

Fig. 5.—A female *Araneus diadematus* spider was photographed while it descended on its thread. Note the emergence of silk from the spinneret at the end of the spider's abdomen, and the position of one of the hind legs on the thread. However, spiders can also descend on a new silk strand without the help of a leg, using some mechanism along the path of the emerging thread to regulate speed; the animal's weight provides the pull.

Something that has been observed by nearly everybody in spiders is their ability to let out thread as they descend (Fig. 5), and that they can climb back up on such a thread, taking the silk in during the return. This observation, taken together with the fact that spiders always run on the underside of a web or a bridge thread, hanging down as they move, makes one aware of the important role which the use of the animal's own weight plays in locomotion and silk production. It is probably the absence of body weight which disturbed each of the two animals severely during the first days after release from the vial. They had to build frame threads by running along the given structures rather than dropping down; reports about their restless behavior preceding construction of the first web in Skylab can be interpreted as exploring such alternate mechanisms. Once the spiders had accomplished this, they showed no more difficulty in laying radii and spiral turns, with the result of accomplishing a large, regular web. Thus those features which underly detailed symmetry and make the orb an orb do not require gravity as a cue. The ability of an invertebrate animal with as rigid a behavior pattern as orb-web construction which is relatively independent of experience (Reed, *et al.*, 1970) to find alternate ways

to complete a perfect trap for food and thereby increase its chance for survival, is possibly the most interesting finding in the evaluation of Skylab web records.

SUMMARY

Two spiders built orb-webs in Skylab under zero gravity only four days after release from transportation vials. The first webs resembled pre-flight controls in size and regularity, but the unusual distribution of radial angles and thinness of thread together with a probably low number of turning points in the spiral indicated a deviation from earth webs which can be attributed to the absence of gravity as a cue. Other web changes like a gradual decrease in regularity, diminished web size, and the spiders' decrease in body weight are identified as being likely consequences of starvation, Skylab stress and unknown circumstances not directly connected with zero gravity.

ACKNOWLEDGEMENTS

All records came from the NASA Marshall Space Flight Center. We acknowledge the help from Mr. Henry Floyd, manager of the Skylab Student Project, who provided the photographs and other data as the basis for our evaluation. Mr. Wolfgang Brandner from Marshall Space Flight Center participated in the early stages of experimentation and contributed substantially to the preparation of the Skylab Spider Experiment.

The web measuring work was carried out in the laboratories of the North Carolina Department of Mental Health, Research Section, and was supported by National Science Foundation Grant Number GB 25274 to Peter N. Witt. Thread measurements were performed at Cornell University.

LITERATURE CITED

- Christiansen, A., R. Baum and P. N. Witt. 1962. Changes in spider webs brought about by mescaline, psilocybin and an increase in body weight. *J. Pharmacol. exp. Ther.* 136:31-37.
- Jackson, R. R. 1974. Effects of d-amphetamine sulfate and diazepam on thread connection fine structure in a spider's web. *J. Arachnol.* 2:37-41.
- Mayer, G. 1953. Untersuchungen über Herstellung und Struktur des Radnetzes von *Aranea diadema* und *Zilla-x-notata* mit besonderer Berücksichtigung des Unterschieds von Jugend- und Altersnetzen. *Z. Tierpsychol.* 9:337-362.
- Peakall, D. B. 1968. The spider's dilemma. *New Sci.*, Jan. 4:28/29.
- Reed, C. F., P. N. Witt, M. B. Scarboro and D. B. Peakall. 1970. Experience and the orb web. *Developm. Psychobiol.* 3:251-265.
- Witt, P. N. 1963. Environment in relation to the behavior of spiders. *Arch. environm. Hlth.* 7:4-12.
- Witt, P. N. 1971. Drugs alter web-building of spiders. *Behav. Sci.* 16:98-113.
- Witt, P. N., C. F. Reed and D. B. Peakall. 1968. A spider's web. Springer Verlag, Berlin.
- Zahl, P. A. 1971. What's so special about spiders. *Nat. Geogr.* 140:190-219.

TWO EMENDATIONS TO STAHNKE'S (1974) VAEJOVIDAE REVISION (SCORPIONIDA, VAEJOVIDAE)

Oscar F. Francke¹

Department of Zoology
Arizona State University
Tempe, Arizona 85281

ABSTRACT

Two emendations to Stahnke's (1974) "Revision and keys to the higher categories of Vaejovidae" are given. First, Stahnke's nomenclatorial decision to use the spelling "*Vejovis*", rather than the correct original spelling of *Vaejovis* Koch, is based on an inappropriate article of the Code, and contradicts the ruling relative to this nomenclatorial problem. Thus, Vaejovidae, Vaejovinae, and *Vaejovis* are the correct spellings for the family, subfamily, and genus, respectively. Taxonomically, the holotype of *Physoctonus physurus* Mello-Leitao is redescribed, establishing that this supposedly vaejoivid taxon is a junior synonym of *Rhopalurus debilis* (Koch), belonging to the family Buthidae.

