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FURTHER ADDITIONS TO THE SCORPION FAUNA OF TRINIDAD AND TOBAGO

Lorenzo Prendini: Percy FitzPatrick Institute, University of Cape Town, Rondebosch 7700, South Africa

ABSTRACT. The results of a study of new scorpion material, comprising nine species collected during a recent field trip to Trinidad and Tobago, are presented. The Trinidad population of *Tityus discrepans* (Karsch 1879) is described as a new species, *Tityus tenuicauda*, endemic to Trinidad, and more closely related to *Tityus arellanoparrai* González-Sponga 1985 than *T. discrepans*, both from Venezuela. A key to the identification of the three species is provided. New records are provided for *Ananteris cussinii* Borelli 1910, *Microtityus rickyi* Kjellesvig-Waering 1966, *Tityus clathratus* C.L. Koch 1844 and *Tityus melanostictus* Pocock 1893. Specimens of *Microtityus* collected on Tobago provide evidence for the synonymy of *Microtityus starri* Lourenço & Huber 1999 with *M. rickyi*. Previously unreported ecological observations are presented, including the burrowing biology of *Broteochactas laui* Kjellesvig-Waering 1966, and the microhabitat of *Chactas raymondhansorum* Francke & Boos 1986, which is apparently not restricted to water-filled spaces between the leaf sheaths of bromeliads.

Keywords: Scorpiones, Trinidad and Tobago, *Tityus*, *Microtityus*

Kjellesvig-Waering (1966) provided the first synopsis of the scorpion fauna of Trinidad and Tobago, wherein he recognized eight species in two families, Buthidae and Chactidae, and described a new buthid genus and species, *Microtityus rickyi* Kjellesvig-Waering 1966, and a new chactid species, *Broteochactas laui* Kjellesvig-Waering 1966. Francke & Boos (1986) subsequently revised the chactid scorpions of the islands, and described another new species, *Chactas raymondhansi* Francke & Boos 1986, from Trinidad. Sissom (2000) changed this name to *Chactas raymondhansorum* Francke & Boos 1986, in accordance with Article 31(a)(ii) of the International Code of Zoological Nomenclature (1985), since it is named after two people (Raymond A. Mendez and Hans Boos).

Recently, Lourenço & Huber (1999) published additional records of scorpions from Trinidad and Tobago, based on a large series of new material. These authors described another new buthid, *Microtityus starri* Lourenço & Huber 1999, and provided a brief account of the taxonomic status and geographical distribution of six of the other nine species known from Trinidad and Tobago: *Ananteris cussinii* Borelli 1910; *M. rickyi*; *Tityus discrepans* (Karsch 1879); *Tityus melanostictus* Pocock 1893; *Tityus trinitatis* Pocock 1897; *Broteochactas nitidus* Pocock 1893.

The author conducted a collecting trip to Trinidad and Tobago during July 1999 for the purpose of acquiring tissue samples and voucher specimens of Neotropical scorpions for DNA isolation and sequencing. This yielded 163 specimens, classified into nine species, from several localities, some of which are new records. The findings of this trip are reported here. New records are provided for *A. cussinii*, *M. rickyi*, *Tityus clathratus* C.L. Koch 1844 and *T. melanostictus*. Specimens of *Microtityus* collected on Tobago provide evidence for the synonymy of *M. starri* with *M. rickyi*. In addition, previously unreported ecological observations are presented, including the burrowing biology of *B. laui* and the microhabitat of the ''bromeliad-dwelling scorpion'' (Francke & Boos 1986; Rudd 1996; Ward 1996), *C. raymondhansorum*, which was recollected on Mt. El Tucuche.

The main finding presented here is the observation that the Trinidad population of *T. discrepans* is an undescribed species, quite distinct morphologically (and genetically) from the typical Venezuelan population. This new species, endemic to Trinidad, is described as *Tityus tenuicauda*. It is most closely related to *Tityus arellanoparrai* González-Sponga 1985, which is endemic to the highlands of northeastern Venezuela (González-Sponga

1985, 1996). A key, modified from González-Sponga (1996: 140), is provided for the identification of *T. arellanoparrai*, *T. discrepans* and *T. tenuicauda*.

Nine species are now recorded from Trinidad and Tobago, six of which are apparently endemic to the islands (Table 1). As noted by Francke & Boos (1986), the high percentage of scorpion endemism (67%) in Trinidad and Tobago supports Kjellesvig-Waering's (1966) hypothesis of speciation after faulting and subsequent erosion had isolated the islands from the South American mainland.

METHODS

Except where noted, all specimens listed were collected at night with the use of a portable ultraviolet light, comprising two mercury-vapor tubes attached to a chromium parabolic reflector and powered by a rechargeable 7 Amp/h, 12 V battery. A few others were collected during the day by turning stones, logs, tree bark, and inspecting other potential diurnal retreats. UV detection is known to greatly increase collecting yields and has led to the discovery of numerous undescribed species, even in previously well-collected areas (Lamoral 1979; Williams 1980; Sissom et al. 1990). Many scorpions, especially fossorial and humicolous forest species, cannot be collected with normal daytime collecting techniques.

All specimens examined (including the type specimens of *T. tenuicauda*) are deposited in the collection of the American Museum of Natural History, New York. Tissue samples of each species, stored in absolute ethanol, have been retained separately for DNA isolation and sequencing in the Ambrose Monell Collection for Molecular and Microbial Research at the American Museum of Natural History. Illustrations of *T. discrepans* and *T. tenuicauda* were produced using a stereomicroscope and camera lucida. Measurements were made with digital calipers. Color designation follows Smithe (1974, 1975, 1981), trichobothrial notation follows Vachon (1974), and mensuration follows Stahnke (1970) and Lamoral (1979). Morphological terminology follows Couzijn (1976) for the segmentation of legs, Hjelle (1990) and Sissom (1990) for the segmentation of pedipalps, and Stahnke (1970), Lamoral (1979), and Sissom (1990) for other features. However, the terms used by previous authors (Stahnke 1970; Lamoral 1979; Sissom 1990) for certain metasomal carinae have been replaced with terms deemed more consistent and implying specific homology between carinae on segment V and those on the preceding segments. The term ''ventral'' (segments I–V) is replaced with ''ventrosubmedian'' (segment I only) and ''ventromedian'' (segments II–V only), and the term ''dorsal'' (segments I–IV only) is replaced with ''dorsosubmedian.''

KEY

Key to the identification of *Tityus arellanoparrai* González-Sponga 1985, *Tityus discrepans* (Karsch 1879) and ***Tityus tenuicauda*** new species (modified from González-Sponga 1996: 140), all of which are characterized by the presence of a single ventromedian carina on metasomal segments II–IV.

