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A second camel spider (Arachnida: Solifugae) from Baltic amber

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ABSTRACT:

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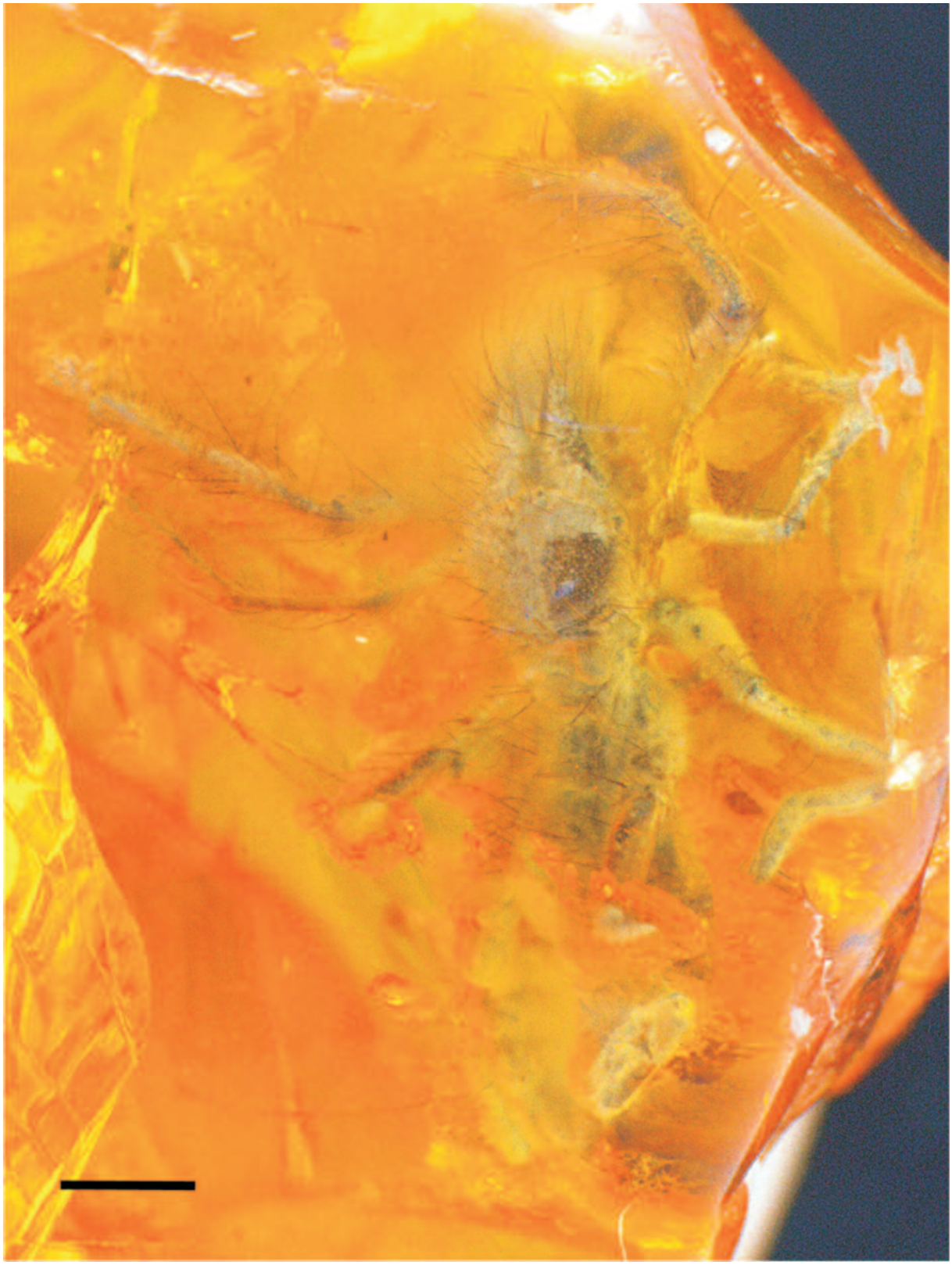
Fossil camel spiders (Arachnida: Solifugae) are extremely rare and only the second example ever recovered from Baltic amber (Paleogene: Eocene) is described here. Although superficially well preserved and more than twice the size of the previously known Baltic amber specimen, key taxonomic characters allowing meaningful comparisons to the other fossil and living material cannot, unfortunately, be resolved. It is formally treated here as Solifugae gen. et sp. indet., although we concede that it could be an adult of the previously recorded Baltic amber species *Palaeoblossia groehni* Dunlop, Wunderlich and Poinar, 2004.

Key words: Arachnida; Solifugae; Eocene.