INTRODUCTION

The higher categories of the family Vaejovidae, a very conspicuous element of the North American scorpiofauna, have been recently revised by Stahnke (1974). That author however, failed to examine a considerable number of taxa at both the specific and supraspecific levels (Francke, 1976), and for this reason his proposed classification of the higher categories leaves much to be desired, particularly in the eyes of taxonomists that appreciate the concepts of phylogenetic (Hennigian) systematics. Stahnke's proposed classification of the vaejovids is often monothetic, occasionally leading him to recognize polyphyletic and paraphyletic taxa. In order to understand the sister-group relationships in vaejoivid scorpions it is necessary to have a thorough knowledge of the taxa in question, and this is but one of a series of contributions (see Francke, 1976, and in press) in which I aim to increase our knowledge of the lower categories of Vaejovidae before venturing to propose a classification of the higher categories based on sound phylogenetic principles.

In this contribution I deal with two important issues raised by Stahnke's revision of the higher categories of Vaejovidae, one nomenclatorial and one taxonomic. Nomenclatorially I settle once and for all the controversy over the correct spelling of the generic and familial names. Taxonomically, I remove a controversial genus from the family Vaejovidae and synonymize it in the family Buthidae.

I. THE CORRECT ORIGINAL SPELLING OF THE TYPE GENUS NAME

The type genus for the family was erected by C. L. Koch (1836) when his description of *Vaejovis mexicanus* Koch was published. The generic name was subsequently used by

¹ Present address: Department of Biological Sciences and Department of Entomology, Texas Tech University, Lubbock, Texas 79409.

its author with the same spelling, i.e., *Vaejovis* (Koch 1841, 1843), leaving no doubts about his intentions. However, Thorell (1876) discovered that the original spelling was grammatically incorrect, emending it to "*Vejovis*"; and since then both spellings have been used in the taxonomic literature, with the amended spelling appearing more frequently though. The first attempt to rectify the situation was by Williams (1971), who concluded correctly that Thorell's emendation was unjustified in the meaning of the Code because Koch had used the spelling *Vaejovis* consistently, ruling out a *lapsus calami* (ICZN, Articles 32, 33).

In 1972 Stahnke agreed with the decision to retain *Vaejovis* as the correct original spelling, but in 1974 he reverted to using "*Vejovis*" in his revision of the higher categories, basing his decision on Article 23b of the ICZN (Statute of Limitation of the Law of Priority). This is totally incorrect for several reasons. In the first place, the issue in question was not an unused senior synonym but only the spelling of the name *Vaejovis* versus "*Vejovis*", thus Article 23b could not contribute to the solution of the problem; Article 32 (Original spelling) and 33 (Subsequent spelling) were included in the ICZN specifically to handle problems of this nature, and are the ones that Stahnke should have used. Secondly, the International Commission of Zoological Nomenclature reworded Article 23b in its entirety (ICZN, 1970), and the reworded version was made retroactive to 6 November 1960. If Stahnke had been aware of this, then even if he incorrectly invoked Article 23b, his conclusion should have been to continue using *Vaejovis* as the correct spelling.

Finally, the 17th International Congress of Zoology held in Monaco during September 1972 approved amended versions of Article 23(a-b) and Article 79(b) (Corliss, 1972; ICZN, 1972, 1974). Briefly, an application has to be made to the Commission to suppress an unused senior synonym, and a case that nomenclatorial stability is threatened can be made by showing that the senior name is not known to have been used once during the immediately preceding fifty years. Thus, Stahnke had no reason nor right to suppress *Vaejovis* without getting a ruling from the Commission, and he does not have a case for that because we are not dealing with an unused senior synonym, and because *Vaejovis* has been used several times in the last fifty years (see Stahnke 1974, p. 132 for some of these citations).

In conclusion, the amended version of Article 32, and Article 33 in the Code clearly states that the spelling *Vaejovis* is to be maintained as the correct original spelling. Accordingly, the family and subfamily names are to be spelt Vaejoidea and Vaejovinae respectively.

II. REDESCRIPTION OF *PHYSOCTONUS PHYSURUS* MELLO-LEITAO (VAEJOVIDAE), A JUNIOR SYNONYM OF *RHOPALURUS DEBILIS* (KOCH) (BUTHIDAE)

The monotypic genus *Physoctonus* was erected, in the family Vaejoidea, by Mello-Leitao (1934) on the basis of a single specimen from northeast Brazil. This genus was poorly characterized in the original description, and has been a continuous source of confusion to scorpion taxonomists since that time. During a visit to Brasil in 1975, I had the opportunity to borrow the holotype of *Physoctonus physurus*, on which the following redescription and taxonomic changes are based.

FAMILY BUTHIDAE

Rhopalurus Thorell

Rhopalurus Thorell 1876, p. 9 (Type species *R. laticauda* Thorell).

Heteroctenus Pocock 1893, pp. 391-393 (Type species *Scorpio junceus* Herbst).