1. Chela manus of adult ♂ bulbous (Fig. 1), of adult ♀ slender (Fig. 2), with 15–16 rows of denticles on movable finger; metasomal segments of adult ♂ and ♀ short and stout, with large conical spiniform granules on dorsosubmedian carinae of segments II-IV and dorsolateral carinae of segment V (Figs. 5, 6); telson globose in ♂ and ♀ (Figs. 5, 6) . . . . . *Tityus discrepans*
   Chela manus of adult ♂ and ♀ slender (Figs. 3, 4), with 14 rows of denticles on movable finger; metasomal segments of adult ♂ elongate and narrow (Fig. 7), of adult ♀ short and narrow (Fig. 8), with weakly developed rounded spiniform granules on dorsosubmedian carinae of segments II-IV and dorsolateral carinae of segment V (Figs. 7, 8); telson moderately globose in ♀, subadults and juveniles (Fig. 8), but distinctly elongated in adult ♂ (Fig. 7). 2
2. Metasomal segments I-II with lateral carinae obsolete; endemic to Venezuela . . . . . *Tityus arellanoparrai*
   Metasomal segment I with lateral carinae fully developed, segment II with lateral carinae reduced to a few granules in distal third; endemic to Trinidad . . . . . ***Tityus tenuicauda***

Table 1.—Scorpion species recorded from Trinidad and Tobago. All except three are endemic to the islands. Species indicated with an asterisk have also been recorded from northern South America.

Family	Species	Trinidad	Tobago
Buthidae:	*Ananteris cussinii**	x	x
	Microtityus rickyi	x	x
	*Tityus clathratus**	x	
	Tityus tenuicauda	x	
	*Tityus melanostictus**	x	
	Tityus trinitatis	x	x
Chactidae:	*Broteochactas laui*		x
	Broteochactas nitidus	x	x
	Chactas raymondhansorum	x	

FAMILY BUTHIDAE

Ananteris cussinii Borelli 1910

Ananteris cussinii Borelli 1910: 1–3.

Ananteris cussinii: Mello-Leitão 1932: 28; Hummelinck 1940: 144, 145, figs. 19, 20; Roewer 1943: 218; Mello-Leitão 1945: 243, 247, 248; Scorza 1954a: 159; Scorza 1954b: 189, 200; Kjellesvig-Waering 1966: 125, 128; Bücherl 1969: 767; González-Sponga 1971: 6–14, pl. 1–8; Vachon 1977: 298, figs. 10–14; Lourenço 1982: 138, 145, 146, figs. 31, 32, 44, 101; González-Sponga 1984: 61, 62, fig.; Armas 1988: 43, 44, 92, figs. 15, 16; Flórez 1991: 118; Lourenço 1993: 698, fig. 7; Rudloff 1994: 8; González-Sponga 1996: 118, 120, 121, figs. 276–278; Kovařík 1998: 103; Lourenço & Huber 1999: 250, 251; Fet & Lowe 2000: 61.

Ananteris cussini: Scorza 1954c: 165; Caporiacco 1951: 4; Esquivel de Verde & Machado-Allison 1969: 28; Armas 1977: 3; Cekalovic 1983: 189.

Ananteris cusinii: González-Sponga 1971: 9.

This species was reviewed by Kjellesvig-Waering (1966), Lourenço (1982), González-Sponga (1996), and Lourenço & Huber (1999). It occurs on the South American mainland (recorded from Colombia and Venezuela) and on Trinidad, but has not previously been reported from Tobago or from Gaspar Grande Island, off the northwestern peninsula of Trinidad. It was found in sympatry with *M. rickyi*, *T. trinitatis* and *B. laui* at Speyside, with *M. rickyi*, *T. clathratus* and *T. melanostictus* on Gaspar Grande, and with *M. rickyi*, *T. trinitatis* and *B. nitidus* at Mt. St. Benedict. All specimens personally collected were found running on open, stony ground in exposed areas (near paths and forest margins).

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 1♂, Mt. St. Benedict, 10°39′49″N, 61°23′56″W, 30 June 1999, R. Pinto-da-Rocha; 1♂, Mt. St. Benedict, 9 July 1999, L. Prendini & I. Samad; 4♂2♀, Gaspar Grande Island, 7 July 1999, L. Prendini, H. Guarisco & I. Samad. *Tobago:* 2♂, Speyside, 1 km N on road to Charlotteville, 11°18′20″N, 60°32′15″W, 4 July 1999, L. Prendini & H. Guarisco.

Microtityus rickyi Kjellesvig-Waering 1966

Microtityus rickyi Kjellesvig-Waering 1966: 125, 131–134, figs. 3–8.

Microtityus starri Lourenço & Huber 1999: 253–259, figs. 11–22 (new synonym).

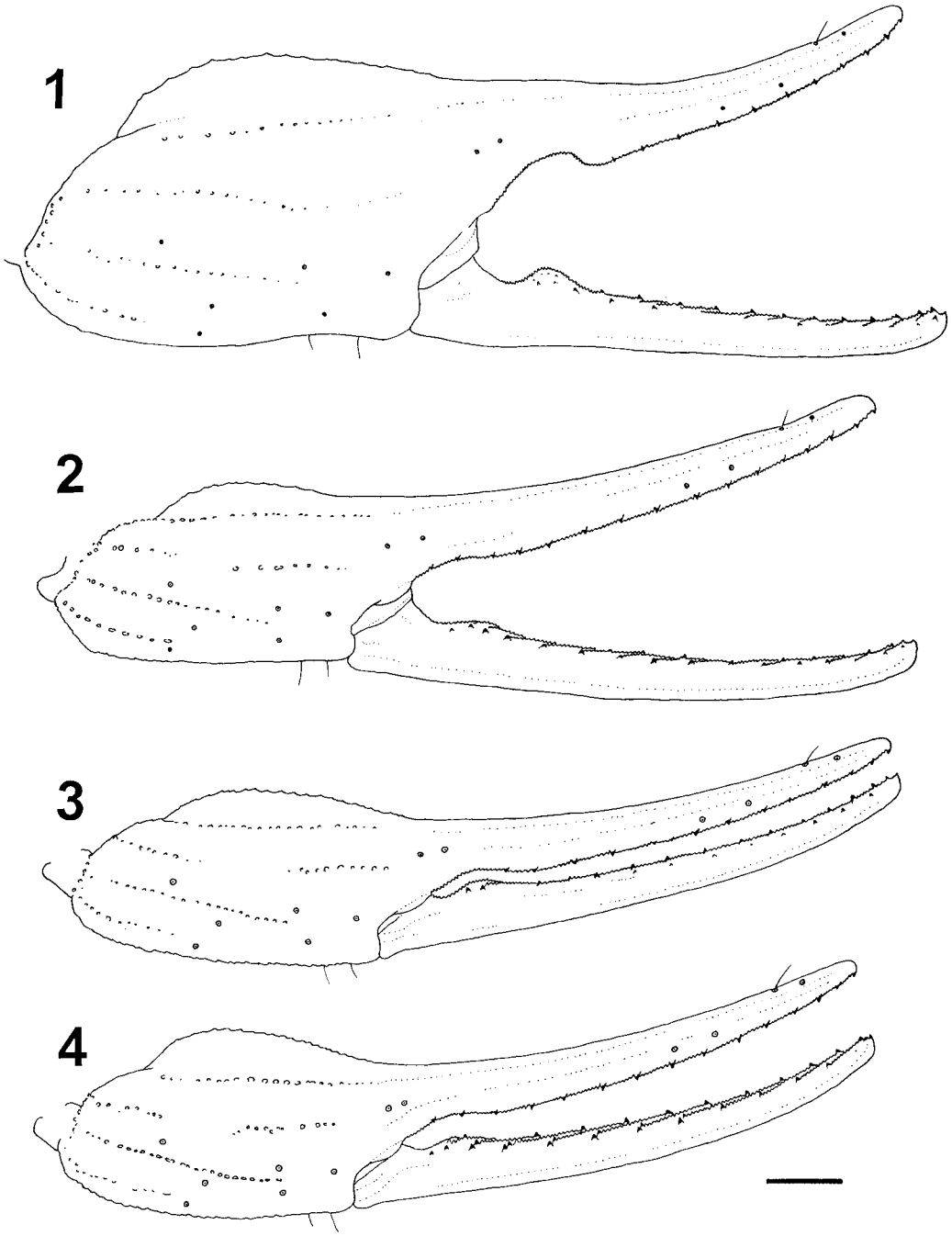
Microtityus rickyi: Vachon 1977: 285, 286, figs. 1–8; Lourenço & Eickstedt 1983: 71; Santiago-Blay 1985: 2; Lourenço 1986a: 232, fig. 1; Lourenço 1986b: 561, fig. 1; Armas 1988: 66; Santiago-Blay et al. 1990: 117; Kovarik 1998: 115; Lourenço & Huber 1999: 250, 252, 253; Fet & Lowe 2000: 184.

