

New morphological data for the order Ricinulei with the description of two new species of *Pseudocellus* (Arachnida: Ricinulei: Ricinoididae) from Mexico

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Abstract. Two new species of ricinuleids of the genus *Pseudocellus* Platnick, 1980 are described based on adult males and females from Mexico: *Pseudocellus quetzalcoatl* sp. nov. and *Pseudocellus olmeca* sp. nov. from the same type locality in the state of Veracruz. The two new species represent the first record of two sympatric epigeal species of ricinuleids for North America. The total number of described species of *Pseudocellus* from Mexico increases to 18, holding first place in terms of number of known ricinuleid species worldwide. With the two new species described herein, Veracruz, with four species, is the second state of Mexico with higher diversity after Chiapas, which has five recorded species. We describe for the first time, for any ricinuleids, pores on the membrane below the spermathecae, revealed using a staining technique. The function of these pores is unknown, although it is possible that these could be secretion glands for some kind of substance during the reproductive process. A taxonomic key for identification of males of species from Mexico and the southern United States is provided.

Keywords: Taxonomy, sympatry, glands, Veracruz, new data

Ricinulei is the second least diverse order of Arachnida, comprising 89 extant (including the two new species herein described) and 22 fossil species. Suborders Palaeoricinulei Selden, 1992 and Neoricinulei Selden, 1992, each gathering extinct and living taxa, respectively, were traditionally recognized (Selden 1992; Harvey 2003). A few years ago, the classification scheme was modified by Wunderlich (2012, 2015). This author proposed that all previously known species be placed in suborder Posteriorricinulei Wunderlich, 2015, while a newly discovered fossil, *Primoricinuleus pugio* Wunderlich, 2015, was assigned to suborder Primoricinulei Wunderlich, 2015 on account of it presumably being the sister taxon to all other ricinuleids. More recently (Wunderlich 2017), two new monogeneric families of extinct ricinuleids were described into the Primoricinulei: Hirsutisomidae Wunderlich, 2017 and Monooculricinuleidae Wunderlich, 2017.

The Superfamily Ricinoidoidea Ewing, 1929 comprises the genera *Cryptocellus* Westwood, 1874, *Pseudocellus* Platnick, 1980 and *Ricinoides* Ewing, 1929, each with 42, 34 and 11 previously known species, respectively. Of these, only *Ricinoides* occurs in the Old World, having thus far remained restricted to western and central African countries (Tuxen 1974; Naskrecki 2008; Penney et al. 2009). In contrast, *Pseudocellus* and *Cryptocellus* are exclusive New World elements; the former is primarily distributed in North and Central America, with some species having been described from Caribbean islands, whereas *Cryptocellus* is predominantly South American, the distribution of both overlapping in the Central American region (Harvey 2003; Tourinho & Azevedo 2007; Botero-Trujillo & Pérez 2008,

2009; Teruel & Armas 2008; Tourinho & Saturnino 2010; Tourinho et al. 2010, 2014; Valdez-Mondragón & Francke 2011, 2013; Pinto-da-Rocha & Andrade 2012; Botero-Trujillo 2014; Armas & Agreda 2016; Botero-Trujillo & Valdez-Mondragón 2016; Armas 2017; Botero-Trujillo & Flórez, 2017).

Ricinuleids are typically found in the soil of lowland tropical rainforests (i.e., in the leaf litter and underlying layers) as well as under rocks and rotten logs (Platnick 2002; Harvey 2003). Many species, all belonging to *Pseudocellus*, are cave inhabitants and frequently true troglobites with distinct troglomorphisms. Mexico holds first place in number of known ricinuleid species, with 16 out of 33 currently recognized valid *Pseudocellus* species (not including the two new species described herein). Many works have contributed to the knowledge of the ricinuleid fauna of Mexican natural subterranean systems (Bolívar y Pieltain 1946; Gertsch 1971, 1977; Pittard & Mitchell 1972; Brignoli 1974; Reddell 1981; Cokendolpher & Enríquez 2004; Valdez-Mondragón & Francke 2011). Mexico is also the country with the largest number of known troglobitic ricinuleids, eight thus far: *Pseudocellus bolivari* (Gertsch, 1971), *P. boneti* (Bolívar y Pieltain, 1942), *P. monjarazi* Valdez-Mondragón & Francke, 2013, *P. osorioi* (Bolívar y Pieltain, 1946), *P. oztotl* Valdez-Mondragón & Francke, 2011, *P. platnicki* Valdez-Mondragón & Francke, 2011, *P. reddelli* (Gertsch, 1971) and *P. sbordonii* (Brignoli, 1974).

Species of Ricinulei generally exhibit narrow geographical distributions and normally no more than one species is known to occur in a given area. *Cryptocellus lampeli* Cooke, 1967 and

Cryptocellus albosquamatus Cooke, 1967 were described from Amatuk, British Guiana; this became the first case of sympatric ricinuleid species to be documented, and thus far remains the only one to our knowledge.

In this contribution, we describe two new *Pseudocellus* species from a single locality of tropical rainforest in the state of Veracruz, Mexico. The Jaguaroundi Ecological Park is a natural reserve, embedded within a large petrochemical complex administered by the Mexican oil company PEMEX (Fig. 90). Specimens of *P. quetzalcoatl* sp. nov. were collected in the ground, all under the same boulder which was about 80 cm in diameter. Specimens of *P. olmeca* sp. nov. were found by digging in the ground, close to the roots of some plants. The collection points where the two species were found are separated from each other by only some 200 m or less. Also, a taxonomic key for identification of males of species from Mexico and the southern United States is provided.

METHODS

All the material is deposited in the Colección Nacional de Arácnidos (CNAN) (Curator: Dr. Oscar F. Francke), Instituto de Biología, Universidad Nacional Autónoma de México (CNAN-IBUNAM), Mexico City. Specimens were examined in a Zeiss DiscoveryV8 stereomicroscope. Photographs were obtained with a Zeiss Axiocam 506 digital camera attached to a Zeiss AXIO ZoomV16 stereomicroscope. Photography was conducted with specimens and structures submerged into commercial-use gel alcohol (to hold them in the appropriate position), and the preparation completely

covered with 80% ethanol. Spermathecae were stained using a drop of chlorazol (1%) for a few seconds followed by wash with 80% ethanol. Images were edited in Adobe Photoshop CS6. The map was produced using SimpleMapp (Shorthouse 2010). Measurements, in millimeters, were obtained using the methodology outlined by Cooke & Shadab (1973). Terminology used for referring to leg segments follows Gertsch (1971), whereas that used for the copulatory structures follows Pittard & Mitchell (1972) and Botero-Trujillo & Valdez-Mondragón (2016). The length/diameter (l/d) ratio of femur II of males was calculated in prolateral view. We use the following abbreviations for some cuticular structures on the male copulatory apparatus following Salvatierra & Tourinho (2016): *BS*, barbed setae; *CS*, clubbed setae; *FD*, flat depressions; *Lct*, long curved-tip setae; *OS*, ordinary setae; *Sct*, sculptured surface tubercles. The following abbreviations are used for some copulatory structures following Botero-Trujillo & Valdez-Mondragón (2016): *ac*, accessory piece of the male copulatory apparatus; *Lc*, lamina cyathiformis; *MT*, metatarsus; *mP*, metatarsal process; *st*, spermatheca; *tP*, tarsal process.

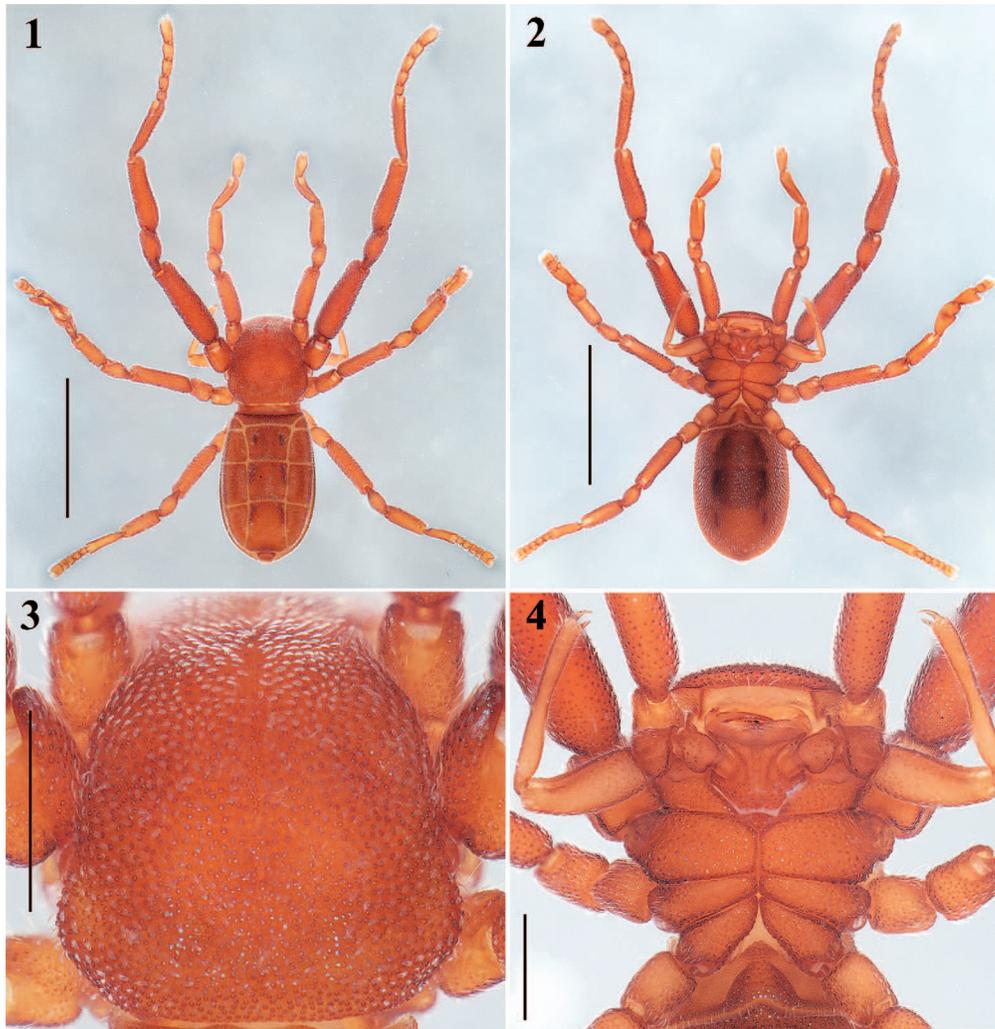
RESULTS TAXONOMY

Family Ricinoididae Ewing, 1929
Genus *Pseudocellus* Platnick, 1980

Type species.—*Pseudocellus dorotheae* (Gertsch & Mulaik, 1939).