Physoctonus Mello-Leitao 1934, pp. 75-76 (Type species *P. physurus* Mello-Leitao) **NEW SYNONYMY.**

Physoctonus can be recognized as a buthid scorpion on the basis of the characters indicated below. Cheliceral fixed finger with one distal, three external, and one internal teeth. Cheliceral movable finger with five external (two basals) and three internal teeth, and the external distal tooth is longer than the internal distal tooth (Figs. 1-4). Orthobothriotaxia "A": with 11 trichobothria on the femur (Figs. 5-6); 13 on the tibia (Figs. 7-8); eight on the manus, and seven on the fixed finger of the chela (Figs. 9-10). Prosomal sternum subpentagonal to triangular. Walking legs with internal and external pedal spurs. Furthermore, *Physoctonus* is a centrurine buthid on the basis of the following characters: pectinal fulcra present; tibial spur absent on all legs; tergites mono-keeled; pedipalp fingers armed with 7-9 median rows of granules, flanked by supernumerary granules (Fig. 11); femoral trichobothrium **d**₂ displaced to internal face from its normal position dorsally. Finally, *Physoctonus* is a junior synonym of *Rhopalurus* by sharing with the species included in this genus the rugosity or granulation found on the antero-lateral regions of sternite 3 under the pectines (stridulatory apparatus), and the marked broadening of the metasomal segments distally. This last character gave both genera and their type species their respective names: *Rhopalurus* means "clubbed-tail" (Greek), *laticauda* means "wide tail" (Latin); and, *Physoctonus* means "inflated killer" (Greek; obviously in reference to the metasoma which bears the aculeus terminally), *physurus* means "inflated tail" (Greek) once again.

Rhopalurus debilis (Koch)

Figs. 1-15

Vaejovis debilis Koch, 1841, pp. 21-22, fig. 605.

Vejovis debilis Kraepelin, 1899, p. 96 (Buthidae, *incertae sedis*).

Rhopalurus debilis Borelli, 1910, pp. 5-8, fig.; Mello-Campos, 1924, p. 252; Mello-Leitao, 1932, pp. 14, 30; Meise, 1934, p. 42; Prado, 1939, pp. 29-30; Mello-Leitao, 1945, pp. 272-273; Caporiacco, 1948, p. 610; Bücherl, 1959, p. 268.

Physoctonus physurus Mello-Leitao, 1934, pp. 76-77, figs. 1-7; Mello-Leitao, 1945, pp. 129-132, figs. 40-41; Bücherl, 1969, p. 768; Stahnke, 1974, p. 129. **NEW SYNONYMY.**

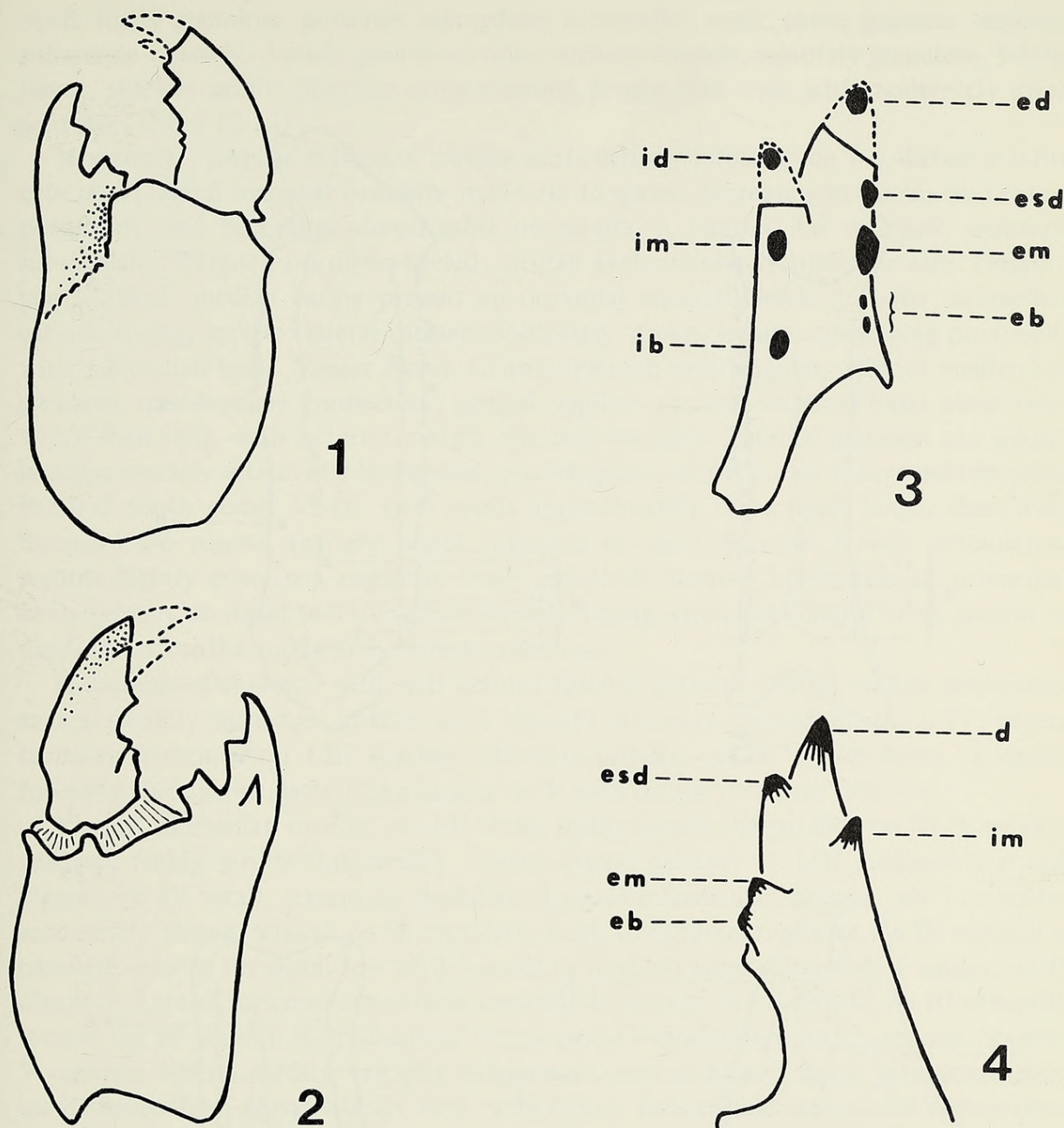
As far as I have been able to establish, all taxonomic references to *Rhopalurus debilis* are based on only three specimens: (1) Koch's original type specimen from Brasil, probably an adult female (25.9 mm long, pectinal tooth count 12) which I have been unable to locate; (2) Borelli's (1910) specimen from the state of Ceara in NE Brasil, an adult female discussed below; and (3) Mello-Leitao's type specimen of *Physoctonus physurus* from the state of Paraiba in NE Brasil, an adult male (23.25 mm long, pectinal tooth count 15-16). Although Bücherl (1959) reported that five specimens of *R. debilis* from the state of Ceara were at that time deposited in the collection of the Instituto Butantan, Sao Paulo, I was unable to locate them during my visit there in 1975.

