

Cretaceous Canadian amber spider and the palpimanoidean nature of lagonomegopids

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The first formally described spider from mid-Campanian (76.5–79.5 Ma), Upper Cretaceous amber from Cedar Lake, Manitoba, Canada is named as *Grandoculus chemahawinensis* new genus and species. It belongs in the fossil family Lagonomegopidae, based on the large eyes situated anterolaterally on the carapace. The proposed systematic position of this family in Palpimanoidea was based on tenuous characters, such as spineless legs and a single metatarsal trichobothrium. The new fossil possesses dense scopulae prolaterally on the metatarsus and tarsus of the first pair of legs, confirming placement of the Lagonomegopidae in Palpimanoidea along with the only other known families to exhibit this character. However, the individual setae differ between the new specimen and the other families, in that they have a pointed, hooked-tip on the metatarsus and a straight, pointed tip on the tarsus, rather than a spatulate tip. Both hooked and spatulate setal types presumably evolved from a “normal-type” seta and may represent two different lineages derived from a common ancestor.

Key words: Araneae, Palpimanoidea, Lagonomegopidae, Campanian, Cedar Lake, Manitoba, Canada.

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Introduction

Canadian amber, also occasionally known as chemawinite or cedarite, was first revealed to W.C. King of the Hudson Bay Company trading post, by an Indian of the local Chema-hawin Indian Reservation in Manitoba (McAlpine and Martin 1969). The amber was first studied by J.B. Tyrrell in 1890, whose group subsequently then traced its source back to the shore of Cedar Lake. However, there are no known amber-bearing sediments remotely close to Cedar Lake and it is possible that the amber originates over 1,000 miles away in the western provinces of Saskatchewan and Alberta and that it was transported to its present location by the easterly flowing Saskatchewan River (e.g., Poinar and Poinar 1994). The first published report on this amber was by Harrington (1891) and the amber was mentioned by Tyrrell (1892) in a report to the Geological Survey of Canada.

The first fossil inclusions were reported by Walker (1934), and Carpenter et al. (1937) provided the first comprehensive report of the arthropod inclusions but did not mention spiders. Further collecting ensued and McAlpine and Martin (1969) provided a review of the history, relative abundance, biological origin and significance of this amber deposit. They provided a list of inclusions, which included spiders tentatively assigned to the families Araneidae, Linyphiidae, and Theridiidae. According to these authors the relative frequency of spider inclusions in this amber was 4.8%. Pike (1994) reviewed the total known fauna of Alberta (Grassy Lake) amber and found spiders to represent

6.3% of the total. He also commented that almost all species occurring in this deposit belonged to extinct genera, a finding substantiated by Christiansen and Pike (2002) in a study of 78 Canadian amber Collembola. The amber dates from a part of the Campanian, 76.5–79.5 million years (Ma) old (e.g., Poinar et al. 2000), a period shortly before the end-Cretaceous extinction event that wiped out the dinosaurs. Although spiders and most insects seem to have been relatively unaffected by this event (e.g., Penney et al. 2003), there may have been subtle biodiversity changes in the “build up” to the extinction. Thus, this amber source is potentially extremely important for assessing any changes in the terrestrial arthropod fauna that may have occurred at this time.

Fossil spiders in Cenozoic ambers have been known for centuries, the first major work with formal descriptions appeared in the mid-nineteenth century (Koch and Berendt 1854) and concerned spiders in Baltic amber. In contrast, it was only a decade ago that the first spider inclusion in Mesozoic amber was formally described by Eskov and Wunderlich (1995) of Santonian age from Siberia. However, it is only within the last few years that further descriptions of Cretaceous amber spiders have been published, for example in fossil resins of Turonian age from New Jersey (Penney 2002, 2004a), Barremian age from the Isle of Wight (Selden 2002), Upper Neocomian–basal Lower Aptian age from Lebanon (Penney and Selden 2002; Penney 2003a; Wunderlich and Milki 2004 [not 2001 as cited by Poinar and Milki 2001]), and Albian age from Myanmar (Penney

