

NEW TROGLOBITE SCORPION OF GENUS *DIPLOCENTRUS* (SCORPIONIDA: DIPLOCENTRIDAE)¹

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ABSTRACT: *Diplocentrus cueva*, a new species of troglobitic scorpion from Cueva Desapareciendo, near Acatlan, Estado de Oaxaca, Mexico, is described and illustrated. Regressive evolution in troglobitic scorpions of the genus *Diplocentrus* is briefly discussed.

DESCRIPTORS: *Diplocentrus cueva*, new species, scorpion, troglobite, cave, speleobiology, regressive evolution.

Recently I revised the scorpions of the genus *Diplocentrus* Peters, from the state of Oaxaca, Mexico (Francke, 1977 a). In that contribution eight species and one subspecies were recognized, and I postulated that with this species diversity the state of Oaxaca might represent the center of distribution (Darlington, 1957) of the genus *Diplocentrus*. The new species described below tends to further support this by increasing the diversity (in terms of species numbers) known from that area.

In this contribution I describe the sixth, and largest troglobitic scorpion known, and the third one belonging to the family Diplocentridae. The description is followed by some remarks on regressive evolution in cave-dwelling scorpions.

Diplocentrus cueva, new species

Figures 1-12

Type data.—Holotype, adult male, from Cueva Desapareciendo, 2 km W. Acatlan, Oaxaca, Mexico, 5 January 1976 (A. Grubbs). Permanently deposited in the collection of the American Museum of Natural History, New York.

Etymology.—Specific name based on the Spanish word for cave.

Distribution.—Known only from the type locality.

Diagnosis.—Troglobite, adult male 80.4 mm long. Ochreous to testaceous throughout. Carapace subpentagonal with deep anteromedian notch; median eyes and ocular tubercle reduced. Tergite VII vestigially tetracarnate, sternite VII vestigially bicarnate. Pectinal tooth count 14-15. Metasoma attenuated, segment IV longer than carapace; strongly compressed dorsoventrally. Cheliceral fixed finger shorter than chela width; movable finger shorter than chela length, with superior distal tine closely apposed to inferior distal tine. Pedipalp: orthobothriotaxia "C"; femur wider than deep; chela moderately to strongly carinate, fixed finger shallowly arcuate. Legs attenuated, femur IV longer than

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carapace; tarsomere II spine formula 4/5:5/5:5/6:5/6.

Description.—Based on male (female unknown), measurements of holotype in Table 1.