Table 1.—Measurements (in mm) of *Rhopalurus debilis* (Koch) from Brasil.

		Adult male (<i>P. physurus</i> holotype)	Adult female from Ceara
Total length		23.25	30.95
Carapace:	length	3.00	4.00
	anterior margin to median eyes	1.25	1.50
	posterior margin to median eyes	1.75	2.50
	anterior width	1.65	2.15
	width at median eyes	2.60	3.50
	posterior width	3.25	4.50
Mesosoma:	length	6.45	9.10
Metasoma:	length	13.70	17.85
	I length/width/depth	1.75/1.75/1.35	2.30/2.30/1.70
	II length/width/depth	2.10/1.75/1.40	2.75/2.05/1.60
	III length/width/depth	2.35/2.00/1.40	2.90/2.20/1.60
	IV length/width/depth	2.50/2.55/1.45	3.30/2.40/1.65
	V length/width/depth	2.70/2.45/1.30	3.60/2.40/1.60
	width at anal arc	1.00	1.35
	telson length/vesicle length	2.40/1.30	3.00/1.80
	vesicle width/vesicle depth	1.00/0.95	1.35/1.25
	aculeus length	1.20	1.20
Pedipalp:	length	11.60	15.25
	femur length/width	2.75/0.75	3.70/1.10
	tibia length/width	3.10/1.30	4.10/1.55
	chela length/width/depth	5.75/1.60/1.45	7.45/1.50/1.40
	movable finger length	4.00	5.30
	fixed finger length	3.35	4.60
Chelicera:	chela length/width	1.15/0.70	1.30/0.95
	movable finger length	0.65	0.90
	fixed finger length	0.35	0.50
Pectines:	tooth count	16-15	16-15
	middle lamellae count	6-6	6-7

