STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 196

REVISION OF THE AMBLYPYGID SPIDERS OF CUBA AND THEIR RELATIONSHIPS WITH THE CARIBBEAN AND CONTINENTAL AMERICAN AMBLYPYGID FAUNA

by

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Abstract: Twelve species of amblypygids from Cuba are described and pictured. Data are given on the distribution and a Key to species is provided. Nine out of the twelve species are endemic to Cuba, indicating a high degree of endemism. The inferred relationships among the species of *Phrynus* and *Paraphrynus* are plotted as cladograms. Relationships of *Charinides* species are discussed. Of the three genera present in Cuba, *Charinides* is reported for the first time for the Caribbean and four new species are described. The genus *Speleophrynus* Ravelo, which includes two endemic species from Venezuelan caves, *S. tronchonii* Ravelo and *S. bordoni* Ravelo, is placed in synonymy under *Charinides*. Two species are transferred to *Phrynus*: *Hemiphrynus machadoi* Fage, the only phrynid species known from outside of America, and the fossil species *Tarantula resinae* Schawaller. The biogeographic relationships of the Caribbean amblypygid fauna are discussed.

INTRODUCTION

The first report on the occurrence of amblypygids in Cuba is RAMÓN DE LA SAGRA's (1857) general description of *Phrynus palmatus* (Herbst, 1797). POCOCK (1893) considered his new species *Tarantula keyserlingii* (*Phrynus marginemaculatus* C. L. Koch, 1841), locality of type unknown, "very likely the Cuban species that is figured as *Phrynus palmatus* by Ramón de la Sagra." KRAEPELIN (1899) reported *P. marginemaculatus* from Cuba, and POCOCK (1899, p. 219) includes Cuba in the distribution of *Admetus fuscimanus mexicanus*, probably referring to *Paraphrynus mexicanus* (Bilimek, 1867). Next, PELEGRÍN FRANGANILLO BALBOA (1926, 1930, 1931, 1936, 1938) described five new species and a new subspecies: *Paraphrynus intermedius* (Fr., 1926), *Paraphrynus robustus* (Fr., 1931) comb. n., *Paraphrynus laevifrons subspinosus* (Fr., 1936), *Phrynus pinarensis* (Fr., 1930), *Phrynus rangelensis* (Fr., 1931), and *Phrynus viridescens* (Fr., 1931). The new species described by FRANGANILLO in 1931 in *Revista Belén*, were practically unknown outside of Cuba until they were redescribed in 1936, some again in 1938, because *R. Belén* had little or no circulation in the scientific community, as pointed out in a footnote by the editor of *Mem. Soc. Cubana Hist. Nat. Poey* (1938, p. 145). Because of the incomplete descriptions given by FRANGANILLO and the impossibility of examining his type specimens (without labels, marked only with numbers and their catalogue lost, at Academia de Ciencias de Cuba), the new species remained unreported until recently (MULLINEX, 1975, QUINTERO, 1981). FRANGANILLO also reported five species of *Phrynus* from Cuba: *P. parvulus* Poc., 1902, *P. operculatus* Poc., 1902, *P. whitei* Gervais, 1842, *P.*

barbadensis (Poc., 1893) and *P. parvulus* (Poc., 1902) and two species of *Paraphrynus*: *P. raptator* (Poc., 1902) and *P. azteca* (Poc., 1894). MULLINEX (1975) in her revision of *Paraphrynus* recognized only three species from Cuba: *P. viridiceps* (Pocock, 1893), *P. mexicanus* (Cuban form) and *P. astes* Mullinex, 1975. MULLINEX was unable to assign any specimens to *Paraphrynus intermedius* (Franganillo) because of its incomplete description and the lack of distinct characteristics for recognition. *Paraphrynus robustus* (Franganillo) is absent in MULLINEX's revision, but a new species, *P. astes*, was described from a single specimen found near the collecting site of *P. robustus*. In his revision of the genus *Phrynus*, QUINTERO (1981a) recognized four species from Cuba: *P. armasi* Quintero, *P. levii* Quintero, *P. damonidaensis* Quintero and *P. marginemaculatus* C. L. Koch; he considered FRANGANILLO's *Phrynus* species as Incertae Sedis.

Amblypygids collected in caves – reported by GONZÁLEZ (1967, Cueva de las Majaguas), ACEVEDO (1967, Cueva del Vaho), GRAÑA & IZQUIERDO (1970, Cueva en Punta Judas) and by SILVA (1974) – were identified as *Tarantula palmata* (Herbst) (*Phrynus* spp.). With a renewed interest in the biology of the species inhabiting the extensive cave system of Cuba (one of the most important karst regions in the Antilles, with perhaps the largest number of caves per unit of land surface area in the world; SILVA, 1979), extensive collections were made by members of the Academia de Ciencias de Cuba (ACC), in particular by my friend Luis F. DE ARMAS of the Instituto de Zoología, and by members of the Institut de Spéologie "Emile G. Racovitza", Roumanie (ISR). Specimens from both institutions were sent to me on loan, and in December 1980 I examined the rest of the collection during a three-weeks stay at the ACC. From the following institutions, to whom I express my gratitude for the hospitality and facilities provided, additional material from Cuba and the Caribbean area was examined: Museum of Comparative Zoology (MCZ), Dr. H. W. LEVI; American Museum of Natural History (AMNH), Dr. N. I. PLATNICK; British Museum (Natural History) (BMNH), Drs F. R. WANLESS and K. H. HYATT, and the Zoologisches Museum, Hamburg (ZMH), Dr. O. KRAUSS.

I gratefully acknowledge the help received from LUIS F. DE ARMAS, ACC, who supplied not only the majority of the specimens from Cuba, but also additional field data and warm hospitality. I furthermore would like to express my thanks to Dr. CEFERINO SÁNCHEZ, Universidad de Panamá, who authorized and made possible my visit to Cuba.

My sincere thanks also to Dr. JEROME G. ROZEN, Jr., Deputy Director of Research, AMNH, for waving the hourly fee due to use the Cambridge Stereoscan 250 at the AMNH and for being such an excellent host.

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MATERIAL AND METHODS

In the course of this study the author examined 511 specimens from Cuba. In addition, specimens from continental America and other Caribbean islands were studied, paying much attention to distribution limits, habitats and variation. Phylogenetic conclusions were obtained from detailed morphological comparisons on external features, taking into consideration current concepts of cladistic and historical biogeography to explain the present limit of distribution of species and their interrelationships.

Opisthogeminate organs (male sexual organs, QUINTERO 1981, p. 121) are not depicted in the present work because they do not offer useful diagnostic characters, being soft-muscular and thus subject to variation in shape during preservation. The female gonopods of the *Phrynus* and *Paraphrynus* species treated herein, however, have been illustrated, as they offer important diagnostic characters and should be used for confirmation of all identifications. In charontids, female gonopods lack claw sclerites and are small, soft, and pale, thus it is difficult to observe details of their anatomy. They were examined with the SEM Cambridge Stereoscan 250 at the AMNH. It is advisable that in future work, when fresher specimens are available, the gonopods should be cleared and slide mounted to gain a more detailed image of their organization. Similarity of genitalic structures cannot be used at present to define species as a thorough study of their organization is missing. Allometric growth curves of pedipalp tibia length versus median prosomal length are helpful in identifications, particularly in order to avoid describing both sexes as different species in sexually dimorphic species, but cannot be used for species recognition.

Chaetotaxy, that is trichobothria present on leg IV tibia, (illustrated here only for *Charinides* species) is important for confirmation of species identification in the genera *Phrynus* and *Charinides*. Chaetotaxy is an unreliable character in *Paraphrynus*, because of the presence of frequent abnormalities and variation.

Allometries

The significance of allometric changes in the different species of amblypygids had not been previously studied. After revising and measuring specimens from natural populations of the majority of the species of phrynids, the x and y values were tabulated and the information compared with the here recognized relationships among species (Figs. 13 and 14, p. 44). It was not found to be congruent. It appears that different rates in elongation of the pedipalps with respect to the median prosomal length or other chosen variables had occurred at random.

It is interesting to compare the allometries of the wild populations of *Phrynus marginemaculatus* ($y = 0.50 \cdot x^{1.455}$) with the values found by Weygoldt (1970) from laboratory reared specimens obtained originally from Florida ($y = 0.63 \cdot x^{1.35}$). The differences must be ascribed to the methodology as Weygoldt measured exuvia (thus distortions might have occurred) and the measurements were taken from the same individuals as they grew.

Key to families of Cuban AMBLYPYGI

1. Tarsi of walking legs with pulvilli (Fig. 1A); pedipalp distitarsus with distinct articulation between basal and distal segments (tarsus and post-tarsus), the former having two supramedial spines (Fig. 1C); internal margin of the anteroventral surface of the cheliceral basal segment with four teeth (Fig. 2F); female gonopods without two claw-like sclerites (Figs. 8F, G) . . . . Charontidae

– Tarsi of walking legs without pulvilli (Fig. 1B), distitarsus of pedipalps undivided or with an incomplete suture between tarsus and post-tarsus; a single inconspicuous spine present in some species in their lower third, supramedial surface (Fig. 1D, arrow) or none (Figs. 1A, F, G); internal margin of the anteroventral surface of the basal cheliceral segment with three teeth (Fig. 2E); female gonopods with two claw-like sclerites (Figs. 3F, G, H, I) . . . . Phrynidae

PHRYNIDAE Wood, 1863

PHRYNINAE Pocock, 1902

KEY TO THE SPECIES FROM CUBA

1. Dorsal margin of pedipalp tibia with two spines (Td 4 and Td 5) between the two longest spines (Figs. 3A, C) . . . . *Paraphrynus* Moreno 2
– Dorsal margin of pedipalp tibia with a single spine (Td 4) between the two longest spines (Fig. 7A) . . . . *Phrynus* Lamarck 5

2. Proximal end of the inner dorsal surface of the pedipalp tarsus without a small spine (Fig. 2A); ventral surface of the pedipalp tibia without a longitudinal ridge (Fig. 3B) . . . . *Paraphrynus cubensis* Mullinex
– Proximal end of the inner dorsal surface of the pedipalp tarsus with a small spine (Figs. 2B, C, D, arrow); ventral surface of the pedipalp tibia with a granular ridge, sometimes inconspicuous (Fig. 3D) . . . 3

3. Proximal spine dorsal on pedipalp basitarsus (Bd-1) longer than the third (Bd-3) (Fig. 2B); a single tooth on the external margin of the anteroventral surface of the basal segment of the chelicera . . . . *Paraphrynus raptator* (Poc.)
– Proximal spine dorsal on the pedipalp basitarsus shorter than the third (Figs. 2C, D); three teeth on the external margin of the anteroventral surface of the basal cheliceral segment (Figs. 2E, teeth a–c) 4

4. Inner lateral surface of the basal cheliceral segment with claviform setae (Figs. 3E); inner lateral suture visible between pedipalp post-tarsus and tarsus, rest of the perimeter is fused (Fig. 2C). . . . . *Paraphrynus robustus* (Franganillo)
– Acuminated setae on the inner lateral surface of basal cheliceral segment; tarsus and post-tarsus of pedipalp completely fused, no suture visible (Fig. 2D) . . . . *Paraphrynus viridiceps* (Poc.)

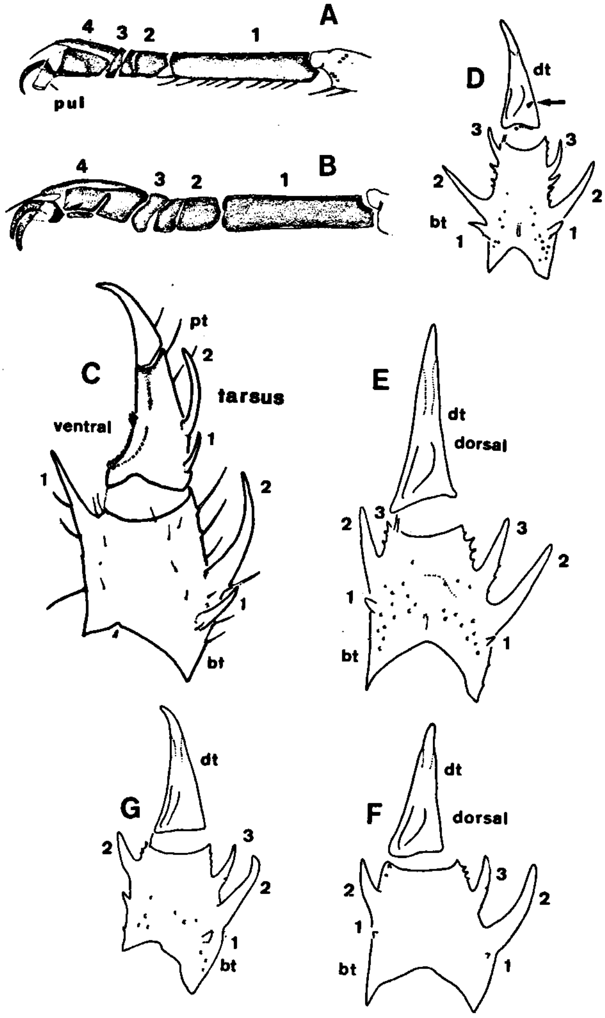


Fig. 1. A and B. Tarsi of leg IV, external faces both have membranous transverse bands distal on second tarsomeres. A. *Charinides acosta* (pul, pulvillus). B. *Phrynus marginemaculatus*, lacks pulvillus. C, D, E, F and G: Right pedipalp hands (pt, post-tarsus; dt, distitarsus; bt, basitarsus), medial faces. C. *Charinides acosta* (Camaguey). D. *Phrynus armasi*. E. *Phrynus levii cubensis*. F. *Phrynus marginemaculatus*. G. *Phrynus damonidaensis*.

5. Three tibial segments on leg four; four teeth on external margin of basal cheliceral segment (proximal very small and inserting on a common base with teeth *b* and *c*). *Phrynus damonidaensis* Quintero
– Four tibial segments on leg four; one to three teeth on external margin of basal cheliceral segment 6

6. One tooth on external margin of basal cheliceral segment; Td-7 with a basal spine; Td-4 longer than Td-2; proximal end of dorso-inner lateral surface with inconspicuous spine; second tarsomeres of leg four tarsi without membranous transverse band on distal end . . . .*Phrynus armasi* Quintero
– Two or three teeth on external margin of basal cheliceral segment; Td-7 without a basal spine; Td-4 shorter than Td-2; proximal end of dorso-inner lateral surface without inconspicuous spine; second tarsomeres of leg four tarsi with complete membranous transverse band on distal end 7

7. Two teeth on external margin of basal cheliceral segment (tooth *a* obsolete, just a ridge connecting base of tooth *b* with 1); female gonopod claw distinctly wider at base; adult sf row with trichobothrial hairs no. 7 or 8 to 10 present (four to three distal hairs in row sf) and sc row with trichobothria nos. 7 to 11 (five distal hairs in row sc) . . . . *Phrynus marginemaculatus* C. L. Koch
– Three teeth on external margin of basal cheliceral segment (an additional denticle between teeth *b* and 2; tooth *a* might be reduced in size); thinner claw of female gonopods; present in row sf trichobothria nos. 4, 5 or 6 to 10 (five to seven distal hairs in row sf and row sc with 6 to 7 distal hairs present . . . . . . *Phrynus levii cubensis* n. subsp.

Paraphrynus Moreno, 1940

Paraphrynus MORENO, 1940: 167–168. MULLINEX, 1975: 1–80.

Type-species: *Paraphrynus laevifrons* (Pocock, 1894), by original designation.

Paraphrynus cubensis Mullinex, 1975

Figs. 2A; 3A, B; 4D, E; 5B; 12A

Paraphrynus mexicanus (Bilimek), Cuban form. MULLINEX, 1975: 30–32, in MCZ, examined.

Type data. Two male syntypes from Cayanas, homotype female, Laguna de Aruguanabo, Habana, Feb. 1972, G. Alayon deposited in ACC. Homotype male, Reparto Atabex, Mariano, *La Habana*, 15.X.1973, L. F. de Armas, deposited in BMNH.

A homotype, according to MAYR et al. (1953) is "a specimen compared by another than the author of the species with the type and determined by him to be conspecific with it." Although homotypes have great practical value in identifications, the International Code of Zoological Nomenclature does not recognize them as types.