KEY TO ADULT MALES OF *PSEUDOCCELLUS* SPECIES FROM MEXICO AND THE USA

1. Troglomorphic species with elongated legs (e.g., Valdez-Mondragón & Francke 2013: fig. 14): femur II at least 1.5 times longer than carapace; tibia II longer than carapace 2
Edaphomorphic species with short appendages (e.g., Figs. 1, 40): femur II less than 1.5 times the carapace length; tibia II shorter than carapace 9
2. Femur II length/width ratio greater than 9; femur II more than twice longer than carapace 3
Femur II length/width ratio less than 9; femur II less than twice longer than carapace 6
3. Cheliceral fingers with 5 teeth *P. reddelli* (Durango, Mexico) 4
Cheliceral fingers with more than 5 teeth 4
4. Leg formula 2413; tibia II twice as long as patella II *P. sbordonii* (Chiapas, Mexico) 5
Leg formula 2431; tibia II less than twice as long as longer than patella II 5
5. Tibia I with distinct ventral hump (Valdez-Mondragón & Francke 2011: figs. 24, 26); tibia and tarsus of leg II unarmed *P. platnicki* (Coahuila, Mexico) 6
Tibia I without distinct ventral hump (Valdez-Mondragón & Francke 2011: fig. 17); tibia and tarsus of leg II with distinct proventral and retroventral rows of spines (Valdez-Mondragón & Francke 2011: fig. 19) *P. oztotl* (Puebla, Mexico) 6
6. Leg formula 2341; cheliceral fixed finger with 4 teeth; tarsal claws asymmetrical and somewhat spatulate *P. bolivari* (Chiapas, Mexico) 7
Leg formula 2431; cheliceral fixed finger with 5 or 6 teeth; tarsal claws symmetrical, none spatulate 7
7. Tibia II elongated, about 11 times longer than wide, with scattered spines or granules ventrally; cheliceral movable finger with basal tooth not distinctly larger than the others 8
Tibia II short, about 6 times longer than wide, with two distinct rows of spines ventrally; cheliceral movable finger with basal tooth distinctly larger than the others *P. boneti* (Guerrero, Mexico) 8
8. Tibia II with few scattered spines ventrally; cheliceral movable finger with teeth uniform in size *P. osorioi* (San Luis Potosí, Mexico) 9
Tibia II without scattered spines, but with numerous granules ventrally (Valdez-Mondragón & Francke 2013: fig. 17); cheliceral movable finger with teeth progressively decreasing in length distally *P. monjarazi* (Chiapas, Mexico) 9
9. Tibia II armed ventrally with one or two distinct apophyses (e.g., Figs. 52, 53) 10
Tibia II without distinct ventral apophyses (e.g., Figs. 11, 12) 13



Figures 1–4.—*Pseudocellus quetzalcoatl* sp. nov. Male holotype: 1–2. Habitus, dorsal and ventral views. 3. Carapace, dorsal view. 4. Prosoma, ventral view showing coxosternal region. Scale bars: 0.5 mm (Figs. 3–4), 2 mm (Figs. 1, 2).

10. Femur II moderately thickened, 4 times longer than wide; tibia II with a single proventral tubercle, lacking a distinct retroventral tubercle..... *P. pearsei* (Yucatán, Mexico)
 Femur II strongly thickened, less than 2.5 times longer than wide; tibia II with proventral and retroventral apophyses subequal in size 11
11. Femur II shorter than carapace; tibia II with small proventral and retroventral apophyses placed at same level, medially on segment..... *P. spinotibialis* (Chiapas, Mexico)
 Femur II distinctly longer than carapace; tibia II with long and stout apophyses not aligned to each other on segment (e.g., Figs. 52, 53) 12
12. Femur II 2.4 times longer than wide. Ventral apophyses of tibia II more robust than those of *P. olmeca* (Valdez-Mondragón & Francke 2011, figs. 1, 3). Tarsal process (*tP*) of leg III in prolateral view slightly sigmoidal in distal half (Valdez-Mondragón & Francke 2011: fig. 5). Metatarsal process (*mP*) long and predominantly straight (Valdez-Mondragón & Francke 2011: fig. 4)..... *P. chankin* (Chiapas, Mexico; Petén, Guatemala)
 Femur II 2.6 times longer than wide (Figs. 50, 51). Ventral apophyses of tibia II weaker (Figs. 40, 41, 52, 53). Tarsal process (*tP*) of leg III in prolateral view curved in distal half (Figs. 58, 61, 64, 65). Metatarsal process (*mP*) short and slightly sigmoidal (Figs. 58, 59, 64, 70)..... *P. olmeca* sp. nov. (Veracruz, Mexico)
13. Leg formula 2431; carapace and opisthosoma distinctly and evenly pitted 14
 Leg formula 2341; integument not distinctly pitted..... 15
14. Adult 3.2 mm in total length; tibia II slightly more than 0.5 times the carapace length; patella and tibia of leg II subequal in length *P. dorotheae* (Texas, USA)
 Adult 5.0 mm in total length; tibia II almost as long as carapace as long as carapace; tibia II 1.5 times longer than patella II *P. mitchelli* (Durango, Mexico)

15. Femora I and IV markedly bulky, at least 1.5 times thicker than other segments *P. gertschi* (Veracruz, Mexico)
 Femora I and IV not remarkably bulky, about same thickness as other segments (e.g., Valdez-Mondragón & Francke, 2013: fig. 1) 16
16. Femur II thickened (Valdez-Mondragón & Francke, 2013: fig. 1), about 2.5 times longer than wide; tibia II at least 1.5 times the length of patella II..... 17
 Femur II not thickened, slightly more than 4 times longer than wide; tibia II 1.2 times the length of patella II.....
 *P. pelaezi* (San Luis Potosí, Mexico)
17. Tarsal process of the copulatory apparatus narrow, apically with two tips or lobes (Valdez-Mondragón & Francke 2011: figs. 13, 14)..... *P. jarocho* (Veracruz, Mexico)
 Tarsal process of the copulatory apparatus wide, apically with one or three tips or lobes (Figs. 21–23)..... 18
18. Tarsal process of the copulatory apparatus ending in a single, long, thin and sharp tip (Valdez-Mondragón & Francke, 2013: figs. 10–12)..... *P. cruzlopezi* (Oaxaca, Mexico)
 Tarsal process of the copulatory apparatus ending in three rounded and conspicuous tips or lobes (tripod-shaped) (Figs. 21–26) *P. quetzalcoatl* sp. nov. (Veracruz, Mexico)

Pseudocellus quetzalcoatl sp. nov.

Figs. 1–39

Type material.—*Holotype male*. MEXICO: Veracruz: Parque Ecológico Jaguarundi, camino al Ejidal Cangrejera Uno (18.11196°N, 94.35796°W; 25 m elev.), Municipio Coatzacoalcos, 6 July 2016, A. Valdez, E. Briones, M. Cortez, J. Valerdi (daytime collection) (CNAN-T1172).

Paratypes: MEXICO: Veracruz: 1 ♀, same collection data as holotype (CNAN-T1173); 1 ♂, 1 ♀, 1 deutonymph, 1 tritonymph, same collection data as holotype (CNAN-T1174).

Diagnosis.—Males can be distinguished by the following combination of features: (1) the rounded edges of the cucullus (Fig. 9); (2) two ventral rows of small conical spines on tibia

II, which are the same size (Figs. 11, 12); (3) the scattered spines on metatarsus II (Figs. 13, 14); (4) the robust femur II, 3.2 times longer than wide (Figs. 1, 2, 15); (5) tarsal process (*tP*) of the copulatory apparatus wide, canoe-shaped in prolateral view, ventrally curved and stout (Figs. 18, 21, 24, 25); (6) *tP* with dorsal carina on distal half (Figs. 22, 23); (7) *tP* apically with three rounded and conspicuous tips or lobes (Figs. 21–26); (8) *tP* with additional inconspicuous lobe (Fig. 23); and (9) accessory piece (*ac*) simple, curved and thin, with sharp tip (Figs. 21, 26). Females can be distinguished by the spermathecae slightly oval apically, and with two long lobules on each side: one large and curved in an upside-down J-shape, and other smaller and straight (Figs. 33–35). Also, the spermathecae have a pale medial region below (Figs. 33, 35).

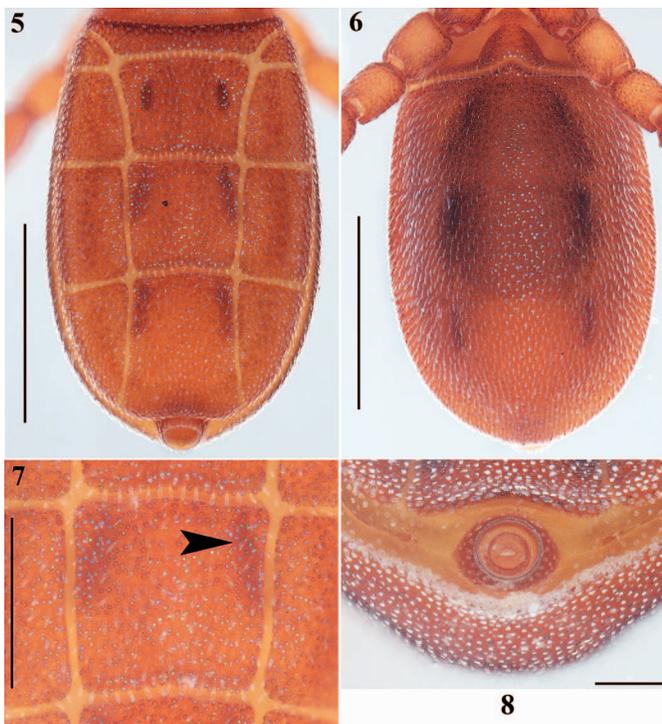
Description (male holotype).—*Coloration*. Cucullus, carapace and sternal region reddish (Figs. 3, 4, 9). Pedipalps, leg I, III and IV lighter reddish than leg II, which is darker; metatarsus and tarsus of legs I, III and IV paler reddish than other segments (Figs. 1–2). Opisthosoma brownish dorsally, darker ventrally (Figs. 5, 6).

Carapace (Fig. 3). Slightly longer than wide, trapezoidal, widest at posterior margin near coxae III. Tegument covered with abundant, fine translucent setae and rounded granules. Anterior margin straight, lateral margins not parallel, narrowing anteriorly; posterior margin procurved. Translucent areas completely absent. Carapace with six depressions: median longitudinal depression, $\frac{3}{4}$ the length of carapace; two small circular depressions at level of coxae II; three depressions on each side, close to posterior margin.

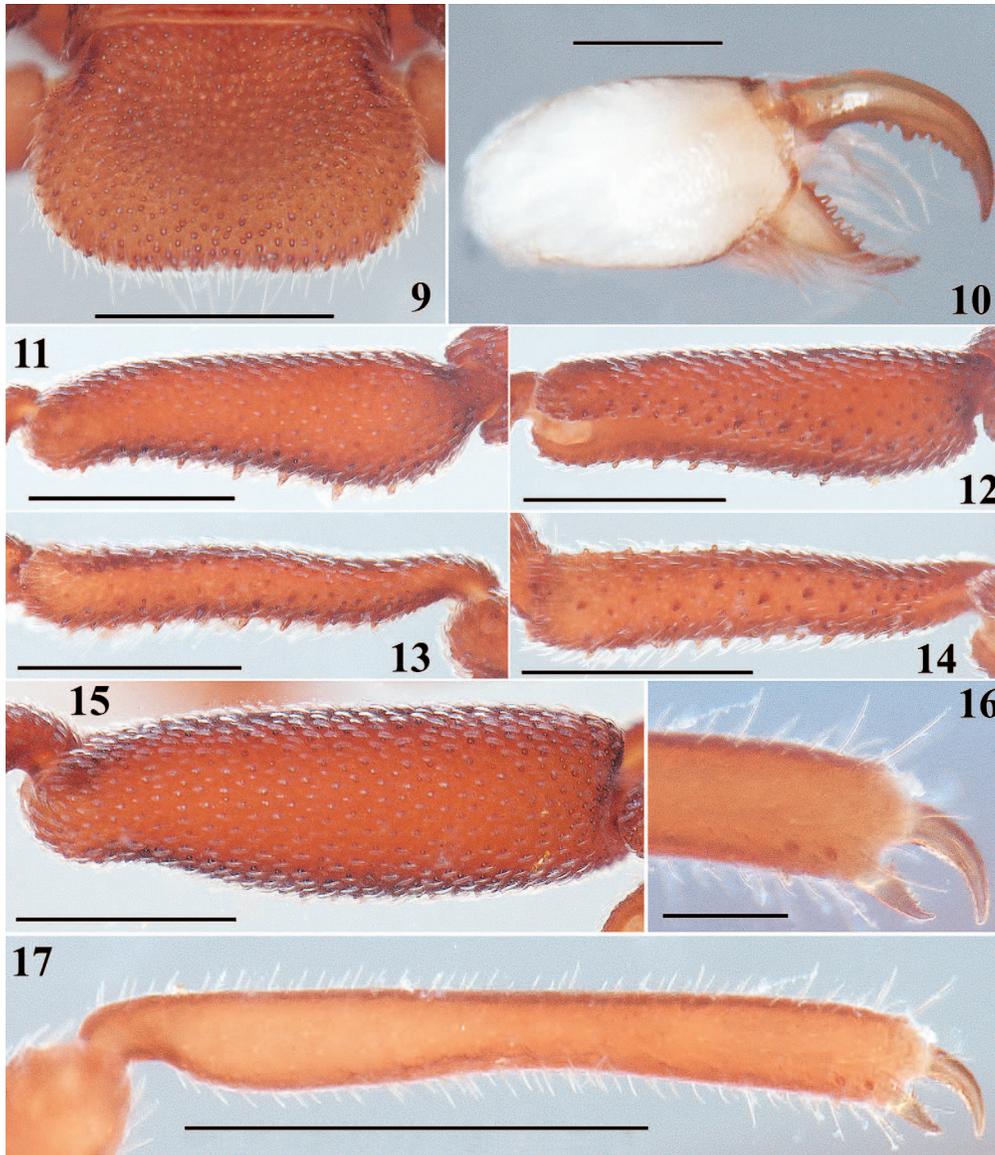
Cucullus (Fig. 9). Wider than long, widest distally; anterior margin straight, lateral margins rounded on anterior corners, where widest. Tegument covered with abundant translucent setae and granules similar to those on carapace; granules become larger and more conspicuous distally; depressions and cuticular pits absent. Distal margin with long, translucent setae; with shallow concavity in dorsal view.