INTRODUCTION

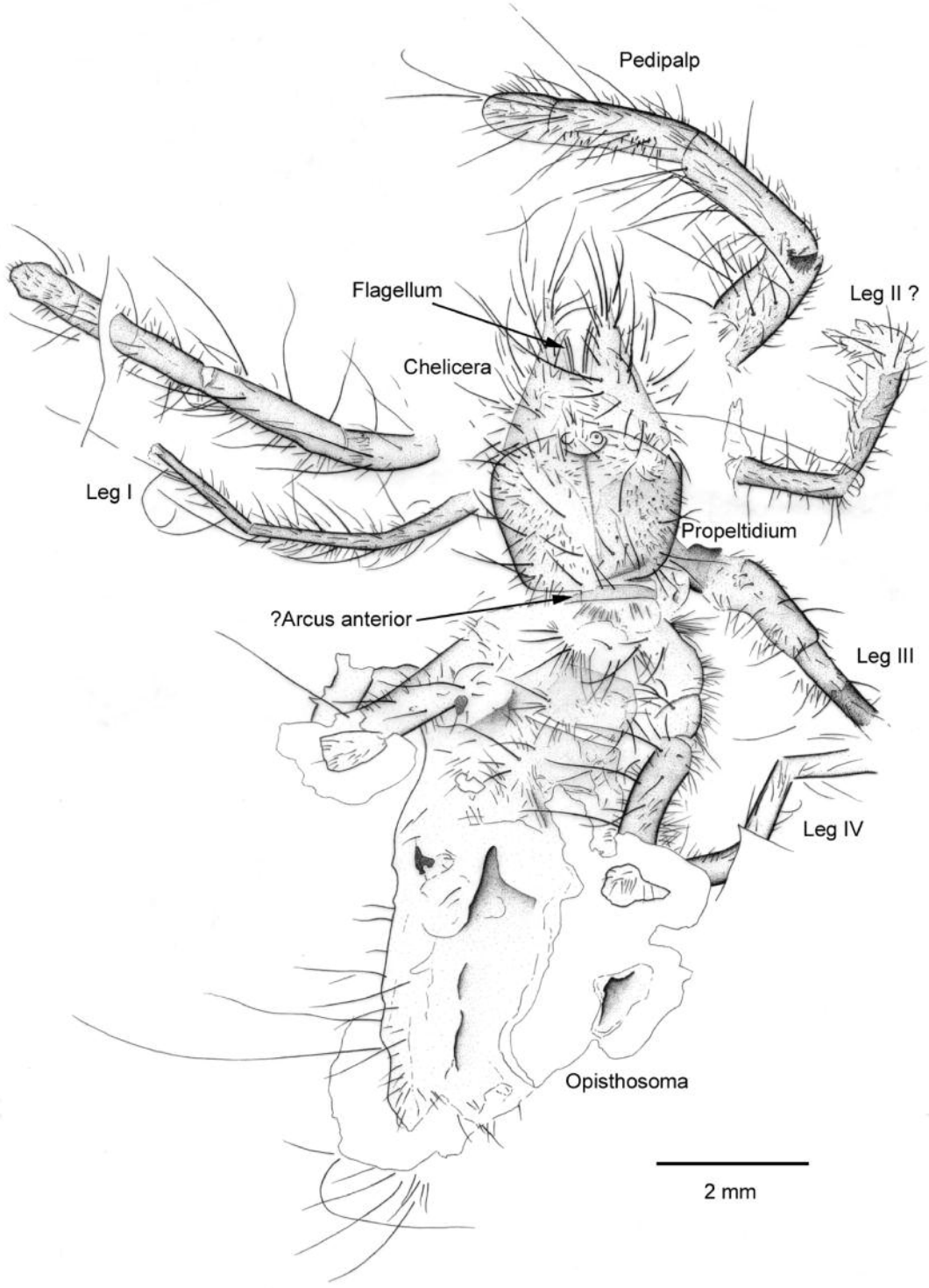
Camel spiders (Solifugae) are a distinctive group of arachnids which tend to be associated today with arid habitats – hence their common name. They are also known as sun spiders or wind scorpions, the latter relating to the speed at which they can run. The catalogue of Harvey (2003) documented 1,075 extant species, placed in 140 genera and 12 families. These occur world-wide in the mostly arid regions of the subtropics to the tropics, including also Central Asia and the Mediterranean region; although they are curiously absent from Australia. Camel spiders are voracious predators with large, two-segmented jaws (chelicerae) in proportion to the rest of the body. They feed mainly on small arthropods, but occasionally also on small vertebrates (e.g. Cloudsley-Thompson 1977; Banta and Marer 1972). They are typically extremely setose (Textfigs 1–2) and these long setae might be important sensory organs with a tactile function, but this remains to be investigated (Roewer 1934). Unique autapomorphies of the group include a series of further sensory organs on the ventral side of the coxae and trochanters of the fourth pair of walking legs called malleoli (or racquet organs) and a modified male flagellum on the chelicerae; the shape of which is usually of considerable taxonomic importance. The pedipalps are leg-like, but usually quite robust and end in a further unique character for the group in the form of a suctorial organ (Cushing *et al*. 2005; Klann *et al*. 2008). A summary of camel spider biology can be found in Punzo (1998).