Diagnosis. It has an incomplete (not fused dorsally) membranous light band at the distal end of the second tarsomere of leg four. Other species of *Paraphrynus* from Cuba have a complete membranous band, except for *P. raptator* known only from three deutonymphs that lacked the typical membranous band present in known specimens of that species from northern Honduras, México, and Florida Keys, USA. Like *P. raptator* it has spine Bd-1 longer than Bd-3 and there is a single tooth on the external margin of the anteroventral surface of the basal cheliceral segment. It differs from *P. raptator* in having a longitudinal ridge on the ventral surface of the pedipalp tibia (Fig. 3B), in lacking the small spine on the inner-dorsal surface of the proximal tarsal segment of the pedipalp (Fig. 2A) and in showing a difference in length between Fv-1 and Fv-2 almost equal to the difference between Fv-2 and Fv-3 (gradual decrease in length between Fv-1 and Fv-3, (Fig. 3B). *P. cubensis* is a smaller species (specimens reach a maximum body length of 16 mm) while specimens of *P. raptator* could reach 29 mm. *P. cubensis* is indeed most closely related to *P. mexicanus* (Bilimek), originally recognized as a "form" of this species by MULLINEX (1975). Cuban specimens are consistently different from those on the mainland by their notably shorter dorsal spines on the pedipalp tibia, spine Td-5 slightly shorter than Td-4 (distinctly shorter in *P. mexicanus*), by the presence of a membranous transverse band on the distal end of the second tarsomere of leg IV (absent in the two recognized forms of *P. mexicanus*, Cacahuamilpan and Arizonan), and by the distinctly different shape of the female gonopod sclerites which possess a sclerotized anteroposteriorly oriented rod separating the claw from the expanded lateral segment of the sclerite (Figs. 4D, E). The male of *P.*

cubensis differs in having the fourth opithosomal sternite bent, slightly resembling males of *Phrynus operculatus*. Like the Arizonan form of *P. mexicanus*, *P. cubensis* has numerous setiferous tubercles on the outer anterodorsal edge of the basal cheliceral segment.

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is given in the following formula: $y = b \cdot x^a$ where, $y = 0.40 \cdot x^{1.5399}$. In both sexes the length of the pedipalp tibia grows isometrically with respect to their median prosomal length (Fig. 5B). A few specimens have a wide area of white, instead of a narrow one, on the mesal surface of the ventral side of gnathocoxa. Feeler with 27 tibial and 58 tarsal segments.

Material. Nine males and five females.
Franganillo's collection [all specimens are in formaline]: Jar No. 658 (no other information), 2 males (I suspect that these were the specimens misidentified by Franganillo (1926) as *Paraphrynus raptator* (Poc.), one male and one female); Jar No. 659, 2 males and 2 females.
Prov. La Habana: 1 ♀, San Antonio de los Baños, IX.1974, E. González (pers. coll.); 1 ♀, S. Antonio de los Baños, 13.XI.1973, O. Alayón (ACC).

Distribution. Known only from La Habana Province.

Paraphrynus raptator (Pocock, 1902)

Figs. 2B; 12A

Hemiphrynus raptator Pocock, 1902: 54–55.
Paraphrynus raptator: Mullinex, 1975: 10–12 (redescription).

Remarks. The species is reported for the second time from Cuba. Franganillo (1926) reported a male and a female from Habana, but I was unable to locate these specimens when I examined his collection.

Diagnosis. The only specimens examined were three deutonymphs that differed from the diagnostic characters of the species in lacking the membranous band distal on the second tarsomere of the fourth leg, but agreeing in the other characters examined. It will be necessary to examine adult specimens to confirm their identity. See additional discussion under *P. cubensis* diagnosis. *P. intermedius* (Franganillo) from Habana is probably a misidentification of this species (see discussion under *P. intermedius*). It differs from the brief description given by FRANGANILLO in having four spines on the pedipalp trochanter surface while *P. intermedius* has six.

Material. Three deutonymphs, San Andrés, *Prov. Holquín*, 23.IV.1948, G. R. Proctor (MCZ). Label has the additional information: "Common in damp limestone cave, very fast. Larger specimens seen but not captured." All feelers were missing.

Distribution. From Provincia Holquín; FRANGANILLO's record from Prov. La Habana not confirmed. The species is reported from northern Honduras, Yucatán Península to Tabasco in México and Key West, Florida.

Paraphrynus robustus (Franganillo, 1931) [new combination]

Figs. 2C; 3C, D, E; 4A, B, C; 5B; 12A

Hemiphrynus robustus FRANGANILLO, 1931: 120; 1938: 166.
Hemiphrynus rubustus FRANGANILLO, 1936: 151.
Paraphrynus astes MULLINEX, 1975: 23–24. [new synonymy]

Type data. Syntype of *Hemiphrynus robustus*, Jar No. 664, 3 males and one subadult female. Measurements of largest male correspond closely to FRANGANILLO's description of male from type locality (Baracoa). I found its chelicerae partially dissected and the carapace and the chelicerae were broken as arthropods in formaline become too brittle for dissection. Homotype female from Segunda Cueva Siboney, El Caney, *Oriente*, col. N. Viñas, designated at ACC. Homotype male (holotype specimen of *P. astes*) from Cueva de las Cucarachas, Patana, Baracoa, Oriente, designated in the AMNH (Acc. 5723). Male has fragmented legs at the tibia, chelicerae and genitalia dissected and both feelers missing.

Diagnosis. *P. robustus* is the only species in the genus with clavate setae on the inner lateral surface of the basal cheliceral segment (Fig. 3E) and the only *Paraphrynus* species in Cuba with a visible suture on the inner lateral surface of the pedipalp between tarsus and post-tarsus (Fig. 2C). It reaches a maximum body length of 30 mm, being the second largest amblypygid, after *Phrynus armasi*, of the island. Like *P. viridiceps*, it has a longitudinal ridge on the ventral face of the pedipalp tibia, three teeth on the external margin of the basal cheliceral segment (as *Phrynus damonidaensis*, Fig. 2E, rest of the species of *Paraphrynus* have one or two teeth) and spine Bd-1 shorter than Bd-3 (Fig. 2C). *P. viridiceps* is a smaller species, reaching a maximum of 23 mm in body length. For the first time

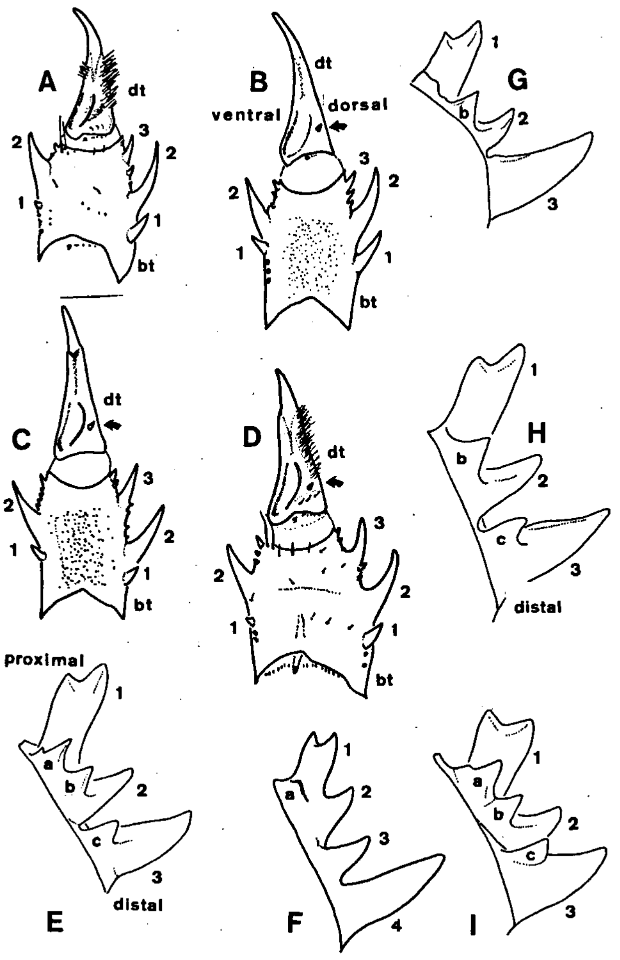


Fig. 2. A, B, C, and D: Right pedipalp hands (dt, distitarsus; bt, basitarsus), medial faces. A. *Paraphrynus cubensis*. B. *Paraphrynus raptator* (Yucatán). C. *Paraphrynus robustus*. D. *Paraphrynus viridiceps*. E, F, G, H, and I: Teeth on basal cheliceral segment, external view, right chelicerae (1–4, teeth on inner margin; a–c, teeth on external margin). E. *Phrynus damonidaensis*. F. *Charinides acosta* (Camaguey). G. *Phrynus armasi*. H. *Phrynus marginemaculatus*. I. *Phrynus levii cubensis*.

females of these species are reported and their genitalia illustrated (Figs. 4A, B, C).

Stridulation. The clavate setae of *P. robustus* "appear to be stridulatory in function" according to Mullinex (1975). Luis R. Hernández (pers. comm.) heard intense, low-key clicking sounds, when preserving in alcohol a male captured alive in Loma de la California, Baracoa, Prov. Guantánamo. I assume these sounds were produced by the clavate setae of its chelicerae. Sounds were not heard previously, in the short time the specimen was kept alive, nor when it was being captured.

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is expressed in the following formula: $y = {}^{0.58} \cdot x^{1.2776}$. In both sexes the pedipalp grows isometrically with respect to their median prosomal length (Fig. 5B), but older males grow longer pedipalps than females.

The number of segments on the first pair of legs is quite variable as in most *Paraphrynus* species. Of nineteen tibia I examined from 13 different individuals, ten had 31 segments (52.6%), the rest having from 32 to 49 (36 in the female syntype, remaining syntypes had lost their feelers). Of twelve tarsi I examined half had 66 segments and the rest 45 to 75 segments. Total number of segments ranged from 76 to 113. Adults have a darker reddishbrown coloration than juveniles (ligth reddish, including abdominal tergites). The homotype female was carrying an embryo sac (12 mm wide by 13 mm long) with 51 embryos and two unembryonated eggs. The female measured: body length, 28 mm; median prosomal length 10 mm; pedipalp tibia length 12.3 mm.

Material. Twenty six males, seventeen females and twelve immatures. [Inst. Spéol. Roum. = ISR]
Prov. La Habana: 2♂ 1♀, Cueva de la Virgen, Zaragoza, Finca Sierra, Habana, 8.XI.1945, Osorio-Alemán (AMNH).
Prov. Holguín: 2♀, Cueva de Arguas Gordas, near Banes, 20.III.1955, A. F. Archer (MCZ); 2♂ 1♀ 3juv., Cueva de las Cuatrocientas Rozas No. 1, Banes, 7.IV.1969, V. Decou, C. Fundora, St. Negrea (ISR 8); 1♂ 1♀, Moa, 1938, P. Thumb (Zool. Mus. Hamb. 9); 2♂, Cueva Bariay, NE of Holguín, 2.III.1973 (ISR); 1♀, Cerro de los Berros, Banes, dried sandy area near the coast, 1.I.1954, M. L. Jaume (ACC); 1♀, Nicaro, in humid forest, shady leaf litter, 13.XII.1975, J. F. Milera (ACC); 1♂ 1♀ 3juv., Cueva de Cañones, Seboruquito, Mayarí, 28.II.1973 (ISR 44).
Prov. Granma: 2♂, Cueva Grande de Pilón, 1.III.1973 (ISR 46.1); 1♀, Cueva del Fustete,

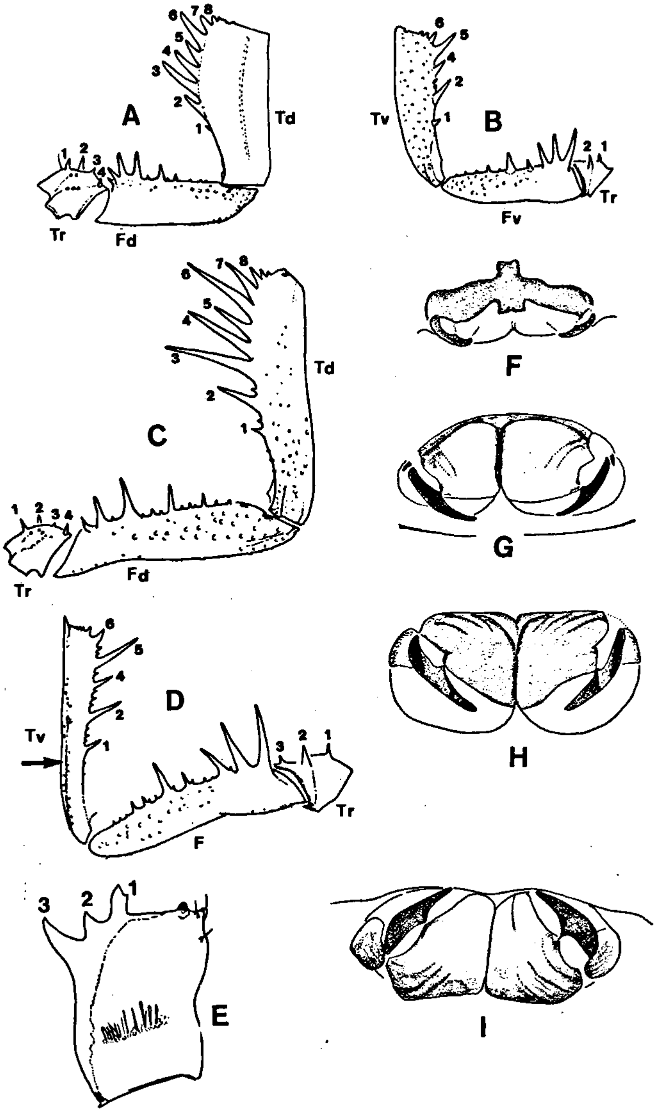


Fig. 3. A, B, C, and D: Pedipalps (Td, tibia dorsal; Tv, tibia ventral; Fd, femur dorsal; Fv, femur ventral; Tr, Trochanter). *Paraphrynus cubensis*: A, dorsal view; B, ventral view. *Paraphrynus robustus*: C, dorsal view; D, ventral view. E. Right basal cheliceral segment, *P. robustus*, with clavate setae. F, G, H, and I: Female gonopods, *Phrynus* sp., dorsal view. F. *P. armasi* (Cueva El Mudo, La Habana). G. *P. damonidaensis* (holotype, Uvero, Sierra Maestra). H. *P. levii cubensis*. I. *P. marginemaculatus*.

10.V.1969, Niquero (ISR 10); 2♂ 2♀, Mts. de Guisa, IX.1936, Thumb (Zool. Mus. Hamb. 10); 2 juv., Cueva de Banega, Matias, 20.III.1973 (ISR 56).

Prov. Santiago de Cuba: 1♂, Cueva de la Virgen, Siboney, El Caney, 14.III.1973 (ISR 52); 1♂, Santiago de Cuba, 27.XI.1970 (ISR); 1♂ 1♀, Cueva Atabex, 1.5 km W. Siboney, 15.II.1973 (ISR 41.2); 2♂, Cueva de los Majaes, Siboney, Caney, 20.III.1969, Decou, Negrea, Fundora (ISR 1); 1♂, Segunda Cueva Siboney, El Caney, Nicasio Viñas (ACC); 1♀, Siboney laboratory, 21–25.V.1973 (ISR).

Prov. Guantánamo: 1♂, Río Toa, Cupeyal del Norte, 20.I.1968 (ACC); 1♂ 1♀ 3 juv., Cueva de la Majana, Guiniao, Baracoa, 4.IV.1969, Decou, Negrea, Fundora (ISR 7); 1♂ 2♀, Cueva de la Majana, Baracoa, 4.X.1973, L. R. Hernández, L. F. de Armas (ACC); 1♀ 1 juv., Cueva de la Patana, 2.IV.1969, Negrea, Decou, Fundora (ISR 6); 1♂, Loma de la California, Cacajal, Baracoa, Hernández (ACC).

Distribution. Endemic to Cuba, common in caves (rarely collected epigean) in the oriental end of Cuba, Provinces of Holguín, Guantánamo, Santiago de Cuba and Granma. The only record from Prov. La Habana was considered by L. F. de Armas (pers. comm.) as possibly erroneously labelled.

