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The first scorpion fossil from the Cretaceous amber of France. New implications for the phylogeny of Chactoidea

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Abstract

A fossil belonging to a new family, genus and species of scorpion, Palaeoscorpidae fam. n., *Palaeoscorpis gallicus* gen. n., sp. n., is described from the Early Cretaceous amber of France. This is the first scorpion to have been found and described from French amber (± 100 Myr). The new family, genus and species are unquestionable chactoid elements and can be classified together with extant families within the Chactoidea. This suggests that modern chactoid scorpions belong to lineages present for at least 100 Myr. **To cite this article:** W.R. Lourenço, C. R. Palevol 2 (2003).

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Résumé

Le premier scorpion fossile dans l'ambre crétacé de France. Nouvelles implications dans la phylogénie des Chactoidea. Un spécimen appartenant à une nouvelle famille, un nouveau genre et une nouvelle espèce de scorpion fossile, Palaeoscorpidae fam. n., *Palaeoscorpis gallicus* gen. n., sp. n., est décrit dans l'ambre du Crétacé inférieur de France (± 100 Ma). La nouvelle famille, les nouveaux genre et espèce sont sans aucun doute des éléments appartenant aux Chactoidea. Ceci suggère que les scorpions appartenant aux Chactoidea modernes sont associés à des lignées déjà présentes depuis au moins 100 Ma. **Pour citer cet article :** W.R. Lourenço, C. R. Palevol 2 (2003).

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Keywords: Scorpion; fossil; Early Cretaceous; amber; France

Mots clés : Scorpion ; fossile ; Crétacé inférieur ; ambre ; France

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Parmi les arthropodes fossiles trouvés dans l'ambre, les scorpions se situent parmi les groupes les plus rares ; cependant, depuis environ deux décennies, plusieurs spécimens ont été décrits de l'ambre de la République dominicaine, du Mexique et de la Baltique. Les fossiles trouvés dans l'ambre de la République dominicaine et du Mexique sont étroitement associés aux scorpions actuels des régions antillaise et néotropicale. La position phylogénétique des scorpions dans l'ambre de la Baltique est cependant différente. Ces éléments peuvent être classés dans certaines lignées primitives actuelles de micro-Buthidae ; cependant, les cinq spécimens décrits depuis 1996 correspondent tous à des genres nouveaux, distincts des genres actuels. Tout récemment, deux découvertes encore plus étonnantes ont été réalisées concernant des spécimens trouvés dans l'ambre crétacé. La première étude a porté sur un fossile de l'ambre du Liban ($\pm 125/130$ Myr), représentant une nouvelle famille, Archaeobuthidae Lourenço. Le deuxième spécimen étudié correspondait au premier scorpion décrit dans l'ambre de Birmanie (± 90 Myr). Malgré l'état incomplet du spécimen, une étude détaillée a autorisé la description d'un nouveau genre, *Palaeoburmesebuthus* Lourenço, placé provisoirement dans une Incertae familiae. Dans les deux cas, la nouvelle famille et le nouveau genre et espèce sont sans aucun doute des éléments appartenant aux Buthoidea.

La présente étude d'un nouveau spécimen trouvé dans l'ambre crétacé de France autorise la description d'une nouvelle famille, d'un nouveau genre et d'une nouvelle espèce. Les caractères diagnostiques définissant la nouvelle famille des Palaeoescorpiidae et le nouveau genre *Palaeoescorpius* sont les suivants.

Scorpions de taille globale petite ou moyenne. Malgré l'état très incomplet du spécimen, on peut estimer la longueur totale des adultes à environ 25 mm. Morphologie du pédipalpe similaire à celle retrouvée chez les Chactioidea, au sens de Soleglad & Sissom [8], voire des Euscorpiidae. Ornementation des doigts des pédipalpes : de petits granules arrondis disposés linéairement ; granules accessoires absents. Modèle trichobothrial voisin du type C défini par Vachon, mais tout de même distinct. Sont observées avec précision les trichobothries suivantes : au niveau du tibia, quatre sur la face dorsale, une sur la face interne, cinq sur la

face externe dorsale, six sur la face externe et 14 sur la face ventrale. Sur la pince, quatre sur la face dorsale de la main, deux à la base du doigt fixe, deux sur la face externo-dorsale, trois sur la face ventrale et une externo-ventrale.