Microtityus ricky: Armas 1988: 93; Rudloff 1994: 8; Lourenço & Huber 1999: 256, tab. I.

Microtityus (Microtityus) rickyi: Armas 1974: 3.

Microtityus rickyi, previously considered endemic to Trinidad and the islands off its northwestern peninsula, was reviewed by Vachon (1977) and Lourenço & Huber (1999). Lourenço & Huber (1999) described *M. starri*, a new species from Little Tobago, an island just off the northeast coast of Tobago, but did not record that species, or *M. rickyi*, from Tobago itself.

The author collected several specimens of *Microtityus* from Speyside, on Tobago directly opposite Little Tobago. These specimens of *Microtityus*, the first to be collected from Tobago, demonstrate that *M. starri* should be regarded as a junior synonym of *M. rickyi*, and extend the range of that species to Tobago and adjacent islands.



Figures 1–4.—External aspect of dextral pedipalp chelae from adult ♂ and ♀ *Tityus discrepans* (Karsch 1879) and ***Tityus tenuicauda*** new species, showing trichobothria, carinae and general shape. Scale bar = 1 mm. 1. *T. discrepans:* ♂ (AMNH), Venezuela, Edo. Miranda, 3 km E of Oraira, 400 m, 20 October 1969, M.A. González-Sponga; 2. *Tityrus discrepans:* ♀ (AMNH), same data; 3. *Tityus tenuicauda:* paratype ♂ (AMNH), Trinidad, Chancellor Hill, Port of Spain, 1500 ft, August 1966, E.N. Kjellesvig-Waering; 4. *Tityus tenuicauda:* paratype ♀ (AMNH), Trinidad, 4 Fourth Street, Saddle Road, Maraval, 3 April 1957, T.H.G. Aitken.

According to Lourenço & Huber (1999), *M. starri* and *M. rickyi* can be reliably separated by examination of the trichobothria of the pedipalp femur. The trichobothrial pattern of *M. starri* is orthobothriotaxic, with d_2 present on the internal surface of the femur, whereas the pattern of *M. rickyi* is neobothriotaxic, with d_2 absent (Vachon 1977). In addition, the coloration of *M. starri* is darker overall, with metasomal segments IV, V and telson darker than segments I-III, and the pectinal tooth count is slightly lower (Lourenço & Huber 1999).

The latter differences in color and pectinal tooth count are well within the normal range of geographic variation for a given scorpion species—e.g., see Lourenço & Huber's (1999: 264) table III, showing pectinal tooth count variation in *T. trinitatis* from Trinidad and Tobago. These differences cannot, alone, provide species status for *M. starri*. Accordingly, recognition of *M. starri* as distinct from *M. rickyi* rests on the consistent presence of d_2, a tiny trichobothrium that is reduced or lost in a number of apparently unrelated buthids. However, in some of the newly collected Speyside specimens, an atrophied trichobothrium is evident in the position of d_2, while this trichobothrium is absent in other specimens from the same locality. The observation that the presence or absence of d_2 is polymorphic in the Speyside population casts doubt on the utility of this character for the separation of *Microtityus* species and provides my rationale for the synonymy of *M. starri* with *M. rickyi*.

Microtityus rickyi was found in sympatry with *A. cussinii, T. clathratus* and *T. melanostictus* at Gaspar Grande, with *A. cussinii*, *T. trinitatis* and *B. nitidus* at Mt. St. Benedict, and with *A. cussinii*, *T. trinitatis* and *B. laui* at Speyside. All specimens were found motionless on rocks, tree trunks or bare soil banks, often with only the carapace and pedipalps protruding from holes or crevices in the substratum. Specimens were observed from ground level to several meters up tree trunks.

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 11♂17♀, Mt. St. Benedict, 10°39′49″N, 61°23′56″W, 28 June 1999, L. Prendini; 4♀, Mt. St. Benedict, 9 July 1999, L. Prendini & I. Samad; 4♂9♀, Gaspar Grande Island, 7 July 1999, L. Prendini, H. Guarisco & I. Samad. *Tobago:* 13♂27♀, Speyside, 1 km N on road to Charlotteville, 11°18′20″N, 60°32′15″W, 3–4 July 1999, L. Prendini & H. Guarisco.

Tityus clathratus C.L. Koch 1844

Tityus clathratus C.L. Koch 1844: 22–24, pl. CCCLXVI, fig. 861.
Tityus quelchii Pocock 1893a: 314, 315, pl. XIV, fig. 1 (synonymized by Kraepelin 1899: 85).
Tityus fahrenholtzi Roewer 1943: 223, 224, figs. 6, 6a-e (synonymized by Lourenço 1984a: 357).
Tityus guianensis Caporiacco 1947: 20 (synonymized by Lourenço 1984a: 352).
Tityus clathratus: C.L. Koch 1850: 91; Kraepelin 1899: 75, 85, 86; Kraepelin 1901: 269; Kraepelin 1908: 187, 190, 193, 194; Mello-Leitão 1931: 119, 141; Mello-Leitão 1932: 29; Mello-Leitão 1939: 58, 64, 67; Roewer 1943: 224; Mello-Leitão 1945: 299, 304, 320–322, figs. 129, 130; Waterman 1950: 168; Caporiacco 1951: 4; Scorza 1954a: 161; Scorza 1954b: 191, 201, fig. 20; Scorza 1954c: 166; Bücherl 1967: 111; Bücherl 1969: 767; Esquivel de Verde 1969: 217, 218, fig. 5; Esquivel de Verde & Machado-Allison 1969: 34; Bücherl 1971: 327; Bücherl 1978: 372; González-Sponga 1978: 197, 201, figs. 9, 273, 274; Cekalovic 1983: 190; Lourenço 1983: 777, figs. 19–25, 118; Lourenço 1984a: 350, 352, figs. 1–3, 15–18, tab. I, II; Brignoli 1985: 415; Lourenço 1986a: 232, fig. 2; Lourenço 1986b: 562, fig. 2; Armas 1988: 74, 75, 93; Lourenço 1991: 116; Lourenço 1992: 476, fig. 5, tab. I; Rudloff 1994: 9; González-Sponga 1996: 118, 154, figs. 357–359; Lourenço 1997: 591; Kovařík 1998: 120; Fet & Lowe 2000: 238, 239.
Tityus quelchii: Kraepelin 1895: 92; Pocock 1897a: 363; Pocock 1897b: 520; Kjellesvig-Waering 1966: 125, 129.
Tityus guianensis: Caporiacco 1948: 610, 611, figs. 4, 5.
Tityus quelchi: Lourenço 1984a: 352, tab. I.