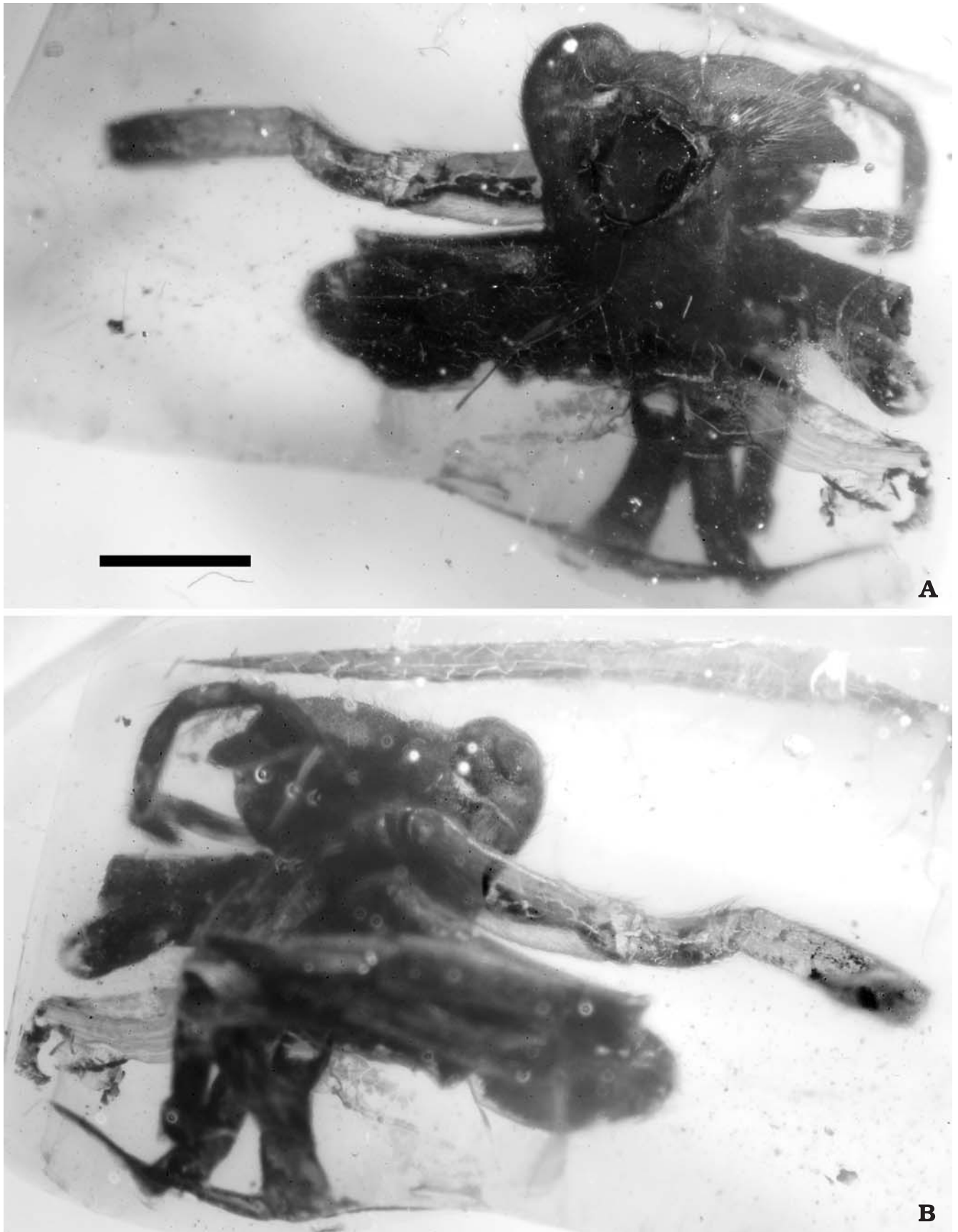


Fig. 1. *Grandoculus chemahawinensis* gen. et sp. nov., holotype MCZ A 5000, juvenile, Canadian amber. A. Dorsolateral view. B. Ventrolateral view. Scale bar 1.0 mm.

