A synopsis of the amber scorpions, with special reference to the Baltic fauna

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Abstract: A synopsis of the fossil scorpions found in amber, from the Lower Cretaceous to the Miocene, is presented. Scorpion remains are rare among the arthropods found trapped in amber. Only five specimens are known from Cretaceous amber, representing four different taxa, whereas eleven specimens have been recorded from Baltic amber, representing nine genera and ten species. A few, much younger, fossils have also been described from Dominican and Mexican ambers.

Key words: Cretaceous, Paleocene, Miocene, Scorpiones.

Santrauka: Straipsnyje pateikiama gintaruose rastų fosilinių skorpionų nuo apatinės kreidos iki mioceno apžvalga. Iš visų nariuotakojų gintaruose skorpionų randama rečiausiai. Tik penki egzemplioriai yra žinomi iš kreidos gintaro. Jie priklauso keturiems skirtingiems taksonams. O iš Baltijos gintaro yra aprašyta vienuolika egzempliorių, priklausančių devynioms gentims ir dešimčiai rūšių. Keletas daug jaunesnių fosilinių skorpionų taip pat buvo rasta Dominikos ir Meksikos gintaruose.

Raktiniai žodžiai: Kreida, paleocenas, miocenas, retas.

Introduction

Scorpions are rare among the fossil arthropods found in amber, although in recent years several specimens have been described from Dominican and Mexican ambers (Schawaller 1979, 1982; Santiago-Blay & Poinar 1988, 1993; Santiago-Blay et al. 1990). Although new taxa from Dominican amber remain to be described (Lourenço, in press), the amber fossils found in this region of the world seem in all cases closely related to the extant scorpion taxa of the Caribbean region.

Much more remarkable was the description, during the last ten years, of fossil scorpions trapped in Cretaceous amber, which has been dated from 90 to 135 Ma. These comprise two buthoid elements, *Archaeobuthus estephani* Lourenço, 2001 (family Archaeobuthidae Lourenço, 2001) from amber of Lebanon, and *Palaeoburmesebuthus grimaldii* Lourenço, 2002 (incertae sedis) from amber of Myanmar (Burma). Two non-buthoid elements have also been recorded and described, *Palaeoeuscorpius gallicus* Lourenço, 2003 (family Palaeoeuscorpiidae Lourenço, 2003) from amber of France, and *Electrochaerilus buckleyi* Santiago-Blay et al., 2004 (family Chaerilidae Pocock, 1893) from amber of Myanmar. With an age of almost 135 Ma, *Archaeobuthus estephani* (Fig. 1) remains the oldest fossil scorpion ever found in amber (Lourenço 2001, 2002a, 2003; Santiago-Blay et al. 2004).

Baltic amber was the first to provide fossil scorpions, at the beginning of the 19th century. Several new discoveries have been the subject of studies since 1996 (Lourenço & Weitschat 1996, 2000, 2001, 2005; Lourenço 2004; Lourenço et al. 2005).

The first species to be described was *Scorpio schweiggeri* (Holl, 1829). However, both the description and illustration of this species are so inexact that the only conclusion that can be reached is that the scorpion almost certainly belongs to the family Buthidae Koch, 1837. This description has been ignored by most authors, although Schawaller (1979) produced a brief comment, suggesting that *S. schweiggeri* should be considerate a nomen nudum. Since the type specimen has been lost, not much can be added regarding its status.

A second species, *Tityus eogenus* Menge, 1869, was also described from Baltic amber. Unlike *Scorpio schweiggeri*, which has been almost totally ignored, *Tityus eogenus* has attracted the attention of many authors, both because of its assignment by Menge to a typically Neotropical extant genus, and secondly because the type-specimen was apparently lost soon after its description and nobody has been able to confirm its taxonomic position. Menge's collection included 2 specimens, but apparently only one was sufficiently well preserved to be of scientific value (Menge 1869; Larsson 1978). From the poor description and illustrations given by Menge (1869), it can only be concluded