This species was reviewed by Kjellesvig-Waering (1966), Lourenço (1984a) and González-Sponga (1996). It is evidently widespread in South America east of the Andes (recorded from Brazil, French Guiana, Guyana, Suriname, Venezuela and Trinidad), but has not previously been reported from the islands between the northwestern peninsula of Trinidad and the Paria Peninsula of Venezuela. It was found in sympatry with *A. cussinii*, *M. rickyi* and *T. melanostictus* at Gaspar Grande. All specimens were found motionless on bare soil banks or leaf litter in exposed areas (near paths and forest margins). No specimens were collected above ground level (cf. *T. melanostictus*).

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 8♀, Gaspar Grande Island, 7 July 1999, L. Prendini, H. Guarisco & I. Samad.

Tityus melanostictus Pocock 1893

Tityus melanostictus Pocock 1893b: 377, 381, 382, pl. XXIX, figs. 4, 4b.
Tityus melanostictus: Kraepelin 1895: 92; Kraepelin 1899: 74, 84; Kraepelin 1901: 269; Kraepelin 1908: 190, 193; Mello-Leitão 1931: 120, 141; Mello-Leitão 1939: 60, 64, 72; Werner 1939: 352; Mello-Leitão 1945: 300, 309, 339–341, figs. 2, 137–139; Caporiacco 1951: 40; Scorza 1954a: 162; Scorza 1954b: 191, 202; Scorza 1954c: 166; Weidner 1959: 104; Kjellesvig-Waering 1966: 125, 128, 129; Esquivel de Verde 1969: 220, fig. 7; Esquivel de Verde & Machado-Allison 1969: 28; Bücherl 1971: 327; Bücherl 1978: 372; Lourenço 1984a: 354, 355, figs. 7–18, tables I, II; Lourenço 1986a: 232, fig. 3; Lourenço 1986b: 562, fig. 15; Lourenço & Eickstedt 1987: 89, 90, tab. I; Armas 1988: 78, 79, 93; González-Sponga 1989: 218; Rudloff 1994a: 9; González-Sponga 1996: 118, 155, figs. 360–362; Kovařík 1998: 121; Lourenço & Huber 1999: 259, 260; Fet & Lowe 2000: 250.
Tityus melanosticus: Waterman 1950: 168.
Tityus melanostrihus: Cekalovic 1983b: 190.

This species was reviewed by Kjellesvig-Waering (1966), Lourenço (1984a), Lourenço & Eickstedt (1987), González-Sponga (1996) and Lourenço & Huber (1999). It occurs on the South American mainland (Venezuela), on Trinidad, Tobago, and the islands between the northwestern peninsula of Trinidad and the Paria Peninsula of Venezuela. It was found in sympatry with *A. cussinii*, *M. rickyi* and *T. clathratus* at Gaspar Grande. All specimens were found motionless on tree branches, at least 1 m above ground level, indicating that this is an arboreal species (cf. *T. clathratus*).

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 2♂1♀, Gaspar Grande, 7 July 1999, L. Prendini, H. Guarisco & I. Samad.

Tityus tenuicauda new species
Figs. 3, 4, 7, 8; Table 2

Tityus discrepans (misidentification): Kjellesvig-Waering 1966: 128; Kovařík 1998: 120 (part); Lourenço & Huber 1999: 259; Fet & Lowe 2000: 242, 243 (part).

Tityus discrepans was described from Caracas, Venezuela, but has also been reported from Brazil, Guyana and Suriname (Fet & Lowe 2000). Kjellesvig-Waering (1966: 128) reported the first records of *T. discrepans* from Trinidad, noting that the ''Trinidad form differs slightly from those in Venezuela and Guyana . . . as both the male and female have well developed lobes on the free finger of the pedipalp [and the] number of rows of denticles almost always is 15, as against 16.''

Lourenço (1982) later described *Tityus gasci* Lourenço 1982 from French Guiana, which he maintained was most closely related to *T. discrepans*, while González-Sponga (1981) described *Tityus pittieri* González-Sponga 1981, and subsequently (González-Sponga 1985) *T. arellanoparrai*, two closely related species from Venezuela. González-Sponga (1996) provided a detailed key to the identification of *T. arellanoparrai*, *T. discrepans*, and *T. pittieri*. Recently, Lourenço & Huber (1999: 259) provided additional records of *T. discrepans* from Trinidad, but noted that the species ''remains poorly known.''

As part of a separate study investigating scorpion higher phylogeny, a tissue sample of *T. discrepans* was obtained from the type locality, Caracas, for DNA isolation and sequencing. When the resultant sequences were compared with sequences of homologous gene regions obtained from tissue samples of *T. discrepans* and *T. trinitatis* from Trinidad, greater percentage similarity was observed between the latter two samples than between the samples of *T. discrepans* from Venezuela and Trinidad. On closer inspection of *T. discrepans* specimens from Venezuela and Trinidad in the collection of the AMNH, it became clear that the Trinidad population is not conspecific with *T. discrepans*, but constitutes an undescribed species, differing quite considerably from the latter in external morphology. It is here described as *Tityus tenuicauda*.

Types.—TRINIDAD AND TOBAGO: *Trinidad:* Holotype ♀, Trinidad Regional Virus Lab. Building, Wrightson Road, Port of Spain, 14 March 1955, T.H.G. Aitken. Paratypes: 1♂, 1 juv ♀ [DNA sample], Mt. El Tucuche (summit), 8 July 1999, L. Prendini & I. Samad; 1♂, 1 juv ♂, 1 juv ♀, Chancellor Hill, Port of Spain, 1500 ft, August 1966, E.N. Kjellesvig-Waering; 1♀, 4 Fourth Street, Saddle Road, Maraval, 3 April 1957, T.H.G. Aitken.

Etymology.—The specific name refers to the long, slender metasoma of the adult male.

Relationships.—*Tityus tenuicauda* occurs in the *discrepans* group of *Tityus*, which also includes *T. arellanoparrai*, *T. discrepans* and *T. pittieri*, all of which are characterized by the presence of a single ventromedian carina on metasomal segments II-IV (González-Sponga 1996). This unusual character is hypothesized to be synapomorphic for these species, as most other species of *Tityus* display paired ventrosubmedian carinae on these segments (although, in certain species, these may be partially fused into a single ventromedian carina on some segments).