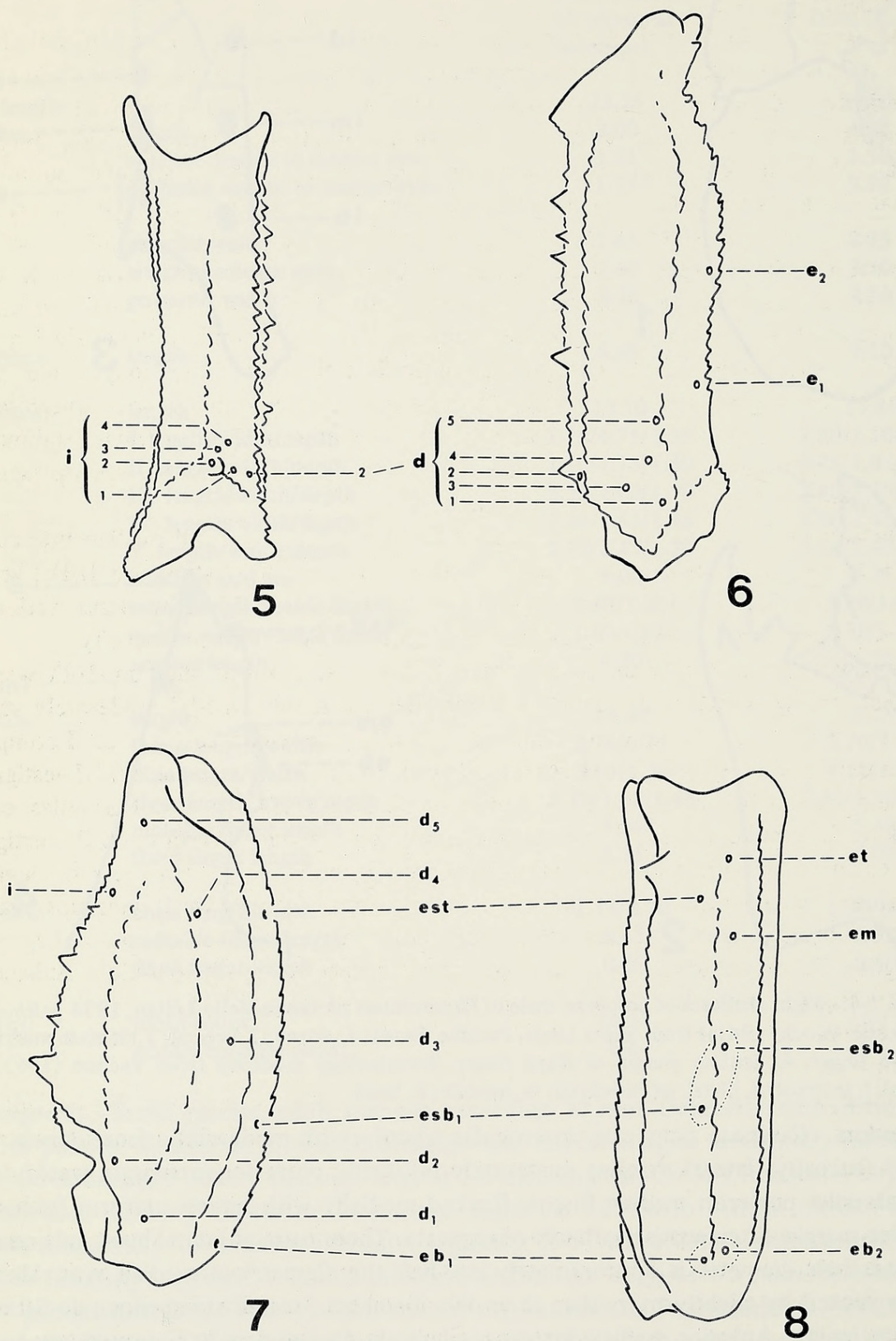
Diagnosis.—Small species, adult size not exceeding 30 mm. Ochreous, with distinctive fuscous pattern: carapacial interocular triangle and lateral margins moderately infusate, posterior submargin weakly fuscous; tergites 1-6 median keels densely infusate, tergite 7 median keel diffusely infusate; metasomal segments I-IV with ventral median intercarinae moderately to densely infusate, segments II-V ventral lateral intercarinae with variable fuscosity, segment V lateral intercarinae fuscous. Tergites 1-6 mono-keeled, tergite 7 pentacarinat. Sternite 3 anterolaterally rugose, sternite 7 tetracarinate. Metasomal segments I-II with 10 complete carinae, segments III-IV with eight complete carinae; intercarinal spaces shagreened to rugose. Telson with subaculear tubercle vestigial. Movable finger of pedipalps with seven median rows of granules, and abundant supernumerary granules. Pectinal tooth count 15-16 in males, 12-16 in females.

Description.—Adult male (measurements in Table 1).



Figs. 1-4.—Right chelicera of holotype male of *Physoctonus physurus* Mello-Leitao, 1934 [= *Rhopalurus debilis* (Koch, 1841)] from Santa Luzia, Paraíba, Brasil: 1, dorsal; 2, ventral; 3, dentate margin of movable finger; 4, dentate margin of fixed finger. Terminology modified from Vachon (1963): *e*, external; *i*, internal; *d*, distal; *sd*, subdistal; *m*, median; *b*, basal.