Chelicera (Fig. 10). Fixed finger with six teeth, distalmost slightly larger than others, which are subequal in size. Movable finger with eight teeth: basalmost smallest, 3rd basal tooth largest; 4th to 7th of intermediate size; distalmost (8th) slightly smaller than 3rd.

Sternal region (Figs. 2, 4). Coxae covered with abundant translucent setae and granules similar to those on carapace. Coxa I rhomboidal, II sub-rectangular, III and IV conical. Coxa II considerably larger than others; coxa IV smallest.



Figures 5–8.—*Pseudocellus quetzalcoatl* sp. nov. Male holotype: 5–6. Opisthosoma, dorsal and ventral views. 7. Tergite XII median plate (arrow indicates the depression). 8. Pygidium, posterior view. Scale bars: 0.2 mm (Fig. 8), 0.5 mm (Fig. 7), 1 mm (Figs. 5–6).



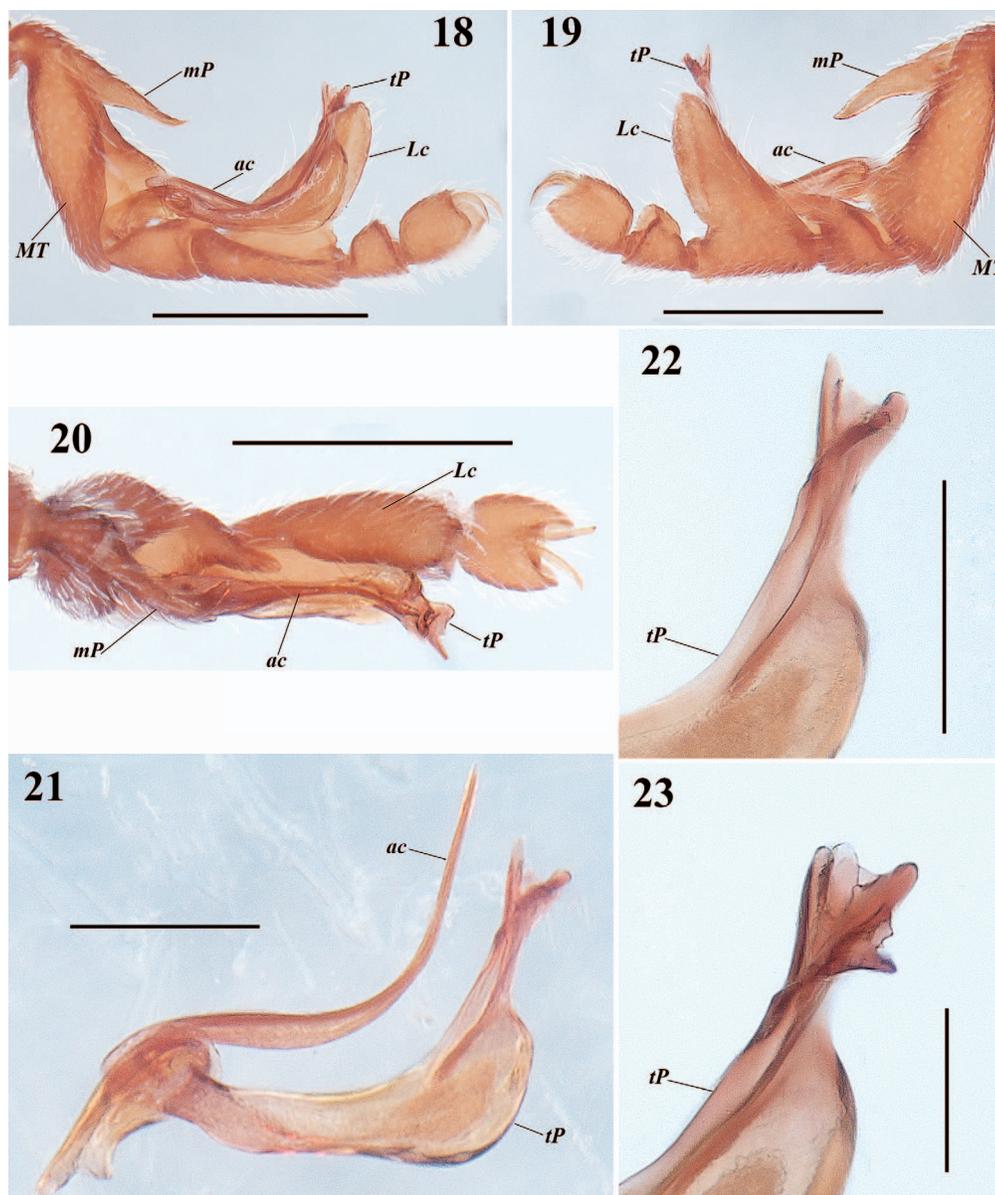
Figures 9–17.—*Pseudocellus quetzalcoatli* sp. nov. Male holotype: 9. Cucullus, dorsal view. 10. Left chelicerae, dorsal view. 11–12. Right tibia II, prolateral and proventral views. 13–14. Right metatarsus II, prolateral and proventral views. 15. Right femur II, prolateral view. 16. Detail of the movable and fixed claws of right pedipalp, retrolateral view. 17. Right pedipalp tibia, retrolateral view. Scale bars: 0.1 mm (Fig. 16), 0.2 mm (Fig. 10), 0.5 mm (Figs. 9, 11–15, 17).

Coxae I not meeting tritosternum; coxa II meeting tritosternum along 1/3 of its length. Coxae II anterior and posterior margins perpendicular to median axis of prosoma; coxae III slightly oblique, their posterior margins forming an obtuse angle ($>90^\circ$) with each other; coxae IV oblique, their posterior margins forming an acute angle ($<90^\circ$) with each other.

Opisthosoma (Figs. 5, 6). Longer than wide, widest at level of tergite XII. Tegument covered with abundant setae and granules similar to those on carapace; cuticular pits absent. Median plates of tergites XI–XIII with paired longitudinal depressions, those of tergite XI being the smallest. Tergite X widest and shortest. Median tergite XI trapezoidal, wider than long; XII as wide as long; median tergite XIII markedly longer than wide with posterior corners pointed, protruding laterally. Lateral tergites in oblique position; X smallest, XII and XIII

largest. Lateral tergites XI trapezoidal, XII square and XIII triangular. Sternites XI–XIII with paired depressions. Sternites XI and XII dark medially. Pygidium segments without notch (Fig. 8).

Pedipalps (Figs. 4, 16, 17). Coxa without cuticular pits, with fine translucent setae and rounded granules on posterior half. Trochanter 1 rounded, with sparse fine translucent setae and granules restricted to ventrodistal half, and with small distal protuberance; trochanter 2 conical, ventrally with basal setae and granules (similar to those on 1st). Femur curved and wider proximally, with deep prolateral concavity distally close to the tibial joint; tegument with abundant translucent setae, which are thinner and longer in the prolateral surface. Femur with granules restricted to basal third of segment. Tibia predominantly straight, slightly concave medially in ventral view, with



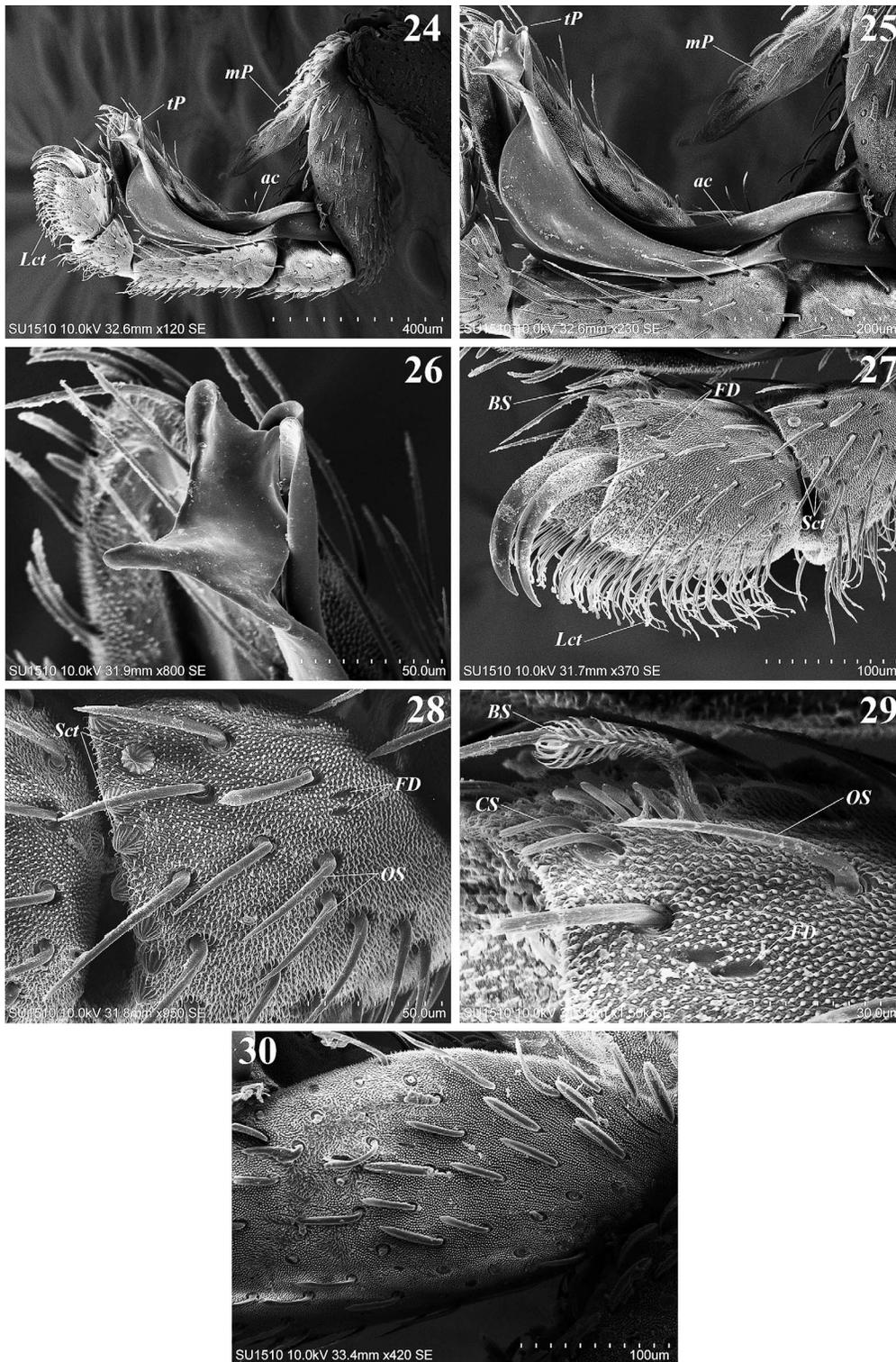
Figures 18–23.—*Pseudocellus quetzalcoatl* sp. nov. Male holotype: 18–20. Left leg III (copulatory apparatus), prolateral, retrolateral and dorsal views. 21. Copulatory apparatus, prolateral view. 22. Tarsal process, distal half, prolateral view. 23. Tarsal process, distal half, prodorsal view. Scale bars: 0.1 mm (Fig. 23), 0.2 mm (Figs. 21–22), 0.5 mm (Figs. 18–20).

numerous thin translucent setae which are longer on distal half of segment. Movable claw longer than fixed claw.

