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A NEW SPECIES OF *CENTRUROIDES* MARX, 1890 FROM CHIAPAS AMBER, MEXICO (SCORPIONES: BUTHIDAE)

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Abstract: *Centruroides knodeli* **sp. n.**, a new species of fossil scorpion, is described from a specimen in amber from Chiapas, Mexico. The new species is clearly related to the extant fauna of the Neotropical region and is placed in the genus *Centruroides* Marx, 1890, presently distributed in North, Central and South America and in the Caribbean region. Also, the fossil species *Tityus hartkorni* Lourenço, 2009 and *Tityus azari* Lourenço, 2013, described from Dominican amber and inappropriately regarded by Rolando Teruel as junior synonyms of *Tityus geratus* Santiago-Blay & Poinar, 1988, are herein restored as valid taxa.
Key words: Scorpiones, Buthidae, *Centruroides*, fossil, new species, amber, Chiapas, Mexico.

Una especie nueva de *Centruroides* Marx, 1890 del ámbar de Chiapas, México (Scorpiones: Buthidae)
Resumen: Se describe *Centruroides knodeli* **sp. n.**, especie nueva de escorpión fósil, a partir de un espécimen del ámbar de Chiapas, México. La especie nueva está claramente emparentada con la fauna actual de la región Neotropical, y se encuadra en el género *Centruroides* Marx, 1890, actualmente distribuido por Norteamérica, América Central, Sudamérica y el Caribe. Por otra parte, se les devuelve su estatus de taxones válidos a las especies fósiles *Tityus hartkorni* Lourenço, 2009 y *Tityus azari* Lourenço, 2013, descritas del ámbar dominicano e impropiamente consideradas por Rolando Teruel como sinónimos posteriores de *Tityus geratus* Santiago-Blay & Poinar, 1988.
Palabras clave: Scorpiones, Buthidae, *Centruroides*, fósil, especie nueva, ámbar, Chiapas, México.

Taxonomy / Taxonomía: *Centruroides knodeli* **sp. n.**

Introduction

As already synthesized in a recent publication (Lourenço, 2016), among the fossil arthropods found in amber, scorpions remain extremely rare. Baltic amber was the first to provide fossil scorpions, at the beginning of the 19th century. The first discovered species was *Scorpio schweiggeri*, described by Holl (1829). However, both the description and the illustration of this species were extremely poor and the only conclusion that can be reached is that the scorpion most certainly belongs to the family Buthidae C. L. Koch, 1837. Subsequently, a second species, *Tityus eogenus* Menge, 1869, was described. Contrarily to *Scorpio schweiggeri, Tityus eogenus* has received the attention of many authors, mainly because of its assignment by Menge (1869) to a typically Neotropical extant genus, and also because the type-specimen was apparently lost soon after its description, which prevented the confirmation of its taxonomic position.

The renewal of studies on scorpions trapped in amber began in the early 1980s when a few specimens from Dominican and Mexican amber were described (Schawaller, 1979, 1982; Santiago-Blay & Poinar, 1988, 1993; Santiago-Blay *et al*., 1990). Even if only a few taxa from Dominican and Mexican amber have been described until now, the amber fossils found in these regions of the world seem in all cases closely related to the extant scorpion taxa of the Caribbean and North/Central America.

In 1995, after more than 120 years, a new specimen of scorpion from Baltic amber was located in Hamburg, Germany (Lourenço & Weitschat, 1996). After the description of this new finding as *Palaeolychas balticus* Lourenço & Weitschat, 1996 several new discoveries followed, both from Baltic but also Cretaceous amber what lead to numerous descriptions. A synopsis of all these findings and descriptions can be found in Lourenço (2016) and will not be treated here.

Even if a significant progress in the study of amber trapped scorpions can be observed since the 1990s, those found from sites located in the New World remain still poorly known. Besides, some of the early studies carried out since the end of the 1970s on amber trapped scorpions from Dominican Republic and Mexico did not necessarily lead to precise diagnosis (e.g. Schawaller, 1979, 1982; Santiago-Blay & Poinar, 1988, 1993; Santiago-Blay, Schawaller & Poinar, 1990).