Paraphrynus viridiceps (Pocock, 1893)

Figs. 2D; 4F, G, H; 5A; 12A

Tarantula viridiceps Pocock, 1893: 540–541; 1894: 279.
Hemiphrynus viridiceps: Banks, 1906: 189.
Paraphrynus viridiceps: Mullinex, 1975: 25–26.

Diagnosis. It can be easily distinguished from *P. robustus* by the presence of acuminate setae on the inner face of the basal cheliceral segments (clavate setae in *P. robustus*) and by its darker, blackish red-brown, carapace and pedipalps coloration. Maximum body length measured for *P. robustus* was 30 mm, while *P. viridiceps* reaches only 23 mm. The female gonopods of *P. viridiceps* are illustrated for the first time (Figs. 4F, G).

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is expressed in the following formula: $y = 0.50 \cdot x^{1.4281}$. Males and females of this species have an isometric growth of their pedipalp tibia with respect to the median prosomal length.

The number of segments of the antenniform first leg is quite variable, often showing individual asymmetries in the numbers of segments between both legs 1. Of twenty-two tibia I examined from sixteen different specimens, 13 (59.1%) had 31 segments, three had 29–30 segments and six had from 33 to 35 segments. Of 20 tarsi I examined, eleven (55%) had 66 segments, six had from 49 to 65 segments and three from 67 to 68 segments. The holotype male, from the Bahamas (at BMNH), had only one feeler tibia intact with 31 segments. The total number of segments ranged from 92 to 102.

Material. Fifty nine males, forty four females and two immatures. [Inst. Speol. Roum. = ISR]
Isla de Pinos: 1 ♂ 2 ♀, Cueva del Abono, Sierra de Casas, 11.VI.1969, St. Negra, V. Decou, G. Racovita, C. Fundora (ISR 31); 1 ♀, Entrance Cueva No. 6, Punta del Este, I.1975, L. R. Hernández (ACC).
Prov. Cienfuegos: 2 ♀, Cienfuegos, under stones and tables near a house, 31.VII.1931, L. B. Worley (MCZ); 1 ♂, Central Soledad, VII.1957, P. Adams (MCZ); 3 ♂ 3 ♀, Soledad, 11.III.1925, Salt, Myers (MCZ); 2 ♂ 1 ♀, Soledad, near Cienfuegos, 1–15.II.1912, T. Barbour (MCZ); 1 ♂, Soledad, 1917–1918, Barbour (MCZ); 1 juv., Soledad, 10 mi. E. Cienfuegos,

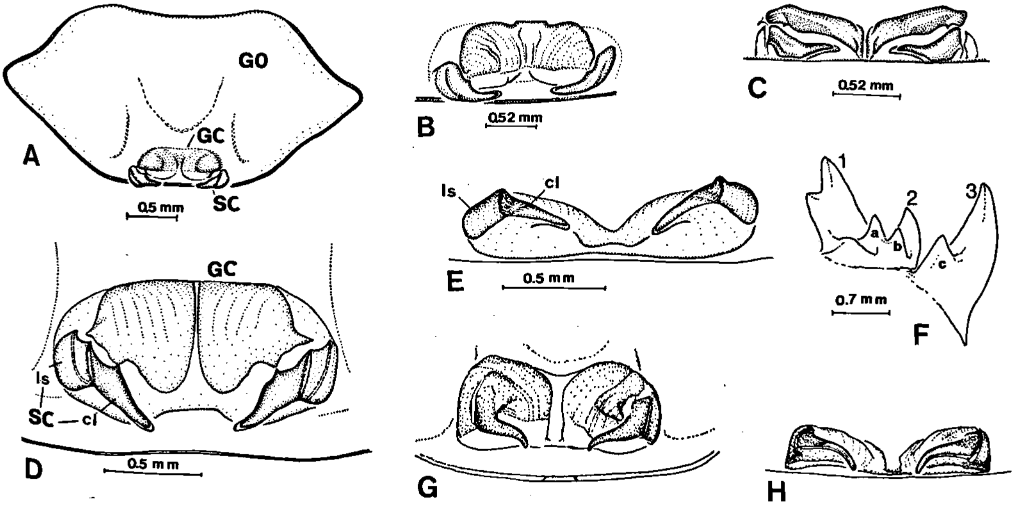


Fig. 4. A–C: *Paraphrynus robustus*, female homotype, Segunda Cueva Siboney, El Caney. A. Genital operculum (GO), dorsal view; gonopod covers (GC); sclerite (SC). B. Gonopods, dorsal view. C. Gonopods, posterior view. D–E: *Paraphrynus cubensis*, female gonopods, San Antonio de Los Baños, La Habana. D. Dorsal view, gonopod cover (GC); sclerite (SC) lateral segment (ls) and claw (cl). E. Posterior view. F–H: *Paraphrynus viridiceps*, Cueva del Abono, Isla de Pinos. F. Teeth on basal cheliceral segment, external view, right chelicera. G. Dorsal view female gonopods. H. Posterior view, gonopods.

flower garden (AMNH 5320); 1♂ 2♀, Soledad, under logs and stones near Vilches Cave, 14.VIII.1931, Worley (MCZ); 1♀, Rancho Luna, Goenaga (ACC); 3♂ 2♀, Finca Sta. Martina, Gavilán, 4.IX.1972, Hernández, L. F. de Armas (ACC); 1♀, Soledad, 15.III, Weber (MCZ); 2♂ 1♀, La Legua, 13 km S. of Soledad, under stone, VIII.1978, Armas (ACC).

Prov. Villa Clara: 2♀, Santa Clara, Sierra de Jatinoco, IV.1911, B.B. (AMNH).

Prov. Sancti Spiritus: 1♂ 1♀, Mina Carlota, Mts. Trinidad, 10–15.VII, Parsons (MCZ); 1♀, Cueva de Colón, Punta Cagüanes, Yaguajay, G. Silva T. (ACC); 1♂ 1♀, Cueva Colón, 24.IV.1969, Decou, Negrea, Racovita, Fundora (ISR 22); 1♂, Cueva Grande, Punta Cagüanes, Yaguajay, Silva (ACC); 2♂, Cueva Grande de Cagüanes, 29.IV.1969, Negrea, Decou, Racovita, Fundora (ISR 23); 5♂ 3♀, Cueva de las Columnas, near Sierra Escambray, 10 km W. Trinidad, 3.V.1969, Decou (ISR 24); 2♂ 1♀ 1 juv., hills approx. 200 m S. of San Felipe, Arroyo Blanco, I.1971, Armas (ACC); 2♂ 2♀, Sabanas de San Felipe, Jatibonico, 13.VIII.1976, Armas (ACC); 2♀, El Chorrito, Topes de Collantes, under stones, VIII.1976, Armas (ACC); 1♀, Sabanas de San Felipe, Arroyo Blanco, under stones, 27.IV.1973, Armas (ACC); 5♂, Lomas de San Felipe, Arroyo Blanco, III.1972, Armas (ACC); 1♂ 2♀, Las Cuevas, Trinidad, near motel, 16.XII.1973, Armas (ACC); 1♀, Cueva de los Masones, Trinidad, V.1970, Fundora (ACC); 1♀, Sabanas de San Felipe, Jatibonico, 8.VIII.1977, under stones, Armas (ACC); 1♂, Cueva en Topes de Collantes, 1976, Armas (ACC).

Prov. Camaguey: 2♀, Cueva Los Lagos, 25.IV.1969 (ISR 17); 3♂ 2♀, Cueva del Indio, Sierra de Cubitas, 20 km S. Bahia de Jigüey, 27.IV.1969 (ISR 19); 1♂, Ciudad Camaguey, 26.IX.1965, M. L. Jaume (ACC).

Prov. Las Tunas: 1♂, El Dieciocho, Central Amancio Rodríguez, under stones, 29.V.1973, L. Zayas (ACC).

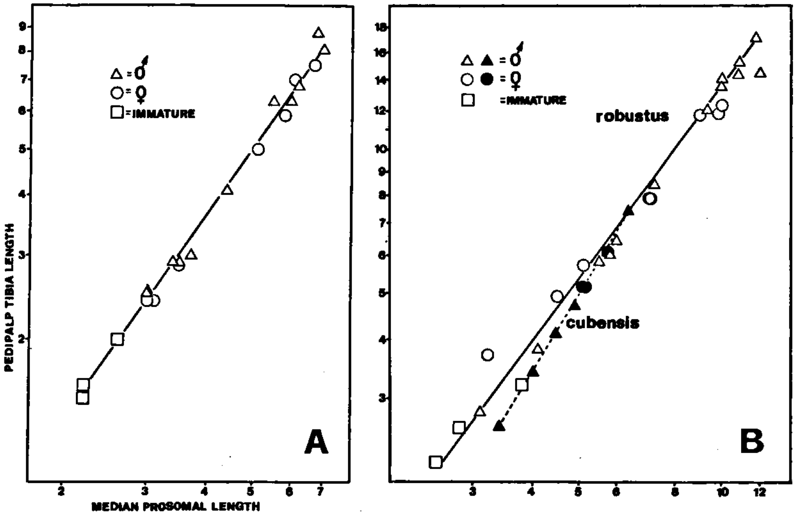


Fig. 5. Allometric growth curves in double log coordinate system: Median Prosomal Length (abscissa) versus Pedipalp Tibia Length (ordinate), measurements in mm. A. *Paraphrynus viridiceps*. B. *Paraphrynus robustus* and *P. cubensis*.

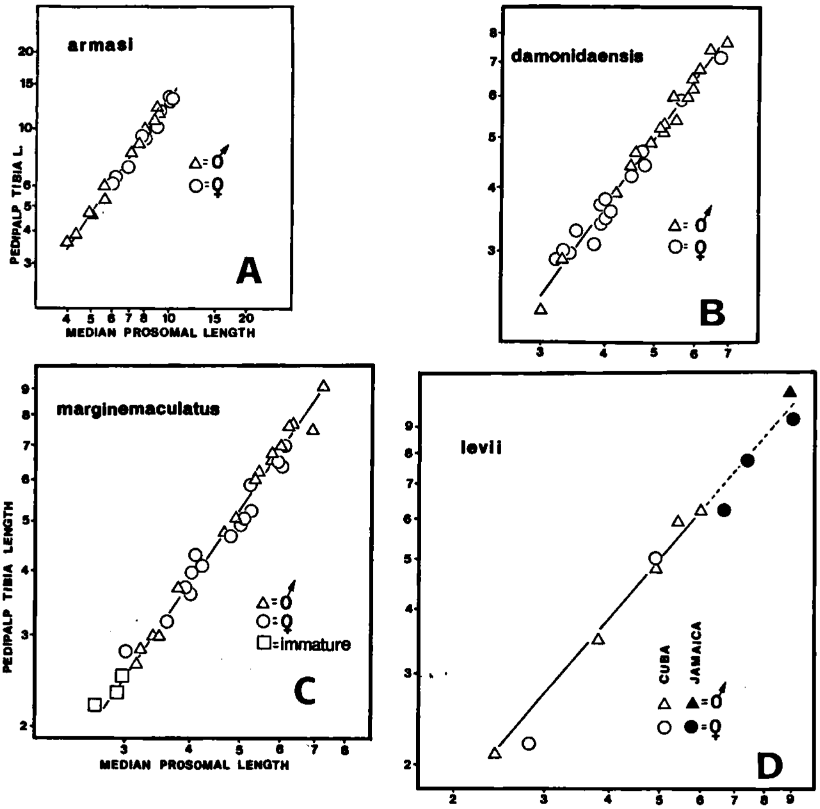


Fig. 6. Allometric growth curves in double log coordinate system: Median Prosomal Length (abscissa) versus Pedipalp Tibia Length (ordinate), measurements in mm. A. *Phrynus armasi*. B. *Phrynus damonidaensis*. C. *Phrynus marginemaculatus*. D. *Phrynus levii*, sensu stricto (Jamaica), *P. levii cubensis*.

Prov. Holguín: 1♂, Cerro Manantiales, 26.XII.1975, R. González, J. Fernández M. (ACC); 3♂ 2♀, Cueva del Guano, Sur de Gibara, 9.III.1973 (ISR 50); 3♂, Cueva de los Panaderos, Gibara, 8.III.1973 (ISR 48.1); 4♂ 3♀, Cueva de Los Santos, Gibara, 8.III.1973 (ISR 51). Incomplete localities: 2♂ 1♀, Cueva del Jibaro, Loma del Batey, 27.III.1970 (ISR); 3♂, Cueva del Círculo de Piedra, Loma del Batey, 8.I.1970 (ISR). Franganillo's collection, No. 660 (1♂) and No. 665 (1♂).

Distribution. Previously known from the Bahamas (Pocock 1893 and 1894; Banks 1906 and Mullinex, 1975) and Prov. Villa Clara, Santa Clara, Cuba (Mullinex, 1975). Reported for the first time from I. de Pinos, Provinces of Cienfuegos, Sancti Spiritus, Camaguey, Las Tunas and Holguín.

Phrynus Lamarck, 1801

Phrynus LAMARCK, 1801: 175.

Type species. *Phalangium palmatum* Herbst, 1797 by subsequent designation. I have requested the I.C.Z.N. to suppress the specific name *palmatum*, as published in the binomen *Phalangium palmatum*, for the purpose of the Law of Priority but not for that of the Law of Homonymy and to designate *Phrynus operculatus* Pocock, 1902 to be the type species of that genus (QUINTERO, 1981, 1982).

Phrynus damonidaensis Quintero, 1981

Figs. 1G; 2E; 3G; 6B; 12B

Phrynus damonidaensis QUINTERO, 1981: 138–141.

Diagnosis. Only amblypygid in Cuba with three tibial segments on leg IV and four teeth on external margin of basal cheliceral segment.

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is expressed in the following formula: $y = 0.52 \cdot x^{1.3865}$. Both sexes grow the length of their pedipalp tibia isometrically with respect to the median prosomal length (Fig. 6B).

Like *P. levii* and *P. marginemaculatus*, *P. damonidaensis* has 27 tibial and 59 tarsal segments on their antenniform legs, having a total of 86 segments. Seventy nine feelers examined from 98 individuals presented 29.1% of abnormalities in segmentation: 26–39 tibial, 54–72 tarsal segments, total number of segments ranging in the abnormal feelers from 82 to 111. The unique segmentation of *P. damonidaensis* (3 tibial IV segments; other species in Phrynidae have four) is quite constant; only one specimen (female holotype) had one of its tibia IV with only two segments.

Material. Sixty eight males, sixty females and three immatures. For previous records, see QUINTERO 1981. [Inst. Speol. Roum. = ISR]
Prov. Holguín: 2♂ 1 juv., Loma de la Cruz, VIII.1976, L. Riveron, G. Alayon (ACC).
Prov. Granma: 1♀, Cueva del Fustete, 10.IV.1969 (ISR).
Prov. Santiago de Cuba: 2♂ 3♀, El Morro, under stones, 5.VIII.1975, L. F. de Armas, L. R. Hernández (ACC); 1♂, Chivirico, 28.X.1970 (ISR); 1♂ 3♀, Juraguá, El Caney, under stones,

20.V.1972, Armas (ACC); 2♂ 1♀, Cayo Dama. Chivirico. El Cobre, 24.V.1972, Armas (ACC); 2♂ ♀♀, Siboney, El Caney, VIII.1975, Armas (ACC); 9♂ 4♀, Siboney, under stones, 19.V.1972, Armas (ACC); 1♀, Laguna de Baconao, 20.VIII.1966, M. L. Jaume (ACC); 5♂ 4♀, Jutisi, West Siboney, 20.VIII.1975, Armas (ACC); 10♂ 8♀, Cabagán, El Cobre, under stones, VIII.1975, Armas, Hernández (ACC); 1♂ 1♀, Juraguá, near beach, Hernández (ACC); 1♂, La Mula, Guamá, S. base of Pico Turquino, III.1980, O. H. Garrido, R. Carnero (ACC); 1♂ 2♀, Las Cuevas, S. base P. Turquino, III.1980, Garrido, Carnero (ACC). *Prov. Guantánamo*: 3♂ 1♀, Pta. Maisí, Baracoa, 6.X.1973, Armas, C. Fundora (ACC); 3♂ 4♀, S de la Canasta, La Yaya, under stones, I.1979, Hernández, Armas (ACC); 5♂ 3♀, Tortugilla, arid conditions, VIII.1975, Armas, Hernández (ACC); 1♀, Cuesta del Chivo, Maisí, dried woods near shore, 6.X.1973, Fundora (ACC); 1♂, Imías, VIII.1975, Armas (ACC); 1♂, La Asunción, Gran Tierra, VII.1980, Alayón (ACC).