Fossil camel spiders are extremely rare. An enigmatic find from the Early Carboniferous of Poland reveals some characters consistent with Solifugae or at



Text-fig. 1. A near complete camel spider (Arachnida: Solifugae *incertae sedis*) preserved in Baltic Amber (Paleogene, Eocene) held in the Muzeum Bursztyn, Gdańsk, Poland. Scale bar equals 2 mm

least their putative stem-lineage (Dunlop and Rößler 2003). The oldest unequivocal camel spider comes from the Late Carboniferous Coal Measures of Mazon Creek, USA. Preserved only in outline, it was redescribed by Selden and Shear (1996) who noted that it can barely be recognised as belonging to Solifugae and cannot be assigned to any particular higher taxon. There then follows a considerable hiatus until the Early Cretaceous. Camel spiders assignable to the modern African family Ceromidae have been recovered from the Crato Formation of



Text-fig. 2. Interpretative *camera lucida* drawing of the specimen shown in Text-fig. 1

Brazil (Selden and Shear 1996; Dunlop and Martill 2004). They reveal that ceromids originally had a more widespread, i.e. Gondwanan, distribution.

Two camel spiders have been recorded from Cenozoic ambers. Dominican Republic amber (Neogene: Miocene) has yielded one species (Poinar and Santiago-Blay 1989) assignable to the modern family Ammotrechidae. This makes biogeographical sense, since ammotrechids occur only in the Americas today (Punzo 1998; Harvey 2003). The second find comes from Baltic amber (Dunlop *et al*. 2004) and was assigned to the family Daesiidae. This family has quite a widespread distribution today, being found in Africa, southern Europe, the near East and South America. The Baltic amber camel spider was tentatively raised to a new genus and treated as a possible adult or subadult male. Its very small size (if adult) was also noted. Here, we describe only the second specimen of a camel spider from Baltic amber. This could turn out to be the true adult of the previous Baltic amber species, but insufficient details are preserved to allow a formal taxonomic assignment.

MATERIAL AND METHODS

The specimen described here is held in the Muzeum Bursztyn [Museum of Amber], Targ Węglowy Str., 80-831 Gdańsk, Poland. It was photographed using a Leica Systems camera arrangement attached to a stereomicroscope, which generates a series of images through the specimen at different focal planes. The *c*. 80 individual images were combined into a final composite using the software package Auto Montage©. The specimen was drawn using a Leica MZ12 stereomicroscope with a *camera lucida* attachment. Amber is difficult to date precisely, but Baltic amber is usually treated as being of Paleogene (Eocene) age, or *c*. 45–50 Ma.

SYSTEMATIC PALAEONTOLOGY

Order Solifugae Sundevall, 1833
Solifugae gen. et sp. indet.

MATERIAL: Muzeum Bursztyn, Gdańsk, Poland (*ex* Jonas Damzen collection).

HORIZON AND LOCALITY: Paleogene (Eocene) Baltic amber; precise locality uncertain.

DESCRIPTION: Relatively complete specimen visible in dorsal view only. Total body length *c*. 12 mm. Chelicerae robust, subtriangular, tapering anteriorly; length 1.9 mm, basal width 1.2 mm. Chelicerae highly setose with long putative tactile setae (some over 2 mm) interspersed with numerous shorter setae. Each chelicera with putative flagellum in the form of a single, probably backwards-pointing rod or spine, at least 0.8 mm long, originating near the anterior cheliceral tip and lying mesally along the inner face of the chelicera with a slight curvature. No further ornament visible, but details of this flagellar structure equivocal.

Propeltidium of carapace trapezoidal. Wider anteriorly, maximum width 2.6 mm, and slightly procurved across this anterior margin. Right side hints at the presence of exterior lobes, but these are not strongly pronounced. Anterior margin also bears paired median eyes on a single, oval ocular tubercle, width 0.6 mm. Posterior margin of carapace straight, width 1.9 mm, but with a distinct fold (?the arcus anterior) along this posterior margin. Propeltidium length 2.2 mm, with faint median sulcus originating immediately behind the ocular tubercle. Propeltidium highly setose with longer setae interspersed with coating of short setae; those immediately behind the ocular tubercle directed inwards towards the midline. Meso- and metapeltidium equivocal, but folded arthrodial membrane immediately behind propeltidium can be resolved and behind this numerous setae. Details of opisthosoma largely lacking, but two anterior tergites preserved. Both bear numerous short setae and groups of longer, stouter setae localized into paired patches either side of the midline. Lateral margins of opisthosoma also bear numerous long tactile setae, at least one of which approaches 5 mm in length.