Although the hypothesis that a single ventromedian carina on metasomal segments II-IV is synapomorphic for the *discrepans* group remains to be tested cladistically, the available evidence refutes Lourenço's (1982) claim that *T. discrepans* is the closest relative of *T. gasci*. *Tityus gasci* displays paired ventrosubmedian carinae on segments I-IV (the hypothesized plesiomorphic condition for *Tityus*), and no other potential synapomorphies were provided for the two species by Lourenço (1982): ''A notre avis, la seule espèce qui se rapproche de *Tityus gasci* est *Tityus discrepans* (Karsch, 1879) qui a été signalée en Guyane française par Mello-Leitão, en 1945. Elles peuvent néanmoins être distinguées l'une de l'autre par la disposition des carènes ventrales du metasoma: chez *Tityus gasci* ces carènes cv (fig. 10 [illustrating paired ventrosubmedian carinae on metasomal segments I-IV]) sont paires dans les anneux I à IV, alors que chez *Tityus discrepans* il n'existe qu'une seule carène ventrale axiale, cva (fig. 11 [illustrating paired ventrosubmedian carinae on metasomal segment I, and a single ventromedian carina on segments II-IV]).''

Diagnosis.—The presence of a single ventromedian carina on metasomal segments II-IV serves to distinguish *T. tenuicauda* from all other *Tityus* species in Trinidad (Kjellesvig-Waering 1966; Lourenço & Huber 1999). Although it has been referred to *T. discrepans*, *T. tenuicauda* is actually more closely related to another member of the *discrepans* group, *T. arellanoparrai*, from the highlands of northeast Venezuela (González-Sponga 1985, 1996).

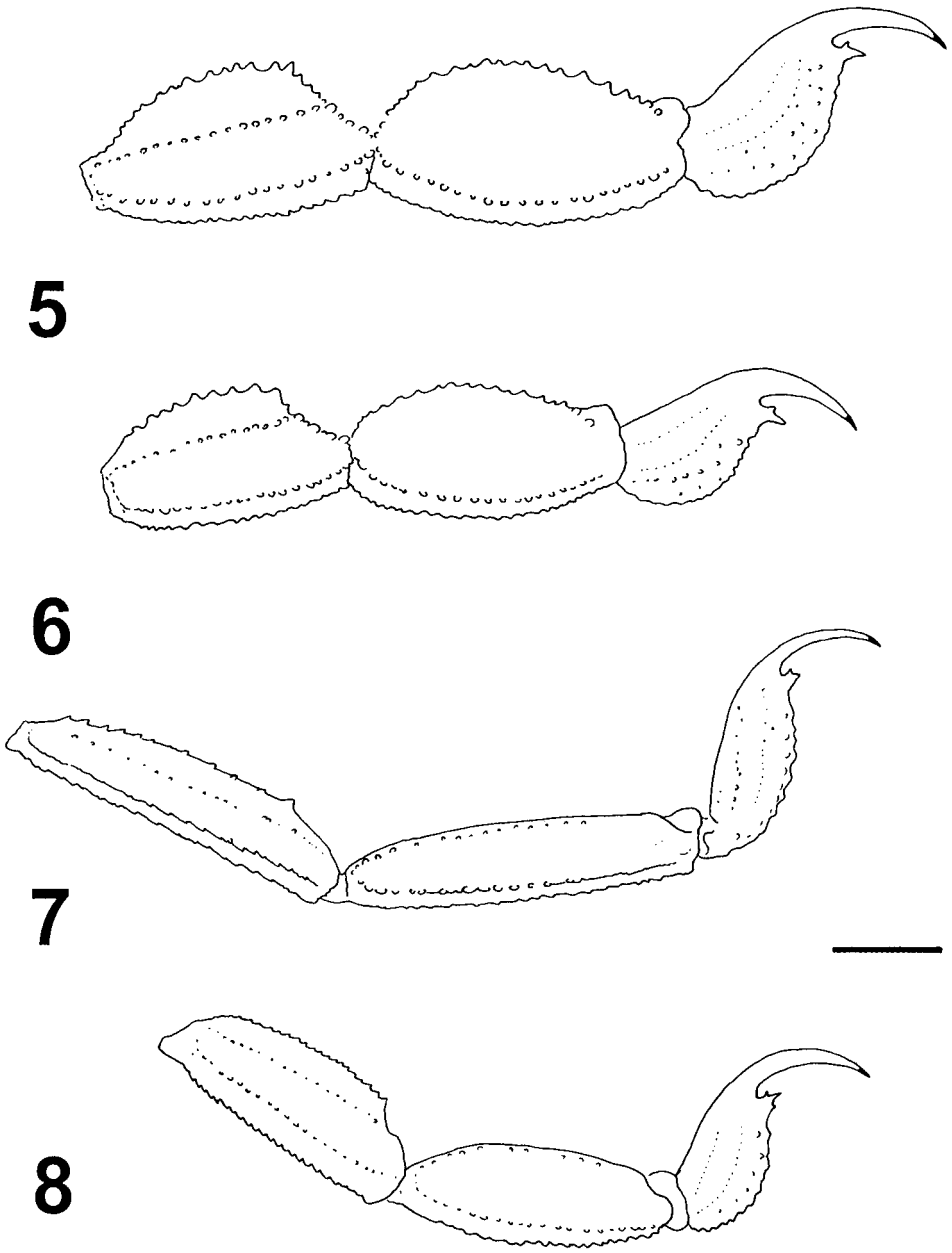
Both species are readily separated from *T. discrepans* by the slender pedipalp chelae (Fig. 3) and slender, elongated metasomal segments (Fig. 7) of the adult ♂; in adult ♂ *T. discrepans*, the chelae are bulbous (Fig. 1) and the metasomal segments are short and stout (Fig. 5). *Tityus discrepans* can be further distinguished by the presence of large conical spiniform granules on the dorsosubmedian carinae of metasomal segments II-IV and dorsolateral carinae of segment V (Figs. 5, 6); in *T. arellanoparrai* and *T. tenuicauda*, the spiniform granules are small and rounded, especially on segment V (Figs. 7, 8). Finally, *T. discrepans* can be distinguished by the greater number of rows of denticles on the movable finger of the pedipalp chela (Table 2; note that the counts reported by Kjellesvig-Waering [1966] and González-Sponga [1996] included the apical row).

Tityus tenuicauda can be readily separated from *T. arellanoparrai* by the presence of fully developed median lateral carinae of metasomal segment I; in *T. arellanoparrai* the median lateral carinae of segment I are obsolete.

Description.—The following description is based primarily on the holotype ♀ and a paratype ♂ (Chancellor Hill).