Distribution. Collected once, in epigean habitats, from the Provinces of Pinar del Río (QUINTERO, 1981) and Holguín. Common in the Provinces of Santiago de Cuba and Guantánamo, frequently found under rocks. It has also been collected from a cave in Prov. Granma. Outside of Cuba, it has been found in Swan Islands, Honduras.

Phrynus armasi Quintero, 1981

Figs. 1C; 2G; 3F; 6A; 12B

Phrynus armasi QUINTERO, 1981: 132–133.

Diagnosis. Easily recognizable by its large size, up to 32.5 mm long (largest amblypygid species from Cuba), the presence of a single tooth on the external margin of the basal cheliceral segment (Fig. 2G) and the peculiar, pale yellow-brown sclerites of the female gonopods (Figs. 3F).

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is expressed in the following formula: $y = 0.44 \cdot x^{1.4826}$. Both sexes grow their pedipalp tibia length isometrically with respect to the median prosomal length (Fig. 6A).

P. armasi is the only *Phrynus* species in Cuba with 31 tibial and 66 tarsal segments on their antenniform legs, making a total of 97 segments. Frequent abnormalities and asymmetries in segmentation are present (the male holotype has 39 tibial and 72 tarsal segments). Thirty feelers examined from 20 individuals yielded 16.7% of abnormalities, they had from 35 to 53 tibial segments. The other 83.3% had 30 tibial segments. In the tarsi of leg I, 23.8% abnormalities of segmentation were found, having from 65 to 90 tarsal segments, while 76.2% had 66. Total number of segments ranging from 96 to 137 on leg I.

The small proximal spine at the base of spine Td-7 is absent in immatures (body length shorter than 10 mm).

Material. Twenty nine males, forty females and four immatures. For previous records see QUINTERO 1981. [Inst. Speol. Roum. = ISR]

Prov. Pinar del Río: 1 ♀, Ruba, Sierra del Rangel, near Taco-Taco, II.1903, H. C. Voelekers (Mus. Ham. 29); 1 ♀ 3 juv., Loma Pendejeral, Mil Cumbres, La Palma, 15.II.1980, J. de la Cruz (ACC); 1 ♀, Cueva del Fango, Granja Moncada, Sumidera, Sierra de Los Organos, 14.IV.1973 (ISR 59); 2 ♂ 5 ♀, Cueba de la Vela, Granga Moncada, Sierra de Los Organos, 14.IV.1973 (ISR 60.1).

Prov. La Habana: 2 ♂ 2 ♀, cave between Maranas and La Jaimanita, 1.II.1917, T. Barbour, Brooks, Warner (MCZ); 1 ♀, Cueva del Baño, near Las Cañas, 50 km SW La Habana, 18.XI.1970 (ISR 13); 1 ♀, Cueva El Mudo, Catalina de Güines, 7.V.1964, E. Elso (ACC); 3 ♂ 2 ♀, Cueva El Mudo, 20.III.1964, Elso (ACC); 2 ♀, Cueva El Mudo, III.1966, Elso (ACC); 1 ♀, Cueva Habana, Aguacate (ACC); 1 ♀, Universidad de Villanueba, Siboney, 9.IX.1958, Lázaro, Iterián (ACC); 2 ♂ 3 ♀, Cueva del Abono, Cascajales, San Andrés, Caiguanabo, Sierra de Los Organos, 24.I.1975, de la Cruz (ACC); 4 ♂ 7 ♀, Cueva del Indio, Tapaste, 3.X.1959, M. L. Jaume (ACC); 1 ♂, Rancho Mundito, San Cristóbal, 7.X.1951, Jaume (ACC); 1 ♂ 1 ♀, Rancho Mundito, 14.IV.1973, de la Cruz (ACC); 1 ♂ 1 ♀, Cueva del Indio, San Vicente, 23.I.1975, de la Cruz, R. Novo (ACC); 1 ♂ 1 ♀, Cueva del Cable, Viñales, de la Cruz (ACC); 1 ♂, Valle de Pica-Pica, Sumidero, 3.IV.1967, Jauna (ACC); 1 juv., Cueva Cinco Cuevas, Boca de Jaruco, 15.V.1973 (ISR 68.1); 9 ♂ 4 ♀, Cueva del Jagüey (100 m E Cueva del Mudo), Catalina de Güines, 14.XII.1980, D. Quintero, Armas, Noel Gotera G. (pers. coll.).

Distribution. Troglophilic species endemic in the Provinces of Pinar del Río and La Habana.

Phrynus marginemaculatus C. L. Koch, 1841

Figs. 1B, F; 2H; 3I; 6C; 12B

Phrynus marginemaculatus C. L. KOCH, 1814: 6–8.
Phrynus marginemaculatus: QUINTERO, 1981: 141–142.

Diagnosis. *P. marginemaculatus* is closely related to *P. levii* and its diagnosis is dealt with under that species.

Allometry & variation. The relationship between pedipalp tibia length (y) and median prosomal length (x) is given by the following formula: $y = 0.50 \cdot x^{1.4550}$. Both sexes grow their pedipalp tibia length isometrically with respect to the median prosomal length (Fig. 6C) and the length of leg IV femur isometrically to the prosomal width. Two males, one from Sto. Tomás, Ciénaga de Zapata and the other from Cotland Cay, Abado, had their fifth abdominal sternite divided in the middle by a narrow transverse membranous thin band, an abnormality previously reported for another species of *Phrynus* (Quintero 1981a, one

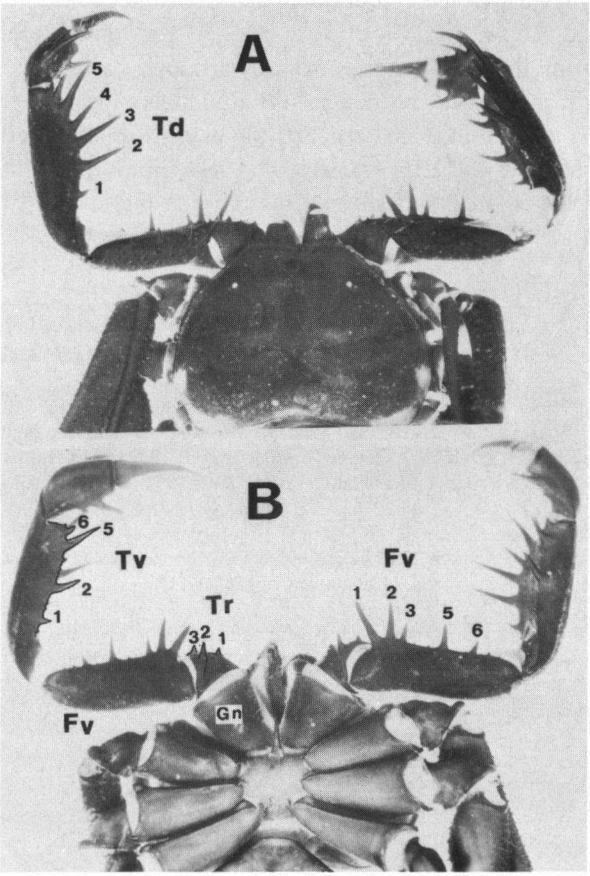


Fig. 7. A–B: *Phrynus marginemaculatus* C. L. Koch, gravid female (Bahamas, New Providence). A. Dorsal view of carapace and pedipalps; Td, tibia dorsal, spines 1–5. B. Ventral view. Tv, tibia ventral; Tr, trochanter ventral; Fv, Femur ventral. Below gnathocoxa (Gn), the sternal plate.

male of *P. damonidaensis* from Cayo Dama, Chivirico, El Cobre, Cuba). The segmentation of the feelers was examined in 24 individuals: in 29 tibia there were 24.1% abnormalities in segmentation (3 had 25–26 segments; 4 had 28–32 segments), the rest having 27 tibial segments. In 29 tarsi, there were 20.7% abnormalities in segmentation (4 with 53–55 segments and 2 with 60–62 segments), the rest having 59 segments. Total number of segments ranging from 79 to 94. *P. marginemaculatus* is the most variegated amblypygid species present in Cuba. No distinct color morphs can be recognized. The coloration of carapace and abdominal tergites from specimens from different localities is quite variable. Variation in coloration is in part influenced by the age of individuals. Specimens from La Asunción, Guantánamo, Cuba reached the greatest body length for the species, 20 mm. The Cuban specimens of *P. levii* (holotype of this species from a cave in Jamaica) superficially resemble *P. marginemaculatus* (see discussion under *P. levii*).

Material. Sixty four males, forty eight females and seven immatures; records too numerous to be listed. Specimens from *all Provinces* and in *Isla de Pinos*. It's the only amblypygid that has been collected from the Provinces of Matanzas (10 records) and Ciego de Avila (1 record).
New records. PUERTO RICO: 1♀, Isla Mona, on road, at night after rain, 21.II.1974, W. Mohler, T. A. Wiewandt (AMNH); 1♀, Mona, Faro Rd., at night on dry pavement, 26.V.1974, Wiewandt (AMNH); 1♀, Coamo Springs, 25.VIII.1919 (AMNH). ANTIGUA: 1♂, Reeds Point near Jolly Beach, under igneous rocks, 2.VII.1963, E. N. Kjellesvig-Waering (AMNH); 4♂, Crab Point, 5.X.1963, Kjellesvig-Waering (AMNH).

Distribution. This amblypygid has the widest distribution in Cuba and is the only species collected in the Provinces of Matanzas and Ciego de Avila. – Previous records (QUINTERO 1981) indicate that *P. marginemaculatus* occurs in Bermuda (one record), the Bahamas and Southern Florida (the amblypygid species with the uppermost latitudinal distributional range in the Eastern part of America), Cuba, Jamaica, Haiti and Dominican Republic. The new records enlarge the southernmost distributional range to Puerto Rico and, in the Lesser Antilles, Antigua.

Phrynus levii cubensis new subspecies

Figs. 1E; 2I; 3H; 6D; 12B

Phrynus levii QUINTERO, 1981: 143–144 (in part).

Type data. Syntype: 2 males, 3 females, Manacal, Carretera Topes-Trinidad, km 14, *Prov. Sancti Spiritus*; VIII.1976, L. F. de Armas, deposited in ACC.

Diagnosis. Body length measurements of nineteen specimens of *P. levii* from Cuba showed that they were shorter (maximum 15 mm) than the Jamaican specimens of this species (maximum 24 mm). The great difference in size, its epigean habit and the consistent differences listed below warrant sufficient grounds to separate the Cuban specimens as a subspecies. Three of the four differences indicated previously between *P. levii* and *P. marginemaculatus* (QUINTERO, 1981, in key) are variable for the Cuban specimens (only two males of *P. levii* had been previously examined from Cuba) and therefore are no longer useful to separate both species. These invalidated differences are: dorsal coloration of basal cheliceral segments as compared to that of frontal area of carapace; whether or not spines Fv 1, 2 and 3 were implanted on separate bases each; coloration of abdominal tergites, whether unicolored or variegated. Claws of female gonopods of *P. levii* closely resemble those of *P. marginemaculatus*, in particular the Cuban specimens of *P. levii*, but are thinner at their base and distinctly more inflated basally in *P. marginemaculatus*. *P. levii* is diagnosed by the dentition on the external margin of the basal cheliceral segment (three teeth, while *P. marginemaculatus* has only two) and by the different trichobothria pattern on the sf rows of the fourth distitibia leg (five to seven hairs present distally in *P. levii*, while *P. marginemaculatus* has only three to four hairs distally on row sf). The proximal margin of tooth *a*, extending to tooth 1 on the external margin, presents a carina in a few *P. marginemaculatus* specimens giving the impression of an additional tooth. The occurrence of this type of variation can be confusing, making species recognition difficult. Specimens of *P. levii* both from Cuba and Jamaica present a wide yellowish band around the carapace endites, more conspicuously around the posterior half. The posterior maculae on the ectal angles of the carapace when present in *P. marginemaculatus* might be joined in some specimens by a continuous posterior yellowish band different from the one of *P. levii* as it is not continuous around the anterior portion of the carapace. The abdominal tergites of *P. levii* from Cuba and *P. marginemaculatus* are variegated while the only four known specimens of *P. levii* from Jamaica have plain yellowish-brown tergites.

Allometry. The relationship between pedipalp tibia length (y) and median prosomal length (x) is expressed in the following formula: $y = 0.74 \cdot x^{1.1626}$. See graph 6D.

Material. For previous records see QUINTERO 1981a. Six males and nine females have been examined.
Prov. Sancti Spiritus: 1 ♂ 5 ♀, Carretera Topes-Trinidad de Collantes, km 2, 17.XII.1973, L. F. de Armas, L. R. Hernández (ACC); 1 ♂, Trinidad, 15.XII.1975, Hernández (ACC); 1 ♂ 1 ♀, banks of Río Guaurabo, Trinidad, XI.1976, Armas (ACC).
Prov. Guantánamo: 1 ♂, Cayo Güin, Baracoa, II.1972, Armas (ACC).
New records for *P. levii* sensu stricto: JAMAICA, 1 ♀, Claremont, 24.VII.1960, Vaurie (AMNH); 1 ♂ 1 ♀, Palm Beach, Montego Bay, 3.III.1911 (AMNH).

Distribution. This subspecies of *P. levii* is known only from Provinces Sancti Spiritus and Guantánamo.

CHARONTIDAE Simon, 1892

Charinides Gravely, 1911

KEY TO THE SPECIES FROM CUBA

1. Median eyes and ocular tubercle reduced in size, in some cases only a minute black protuberance without distinct median eyes (Figs. 8A, 9A) 2
– Median eyes and ocular tubercle completely wanting (Figs. 10A, 11D) 3

2. Antenniform legs with 21 tibial and 36 tarsal segments; each cushioned gonopod covered with a thin, longitudinal finger-like gonopod cover extending anteroposteriorly, rising dorsally at the middle of its posterior (Fig. 8F); median ocular tubercle a minute black protuberance; trogophiles . . . . *cubensis* n. sp.

– Antenniform legs with 23 tibial and 41 tarsal segments; gonopod cover on median half of cushioned gonopods as finely grooved, thin, wide plate (Fig. 8G); median eyes and ocular tubercle reduced in size; epigean . . . . *acosta* n. sp.

3. Antenniform legs with 33 tarsal segments, proximal tarsal segment less than three times as long as second segment (Fig. 10D); wide frontal area of carapace subdivided by a horizontal row of short setae (Fig. 10A); second tarsomere of leg four tarsi entire (four tarsomeres can be counted); trichobothria bc much closer to sbf (Fig. 11E) . . . . *wanlessi* n. sp.
– Antenniform legs with 39 tarsal segments, proximal segment 4–4.5 times length of following segment; entire and noticeably narrow frontal area of carapace (Fig. 11D); second tarsomere on leg four divided distally in two parts by a transverse membranous band (five tarsomeres can be counted); trichobothria bc near center of bf and sbf (Fig. 11A) . . . . *decu* n. sp.

Charinides Gravely, 1911

Charinides Gravely, 1911: 35; 1915: 442.
Speleophrynus Ravelo, 1975: 77–85; 1977: 17–25. [new synonymy]

Type species. *Charinides bengalensis* Gravely, 1911, by monotypy. Known only from Calcutta, *India*. Topotypic specimens and four cotypes at BMNH, examined.

Diagnosis. Resembling the pedipalp spination of *Charinus* Simon, 1892 in the following features: basitarsus with two long spines on the upper edge, distal the longest; a single spine on ventral border of basitarsus, near its distal end; tibia dorsally expanded distally with one spine and a setiferous tubercle distal to the longest spine; distitarsus clearly divided into two segments; the post-tarsus without spines and the tarsus with two spines on its upper edge, the distal being the longest; trochanter with a well developed process on its lower face studded with strong setiferous tubercles and projecting anteriorly; proximal half of the dorsal margin of the femur conspicuously flared out. Like *Charinus*, species of *Charinides* are small sized amblypygids which lack the two opercular sacs at the posterior border of the second abdominal sternite (ninth segment) and have similar basic chaetotaxy on leg IV tibia, except the number of trichobothria in rows sc and sf which are variable according to species.