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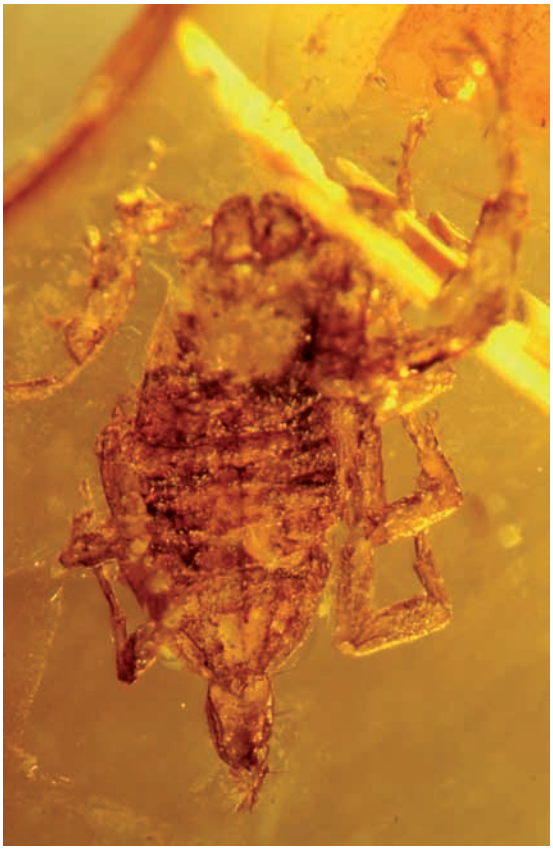

Fig. 1: Habitus of *Archaeobuthus estephani*, dorsal aspect. Fossil from Lebanese amber (135 Ma old).

that *Tityus eogenus* is indeed a buthid scorpion. It could, however, equally well be assigned to any of several genera within this family.

Because of the early disappearance of MENGE's material, this Baltic amber fossil has been the subject of discussion and speculation for over a hundred years, and has been cited in a number of publications (e.g. WERNER 1935; PETRUNKEVITCH 1955, 1958; LARSSON 1978; SCHAWALLER 1979; KJELLESVIG-WAERING 1986; SPAHR 1993).

Fig. 2: Habitus of *Palaeolychas balticus*, dorsal aspect.

In 1995, a new scorpion specimen from Baltic amber was located in Hamburg. After examination of all visible characters it was diagnosed as a member of the family Buthidae, belonging to a new genus and species, allied to the genus *Lychas* KOCH, 1845. Nothing, however, could clearly associate this specimen to the two species previously described by HOLL (1829) and MENGE (1869). It only demonstrated that Baltic amber scorpions could be associated with the Old World extant fauna. The subsequent discovery and description of eight new specimens representing seven genera and eight species confirmed this association. A list of the Baltic amber scorpions described since 1996 is given here and a short diagnosis is provided for each species.

Palaeolychas balticus LOURENÇO & WEITSCHAT, 1996 (Fig. 2)

Diagnosis: Total length of holotype (♂) 13 mm. Anterior margin of carapace with a moderate concavity. Tegument with carinae and granulations very weakly marked, as in some extant "primitive" genera, e.g. *Ananteris* THORELL, 1891, *Tityobuthus* POCOCK, 1893 *Pseudouroplectes* LOURENÇO, 1995 and *Microcharmus* LOURENÇO, 1995. Three lateral eyes. Pectines: pectinal tooth count 12-14; absence of fulcra. Sternum pentagonal in shape. Spiracles short but slit-like. Aculeus moderately long; subaculear tooth strongly marked. Tibial spurs strongly marked. Trichobothrial pattern A-β, probably orthobothriotaxic.

Palaeotityobuthus longiaculeus LOURENÇO & WEITSCHAT, 2000

Diagnosis: Total length of holotype (♂) approximately 25 mm, taking into account the total length of the metasoma which is about 16 mm long. The specimen is rather incomplete, since the amber piece was cut in two parts. Only the last two sternites, metasoma, telson, third and fourth legs and one chela could be examined. Tegument with carinae and granulations very weakly marked, as in the genus *Tityobuthus*. Lateral eyes unknown. Pectines unknown. Sternum unknown. Spiracles slit-like. Aculeus very long; subaculear tooth strongly marked. Tibial spurs absent. Movable finger of the pedipalp with six rows of linear granules separated by five very sharp spinoid accessory granules. Trichobothrial pattern A (α or β cannot be defined).