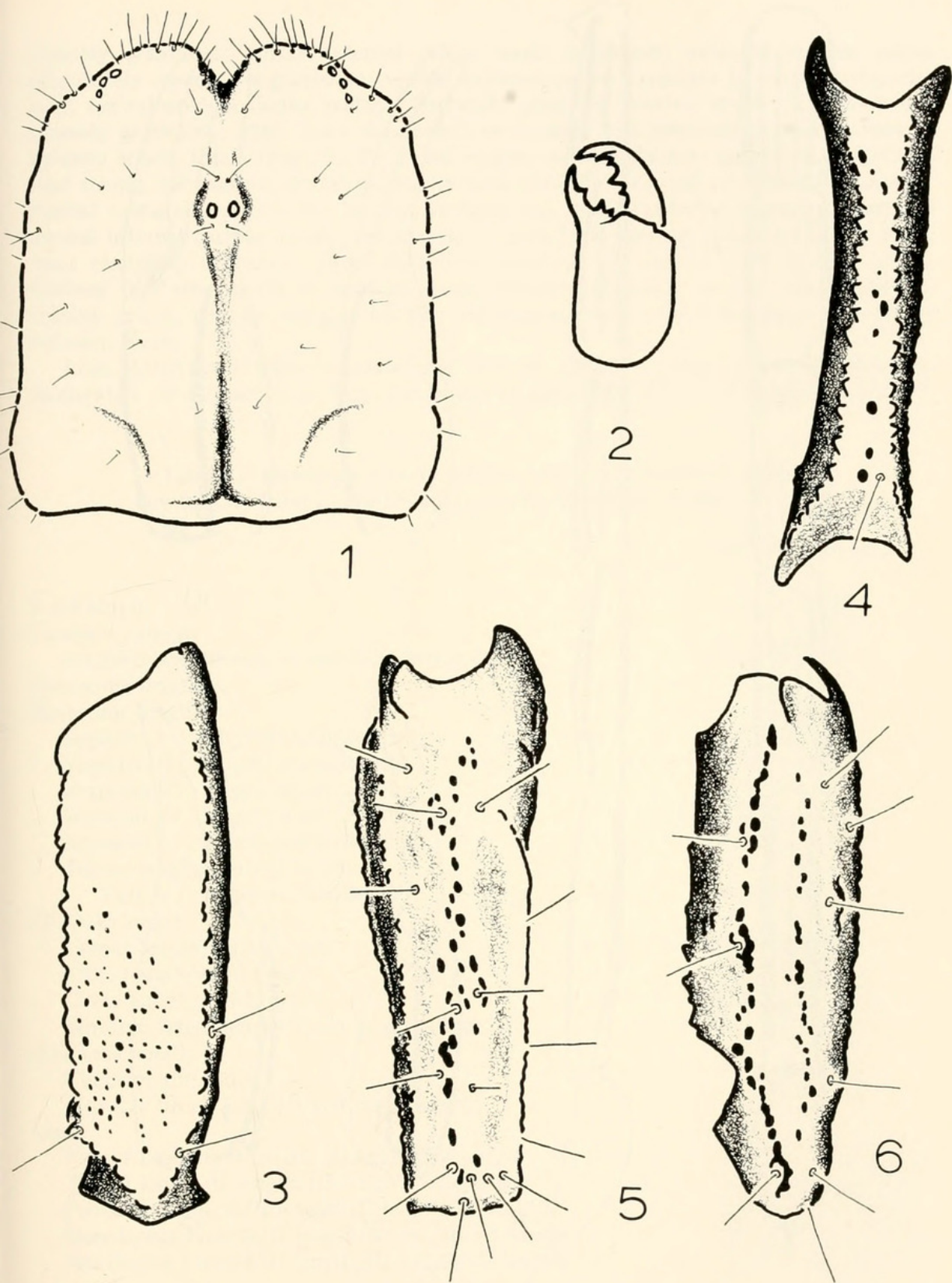
Prosoma. Carapace rather flattened dorsoventrally, accounting for its unusual shape (Fig. 1): testaceous, shagreened, anterior margin moderately setate, lateral margins sparsely setate, posterior margin bare; longer than wide, subpentagonal with deep anteromedian notch; posteromedian, posteromarginal, and posterolateral furrows moderate to deep; three pairs of lateral eyes, subequal in size; median eyes slightly larger than lateral eyes, located at anterior 0.35 of carapace length, ocular tubercle small. Venter: gnathobase I brunneous, gnathobase II and leg coxae ochreous fuscous; smooth, lustrous, moderately setate. Sternum: ochreous fuscous; moderately setate; pentagonal, 1.2 times longer than wide, with posteromedian furrow very deep.

Mesosoma. Tergites: testaceous, shagreened, bare; VII vestigially tetracarinate with submedian and lateral keels represented by sparse small granules on distal one-half. Genital operculum: ochreous, moderately setate; genital papillae present. Pectines: basal piece brunneous, moderately setate, two times wider than long with moderately deep anteromedian notch; marginal lamellae, middle lamellae, and fulcra ochreous, moderately setate; teeth with shaft ochreous and sensory area leucous, four times longer than wide with sensory area covering distal 75% of ventral aspect. Sternites III-VI: brunneous, smooth, lustrous, discs sparsely setate, lateral and posterior margins moderately setate; stigmata about three times longer than wide. Sternite VII: brunneous; submedian carinae obsolete, lateral carinae vestigial and smooth; median and submedian intercarinae lustrous, lateral intercarinae shagreened.