D'après certains des caractères diagnostiques indiqués ci-dessus, la famille des Palaeoescorpiidae se rapprocherait davantage des Euscorpiidae ; cependant, le modèle trichobothrial observé semblerait indiquer un état primitif déjà présent lorsqu'un modèle fondamental a été établi.

Paléogéographie et âge de l'ambre crétacé français

Le site où le spécimen a été trouvé, Archingeay, correspond à un niveau d'argiles sableuses de Charente-Maritime, dans le Sud-Ouest de la France. Ce site a fourni un nouveau gisement à ambre et végétaux fossiles. Daté de l'Albien terminal par les dinoflagellés (± 100 Ma), ce gisement d'ambre devient le plus ancien site français fossilifère. Plusieurs inventaires des arthropodes trouvés dans l'ambre, les déterminations xylologiques et palynologiques et l'étude sédimentologique du gisement sont en cours (A. Nel, in litt.). Les premiers résultats permettent déjà de proposer une reconstitution paléoenvironnementale de la zone côtière du Nord du bassin d'Aquitaine à la fin du Crétacé inférieur : un milieu estuarien sous climat chaud et humide [7].

1. Introduction

Scorpions are rare among the Arthropods fossilised in amber. Nevertheless, several specimens have recently been described from Dominican, Mexican and Baltic amber [3–5]. Even though some of these descriptions may require amendment, there is little doubt that the amber fossils found in Hispaniola and Mexico are closely related to the extant Buthidae of the Caribbean and Neotropical regions. The position of the Baltic amber scorpions is somewhat different, because the known specimens, which also belong to the family Buthidae, can be classified among some extant but primitive lineages of micro-buthids. Five of these specimens have been described in recent years and represent distinct new genera that are related only approximately to extant groups. They are almost certainly primitive micro-buthids [3–5]. The history of the

study of amber scorpions, particularly those from the Baltic region, is complex. It has been described in detail by Lourenço & Weitschat [3–5].

Two remarkable scorpion fossils have recently been described from Cretaceous amber. The first was found in Lebanese amber [1], which is the oldest known to contain biological fragments ($\pm 125/130$ Myr). A new family, Archaeobuthidae Lourenço, was created for this specimen, which belongs to the Buthoidea. Cretaceous amber scorpions are much less common than those found in Baltic, Mexican or Caribbean amber. The type specimen of *Archaeobuthus estephani* Lourenço is not only the first Lebanese amber scorpion to have been discovered, but is undoubtedly the oldest scorpion found in amber of any kind ($\pm 125/130$ Myr). The fossil scorpion found in Burmese amber [2] is the second oldest amber fossil so far discovered (± 90 My). Only *Archaeobuthus estephani* from Lebanon is older. A new genus *Palaeoburmesebuthus* Lourenço, was created for this specimen, which was also tentatively classified among the Buthoidea, although for the moment it is regarded as *Incertae familiae*.

The specimen described in the present study is the first fossil scorpion to have been found in French amber. It is also the second oldest amber fossil so far discovered (± 100 Myr). A new family, genus and species are required for it. For the first time, a fossil scorpion has been found in amber that is not associated with the buthoid scorpions. In fact, this new fossil family rather represents a proto-element to the extant chactoids, sensu Soleglad & Sissom [8].

2. Material and method

The specimen investigated is trapped in a very clear block of pale yellow amber that measures 9×5 mm. It has been embedded in epoxy under vacuum [6]. The scorpion is incomplete, since the block of amber had been broken. Only the left pedipalp with patella and tibia are present. Both sides of the pedipalp are clearly visible, however, and allow detailed investigation.

