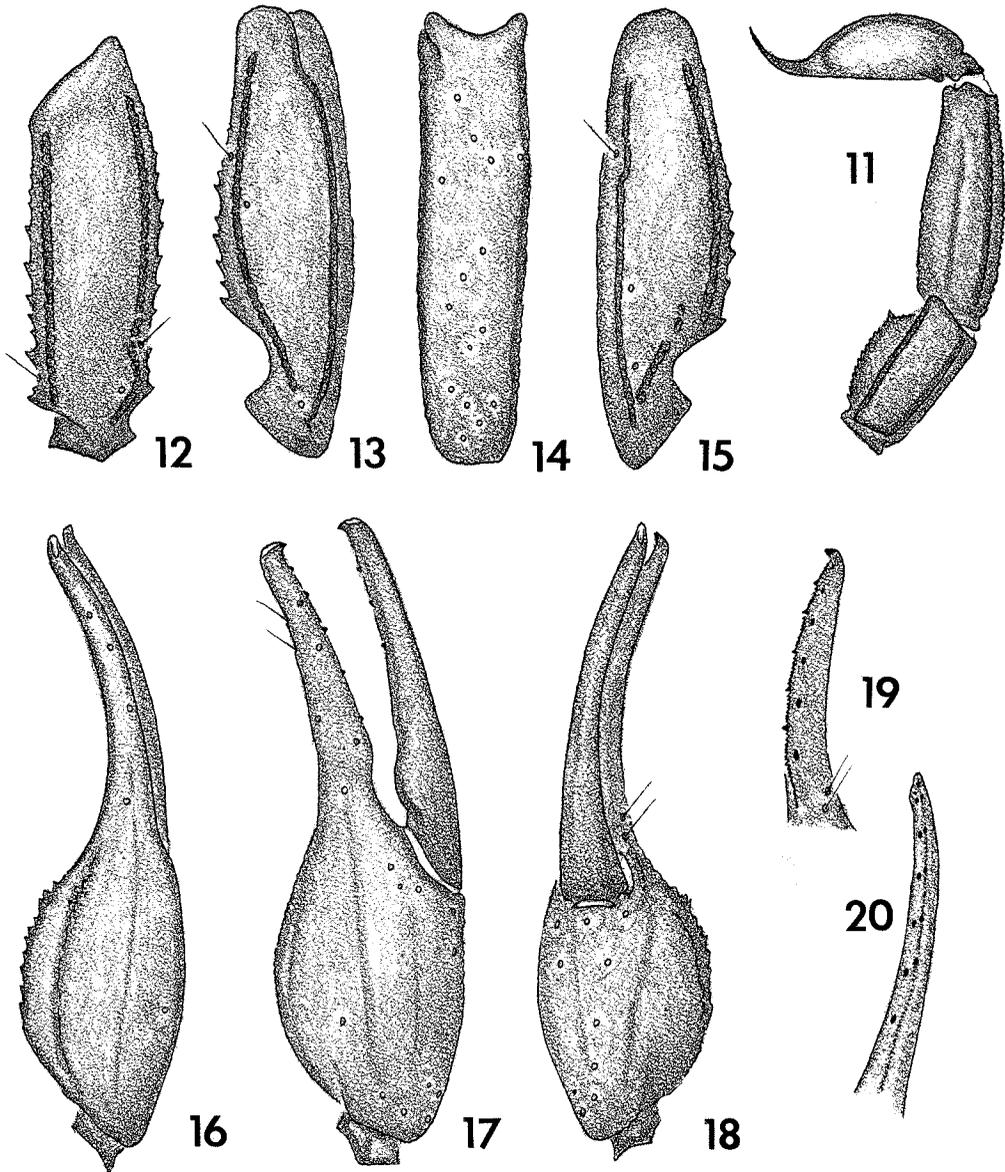
**Prosoma:** Anterior margin of carapace obtusely emarginate, median notch weak. Interocular area smooth; lateral and posterior portions of carapace densely, coarsely granular.

**Mesosoma:** Median carina on tergites I-III obsolete, on IV-VI weak, smooth; tergite VII pentacarinata with median carina weak, smooth (finely granular) and lateral carinae moderate to strong, crenulate. Pectinal teeth numbering 22 in males, 19-21 in females. Sternites III-VI smooth, sparsely setose; VII with pair of weak, smooth lateral keels.

**Metasoma:** Segments I-IV: Dorsolateral carinae strong, crenulate (serrate); distalmost denticles on I-IV enlarged, spinoid. Lateral supra-median carinae on I strong, crenulate; on II moderate, finely granular; on III-IV weak to moderate, smooth (on I crenulate, on II-IV finely granular); distalmost denticles on I-III enlarged, spinoid; on IV widely flared. Lateral inframedian carinae on I complete, strong, finely granular (crenulate); on II-III present on distal one-fourth of segment, moderate to strong, smooth (finely granular); on IV absent. Ventrolateral carinae on I-III weak, smooth; on IV essentially obsolete. Ventral submedian carinae on I-IV obsolete. Dorsal and lateral intercarinal spaces sparsely, coarsely granular. Segment V (Fig. 11): Dorsolateral carinae weak, granular on anterior one-third to one-half. Lateromedian carinae obsolete. Ventrolateral and ventromedian carinae weak, smooth to finely granular. Intercarinal spaces smooth, lustrous.

**Telson:** (Fig. 11). Ventral surface of vesicle smooth, with about 12-15 pairs setae.

**Pedipalp:** Trichobothrial pattern (Figs. 12-19) Type C, neobothriotaxic (Vachon 1974): patella with 3 *esb* trichobothria (Fig. 14). Femur (Fig. 12): carinae strong, granulose; internal face with 8-10 large, pointed granules; dorsal face moderately, coarsely granular. Patella (Figs. 13-15): dorsointernal and ventrointernal carinae strong,



Figures 11-20.—Morphology of *Vaejovis kochi*, new species, from Hidalgo, México: 11, lateral aspect of metasomal segments IV and V, and telson; 12, dorsal aspect of pedipalp femur; 13, dorsal aspect of pedipalp patella; 14, external aspect of pedipalp patella; 15, ventral aspect of pedipalp patella; 16, dorsal aspect of pedipalp chela; 17, external aspect of pedipalp chela; 18, ventral aspect of pedipalp chela; 19, dentation pattern on fixed finger of pedipalp chela; 20, dentation pattern on movable finger of pedipalp chela.

crenulate; dorsoexternal carina moderate, smooth; ventroexternal carina moderate, granular. Inner face with oblique longitudinal carina of 8 larger and 3-4 smaller granules; dorsal and ventral faces smooth; external face with scattered granulation. Chela (Figs. 16-20): Dorsal marginal carina weak, finely granular; dorsointernal carina weak, with a few larger, rounded granules; ven-

trointernal carina weak, granular; other carinae essentially obsolete. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged denticles; six inner accessory granules (Fig. 19). Dentate margin of movable finger with primary denticle row divided into six subrows by five enlarged denticles; seven inner accessory granules (Fig. 20). Fingers

of male with distinct scalloping. Chela relatively robust (Figs. 16-18).

*Hemispermatophore*: Not dissected due to scarcity of material.

**Variation.**—Only two adult males, a single adult female, and a number of late instar juvenile females were available for study. Juveniles differ from adults primarily in coloration and morphometrics: the body is yellowish brown with distinct dusky markings; the distal metasomal segments are more reddish brown, contrasting with the rest of the body; the pedipalps are yellowish; and the pedipalps are more slender. Pectinal tooth count variation in all specimens is as follows: in males, four combs with 22 teeth; in females, four combs with 19 teeth, ten with 20, and four with 21. Morphometric variation is summarized in the diagnosis.

**Comparisons.**—*Vaejovis kochi* is most similar to *V. platnicki*, *V. nigrescens*, and *V. curvidigitus*. From *V. platnicki*, it can be easily distinguished by its larger body size, uniform reddish brown coloration, more robust pedipalp chelae, and higher pectinal tooth counts (22 in males and 19-21 in females, rather than 16 in males and 13-15 in females).

*Vaejovis kochi* is easily distinguished from both *V. nigrescens* and *V. curvidigitus* by the possession of three, rather than two, patellar *esb* trichobothria. From *V. nigrescens*, it may be further distinguished by the stronger scallop in the male chela fingers and the more robust chela palm. Metasomal segment V in *V. kochi* has weak to obsolete keels; in *V. nigrescens*, the dorsal and lateral keels are moderate, and the ventrolateral and ventromedian keels are strong.

**Specimens examined.**—MEXICO: no locality data, 1 male paratype (RS-4086)(MNHN). *Hidalgo*: Progreso, 5 July 1963 (L. Mazzotti), 1 male holotype (RS-4036)(MNHN), Cuauhtepic, 20 March 1964 (no collector), 1 female, 1 juv. paratypes (RS-4287)(MNHN), 10 km NW Atotonilco El Grande, surface above Puente de Dios, 19 March 1981 (J. Reddell), 3 subadult female paratypes (WDS). *Distrito Federal*: Teotihuacán, 14 November 1973 (E.-G. Burmeister), 3 subadult female paratypes (WDS), San Juan Teotihuacán, 28 July 1947 (collector unknown), 1 subadult female paratype (AMNH).

*Vaejovis mitchelli*, new species

Figs. 21-30; 79, 80

**Type data.**—Holotype male from 8 mi. W Jalpan, Querétaro, México, 10 March 1977 (R. W. Mitchell, et al.). Deposited in the American Museum of Natural History, New York.

**Etymology.**—The specific epithet is a patronym honoring Robert W. Mitchell, collector of most of the known specimens of this taxon, for his outstanding contributions to arachnology and Mexican cave biology.