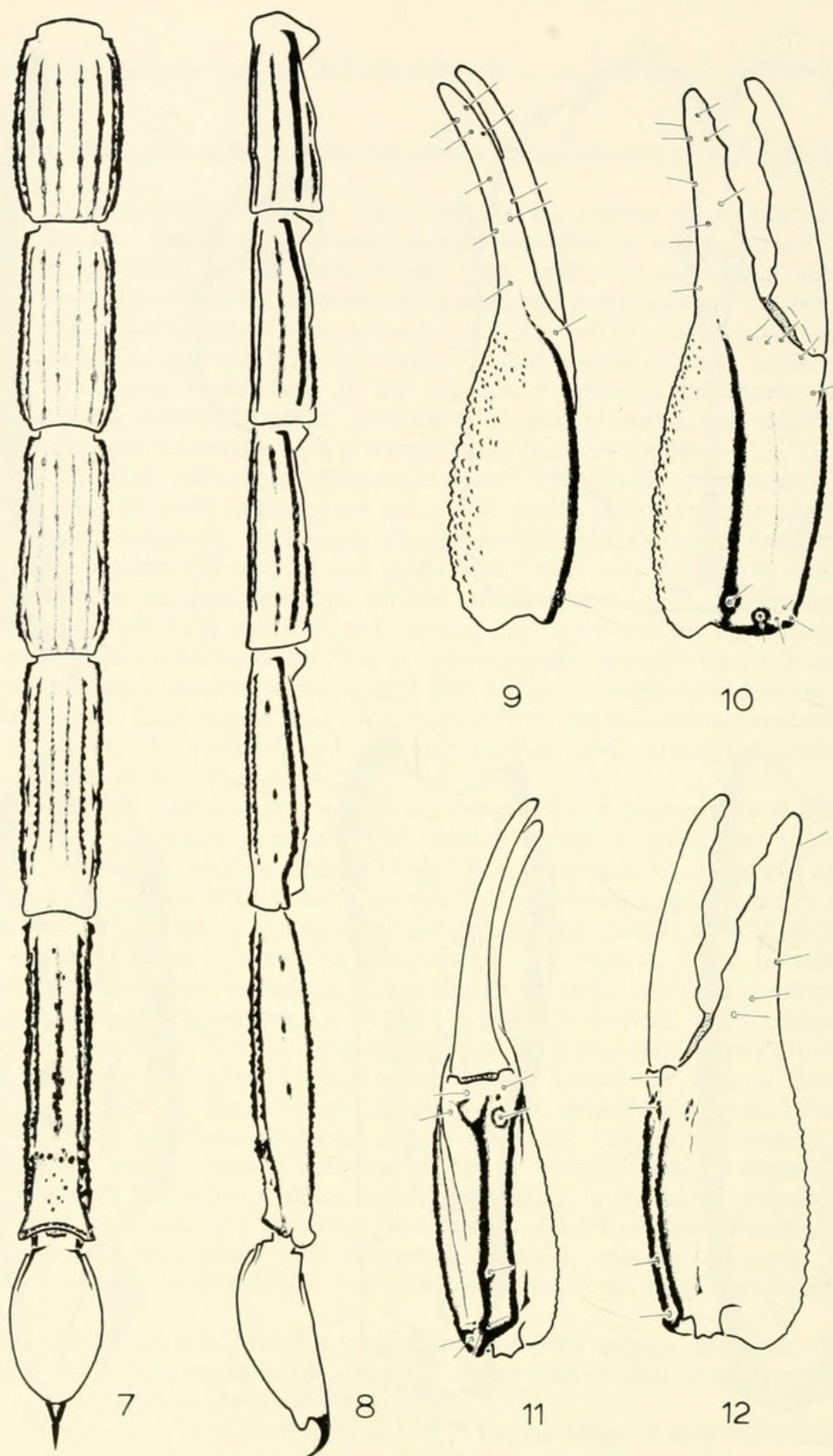
Metasoma. Preanal segments very elongate, compressed dorsoventrally (Figs. 7 and 8): brunneous to testaceous; segments I-IV sparsely setate, V and telson moderately setate. Dorsal submedian carinae absent. Dorsal lateral carinae: on I present on distal one-third, weak, granulose; II-III present on distal one-half, weak, granulose; IV present on distal one-half, moderate, granulose. Lateral supramedian carinae on I-IV moderately strong, granulose. Lateral inframedian carinae: on I complete, weak to moderate, granulose; II complete, weak, granulose; III present on proximal one-fourth and on distal one-half, weak, vestigially granulose; IV vestigial to obsolete. Ventral lateral carinae: on I weak, vestigially granulose; II weak to vestigial, sparsely granulose; III weak, sparsely to moderately granulose; IV weak to moderate, densely granulose. Ventral submedian carinae: on I-II vestigial to obsolete, smooth; III vestigial, sparsely granulose; IV weak to vestigial, moderately granulose. Segment V: dorsal lateral carinae moderately strong, densely granulose; lateral median carinae obsolete to vestigial; ventral lateral, ventral median, and ventral transverse carinae moderately strong, moderately granulose; anal subterminal keel moderate and granulose, anal terminal keel vestigial to obsolete and smooth. Metasomal intercarinae flat (including dorsals), smooth, lustrous. Telson: smooth, lustrous; subaculear tubercle well developed; aculeus short, moderately and evenly arcuate.