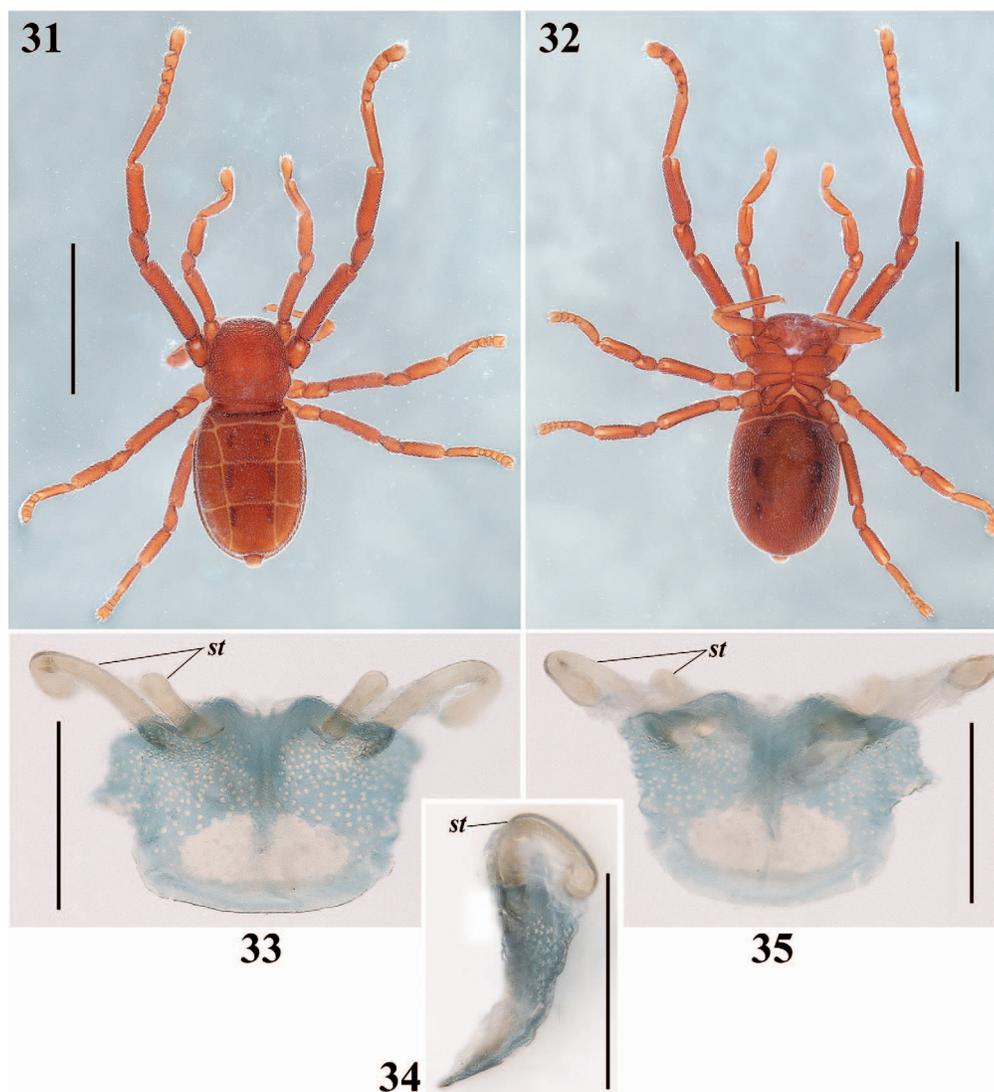
Legs. Without cuticular pits but with translucent setae and rounded granules on all segments (Figs. 1, 2). Leg II noticeably longer (Fig. 2). Femur II wider and longer than the others, femur and patella II ventrally with some sharp-tipped granules distally (Fig. 15). Tibia II ventrally with two longitudinal rows of curved spines (Figs. 11, 12). Metatarsus II with scattered sharp-tipped granules, not forming rows, dorsal ones smaller than ventral (Figs. 13, 14). Tarsomeres of leg II dorsally with sharp-tipped granules, tarsomeres 4 and 5 have fewer granules. Femora I, III and IV ventrally with few sharp-tipped granules. Patellae I, III and IV with normal granules. Tibiae I, III and IV ventrally with few sharp-tipped granules

distally. All metatarsi dorsally with V-shaped invaginations distally; metatarsus I ventrally with numerous granules, metatarsus III without granules, metatarsus IV without granules ventrally, only few slightly sharp-tipped granules dorso distally. Tarsomere of leg I without granules, tarsomeres of legs III and IV with few granules apically.

Leg III and copulatory apparatus. Metatarsus conical, with numerous translucent setae; metatarsal process (*mP*) long and sigmoidal (Figs. 18, 24). Lamina cyathiformis (*Lc*) of tarsomere 2 conical, with a notch basally on retrolateral view (Fig. 19), with long translucent setae throughout. All tarsomeres ventrally with long curved-tip setae (*Lct*), more numerous and longer on tarsomere 4 (Figs. 24, 27). Tarsomere 3 with several sculptured surface tubercles (*Sct*) on distal



Figures 24–30.—*Pseudocellus quetzalcoatl* sp. nov. Male holotype: 24. Right leg III (copulatory apparatus), prolateral view. 25. Detail of copulatory apparatus, prolateral view. 26. Distal end of the copulatory apparatus, showing the apices of the tarsal process and accessory piece. 27. Distalmost tarsomere and tarsal claws of the right leg III, prolateral view. 28. Third tarsomere of the right leg III, prolateral view. 29. Detail of the dorsal setae on the fourth tarsomere of the right leg III. 30. Metatarsus of the right leg III, prolateral view.



Figures 31–35.—*Pseudocellus quetzalcoatl* sp. nov. Female paratype: 31–32. Habitus, dorsal and ventral views. 33–35. Spermathecae, anterior, lateral and posterior views, respectively. Scale bars: 0.2 mm (Figs. 33–35), 2 mm (Figs. 31–32).

region (Figs. 27, 28). Tarsomere 4 with two curved claws (Fig. 27); dorsally with barbed setae (*BS*) and flat depressions (*FD*) (Figs. 27–29).

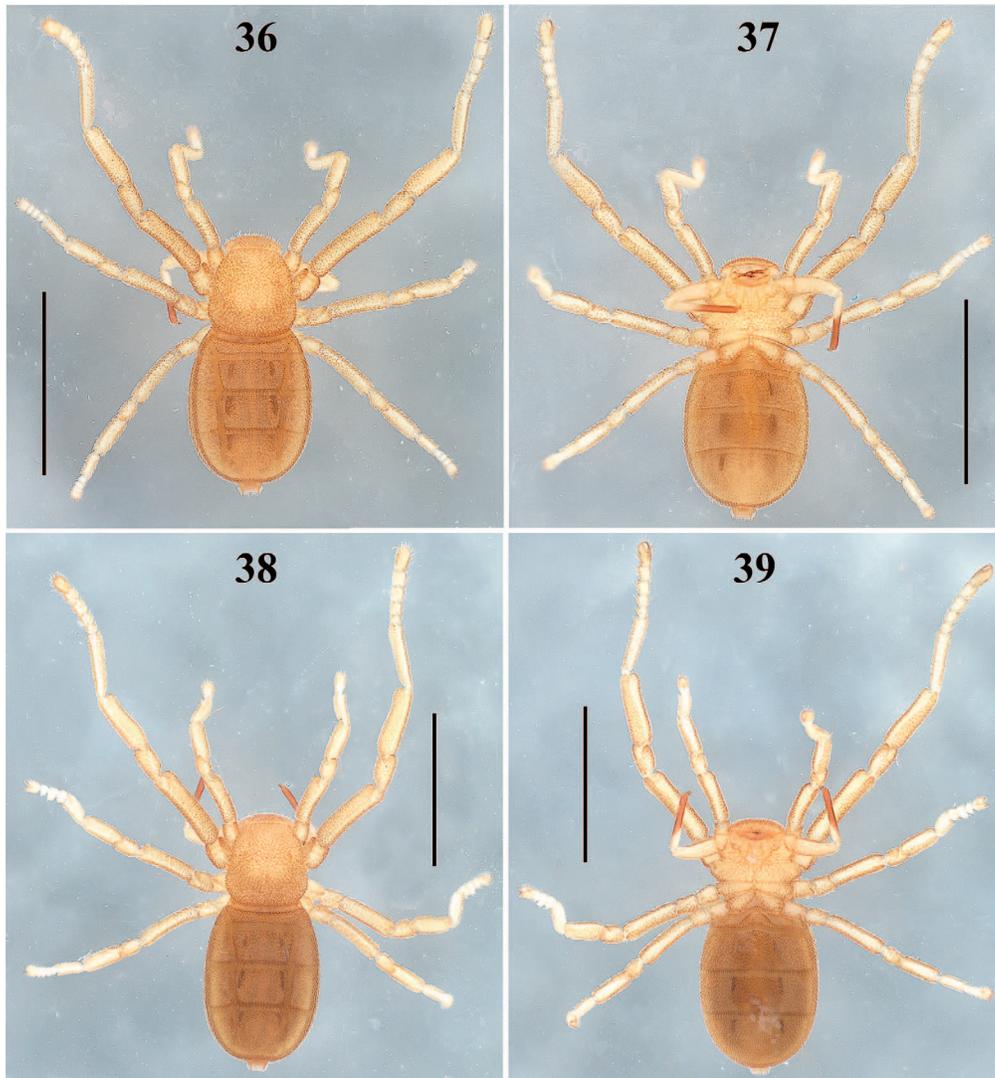
Measurements (in mm). Total length (carapace + opisthosoma including pygidium) 3.45. Carapace 1.18 long, 1.15 wide (widest part). Cucullus 0.54 long, 0.83 wide. Opisthosoma 2.13 long (not including pygidium), 1.38 wide (widest part). Femur II length/diameter (l/d): 3.11. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths; I: coxa 0.56/ trochanter 1 0.33/ trochanter 2 -/ femur 0.86/ patella 0.44/ tibia 0.60/ metatarsus 0.70/ tarsus 0.38/ total 3.87; II: 0.67/ 0.43/ -/ 1.38/ 0.66/ 1.08/ 1.06/ 1.20/ 6.48; III: 0.52/ 0.33/ 0.41/ 0.92/ 0.50/ 0.61/ 0.60/ 0.86/ 4.75; IV: 0.49/ 0.33/ 0.34/ 0.95/ 0.47/ 0.64/ 0.63/ 0.65/ 4.50. Leg length formula: 2341.

Female (paratype).—Differs from male as follows: Carapace darker reddish, median longitudinal depression deeper than on male. Coxa II smaller and femur II less robust than those on male. Tibia II without the two longitudinal rows of curved spines, only with few sharp-tipped granules. Metatarsus II

with the scattered sharp-tipped granules smaller than those on male. Opisthosoma wider, higher and shorter than in male; darker reddish (Figs. 31, 32). Median tergites XI and XII wider than those on male (Fig. 31). Spermathecae with widespread tiny pores throughout (Figs. 33–35).

Measurements: Total length 3.24. Carapace 1.16 long, 1.14 wide. Cucullus 0.51 long, 0.80 wide. Opisthosoma 1.98 long, 1.50 wide. Femur II length/diameter (l/d): 4.27. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths; I: coxa 0.49/ trochanter 1 0.28/ trochanter 2 -/ femur 0.76/ patella 0.37/ tibia 0.54/ metatarsus 0.63/ tarsus 0.33/ total 3.40; II: 0.65/ 0.40/ -/ 1.22/ 0.58/ 0.96/ 0.94/ 1.12/ 5.87; III: 0.52/ 0.32/ 0.34/ 0.83/ 0.44/ 0.56/ 0.58/ 0.50/ 4.09; IV: 0.48/ 0.33/ 0.31/ 0.87/ 0.41/ 0.63/ 0.55/ 0.52/ 4.10. Leg length formula: 2431.