3. Palaeogeography and the age of French Cretaceous amber

The specimen was collected from a layer of clay interbedded in sandstone at Archingeay, Charente-

Maritime (southwestern France). This site has yielded new deposits of amber as well as fossil plants. The age of the site can be dated as Uppermost Albian by the presence of dinoflagelates (± 100 Myr). A survey of the arthropods found in amber from this site is in progress, together with xylological, palynological and sedimentological studies (A. Nel, in litt.). Preliminary results allow a palaeoenvironmental reconstruction of the coast of the northern Aquitaine Basin at the end of the Lower Cretaceous as an estuarine area with a warm and humid climate [7].

4. Systematic description

Superfamily Chactoidea Pocock, 1893

Family Palaeoescorpiidae fam. n.

Diagnosis

Total length probably about 25 mm, based on the length of the pedipalp segments. These are as follow, in mm: Tibia length, 6.11; chela width, 1.81, depth, 1.36. Patella length, 3.32, width, 1.71, depth, 1.37. In comparison, an adult specimen of *Euscorpium flavicaudis* (Euscorpiidae) from France, with a total length of 25.7 mm, shows the following values: tibia length, 6.21; chela width, 2.90, depth, 1.80; patella length, 3.31, width, 1.70, depth, 1.31.

The general morphology of the pedipalp segments is somewhat similar to that of a few chactoid genera but is closer to that of extant species of the genus *Euscorpium*. The main difference is its strong flattened appearance. The new family and genus can be distinguished from other known chactoid families and genera by its unusual trichobothrial pattern. This is similar to type C of Vachon [9], but with a much reduced number of trichobothria, in particular on the external aspect of patella (six trichobothria). According to Vachon [9], the fundamental trichobothrial pattern of type C (orthobothriotaxy) always presents a minimum of 13 trichobothria on the external aspect of patella, and, in the case of exceptions (major neobothriotaxy), this number is always higher.

Genus *Palaeoescorpius* gen. n.

Diagnosis: as for the new family.

Type species: *Palaeoescorpius gallicus* gen. n. et sp. n.

Palaeoescorpius gallicus gen. n. et sp. n. (Figs. 1–9)