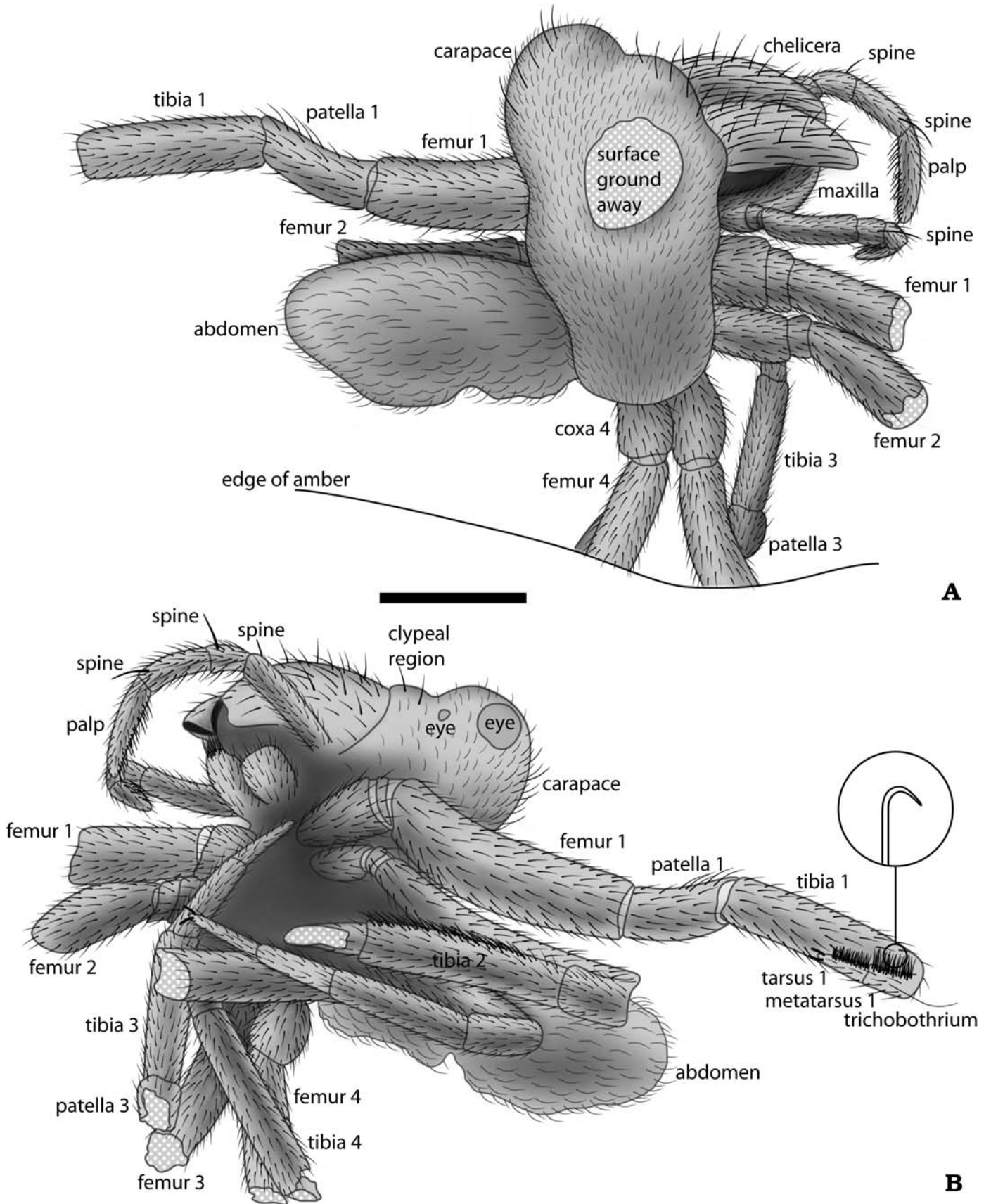


Fig. 2. *Grandoculus chemahawinensis* gen. et sp. nov., holotype MCZ A 5000, juvenile, Canadian amber. **A.** Dorsolateral view. **B.** Ventrolateral view, showing structure of hook-tipped scopular hair. Scale bar 1.0 mm.

2003b, 2004b). Spiders have been listed as present (and occasionally figured) in Mesozoic amber from Canada (McAlpine and Martin 1969), the Caucasus (Eskov and Wunderlich 1995), France (Schlüter 1978; Néraudeau et al. 2002; Perrichot 2004), Álava, Spain (Alonso et al. 2000) and Asturias, Spain (Arbizu et al. 1999), but none of these have yet been formally described.

The enigmatic spider family Lagonomegopidae was first described by Eskov and Wunderlich (1995) from two specimens in Upper Cretaceous Siberian amber from the Taimyr Peninsula. Penney (2002) described an additional but rather poorly preserved specimen from Cretaceous (Turonian) New Jersey amber as *Lagonomegops* sp. indet. and Grimaldi et al. (2002) figured an undescribed lagonomegopid in Lower Cretaceous (Albian) Myanmar (formerly Burmese) amber. The present paper describes the first spider from Canadian amber and discusses the systematic placement of the family Lagonomegopidae within the superfamily Palpimanoidea.

Material and methods

The specimen in Canadian amber (chemawinite/cedarite) from Cedar Lake, Manitoba, held in the Museum of Comparative Zoology, Harvard (MCZ), is preserved in a small piece (7×4×2 mm) of clear yellow-orange amber mounted in Canada balsam on a microscope slide.