Palaeoprotobuthus pusillus Lourenço & Weitschat, 2000 (Fig. 3)

Diagnosis: Total length of holotype (♂ juvenile) 8 to 9 mm. Anterior margin of carapace with a strong concavity. Tegument with carinae and granulations weakly marked, as in the genus *Neoprotobuthus* Lourenço, 2000. Three lateral eyes. Pectines: pectinal tooth count 12-13; absence of fulcra. Sternum subtriangular in shape. Spiracles round. Aculeus and subaculear tooth unknown. Tibial spurs absent. Rows of granules on pedipalp finger unknown. Trichobothrial pattern A (α or β cannot be defined).

Palaeoakentrobuthus knodeli Lourenço & Weitschat, 2000 (Fig. 4)

Diagnosis: Total length of holotype (♂ juvenile) 7 mm. The specimen is complete, however, the ventral face can only be partially observed and some characters cannot be precisely described. Anterior margin of carapace with a weak concavity. Tegument with carinae and granulations weakly marked. Two lateral eyes. Pectines: pectinal tooth count 10-11; absence of fulcra. Sternum subpentagonal in shape. Spiracles oval. Aculeus and subaculear tooth moderate in size. Tibial spurs strong. Movable finger of the pedipalp with seven rows of linear granules, without accessory granules. Trichobothrial pattern A-α, minor neobothriotaxy.

Palaeoananteris ribnitiodamgartensis Lourenço & Weitschat, 2001 (Fig. 5)

Diagnosis: Total length of holotype (♂) 16 mm. The specimen is complete, however, the ventral face can only be partially observed, hence some characters cannot be precisely described. The general morphology generally recalls that of the genus *Ananteris*. Anterior margin of carapace with a weak concavity. Tegument with carinae and granulations weakly marked. Three lateral eyes. Pectines: pectinal tooth count 15-15; absence of fulcra. Sternum subtriangular in shape. Spiracles oval/round. Aculeus and subaculear tooth moderate to strong in size. Tibial spurs strong. Movable finger of the pedipalp with six linear rows of granules, separated by small knife-shaped denticles. Trichobothrial pattern A-α, orthobothriotaxic.

Palaeoananteris wunderlichi Lourenço, 2004

Diagnosis: Total length of holotype (sex unknown) approximately 13 mm, taking into account the total length of the metasoma which is about 7 mm long. The specimen is rather incomplete, since the amber piece was cut in two parts. Only the metasoma and telson were examined, however, the quality of the amber is particularly good, allowing a very detailed examination. General morphology of metasoma similar to that of *Palaeoananteris*, particularly in the spinoid shape of the subaculear tooth. Tegument with carinae and granulations moderately marked. Lateral eyes unknown. Pectines unknown. Sternum unknown. Spiracles unknown. Metasomal segments with 10-8-8-8-5 carinae; metasomal segment V flattened laterally. Aculeus long; subaculear tooth strongly marked. Trichobothrial pattern unknown.

Fig. 3: Habitus of *Palaeoprotobuthus pusillus*, ventral aspect.

Fig. 4: Habitus of *Palaeoakentrobuthus knodeli*, dorsal aspect.

Fig. 5: Habitus of *Palaeoananteris ribnitiodamgartensis*, dorsal aspect.