Specimens of *Charinides* can be clearly separated from *Charinus*, having four tibial segments on leg IV while *Charinus* has five. All presently known species of *Charinus* have 23 tibial segments on the feeler (unpublished data), while four of the seven now known species of *Charinides* have 21 tibial segments in their feelers. *C. acosta* n. sp., *Charinides tronchonii* (Ravelo, 1975) [new combination] and *Charinides bordoni* (Ravelo, 1977) [new combination] have 23 segments.

Besides drawing attention to the number of segments on leg IV tibia, GRAVELY characterized *Charinides* as having the tarsi of the walking legs IV jointed instead of V jointed as *Charinus*. What has been counted as the fifth tarsal segment is the apparent division of the second tarsomere by a transverse membranous band near its distal end (see Fig. 1A). This character is species specific but not generic.

Two other charontid genera have four tibial segments on leg IV: *Cataegeus* Thorell, 1889, and *Phrynichosarax* Gravely, 1915. The only known species of *Cataegeus*, *C. pusillus* Thorell, 1889, found in caves of Burma, SE Asia, can be clearly separated, having the proximal dorsal spine on the pedipalp basitarsus longer than the following, while in *Phrynichosarax* the distal is the longest. The type species of *Phrynichosarax*, *P. cochinensis* has, according to GRAVELY, 1915, three to four segments ["more or less distinctly 2- or 3-jointed," "normally 3-jointed (? always)"]. In 1915 the distitibia was not considered to be part of the tibia and thus not included in segment counts of the leg IV tibia; it was considered to be a separate segment: the metatarsus. By indiscriminately using the outdated terminology given in the keys of KRAEPELIN (1899) and WERNER (1935) or reading the old species descriptions without examining specimens, erroneous keys of the Charontidae have been prepared (see for example, KRITSCHER, 1959, and STOCKTON, 1976).

It appears to me necessary to transfer some of the species now included in *Phrynichosarax* to *Sarax* and to redefine *Phrynichosarax* to include only species having four tibial segments instead of five as in *Sarax*, but having in common a similar pedipalp spination and the presence of two opercular sacs at the posterior border of the second abdominal sternite.

RAVELO (1975, 1977), on the basis of an unpublished manuscript of

STOCKTON's keys for the Charontidae, considered the presence of four tibial segments on leg IV a unique generic character not previously described. He thus created a new genus, *Speleophrynus* solely on the presence of this segmentation, to include two cavernicolous pulvinated species from Venezuela. A revision of topotypic specimens of these two species indicated that this genus should fall under *Charinides*. A revision of *Charinides* is being completed by the present author, describing five additional new species for America.

Charinides cubensis new species

Figs. 8A–E, 9E, 12C

Type data. Male holotype, Cueva La Majana, *Prov. Guantánamo*, 4.IV.1969 (Inst. Speol. Roum., No. 7), deposited in ACC. Two females and three immatures, paratypes, with same data as holotype, deposited in BMNH.

Diagnosis. Four species of *Charinides* have 21 tibial segments on the feelers: *C. bengalensis*, *C. wanlessi*, *C. decu* and *C. cubensis*. *Charinides wanlessi* and *C. decu* can be easily separated from the other two species because they completely lack the median eyes and ocular tubercle. *Charinides bengalensis*, only known from Calcutta, India, has a well developed median ocular tubercle, an entire tarsomere on leg IV tarsi and button-like sternites (meso- and pentasternum). *Charinides cubensis* has only a minute black protuberance as median ocular tubercle (Fig. 8A), the second tarsomere divided distally by a membranous transverse band and the sternites (meso and penta) much wider than long. Both species apparently have a very similar number of tarsal segments on their feelers: 35 in *C. bengalensis* and 36 in *C. cubensis*, while the females have cushion-like gonopods. The gonopod covers and other details of the external anatomy of the gonopods are quite distinctive for each species.

Description of male holotype. Carapace and pedipalps yellowish-dark brown. Diffuse lighter transverse band behind frontal area. Opisthosomal tergites and femora lighter than carapace, uniformly colored.
Carapace. – Slightly convex anterior edge with 6 fine pointed setae. Scatt-

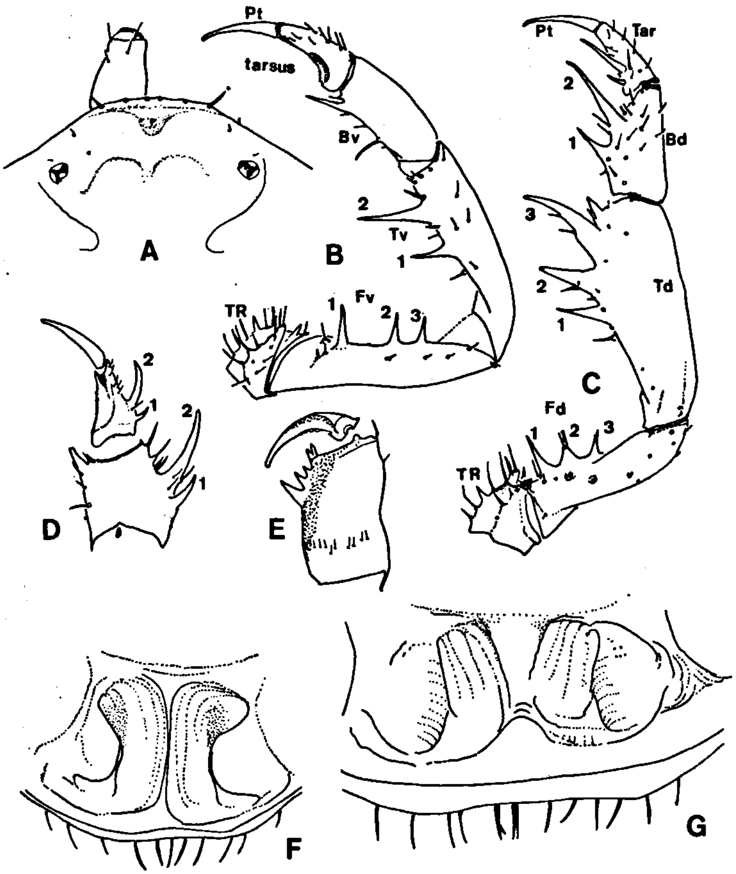


Fig. 8. A–E: *Charinides cubensis* n. sp., holotype male. F. Paratype female. A. Frontal area of carapace and dorsal of chelicera. B. Left pedipalp, ventral (Pt, post-tarsus; Bv, basitarsus; Tv, tibia; Fv, femur; Tr, trochanter). C. Right pedipalp, dorsal. D. Right pedipalp hand, dorsal spines numbered. E. Chelicera, medial face. F. Dorsal view of female gonopods. G. *Charinides acosta* n. sp., gonopods, paratype female.

ered short, sharp pointed setae over carapace. Frontal process concealed from above. Frontal area well defined, dark, and distinctly more narrow anteriorly. Median ocular tubercle nearly obsolete, a minute black protuberance without distinct median eyes, 0.1 mm from anterior border. Lateral eyes well developed, 1.0 mm from each other, 0.5 mm from anterior edge, 0.1 mm to lateral edge.

Chelicerae. – Fig. 8E. Basal cheliceral segment without teeth on external margin. First tooth on internal margin with proximal cusp distinctly longer than distal. Medial face with ventrodorsal irregular row of some 10 thin, fine-pointed bristles in lower third.

Genitalia. – Minute and pale opisthogeminate organs, at dorsoposterior edge of genital operculum, each having several thin projections towards a centrally positioned cushion on medial and external sides. Paratype female gonopods as in Fig. 8F.

Chaetotaxy. – A total of 18 trichobothria on tibia of leg IV, as in Fig. 9E. Distitibia with 5 trichobothria each in rows sc and sf. Hair bc closer to bf than to sbf.

Pedipalps. – Figs. 8C, D. Trochanter with two spines on anteroventral edge, proximal longest. Femur with three spines dorsally and ventrally, decreasing distally in length. On either side of femur, proximal to spines Fv-1 and Fd-1 (longest spines), two setiferous tubercles extending from their bases to lower distal border. Tibia dorsally with 4 spines, Td-3 the longest. Proximal to Td-1, displaced from spinous border toward tibial medial face, one spine-like setiferous tubercle. Three spines ventral on tibia, increasing distally in length, distal Tv-3 a well developed setiferous tubercle. Basitarsus with two spines dorsally, distal is longest. Distal to Bd-2, two setiferous tubercles. One spine ventrally near distal border. Tarsus with 2 spines dorsally, longest is distal.

Legs. – Second tarsomeres of all tarsi with membranous transverse band near distal end. Feeler (antenniform leg) with 21 tibial and 36 tarsal segments. Proximal tarsal segment about 1.8 times longer than following.

Measurements of male holotype. – Total length, 4.6 mm. Median prosomal length, 1.8 mm; maximal prosomal length, 1.9 mm; prosomal width, 2.6 mm. Pedipalp tibia length, 1.5 mm. Legs: femur I, 3.9 mm; femur II, 2.6 mm; femur III, 3.1 mm; femur IV, 2.7 mm; tibia IV, 3.8 mm; ratio of tibial segments from proximal to distal: 0.34/0.10/0.17/0.39. Basitarsus IV, 1.7 times longer than following tarsal segments added.

Distribution. Known only from type locality.

Etymology. Adjective derived from Cuba.

Charinides acosta new species

Figs. 1A, C; 8G; 9A–F; 12C

Type data. Female holotype, from Camaguey, *Prov. Camaguey*, 1954, J. T. Acosta (MCZ), deposited in MCZ. Female paratype, Loma de La California, Cacayal, Baracoa, *Prov. Guantánamo*, XI.1980 L. R. Hernández (ACC), deposited in ACC.

Diagnosis. Like *Charinides tronchonii*, species only known from one cave in Venezuela, it has 23 tibial and 41 tarsal segments in its feeler. Both species and *C. decu* have the unique feature within the Charontidae of having the distal cusp of tooth one on the medial edge of the basal cheliceral segment longer than the proximal cusp (Fig. 9F). This feature had been considered to be a characteristic of phrynids among non-pulvinated amblypygids (see QUINTERO, 1980a for a discussion). *C. tronchonii*'s carapace differs in the following points from *C. acosta*: it is deeply cordate, with median eyes and eye tubercle completely wanting, lateral eyes whitish and six setae on anterior border. *C. acosta* has a shallow cordate carapace, well developed median eyes and eye tubercle, although reduced in size and partly sunken in carapace, lateral eyes with black pigmentation, and seven setae on anterior border.

C. tronchonii has 6 teeth on the medial margin of the cheliceral claw while *C. acosta* has 5. In *C. tronchonii* males, femur I is 3.6 to 4 times the median prosomal length (m.p.l.), 2.6 to 3.4 times in females of the same species. Only two females of *C. acosta* are known and their femur I length is 1.5 and 2.2 times m.p.l. (body length 4.3 and 4.9 respectively). In paratype female of *C. cubensis* (4.7 mm body length), femur I is 1.7 times m.p.l.

Description of female holotype. Carapace, pedipalps and femur I, yellowish-light reddish-brown. Femora of legs yellowish-light brown. Abdominal tergites yellowish, without a trace of pattern.

Carapace. – Evenly convex anterior edge with seven fine pointed setae (Fig. 9A). Carapace covered with very short, sharp pointed scales arranged in irregular waving rows, more distinct on frontal area. At low magnification, they appear as rows of small granulations. Frontal process concealed from above. Frontal area slightly darker and more convex than rest of carapace but not distinctly set off. Black median ocular tubercle reduced in size, appears partly sunken in carapace with well developed

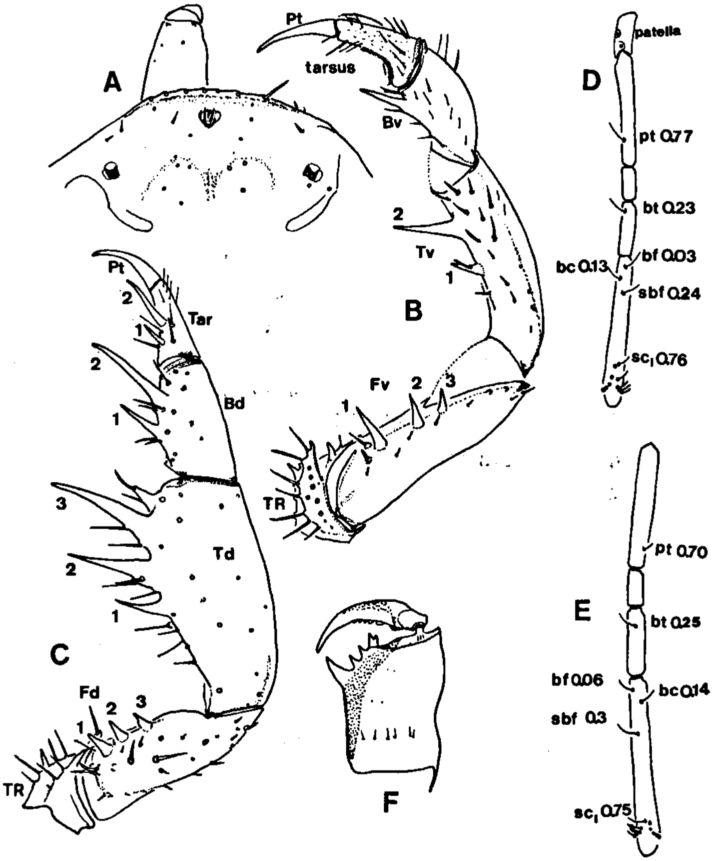


Fig. 9. *Charinides acosta* n. sp., holotype female. A. Frontal area of carapace and dorsal view of left chelicera. B. Left pedipalp, ventral. C. Right pedipalp, dorsal. D. Patella and tibia, right leg IV. Numbers indicate positional ratios of respective trichobothria (pt, proximotibial; bt, basitibial; bf, basofrontal; bc, basocaudal; sbf, subbasofrontal; sc_1, first trichobothrium in series caudal). F. Chelicera, medial face. E. *Charinides cubensis*, holotype male, left tibia IV.

median eyes and two thick setae at its posterior border, 0.13 mm from anterior border. Lateral eyes with black pigment, 1.1 mm from each other, 0.26 mm to lateral edge.

Chelicerae. – Fig. 9F. Basal cheliceral segment without teeth on external margin. First tooth on internal margin with proximal cusp shorter than distal. Medial face with ventrodorsal, straight row of 6 fine pointed bristles positioned in posterior (basal) third of the segment.

Genitalia. – Male ophistogeminate organs not known. Female gonopods as in Fig. 8G.

Chaetotaxy. – A total of 18 trichobothria on tibia of leg IV, as in Fig. 9D. Distitibia with 5 trichobothria in each row sc and sf. Hairs bc near center between bf and sbf.

Pedipalps. – Figs. 9B, C. Trochanter with two spines on anteroventral edge, longest is proximal. Femur with three spines dorsally and ventrally, decreasing distally in length. Femur, proximal to longest spines ventrally and dorsally, two well developed setiferous tubercles. Small tubercles in diagonal row on ventral, lower surface of femur. Tibia dorsally with 4 spines, Td-3 the longest. Proximal to Td-1, two well developed setiferous tubercles, displaced from spinous border toward medial face of tibial. Two spines ventral on tibia, distal longest. Proximal to Tv-1, one spinule. Without setiferous tubercles distal to Tv-3. Basitarsus with two spines, proximal about half length of distal. Distal to Bd-2, two setiferous tubercles. One spine ventrally near distal border. Tarsus with two spines, proximal less than half length of distal and markedly thinner.

Legs. – Second tarsomeres of all tarsi with membranous transverse band near distal end Fig. 1A. Feeler with 23 tibial and 41 tarsal segments. Proximal tarsal segment of feeler, 1.4 times length of second segment.

Measurements of female holotype. – Total length, 4.9 mm. Medial prosomal length, 2.1 mm: maximal prosomal length, 2.2 mm; prosomal width, 2.9 mm. Pedipalp tibia length, 1.5 mm. Legs: femur I, 4.5 mm; femur II, 2.8 mm; femur III, 3.4 mm; femur IV, 2.8 mm; tibia IV, 4.6 mm, ratio of segments from proximal to distal: 0.32/0.10/0.16/0.42. Basitarsus IV, 1.6 times length of following tarsal segments added.