Chelicera. Chela ochreous, fingers brunneous; standard generic dentition (Fig. 2); fixed finger shorter than chela width; movable finger shorter than chela length, distal superior tine closely apposed to distal inferior tine.

Pedipalp. Testaceous, orthobothriotaxia "C". Femur (Figs. 3 and 4): quadrate in cross-section, two times wider than deep; dorsal internal and ventral internal carinae strong, granulose; dorsal external carina strong basally and moderate to weak distally, granulose; external median keel weak to moderate, vestigially granulose; ventral external keel weak to moderate, granulose; femoral faces shagreened to minutely granulose, sparsely setate. Tibia (Figs. 5 and 6): dorsal internal carina represented by three to five strong granules basally, obsolete distally; dorsal median carina moderate to strong,



Figures 1-6.—Holotype male of *Diplocentrus cueva*, a new species of troglobite scorpion from Oaxaca, Mexico: 1, dorsal aspect of carapace; 2, dorsal aspect of chelicera; 3, dorsal aspect of pedipalp femur; 4, internal aspect of pedipalp femur; 5, external aspect of pedipalp tibia; 6, dorsal aspect of pedipalp tibia.



Figures 7-12.—Holotype male of *Diplocentrus cueva*, new species of troglobite scorpion from Oaxaca, Mexico: 7, ventral aspect of metasoma; 8, lateral aspect of metasoma; 9, dorsal aspect of pedipalp chela; 10, external aspect of pedipalp chela; 11, ventral aspect of pedipalp chela; 12, internal aspect of pedipalp chela.

coarsely granulose; dorsal external carina weak, granulose; external median carina moderately strong, subgranulose; ventral external carina moderate to strong, subgranulose; ventral median carina vestigial, minutely granulose; ventral internal carina strong, coarsely granulose; tibial faces shagreened to densely and minutely granulose, bare to sparsely setate. Chela (Figs. 9-12): dorsal margin carinate, densely granulose; digital keel very strong, subgranulose; dorsal secondary keel obsolete; external keel vestigial, smooth; ventral external keel obsolete basally, vestigial and smooth distally; ventral median and ventral internal carinae strong, subgranulose to granulose; internal carinae obsolete; chelal faces vestigially reticulate, dorsal face bare, external and ventral faces sparsely setate, internal face moderately to densely setate. Fingers: shallowly arcuate, moderately to densely setate; dentate margins broadly sub serrate, when closed leaving a narrow gap between them.

Legs. Attenuated; ochreous fuscous, smooth, sparsely setate. Prolateral pedal spurs moderately developed on all legs. Tarsomere II spines 4/5 4/5:5/5 5/5:5/6 5/6:5/6 5/*.

Table 1.—Measurements (in millimeters) of *Diplocentrus cueva*, new species from Cueva Desapareciendo, Estado de Oaxaca, Mexico.

	HOLOTYPE MALE
Total length	80.40
Carapace Length	8.80
Anterior width/median width/posterior width	4.00/7.00/7.80
Mesosoma length	21.40
Metasoma length	50.20
Segment I length/width/depth	6.60/3.80/2.50
Segment II length/width/depth	7.30/3.40/2.40
Segment III length/width/depth	7.90/3.10/2.30
Segment IV length/width/depth	8.90/2.80/2.30
Segment V length/width/depth	11.50/2.30/2.30
Telson length/aculeus length	8.00/1.50
Vesicle length/width/depth	6.50/3.40/2.60
Pedipalp length	39.90
Femur length/width/depth	10.60/3.00/1.50
Tibia length/width/depth	9.00/3.00/2.50
Chela length/width/depth	20.30/6.10/3.80
Movable finger length/fixed finger length	10.70/8.40
Chelicera length	3.80
Chela length/width	2.60/1.90
Movable finger length/fixed finger length	2.10/1.20
Legs	
Femur I length/II length/III length/IV length	6.00/7.10/8.60/10.00
Tibia I length/II length/III length/IV length	5.50/6.20/7.50/8.30
Protarsus I length/II length/III length/IV length	3.60/4.00/4.40/4.70
Mesotarsus I length/II length/III length/IV length	3.60/4.00/4.50/5.00
Metatarsus I length/II length/III length/IV length	2.10/2.10/2.35/2.50