Palaeospinobuthus cenozoicus Lourenço, Henderickx & Weitschat, 2005 (Fig. 6)

Diagnosis: Total length of holotype (♂ juvenile) 8 mm. The specimen is incomplete: the piece of amber was cut at the level of tergite II, therefore tergites III to VII, the metasomal segments and telson are missing and some structures have been fragmented. As a result of this the ventral side is slightly more difficult to study than the dorsal side. Morphology similar to that of buthoid scorpions in general. Anterior margin of carapace with a strong concavity. Carapace, pedipalps and legs armed with spinoid granules. Tergites tricarinate. Tegument with carinae and granulations weakly to moderately marked. Three lateral eyes. Pectines: pectinal tooth count 14-14; absence of fulcra. Sternum pentagonal in shape. Spiracles small, between slit-like and oval in shape. Aculeus and subaculear tooth unknown. Movable finger of chelicerae with basal teeth absent. Tibial spurs weak. Fixed and movable fingers of the pedipalps with one longitudinal row of small rounded granules separated by small knife-shaped spines; extremity of the fingers with a long spinoid granule, similar to that seen in the genus *Birulatus* Vachon, 1974. Trichobothrial pattern A-α, possibly orthobothriotaxic; internal trichobothria of patella displaced to the dorsal surface.

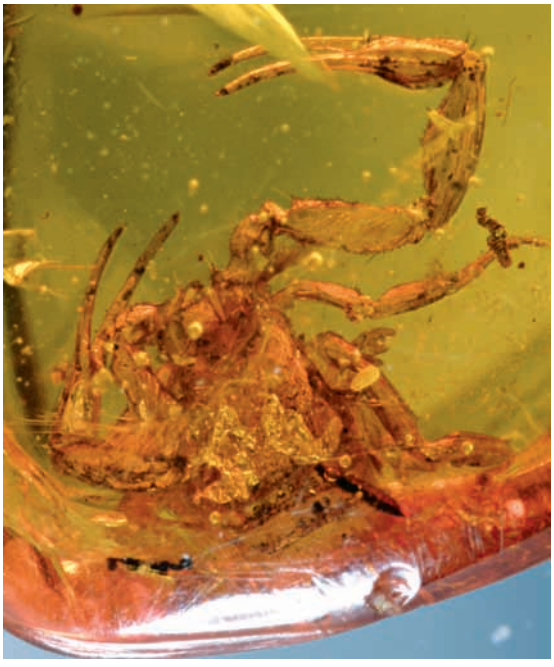

Fig. 6: Habitus of *Palaeospinobuthus cenozoicus*, dorsal aspect.

Palaeoisometrus elegans Lourenço & Weitschat, 2005 (Fig. 7)

Diagnosis: Total length of holotype (♀ juvenile) 19 mm. The specimen is almost complete, however, the ventral face can only be partially observed, hence some characters cannot be precisely described. Morphology similar to that of buthoid scorpions in general, but most similar to that of the extant genus *Isometrus* Ehrenberg, 1828. Anterior margin of carapace with a moderate concavity. Tegument with carinae and granulations moderately marked. Three lateral eyes. Pectines unknown. Sternum unknown. Spiracles unknown. Aculeus longer than the vesicle; subaculear tooth strong and rhomboid. Movable finger of chelicerae with basal teeth reduced. Tibial spurs very reduced. Fixed and movable fingers of the pedipalps with 7/8 longitudinal rows of small rounded granules separated by small accessory granules; extremity of the fingers with a more spinoid granule. Trichobothrial pattern A-β, possibly orthobothriotaxic; trichobothrium e_1 of femur in a proximal position in relation to d_5; trichobothria e_1 and e_2 largely separated.

Possible phylogenetic position of Baltic amber scorpions

As noted in previous papers (Lourenço & Weitschat 1996, 2001), it is not easy to establish precise phylogenetic relations between the Baltic amber genera and extant ones. Some suggestions, however, can be made as to the possible position of Baltic amber scorpions.