**Distribution.**—Known from the type locality and southeastern San Luis Potosí.

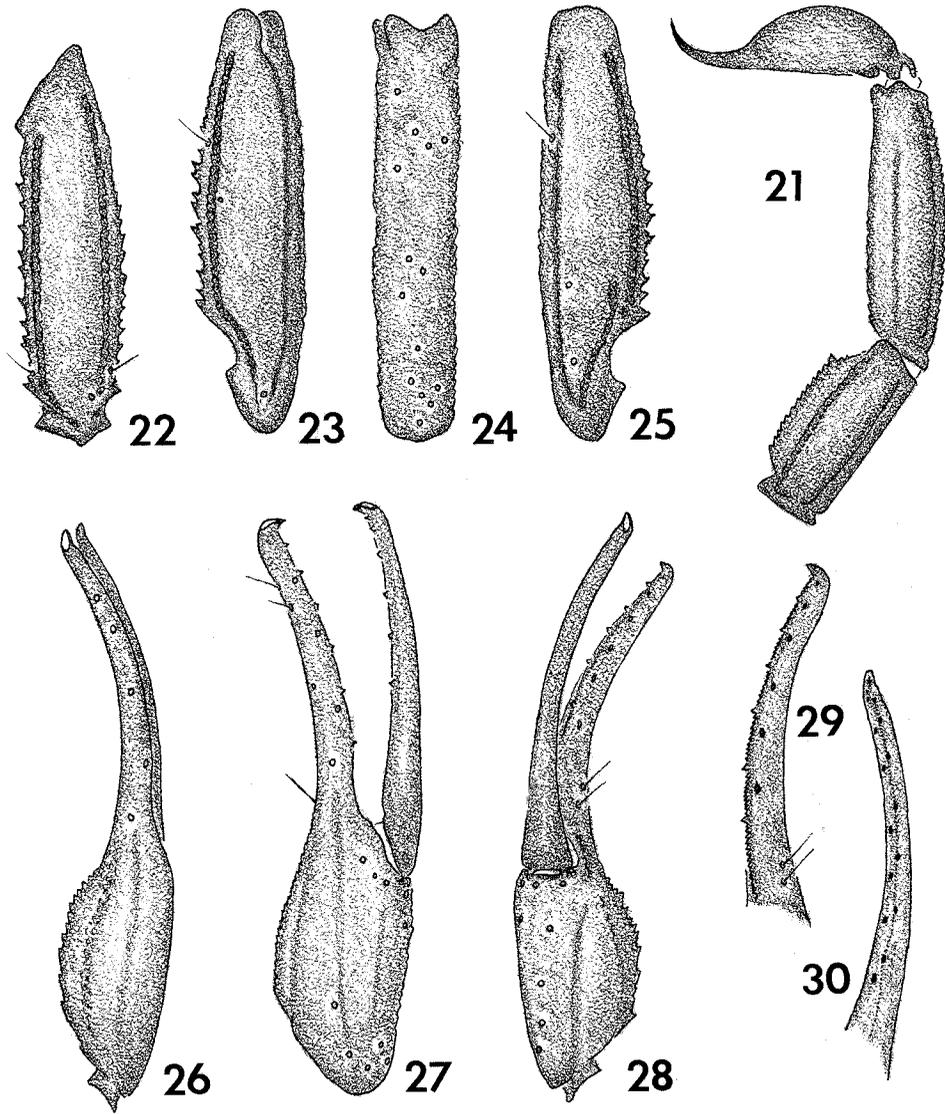
**Diagnosis.**—Adults 50-70 mm in length. Base color dark orange brown to dark brown with faint underlying dusky markings. Sternite VII with lateral keels moderate, finely granular. Pectinal tooth counts 27-28 in males, 25-26 in females. Metasomal segment III length/width 1.28-1.41 in males ( $N = 3$ ), 1.10-1.13 in females ( $N = 3$ ); segment V length/width 2.45-2.58 in males ( $N = 3$ ), 2.26-2.36 in females ( $N = 3$ ). Metasoma with ventrolateral carinae moderate, smooth to finely granular on I-IV; ventral submedian carinae on I-IV obsolete or discernible as faint, smooth ridges. Pedipalp patella with 2 *esb* trichobothria; fixed finger with primary denticle row divided into seven subrows; movable finger with eight subrows and eight inner accessory granules; dorsal and external keels of palm reduced. Chela length/width 4.90-5.81 in males ( $N = 3$ ), 5.43-5.92 in females ( $N = 3$ ); fixed finger length/carapace length 0.91-1.08 ( $N = 6$ ); femur length/carapace length 0.99-1.12 ( $N = 6$ ).

**Description.**—Based on adults; parenthetical statements refer to females. Measurements are given in Table 1.

**Coloration.** Carapace and tergites dark orange brown to dark brown with underlying dusky pattern. Metasoma: dark brown to dark orange brown, either uniformly colored or with segments IV-V darker. Telson vesicle yellow orange or reddish. Pedipalp femur and patella light orange brown to brown, with variable underlying dusky markings. Pedipalp chela manus light orange brown; fingers brown basally, light yellow brown distally. Legs yellow brown (males) to brown (females) with dusky markings on proximal segments, uniformly yellowish on tibiae and tarsi.

**Prosoma.** Anterior margin of carapace obtusely emarginate, median notch shallow. Interocular area finely granular with some scattered coarse granules (smooth with few scattered coarse granules); remainder of carapace densely (sparsely), coarsely granular.

**Mesosoma.** Median carina on tergites I-II obsolete; on III faint; on IV-VI weak, granular. Tergite VII pentacarinata, with median carina moderate, granular; lateral carinae strong, crenulate to serrate. Pectinal teeth numbering 27-28 (25-



Figures 21-30.—Morphology of *Vaejovis mitchelli*, new species, from Querétaro, México: 21, lateral aspect of metasomal segments IV and V, and telson; 22, dorsal aspect of pedipalp femur; 23, dorsal aspect of pedipalp patella; 24, external aspect of pedipalp patella; 25, ventral aspect of pedipalp patella; 26, dorsal aspect of pedipalp chela; 27, external aspect of pedipalp chela; 28, ventral aspect of pedipalp chela; 29, dentition pattern on fixed finger of pedipalp chela; 30, dentition pattern on movable finger of pedipalp chela.

26). Sternites III-VI smooth, sparsely setose; VII with pair of moderate, finely granular lateral carinae.

*Metasoma*: Dorsolateral carinae strong, crenulate to serrate; distalmost denticles of dorsolateral carinae on I-III enlarged, spinoid; on segment IV only slightly enlarged, spinoid. Lateral suprmedian carinae on I-II strong, crenulate; on III-IV moderate, finely crenulate; distalmost denticles on I-III slightly enlarged, spinoid and

on IV flared. Lateral inframedian carinae on I complete, strong, crenulate; on II present on posterior one-half, strong, crenulate; on III present on posterior one-fourth, moderate, crenulate; on IV absent. Ventrolateral carinae on I-IV moderate, smooth to finely granular. Ventral submedian carinae on I-IV obsolete or present as very faint, smooth ridges. Dorsal and lateral intercarinal spaces with scattered coarse granules. Segment V (Fig. 21): Dorsolateral carinae mod-

erate, granular. Lateromedian carinae weak, granular, present on anterior three-fourths. Ventrolateral and ventromedian carinae moderate, crenulate to serrate. Intercarinal spaces with scattered fine granulation.

*Telson*: (Fig. 21). Ventral surface with small, irregularly spaced granules and punctations; about 25 pairs of setae.

*Pedipalp*: Trichobothrial pattern (Figs. 22-29) Type C, orthobothriotaxic (Vachon 1974). Femur (Fig. 22) with carinae strong, granulose; internal face with 16-20 medium to large subconical granules; dorsal face densely, finely granular. Patella (Figs. 23-25) dorsointernal, ventrointernal, and ventroexternal carinae strong, crenulate; dorsoexternal carina moderate, granular to weakly crenulate. Internal face with moderate basal tubercle and oblique longitudinal carina of 10-12 large, subconical granules. Dorsal face with scattered fine granules; external face with moderately dense coarse and fine granulation. Chela (Figs. 26-30). Dorsal marginal carina weak, granular. Dorsal secondary carina faint, smooth. Digital carina weak, smooth. External secondary carina obsolete. Ventroexternal carina weak, smooth. Ventromedian carina obsolete. Ventrointernal carina weak, essentially smooth. Dorsointernal carina moderate, with enlarged, sharp granules. Dentate margin of fixed finger with primary denticle row divided into seven subrows by six enlarged granules; six inner accessory granules (Fig. 29). Dentate margin of movable finger with primary denticle row divided into eight subrows by seven enlarged granules; eight inner accessory granules (Fig. 30). Fingers of male with subtle scalloping. Chela slender with fingers long and tenuous (Figs. 26-28).

*Hemispermatothore*: (Figs. 79, 80). Distal lamina relatively slender (laminar length/width = 6.48,  $N = 1$ ), with slight tapering; inner lobe of capsule long, broad, slightly tapering distally; median and basal lobes rounded.

**Variation.**—Variation in the pectinal tooth counts of the adult specimens examined is as follows: in males, two combs with 26 teeth and four with 27; in females, four combs with 25 teeth and two with 26. In addition, pectinal tooth counts of 20 neonates born in the laboratory were also counted. Because neonates cannot be accurately sexed, the counts obtained include both males and females. There were 1 comb with 24 teeth, 13 combs with 25 teeth, 13 with 26 teeth, 3 with 27 teeth, and 10 with 28 teeth. Because pectinal tooth counts do not change after birth,

these counts provide a reasonable estimate of variation in the pectinal tooth counts in this species, which was not possible using only the six adults. Morphometric variation is summarized in the diagnosis.

**Comparisons.**—*Vaejovis mitchelli*, *V. nitidulus*, and *V. pococki* are the only three species in the genus to have seven subrows on the pedipalp chela fixed finger. *Vaejovis mitchelli* may be easily distinguished from *V. nitidulus* by its dark coloration, by having eight subrows of denticles on the movable finger and eight inner accessory granules (not seven subrows and seven inner accessory granules), by having only two *esb* trichobothria on the patella, and by differences in pedipalp and metasomal morphometrics.

The movable finger characteristic also serves to distinguish *V. mitchelli* from *V. pococki*. In addition, pectinal tooth counts in *V. mitchelli* are distinctly higher than in *V. pococki*, and morphometrics of the pedipalp chela and metasoma differ considerably between the two. The ventrolateral carinae of metasomal segments I-IV are moderate in *V. mitchelli*, essentially obsolete in *V. pococki*. Carinal development on metasomal segment V is also stronger in *V. mitchelli*.

**Comments.**—The type series, collected by Dr. Robert W. Mitchell and his 1977 Arachnology class at Texas Tech University, was returned to the laboratory alive after their capture. One of the females was observed mating on 13 March 1977 and subsequently gave birth to 39 offspring on 4 August 1977. Assuming the female had not been previously inseminated in the field, the gestation period was 144 days (= 4.5 months). A second female gave birth to 36 young shortly upon her return to the laboratory.

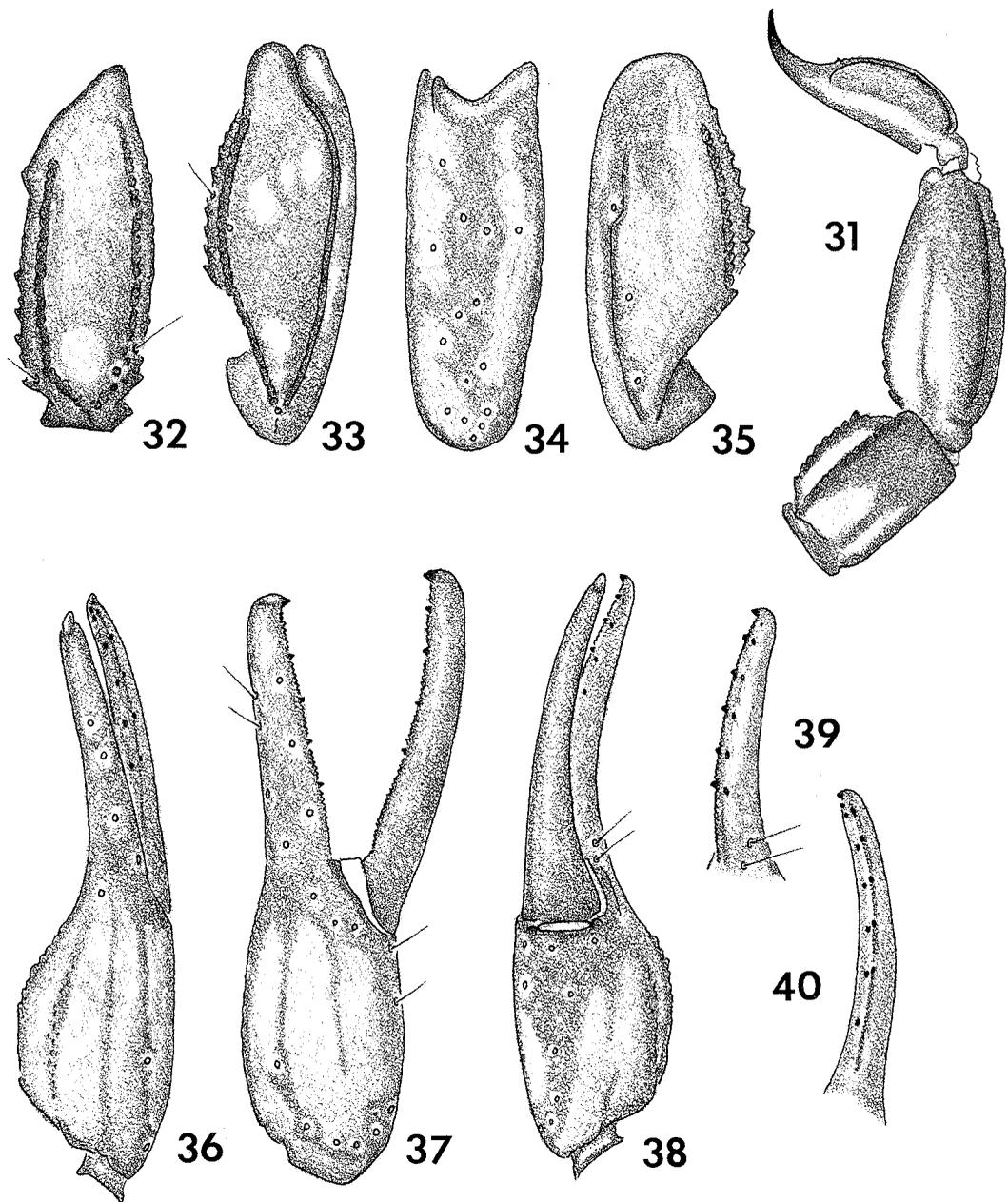
**Specimens examined.**—MEXICO: *Querétaro*: 8 mi. W Jalpan, 10 March 1977 (R. W. Mitchell, et al.), 1 male holotype (AMNH), 1 male paratype, 2 female paratypes (AMNH-OFF), 1 female paratype (WDS). *San Luis Potosí*: Cueva de Cristian, 4 km E Xilitla, 4 January 1976 (A. Grubbs), 1 male paratype (WDS).