Prosoma.—Carapace ochreous: interocular triangle with moderately dense, finely variegated fuscosity; lateral margins moderately infusate; posterior submargin weakly fuscous laterally; posterior median furrow flanked medially with sparse, uniform fuscosity. Anterior margin of carapace shallowly emarginate. Three pairs of lateral eyes, subequal in size and their diameter is approximately one-half the diameter of median eyes. Median eyes separated by slightly more than their own diameter, located at anterior two-fifths of carapace length. Anterior median furrow moderately deep and wide, narrowing gradually over median ocular prominence. Posterior median furrow: proximal one-half (immediately behind ocular prominence) shallow, wide; distal half abruptly deeper, moderately wide. Posterior marginal furrow moderately deep, wide. Posterior submedian furrows short, strongly divergent, moderately deep. Carapacial carinae: superciliaries well devel-



Figs. 5-8.—Trichobothria on right pedipalp femur and tibia of holotype male of *Physoctonus physurus* Mello-Leitao, 1934 [= *Rhopalurus debilis* (Koch, 1841)] from Santa Luzia, Paraíba, Brasil. Trichobothrial terminology after Vachon (1974): 5, femur, internal view; 6, femur, dorsal view; 7, tibia, dorsal view; 8, tibia, external view.

oped, finely granulose; posterior submedians subparallel, weak, short, granular. Anterior submargin coarsely, densely granulose; other surfaces densely, minutely granulose. Venter flavus, sparsely setate. Sternum subpentagonal, longer than wide with moderately divergent sides (Figs. 12-13).

Mesosoma.—Tergites ochreous: median keels densely infusate on 1-6, diffusely infusate on 7; lateral marginal fuscidity moderate to sparse, decreasing in density and extent posteriorly and becoming unnoticeable on tergite 7; tergites 3-6 vestigially infusate submedially. Tergites 1-6 mono-keeled; median keel moderately strong, serrate. Tergite 7 penta-keeled: median carina present on proximal one-half, weak, granular; submedian carinae strong, serrate; lateral carinae moderately strong, serrate, converging proximally with