Deutonymph (Figs. 36, 37).—Appendages and body coloration pale orange, darker on carapace and mainly on opisthosoma; distal half of pedipalp tibia brown. Carapace slightly longer than wide, trapezoidal, with five pits dorsally: two on each side medially, two on each side posteriorly and



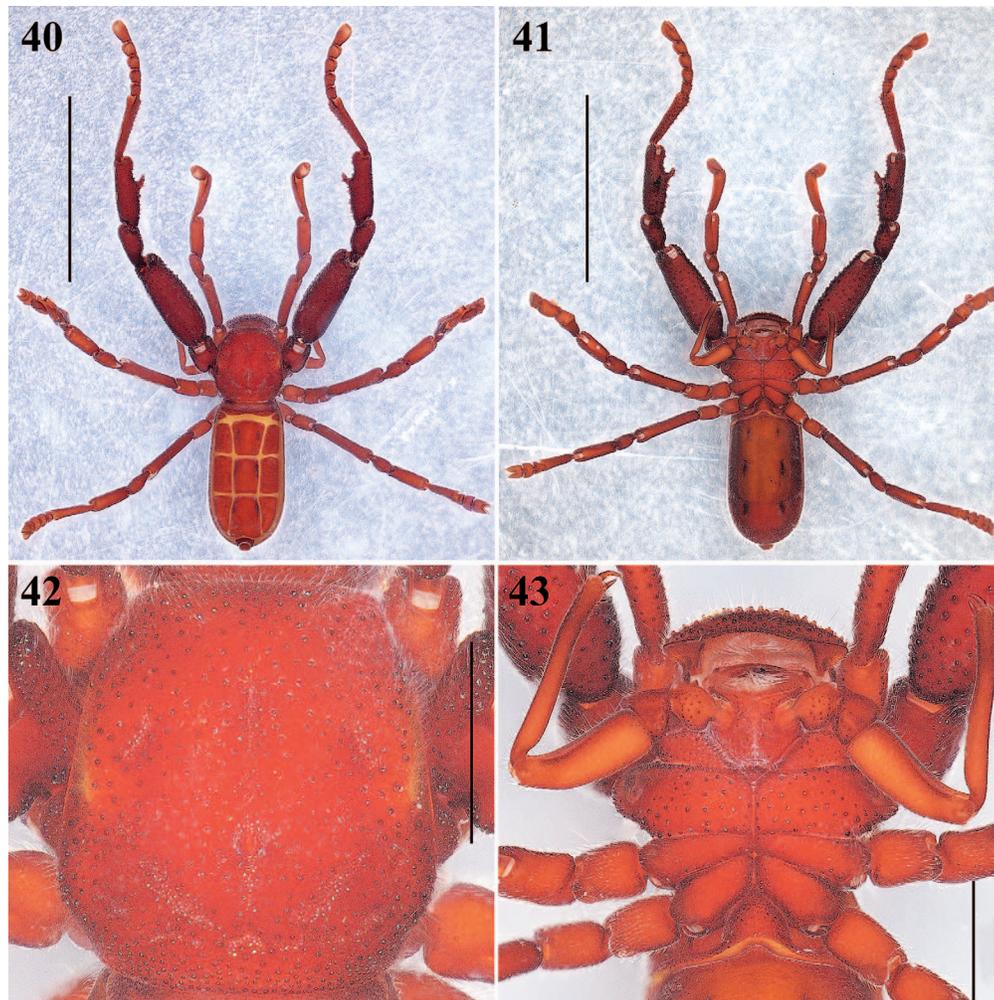
Figures 36–39.—*Pseudocellus quetzalcoatl* sp. nov. Deutonymph: 36–37. Habitus, dorsal and ventral views. Tritonymph: 38–39. Habitus, dorsal and ventral views. Scale bars: 2 mm.

one longer centrally. Cucullus wider than long, distal margin with long translucent setae like the adults. Cucullus, carapace, sternal region, legs and opisthosoma covered with abundant, fine translucent setae and rounded granules, except pedipalps with sparse rounded granules. Opisthosoma longer than wide, widest at level of tergite XII, median tergites X–XIII wider than long. Lateral tergite X smallest, XII and XIII largest. Lateral tergites: XI trapezoidal, XII square and XIII triangular. All tergites widely separated from each other in comparison to adults. Sternites X–XIII distinct and not fused in comparison to adults. Pygidium segments without notch. *Measurements*: Total length 2.77. Carapace 1.00 long, 0.96 wide (widest part). Cucullus 0.42 long, 0.65 wide. Opisthosoma 1.75 long, 1.30 wide. Legs tarsal formula (leg I to IV): 1-5-4-4.

Tritonymph (Figs. 38, 39).—Same appendages and body coloration pale orange like deutonymph but slightly darker, mainly in opisthosoma, distal half of pedipalp tibia brown. Carapace slightly longer than wide, trapezoidal, with five pits

dorsally like deutonymph. Cucullus wider than long, distal margin with long translucent setae like the adults and deutonymph. Opisthosoma longer than wide, widest at the level of tergite XII, median tergites X–XII wider than long, tergite XIII as long as wide. Lateral tergite X smallest, lateral tergites XII and XIII largest, XI trapezoidal; XII square and XIII triangular. Sternites X–XIII widely separated from each other like deutonymph. Sternites X–XIII distinct like deutonymph, not fused in comparison to adults. Pygidium segments without notch. *Measurements*: Total length 3.32. Carapace 1.10 long, 1.08 (widest part). Cucullus 0.47 long, 0.70 wide. Opisthosoma 2.09 long, 1.46 wide. Legs tarsal formula (leg I to IV): 1-5-4-5.

Related species.—*Pseudocellus quetzalcoatl* sp. nov. is similar to *Pseudocellus cruzlopezi* Valdez-Mondragón & Francke, 2013 from Cerro Caballero, San José Tenango, Oaxaca, Mexico. Males resemble each other in overall body shape, proportions of femur II and the shape of the ventral spines of tibia II and metatarsus II. However, several



Figures 40–43.—*Pseudocellus olmeca* sp. nov. Male holotype: 40–41. Habitus, dorsal and ventral views. 42. Carapace. 43. Prosoma, ventral view showing coxosternal region. Scale bars: 1 mm (Figs. 42–43), 5 mm (Figs. 40–41).

morphological characters separate them; lateral margins of cucullus are more rounded in *P. quetzalcoatl* (Fig. 9) than in *P. cruzlopezi* (Valdez-Mondragón & Francke 2013: fig. 3). *Pseudocellus quetzalcoatl* has the ventral spines of tibia II (Figs. 11, 12) smaller and evenly sized, whereas those of *P. cruzlopezi* are larger and have different sizes (Valdez-Mondragón & Francke 2013: figs. 4, 5). The accessory piece (*ac*) of the *tP* is simple in *P. quetzalcoatl* (Fig. 21), whereas that of *P. cruzlopezi* is bifid (Valdez-Mondragón & Francke 2013: figs. 10, 11, 13). As for the females, the spermathecae of *P. quetzalcoatl* have two distinct pairs of lobes each of which is slightly oval apically, one is large and curved (i.e., J-shaped), and other is small and straight (Figs. 33–35); whereas in *P. cruzlopezi* the spermathecae have only one distinct pair of lobules, which are long, curved, and horn-shaped, with the apex evidently rounded (Valdez-Mondragón & Francke 2013: figs. 6, 7).

Etymology.—The specific name is a noun in apposition dedicated to the Aztec and Mesoamerican deity *Quetzalcoatl*, which in the mythology and in terms from the Nahuatl language means “feathered snake”.

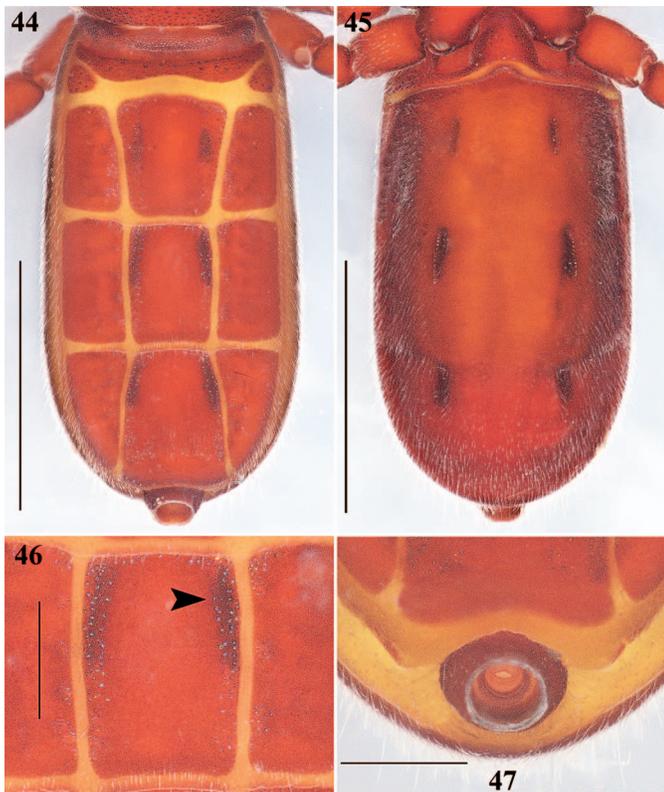
Pseudocellus olmeca sp. nov.
Figs. 40–85, 86, 87

Type material.—*Holotype male*: MEXICO: Veracruz: Parque Ecológico Jaguaroundi, camino al Ejidal Cangrejera Uno (18.11196°N, 94.35796°W; 25 m elev.), Municipio Coatzacoalcos, 7 July 2016, A. Valdez, E. Briones, M. Cortez, J. Valerdi (daytime collection) (CNAN-T1175).

Paratypes: MEXICO: Veracruz: 1 ♀, same data as holotype (CNAN-T1176), 1 ♂, 1 protonymph, 3 deutonymphs, 4 tritonymphs, same data as holotype (CNAN-T1177).

Other material examined.—MEXICO: Veracruz: 1 ♀, same locality as holotype, 30 April 2012, A. Reyna (CNAN-Ri0030).

Diagnosis.—Males can be distinguished by the following combination of features: (1) a pair of long, conical, pro- and retroventral apophyses in tibia II; covered with rounded granules throughout (Figs. 52, 53); (2) the scattered spines on metatarsus II (Figs. 54, 55); (3) the very robust femur II (Figs. 50, 51), 2.6 times longer than wide; (4) tarsal process (*tP*) of copulatory apparatus of leg III thin and arc-shaped in prolateral view (Figs. 58, 61, 64, 65), sigmoidal in dorsal and



Figures 44–47.—*Pseudocellus olmeca* sp. nov. Male holotype: 44–45. Opisthosoma, dorsal and ventral views. 46. Tergite XII median plate (arrow indicates the depression). 47. Pygidium, posterior view. Scale bars: 0.5 mm (Figs. 46–47), 2 mm (Figs. 44–45).

prodorsal views (Fig. 63), conical apically (Figs. 62, 65, 66); 5) the accessory piece (*ac*) is thin and bifurcated distally (Fig. 61). Females can be distinguished by the two small paired apophysis ventrally on tibia II, homologous to those in the male (Figs. 75, 76); and by the spermathecae with two lobules on each side, one long, wide and S-shaped and the other one smaller, below the first one (Figs. 77–79).

Description (male holotype).—*Coloration.* Body coloration reddish, darker in carapace and leg II; pedipalps, legs and opisthosoma lighter reddish (Figs. 40, 41, 86, 87).

Carapace (Fig. 42). Longer than wide, trapezoidal, widest at posterior margin near level of coxae III. Tegument covered with abundant, long and fine translucent setae and rounded granules, which are more abundant posteriorly. Anterior margin straight; lateral margins not parallel, narrowing anteriorly; posterior margin procurved. Conspicuous elongated translucent areas, located at level of coxae II. Carapace with pits: three median longitudinal, one long, another circular at median part, and last upside down V-shaped close to posterior margin; two lateral and small at level of coxae I; two lateral bigger at level of coxae II; and two lateral pairs in oblique position close to posterior margin.

Cucullus (Fig. 48). Wider than long, widest distally; anterior margin straight, lateral margins rounded on anterior corners, where widest. Tegument covered with abundant translucent setae, longer distally; rounded granules similar to those on carapace, becoming bigger distally. Depressions and cuticular

pits absent. Distal margin with shallow concavity in dorsal view.