*Vaejovis platnicki*, new species

Figs. 31-40

**Type data.**—Holotype female from Guayla-lejo, Tamaulipas, México, 18 February 1973 (J. P. Webb). Deposited in the American Museum of Natural History.

**Etymology.**—The specific epithet is a patronym honoring Dr. Norman I. Platnick, curator



Figures 31-40.—Morphology of *Vaejovis platnicki*, new species, from Tamaulipas, México: 31, lateral aspect of metasomal segments IV and V, and telson; 32, dorsal aspect of pedipalp femur; 33, dorsal aspect of pedipalp patella; 34, external aspect of pedipalp patella; 35, ventral aspect of pedipalp patella; 36, dorsal aspect of pedipalp chela; 37, external aspect of pedipalp chela; 38, ventral aspect of pedipalp chela; 39, dentition pattern on fixed finger of pedipalp chela; 40, dentition pattern on movable finger of pedipalp chela.

of Arachnida at the American Museum of Natural History, for his numerous contributions to arachnid systematics.

**Distribution.**—Known only from southern Tamaulipas and northeastern San Luis Potosí.

**Diagnosis.**—Adults 20-25 mm in length. Base color yellow brown to orange brown; carapace, tergites, and metasoma with strong variegated pattern. Pectinal tooth count 13-15 in females; sternite VII with carinae obsolete. Metasomal

segments I-IV with ventrolateral and ventral submedian carinae obsolete; segment V with ventrolateral carinae weak, granular to crenulate and ventromedian carina vestigial. Metasomal segment III length/width 0.77-0.80 ( $N = 6$ ); V length/width 1.64-1.77 ( $N = 6$ ). Pedipalp patella with 3 *esb* trichobothria. Pedipalp chela fixed finger with primary denticle row divided into six subrows; movable finger with six subrows and seven inner accessory granules. Chela manus with dorsal marginal and dorsointernal carinae weak, granular; other carinae obsolete. Chela length/width 3.32-3.78 ( $N = 6$ ); fixed finger length/carapace length 0.62-0.65 ( $N = 6$ ); pedipalp femur length/carapace length 0.73-0.79 ( $N = 6$ ).

**Description.**—Based on adult females; measurements appear in Table 2.

**Coloration:** Base color of body light brown to orange brown; metasoma darker orange brown, especially distal segments. Carapace, tergites, and metasoma with strong variegated pattern; pedipalps and legs with less distinct dusky markings.

**Prosoma:** Anterior margin of carapace weakly emarginate; median notch vestigial. Carapace lustrous, sparsely granular.

**Mesosoma:** Median carina on tergite I obsolete, on II-VI weak, granular; tergite VII with median carina weak, granular and lateral pairs moderate, crenulate. Pectinal teeth numbering 13-15. Sternites III-VI smooth, sparsely setose, with suboval stigmata; VII with carinae obsolete.

**Metasoma:** Segments I-IV: Dorsolateral carinae moderate, crenulate; distalmost denticles enlarged, spinoid. Lateral supramedian carinae on I-III strong, crenulate; on IV moderate, granular; distalmost denticles enlarged, spinoid on I-III, flared on IV. Lateral inframedian carinae on I complete, strong, crenulate; on II present on posterior one-half, strong, crenulate; on III present on posterior one-third, moderate, crenulate; on IV absent. Ventrolateral carinae essentially obsolete (sometimes with a few small distal granules on I-II); ventral submedian carinae obsolete. Intercarinal spaces smooth, lustrous. Segment V (Fig. 31): Dorsolateral carinae moderate, serrate proximally, granular distally. Lateromedian carinae obsolete. Ventrolateral carinae weak, granular to finely crenulate. Ventromedian carina vestigial, present only on distal one-half, weak, granular. Intercarinal spaces moderately granular.

**Telson:** (Fig. 31). Ventral aspect of vesicle with few irregularly spaced punctations; midline with a few small granules terminating in a subtle,

pointed subaculear tubercle; about 20 pairs of setae.

**Pedipalp:** Trichobothrial pattern (Figs. 32-39) Type C, neobothriotaxic (Vachon 1974); patella with three *esb* trichobothria (Fig. 34). Femur (Fig. 32): dorsointernal and ventrointernal carinae moderate, crenulate; dorsoexternal carina weak, granular; ventroexternal carina essentially obsolete; inner face with about eight larger granules; dorsal face moderately granular. Patella (Figs. 33-35): Dorsointernal carina moderate, smooth to weakly crenulate; ventrointernal carina moderate, crenulate; dorsoexternal and ventroexternal carinae obsolete or faint, smooth; inner face with vestigial basal tubercle and oblique longitudinal carina of about 10 granules. Chela (Figs. 36-40): Dorsal marginal and dorsointernal carinae weak, granular; others obsolete. Fixed finger (Fig. 39) with primary row of denticles divided into six subrows by five enlarged denticles; six inner accessory granules. Movable finger (Fig. 40) with primary denticle row divided into six subrows by five enlarged denticles; seven inner accessory granules. Chela fingers ending in slightly enlarged, blade-like terminal denticles which overlap when chela closed.

**Hemispermaphore:** Not dissected; males not available.

**Variation.**—Pectinal tooth counts in adults and subadults varied as follows: in females, one comb with 13 teeth, eight with 14, and seven with 15. The first instar specimens from Guaylalejo had pectinal tooth counts of 15-15, 15-?, and 16-16. Variation in morphometrics is summarized in the diagnosis.

**Comparisons.**—This species is quite distinct from all other *nitidulus* group species with six subrows of denticles on the chela fingers and three *esb* trichobothria on the pedipalp patella. In carinal morphology of the metasoma, it is similar to *V. kochi*; for characters to distinguish these species, see the "Comparisons" section under *V. kochi*.

There is a strong superficial resemblance (small size and variegated pattern) between *V. platnicki* and *V. bilineatus* Pocock, which belongs to a different species group. The possession of six subrows of granules on the pedipalp chela fixed finger, the basal position of chela trichobothria *ib* and *it*, presence of pedipalpal carinae, and other characters diagnostic for the *nitidulus* group serve to distinguish these species.

**Specimens examined.**—MEXICO: San Luis Potosí: El Tinieblo, March 1977 (R. W. Mitchell, et al.), 1

Table 2.—Measurements in mm and pectinal tooth counts of new species of *Vaejovis*: *V. platnicki*, *V. rubrimanus*, and *V. solegladi*.

	<i>V. platnicki</i>		<i>V. rubrimanus</i>		<i>V. solegladi</i>	
	Holotype female	Holotype male	Paratype female	Holotype male	Paratype female	
Total length	25.4	45.0	58.8	41.2	46.1	
Carapace length	3.3	5.2	7.1	5.5	5.8	
Mesosoma length	8.7	12.7	18.5	11.8	14.8	
Metasoma length	10.2	21.1	25.6	18.5	19.7	
I length/width	1.3/2.2	2.9/2.7	3.4/3.8	2.4/3.3	2.6/3.5	
II length/width	1.4/2.1	3.6/2.6	3.9/3.6	2.8/3.3	3.0/3.4	
III length/width	1.6/2.1	3.7/2.5	4.2/3.4	3.0/3.2	3.2/3.4	
IV length/width	2.4/2.1	4.7/2.4	5.9/3.3	4.2/3.1	4.5/3.3	
V length/width	3.5/2.1	6.3/2.3	8.2/3.2	6.1/3.1	6.4/3.2	
Telson length	3.2	6.0	7.6	5.4	5.8	
Vesicle length/width	2.1/1.3	4.0/2.0	4.8/2.7	3.2/2.2	3.8/2.3	
Vesicle depth	0.9	1.6	2.3	1.6	1.8	
Aculeus length	1.0	2.0	2.8	2.2	2.1	
Pedipalp length	9.7	20.5	25.9	18.9	20.6	
Femur length/width	2.5/1.0	5.4/1.4	6.9/1.9	5.2/1.3	5.6/1.5	
Patella length/width	2.8/1.1	5.7/1.7	7.1/2.2	5.4/1.3	5.8/1.6	
Chela length/width	4.4/1.2	9.4/2.5	11.9/2.6	8.3/1.7	9.2/1.8	
Chela depth	1.3	2.7	3.0	1.8	2.0	
Movable finger length	2.7	6.0	8.0	5.6	6.2	
Fixed finger length	2.2	5.0	6.8	4.8	5.2	
Pectinal teeth (lt/rt)	15-14	27-28	26-26	18-18	18-19	

paratype female (WDS). *Tamaulipas*: Guaylalejo, 18 February 1973 (J. P. Webb), 1 holotype female, 1 paratype female, 3 paratype first instars (AMNH), 1 paratype female (WDS), Tampico, no date (Palmer), one subadult paratype female (USNM), 17 mi. S Victoria, 28 December 1947 (no collector), 1 subadult paratype female (AMNH), 25 km S Cd. Victoria (under rock), 7 January 1987 (J. A. Nilsson), one paratype female (JAN), km 190, Highway 85, 18 February 1973 (C. McConnell), 1 paratype female (WDS).

*Vaejovis pococki*, new species  
(Figs. 41-50, 83, 84)

*Vaejovis nitidulus nitidulus*, Díaz Nájera 1964:27; 1975:30.

**Type data.**—Holotype female (RS-4288) from Querétaro, Querétaro, México, 5-23 August 1963 (collector unknown). Deposited in the Muséum National d'Histoire Naturelle, Paris.