Moreover, if several specimens from these two sites have been found in the last decades, most have not been studied (Grimaldi, 1996). This is particularly true for specimens from Mexican amber. To date only three Mexican amber scorpion has been studied and described (Santiago-Blay & Poinar, 1993; Lourenço, 2014; Riquelme *et al*., 2015). In the case of Santiago-Blay and Poinar (1993) the authors remained vague about the true identity of the scorpion. The specimen was tentatively placed in the genus *Centruroides* Marx, 1890, but no specific name was given. In the two subsequent studies (Lourenço, 2014; Riquelme *et al*., 2015) the scorpions were better studied and both placed in the genus *Tityus* C. L. Koch, 1837. The amber fossils found in Hispaniola and Mexico seem, without exception, to be closely related to the extant buthid scorpion taxa of the Caribbean and Neotropical regions.

In this publication a new species of Buthidae is described from Mexican Chiapas amber. It is clearly assigned to the genus *Centruroides* Marx, 1890 which has a modern distribution comprising North, Central and South Americas and the Caribbean region. A necessary reply is also addressed to Teruel (2017).

Chiapas amber

For the history, geological setting and locality details of Chiapas amber, also referred to as Mexican amber, one can consult Dunlop *et al*. (2008). Part of this information is resumed here. This amber is mostly recovered from the state of Chiapas in southern Mexico, typically from the northern mountain ranges of the state (the Chiapas highlands) in the Simojovel area between Rapilula, Yajalón and Los Cruces. Chiapas amber, which is typically very transparent and similar in its appearance and formation history with Dominican amber, originated from the extinct Leguminoseae tree *Hymenaea mexicana*. Langenheim (1995) suggested that it was produced by mangrove vegetation in a shallow marine environment; i.e. a nearshore habitat, such as a coastal lagoon. The putative amber-forming period was originally thought to span the Palaeogene-Neogene boundary, with an estimated age of late Oligocene (26 Ma) to early Miocene (22.5 Ma). However, more recent results suggest a slightly younger, mid-Miocene date of perhaps 16 Ma. For further details see other references cited by Dunlop *et al*. (2008) and Solórzano-Kraemer (2010).

Material and methods

The specimen investigated was obtained by Mr. Herbert Knodel (Rotonda, USA), and is now deposited in his personal collection. It is in a very clear, rectangular piece of yellow amber (45 x 33 x 8 mm), without inclusions and the presence of a few insects. The amber shows a typical laminated structure and it is possible to see how individual layers have been formed as a result of several resin flows at regular intervals. Both dorsal and ventral sides of the scorpion are well visible, allowing a more or less detailed investigation, particularly of the trichobothria, but a zone of fracture is present at the prosoma's level. The schematic drawings provided here are interpretations of what was observable. Illustrations and measurements were produced with the aid of a Wild M5 stereomicroscope equipped with a drawing tube and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974). Trichobothria were definitely recorded only when their bothria (areoles) could be observed. Other trichobothria may be suggested by the presence of transverse hairs.

Systematic description

Family BUTHIDAE C. L. Koch, 1837

Genus ***Centruroides*** Marx, 1890

***Centruroides knodeli* sp. n.**

Fig. 1-12.

DIAGNOSIS: Total length of 10.96 mm (including telson). Morphology largely similar to that of extant *Centruroides* species, however the specimen has suffered some dissection within the resin and some volumes may result unnatural. Cutting edges of pedipalp chela fingers with 7-8 (8-8) rows of granules; accessory granules absent or inconspicuous, as for most juveniles of *Centruroides*. Sternum clearly pentagonal, longer than large; genital operculum formed by two oval to slit-like plates. Pectines large and almost overlapping with 20-20 teeth; fulcra present small and regular. Trichobothrial pattern A-α (alpha), probably orthobothriotaxic.