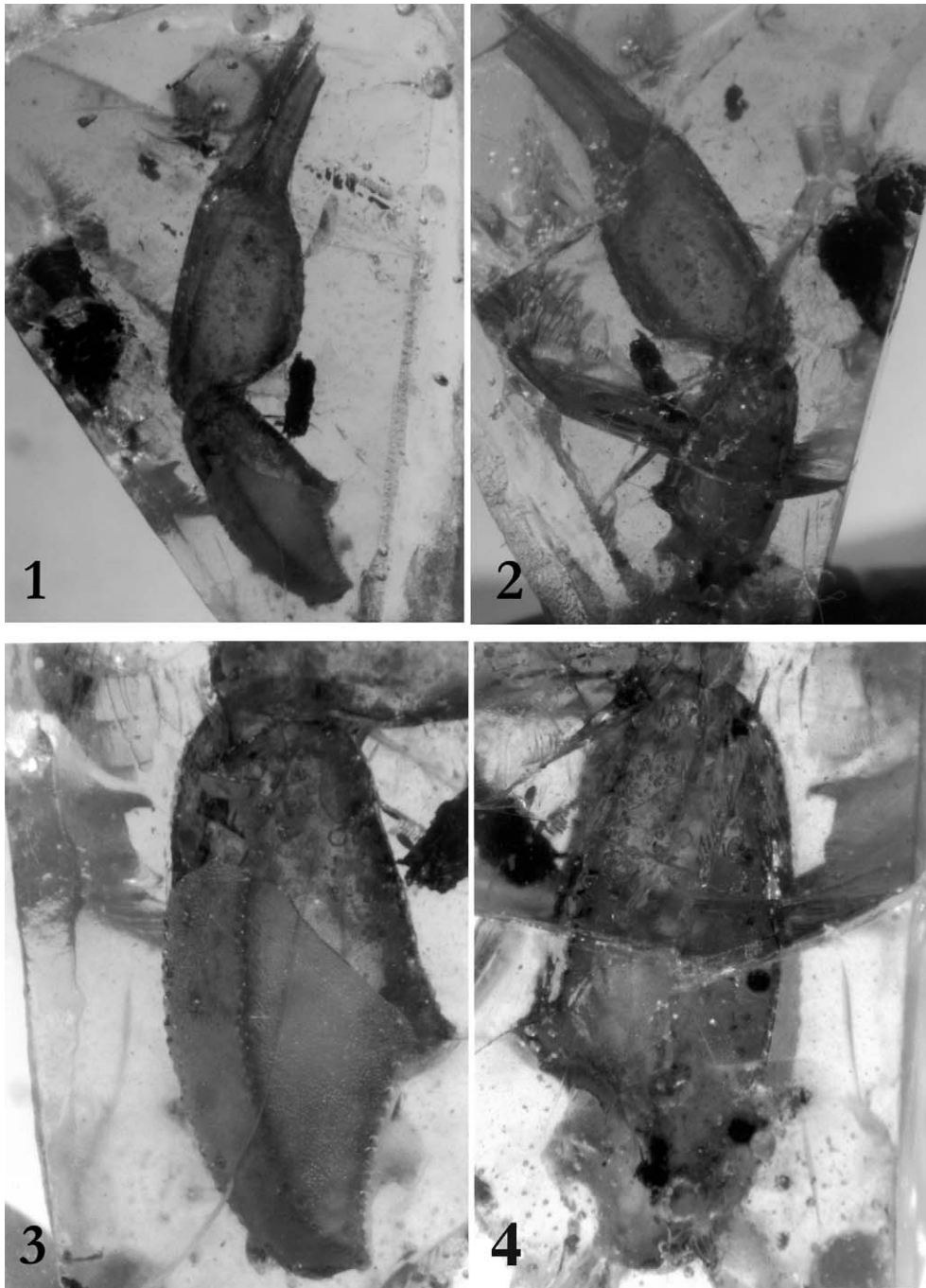


Fig. 1–4. *Palaeoscorpius gallicus* gen. n., sp. n. 1. Pedipalp tibia and patella, dorsal aspect. 2. Idem ventral aspect. 3. Patella, dorsal aspect, showing some trichobothria. 4. Idem, ventral aspect.

Palaeoscorpius gallicus gen. n., sp. n. 1. Pince et tibia du pédipalpe, vue dorsale. 2. Idem, vue ventrale. 3. Tibia, vue dorsale, avec la présence de quelques trichobothries. 4. Idem, vue ventrale.