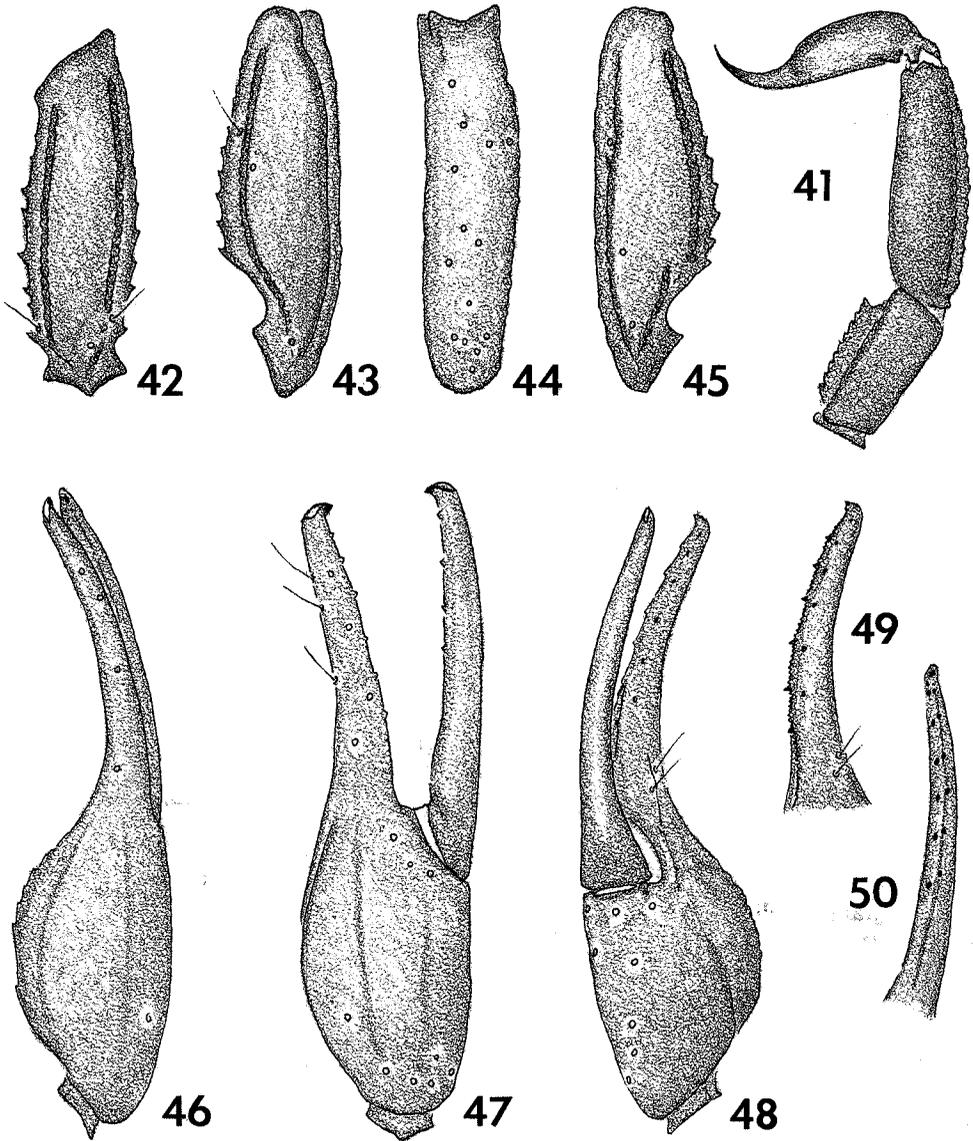
**Etymology.**—The specific name is a patronym honoring Reginald I. Pocock for his numerous contributions to scorpion systematics at the turn of the century.

**Distribution.**—Known from several localities in southern San Luis Potosí and western Querétaro, México.

**Diagnosis.**—Adults 40-65 mm in length. Base color dark orange brown to reddish brown with faint dusky markings. Sternite VII with lateral keels faint to obsolete. Pectinal tooth counts 20-21 in males, 19-21 in females. Metasomal segment III length/width 1.01-1.12 ( $N=9$ ); V length/width 2.00-2.19 ( $N=9$ ). Metasoma with ventrolateral carinae on I-IV obsolete or weak, smooth; ventral submedian carinae on I-IV obsolete. Metasomal segment V with keels weak to obsolete. Pedipalp patella with 2 *esb* trichobothria; fixed finger with primary denticle row divided into seven subrows; movable finger with seven subrows and seven inner accessory granules; dorsal and external keels of palm obsolete or faint. Chela length/width 3.68-3.74 in males ( $N=2$ ), 4.38-4.86 in females ( $N=7$ ); pedipalp chela fixed finger length/carapace length 0.80-0.88 ( $N=9$ ); pedipalp femur length/carapace length 0.88-0.96 ( $N=9$ ).

**Description.**—Based on adults; measurements are given in Table 1.

**Coloration:** Carapace and tergites orange brown to reddish brown with dusky underlying markings. Metasomal segments I-III orange brown above, more reddish brown below; IV with ven-



Figures 41-50.—Morphology of *Vaejovis pococki*, new species, from Querétaro, México: 41, lateral aspect of metasomal segments IV and V, and telson; 42, dorsal aspect of pedipalp femur; 43, dorsal aspect of pedipalp patella; 44, external aspect of pedipalp patella; 45, ventral aspect of pedipalp patella; 46, dorsal aspect of pedipalp chela; 47, external aspect of pedipalp chela; 48, ventral aspect of pedipalp chela; 49, dentition pattern on fixed finger of pedipalp chela; 50, dentition pattern on movable finger of pedipalp chela.

tral and lateral faces reddish brown; V completely reddish brown. Telson vesicle orange red. Pedipalps: femur yellow brown, patella more orange brown. Chela darker orange brown to reddish brown. Legs yellow brown with dusky markings.

*Prosoma*: Anterior margin of carapace obtusely emarginate. Interocular area finely granular; remainder of carapace with moderately dense, coarse granulation.

*Mesosoma*: Median carina on tergite I obsolete, on II-VI faint, smooth; tergite VII with median carina weak, granular; lateral pairs strong, crenulate. Pectinal teeth numbering 20-21 in males, 19-21 in females. Sternites III-VI smooth, sparsely setose; VII with pair of faint to obsolete lateral keels.

*Metasoma*: Segments I-IV: Dorsolateral carinae strong, crenulate to serrate; distalmost den-

ticles enlarged, spinoid. Lateral supramedian carinae on I-II strong, crenulate; on III strong, finely crenulate; on IV weak, smooth to finely granular; distalmost denticles on I-III enlarged, spinoid and on IV flared. Lateral inframedian carinae on I complete, strong, crenulate; on II-III present on posterior one-third, granular; on IV absent. Ventrolateral carinae obsolete or weak, smooth. Ventral submedian carinae obsolete. Intercarinal spaces essentially smooth, ventral faces with numerous setae. Segment V (Fig. 41): Dorsolateral carinae weak, finely granular; lateromedian carinae obsolete; ventrolateral and ventromedian carinae weak, finely crenulate. Intercarinal spaces smooth.

*Telson*: (Fig. 41). Ventral surface of vesicle with fine granulation, about 15 pairs of large setae.

*Pedipalp*: Trichobothrial pattern (Figs. 42-49) Type C, orthobothriotaxic (Vachon 1974). Femur (Fig. 42): carinae strong, granulose; internal face with about 8 larger granules and several smaller ones; dorsal face with scattered fine granulation. Patella (Figs. 43-45) with dorsointernal and ventrointernal carinae strong, crenulate; dorsoexternal carina weak, smooth; ventroexternal carina weak, granular; internal face with moderate basal tubercle and oblique longitudinal carinae of 7-8 large granules. Dorsal face smooth or finely granular; external face finely granular (smooth). Chela (Figs. 46-50). Dorsointernal carinae weak, granular; all other keels obsolete or very faint. Dentate margin of fixed finger with primary row of denticles divided into seven subrows by six enlarged granules; six inner accessory granules (Fig. 49). Dentate margin of movable finger divided into seven subrows by six larger denticles; apical subrow with only one or two granules; seven inner accessory granules (Fig. 50). Scalloping subtle in male chela fingers.

*Hemispermaphore*: (Figs. 83, 84). Distal laminar length/width = 6.25; lamina with distinct tapering toward distal end; inner lobe relatively broad; basal lobe small, rounded; median lobe larger, rounded.

**Variation.**—Only two adult males and seven adult females were available for study. Variation in pectinal tooth counts in these specimens is as follows: in the males, one comb with 20 teeth and three with 21; in females, two combs with 19 teeth, six with 20, and six with 21. Variation in morphometrics is summarized in the diagnosis.

**Comparisons.**—*Vaejovis pococki*, in bearing seven subrows on the chela fixed finger, is most

similar to *V. nitidulus* and *V. mitchelli*. For comparisons with *V. mitchelli*, consult the "Comparisons" section for that species. *Vaejovis pococki* may be easily distinguished from *V. nitidulus* by its dark reddish brown coloration, its lower pectinal tooth counts, the possession of only two *esb* trichobothria on the pedipalp patella, and extremely reduced carination of metasoma V.

This species was apparently mistaken for *V. nigrescens* and *V. nitidulus* by earlier authors (Hoffmann 1931; Díaz Nájera 1964, 1975). The type specimens of *V. pococki* are apparently the same ones examined by Díaz Nájera (1964, 1975) and referred by that author to *V. nitidulus*. *Vaejovis pococki* occurs on the eastern side of the Sierra Madre Occidental and apparently is allopatric with *V. nigrescens* (which occurs on the western side of that mountain range). Although *V. pococki* is quite similar to *V. nigrescens* in coloration, it may be easily distinguished from that species by the possession of seven subrows of denticles on the pedipalp chela fingers.

**Specimens examined.**—MEXICO: *Querétaro*: Querétaro, 5-23 August 1963 (no collector data), 1 holotype female, 3 paratype females (RS-4288)(MNHN), 8 km NW Querétaro on border Guanajuato/Querétaro states, January 1982 (S. A. Minton), 1 paratype male (MEB), Querétaro (in house), Fall 1978 (S. A. Minton), 1 paratype female (SAM), Querétaro (in house), early July 1988 (Mrs. M. Cervantes), 1 paratype male, 1 paratype female (WDS). *San Luis Potosí*: 32 km S San Luis Potosí (on vertical face of large boulder, UV light), 24 August 1984 (C. Myers, W. D. Sissom, L. Born), 1 paratype female (WDS), Villa Hidalgo, 12 March 1977 (R. W. Mitchell), 1 juv. (AMNH-OFF), Alvarez, June-September 1976 (W. W. Brown), 1 paratype female (MCZ).