By a number of characters the new species seems to be distinct from the other specimen of *Centruroides* cited from Chiapas amber, partially described but not named by Santiago-Blay and Poinar (1993): (i) pectines with 20-20 teeth for a female while these authors indicate 18-19 for a male; (ii) sternum clearly pentagonal; (iii) aculeur strongly curved and subaculear tooth strong but much less spinoid.

HOLOTYPE: Most certainly a juvenile. Considering the morphology and distance between pectines it is unquestionably a female.

TYPE LOCALITY AND HORIZON: Mexico, Chiapas, Simojovel area (precise locality not recorded). Neogene: Miocene.

DEPOSITORY: The specimen is deposited in the personal collection of Mr Herbert Knodel, Rotonda, USA.

DERIVATIO NOMINIS: The specific name is dedicated to Mr Herbert Knodel, (Rotonda, USA), who allowed me to study the specimen.

DESCRIPTION:

Coloration: general colour yellowish with some brownish patches more or less well defined on carinae of the pedipalps and metasoma. The ventral aspect of the specimen shows shaded areas associated with the region of sternites.

Morphology. Carapace weakly granular; anterior margin with a moderately marked median concavity. All visible carinae weak. Furrows weak. Median ocular tubercle anterior to the centre of the carapace. Median eyes separated by more or less one ocular diameter. Three pairs of lateral eyes. Sternum clearly pentagonal, longer than wide. All mesosomal tergites well observable; weakly to moderately granular; tergites I to VI with one moderate to strong longitudinal carina. Tergite VII pentacarinate. Venter: genital operculum formed by two oval plates. Pectines well observable, with 5-6 marginal lamellae and six small median lamellae; fulcra small but round and regular; pectinal tooth count 20-20. Sternites almost smooth; spiracles small and oval to slit-like. Metasomal segment I with 10 carinae; segments II-IV with 8 carinae; segment V with 5 carinae; dorsal and dorso-lateral carinae on segments I to IV without spinoid granules posteriorly. Telson elongated and only slightly globular; vesicle with 3 ventral carinae; aculeus long and strongly curved; subaculear tooth strong and moderately spinoid. Cheliceral dentition with characteristics of the family Buthidae; external and internal distal teeth of movable finger similar in length (Vachon, 1963). Pedipalps: Femur pentacarinate; patella with seven carinae; internal aspect with 5-6 spinoid granules; chela with nine carinae; all faces almost smooth. Fixed and movable fingers with 7-8 (8-8) rows of small granules; accessory granules absent or inconspicuous. Trichobothriotaxy: Type A-α (alpha) (Vachon, 1974, 1975) possibly orthobothriotaxic. Can be observed 5 dorsal, 2 external and 2 internal on femur; 5 dorsal and 1 internal on patella; some external trichobothria are suggested by hairs; 6 on chela-hand and 4 on fixed finger. Tarsus of legs with thin ventral setae; pedal spurs moderate; tibial spurs absent.

Measurements (in mm) of female holotype of *Centruroides knodeli* sp. n. (some measurements could not be taken because of the position of the specimen). Total length 10.96 (including telson). Carapace: length 1.47, anterior width 0.87, posterior width 1.34. Mesosoma length 2.34. Metasoma:





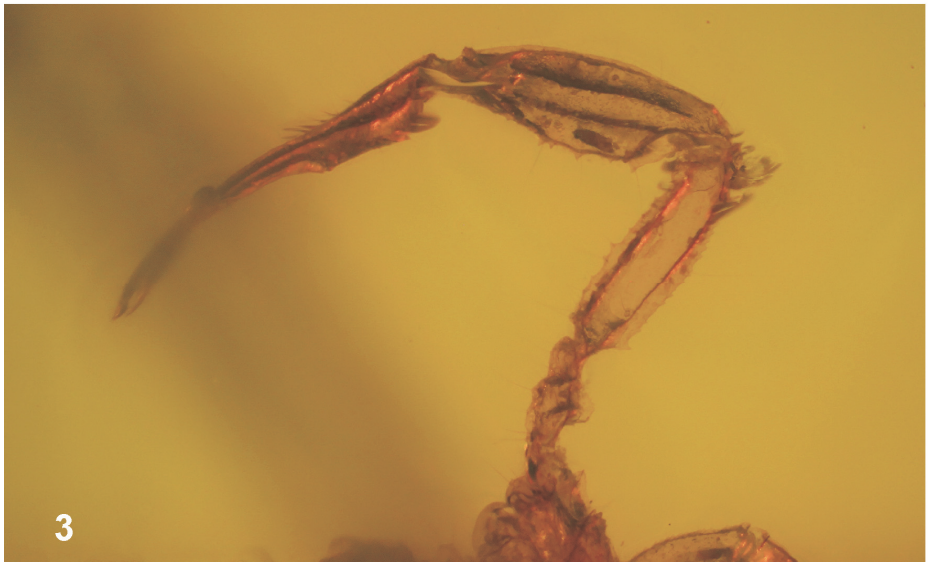
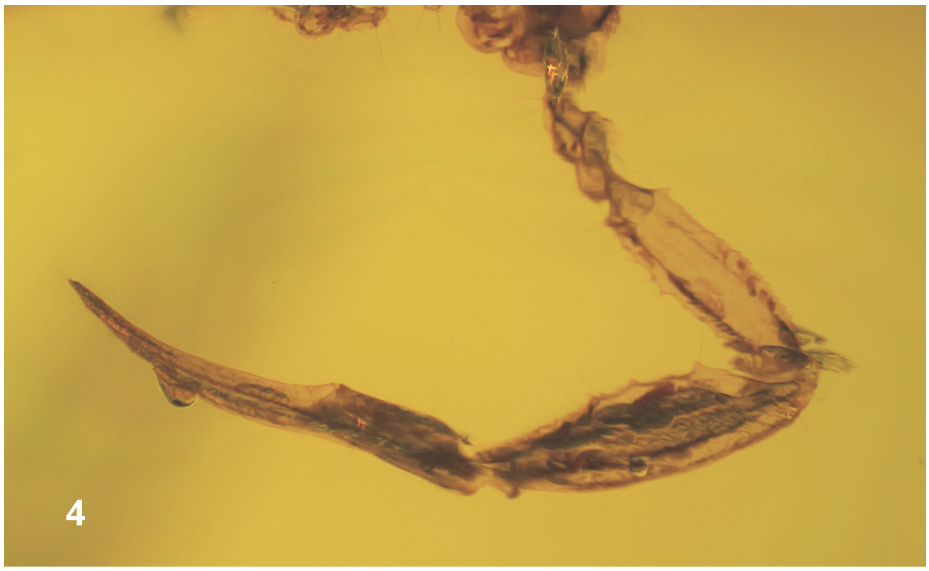
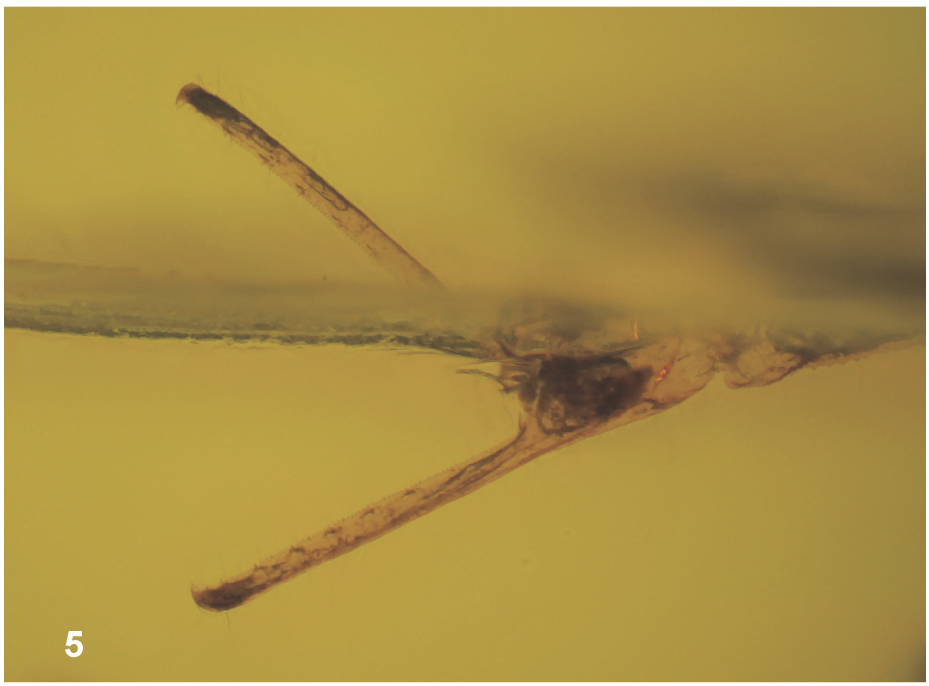