All measurements were made using an ocular graticule and are in mm. Drawings were done freehand, then scanned and computer generated using Adobe Illustrator and Adobe Photoshop. Photographs were taken with a Nikon D1X digital camera attached to the microscope. In the leg formula (e.g., 1234), the legs are ranked in order of length (longest first).

Description

Order Araneae Clerck, 1757

Suborder Araneomorphae Smith, 1902

Superfamily Palpimanoidea *sensu* Forster and Platnick, 1984

Family Lagonomegopidae Eskov and Wunderlich, 1995

Genus *Grandoculus* nov.

Type species: *Grandoculus chemahawinensis* sp. nov. by monotypy.

Derivation of name: *Grand* from the Latin *grandis*, meaning large, and *oculus* from the Latin *oculus*, meaning eye.

Diagnosis.—*Grandoculus* can be distinguished from *Lagonomegops*, the other genus in this family by having a raised cephalic region, the elongate, curved chelicerae and the long, dense, hook-tipped scopulae on the prolateral surface of metatarsus 1.

Grandoculus chemahawinensis sp. nov.

Figs. 1, 2.

Holotype and only known specimen: MCZ A 5000, juvenile (or female), Canadian amber, Manitoba, Cedar Lake; coll. Carpenter.

Type horizon and locality: Fossil in amber from Cedar Lake, Manitoba, Canada; mid-Campanian (76.5–79.5 Ma), Upper Cretaceous.

Derivation of the name: The specific epithet is after the Chemahawin Indian Reservation at Cedar Lake, in recognition of the Indian who presented a piece of amber to W.C. King in 1890 and thus sparked an interest in this amber deposit.

Diagnosis.—As for the genus.