#### *Vaejovis rubrimanus*, new species

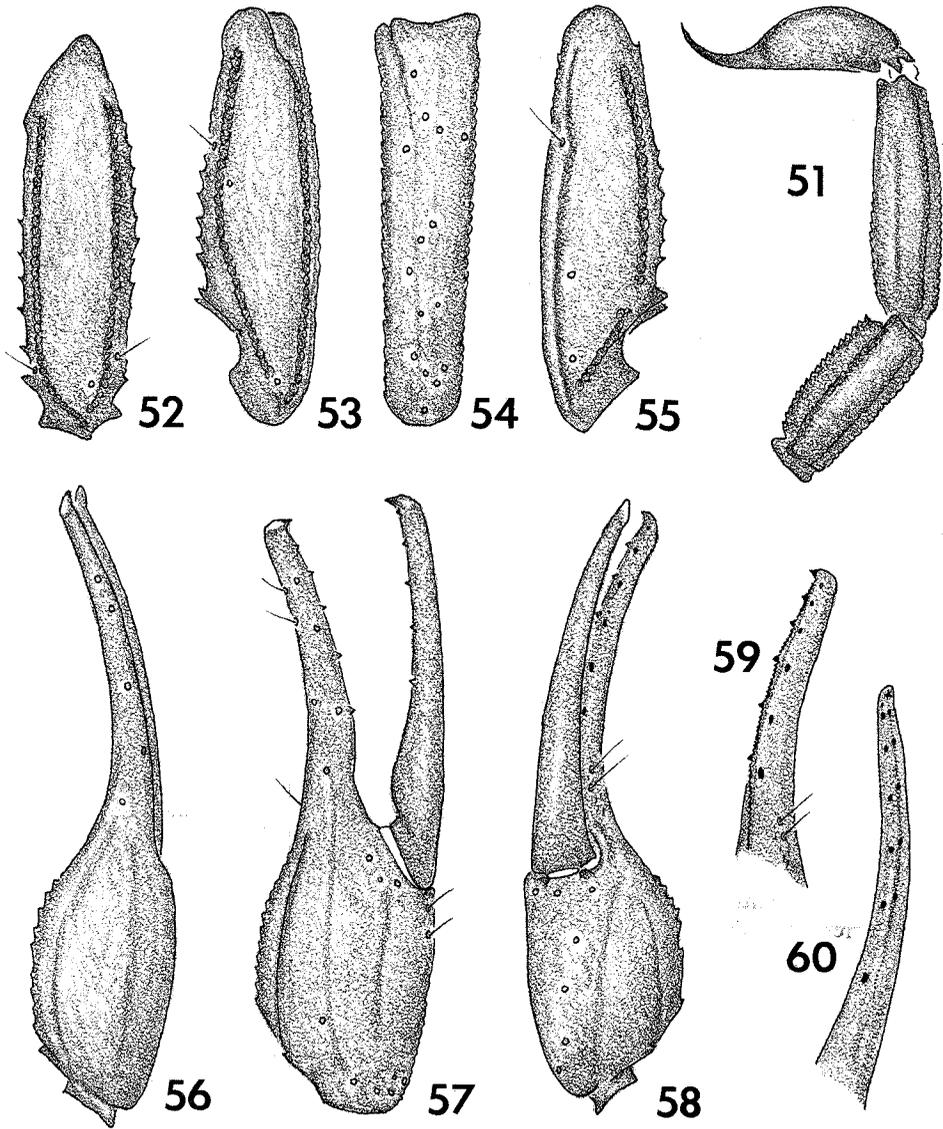
Figs. 51-60

**Type data.**—Holotype male from Gruta Sur de San Bartolo, approximately 3 mi. S Santa Catarina, Nuevo León, México, 3 December 1966 (T. Raines). Deposited in the American Museum of Natural History, New York.

**Etymology.**—The specific epithet is derived from the Latin words "*ruber*", meaning red, and "*manus*", meaning hand, which describes the coloration of the pedipalps in this species.

**Distribution.**—Known only from the type locality.

**Diagnosis.**—Adults 45-60 mm in length. Base color of body yellow brown; pedipalp femur and



Figures 51-60.—Morphology of *Vaejovis rubrimanus*, new species, from Nuevo León, México: 51, lateral aspect of metasomal segments IV and V, and telson; 52, dorsal aspect of pedipalp femur; 53, dorsal aspect of pedipalp patella; 54, external aspect of pedipalp patella; 55, ventral aspect of pedipalp patella; 56, dorsal aspect of pedipalp chela; 57, external aspect of pedipalp chela; 58, ventral aspect of pedipalp chela; 59, dentition pattern on fixed finger of pedipalp chela; 60, dentition pattern on movable finger of pedipalp chela.

patella light yellow, chela orange red. Pectinal tooth count 27-28 in males, 24-26 in females. Metasomal segment III length/width 1.48 in male, 1.23-1.24 in females; segment V length/width 2.74 in male, 2.60-2.61 in females. Metasoma with ventral submedian carinae on I-IV present, granular to finely crenulate; ventrolateral carinae on I-IV moderate, finely crenulate; segment I longer than wide in male, wider than long in

female; other segments distinctly longer than wide in both sexes. Pedipalp patella with 3 *esb* trichobothria; fixed finger with primary row of denticles divided into six subrows; movable finger with six subrows and seven inner accessory granules; dorsal and external keels of chela palm smooth or finely granular. Scalloping of male chela fingers moderate. Ratio of chela length/width 3.76 in male, 4.62-4.67 in females; fixed

finger length/carapace length 0.96-0.97; femur length/width 0.97-1.04.

**Description.**—Based on adults; parenthetical statements refer to females. Measurements are given in Table 2.

**Coloration:** Carapace and tergites yellow brown without underlying dusky markings. Metasomal segments I-IV yellow brown, IV slightly darker on distal portion; V orange brown. Telson light orange brown, aculeus dark reddish brown. Pedipalp femur and patella uniformly yellow. Chela palm yellowish proximally; inner surface yellow orange; outer surface orange red. Fingers orange brown basally, yellowish distally. Keels of pedipalps and metasoma dark yellow brown. Legs pale yellow.

**Prosoma:** Anterior margin of carapace obtusely emarginate. Median ocular prominence moderately raised above carapacial surface. Interocular area essentially smooth; remainder of carapace with dense, fine granulation interspersed with larger granules.

**Mesosoma:** Median carina on tergites I-III weak, granular; on IV-VI moderate, granular; tergite VII with median carina moderate, granular and lateral pairs strong, granulose. Pectinal teeth numbering 27-28 in males, 24-26 in females. Sternites III-VI smooth, sparsely setose; VII with pair of strong, crenulate lateral carinae.

**Metasoma:** Segments I-IV: Dorsolateral carinae strong, crenulate; distalmost denticles slightly enlarged on I-III, not enlarged on IV (Fig. 51). Lateral supramedian carinae strong on I-IV, crenulate on I-III, finely crenulate on IV; distalmost denticles on I-III roughly equal in size to preceding ones, on IV flared. Lateral inframedian carinae on I strong, complete, irregularly crenulate; on II present on posterior one-fourth, strong, crenulate; on III present on posterior one-fifth, strong, crenulate; on IV absent. Ventrolateral carinae on I-IV strong, finely crenulate. Ventral submedian carinae on I weak, finely granular; on II-IV moderate, finely granular to finely crenulate. Dorsal and lateral intercarinal spaces with few scattered coarse granules. Segment V (Fig. 51): Dorsolateral carinae moderate, granular to crenulate. Lateromedian carinae moderate, present on anterior three-fourths, irregularly crenulate. Ventrolateral and ventromedian carinae strong, crenulate. Dorsal and lateral surfaces with few scattered coarse granules.

**Telson:** (Fig. 51). Ventral surface with very fine, irregular punctations and granulation, 10 pairs large setae.

**Pedipalp:** Trichobothrial pattern (Figs. 52-59) Type C, neobothriotaxic; patella with 3 *esb* trichobothria (Fig. 54). Femur (Fig. 52): carinae strong, granulose; internal face with 7-8 larger, pointed granules; dorsal face with sparse fine granulation. Patella (Figs. 53-55): dorsointernal, ventrointernal, dorsoexternal, and ventroexternal carinae strong, granulose. Internal face with moderate basal tubercle and oblique longitudinal carinae of 6-8 large, subconical granules; dorsal face finely granular. Chela (Figs. 56-60). Dorsal marginal carina moderate, granular. Dorsal secondary and digital carinae weak, smooth to finely granular. External secondary carina obsolete to weak, finely granular. Ventroexternal carina moderate, granular. Ventromedian carina vestigial, weak around base of movable finger, granular. Ventrointernal carina weak to moderate, granular. Dorsointernal carina strong, composed of enlarged, sharp granules. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged granules; six inner accessory granules (Fig. 59). Dentate margin of movable finger with primary denticle row divided into six subrows by five enlarged granules; apical subrow consisting of a single granule; seven inner accessory granules (Fig. 60). Fingers of male with distinct scalloping.

**Hemispermaphore:** Not dissected due to scarcity of material.

**Variation.**—The holotype male had a pectinal tooth count of 26-27; the two paratype females had counts of 24-24 and 26-26. Variation in morphometrics, based on the holotype male and two adult paratype females, is summarized in the diagnosis.

**Comparisons.**—*Vaejovis rubrimanus* is most similar to *V. minckleyi* Williams. From this species it can be easily distinguished by the following characters: (1) the outer keels of the pedipalp chela palm are smooth to finely granular (not granulose); (2) the entire outer chela surface is reddish orange (not with the palm yellow and fingers reddish brown); (3) the inferior margin of the cheliceral fixed finger is smooth (not with several denticles); (4) chela length/width ratio in males is approximately 3.8 (not exceeding 4.6) and in females 4.6-4.7 (not exceeding 6.0); and (5) the metasoma is not as slender.

**Comments.**—The holotype male was taken from a cave in Huasteca Canyon, near Monterey, Nuevo León, but its occurrence in that habitat is certainly accidental (Mr. J. R. Reddell, pers. comm.). The two females were taken from

steep slopes in the canyon with UV light. This canyon is characterized by impressive vertical walls reaching approximately 300 m in height, at the base of which are talus slopes ranging to about 60 degrees. Both specimens were taken about 50-100 m from the base of such a slope.

Three other species were collected on the same slope as the paratypes: *Centruroides vittatus* (Say), *Diplocentrus colwelli* Sissom, and *Vaejovis crasimanus* Pocock. Of the species collected, the diplocentrid was the most abundant and *V. rubrimanus* the least abundant. *Vaejovis rubrimanus* was not found on the lower slopes, where most of the other scorpions were taken.

**Specimens examined.**—MEXICO: *Nuevo León*: Gruta Sur de San Bartolo, 3 December 1966 (T. Raines), 1 male holotype (AMNH), Cañon de Huasteca, 3 mi. S Santa Catarina, 22 May 1984 (W. D. Sissom, C. S. Colwell), 2 female paratopotypes (WDS).

***Vaejovis solegladi*, new species**

Figs. 61-70, 77, 78

*Vejovis nitidulus nitidulus*, Hoffmann 1931:371-372 (misidentification); 1939:318 (misidentification).

*Vaejovis nitidulus nitidulus*, Díaz Nájera 1975:29 (misidentification repeated).

**Type data.**—Holotype male from Cuicatlán, Oaxaca, México (no date or collector), C. C. Hoffmann Collection. Deposited in the American Museum of Natural History, New York.

**Etymology.**—The specific epithet is a patronym honoring Michael E. Soleglad for his contributions to vaejovid systematics.

**Distribution.**—Known from the Tehuacán area in Puebla and from northern and central Oaxaca, México.

**Diagnosis.**—Adults 38-55 mm in length. Base color yellow, without dusky markings on carapace and tergites. Sternite VII with lateral carinae moderate, granular. Pectinal tooth count 18-22 in males, 18-20 in females. Metasomal segment III length/width 0.95-1.00; segment V length/width 1.90-2.02. Metasoma with inframedian carinae present on distal two-thirds of segment II and distal one-half of segment III; ventral submedian carinae on I-IV obsolete; ventrolateral carinae on I-IV moderate, granular; ventral surfaces of metasoma and telson very hirsute. Pedipalp patella with 2 *esh* trichobothria; chela manus with outer carinae greatly reduced, smooth to finely granular or obsolete; fixed finger dentate margin with six subrows of denticles; movable finger with six subrows and seven inner accessory

granules. Chela very slender with elongate fingers; chela fingers of male without scalloping. Chela length/width ratio 4.8-5.3; chela length/palm length ratio 2.75-3.0; fixed finger length/carapace length 0.84-0.93; femur length/carapace length 0.93-0.96.