submedian keels. Venter flavus. Genital operculi subtriangular, without median longitudinal membranous connection; genital papillae present. Pectinal basal piece twice wider than long, with anterior margin notched medially. Pectinal marginal and middle lamellae sparsely setate; middle lamellae quadrangular, six per comb. Fulcra subtriangular. Pectinal tooth count 15-16, each tooth approximately three times longer than wide. Sternites 2-6 rugose, sparsely setate; stigmata elongate. Sternite 3 with anterolateral regions slightly depressed, rugose to finely granulose. Sternite 7 tetracarinate: submedian keels present on distal two-thirds, moderately strong, granulose; lateral keels present on distal three-fourths, moderately strong, granulose.

Metasoma.—Ochreous, with well defined fuscous pattern: ventral median intercarinal spaces sparsely infusate distally on I, densely infusate throughout on II-IV; ventral lateral intercarinae on I-III sparsely infusate distally, on IV-V with dense variegated fuscidity throughout; lateral intercarinae on V with diffuse, uniform fuscidity.

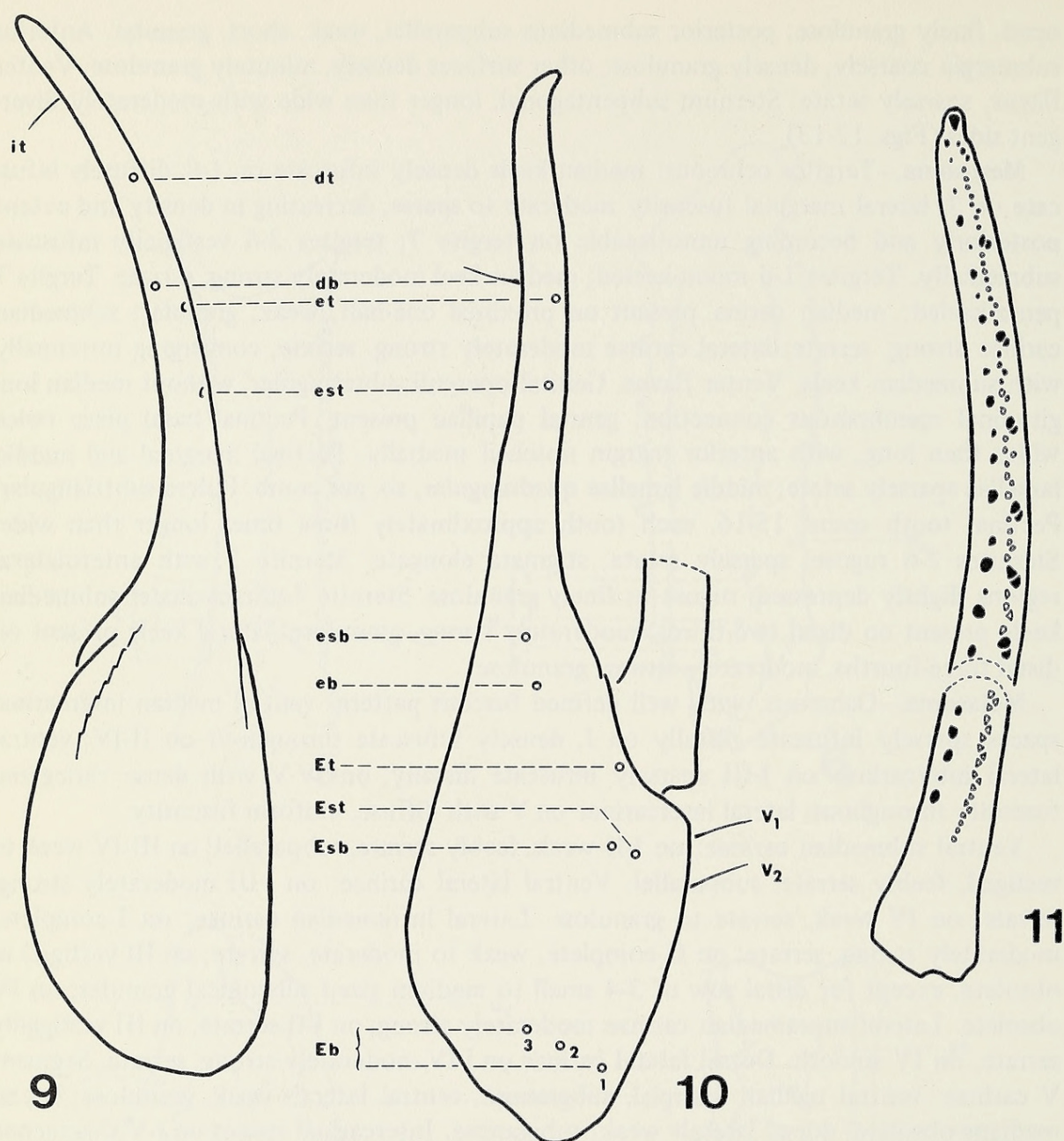
Ventral submedian carinae: on I-II weak, feebly serrate, subparallel; on III-IV weak to vestigial, feebly serrate, subparallel. Ventral lateral carinae: on I-III moderately strong, serrate; on IV weak, serrate to granulose. Lateral inframedian carinae: on I complete, moderately strong, serrate; on II complete, weak to moderate, serrate; on III vestigial to obsolete, except for distal row of 3-4 small to medium sized subconical granules; on IV obsolete. Lateral supramedian carinae moderately strong; on I-II serrate, on III vestigially serrate, on IV smooth. Dorsal lateral carinae on I-IV moderately strong, serrate. Segment V carinae: ventral median vestigial, subgranose; ventral laterals weak, granulose; lateral medians obsolete; dorsal laterals weak, subgranose. Intercarinal spaces on I-V shagreened to rugose. Telson ochreous, with vesicular ventral surface vestigially granulose. Subaculear tooth vestigial, tuberculate; aculeus long, sharply curved (Figs. 14-15).