Distribution. Known from two epigean localities in Provinces of Camaguey and Guantánamo, Cuba.

Etymology. Patronym honoring the collector.

Charinides wanlessi new species

Figs. 10A–E, 12C

Type data. Male holotype and one immature, Cueva Los Majaes, Estación 12, Siboney, El Caney, *Prov. Santiago de Cuba*, XII.1966, C. Fundora (ACC), deposited in ACC. Paratypes, one male, 2 females, 2 immatures, Cueva Los Majaes, 23.III.1969 (Inst. Speol. Roum.). Deposited in MCZ.

Diagnosis. *Charinides decu* and *C. wanlessi* are the only two species of *Charinides* present in Cuba that lack the median eye and ocular tubercle and have 21 tibial segments in leg I. *C. wanlessi* can be separated

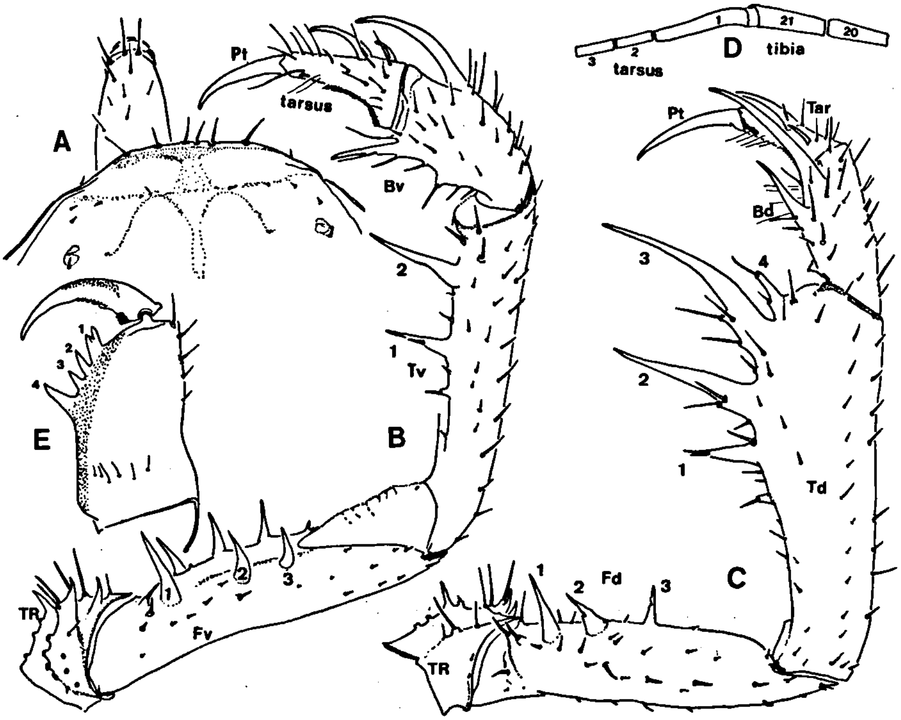


Fig. 10. *Charinides wanlessi* n. sp., holotype male. A. Frontal area of carapace and dorsal view of left chelicera. B. Left pedipalp, ventral. C. Right pedipalp, dorsal. D. Articulation tibia-tarsus, feeler. E. Chelicera, medial face.

from *C. decu* by being larger animals that have 33 tarsal segments in leg I, proximal tarsal segment of leg I less than 3 times as long as second segment, a distinctly wider frontal area of carapace; entire second tarsomere on leg IV and trichobothria bc much closer to sbf than to bf in distitibia of leg IV. *C. decu* are small animals that have 39 tarsal segments in leg I, proximal tarsal segment of leg I from 4 to 4.5 times length of following segments added, a distinct narrow frontal area of carapace, second tarsomere divided and trichobothria bc near center, between bf and sbf.

Description of male holotype. Carapace pedipalps and femur I, yellowish-brown; abdominal tergites and femora of legs lighter, more yellowish than carapace, without a trace of pattern.

Carapace. – Slightly convex anterior edge with 6 fine pointed setae (Fig. 10A). Transverse row of short setae marking division of frontal area in two parts: an anterior band, broadly conical, carrying the six forward directed setae and having its surface subdivided by two low elevations confluent at the center. Posterior frontal area with whitish, rudimentary lateral eyes and no trace of median ocular tubercle; lighter than rest of carapace. Fine pointed setae scattered on carapace. Lateral eyes 1.5 mm from each other, 0.5 mm from anterior border, 0.1 mm to lateral edge.

Chelicerae. – Fig. 10E. Basal cheliceral segment without teeth on external margin. First tooth on internal margin with proximal cusp distinctly longer than distal. Medial face with ventromedial row of 6 stronger bristles in posterior third.

Genitalia. – On ventral side, each half of ophisthogeminate organ shows two dark sclerites bordering posterior opening for lobes, dark band which continues toward the medial part of the dorsal side. Lateral and dorsolateral lobes projecting from a common base, having V-shaped dark sclerite at the lateroventral corner. Ventramedial lobe is a large, pale and conical lobe, with its elongated apex pointing toward the lower part of the dorsoventral middle line. Lateromedial lobe small, hardly visible behind the above mentioned lobes. On dorsal side, two under-surface visible sclerotized margins, arching outwards from posterior sclerotized rim (lobes opening), and extending posteroanteriorly.

Chaetotaxy. – A total of 18 trichobothria on tibia of leg IV, as in Fig. 11E. Distitibia with 5 trichobothria in rows sc and sf. Hair sc closer to sbf.

Pedipalps. – Figs. 10B–C. Trochanter with two spines on anteroventral edge, proximal longest. Femur dorsally with 4 spines decreasing distally in length, distal a spinule. Two strong setiferous tubercles proximal to spine Fd-1; proximal to spine Fv-1, smaller setiferous tubercles. Femur ventrally with 3 spines decreasing distally in length, tibia dorsally with 4 spines, Td-3 the longest. Proximal to Td-1, two setiferous tubercles. Tibia ventral with two spines and proximal to shorter Tv-1, two shorter, spine-like setiferous tubercles. Distal to Tv-2, three strong setiferous tubercles. Spine Bd-1 about half length of Bd-2. Ventrally, one distal spine and an elongated spine-like setiferous tubercle near half the segment. Tarsus with two spines dorsally, distal more than double length of proximal.
Legs. – Second tarsomeres entire. Feeler with 21 tibial and 33 tarsal segments. Feeler proximal tarsal segment 2.8 times longer than following segment.

Asymmetries. – Left leg IV tibia, bisegmented. Segments ratio: 0.61, proximal; 0.39, distal. Proximal segment with two trichobothria positioned 0.81 and 0.84, probably representing trichobothria pt and bt, respectively. Partial membranous line only on external face of second tarsomere of left leg IV tarsus.

Measurements of male holotype. – Total length, 7.2 mm. Medial prosomal length, 2.4 mm; maximal prosomal length, 2.7 mm; prosomal width, 3.2 mm. Pedipalp tibia length, 2.4 mm. Legs: femur I, 6.0 mm; femur II, 3.6 mm; femur III, 4.2 mm; femur IV, 3.7 mm; tibia IV, 5.7 mm; ratio of segments from proximal to distal: 0.32/0.11/0.20/0.36. Basitarsus IV, twice length of following tarsal segments added.

Material. Three males, eight females and eight immatures. (Inst. Speol. Roum. = ISR)
Prov. Santiago de Cuba: 2♀ 2 juv., Cueva Los Majaes, Siboney, 23–24.I.1963 (ISR 1); 1♂ 3♀, 1 juv. exh., Cueva Atabex, 1.5 km W Siboney, 15.II.1973 (ISR 41.2); 1♀, Cueva Atabex, 30.XI.1970 (ISR).
Prov. Granma: 2 juv., Cueva de Banega, 20.III.1973 (ISR 56).

Distribution. Troglophile endemic to Cuba; collected only in Provinces Granma and Santiago de Cuba.

Etymology. Patronym in honor of Dr. FRED. R. WANLESS, British Museum of Natural History.

Charinides decu new species

Figs. 11A–D; 12C

Type data. Male holotype, Cueva del Abono, *Isla de Pinos* (Isla de la Juventud), 11.VI.1969 (Inst. Speol. Roum., No. 31), deposited in ACC. Paratypes: 1 male, 1 female, 2 specimens without abdomens, Sierra de Casas, Isla de Pinos, 23.IV.1973 (Inst. Speol. Roum., No. 87), deposited in MCZ.

Diagnosis. *Charinides decu* in closely related to *C. wanlessi*, from which it may be distinguished by the entire, more narrow frontal area of carapace, number of tarsal segments on feelers and by having the second tarsomere of leg IV divided distally by a membranous band.

Description of male holotype. Carapace and pedipalps, yellowish-brown. Anterior border convex, with 6 fine pointed setae (Fig. 11D). Short, sharp pointed setae scattered over carapace. Frontal process concealed from above. Frontal area lighter than rest of carapace and distinctly more narrow anteriorly.
Median ocular tubercle absent. Lateral eyes abnormal but with black pigment, 0.45 mm from anterior border, 0.97 mm from each other, 0.19 mm to lateral edge.
Chelicerae. – Basal cheliceral segment with a small granule on medial margin, near tooth one of external margin. Distal cusp of tooth one distinctly longer than proximal cusp. Medial face has ventrodorsal row of five stronger fine, pointed bristles in lower third. Four denticles on medial margin of cheliceral claw.
Genitalia. – Ophistogeminate organ almost indistinguishable from *C. wanlessi*'s, except that apex of ventromedial lobe is set more dorsally and toward middle.
Chaetotaxy. – A total of 18 trichobothria on tibia of leg IV, as in Fig. 11A. Distitibia with 5 trichobothria in rows sc and sf. Hair sc near center, slightly closer to bf.
Pedipalps. – Fig. 11B–C. Trochanter with 2 spines about equal in length. Femur with 3 dorsal spines increasing distally in length. Proximal to Fd-1, three strong setiferous tubercles. Oblique row of strong setiferous tubercles extending on femur from base of Fv-1 to distal lower edge. Three spines ventral on femur, decreasing distally in length, proximal to Fv-1 one spine-like setiferous tubercle.

Tibia dorsally with 4 spines, Td-3 the longest, proximal to Td-1, displaced from spinous border toward medial face of tibia, one setiferous tubercle. Tibia ventrally with 2 spines, a tubercle proximal to Tv-1, two distal to Tv-2. Basitarsus Bd-1 about half length of Bd-2, distal to Bd-2 two setiferous tubercles. Ventrally, one spine near distal end. Tarsus proximal spine about half length of distal.

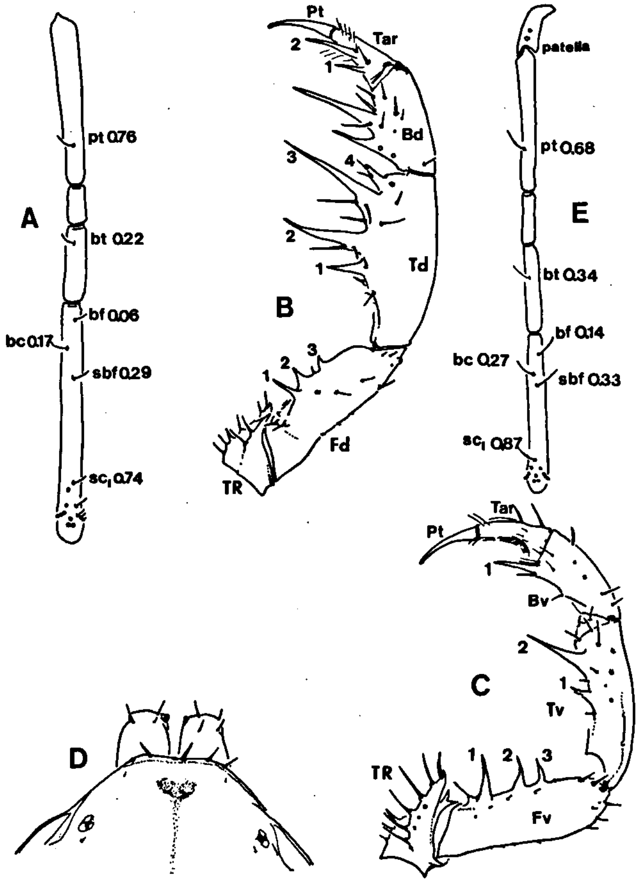


Fig. 11. *Charinides decu* n. sp., holotype male. A–D: A. Right tibia IV, trichobothria present and ratios. B. Right pedipalp, dorsal. C. Left pedipalp, ventral. D. Frontal area of carapace and dorsal view of basal cheliceral segments. E. *Charinides wanlessi* n. sp., right tibia IV, trichobothria present and ratios.

Legs. – Second tarsomeres of all tarsi with membranous transverse band near distal end. Feeler with 21 tibial and 39 tarsal segments. Feeler proximal tarsal segment about 4.5 times length of following segment.

Measurements of male holotype. – Total length, 4.5 mm. Median prosomal length, 1.7 mm; maximal prosomal length, 1.9 mm; prosomal width, 2.3 mm. Pedipalp tibia length, 1.2 mm. Legs: femur I, 3.6 mm; femur II, 2.40 mm; femur III, 2.8 mm; femur IV, 2.46 mm; tibia IV, 6.7 mm; ratio of tibial segments from proximal to distal: 0.32/0.70/0.15/0.46. Basitarsus IV, 1.7 times length of following segments.

Distribution. Only known from the type localities in Isla de Pinos, Cuba.

Etymology. Patronym in honor of Dr. VASILE DECU, who gave me on loan amblypygid specimens collected by the Institut de Spéologie Roumanie, "Emile G. Racovitza".

DUBIOUS SPECIES

Paraphrynus intermedius (Franganillo, 1926)

Hemiphrynus intermedius FRANGANILLO, 1926: 67.
Paraphrynus intermedius: MULLINEX, 1975: 37.

In his brief latin description, FRANGANILLO did not mention how many specimens he had examined but indicated "Habana" as the collecting site. A spanish translation of his original description was published at a later date (1936: 152). When I examined his collection, I searched for the type material of this species based on the three diagnostic characters given by FRANGANILLO (see MULLINEX, 1975), but I was unable to locate specimens that fit the description. As the specimens were only labelled with numbers and their catalog lost, there was no other possibility than to rely on the original description in locating the specimens. Two of the three key characters given by FRANGANILLO are present in *Paraphrynus raptator* while the other *Paraphrynus* species known from Cuba have but one of the three. *P. intermedius* is described as having six spines on the inner lateral surface of the pedipalp trochanter (all other known species in that genus have four to five spines) while *P. raptator* has four spines, as the remaining presently reported *Paraphrynus* species from Cuba. The specimens of *P. raptator*, reported from Habana by FRANGANILLO (1926), were not found in his collection, but three deutonymphs of this species were identified from Prov. Holguín.

Paraphrynus laevifrons subspinosus (Franganillo, 1936)

Hemiphrynus laevifrons subspinosus Franganillo, 1936: 153.

This variety, missed by Mullinex in her revision of *Paraphrynus* (1975), is certainly a misidentification. The species has never been found in the Caribbean islands and it is known to be distributed only from Nicaragua to northern Colombia. Franganillo did not mention number, sex or localities of examined specimens. This new subspecies was suppose to differ from *P. laevifrons* sensu strictu in a single character, having four spines on the pedipalp trochanter instead of five.

Phrynus Incertae Sedis

Phrynus pinarensis Franganillo, 1936: 48–49.
Phrynus rangelensis Franganillo, 1938: 162.
Phrynus viridescens Franganillo, 1938: 162–163.

For discussion on the above; see Quintero (1981, p. 158–159).