**Description.**—Based on adults; measurements of the holotype male and a paratype female are given in Table 2.

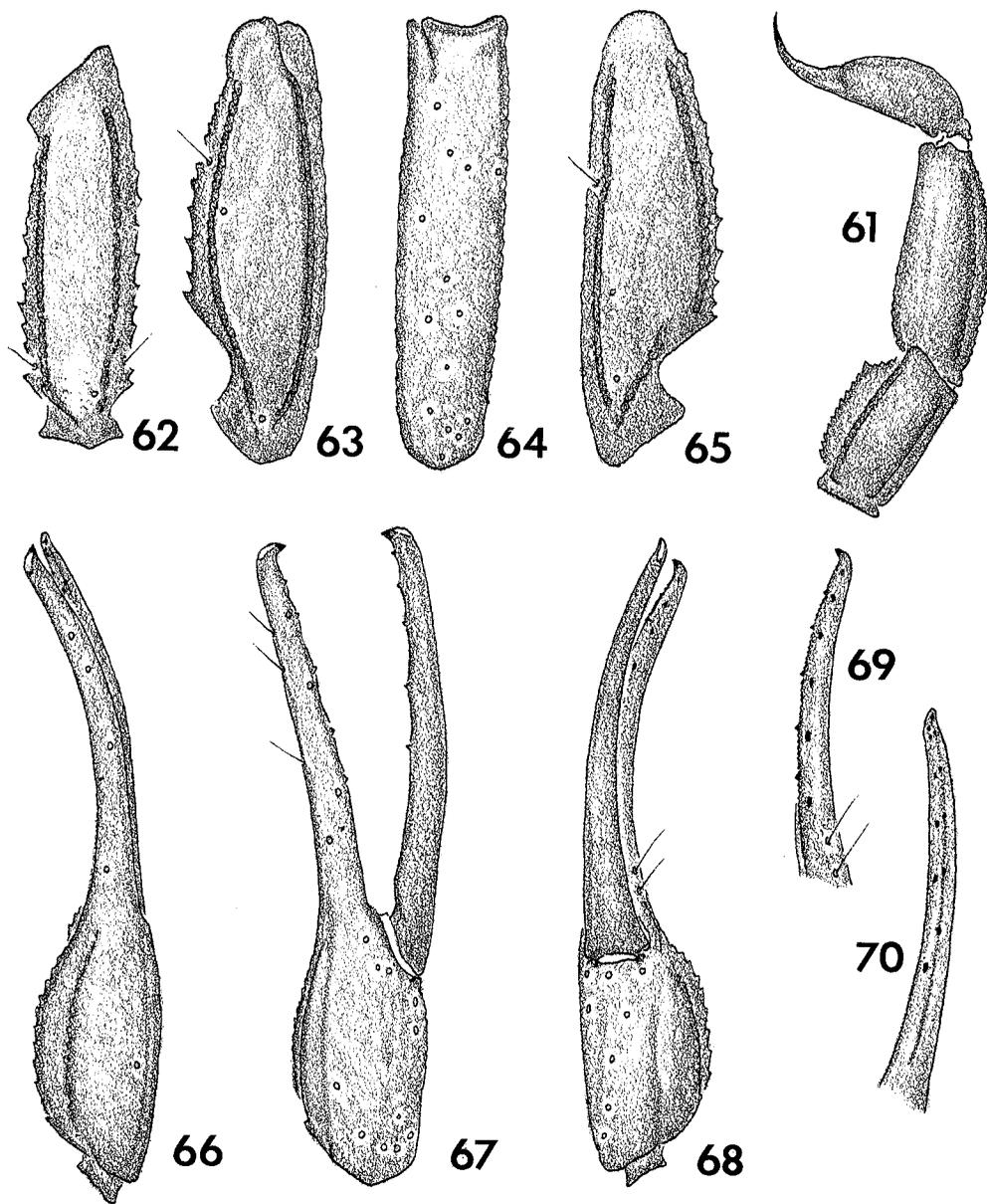
**Coloration:** Carapace, tergites, and venter yellow to yellow brown, lacking underlying dusky markings. Metasomal segments I-III yellowish; IV yellowish above, orange brown with dusky markings below; V yellow proximally, orange brown to brown distally with dusky markings. Telson vesicle orange brown with dusky markings on ventral surface. Pedipalps: femur and patella yellowish, chela manus yellow to yellow orange with fingers somewhat darker; carination dark orange brown. Legs pale yellow.

**Prosoma:** Anterior margin of carapace obtusely emarginate, median notch weak. Interocular area smooth or finely granular; remainder of carapace densely, coarsely granular.

**Mesosoma:** Median carina on I-II obsolete, on III-IV weak, granular; on V-VI moderate, granular. Tergite VII with median carina moderate, granular; lateral pairs strong, granulose. Pectinal tooth count 18-22 in males; 18-20 in females. Sternites III-VI smooth, moderately setose; VII with one pair moderate, granular lateral carinae.

**Metasoma:** Dorsolateral carinae strong, crenulate to serrate; distalmost denticles on I-III slightly enlarged, spinoid; on IV not noticeably enlarged. Lateral supramedian carinae on I-III strong, crenulate; on IV moderate, irregularly granular; distalmost denticle on I-III enlarged, spinoid and on IV flared. Lateral inframedian carinae on I complete, strong, crenulate; on II present on posterior two-thirds, moderate, crenulate; on III present on posterior one-half, weak, crenulate; on IV absent. Ventrolateral carinae moderate, granular. Ventral submedian carinae obsolete. Intercarinal spaces with scattered coarse granulation; setae of ventral surface moderately dense, not paired along ventral submedian carinae. Segment V (Fig. 61): Dorsolateral carinae weak, granular on anterior one-half, smooth posteriorly; lateromedian carinae essentially obsolete; ventrolateral and ventromedian carinae weak, finely crenulate. Dorsal and lateral intercarinal spaces with scattered coarse granulation; ventral surface smooth, moderately setose.

**Telson:** (Fig. 61). Ventral surface with irregular



Figures 61-70.—Morphology of *Vaejovis solegladi*, new species, from Oaxaca, México: 61, lateral aspect of metasomal segments IV and V, and telson; 62, dorsal aspect of pedipalp femur; 63, dorsal aspect of pedipalp patella; 64, external aspect of pedipalp patella; 65, ventral aspect of pedipalp patella; 66, dorsal aspect of pedipalp chela; 67, external aspect of pedipalp chela; 68, ventral aspect of pedipalp chela; 69, dentition pattern on fixed finger of pedipalp chela; 70, dentition pattern on movable finger of pedipalp chela.

punctations interspersed with fine granules; vesicle of female moderately globose; ventral aspect conspicuously hirsute, with 50 or more setae.

**Pedipalp:** Trichobothrial pattern (Figs. 62-69) Type C, orthobothriotaxic (Vachon 1974). Femur (Fig. 62): carinae strong, granulose; internal face with 7-9 larger granules and several smaller

ones; dorsal face essentially smooth. Patella (Figs. 63-65): dorsointernal and ventrointernal carinae strong, granulose; dorsoexternal carina weak to moderate, finely granular; ventroexternal carina moderate, granulose. Internal face with moderate basal tubercle and oblique longitudinal carina of 9-11 large, irregularly spaced granules; dorsal

face more or less smooth. Chela (Figs. 66-70). Dorsal marginal carina weak, granular. Dorsal secondary and digital carinae weak, smooth. External secondary carina obsolete. Ventroexternal carina obsolete to weak, smooth. Ventromedian carina obsolete. Ventrointernal carina weak, granular. Dorsointernal carina moderate, composed of enlarged, sharp granules. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged granules; six inner accessory granules (Fig. 69). Dentate margin of movable finger with primary denticle row divided into six subrows by five enlarged granules; seven inner accessory granules (Fig. 70). Fingers long and tenuous, ratio of movable finger length/palm length 1.8-2.1; fingers of male without scalloping.

*Hemispermatothore*: (Figs. 77-78). Distal lamina of average proportions (distal laminar length/width = 6.09,  $N = 1$ ), not distinctly tapered. Median lobe relatively large, rounded.

**Variation.**—Variation in pectinal tooth counts is summarized as follows: in males, two combs with 18 teeth, two with 20, one with 21, and one with 22; in females, two combs with 18 teeth, two combs with 19, and two combs with 20. Morphometric variation, based on the three adult males and three adult females, is summarized in the diagnosis.

Sexual differences, except in body size, are not conspicuous. Keel structure and granulation, which typically exhibit considerable sexual variation in this species group, are not noticeably different in males and females of *V. solegladi*. Morphometrics are also quite similar, although sample sizes do not permit statistical analysis. Juveniles differ considerably from the adults in coloration. Instead of yellow, their base coloration is brownish with distinct underlying dusky markings on all cuticular surfaces.

**Comparisons.**—*Vaejovis solegladi* is most similar to *V. intermedius* and *V. nigrescens*. It can be readily distinguished from *V. intermedius* by the following characters: (1) males of *V. solegladi* have pectinal tooth counts of 18-22 (not 21-26), females 18-20 (not 19-24); (2) males lack scalloping on the pedipalp chela fingers; (3) the lateral inframedian carinae on metasomal segments II and III are more complete than in *V. intermedius*, extending two-thirds to one-half the length of their respective segments; (4) the distalmost denticles of the dorsolateral carinae of the metasoma are not distinctly enlarged, as in *V. intermedius*; (5) the pedipalp chela fingers are

proportionately longer; and (6) the chela palm is more slender. The hemispermatothore of *V. solegladi* has a proportionately stouter distal lamina and a different configuration of dorsoectal lobes than found in *V. intermedius* (cf. Figs. 73 and 77).

Characters 2, 3, 4 and (with few exceptions) 6 also serve to distinguish *V. solegladi* from *V. nigrescens*. In addition, the body color of *V. solegladi* is yellow, whereas that of *V. nigrescens* is dark reddish brown, and the ventral surfaces of the metasoma and telson are much more hirsute than in *V. nigrescens*. The configuration of dorsoectal hemispermatothoric lobes also serves to distinguish the two species (cf. Figs. 75 and 77).