Comparisons.—*Diplocentrus cueva* can easily be separated from all described species in the genus by the unusual shape of the carapace, the attenuation and dorsoventral flattening of the metasoma, and the attenuation of the legs. It appears to be most closely related to *Diplocentrus mexicanus* Peters, also from the state of Oaxaca, as indicated by

similarities in cheliceral morphometrics, pedipalp femora proportions, presence of a ventral median carina on the pedipalp tibiae, and in morphology and carination of the pedipalp chelae. The two species differ, in addition to the unique characters of *D. cueva* given above, in size, color, tarsomere II spine counts, carinal development on the metasoma, texture of the sclerites, and numerous other less significant characters.

Discussion

Cave-inhabiting organisms are usually classified into three discrete categories, based on their degree of dependence to (or independence from) the cave environment, as follows: (1) troglobites, or obligatory cave-dwellers found exclusively in caves; (2) troglaphiles, or cave-lovers capable of completing their life-cycle in caves but also found in favorable habitats outside caves; (3) troglloxenes, or cave-guests unable to complete their life-cycle in the confines of a cave. Troglobitic scorpions have been found only in North America, and represent two of the four families present on this continent. The family Buthidae has some troglloxene species, and the family Vaejovidae has both troglloxenes and troglaphiles, but neither family has any known troglobites. The family Chactidae has three eyeless troglobitic species belonging to the genus *Typhlochactas* Mitchell from Mexico (Mitchell, 1968, 1971). Finally, the family Diplocentridae has three eyed troglobitic species belonging to the genus *Diplocentrus*, two from the Yucatan Peninsula in Mexico (Francke, 1977 b), and the species described above from Oaxaca.

Table 2.—Extent of development of troglobitic facies in the three species of cave-dwelling *Diplocentrus*, based on comparisons to their respective epigeal relatives.

	<i>D. anophthalmus</i>	<i>D. mitchelli</i>	<i>D. cueva</i>
Appendage attenuation	conspicuous	conspicuous	conspicuous
Metasomal carinae	reduced	reduced	reduced
Pedipalpal carinae	absent	absent	slightly reduced
Tarsomere II spination	reduced	equal ?	slightly reduced
Pigmentation	absent	vestigial	slightly reduced
Lateral eyes	vestigial	reduced	equal
Medial eyes	absent	vestigial	reduced

Regressive evolution is usually manifest in most troglobites, and often culminates with total loss of visual organs and pigmentation. The three troglobitic scorpions of the genus *Typhlochactas* lack both eyes and pigment, but so does the only other species in the genus, a montane-forest litter inhabitant (Mitchell and Peck, in press). Thus it is quite possible, as suggested by Mitchell and Peck (loc. cit), that the ancestor of the troglobitic species was already "pre-adapted," to some extent, to cave existence, accounting for the extreme regressive facies shown by all three troglobitic *Typhlochactas* spp.

The troglobitic diplocentrids have not yet reached such an advanced stage of cave-adaptedness. *Diplocentrus anophthalmus* Francke lacks pigment and median eyes, but still retains vestigial lateral eyes; *Diplocentrus mitchelli* Francke lacks pigment except for the visual organs, and still retains vestigial median and lateral eyes; and *D. cueva* has both pigment and eyes, although the median eyes are somewhat reduced in size. Evolutionarily, each of the three species is believed to be more closely related to epigeal members of the genus than they are to each other. The respective epigeal relatives, however, show no evidence of "pre-adaptation" to cave existence, and the three troglobites probably represent separate invasions of the cave environment. The cave-dwelling *Diplocentrus* show different degrees of cave adaptedness (Table 2), enabling us to understand for the first time in scorpions the steps of regressive evolution experienced by cave-dwellers. *D. cueva* displays the initial stages of regressive evolution, *D. mitchelli* the intermediate stages, and *D. anophthalmus* approaches the final stages but has yet to reach the condition of total eyelessness.

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