Color: Carapace, tergites, metasomal segments I-IV, pedipalps, and dorsal surfaces of legs: Maroon No. 31. Metasomal segment V, telson and chela fingers: Warm Sepia No. 221A. Chelicerae, sternites, and ventral surfaces of legs: Cinnamon-Brown No. 33. Distal edges of post-tergites and post-sternites: Buff No. 124. Pectines and genital operculum: Cream Color No. 54. Metasomal segment V, telson and chela fingers distinctly infuscated, whereas distal edges of tergites and sternites distinctly lighter in color. Slight infuscation in interocular region of carapace.

Carapace: Carapace coarsely and sparsely granular, mainly on interocular and posterolateral surfaces. Anterior and posterior margins of carapace procurved. Three pairs of lateral ocelli. Median ocelli considerably larger than lateral ocelli, situated anteromedially. Ocular tubercle with pair of smooth superciliary carinae, protruding slightly above median ocelli. Superciliary carinae connected anteriorly to pair of granular anteromedian carinae, but disconnected from pair of granular posteromedian carinae. Weakly developed, granular carina extending posteriorly from proximal lateral ocellus on each side of carapace. Anteromedian furrow moderately deep, ovate; posteromedian furrow narrow, shallow anteriorly, deep posteriorly; posterolateral furrows



Figures 5–8.—External aspect of metasomal segments IV-V and telson from adult ♂ and ♀ *Tityus discrepans* (Karsch 1879) and ***Tityus tenuicauda*** new species, showing carinae, spiniform granules, and general shape. Scale bar = 3 mm. 5. *T. discrepans:* ♂ (AMNH), Venezuela, Edo. Miranda, 3 km E of Oraira, 400 m, 20 October 1969, M.A. González-Sponga; 6. *T. discrepans:* ♀ (AMNH), same data; 7. *Tityus tenuicauda:* paratype ♂ (AMNH), Trinidad, Chancellor Hill, Port of Spain, 1500 ft, August 1966, E.N. Kjellesvig-Waering; 8. *Tityus tenuicauda:* paratype ♀ (AMNH), Trinidad, 4 Fourth Street, Saddle Road, Maraval, 3 April 1957, T.H.G. Aitken.

shallow, wide, curved; posteromarginal furrow narrow, deep.

Chelicerae: Movable finger with distal external and distal internal teeth equal, apposable. Ventral aspect of fingers and manus with long, dense macrosetae.

Sternum: Subtriangular. Median longitudinal furrow Y-shaped, shallow anteriorly, deep and narrow posteriorly.

Pedipalps: Femur pentacarinate; carinae distinct, costate granular, with spiniform granules on internomedian carina; intercarinal surfaces finely and uniformly granular. Patella with seven distinct, costate granular carinae; intercarinal surfaces smooth; internomedian carina with several large spiniform granules proximally, becoming smaller distally; basal tubercle moderately developed. Chela with nine carinae; intercarinal surfaces smooth; dorsal and external carinae distinct, costate granular; internal carinae obsolete, weakly granular (♀) to smooth (♂). Digital carina distinct, costate granular, and discontinuous medially (Figs. 3, 4). External surface with short, costate granular accessory carina. Chela long and slender, length along ventroexternal carina 39% (♂) to 44% (♀) greater than chela width and 47% (♂) to 49% (♀) greater than chela height; length of movable finger 47% (♂) to 48% (♀) greater than length along ventroexternal carina. Chela with small proximal lobe on movable finger and shallow notch in fixed finger. Dentate margins of chela fingers with 13 oblique granular rows on fixed finger, each row terminating in a large granule at the proximal and distal ends, and with 14 rows on movable finger, plus a short apical row of four granules; supernumerary granules absent; chela fingers each with a terminal denticle.

Trichobothria: Orthobothriotaxic, type A, α configuration, with the following segment totals: femur 11 (5 dorsal, 4 internal, 2 external), patella 13 (5 dorsal, 1 internal, 7 external) and chela 15 (8 manus, 7 fixed finger). Total number of trichobothria per pedipalp, 39. Trichobothrium d_5 of pedipalp femur distinctly basal to e_1.

Mesosoma: Tergites entirely granular, finely on pretergites, coarsely on post-tergites, becoming more so distally; I-VII each with a strongly developed, granular median carina; VII additionally with distinct pairs of costate granular dorsosubmedian and dorsolateral carinae. Sternites smooth (♂) to finely granular medially (♀); I-VII each with an obsolete, smooth median carina; VII additionally with paired, costate granular ventrosubmedian and ventrolateral carinae. Distal edge of sternite V with smooth projection medially.

Pectines: First proximal median lamella of each pecten slightly dilated in ♀. Pectinal teeth: 18/18 (♂), 17/19 (♀). The left pecten of the holotype is damaged, but the pectinal tooth count for the paratype ♀ from Maraval is 19/19.

Genital operculum: Completely divided longitudinally. Genital papillae present (♂), absent (♀).

Legs: Tibia III-IV without spurs. Basitarsi each with paired rows of fine macrosetae on retrolateral, and to a lesser extent, prolateral margins. Telotarsi each with paired ventrosubmedian rows of fine macrosetae. Telotarsal laterodistal lobes truncated; median dorsal lobes extending to ungues. Telotarsal ungues short, distinctly curved, and equal in length.

Metasoma and telson: Metasomal segments I-V progressively increasing in length, and decreasing in width, with segment V 19% narrower than segment I; width percentage of length 36% (♂) to 46% (♀) for I, 27% (♂) to 39% (♀) for II, 24% (♂) to 34% (♀) for III, 22% (♂) to 29% (♀) for IV, and 19% (♂) to 29% (♀) for V, giving the metasoma a slender appearance. Telson oval (Figs. 7, 8), height 38% (♂) to 45% (♀) of length, with flattened dorsal surface and rounded ventral surface; moderately globose in ♀, but distinctly elongated in ♂; vesicle not distinctly narrower than metasomal segment V, width 95% (♂) to 98% (♀) of metasomal segment V. Metasoma with intercarinal surfaces smooth, but with carinae granular to costate granular. Metasomal segments II-IV with distal granules of dorsosubmedian carinae enlarged, spiniform. Ten carinae on segment I, nine carinae on segment II, seven carinae on segments III-IV, and five carinae on segment V. Segment I with paired ventrosubmedian carinae; segments II-V with single ventromedian carina. Median lateral carinae fully developed on segment I, reduced to a few granules in the distal third of segment II, and absent in segments III-V. Segment V with paired dorsolateral and ventrolateral carinae. Telson with five obsolete granular carinae, and a well developed, spinoid subaculear tubercle, directed towards the base of the aculeus, and unevenly bifurcated distally

(Figs. 7, 8). Aculeus long, 56% (♂) to 66% (♀) of vesicle length, and sharply curved.

Hemispermatophore: Flagelliform.

Geographic variation: The paratype ♂ from Mt. El Tucuche has a higher pectinal tooth count (19/19) than the paratype ♂ from Chancellor Hill.

Ontogenetic variation: As in other species of *Tityus*, ♂ resembles ♀ very closely until the final instar. However, juveniles and subadults can be readily sexed by examination of the pectines and genital aperture.