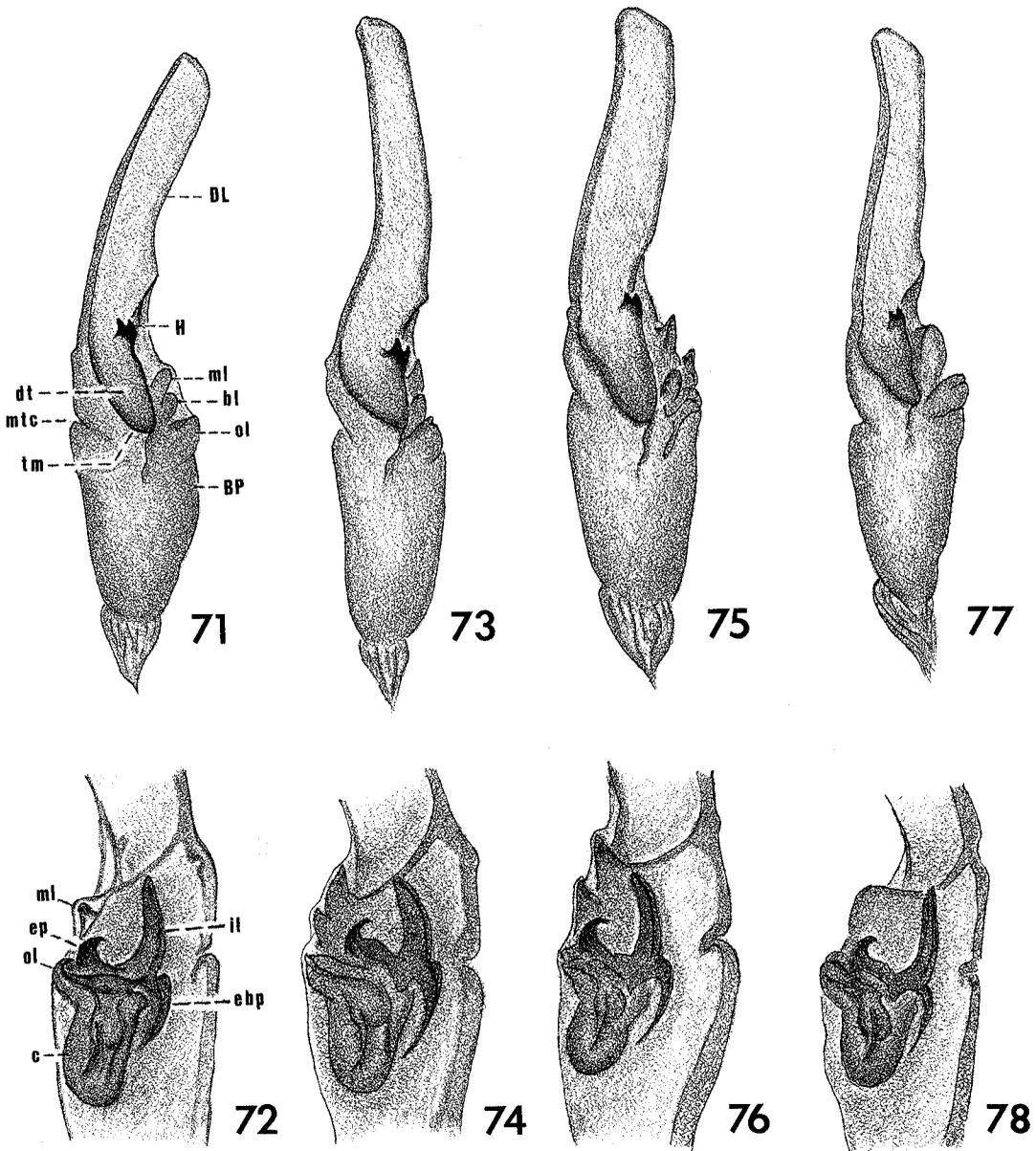
This species was previously mistaken for *V. nitidulus* (Hoffmann 1931). *Vaejovis solegladi* is readily distinguished from *V. nitidulus* by having only six subrows of denticles (not seven) on the pedipalp chela fixed finger; two patellar *esb* trichobothria (not three); and 18-22 pectinal teeth (not 24-28 in males and 21-27 in females).

**Specimens examined.**—MEXICO: Oaxaca: Cuicatlán (no date or collector), 1 holotype male, 1 paratype male, 1 paratype female (C. C. Hoffmann collection; now AMNH), Cuicatlán (in house), 1931 (no collector), 1 juv. (AMNH), 5.8 mi. N Teotitlán, 31 July 1973 (L. R. Erickson, M. E. Soleglad), 2 paratype females (MES, cat. no. MX-131), 30 mi. N Telixtlahuaca, 14 August 1967 (J. Reddell, J. Fish, T. Evans), 1 juv. male (AMNH). Puebla; 6 km N Tehuacán, 22 August 1987 (J. Doyen), 1 male (UCB).

#### *Vaejovis nitidulus* C. L. Koch

Previous confusion surrounding the identity of *V. nitidulus* was discussed earlier (Sissom and Francke 1985), but new information is now available regarding some previous records. Hoffmann's (1931) records of *V. nitidulus* in Oaxaca were based on misidentifications; the taxon found there represents a new species, *V. solegladi*, described above. The two specimens from Etna, Oaxaca listed by Bücherl (1959) as *V. nitidulus* are juveniles of a species of *Diplocentrus* (Diplocentridae). *Vaejovis nitidulus* seems to be restricted to the Sierra Madre Oriental in Hidalgo and northeastern Querétaro. Díaz Nájera's (1964, 1975) records for *V. nitidulus* in Guanajuato and Querétaro (city), along the eastern side of the Sierra Madre Occidental, are almost certainly misidentifications. Two other species occur in that area: *V. nigrescens* and *V. pococki*.

The hemispermatothore of *V. nitidulus* (Figs. 81-82) is characterized by having a relatively



Figures 71-78.—Right hemispermatophores of species of the *Vaejovis nitidulus* group: 71, 72, *V. curvidigitus*; 71, dorsal aspect; 72, ventral aspect; 73, 74, *V. intermedius*; 73, dorsal aspect; 74, ventral aspect; 75, 76, *V. nigrescens*; 75, dorsal aspect; 76, ventral aspect; 77, 78, *V. solegladii*; 77, dorsal aspect; 78 ventral aspect (composite drawing based on both left and right hemispermatophores). bl = basal lobe; BP = basal portion; c = sperm canal; DL = distal lamina; dt = dorsal trough; ep = ental process of inner lobe; ebp = ectobasal process of inner lobe; H = hooks; il = inner lobe; ml = median lobe; mtc = median transverse cleavage; ol = outer lobe; tm = dorsal trough margin.

broad (distal lamina length/width 5.56-5.60,  $N = 2$ ), straight, and untapered lamina; the inner lobe of the capsule is long and narrow; the basal and median lobes are rounded.

**New records.**—MEXICO: *Hidalgo*: Ixmiquilpan, July 1963 (collector unknown), 1 male, 1 female, 1 juv. (MNHN, RS-4072), Jacala, 8-VIII-? (R. Haag), 1 female (MCZ), Zimapan, July 1963 (collector unknown), 1 male, 1 female (MNHN, RS-4091).

*Vaejovis nigrescens* Pocock

The specimens referable to *V. nigrescens* that I have been able to obtain are from the central Mexican states of Aguascalientes, Distrito Federal, Guanajuato, Jalisco, Michoacán, and Zacatecas. Hoffmann (1931, 1937) and Díaz Nájera (1964, 1975) cited records for *V. nigrescens* from Hidalgo, Querétaro, and adjacent parts of San Luis Potosí. These records are almost certainly based on misidentifications. In western Querétaro and southern San Luis Potosí is a new species (described above) that superficially resembles *V. nigrescens* and was confused with it in the past. In the southern portion of the Sierra Madre Oriental in the state of Hidalgo, only two *nitidulus* group species have been identified: *V. nitidulus* and *V. kochi*. The latter superficially resembles *V. nigrescens* in coloration, but differs from it in morphometrics, carination, and trichobothrial pattern.

The hemispermaphore of *V. nigrescens* (Figs. 75-76) is relatively broad (distal lamina length/width = 5.70,  $N = 1$ ), slightly curved, and untapered; the inner lobe of the capsule is long and relatively broad; the basal and median lobes are sharply rimmed.

**New records.**—MEXICO: *Jalisco*: Arandas (no date or collector), one male (MNHN, RS-4290), 2 juvs. (MNHN, RS-4286), Tepatitlán (no date or collector), 1 male, 1 female (MNHN, RS-4289). *Michoacán*: El Sabino, April 1928 (H. Faber), 1 male, 1 female (ZMK), Uruapán, 15 July 1941 (Leavenworth) (on side of house), 1 female (AMNH). *Zacatecas*: Valparaiso, 16 July 1963 (L. Mazzotti), 1 male (RS-4021)(MNHN).

*Vaejovis intermedius* Borelli

*Vaejovis intermedius* is known from southwestern Texas (Brewster, Crockett, Presidio, Terrell, and Val Verde Counties) and the states of Chihuahua, Coahuila, Durango, and Nuevo León in México. Attempts to confirm some earlier records of Hoffmann (1931) and Díaz Nájera (1964, 1975) have met with partial success. Hoffmann's specimens from the Sierra de Guadalupe, Distrito Federal could not be located, although they are presumably deposited in the Instituto de Biología, México City. This record was certainly based on a misidentification, and the specimens may be referable to *V. nigrescens*. I have examined a specimen determined by Díaz Nájera as "*Vaejovis nitidulus intermedius*" from San Juan de los Lagos, Jalisco (MNHN, RS-4291)(see Díaz Nájera 1964: 25, 1975:26). This specimen

is not referable to *V. intermedius*, but rather to *V. cristimanus* Pocock (*intrepidus* group). The specimens from Ixmiquilpan, Hidalgo (Díaz Nájera 1964: 24, 1975: 25) were not located; however, I have seen only specimens of *V. nitidulus* from that locality, and this record is almost certainly based on that species.

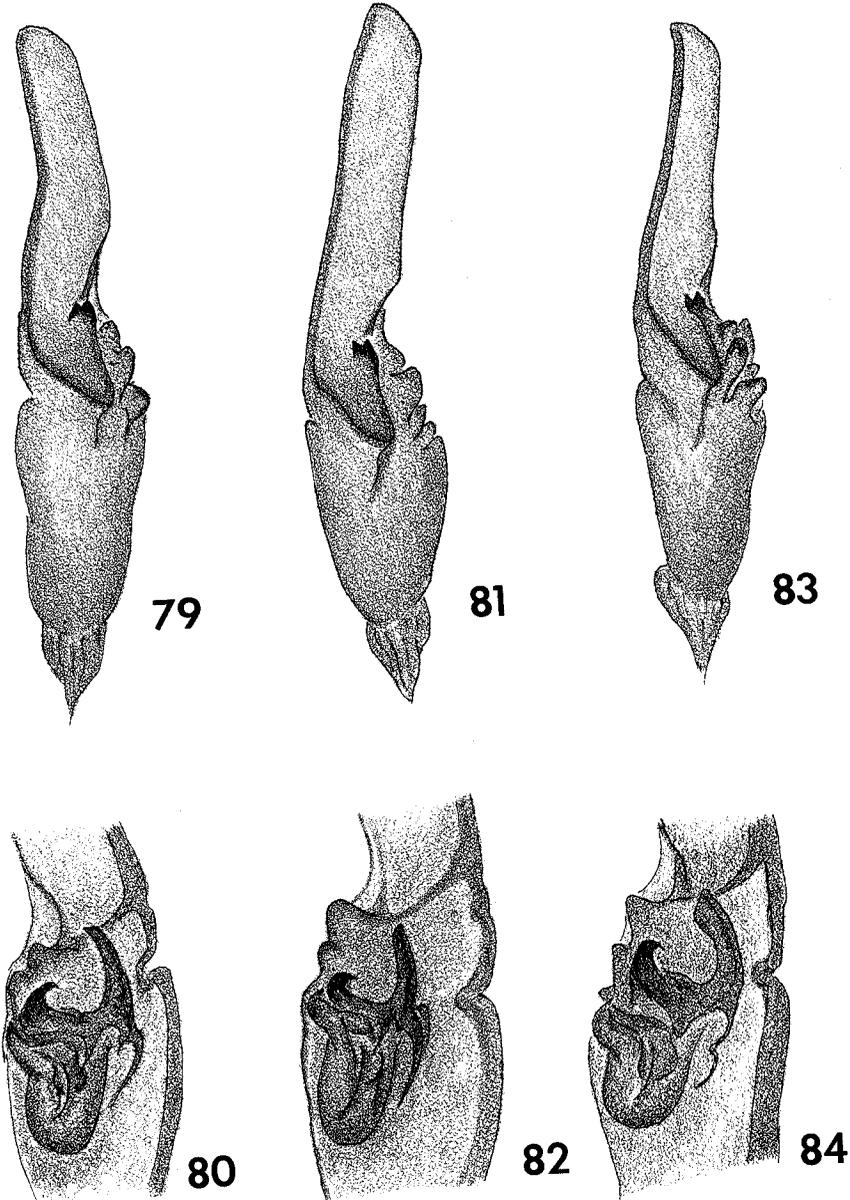
The hemispermaphore of *V. intermedius* (Figs. 73-74) bears a long, slender distal lamina (lamina length/width = 7.05-7.39,  $N = 3$ ) and trunk. The lamina is essentially straight and noticeably tapered. The inner lobe of the capsule is broader at its base; the basal and median lobes are sharply rimmed.