Description.—Juvenile (or female). Body length approximately 4.6; carapace length approximately 2.3, width 1.6, 1.1 high in the cephalic region which is swollen anterolaterally; covered with a pubescence of fine setae and with stronger, erect setae dorsally and on the clypeus; fovea, if present, not visible. Only two eyes are visible, on the left hand side of the carapace (Figs. 1, 2), the right side lies at the surface of the amber and has been ground away during the preparation process prior to receipt by the author (Figs. 1, 2). The uppermost eye is particularly large with a diameter of 0.4, the eye situated below it is much smaller (Figs. 1, 2); thus the spider had at least four eyes. The chelicerae are relatively long (1.1), procurved (Figs. 1, 2), covered with long, stiff setae and lack stridulatory ridges; the presence or absence of peg-teeth or true cheliceral dentition is unclear, however a peg-tooth may be visible on the left chelicera when the specimen is viewed from the left side using transmitted light. The sternum and mouthparts are not clearly visible but the maxillae are longer than wide and with serrula distally (Fig. 2). The opisthosoma has been compressed but is approximately 2.3 long and appears unmodified and covered with fine setae; spinnerets not visible.

Much damage has been caused to the legs during preparation of this specimen prior to receipt by the author, and the only two that remain in their entirety are left leg 1 and left leg 3. Leg formula probably 1234 or 1243; leg 1 distinctly more robust than the others. femur 1.7, patella 0.9, tibia 1.6, metatarsus and tarsus not measurable, but with very closely packed, long, hook-tipped scopular hairs on the prolateral surface of the metatarsus (Fig. 2), and long, straight, pointed scopular hairs on the prolateral surface of the tarsus (Fig. 2). Leg 2 patella 0.6, tibia 1.3 with short scopulae along most of its length (Fig. 2). Leg 3 patella 0.5, tibia 0.9, metatarsus 0.8, tarsus 0.6. The only claws visible are on left tarsus 1 and left tarsus 3 and appear to be two in number, however, an inferior claw may just be visible behind the left superior claw on tarsus 3; superior claws appear to lack teeth, but these are not visible in lateral view and the teeth may be hidden. All legs lack spines and are covered with fine, feathery setae; a single trichobothrium is visible on metatarsus 1 (Fig. 2). The only true spines occur on the femora, patellae and tibiae of the pedipalps, the palpal tarsus lacks a terminal claw and has long, thick setae ventrally (Fig. 2).

Discussion

The new genus is placed in Lagonomegopidae because of the particularly large eyes in flank positions at the anterolateral aspects of the carapace, the spineless legs, and the single metatarsal trichobothrium. The cheliceral structure appears similar to that of some Archaeidae *sensu lato*, e.g., mecy-smaucheniids, but they do not originate from a clypeal foramen. Extreme forms of carapace variation occur in extant spider families, e.g., Araneidae, Linyphiidae, Theridiidae, and this is not considered sufficient justification for erecting a new family for this specimen. However, the unusual carapace in conjunction with the presence and structure of the prolateral scopulae on leg 1 may warrant new family status, but this is avoided here because insufficient fossil specimens of this family are known to fully delimit its natural variation. Unfortunately, all known specimens of Lagonomegopidae (fossil species in Cretaceous ambers from Siberia, New Jersey, Myanmar—formerly Burma, and Canada) are immature or possibly adult female but, if so, the epigynes are not visible. As the genitalia are unknown for this family the current taxonomy is based on somatic characters. Upon future discovery of mature (fossil or extant) specimens the diagnoses can be revised to include details of the genitalia.

This is the first spider to be formally described from Canadian amber and it sheds interesting light on the correct superfamilial placement of the fossil spider family Lagonomegopidae. Forster and Platnick (1984) reviewed the superfamily Palpimanoidea and placed a number of disparate families (Mimetidae, Micropholcommatidae, Textricellidae) alongside the archaeoids, increasing the size of this superfamily considerably, which had previously consisted of only three families: Palpimanidae, Stenochilidae, and Huttoniidae. However, few subsequent authors agreed with Forster and Platnick's (1984) concept of the Palpimanoidea (see below and discussions in Wunderlich 1986; Eskov 1987, 1992; Coddington and Levi 1991; Lehtinen 1996; Schütt 2000), the monophyly of which was questioned in the majority of these papers.