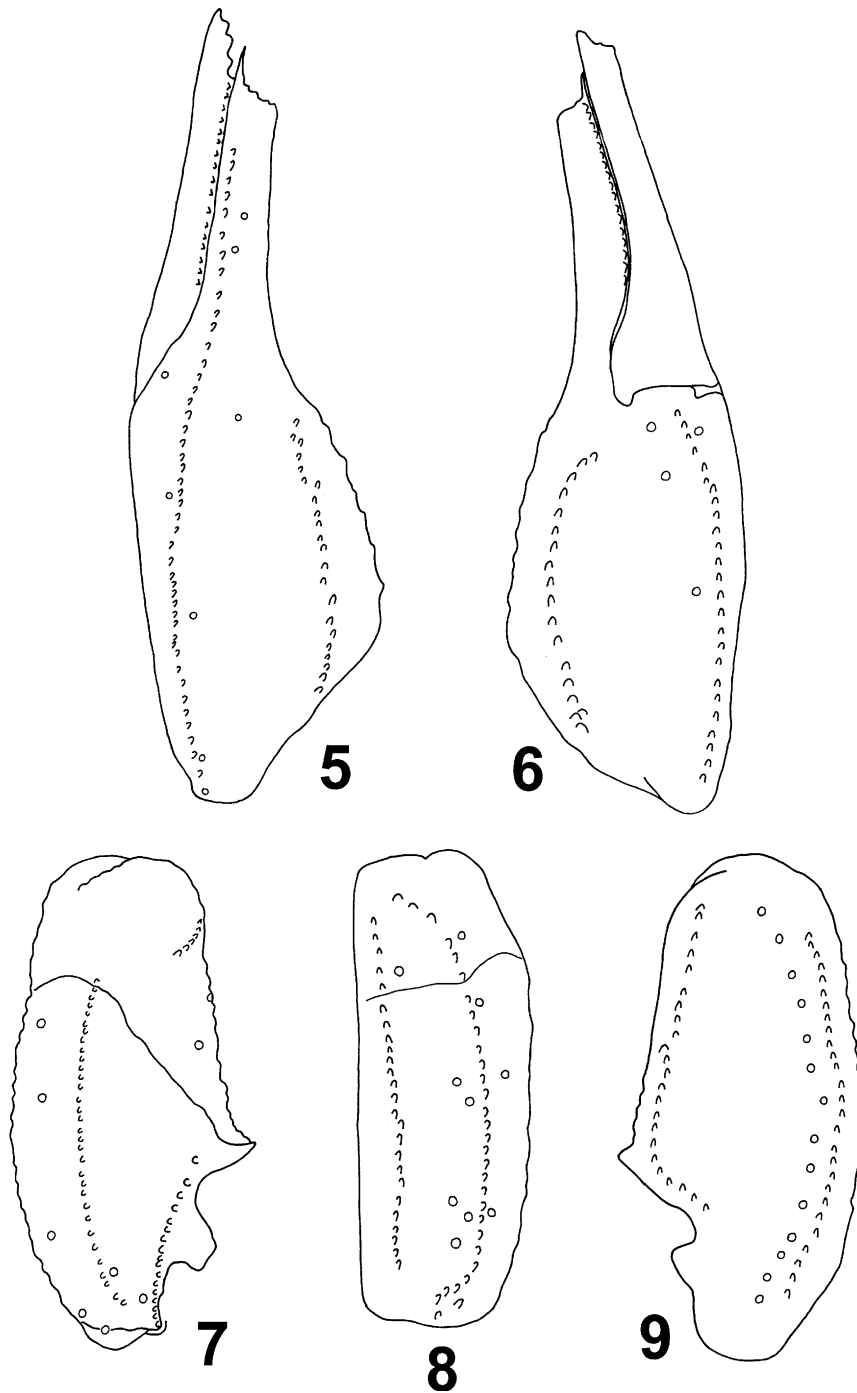


Fig. 5–9. *Palaeoscorpilus gallicus* gen. n., sp. n. Trichobothrial pattern. 5–6. Tibia, dorsal and ventral aspects. 7–9. Patella, dorsal, external and ventral aspects.
Palaeoscorpilus gallicus gen. n., sp. n. Trichobothriotaxie. 5–6. Pince, vues dorsale et ventrale. 7–9. Tibia, vues dorsale, externe et ventrale.