**New records.**—MEXICO: *Chihuahua*: Clarines Mine, 5 mi. NW Santa Barbara (2072 m), 8 February 1947 (G. M. Bradt), 1 juv. female (AMNH). *Coahuila*: 15 mi. E Cuatro Ciénegas de Carranza, 22 July 1972 (E. A. Liner, R. M. Johnson, A. H. Chaney), 1 female (FSCA). *Nuevo León*: Bustamente Canyon, Bustamente, 26 November 1986 (A. G. Grubbs), 2 females (TMM), in the mountains 2 mi. NE Villa de Garcia, 19 August 1984 (W. D. Sissom, C. Myers, L. Born), 6 males, 2 females (WDS); 9 mi. NNW, 2 mi. N Mina, 15 July 1975 (E. A. Liner, et al.), 1 female, 1 subadult female (FSCA). U.S.A.: *Texas*: Brewster Co., Alpine, 22 April 1964 (J. F. Scudday), 1 female (CAS), off Texas Farm Road 170, 9 mi. W Junction of State Highway 118 (5 mi. W Terlingua), 19 May 1989 (R. N. Henson), 1 female (RNH), Nugent Peak, Big Bend National Park, June 1986 (S. Stockwell), 1 juv. (WDS); road to Pine Canyon, 24 May 1987 (R. Henson), 1 female (1450 m), 1 juv. (1115 m)(RNH); Jeff Davis Co., Davis Mountains, 27 June 1990 (W. Vandevender), 1 female (RNH); Presidio Co., 2 mi. W Lajitas, 30 May 1970 (W. Seifert); Val Verde Co., NW side of Amistad Reservoir (on road cut), 3 mi. E Del Rio, 24 May 1983 (W. D. Sissom, C. S. Colwell, N. McReynolds), 1 female (CAS).

*Vaejovis decipiens* Hoffmann

Two early instar juvenile specimens, whose locality data are presented below, are tentatively referred to this species. They bear the appropriate pedipalp chela dentition, patella external trichobothrial pattern, pectinal tooth counts, and metasomal carinal morphology; furthermore, in coloration they are very similar to juveniles of *V. decipiens* examined previously (Sissom and Francke 1985).

**New records.**—MEXICO: *Sonora*: Sierra de Alamos, 15-30 Jan 1968 (V. Roth), 1 juv. female (AMNH), Rancho Los Banos (30°30'N:110°40'W), 9 May 1966 (V. Roth), 1 juv. female (AMNH).



Figures 79-84.—Right hemispermatophores of species of the *Vaejovis nitidulus* group: 79, 80, *V. mitchelli*; 79, dorsal aspect; 80, ventral aspect; 81, 82, *V. nitidulus*; 81, dorsal aspect; 82, ventral aspect; 83, 84, *V. pococki*; 83, dorsal aspect; 84, ventral aspect. To identify structures refer to labels of preceding plate.

*Vaejovis peninsularis* Williams

Williams (1980) placed *V. peninsularis* in the *wupatkiensis* group of *Vaejovis*, but it was subsequently referred to the *Vaejovis nitidulus* group (Sissom and Francke 1985). Williams and Berke (1986), who resurrected the genus *Serradigitus* Stahnke for certain species of the *V. wupatkiensis* group, chose to retain *V. peninsularis* in *Vae-*

*jovis*, thus agreeing with Sissom and Francke (1985). In particular, the possession of six subrows of denticles on the chela fingers, the basal position of trichobothria *ib* and *it*, and the possession of three *esb* trichobothria on the pedipalpal patella are indicators of affinities with the *nitidulus* group.

A specimen in the American Museum of Natural History labeled as a juvenile paratype by

Williams is not *V. peninsularis*, but is referable to *Serradigitus giganteans* (Williams). Seven other juveniles of *V. peninsularis* collected by Vince Roth at Mission San Ignacio on the same date as the paratypes were also located in the AMNH.

**New records.**—MEXICO: *Baja California Sur*: in rockslide ca. 1.5 mi. from Pie de la Cueta Ranch on trail to Guajademi (S of El Portrero), 23 Oct 1972 (D. B. Richman, R. Reeder, P. D. Eliscu), 1 male, 1 female (FSCA), under rock near Pie de la Cueta (between El Portrero and Guajademi), 22 Oct 1972 (D. B. Richman, et al.).

#### THE UTILIZATION OF HEMISPERMATOPHORE MORPHOLOGY IN VAEJOVID SYSTEMATICS

The vaejovid spermatophore (and, consequently, hemispermatochore), like that found in most scorpion families, is lamelliform (Francke 1979; Lamoral 1979). Lamelliform hemispermatochores are characterized by the possession of a basal trunk area and a distal blade-like structure referred to as the distal lamina (e.g., see Fig. 71). Near the junction of the trunk and distal lamina on the ventral and ental (or medial) surfaces may be a system of lobes and processes often referred to as the capsule (Francke 1979), although there is considerable variation in the complexity of this region. The terminology for these lobes was reviewed by Lamoral (1979), and I have attempted to apply his nomenclature to vaejovid hemispermatochores. Vaejovid hemispermatochores differ considerably from those of scorpionids in the structure of the capsular region, so the present interpretation of homologies should be considered tentative until comparative phylogenetic studies, which are in progress, can be completed. Illustrations of hemispermatochores of seven species of the *Vaejovis nitidulus* group are presented together here (Figs. 71-84) to facilitate comparisons.

There is considerable variation among vaejovids in the morphology of the hemispermatochore, and this variation should prove extremely useful to systematics at the generic, species group, and specific levels. The morphology of the distal lamina differs considerably among the different vaejovid groups. The relative length and slenderness of the blade, as well as the degree of tapering towards the distal end, differs among vaejovid species. For this study, I have indicated relative slenderness of the blade as the ratio between distal laminar length (mea-

sured from the base of the dorsal trough to the tip of the lamina) and laminar width at mid-length. Although based on the small sample sizes available here, this ratio appears to be relatively constant.

In vaejovids, the ental (= medial) margin of the dorsal trough is usually produced distally into some type of sclerotized structure. The different types of structures present here may prove to have considerable taxonomic value above the species level. In all species of the *Vaejovis nitidulus* group thus far examined, this structure takes the form of a pair of hooks (e.g., Fig. 71) that is always located basally on the dorsoental surface of the distal lamina. I have observed comparable double hooks on hemispermatochores of at least some representatives of other groups, such as the *Vaejovis mexicanus* group (Sissom 1989a), a few *Uroctonus* (*sensu* Soleglad 1973), *Vejovoidus*, and *Paruroctonus*. Some *mexicanus* group species, such as *V. mexicanus* Koch, *V. granulatus* Pocock, and *V. maculosus* Sissom lack hooks altogether (Sissom 1989a). The hemispermatochores of other vaejovid groups examined (i.e., *Syntropis*, *Serradigitus*, and the *Vaejovis eusthenura*, *punctipalpi*, and *intrepidus* groups) bear a broad flange along the ental margin of the distal lamina which may be bluntly bifurcate distally, possibly representing a condition derived from that seen in the aforementioned groups. This flange typically terminates some distance from the base of the lamina.

The capsular region is highly variable among vaejovids, ranging from a very simple structure to a highly developed system of lobes and processes. The basal portion of the capsule is occupied by a folded canal that may function in sperm transport. The inner lobe, when present, is usually a fingerlike lobe projecting distally towards the distal laminar base (very similar to the condition found in scorpionids). It bears an ental process (e.g., see Fig. 72) that may possess a series of hooklets and a curved, flange-like ectobasal process. The ental process bears hooklets in *Syntropis* and the *eusthenura*, *punctipalpi*, and *intrepidus* groups of *Vaejovis*, but does not in species of other groups, including the *nitidulus* group. In the former case, the number of hooklets appears to vary according to species and has recently been used to separate species (Sissom, 1989b); these hooklets were referred to as "capsular spines" in that paper, but the former term seems more appropriate. In the *nitidulus* group species, the number and shape of lobes com-

prising the dorsoventral portion of the capsule is variable. For example, the median and basal lobes may be produced into a distinct rim, appearing pointed in the dorsal and ventral views (Figs. 73-76), or they may be gently rounded (Figs. 79-84). Two closely related species (perhaps sister species), *V. nigrescens* and *V. intermedius*, possess median and basal lobes that are sharply rimmed; however, the lobes are not so rimmed in closely related species, *V. curvidigitus* and *V. solegladi*. It is also interesting to note that rounded lobes occur in *V. mitchelli*, *V. nitidulus*, and *V. pococki*; these three species are apparently close relatives as well, based on their external anatomy (see comparisons sections for these species). Finally, in addition to the median, basal, and outer lobes, accessory lobes may be present on the dorsoventral aspect (e.g., *V. curvidigitus*, *V. nigrescens*, *V. nitidulus*, and *V. pococki*).

Without doubt, as our understanding of hemispermaphoric structure in vaejovids and the related chactoid groups increases, many new characteristics beyond the few mentioned here will prove to be of taxonomic and phylogenetic value.

#### ACKNOWLEDGMENTS

Numerous curators and institutions provided assistance during the course of this study, either through loans of specimens or by searching through their collections for pertinent material. For the loan of material, including type specimens, I wish to thank E.-G. Burmeister, Zoologische Staatssammlung, Munich (ZSM); G. B. Edwards, the Florida State Collection of Arthropods (FSCA), Gainesville; O. Elter, Museo ed Istituto di Zoologia Sistemática della Università di Torino (TOR), Torino, Italy; H. W. Levi, the Museum of Comparative Zoology (MCZ), Harvard University, Cambridge, Mass.; W. R. Lourenço and M. Vachon, the Muséum National d'Histoire Naturelle (MNHN), Paris; M. Moritz, Zoologisches Museum der Humboldt-Universität (ZMB), Berlin; N. I. Platnick, the American Museum of Natural History (AMNH), New York; W. J. Pulawski and V. F. Lee, the California Academy of Sciences (CAS), San Francisco; J. Reddell, the Texas Memorial Museum (TMM), the University of Texas, Austin; S. A. Stockwell, University of California at Berkeley (UCB); F. R. Wanless and P. D. Hillyard, the British Museum (Natural History) (BMNH), London; and L. Watrous, J. B. Kethley, and D. A. Summers, the Field Museum of Natural History (FMNH),

Chicago. The following individuals kindly loaned me specimens from their personal collections: M. E. Braunwalder (MEB), O. F. Francke (OFF-AMNH), R. N. Henson (RNH), S. A. Minton (SAM), J. A. Nilsson (JAN), and M. E. Sologlad (MES). I am extremely grateful for their assistance. O. F. Francke also allowed me access to specimens he had on loan from the Zoologisk Museum, Copenhagen (ZMK).

For permission to collect in Big Bend National Park, I am grateful to M. Fleming and the National Park Service, Department of the Interior. J. Reddell provided some information on the cave record of *V. rubrimanus* and other localities in México. I also wish to extend a heartfelt thanks to C. S. Colwell and C. and L. (néé Born) Myers, who accompanied me in the field.

L. P. Alberstadt, V. Fet, O. Francke, R. Kral, D. E. McCauley, M. F. Miller, T. L. Page, G. A. Polis, and S. A. Stockwell read various drafts of the manuscript; their comments and suggestions are sincerely appreciated. C. Myers, P. Malone, and S. Hughes provided clerical assistance.

This research represents partial fulfillment of the requirements for the Ph.D. degree at Vanderbilt University and was partially supported by a grant from the graduate school of that institution. Page charges were paid with the assistance of Faculty Research and Development Grants from Elon College.

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*Manuscript received January 1989, revised July 1990.*