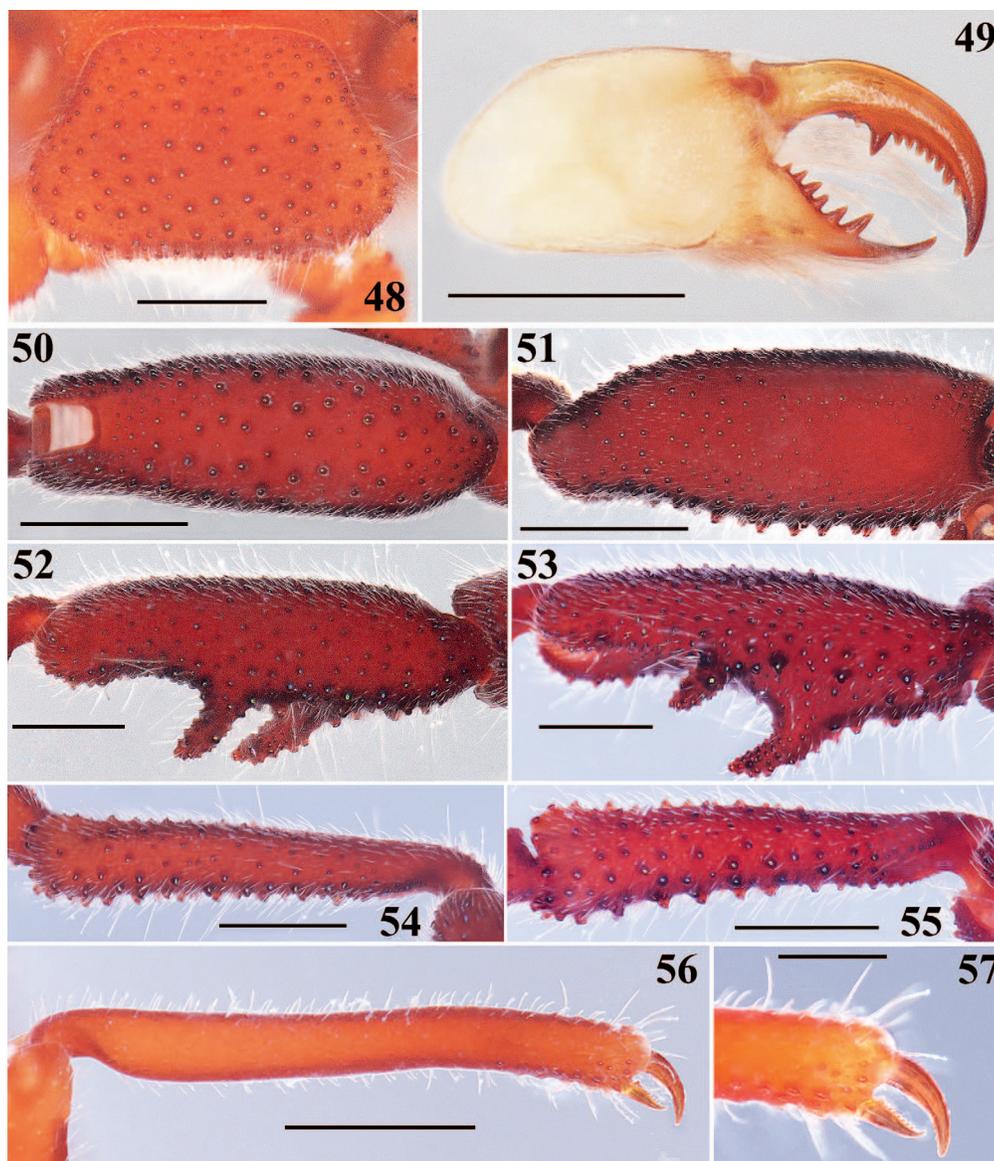
Chelicera (Fig. 49). Fixed finger with six teeth, distalmost largest than others, which are subequal in size. Movable finger with ten teeth: the two basal smallest, 3rd basal tooth largest; 4th–10th subequal in size.

Sternal region (Fig. 43). Coxae covered with abundant translucent setae, without pits. Granules similar to those on carapace, considerably more numerous on coxae I and II. Coxa I triangular, II sub-rectangular, III conical and IV trapezoidal. Coxa II considerably larger than others; coxa IV smallest. Coxa I meeting tritosternum; coxa II meeting tritosternum along 1/4 of its length. Coxa II anterior and posterior margins perpendicular to the median axis of the prosoma; coxae III slightly oblique, their posterior margins forming an obtuse angle ($>90^\circ$) with each other; coxae IV oblique, their posterior margins forming an acute angle ($<90^\circ$) with each other.

Opisthosoma (Figs. 44, 45). Longer than wide, widest at level between tergites XII and XIII. Tegument covered with small and abundant translucent setae. Tergites X with rounded granules on middle and sides. Tergites XI–XIII with granule-containing cuticular pits along lateral margins of median plates and on internal margin of lateral plates; median plates XI–XIII with paired longitudinal depressions (Figs. 44, 46). Tergite X widest and shortest. Median tergite XI trapezoidal, wider than long. Median tergite XII longer than wide, median tergite XIII trapezoidal, longer than wide with posterior corners pointed, protruding laterally. Lateral tergites in oblique position; lateral tergites X smallest, lateral tergites XII and XIII largest. Lateral tergites XI trapezoidal; XII square and XIII triangular. Pygidium segments without notch (Figs. 44, 47). Sternites XI–XIII with paired depressions.

Pedipalps (Figs. 43, 56, 57). Coxa without cuticular pits, with fine translucent setae and rounded granules near the joint. Trochanter 1 rounded, with fine translucent setae and sparse rounded granules ventrally; trochanter 2 conical with rounded granules basally. Femur curved and wider proximally, with deep prolateral concavity close to joint with tibia, tegument with abundant translucent setae, which are thinner and longer on the prolateral surface. Femur without granules. Tibia predominantly straight, slightly concave at $\frac{3}{4}$ of its length, with numerous thin translucent setae which are longer on distal half of segment. Conspicuous oval granules close to chelae. Movable claw longer than fixed claw.

Legs. Without cuticular pits but with translucent setae and rounded granules on all segments (Figs. 50–55). Leg II noticeably long (Figs. 40, 41). Femur II wider and longer than the others (Figs. 40, 41, 50, 51), femur and patella II ventrally with numerous sharp-tipped granules (Figs. 50, 51). Tibia II ventrally with two long, conical paired apophysis, covered with rounded granules (Figs. 52, 53). Metatarsus II with scattered sharp-tipped granules throughout, not forming rows, dorsal ones smaller than ventral ones (Figs. 54, 55). Tarsomeres of leg II dorsally with sharp-tipped granules, tarsomere 5 without granules. Femora I, III and IV ventrally with few sharp-tipped granules. Patella I with few normal granules, patellae II and IV without granules. Tibia I ventrally with few sharp-tipped granules distally, tibiae III and IV without granules. All metatarsi dorsally with V-shaped



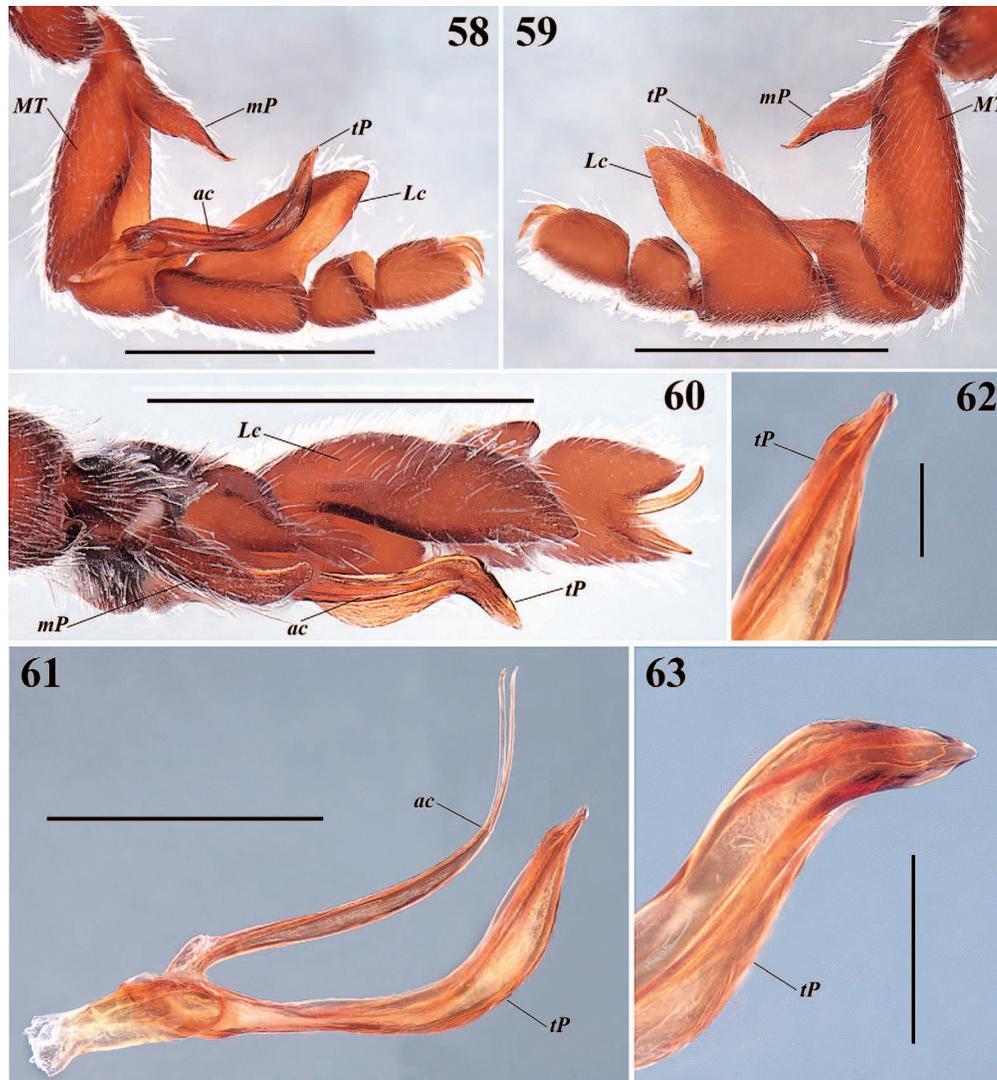
Figures 48–57.—*Pseudocellus olmeca* sp. nov. Male holotype: 48. Cucullus, dorsal view. 49. Left chelicera, dorsal view. 50–51. Right femur II, ventral and prolateral views. 52–53. Right tibia II, prolateral and proventral views. 54–55. Right metatarsus II, prolateral and proventral views. 56. Right pedipalp tibia, retrolateral view. 57. Detail of the movable and fixed claws of right pedipalp, retrolateral view. Scale bars: 0.2 mm (Fig. 57), 0.5 mm (Figs. 48–49, 52–56), 1 mm (Figs. 50–51).

invaginations distally; metatarsus I ventrally with few granules, metatarsi III and IV without granules. Tarsomeres of leg I, III and IV without granules.

Leg III and copulatory apparatus. Metatarsus conical, with long translucent setae; metatarsal process (*mP*) long and slightly sigmoidal (Figs. 58, 59, 64, 70). Lamina cyathiformis (*Lc*) of tarsomere 2 conical and curved dorsally, with a small notch basally in retrolateral view (Figs. 58, 59, 64), with long translucent setae throughout. All tarsomeres ventrally with long curved-tip setae (*Lct*) (Figs. 58, 59, 64), more abundant and longer on tarsomere 4 (Fig. 67). Tarsomere 3 with several sculptured surface tubercles (*Sct*) distally (Figs. 67, 68), with some flat depressions (*FD*) (Fig. 68). Tarsomere 4 with two curved claws (Fig. 67). Tarsomere 4 with barbed setae dorsally (*BS*) and *FD* (Figs. 67, 69).