Wunderlich (1986) rejected the enlarged Palpimanoidea of Forster and Platnick (1984) and included the fossil family Spatiatoridae with the three classical palpimanoid families. Coddington and Levi (1991) accepted the expanded Palpimanoidea of Forster and Platnick (1984) in their cladogram of the Araneomorphae, but this paper was a general review of spider systematics, rather than a critical reanalysis of Forster and Platnick's work. Eskov (1987) did not contest the placement of the archaeoids within the enlarged Palpimanoidea, but did dispute assigning family rank to what were previously subfamilies of Archaeidae *sensu lato*. Eskov (1992) described the Baltic amber fossil spider *Mimetarchaea gintaras* (Pararchaeidae or Holararchaeidae), a specimen that possesses key apomorphies of the families Archaeidae *sensu lato* (modified chelicerae and carapace) and Mimetidae (metatarsal macrosetal brush). Eskov (1990) suggested that

the families form sister taxa within the Palpimanoidea, and as such, are more closely related than was suggested by Forster and Platnick (1984). In a study of leg ultrastructural characters, Lehtinen (1996) considered the Palpimanoidea *sensu* Forster and Platnick (1984) to be polyphyletic and suggested that the presence of peg teeth was a convergent character in spiders. The superfamily Palpimanoidea was cut back to its original size by Schütt (2000), based on a reanalysis of the autapomorphies proposed by Forster and Platnick (1984), but she made no mention of fossil taxa. In reassigning the archaeoids and Mimetidae, i.e., families that possess cheliceral peg-teeth—previously considered an autapomorphy by Forster and Platnick (1984) for Palpimanoidea—Schütt (2000) recognized that her new delimitation of the superfamily Palpimanoidea (i.e., the classical Palpimanoidea: Palpimanidae, Stenochilidae, and Huttoniidae) would only be supported by one very weak character: the reduction in leg spination.

In both Palpimanidae and Stenochilidae the anterior pair of legs possess a thick scopula of distally spatulate hairs on the prolateral surface of the tibia, metatarsus, and tarsus (Forster and Platnick 1984). This peculiar type of spatulate seta is also present in the Huttoniidae on the prolateral surfaces of the anterior metatarsi and tarsi but they do not form the dense scopulae as in Palpimanidae and Stenochilidae. The fossil spider family Spatiatoridae described by Petrunkevitch (1942) from specimens in Baltic amber also has dense scopulae of spatulate setae on the prolateral surfaces of the anterior tibiae, metatarsi and tarsi (Petrunkevitch 1942; Wunderlich 1986) and was thus placed in the Palpimanoidea (e.g., Wunderlich 1986) but this family was not mentioned by Schütt (2000).

Eskov and Wunderlich (1995) placed Lagonomegopidae in the superfamily Palpimanoidea based on the presence of peg teeth, the absence of teeth on the cheliceral promargin, the trichobothrial pattern and the spineless legs. None of the previously described fossil lagonomegopids (Eskov and Wunderlich 1995; Penney 2002) possess scopulae and no mention was made by these authors of spatulate setae, but the features listed above suggest the family was best placed in Palpimanoidea. The discovery of the new fossil lagonomegopid described above, which possess a very similar conformation of dense scopulae prolaterally on the anterior metatarsi and tarsi supports placement of the Lagonomegopidae in Palpimanoidea along with the only other known families to exhibit this strange character. However, it should be noted that the structure of the individual setae differs between this new genus and the other families, in that they have hooked-tips (Fig. 2) and straight, pointed tips, rather than spatulate tips. As such, their assignment here may be incorrect, but when considered in conjunction with the other characters, I consider this unlikely. Both hooked and spatulate setal types presumably evolved from a “normal-type” seta and may just represent two different lineages derived from a common ancestor. I am unaware of such modified, hook-tipped setae in any extant families.

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