Pedipalps robust, length c. 7.6 mm; proximal articles largely equivocal, but more distal ones with measurable lengths of 2.3 (patella), 2.1 (tibia), and 1.0 mm (tarsus). Pedipalps highly setose with numerous tactile setae, typically over 2 mm long, interspersed with other shorter and more slender setae. Tibia of pedipalp bears short, stout, inward facing spines perpendicular to the long axis of the article. Palpal organ equivocal. Legs relatively slender, particularly leg I, but leg series incomplete and all preserved legs only known from proximal articles. All legs highly setose with some individual, putative tactile setae approaching 3 mm. Leg IV femur with three prominent tactile setae forming a dorsal row. Distal leg articles and any division of the tarsi equivocal.

REMARKS: A precise systematic placement of this fossil is hindered by the absence of a clear view of those morphological characters important for assignment to a family. Drawing on identification keys for Recent camel spiders, essential features include the position (terminal or ventral) of the anus, the number of tarsal segments, fossorial or cursorial legs, micro-setae on the

leg claws, claws present or absent on leg I, presence or absence of ctenidia on opisthosomal segment IV, shape and motility of the male flagellum and presence or absence of pairs of ventrolateral spines on the pedipalps (cf. Roewer 1934; Harvey 2003). Muma (1976) established a familial system based partly on characters previously used by Roewer, but Muma's system primarily includes male secondary sexual characters supported by cheliceral dentition and the female opercula.

Some solifuge characters are family-specific. Claws covered with micro-setae only occur in Galeodidae. Rhagodidae is the only family possessing a ventrally located anus. Solpugidae are characterized by the highest number of tarsal segments (2–4 on legs II and III and 6–7 on leg IV) and Hexisopodidae are the only family possessing fossorial legs (Muma 1976). The presence of a clearly developed genital orifice with a genital operculum can help to distinguish between adult females and juveniles, since juveniles lack this structure. Adult males can easily be recognized by the presence of the cuticular flagellum on each chelicera. Furthermore, sexual dimorphism in Solifugae is reflected in the cheliceral dentition, the shape of the genital sternite and also sometimes in the colouration of the animal (Kaestner 1933).

Unfortunately, although the specimen in the Baltic Amber is an unequivocal camel spider, assignment to a specific family is very difficult due to the inability to resolve the characters mentioned above. The studied specimen clearly possesses cursorial legs and thus does not belong to Hexisopodidae. During the Eocene the American continent was already entirely separated from the European, African, Asian and the Australian continents (Stanley 2001). Taking the present biogeographical distribution of the extant families of Solifugae into consideration (cf. Punzo 1998), Ammotrechidae, Eremobatidae and Mummuciidae can most likely be excluded, since they only occur in the Americas (Eremobatidae only in southern North and Central America, Mummuciidae exclusively in South America). Ceromidae are today restricted to southern Africa and Melanoblossidae can be found in southern Africa and southeast Asia and it seems unlikely that the specimen presented here, belongs to one of these families. Solpugidae are very wide-spread throughout Africa and even occur in the near East (e.g. Iraq). Gylippidae are today distributed in southern Africa, the near East and central Asia and Galeodidae occur in northern Africa, and in many parts of Asia and the near East. The rather heavy-bodied and mostly short-legged Rhagodidae are known from northeast Africa, southwest Asia, and the near East. An assignment to this family can be excluded due the rather slender habitus of the new specimen.

Daesiidae, to which the other known fossil solifuge from Baltic amber is assigned (Dunlop *et al*. 2004), is extremely wide-spread and occurs in Africa, southern Europe, the Near East and apparently in South America (with three monotypic genera; see Harvey 2003). Karschiidae are also known from various geographical regions such as Asia, the Near East, southeast Europe, and northwest Africa. Both families include rather small representatives. However, it has to be pointed out that an assignment based on biogeography can only represent a possibility and is not as reliable as a morphological classification.

The new fossil seems to show a flagellum, which hints at a male, but details of flagellar morphology are lacking. In overall appearance and in its relative limb proportions the new specimen is not unlike the holotype of the previous Baltic amber species *Palaeoblossia groehni* Dunlop, Wunderlich and Poinar, 2004 and could be the same taxon. However, these similarities do not translate into unequivocal apomorphies by which we could refer the new specimen to the existing species taxonomically. We should also caution that different species of Recent camel spiders can share a very similar habitus, and differ externally mostly through their primary and secondary sexual characters. The holotype of *P. groehni* was also interpreted as a (very small) putative male, but again here details of its putative flagellum were equivocal. Were the two Baltic amber specimens to prove conspecific, it seems likely that the larger of the two would be the adult male and the flagellum in the smaller (?juvenile) specimen may turn out to be a misinterpretation.

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