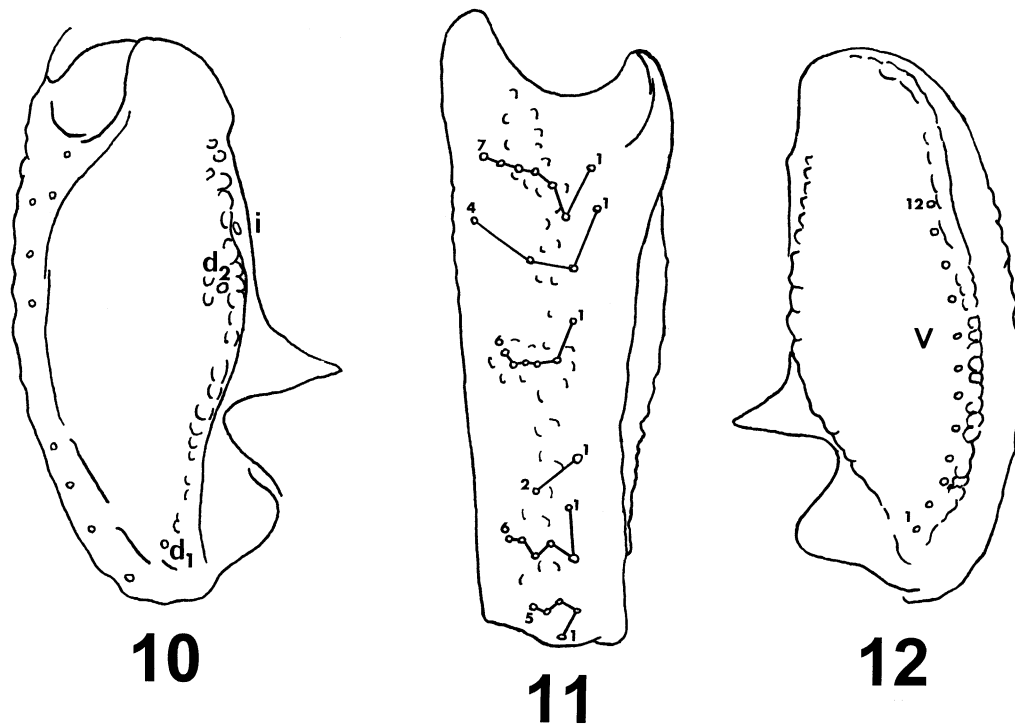


Fig. 10–12. Trichobothrial pattern of *Euscorpius flavicaudis*. Patella, dorsal, external and ventral aspects. Trichobothriotaxie d' *Euscorpius flavicaudis*. Tibia, vues dorsale, externe et ventrale.

Holotype: a possible adult (sex unknown). Deposited in the 'Laboratoire de paléontologie', 'Muséum national d'histoire naturelle', Paris (specimen No. ARC236-2/5).

Type locality and horizon: France, Charente-Maritime. Upper Cretaceous.

Diagnosis: as for the new family and new genus.

Derivatio nominis: the specific name makes reference to France, the country where the fossil specimen was found.

Coloration: the general colour is yellowish. The amber is very clear, but numerous air bubbles are present; no parts of the specimen are covered with the milky white substance, which often prevents more precise observation of coloration.

Morphology (Figs. 1–9). Carapace, keels and furrows unknown. Median ocular tubercle and lateral eyes unknown. Sternum unknown. Mesosoma: tergites I to VII unknown. Venter: genital operculum, pectines and sternum unknown. Sternites and spiracles unknown. Metasoma: unknown. Telson unknown. Cheliceral dentition unknown. Morphology of pedipalps: both tibia and patella very flattened; dentate margins of

pedipalp-tibia fingers with a single linear row of granules, without accessory granules. Tibia with two dorsal and two ventral carinae; patella with one internal apophysis and with two dorsal, one external and two ventral carinae. Trichobothriotaxy: the following trichobothria can be observed with precision (patella, four on dorsal aspect, one on the internal aspect, five on dorso-external aspect, six on external aspect and 14 on the ventral aspect). Tibia, four on dorsal aspect of chela, two on the base of the fixed finger, two on the dorso-external aspect of chela, three on the ventral aspect of chela and one on the ventro-external aspect of chela. Morphology of legs: unknown (Figs. 10–12).

5. Discussion

According to some of the characters mentioned in the description – shape of pedipalp tibia and patella, presence of an apophysis on the internal aspect of patella, and especially the trichobothrial pattern observed – the specimen is unquestionably a member of the Chactioidea, sensu Söglad & Sissom [8]. The

possible assignment to any of the extant chactoid families at present accepted is, however, rejected on account of the very reduced trichobothrial pattern observed (minor neobothriotaxy), the incompleteness of the specimen and in particular on account of the geological horizon (Lower Cretaceous). The specimen is therefore assigned to a new family Palaeoescorpiidae until further material becomes available.

The discovery of this fossil is important in the sense that it represents the first non-buthoid element ever found in amber. Moreover, it may represent one element living on litter rather than an arboricolous element. In fact, according to A. Nel (in litt.), several other typical litter insects have been found in this site, suggesting that fairly large amounts of resin flowed directly onto to the soil.

With regard to extant chactoids, the new family lies at a low evolutionary level. As in the case of the Cretaceous buthoids [1, 2], this suggests that several extant groups may have evolved since the Late Mesozoic and Early Cenozoic.

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