Fig. 1-3. *Centruroides knodeli* sp. n. Female holotype. **1-2**. Habitus, dorsal and ventral aspects. **3**. Right pedipalp, dorsal aspects.

Fig. 4-6. *Centruroides knodeli* sp. n. Female holotype. **4**. Right pedipalp, ventral aspects. **5**. Left pedipalp chela showing rows of granules on fingers. **6**. Metasomal segment V and telson, lateral aspect.







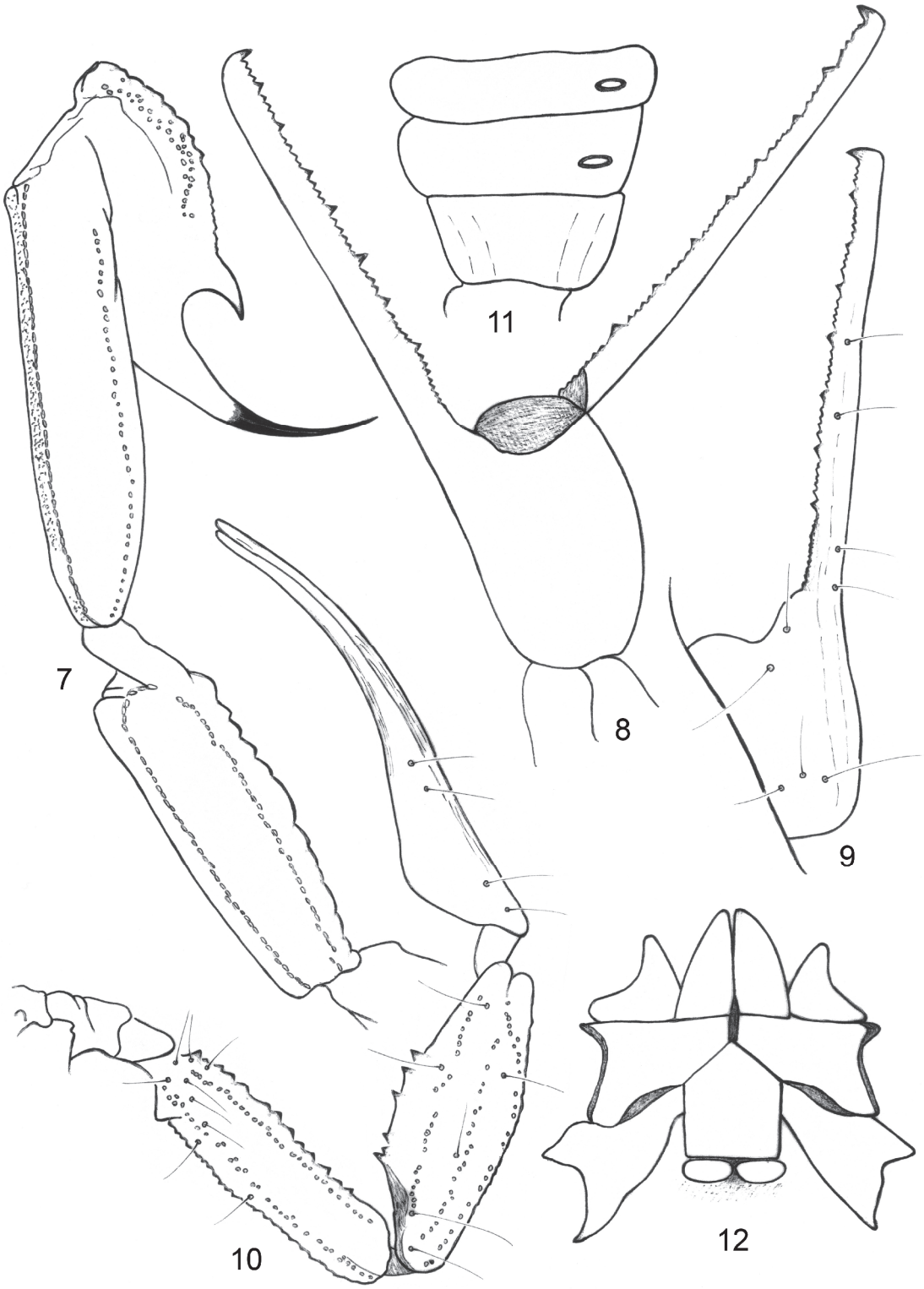


Fig. 7-12. *Centruroides knodeli* sp. n. Female holotype. **7**. Metasomal segments IV-V and telson, lateral aspcct. **8**. Internal aspect of chela showing the granulations on fingers. **9-10**. Trichobothrial pattern. **9**. Chela external aspect. **10**. Chela, patella and femur, dorsal aspect. **11**. Sternites V-VII showing spiracles. **12**. Ventral aspect showing coxapophysis, sternum and genital plates.

segment I length 0.80, width 0.54; segment II length 1.07, width 0.54; segment III length 1.14, depth 0.47; segment IV length 1.20, depth 0.44; segment V length 1.54, depth 0.40. Telson length 1.40, depth 0.40. Pedipalp: femur length 1.20, width 0.30; patella length 1.30, width 0.54; chela length 2.07, width 0.30; movable finger length 1.40.

Taxonomic remarks

When I was about to conclude the present article, I came across a recently published paper by Teruel (2017) in which a number of amendments and synonymies are proposed for species of the genus *Tityus* from Hispaniola. In his analysis this author equally concludes that two scorpions trapped in amber from Dominican Republic, and placed in the genus

Tityus, namely *Tityus hartkorni* Lourenço, 2009 and *Tityus azari* Lourenço, 2013 were not valid species but in fact only synonymies of another previously described amber trapped scorpion, *Tityus geratus* Santiago-Blay et Poinar, 1988. The total inadequacy of this decision but equally the injurious tonality of some of his statements in regard to our work requires a reply. This reply will be the main purpose of my comments, so I will not enter here in the details of other inadequacies concerning the classification of the genus *Tityus* proposed by Teruel (2017). Before formulating some precise contra-arguments to the pure theoretical speculations of Teruel (2017), it seems important to redefine several of the particularities concerning the study of amber trapped scorpions.