Sexual dimorphism: In addition to abovementioned characters, adult ♂ are slightly longer than adult ♀. The increased length of ♂ is attributed mainly to the longer metasomal segments: metasomal length approximately 69% of total length (♂); approximately 66% (♀). Adult ♂ are considerably more slender than adult ♀, with sternite VII length:width ratio 32% lower.

Measurements: As in Table 2.

Distribution.—*Tityus tenuicauda* is endemic to, and evidently widespread in Trinidad. In addition to the type localities at Port of Spain, Maraval, and Mt. El Tucuche, this species has been recorded from Petit Valley, Comuto, Sangre Grande, Bush-Bush Forest (Nariva Swamp), and Mayaro by Kjellesvig-Waering (1966), and from Mt. St. Benedict (Tunapuna) by Lourenço & Huber (1999).

Ecology.—As noted by Kjellesvig-Waering (1966), this species is uncommon, probably because it is arboreal and thus seldom collected. The only specimens personally collected, from cloud forest at the summit of Mt. El. Tucuche, were located with UV light sitting motionless on tree branches about 2 m above the ground. Kjellesvig-Waering (1966: 128) reported that this is ''a forest species, and has been taken from trees as much as fifty feet [16 m] above ground.'' Ward (1996: 76) reported collecting three specimens of this species from bromeliads, *Glomeropitcairnia erectiflora*, on the summit of Mt. El Tucuche, but noted that it can also be found ''under debris.'' *Tityus tenuicauda* was collected in sympatry with *B. nitidus* and *C. raymondhansorum* on the summit of Mt. El Tucuche.

Tityus trinitatis Pocock 1897

Tityus trinitatis Pocock 1897b: 514, 517, 518.

Isometrus androcottoides (misidentification): Pocock 1889: 57.

Tityus androcottoides (misidentification): Pocock 1893b: 377, 378, pl. XXIX, figs. 3, 3b (part).

Tityus trinitatis: Kraepelin 1899: 71, 78; Mello-Leitão 1931: 136, 147; Mello-Leitão 1939: 62, 65, 66; Mello-Leitão 1945: 302, 304, 432–434, figs. 176–182; Waterman 1950: 168, 171, fig.; Caporiacco 1951: 41; Scorza 1954a: 161; Scorza 1954b: 190, 207, figs. 22, 23; Scorza 1954c: 166; Scorza 1954d: 7, 8, fig.; Bücherl 1959: 259; Bücherl 1964: 59; Kjellesvig-Waering 1966: 125, 129, 130; Bücherl 1969: 768; Esquivel de Verde & Machado-Allison 1969: 35; Bücherl 1971: 327, 330, 332, fig. 4; González-Sponga 1974a: 58; Bücherl 1978: 372, 375; Lourenço 1984b: 15–19, figs. 1–10, tab. I; Kjellesvig-Waering 1986: 86, figs. 31C, D; Armas 1988: 82, 83, 93, figs. 31, 32A, 35; Rudloff 1994: 9; Lourenço 1995: 29; Kovařík 1998: 122; Lourenço & Huber 1999: 259, 261–263; Fet & Lowe 2000: 263, 264.

This species was reviewed by Kjellesvig-Waering (1966), Lourenço (1984b) and Lourenço & Huber (1999). It is endemic to Trinidad, Tobago, and the islands off the northwestern peninsula of Trinidad. The Venezuelan record of Scorza (1954b: 207) is presumably erroneous, and the species was omitted by González-Sponga (1996). *Tityus trinitatis* is the most common species of scorpion in Trinidad and Tobago, and has been collected in sympatry with *A. cussinii*, *M. rickyi* and *B. laui* at Speyside, and with *A. cussinii*, *M. rickyi* and *B. nitidus* at Mt. St. Benedict. Most specimens were found motionless on bare ground, leaf litter, rock faces, logs and branches close to ground level. Several adult specimens were observed preying on *M. rickyi*, and on juvenile conspecifics.

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 1♂, Arima road, 10°42′22″N, 61°17′29″W, 29 June 1999, L. Prendini & R. Pinto-da-Rocha, in palm leaf base; 1 juv ♂, Arima, 8 km N, 29 July 1999, B. Cutler, in fern frond; 2♀, 2 juv, Mt. St. Benedict, 10°39′49″N, 61°23′56″W, 28 June 1999, L. Prendini; 1♀, 2 juv, Mt. St. Benedict, 9 July 1999, L. Prendini & I. Samad. *Tobago:* 2♂5♀, Speyside, 1 km N on road to Charlotteville, 11°18′20″N, 60°32′15″W, 3 July 1999, L. Prendini & H. Guarisco; 1♂4♀, 2 juv, same data, except 4 July 1999.

FAMILY CHACTIDAE

Broteochactas laui Kjellesvig-Waering 1966

Broteochactas laui Kjellesvig-Waering 1966: 125–128, figs. 1, 2.

Broteochactas laui: González-Sponga 1974b: 5;

Table 2.—Meristic data for adult ♂ and ♀ *Tityus discrepans* (Karsch 1879) and ***Tityus tenuicauda*** new species. *T. discrepans*: ♂, ♀ (AMNH), Venezuela, Edo. Miranda, 3 km E of Oraira, 400 m, 20 October 1969, M.A. González-Sponga. *Tityus tenuicauda*: holotype ♀ (AMNH), Trinidad, Trinidad Regional Virus Lab. Building, Wrightson Road, Port of Spain, 14 March 1955, T.H.G. Aitken; paratype ♂ (AMNH), Trinidad, Chancellor Hill, Port of Spain, 1500 ft, August 1966, E.N. Kjellesvig-Waering. Measurements following Stahnke (1970) and Lamoral (1979). [1] Total length = sum of carapace, tergites I-VII, metasomal segments I-V and telson. [2] Not including the apical row (Wagner 1977; Sissom & Lourenço 1987). [3] Left pecten of holotype ♀ damaged, count for paratype ♀ from Maraval (AMNH): 19/19.

		T. discrepans		*T. tenuicauda*	
		♂	♀	♂	♀
Total length[1]		77.81	67.36	80.30	73.85
Carapace	length	7.77	7.37	6.87	7.07
	anterior width	4.99	4.83	4.04	4.70
	posterior width	7.66	8.00	6.09	7.27
Mesosoma + telson	total length	21.85	18.63	17.98	18.09
Sternite VII	length	5.32	4.73	4.97	4.66
	width	6.94	7.66	4.96	6.86
Metasoma	total length	48.19	41.36	55.45	48.69
Metasomal segment I	length	6.36	5.22	7.19	6.99
	width	4.09	3.71	2.65	3.24
Metasomal segment II	length	7.65	6.36	8.78	7.64
	width	4.12	3.79	2.41	2.99
Metasomal segment III	length	8.01	6.87	9.86	8.24
	width	4.22	3.80	2.37	2.80
Metasomal segment IV	length	8.52	7.09	10.30	8.60
	width	4.38	3.81	2.30	2.51
Metasomal segment V	length	8.94	8.12	11.18	9.15
	width	4.44	3.86	2.15	2.61
Telson	total length	8.71	7.70	8.14	8.07
	aculeus length	3.53	2.85	3.29	3.57
	vesicle length	6.02	5.12	5.90	5.41
	vesicle width	3.84	3.16	2.11	2.47
	vesicle height	3.24	2.75	2.23	2.42
Pedipalp	total length	33.64	30.47	30.10	31.43
Femur	length	7.49	6.60	6.77	6.70
	width	2.16	2.09	1.78	2.04
Patella	length	7.69	7.07	7.28	7.46
	width	3.35	2.91	2.55	3.04
Chela	length	14.30	12.98	12.92	13.55
	width	4.26	2.74	2.46	2.85
	height	3.79	2.38	2.27	2.48
	length along ventroexternal carina	5.37	4.15	4.41	4.68
	length of movable finger	9.03	8.85	8.52	8.86
	rows of denticles fixed (left/right)	13/13	13/14	13/13	13/13
	rows of denticles mov.[2] (left/right)	15/15	15/15	14/14	14/14
Pecten	total length	4.71	4.31	4.61	4.90
	length along dentate margin	4.49	4.11	4.44	4.24
	tooth count (left/right)	16/16	17/17	18/18	17/19[3]