Measurements (in mm). Total length (carapace + opisthosoma including pygidium) 5.90. Carapace 2.00 long, 1.85 wide (widest part). Cucullus 0.90 long, 1.44 wide. Opisthosoma 3.90 long (not including pygidium), 2.05 wide (widest part). Femur II length/diameter (l/d): 2.65. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths; I: coxa 0.87/ trochanter 1 0.53/ trochanter 2 -/ femur 1.56/ patella 0.80/ tibia 1.09 / metatarsus 1.31 / tarsus 0.59/ total 6.75; II: 1.10/ 0.90/ -/ 2.80/ 1.21/ 1.88/ 1.76/ 2.12/ 11.77; III: 0.92/ 0.60/ 0.75/ 1.72/ 0.87/ 1.00/ 1.12/ 1.53/ 8.51; IV: 0.85/ 0.65/ 0.65/ 1.81/ 0.78/ 1.12/ 1.25/ 1.00/ 8.11. Leg length formula: 2341.

Female (paratype).—Differs from male as follows: Body coloration lighter, more reddish than the male (Figs. 71, 72). Coxa II and femur II smaller than those of male. Femur II less robust than on male, ventrally with sharp-tipped granules



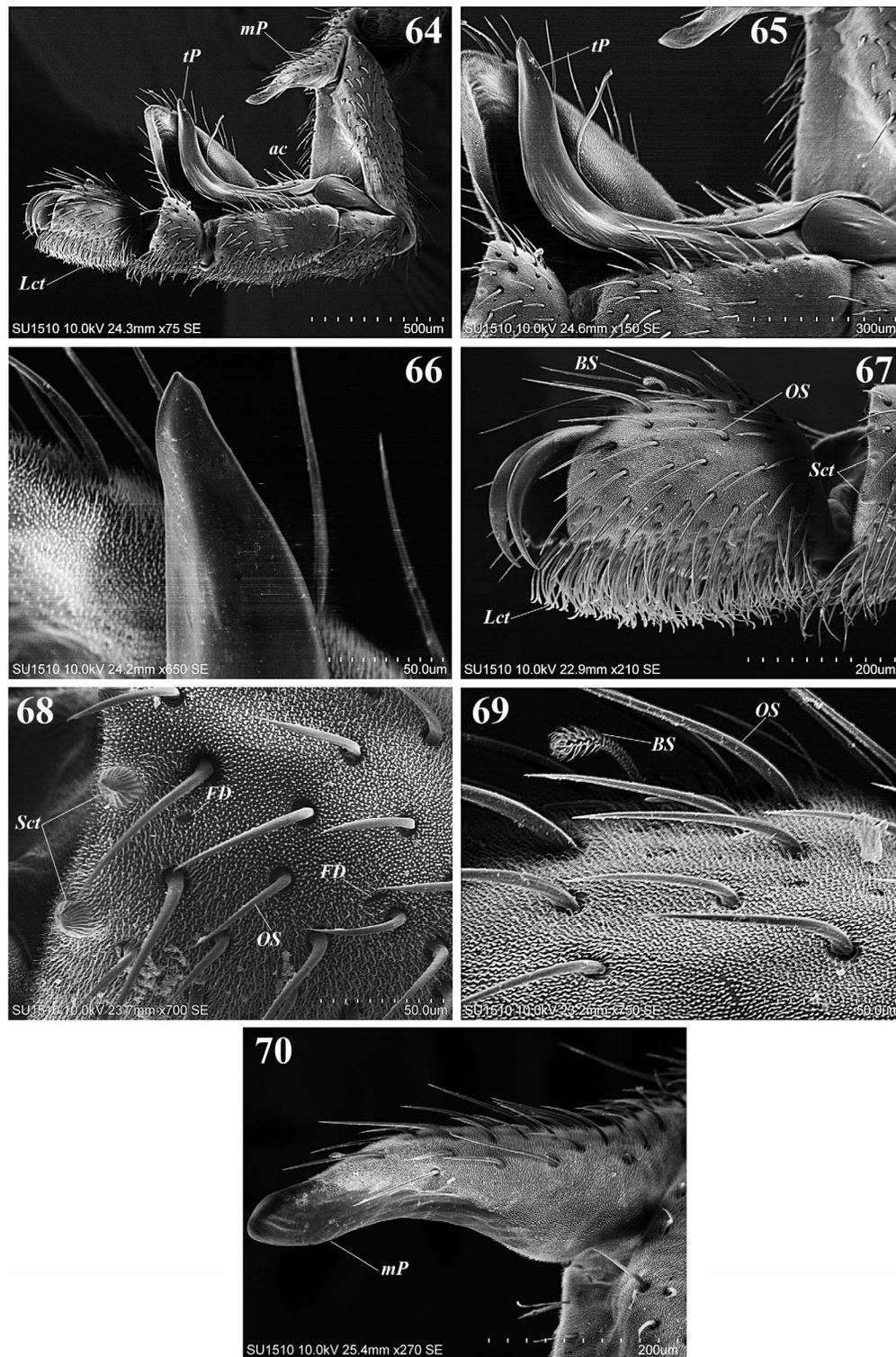
Figures 58–63.—*Pseudocellus olmeca* sp. nov. Male holotype: 58–60. Left leg III (copulatory apparatus), prolateral, retrolateral and dorsal views. 61, Copulatory apparatus, prolateral view. 62. Tarsal process, apex, prolateral view. 63. Tarsal process, apex, prodorsal view. Scale bars: 0.1 mm (Fig. 62), 0.2 mm (Fig. 63), 0.5 mm (Fig. 61), 1 mm (Figs. 58–60).

(Figs. 71–74). Tibia II with numerous sharp-tipped granules, and two small apophyses ventrally (arrows Figs. 75, 76). Metatarsus II with scattered, sharp-tipped granules, smaller than those on male. Opisthosoma shorter than in the male (Figs. 71, 72). Tergite XI wider than long (Fig. 71).

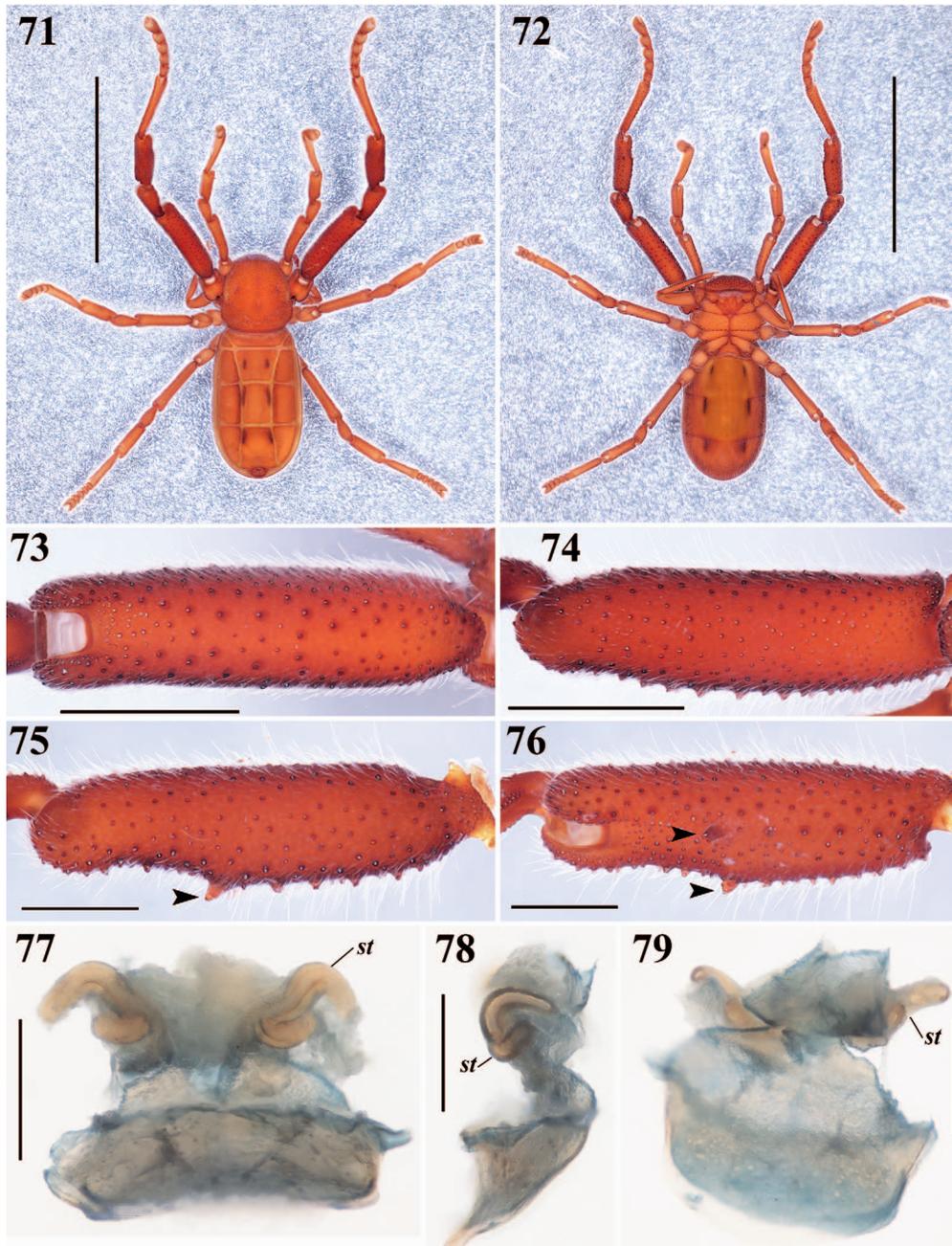
Measurements: (in mm). Total length (carapace + opisthosoma including pygidium) 6.1. Carapace 2.00 long, 1.95 wide (widest part). Cucullus 0.93 long, 1.50 wide. Opisthosoma 3.90 long (not including pygidium), 2.40 wide (widest part). Femur II length/diameter (l/d): 3.60. Legs tarsal formula (leg I to IV): 1-5-4-5. Leg lengths; I: coxa 0.93/ trochanter 1 0.52/ trochanter 2 -/ femur 1.44/ patella 0.68/ tibia 1.00/ metatarsus 1.24/ tarsus 0.57/ total 6.38; II: 1.15/ 0.75/ -/ 2.50/ 1.13/ 1.81/ 1.78/ 2.00/ 11.12; III: 0.90/ 0.54/ 0.63/ 1.56/ 0.75/ 1.00/ 1.13/ 0.96/ 7.47; IV: 0.84/ 0.60/ 0.60/ 1.70/ 0.75/ 1.06/ 1.18/ 0.93/ 7.66. Leg length formula: 2431.

Protonymph (Figs. 80, 81).—Appendages and body coloration pale orange, darker in distal part of cucullus; distal half of

pedipalp tibia brown. Carapace as long as wide, trapezoidal, with rounded corners, with five pits dorsally: two on each side medially, two on each side posteriorly, and one longer centrally. Cucullus wider than long, distal margin with long translucent setae like the adults. Cucullus, carapace, sternal region, legs and opisthosoma covered with abundant, fine translucent setae and rounded granules, except pedipalps where granules are absent. Opisthosoma longer than wide, widest at the level between tergites XI and XII, tergites X–XIII wider than long. Tergites XI–XIII with paired long pits. Lateral tergite X smallest, lateral tergites XI–XIII largest. Lateral tergites XI trapezoidal; XII square and XIII triangular. All tergites widely separated from each other. Sternites X–XIII clearly visible and widely separated from each other, not fused in comparison to adults. Sternites XI–XIII with paired long pits. Pygidium segments without notch. **Measurements:** Total length 3.16. Carapace 1.04 long, 1.04 wide (widest part).



Figures 64–70.—*Pseudocellus olmeca* sp. nov. Male holotype: 64. Right leg III (copulatory apparatus), prolateral view. 65. Detail of copulatory apparatus, prolateral view. 66. Apex of tarsal process of the copulatory apparatus, prolateral view. 67. Distalmost tarsomere and tarsal claws of right leg III, prolateral view. 68. Third tarsomere of right leg III, prolateral view. 69. Detail of setae on dorsal surface of right leg III fourth tarsomere. 70. Metatarsal process of right leg III, prolateral view.