The study of specimens trapped in amber vary from very difficult to reasonable simples according to the quality of the amber itself and the presence of impurities, inclusions and other factors which can severely affect observation. Moreover, during the trapping process specimens and in particular scorpions suffer with processes of dissection and distortion within the resin. The time required for the observation of a given character can be 10 times longer than that of the same observation in a naturalized scorpion. The quality of the photos produced for a given specimen depend on all these factors and, the schematic drawings, which are most important, resume in many cases interpretations of what was observable. So in general, photos are used to improve the esthetical presentation of a given paper. Besides, if the specimen is complete and well preserved, a photo can bring a global view of its morphology. In no case, however, a diagnosis for an amber trapped scorpion is possible based on photos only. To notice that even the diagnosis of extant species can be difficult when based solely on photos. During the many years I spend studying amber trapped scorpions, I never reached a final diagnosis without the examination of the specimens. I believe to be well placed to affirm this since during the last 25 years, I studied and described the totality of all known Baltic scorpions, more than 95% of all Burmite (Myanmar) Cretaceous amber scorpions, the unique specimens found both in Lebanese and French amber and several specimens from Mexico and Dominican Republic. Nevertheless Teruel (2017) stated as follows "The holotypes of both species were not available for study, but fortunately, their original descriptions include good-quality color photographs that allow a satisfactory interpretation of the main diagnostic characters". Naturally this is pure speculation. Besides, the photos I provided for these two descriptions were of average quality and have only an esthetical role in the publication. It seems obvious that Teruel (2017) did not examine either the type specimen of *Tityus geratus*. In fact, I suppose that this author never saw a single specimen of amber trapped scorpion in his life. It is also at least 'curious' that Teruel (2017) used in his publication my original photos of the two described amber scorpions. He never asked me for a permission to use these photos. Even if his publication was done in the same journal where I did my original descriptions, I never signed any document transferring the copyright to the journal. Consequently we have also here an absence of ethics from the part of the editorial staff of the journal.

In his following comments, Teruel (2017) reaches the limit of what can be considered as injurious statements; however one can rapidly see that such comments are rather ridiculous and even pathetic. This kind of 'aggressive behaviour' has become the trade mark of a number of authors studying scorpions, most being lay-persons. Consequently Teruel states as follows: "As pointed out elsewhere [several authors are cited] for other papers authored by Wilson R. Lourenço, both original descriptions are flawed by false and/or incorrectly described characters, plus drawings of an inadmissible, poor quality (underlined by me) and thus, must be discarded as unreliable except for the photographs (when included)". Concerning the quality of my descriptions these are accepted as standard and correct by the majority of the zoological academic community and by academic journals of high standand. The second part of his statement "drawings of an inadmissible poor quality" sounds more like a joke and is totally pathetic. First because the iconography produced in the Arthropods Section of the Muséum in Paris has a very long tradition of high standard quality and many illustrations have been acclaimed as excellent by many scholars and journals. I will not reproduce these drawings here for a lack of space, but hundreds of publications are available for the readers. Second, the statement is pathetic because the same authors who produce such criticism in regard to our drawings are incapable themselves to supply any line-drawings in their own publications.

Consequently the synonymies proposed by Teruel (2017) are formally rejected and both *Tityus hartkorni* Lourenço, 2009 and *Tityus azari* Lourenço, 2013 are revalidated at present.

It is well known that the definition and classification of fossils in particular raise controversial issues which have been largely debated within scorpion taxonomy during quite many years (Lourenço, 2016). However, only the study of other better preserved specimens may elucidate both their precise generic and/or subgeneric classification, but in particular the true status of each species since one deals with specimens and not populations.

In conclusion, as already outlined in other publications (Lourenço, 2016), this new form of procedure is becoming a common method used by many authors to gain credits over other people's discoveries. In most cases the originally described material is never re-examined, but worse, in many cases the critics are only based on the original data of the authors they are precisely criticizing. In fact, when dealing with systematic studies on a given taxonomic group, it should be an obliged routine to refer to and consider the available material cited in previous publications. Moreover, since available fossil specimens are extremely rare, this paucity of information makes any re-evaluation more challenging; consequently, it remains unclear how much of a value it is to base re-evaluations on the same case specimens or even worse in a total absence of any specimens.

The irony is that one can observe the emergence of new authors emphasizing the importance of their discoveries by disqualifying previous work through shortcuts to the detriment of detailed taxonomic treatments, which is paradoxical. Nevertheless, the available data we have until now for most amber fossil is still insufficient to proceed with a revision of the position of most taxa. Enhancement of data on species should arise from examination of further material providing additional evidence and not from empty and unethical criticism upon someone else's work.

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