DISCUSSION

Phylogenetic Reconstruction

The twelve species of amblypygids presently reported from Cuba belong to three contemporaneous genera in two families. Of these families, Phrynidae are non-pulvinated, and considered more apotypic than the pulvinated Charontidae (Millot, 1949; Weygoldt, 1972). The only phrynid species that has ever been reported outside of America is *Paraphrynus machadoi* (sensu Moreno, 1940) (*Hemiphrynus machadoi* Fage, 1952) from an immature collected in Angola, SW Africa (type No. 107 at Mus. nat. Hist.nat.Paris [examined]). That species was later reported by Lawrence (1967) from Namibia (NW Kaokoveld, locality near Angola, one adult male; Transvaal Museum, TM 9336 [later lost]). Fage (1952) suggested that a new genus should be erected for this African phrynid and Lawrence proposed (1967) the name *Afrophrynus* but continued including the species in *Hemiphrynus* in two later papers (1968, 1969). Mullinex (1975) considered its placement in *Hemiphrynus* to be erroneous. I consider the correct placement of this species to be in *Phrynus*, on the basis of

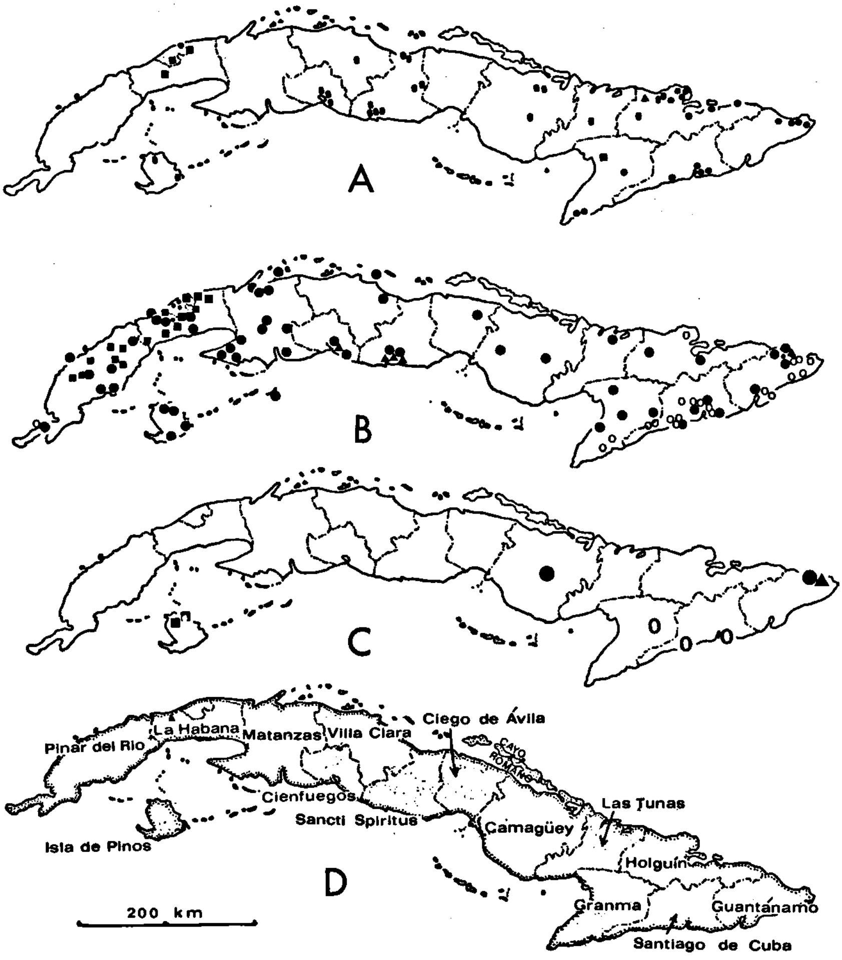


Fig. 12. DISTRIBUTION OF AMBLYPYGIDS IN CUBA.

A. Distribution of *Paraphrynus* species.

○ *Paraphrynus viridiceps* (Pocock)
■ *Paraphrynus cubensis* Mullinex
▲ *Paraphrynus raptator* (Pocock)
● *Paraphrynus robustus* (Franganillo)

B. Distribution of *Phrynus* species.

○ *Phrynus damonidaensis* Quintero
■ *Phrynus armasi* Quintero
▲ *Phrynus levii cubensis* n. subsp.
● *Phrynus marginemaculatus* C. L. Koch

C. Distribution of *Charinides* species.

▲ *Charinides cubensis* n. sp.
● *Charinides acosta* n. sp.
■ *Charinides decu* n. sp.
○ *Charinides wanlessi* n. sp.

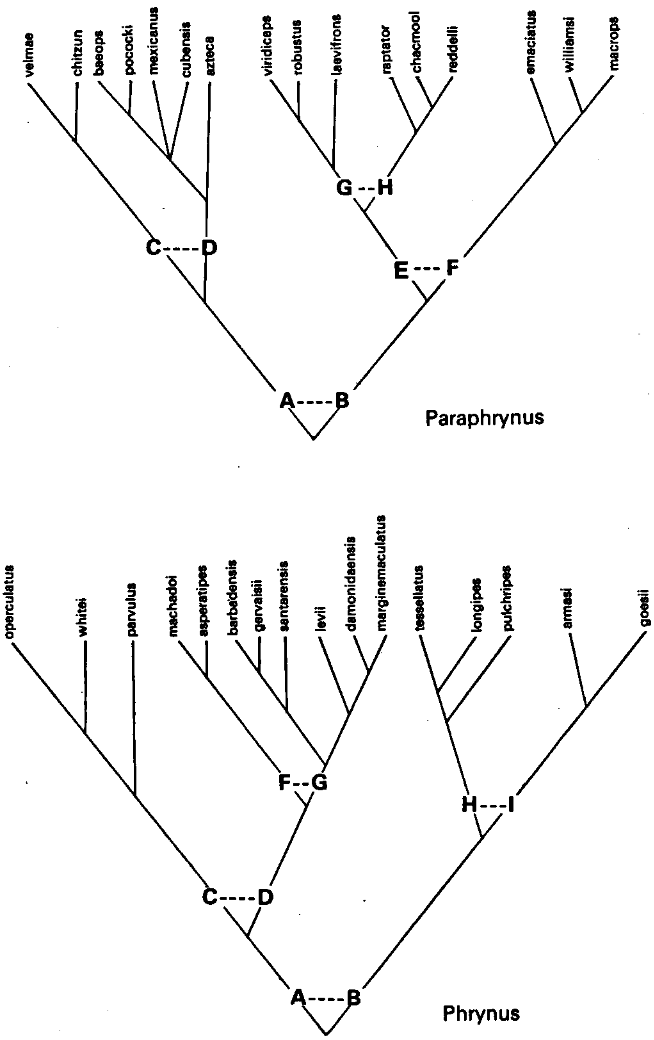
D. Provinces of CUBA.

the descriptions and illustrations given by FAGE and LAWRENCE. The congeneric status of *machadoi* with other *Phrynus* species is indicated by the single spine between the two longest spines on the pedipalp tibia. It also has one small spine on each side of spine Td-4, as frequently seen in specimens of the monotypic *Acanthophrynus* (QUINTERO, 1980a). However this cannot be considered synapomorphous with *Acanthophrynus* because the sharing of a basic ground plan of basitarsal spination in *Phrynus* (including *machadoi*) and *Paraphrynus* other than the unique and apparently autoapomorphous condition in *Acanthophrynus* indicates that the presence of the one spine on each side of the spine Td-4 in *machadoi* is best considered a retained primitive character. Similarly, the lack of a dorsal row of bristles on the cleaning organ in *machadoi, Phrynus asperatipes* and *A. coronatus* indicates that the former two states are similarly a retained plesiomorphy. Probably future examination of specimens of *P. machadoi* for other key characters will corroborate the present placement.

The interrelationships among the known species of *Phrynus* and *Paraphrynus* are little known (QUINTERO 1980b). The inferred phylogenetic relationships of the 32 species are represented in Figures 13 and 14, summarizing my present knowledge of the group. As characterized in these illustrations, both genera are conveniently recognized as monophyletic.

The first major dichotomy in the phylogenies of either *Phrynus* or *Paraphrynus* is the differentiation of species groups A and B. The "B" group of both genera is indicated by the apotypic character state of a single spine dorsal on the pedipalp tarsus. In addition, the species with greater body length (over 26 mm) are found among both B groups of species. All five species in *Phrynus* group B and three species from cluster G (*barbadensis, gervaisii* and *santarensis*) have 31 tibial segments in leg one, the highest number of tibial segments of *Phrynus*. Ontogenic or anatomical differences in the pedipalp tarsal spine have not been found between the two species groups, but more detailed observations are necessary before considering the small spine an homology or an homoplasy (parallel homology). Thus at present it is most parsimonious to consider this apomorphic character state as having evolved independently in both genera.

In *Paraphrynus* species spine Td-4 is longer than Td-2 while in *Phrynus*



Figs. 13 and 14. Inferred phylogenetic relationships of *Phrynus* and *Paraphrynus* species. See text for discussion of the clusters symbolized by the capitals.

the plesiotypic condition, shared by clusters of species D and H, is a shorter spine Td-4 as compared to Td-2. *Phrynus* clusters D and H possess an additional plesiotypy, the female gonopods have dark and thick sclerites. The following autopomorphies are recognized in *Phrynus* cluster I: spine Td-6 with a proximal basal spine, spine Td-4 longer than Td-2 and female gonopods with weakly sclerotized and thin sclerites.

Phrynus armasi is the only species in group B with a single tooth on the external cheliceral margin, a character shared with seven out of the eleven species in group A, *damonidaensis*, *marginemaculatus* and *levii* having 4, 2 and 3 teeth respectively and the number for *machadoi* is not known.

It is clear from the previous discussion that species group B of *Phrynus* has its nearest mainland relationship with northern South America.

Species group A of *Phrynus* is subdivided into two species clusters (C–D), the species in cluster C sharing the apomorphies of four dorsal spines on the pedipalp femur (the lowest number in *Phrynus*) and having spine Td-4 longer than Td-2. In cluster C, *Phrynus operculatus* and *P. whitei* share the synapomorphies of 29 tibial segments in leg one and sharp setae over the pedipalps and carapace, while *P. parvulus* has club-shaped setae and 25 tibial segments in leg one.

Phrynus species cluster D can be easily subdivided into two subclusters, F and G. Species in F lack the dorsal row of bristles in the cleaning organ of the pedipalp tarsus and have a divided second tarsomere in their ambulatory legs. *Phrynus asperatipes* is the only species of *Phrynus* possessing a suture between the pedipalp tarsus and post-tarsus. In species subcluster G, three species (*barbadensis*, *gervaisii* and *santarensis*) can be clearly separated as they share the following characters: 31 tibial segments in leg one and three well developed spines dorsal on their pedipalp basitarsus (spine Bd-1 well developed but nevertheless shorter than spine Bd-3). The remaining three species in subcluster G (*levii*, *damonidaensis* and *marginemaculatus*) have 27 tibial segments in leg one and only two well developed dorsal spines on their pedipalp basitarsus (spine Bd-1 is inconspicuous). *P. damonidaensis* is the *Phrynus* species with the highest number of teeth (4) on the external cheliceral margin and, together with *P. santarensis*, the only two phrynids having less than four tibial segments in leg four.

Paraphrynus species group B, with an inconspicuous dorsal spine on the pedipalp tarsus and an uneven diminution in the length of the three proximal ventral spines on the pedipalp femur, can be subdivided into two clusters of species, E and F. Species in cluster E share the synapomorphy of a spine Bd-1 shorter than Bd-3; all other species in *Paraphrynus* and in *Phrynus* have spine Bd-1 shorter than Bd-3. Except for *P. viridiceps* which has normal eye development, the other five species in cluster E present a marked reduction in the development of the median pair of eyes and the median ocular tubercle. One of these species, *P. reddelli*, is the only eyeless phrynid species known (MULLINEX, 1979). Species cluster E can be subdivided into two subclusters, G and H. The three species in subcluster H share a marked reduction in spine Td-1, which is even absent in *P. reddelli*. *P. robustus* is the only *Paraphrynus* species and second reported phrynid that has a stridulatory apparatus on the inner cheliceral surface.

Paraphrynus species forming cluster F have in common a suture between the pedipalp tarsus and post-tarsus. Variation in the development of this character among the different species deserves special consideration. *P. macrops* has a suture dorsally and ventrally while the outer surfaces are fused; *P. robustus* has an incomplete suture present only on the inner lateral surface.

Except for *Paraphrynus azteca* all other species in group D have a reduced median ocular tubercle and median eyes and a single tooth on the external margin of the basal cheliceral segment. *P. azteca* has normal eye development and two cheliceral teeth on the external margin of the basal cheliceral segment. In species cluster D, *P. baeops* has three well developed ventral spines on the pedipalp basitarsus and lacks the median ocular tubercle, presenting a reduced pair of median eyes positioned over a surface concolorous with the rest of the carapace. Species cluster C of *Paraphrynus* has two teeth on the external margin of the basal cheliceral segment and a distinct suture between the pedipalp tarsus and post-tarsus.

The charontids of America have been described in three genera: *Charinus* Simon, 1892 (with four South American species and one in the Galápagos Islands); *Enantiosarax* Mello-Leitão, 1931 [monotypic, *E. schirchii* from Theresópolis, Brasil, syntype at Museo Nacional de Rio de

Janeiro, examined; here transferred to *Charinus* (NEW SYNONYMY), as *Charinus schirchii* (M.L.), the type material of this species will be redescribed in a revision of the Charontidae (QUINTERO, in preparation)]; and *Speleophrynus* Ravelo, 1975 with two nominal species from Venezuelan caves, here placed in synonymy under *Charinides*, a genus previous considered monotypic.

In addition to the four new *Charinides* species described for Cuba, three additional new species have been recognized from South America and three new species from Caribbean islands. *Charinides acosta*, epigean from Camaguey and Guantánamo, Cuba, is closely related to *C. tronchonii* Ravelo and *C. bordoni* Ravelo from Venezuelan caves. These three species, together with two new epigean yet undescribed species from French Guiana and one from the Virgin Islands, form a natural assemblage of species that appears to have had its origins in South America and later migrated into the Caribbean via the Lesser Antilles. The second group of species of *Charinides*, characterized by 21 tibial-segments in leg one, lacks all representatives in South America. *Charinides bengalensis* Gravely, 1911 belongs to this otherwise strictly Caribbean group. The distribution of this species, only known from urban areas near Calcutta, might suggest human introduction by man from an unknown Caribbean locality. A less uncertain interpretation is to consider its distribution to be a relic from a more widespread ancestor with Gondwanal distribution, and thus product of a vicariant event.

FOSSIL RECORD

Seeking additional insight into the changes that the Caribbean amblypygid fauna has undergone, the fossil record was reviewed. As expected, it is extremely poor. Only two fossil findings have complete pedipalp spination, of which only one has complete tibial segments on the fourth ambulatory legs thus allowing direct family identification.

A single damaged specimen, described as *Electrophrynus mirus* by PETRUNKEVITCH in 1971, was located in fossil amber in the State of Chiapas, México, near Simojovel, in the latest Oligocene – early Miocene transition zone. QUINTERO (1980a) characterized this fossil as a species with pedipalp spination similar to *Phrynus–Paraphrynus* species. Reexamination of the literature on *E. mirus* prompted me to look for a more exact placement of this fossil species. I have found its pedipalp spination remarkably similar to a living species, *Phrynus parvulus*, that occupies the same territory. Thus *E. mirus* can be considered to be the oldest *Phrynus*-like species, that lived some 35 million years ago in Nuclear Central America. *E. mirus* shows a spur on each of the inner faces of the basal cheliceral segments. Such spurs are absent in all known amblypygids. In all members of the Phrynidae two small round sclerites are found on the medial surface of the basal cheliceral segment in a similar location to the paired spurs of *E. mirus*. These sclerites might then represent vestiges of the lost spurs, but as there is no adequate information on character transformations it will be necessary to study the cheliceral development of *P. parvulus* to verify this assumption. Another alternative explanation is that the spurs are artifacts of fossilization.

The only complete fossil amblypygid ever found is an immature specimen, only 3 mm long; the entire animal is in an extraordinarily good state of preservation, presenting even the whole trichobothrial array on the distitibia of leg four. *Phrynus resinae* (Schawaller, 1979) (NEW COMBINATION) was found in oligocene amber in the Dominican Republic, exact locality unknown. This fossil species is indistinguishable from immature specimens of *Phrynus marginemaculatus*, occurring nowdays on the same island, Hispaniola. I am skeptical about the reliability of the age of the specimen, nevertheless the coincidental similar chrono-latitudinal distribution of both fossil records is interesting.