González-Sponga 1974c: 300; González-Sponga 1975: 49; Francke & Boos 1986: 24–27, figs. 21–26; Kovařík 1998: 125; Sissom 2000: 292, 293.

This species, which is endemic to Tobago, was reviewed by Francke & Boos (1986), but nothing was previously known of its biology. As a result of observations made on 14 specimens collected by the author, *B. laui* is now known to be a fossorial scorpion which constructs burrows, approximately 10 cm in length, into hard soil banks. The burrow en-

trances, situated in open ground, are oval in shape and approximately 10 mm wide. The burrows are constructed at an angle into the soil. Most of the specimens were located with UV detection, as their pedipalps were partially extended from their burrow entrances. On discovery, they immediately retreated backwards into their burrows and had to be excavated. One adult ♂ was located on the ground surface. *Broteochactas laui* was collected in sympatry with *A. cussinii*, *M. rickyi* and *T. trinitatis* at Speyside.

Material examined.—TRINIDAD AND TOBAGO: *Tobago:* 3♂12♀, Speyside, 1 km N on road to Charlotteville, 11°18′20″N, 60°32′15″W, 3–4 July 1999, L. Prendini & H. Guarisco.

Broteochactas nitidus Pocock 1893

Broteochactas nitidus Pocock 1893b: 399–401, pl. XXIX, figs. 7, 7a.
Broteochactas gollmeri (misidentification): Kraepelin 1894: 176, 177 (part); Pocock 1897a: 365, 366 (part); Kraepelin 1899: 173 (part); Pocock 1900: 68 (part); Kraepelin 1912: 53 (part?); Mello-Leitão 1932: 32 (part); Roewer 1943: 237; Mello-Leitão 1945: 100 (part); Waterman 1950: 169; Kjellesvig-Waering 1966: 125, 126, fig. 2.
Broteochactas nitidus: Francke & Boos 1986: 21–25, figs. 15–20; González-Sponga 1992: 54; Ward 1996: 10; Kovařík 1998: 125; Lourenço & Huber 1999: 263; Sissom 2000: 293.

This species, which is endemic to Trinidad and Tobago, was reviewed by Kjellesvig-Waering (1966) under the name *B. gollmeri* (Karsch 1879), with which it was confused. Francke & Boos (1986) reinstated the name, *B. nitidus*. The species was reviewed recently by Lourenço & Huber (1999). Like *B. laui*, *B. nitidus* is a fossorial scorpion which constructs burrows in hard soil. The burrows appear to be shorter than those of *B. laui* and are usually constructed under logs or stones (n = 6). One specimen was found inside a rotten log. However, six of the specimens were found motionless on bare ground at night. *Broteochactas nitidus* was found in sympatry with *A. cussinii*, *M. rickyi* and *T. trinitatis* at Mt. St. Benedict, and with *C. raymondhansorum* and *T. tenuicauda* on the summit of Mt. El Tucuche.

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 7♀, 3 juv, Mt. St. Benedict, 10°39′49″N, 61°23′56″W, 28 June 1999, L. Prendini; 1♀, Arena Forest, 10°34′54″N, 61°14′20″W, 1 July 1999, L. Prendini, in rotten log; 1♀, Mt. Zion, 6 July 1999, L. Prendini & H. Guarisco, in burrow under stone; 1♂, Mt. El Tucuche (summit), 8 July 1999, L. Prendini & I. Samad.

Chactas raymondhansorum Francke & Boos 1986

Chactas (Andinochactas) raymondhansi Francke & Boos 1986: 16–19, figs. 1–10.
Chactas raymondhansi: Ward 1996: 10; Rudd 1996: 79–87.
Chactas ryamondhansi: Kovařík 1998: 126.
Chactas raymondhansorum: Sissom 2000: 305.

Chactas raymondhansorum, the largest scorpion in Trinidad, is known only from cloud forest at the summits of the highest mountains in the Northern Range: Cerro Del Aripo (990 m), Mt. El Tucuche (980 m) and Morne Bleu (800 m). In their original description, Francke & Boos (1986: 19) noted that all specimens had been collected from ''water-filled spaces between leaf sheaths of the bromeliad *Glomeropitcairnia erectiflora* Mez.'' and proposed that the species was a bromeliad specialist, with ''a large chamber extending from the stigmata and surrounding the book lungs . . . [that] may act as a reservoir for air if submersion becomes necessary or unavoidable.''

The observation that *C. raymondhansorum* inhabits bromeliads was reinforced by researchers from the University of Glasgow (Ward 1996), who collected several specimens from *G. erectiflora* while searching for the golden tree frog, *Phyllodytes auratus*. Rudd (1996), also from the University of Glasgow, conducted a study of the ''bromeliad-dwelling scorpion'' which resulted in the collection of further specimens from bromeliads.

However, it appears that the view of this scorpion as a bromeliad specialist is nothing more than an artefact of diurnal collecting methods, which target bromeliads as a convenient place to search. The fact that most of the known specimens were located incidentally while searching for golden tree frogs supports this assertion. As has been found in other parts of the world (e.g., southern Africa), the habits and habitats of scorpions are best assessed nocturnally with the aid of UV light (Lamoral 1979). None of the four specimens of *C. raymondhansorum* collected by the author was found near a bromeliad: one retreated into a hole in a rotten tree stump, another into

a hole in a tree trunk, while the remaining specimens were found motionless on tree branches. Were these scorpions true bromeliad specialists, one would expect to have found them sitting on bromeliads. The behavior of *C. raymondhansorum* appears, in fact, to be fairly typical of a generalist arboreal scorpion, bromeliad leaf bases being one of many potential shelters into which such scorpions may opportunistically retreat.

Chactas raymondhansorum was found in sympatry with *T. tenuicauda* and *B. nitidus* on Mt. El Tucuche. None of the specimens was observed less than 1 m above ground level.

Material examined.—TRINIDAD AND TOBAGO: *Trinidad:* 2♂1♀, 1 subadult ♀, Mt. El Tucuche (summit), 8 July 1999, L. Prendini & I. Samad.

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