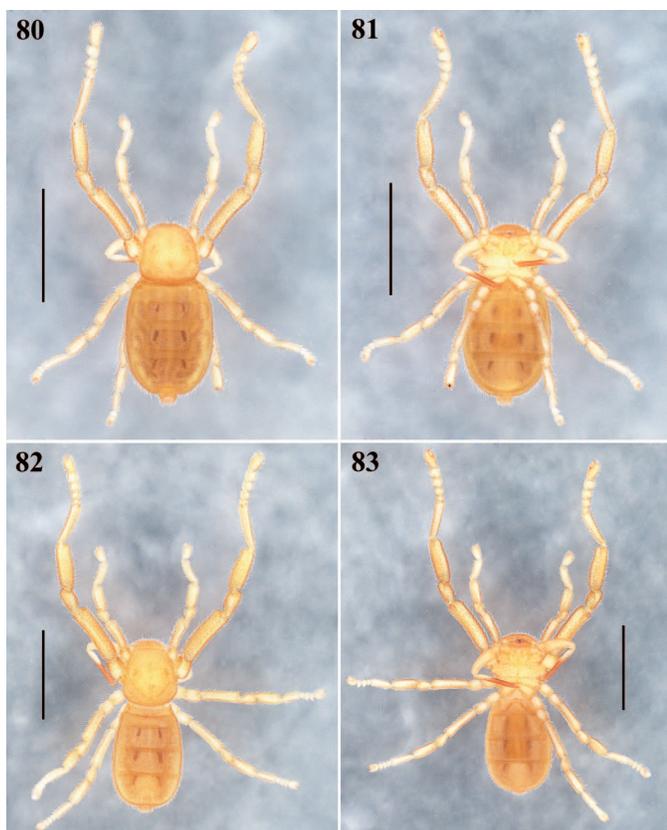


Figures 71–79.—*Pseudocellus olmeca* sp. nov. Female paratype: 71–72, Habitus, dorsal and ventral views. 73–74. Right femur II, ventral and prolateral views. 75–76. Right tibia II, prolateral and proventral views (arrows indicate the two small spines). 77–79. Spermathecae, anterior, lateral and posterior views, respectively. Scale bars: 0.2 mm (Figs. 77–79), 0.5 mm (Figs. 75–76), 1 mm (Figs. 73–74), 5 mm (Figs. 71–72).

Cucullus 0.47 long, 0.69 wide. Opisthosoma 1.96 long, 1.54 wide. Legs tarsal formula (leg I to IV): 1-4-3-2.

Deutonymph (Figs. 82, 83).—Appendages and body coloration darker orange than the protonymph, leg II darker orange than other legs, dark orange in distal part of cucullus, distal half of pedipalp tibia brown. Legs II wider than those on protonymph. Carapace as long as wide, trapezoidal, with rounded corners, with the same five pits dorsally as the protonymph, but more conspicuous. Cucullus wider than long, distal margin with long translucent setae like protonymph. Cucullus, carapace, sternal region, legs and opistho-

soma covered with abundant, fine translucent setae and rounded granules, except pedipalps where granules are absent; the granules are more conspicuous than those on the protonymph. Opisthosoma longer than wide, longer than on protonymph, widest at the level of tergite XII; tergites X–XIII wider than long. Tergites XI–XIII with long paired pits, more marked than on protonymph. Lateral tergite X smallest, lateral tergites XI–XIII largest. Lateral tergites XI trapezoidal; XII square and XIII triangular. All tergites less widely separated from each other in comparison to protonymph. Sternites X–XIII clearly visible and less separated from each



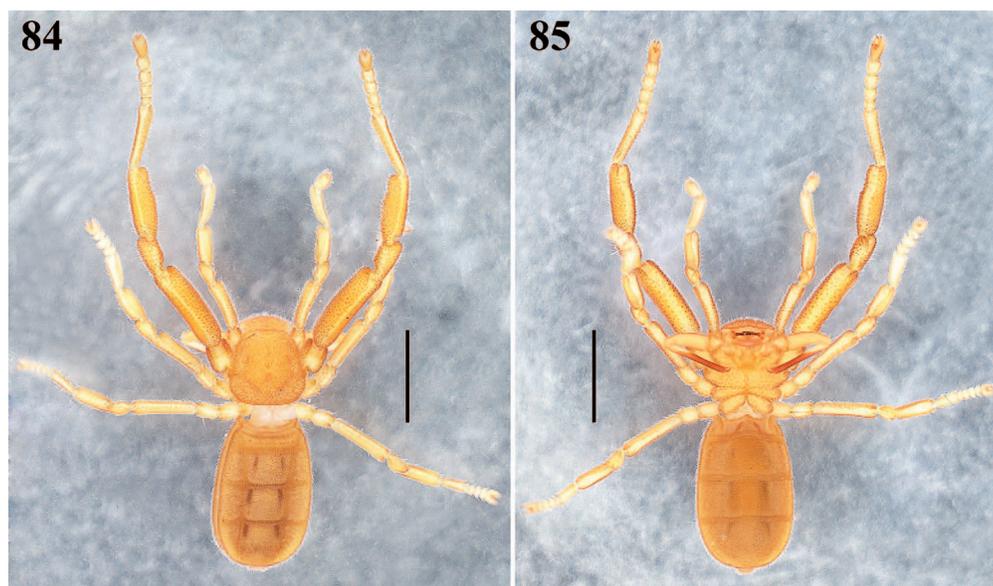
Figures 80–83.—*Pseudocellus olmeca* sp. nov. Protonymph: 80–81. Habitus, dorsal and ventral views. Deutonymph: 82–83. Habitus, dorsal and ventral views respectively. Scale bars: 2 mm.

other in comparison to protonymph; sternites XI and XII dark medially. Sternites XI–XIII with long paired pits more conspicuous than those in the protonymph. Pygidium segments without notch. *Measurements*: Total length 3.67.

Carapace 1.37 long, 1.32 wide (widest part). Cucullus 0.64 long, 0.94 wide. Opisthosoma 2.32 long, 1.72 wide. Legs tarsal formula (leg I to IV): 1-5-4-4.

Tritonymph (Figs. 84, 85, 88, 89).—Appendages and body coloration darker orange than the deutonymph, leg II darker orange than other legs, having the same coloration as cucullus, carapace and opisthosoma. Cucullus uniformly dark orange. The distal half of pedipalp tibia is darker brown than on deutonymph. Legs II wider than those on deutonymph, with more rounded granules. Carapace as long as wide, trapezoidal, with rounded corners, with the same five pits dorsally as the deutonymph but less marked than those on deutonymph. Cucullus wider than long, distal margin with long translucent setae like deutonymph. Cucullus, carapace, sternal region, legs and opisthosoma covered with abundant, fine translucent setae and rounded granules, except pedipalps where granules are absent; the granules are more conspicuous than those on the deutonymph. Opisthosoma longer than wide, longer than on deutonymph, widest at the level between tergites XII and XIII, tergites X–XIII wider than long. Tergites XI–XIII with long paired pits, more conspicuous than on deutonymph. Lateral tergites X smallest, lateral tergites XI–XIII largest. Lateral tergites XI trapezoidal; XII square and XIII triangular. All tergites widely separated as those in the protonymph. Sternites X–XIII clearly visible and separated as those in the deutonymph, sternites XI–XIII with the same coloration, dark orange. Sternites XI–XIII with long paired pits less marked than those in the deutonymph. Pygidium segments without notch. *Measurements*: Total length 4.88. Carapace 1.68 long, 1.64 wide (widest part). Cucullus 0.78 long, 1.20 wide. Opisthosoma 3.15 long, 2.10 wide. Legs tarsal formula (leg I to IV): 1-5-4-5.

Related species.—*Pseudocellus olmeca* sp. nov. is similar to *Pseudocellus chankin* Valdez-Mondragón & Francke, 2011 from Cueva Kolem-chen “Cueva Grande,” Reserva Chan-kin, Municipio Ocosingo, Chiapas, Mexico. The species resemble each other in overall body shape, proportions of femur II, and



Figures 84–85.—*Pseudocellus olmeca* sp. nov. Tritonymph. Habitus, dorsal and ventral views. Scale bars: 2 mm.



Figures 86–89.—Living specimens of *Pseudocellus olmeca* sp. nov. 86–87, Male holotype. 88–89, Tritonymph. Photos by A. Valdez-Mondragón.

shape of the paired apophyses on tibia II of males. However, several morphological differences distinguish both species. The carapace of the male of *P. olmeca* is somewhat quadrangular (Fig. 42), whereas that of *P. chankin* is more trapezoidal, with lateral margins more distinctly narrowing anteriorly (Valdez-Mondragón & Francke, 2011: fig. 1;

Botero-Trujillo & Valdez-Mondragón, 2016: fig. 53). The opisthosoma of the male of *P. olmeca* (Figs. 40, 41, 44, 45) is oval, whereas that of *P. chankin* is somewhat truncated posteriorly (Valdez-Mondragón & Francke, 2011: fig. 1). Males of *P. olmeca* have the femur of leg II thinner than that of *P. chankin*, such that it is 2.6 and 2.4 times longer than



Figure 90.—Location of the Parque Ecológico Jaguaroundi, Veracruz, Mexico; type locality and known records for *Pseudocellus quetzalcoatl* sp. nov. and *Pseudocellus olmeca* sp. nov.

wide, respectively (Figs. 50, 51; Valdez-Mondragón & Francke, 2011: fig. 1). The paired apophyses of tibia II of males are thinner and smaller in *P. olmeca* (Figs. 40, 41, 52, 53) than in *P. chankin* (Valdez-Mondragón & Francke, 2011: fig. 3). The tarsal process (*tP*) of male leg III of *P. olmeca* is curved in the distal half on prolateral view (Figs. 58, 61, 64, 65), whereas the *tP* of *P. chankin* is slightly sigmoidal distally (Valdez-Mondragón & Francke 2011: fig. 5). The metatarsal process (*mP*) of males of *P. olmeca* is wider, shorter and more sigmoidal (Figs. 58, 59, 64, 70) than that of *P. chankin*, where the *mP* is almost straight (Valdez-Mondragón & Francke 2011: fig. 4). As for the females, the lobules of the spermathecae of *P. olmeca* (Figs. 77–79) are larger and more distinctly curved than those of *P. chankin* (Valdez-Mondragón & Francke 2011: figs. 6, 7).

Etymology.—The specific name is a noun in apposition dedicated to the Olmec people, the first major civilization which flourished in Mesoamerica's formative period, dating from as early as 1500 b. c. to about 400 b. c. The Olmecs occupied the state of Veracruz, where the type locality is located.

DISCUSSION

According to the previous records of other species of the genus *Pseudocellus* from North America, the troglobitic species *Pseudocellus osorioi* and *Pseudocellus pelaezi* Coronado-Gutierrez, 1970 have been found in the same cave system in the North of Mexico, in the states of San Luis Potosí and Tamaulipas (Reddell 1981). Both species could be considered sympatric because they share the same cave system; however, more research is needed to prove if both species share the same microhabitat in those caves to be considered as sympatric species.

The case here reported is a well-documented record of sympatry for epigeal species from North America for the genus *Pseudocellus*. The most important evidence to prove the sympatry between both species is that a tritonymph (CNANT1177) of *P. olmeca* sp. nov. (Figs. 88, 89) was found in the same microhabitat, under a big rock on the ground where all the specimens of *P. quetzalcoatl* sp. nov. were collected as well. Although species identification based on immatures specimens is often impossible, the size of specimens within each instar (larva, protonymph, deutonymph and tritonymph) is remarkably invariable for a given ricinuleid species. Likewise, each of the three nymphal stages is characterized by a unique combination of tarsomere counts for each of the four pairs of legs, whereas the larva is six-legged (Platnick 2002). Upon examination, the tritonymph specimen of *P. olmeca*, found in the same collection event and under the very same boulder as *P. quetzalcoatl*, was recognized as different from *P. quetzalcoatl*, because it was noticeably larger (*P. olmeca* total length 4.88 mm, against *P. quetzalcoatl* total length 3.32 mm); similarly, adults of *P. olmeca* are larger than the adults of *P. quetzalcoatl*.

The staining technique with clorazol (1%) was used for the first time with ricinuleids, revealing new morphological information of the order: the presence of numerous tiny pores on the membrane below the spermathecae of the female (Figs. 33–35, 77–79). The function of these pores is unknown, but it is possible that these could be the opening of some kind of

secretory glands. Additional studies are needed to determine the function of these pores, as well as to evaluate if these are present in other ricinuleid taxa (*Cryptocellus* and *Ricinoides*), where this morphological characteristic has been unexplored thus far.

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