HISTORICAL ZOOGEOGRAPHY

An attempt to reconstruct in any given group historical events that have led to the present distribution of species is an uncertain exercise as much as it is the outcome of complex events such as:

1. Geophysical:
    - a. Fragmentation and movement of land masses carrying ancestral populations (vicariance).
    - b. Climatic oscillations and catastrophic events.
2. Dispersal:
    - a. Manner in which species disperse, nature of the gap and stochastic events that have led to successful dispersals and colonizations (active and passive).

b. Length of time examined areas have been available for colonization.
c. Distance from source area with potential colonizers and species composition of these source areas (active).

3. Ecological: a. Size and ecological complexity of the area.
b. Shifts in habitat preferences, ecological transformations and biotic interactions (replacement and extinction).

Without being purely conjectural, by examining presently revised distributional records and the newly recognized systematic relationships among species, it is possible to provide a hypothetical reconstruction of the historical events pertaining to the origin of the West Indian amblypygid fauna. Thereby we assume that modern species reflect the most representative aspects of past diversity and at least one known population has survived within the ancestral species' range.

Partly because of insufficient geophysical data, the paleographic reconstructions of meso-America and the Caribbean are contradictory, to say the least. Two major conflicting hypotheses have been proposed. ROSEN's vicariance model of Caribbean biogeography (1975) says that in the late Cretaceous or very early Tertiary a "proto-Antilles" archipelago filled the gap between South America and Nuclear Central America (parts of present Yucatán peninsula, Guatemala, Honduras and NW Nicaragua). See ERWIN (1979) for comments on ROSEN's vicariance model. PREGILL (1981) states one of the most prevailing interpretations, that the Greater Antilles evolved as a mid-Caribbean archipelago that became fully uplifted and continuously emergent since late Oligocene or early Miocene, the Lesser Antilles having a more recent origin as a series of subsiding volcanos and reefs on the eastern margins of the Caribbean plate. A more ancient origin, early Eocene, was indicated by ITURRALDE-VINENT (1977) for the platform stages of developing Cuba. Up to the middle Eocene Cuba developed as an arc of islands from a mosaic of blocks delimited by faults and flexures.

At the family and generic level, none of the reported Caribbean amblypygid fauna is endemic to the area. One of the two known American charontid genera, *Charinides*, is present in the Caribbean and India but both genera are absent from meso and north America. This fact, in addition to the recent finding of a new charontid genus with three species, one in Jamaica and two in the Guianas (QUINTERO, in preparation), a new genus which is closely related to *Paracharon caecus* Hansen, 1921, from Guinea-Bissau, W. Africa, suggests that the charontids have had a long evolutionary history in the Caribbean. The ancestral populations of the recently recognized new genus and of *Paracharon* occupied the unified masses of Gondwana. With the opening of the Atlantic, major still unexplained extinctions possibly occurred in Africa, inferred to be triggered by a combination of mountain building and climate change over the past four to six million years. The West African remnent descendant populations evolved as the eyeless species *P. caecus*, probably in association with the nest of termite societies, although at present it is also found outside of termite nests. The South American sister charontid group evolved as the newly recognized genus in association with the habitat of the exclusively American fungi growing ants of the genus *Atta* in the Guiana shield, and later colonized Jamaica. The intermediate stages in this distant colonization event are not known and for clarification await the discovery of expected additional taxa along the latitudinal dispersion tract. Pleistocene glaciation periods, with increased aridity and low temperatures, could have been withstood in the moderated environments of social insects.

Twenty five per cent of the total number of known species of the phrynid genera *Phrynus* and *Paraphrynus* occur in Cuba, while forty six per cent of all the species are found in the whole Caribbean basin. Of the two genera, *Phrynus* can be considered the most distinctly Caribbean and probably the oldest in the area. This later point being suggested by its trans-Atlantic relationship and wider distribution of species. Although both genera have an equal percentage of their total number of species present in Cuba, for *Phrynus* it represents almost 50% of its total number of Caribbean species but for *Paraphrynus*, not found outside of Cuba in the Caribbean, it is 100%.

Phrynus' species group B accounts largely for the above-mentioned differences in percentages. Its distribution suggests a more recent origin. Probably evolving from ancestral populations which occupied the northern part of South America, which subsequently radiated into the Lesser Antilles and reached the occidental "natural region" of Cuba forming the endemic cave dwelling species, *Phrynus armasi*.

Phrynus' species group A shows a major dichotomy between a cluster C of three species occupying the majority of the past Nuclear Central America and a widely distributed cluster D of eight species that extends longitudinally from Angola, W. Africa, to Baja California, and latitudinally from northern South America into Costa Rica and the Greater Antilles to the Bahamas and Bermuda. Such a dichotomy must have had rather remote origins, previous to the break up of Gondwana. It is possible that conditions for allopatric speciation developed in association with the opening of the Gulf of Mexico during early Mesozoic time when major structural discontinuities appeared between cratonic North America and northern Mexico, having Mexico rotated 130° counterclockwise (Gose et al. 1982). In addition, the purported area cladograms clearly contradict (*Phrynus* C–D) an exchange in the late Cretaceous between North and South America via Rosen's hypothetical "proto-Antilles" (1975).

It is evident from the area cladograms that there is an absence of wide-ranging species and that allopatry is prevalent within groups of closely related species of *Phrynus* and *Paraphrynus*. Although it is expected that additional collections might discover a larger degree of sympatry than is presently known, my impression is that species ranges will not overlap to a major extent. Area effects in the total number of species that the area is capable of supporting are perhaps accounted for by competitive exclusion for limited and unreliable food resources. This generalization is better visualized in caves where less than 1% of the caves examined have been found simultaneously inhabited by two amblypygid species (then one of the two species is invariably present in very few numbers) and none has been found inhabited by more than two species.

In species subcluster G of *Phrynus*, *marginemaculatus*, *damonidaensis* and *levii* are more closely interrelated among themselves, and thus the areas they occupy (Greater Antilles, southern Florida, Bahamas, Bermuda and the Swan Islands), than any of them to the northern South American group of three species, *santarensis*, *gervaisii* and *barbadensis*. In this subcluster G two endemic species are found in Cuba. *P. damonidaensis* which occupies the Oriental region (it is also present in the Swan Islands but this has been considered as a very recent colonization event) and *P. levii cubensis* which occupies Central Cuba (Prov. Sancti Spiritu) and the Oriental region (Prov. Guantánamo). Thus a total of 75% of the Cuban species of *Phrynus* are endemics.

Species group B of *Paraphrynus* appears to have undergone rapid evolutionary change in the vast cave system of Yucatán and in the immediately adjacent land areas in the south. The insular character of northern Yucatán during the Pleistocene (Wilkens 1979) represents the major scenario necessary for the allopatric speciation of the only troglobitic phrynid species (*P. reddelli*) and a trogophile (*P. chacmool*). The distribution of the three very distinct species that form subcluster G of *Paraphrynus* is puzzling. *P. viridiceps* occupies in Cuba the natural regions of Camaguey-Manibón, Central and part of Occidental. It is also present in the Bahamas and in Key West, Florida. The endemic *P. robustus* occupies the Oriental region. They are closely related to *P. laevifrons* which extends from San Salvador to the Colombian border of Panamá. It is not clear how this distribution came about.

Paraphrynus' species group A appears to have a very complex history. The disjunct populations of *P. mexicanus* suggest that major extinctions have occurred in the central and northern ranges of Mexico. The Isthmus of Tehuantepec and immediately adjacent northern areas serving as the geographic scenario for the differentiation of the majority of the species of this group. *P. cubensis*, an endemic in the Occidental region of Cuba is a sister species of *P. mexicanus* and appears to be a relic from a more widespread distribution, having reached Cuba from North America.

Half of the species of *Paraphrynus* are endemics in Cuba. This number might increase to equal *Phrynus*', if the record of *P. raptator* known only from deutonymphs in Prov. Holguín, turns out to be a new species.

REFERENCES

Acevedo González, M., 1967. Estudio espeleológico de la Cueva del Bao, Boca de Jaruco, Habana. *Mem. Fac. Cien. Univ. La Habana, Ser. Ciencia Biol. 1* (5): 33–54.

Banks, N., 1906. Arachnida from the Bahamas. *Bull. Amer. Mus. Nat. Hist. 22*: 185–189.

Erwin, T. L., 1979. The American Connection, past and present, as a model blending dispersal and vicariance in the study of biogeography. *In*: *Carabid beetles. Proc. First Int. Symposium of Carabidology*: 355–367.

Fage, L., 1952. Pédipalpes (Amblypyges) récoltés en Angola par M. A. de Barros Machado. *Publicaçãoes culturaes da Companhia de Diamantes de Angola 13*: 7–18, figs.

Franganillo Balboa, Pelegrín, 1926. Arácnidos nuevos o poco conocidos de la Isla de Cuba. *Bol. Soc. Ent. España 9* (3/4): 42–68, fig. 5.

— 1930. Mas arácnidos nuevos de la Isla de Cuba. *Mem. Inst. Nac. de Invest. Cient. y Mus. Hist. Nat. [Habana] 1*: 45–99.

— 1931. Excursiones aracnológicas durante el mes de agosto de 1930. *Revista Belén 24*: 116–120.

— 1936. *Los arácnidos de Cuba hasta 1936*. Cultural, S. A., La Habana, 178 pp.

— 1938. Arácnidos Cubanos estudiados desde 1930 hasta 1934. *Mem. Soc. Cubana Hist. Nat. Poey 8* (3): 145–168.

Gose, W. A. & Belcher, R. C. & Scott, G. R., 1982. Paleomagnetic results from Northeastern Mexico: evidence for large mesozoic rotations. *Geology 10* (1): 50–54.

González Gotera, Noel, 1967. Liste de la faune recoltée dans le reseau de la perte de Majaguas. *Stalactité 2*: 42–47.

Gravely, F. H., 1911. Notes on Pedipalpi in the collection of the Indian Museum. *Records Ind. Mus. Calcutta 6*: 33–38.

Graña González, A. & Izquierdo Bordon, 1970. Sistema subterráneo de Junta Judas. *Acad. Cien. Cuba, Ser. Espeleol. Carsol. 30*: 45 pp.

Iturralde-Vinent, M. A., 1977. Los movimentos tectónicos de la etapa de desarrollo platafórmico en Cuba. *Acad. Cien. Cuba, Ser. Geol., Informe Científico-Técnico 20*, 24 pp.

Kraepelin, K. 1899. Scorpiones und Pedipalpi. Pedipalpi. *Das Tierreich 8*, p. 201–251.

Kritscher, E., 1959. Ergebnisse der ... auf Rhodos durchgeführten zoologischen Exkursionen. II. Pedipalpi (Amblypygi). *Ann. Naturhist. Mus. Wien 63*: 453–457.

Lawrence, R. F., 1967. Additions to the fauna of South West Africa: Solifuges, Scorpions and Pedipalpi. *Scient. Pap. Namib Desert Res. Sta. 34*: 1–19, figs. 1–8.

— 1968. The structure of the cleaning brush on the pedipalps of some African Amblypygi (Arachnida). *J. Zool. Lond. 154*: 1–8, figs. 1–2.

— 1969. A collection of African Amblypygi with keys to the subfamilies, genera and species of the Ethiopian fauna. *Rev. Zool. Bot. Afr. 80* (1/2): 80–87.

Mayr, E. & Linsley, E. G. & Usinger, R. L., 1953. *Methods and principles of systematic zoology*. New York.

Milán, G. & Myczyñski, 1978. Fauna Jurásica y consideraciones sobre la edad de las secuencias metamórficas del Escambray. *Acad. Cien. Cuba, Ser. Geol., Informe Cient.-Técnico 80*: 14 pp., 2 pls.

Millot, J., 1949. Amblypygi. *In*: P. P. Grassé, *Traité de zoologie 6*: 563–588. Paris.

Mullinex, C. L., 1975. Revision of Paraphrynus Moreno (Amblypygida: Phrynidae) for North America and the Antilles. *Occ. Papers Calif. Acad. Sci. 116*: 1–80.

— 1979. A new Paraphrynus from Yucatan (Amblypygida, Tarantulidae). *J. Arach. 7*: 267–269, fig. 1–9.

PETRUNKEVITCH, A., 1971. Chiapas amber spiders 2. *Univ. Calif. Publs. Ent. 63*: 1–44, 106 figs.

POCOCK, R. I., 1893. Contributions to our knowledge of the arthropod fauna of the West Indies. III. Diplopoda and Malacopoda, with a supplement on the Arachnida of the class Pedipalpi. *J. Linn. Soc. Zool. 24*: 473–544, pls. 37–40.

— 1899. The geographical distribution of the Arachnida of the orders Pedipalpi and Solifugae. *Natural Science London 14*: 213–231.

— 1902a. Scorpiones, Pedipalpi and Solifugae. *Biologia Centrali-Americana*, ed. F. Ducane Godman & O. Salvin, 71 + 12 pp., 12 pls.

— 1902b. A contribution to the systematics of the Pedipalpi. *Ann. Mag. Nat. Hist.* (7) *9*: 157–165.

PREGILL, G. K., 1981. An appraisal of the Vicariance Hypothesis of Caribbean biogeography and its application to West Indian terrestrial vertebrates. *Syst. Zool. 30* (2): 147–155.

QUINTERO, JR., DIOMEDES, 1980a. Systematics and evolution of Acanthophrynus Kraepelin (Amblypygi, Phrynidae). *Proc. 8 Intern. Arachn.-Congress, Wien*: 341–347.

— 1980b. Origins of American amblypygids (Arachnida: Amblypygi). *Amer. Zoologist 20* (4): [abstract No. 478].

— 1981. The amblypygid genus Phrynus in the Americas (Amblypygi, Phrynidae). *J. Arach. 9* (2): 117–166.

— 1982. Phrynus Lamarck 1801 (Arachnida: Amblypygi) proposed conservation Z.N. (S.) 2169. *Bull. Zool. Nom. 39* (1): 40–44.

RAVELO, P. O., 1975. Speleophrynus tronchonii nuevo género y especie de amblipigios de la familia Charontidae, en una cueva de Venezuela (Arachnida: Amblipygy) [sic]. *Bol. Soc. Venezol. Espel. 6* (12): 77–85.

— 1977. Speleophrynus bordoni nueva especie de amblipigios de la familia Charontidae, en una cueva de Venezuela. *Bol. Soc. Venezol. Espel. 8* (15): 17–25.

ROSEN, D. E., 1975. A vicariance model of Caribbean biogeography. *Syst. Zool. 24* (4): 431–464.

SAGRA, RAMÓN DE LA, (1834–44) 1857. *Historia física, política y natural de la Isla de Cuba*, vol. *7*: 25. Paris, pl. 5, figs. 3, 3a and 3b. [1864. Atlas Zoológico].

SCHAWALLER, WOLFGANG, 1979. Erstnachweis der Ordnung Geisselspinnen in Dominikanischem Bernstein (Stuttgarter Bernsteinsammlung: Arachnida, Amblypygi). *Stuttgarter Beitr. Naturk. Ser. B 50* (125): 1–12.

SILVA TABOADA, G., 1974. Sinopsis de la espéleofauna Cubana. *Acad. Cienc. Cuba, Ser. Espeleol. Carsol. 43*: 65 pp.

— 1979. *Los murciélagos de Cuba.* Editorial Academia, Ac. Ciencias Cuba, 423 pp.

STOCKTON, W. D., 1976. Amblypygi. Mission zoologique belge aux îles Galapagos et en Ecuador (N. et J. Leleup, 1964–1965). *Resultats Scientifiques. Troisième partie*, p. 55–65.

WERNER, F., 1935. Pedipalpen. *Bronn's Klassen und Ordnungen des Tierreichs 5* (4), Buch 8: 317–490.

WEYGOLDT, P., 1970. Lebenszyklus und postembryonale Entwicklung der Geisselspinne Tarantula marginemaculata C. L. Koch (Chelicerata, Amblypygi) im Laboratorium. *Ztschr. Morph. Tiere 67*: 58–85.

— 1972. Charontidae (Amblypygi) aus Brasilien. *Zool. Jb. Syst. 99*: 107–132.

WILKENS, H. VON, 1979. Reduktionsgrad und phylogenetisches Alter: Ein Beitrag zur Besiedlungsgeschichte der Limnofauna Yukatans. *Z. zool. Syst. Evolut. Forsch. 17*: 262–272.