Chelicera.—Chela and fingers ochreous, teeth testaceous. Dentition of fixed and movable fingers typical of centrurine buthids (Figs. 1-4).

Pedipalps.—Orthobothriotaxia "A" (Vachon, 1974). Femur ochreous, five-keeled: ventral external carina strong, irregularly serrate; ventral internal carina moderately strong, with regularly spaced granules; dorsal external keel moderately strong, serrate; dorsal internal keel moderately strong, granulose; internal keel moderately strong, with large subconical granules irregularly spaced. Femoral trichobothrial pattern shown in Figs. 5-6.

Tibia ochreous, with diffuse variegated fuscidity on dorsal, internal and external faces. Seven keels: ventral external, ventral internal, dorsal external, dorsal median, dorsal internal, and external keels moderately strong, finely serrate; internal keel moderately strong, with large and medium sized subconical granules irregularly spaced. Intercarinal spaces rugose. Tibial trichobothrial pattern shown in Figs. 7-8.

Chela ochreous, with vestigial fuscidity dorsally and externally on manus and on fixed finger base. Trichobothrial pattern shown in Figs. 9-10. Carinae vestigial to obsolete,

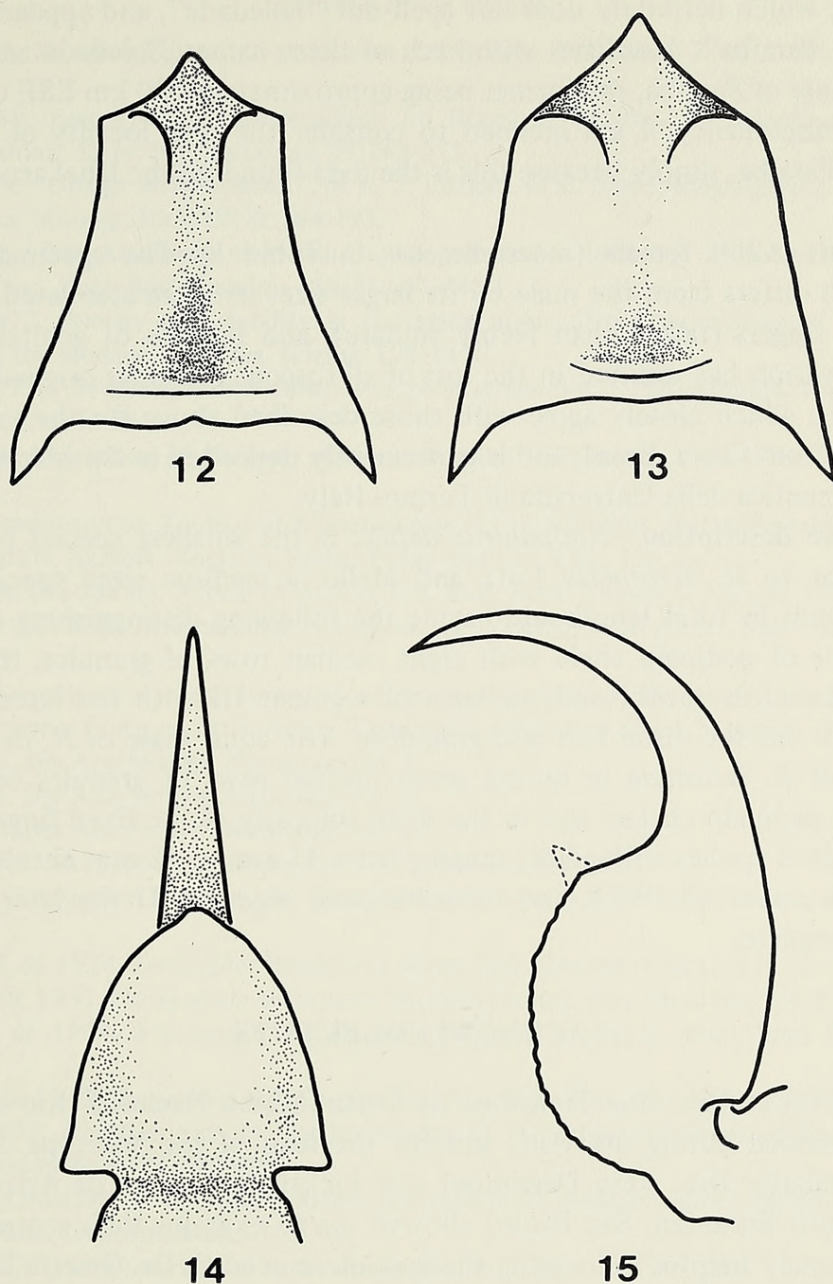


Figs. 9-11.—Right pedipalp chela of holotype male of *Physoctonus physurus* Mello-Leitao, 1934 [*Rhopalurus debilis* (Koch, 1841)] from Santa Luzia, Paraíba, Brasil. Trichobothrial terminology after Vachon (1974): 9, dorsal view; 10, external view; 11, dentate margin of movable finger, showing seven median rows of granules separated by seven triads of larger denticles (terminal triad included), and the presence of numerous supernumerary granules.

obtusely angular “facets” suggesting their presence. Dentate margin of fingers separated at base when fingers close due to sinuous shape of fixed finger (Fig. 10). Moveable finger dentition typical of centrurine buthids (Fig. 11).

Legs.—Ochreous, with fuscous traces on femora and tibia. Internal and external pedal spurs present; internal spur simple, external spur bifurcating subbasally as in other centrurine buthids. Tibial spur absent.

Condition of specimen.—Prolonged immersion in preservative appears to have influenced basic coloration somewhat. The right chelicera is detached from specimen. The movable fingers of the pedipalp chelae are broken: the right one at approximately one-third its length from the base, and the loose portion is preserved with the specimen; the



Figs. 12-15.—Species of *Rhopalurus*: 12, sternum of *R. laticauda* Thorell, adult male from Estado Miranda, Venezuela; 13, sternum of adult male holotype of *Physoconus physurus* Mello-Leitao, 1934 [= *R. debilis* (Koch, 1841)], from Santa Luzia, Paraíba, Brazil; 14, telson of holotype male of *P. physurus*, ventral view showing vestigial subaculear tooth; 15, telson of holotype male of *P. physurus*, lateral view (dashed line indicates position of subaculear tooth in *R. laticauda*).

left moveable finger is broken off at approximately one-half of its length, and the distal portion is missing.

Depository.—The holotype of *Physoconus physurus* Mello-Leitao is permanently deposited at the Museu Nacional, Rio de Janeiro, Brasil.

Locality data.—In the original description Mello-Leitao did not give a type locality and simply mentioned that the holotype was among the specimens collected by the members of the Technical Commission on Pisciculture at Brasil's northeastern states, particularly Pernambuco and Paraíba. Subsequently, Mello-Leitao (1945) gave the type locality for *P. physurus* as Soledade, Paraíba, Brasil. The holotype is accompanied by two hand-written labels: one of them is the identification and type designation label; and the other is the



Francke, Oscar F. 1976. "Two Emendations to Stahnke's (1974) Vaejovidae Revision (Scorpionida, Vaejovidae)." *The Journal of arachnology* 4(2), 125–135.

View This Item Online: <https://www.biodiversitylibrary.org/item/220992>

Permalink: <https://www.biodiversitylibrary.org/partpdf/220823>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In Copyright. Digitized with the permission of the rights holder

Rights Holder: American Arachnological Society

License: <https://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <https://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.