The fossil genera may be associated with a few extant buthoid genera that are defined as "primitive forms". These include genera of small size, which present a simple sculpture of the carinae and moderate to

weak granulation on all parts of the body. The pectines are generally small and may have rounded extremities, such as in the genus *Microcharmus* LOURENÇO; in several cases fulcra are absent. The sternum is pentagonal, subpentagonal, or at least subtriangular in shape. Lateral eyes can number two or three, and the spiracles may vary from almost slit-like to oval and rounded. In all cases the Baltic amber genera present at least some of these features. It therefore seems reasonable to place all the Baltic genera at a low evolutionary level, close to the "primitive forms" of Buthoidea (LOURENÇO 2000). The buthoid genera concerned are the predominantly Neotropical genus *Ananteris* THORELL, which includes one species from Africa; the endemic Madagascan genus *Tityobuthus* POCOCK; the African genus *Lychasioides* VACHON, 1974, endemic to Cameroon; the genus *Himalayotityobuthus* LOURENÇO, 1997, endemic to the Himalayas; *Akentrobuthus* LAMORAL, 1976, endemic to the Kivu area in the Congo; and *Microcharmus*, endemic to the northern region of Madagascar (LOURENÇO 1985, 1997, 1999a,b; LOURENÇO et al. 2006).

These "primitive" genera either show a Gondwanan pattern of distribution (*Ananteris*) or have very limited ranges (*Microcharmus*, *Akentrobuthus*, *Himaloyotityobuthus*, *Tityobuthus* and *Lychasioides*). Such distributions do not, however, contradict the existence of possible common ancestral lineages which were also present in the Baltic region more than 50 million years ago.

All the Baltic genera share with the cited extant genera a low evolutionary level. This limits to some extent the scorpion diversity in Baltic amber forests to a homogeneous group of buthids. One exception to this rule is the genus *Palaeospinobuthus*. Some of the characters in the description (carapace, pedipalps and legs armed with spinoid granules, extremity of pedipalp fingers with a long spinoid granule, tergites tricarinate, sternum pentagonal) suggest that *Palaeospinobuthus* could be distantly related to the enigmatic extant buthid genus *Birulatus* VACHON (LOURENÇO 1999b, 2002b; STATHI & LOURENÇO 2003). Other characters (trichobothrial pattern, with displacement of the internal trichobothria of patella to the dorsal surface, and the dentition of pedipalp-chela fingers, composed of a single linear row of rounded granules separated by small knife-shaped spines) place the new genus in an isolated position in relation to other buthids. The latter character also recalls the Cretaceous genus *Archaeobuthus*, which belongs to the family Archaeobuthidae. This situation suggests that several more recent groups may have evolved since the early Cenozoic.

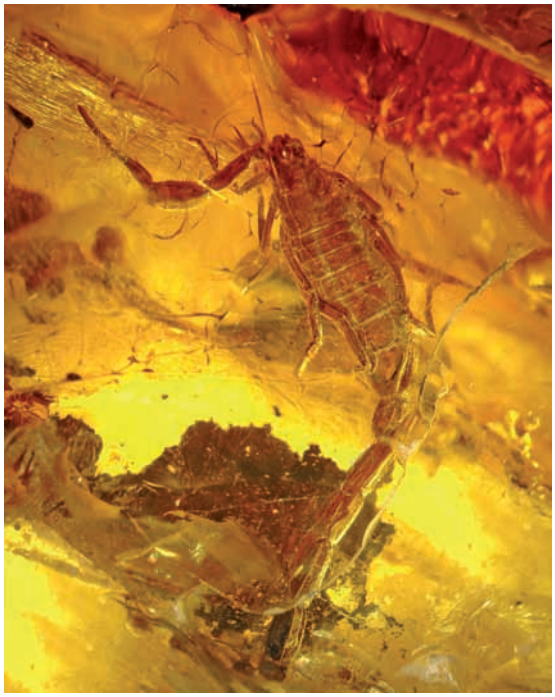

Fig. 7: Habitus of *Palaeoisometrus elegans*, dorsal aspect.

Zusammenfassung

Der Autor präsentiert eine Übersicht der nur selten vorkommenden Skorpione aus Bernstein der Unterkreide bis Miozän. Lediglich fünf Exemplare sind aus kreidezeitlichem Bernstein bekannt, die vier unterschiedlichen Taxa angehören. Aus eozänem Baltischen Bernstein sind 11 Exemplare überliefert, welche 10 Arten und neun Gattungen zugeordnet werden können. Wenige Fossilien wurden zudem aus den sehr viel jüngeren Dominikanischen und Mexikanischen Bernsteinen beschrieben.

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