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Research Advances

Cretaceous Hitchhikers: a Possible Phoretic Association between a Pseudoscorpion and Bird in Burmese Amber

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Objective

Phoresy represents a non-parasitic association between animals of different taxa related to transportation. Members of several pseudoscorpion families are phoretic. In pseudoscorpions, phoresy may or may not be associated with their predatory behavior, enabling dispersal over larger distances than they could manage with their own short legs. This provides a wide distribution, and a potential food supply.

Recent discoveries of mid-Cretaceous amber from Myanmar have provided new insights on the early postnatal development of primitive birds and the integumentary structures of dinosaurs. Over the last three years, Xing et al. have described two precocial Enantiornithes wings, a partial hatchling, and a partial juvenile, as well as a feathered coelurosaurian tail with primitive plumage from mid-Cretaceous Burmese amber. These new findings associate well-preserved feathers with identifiable skeletal material for the first time.

In 2016–2017, the first author observed several pseudoscorpion specimens in Burmese amber with chelae clamped on to parts of feathers or preserved near feathers. These specimens indicate a possible ancient phoretic association between pseudoscorpions and birds. Herein, we describe one of the first of these specimens to enter a museum collection.

Results

The new amber specimen, DIP-V-17198, comes from the Angbamo site, Tanai Township, Myitkyina District, Kachin Province, northern Myanmar. It measures approximately 25 mm x 13 mm x 3 mm, and weighs 0.66 g. The original specimen is housed in the Dexu Institute of Palaeontology (DIP), China.

The pseudoscorpion family Geogarypidae is diagnosed based on a subtriangular carapace without carapaceal alae, four eyes on short ocular tubercles situated away from the anterior margin of the carapace, a narrow cucullus with a furrow, and an ovoid epistosoma. DIP-V-17198 conforms to all these characters, except for the absence of eyes, and is temporarily assigned to the family of Geogarypidae.The detailed morphology and the systematic position of this species will be published later, as part of a separate paper.

DIP-V-17198 contains the apical portion of one feather and may contain barbs that belong to two additional feathers (with different orientations in the amber). The fragmentary appearance of the feathers is a result of breaching the polished surface of the amber piece in multiple places, as opposed to taphonomic fragmentation. The pseudoscorpion is attached to barbules of a contour feather that is preserved as a section of rachis surrounded by barbs with reduced barbules. Very few barbs attach to the preserved section of slightly broadened rachis, while most converge below the preserved region. These widely spaced barbs with attachment points concentrated toward the base of the feather are combined with a uniform set of reduced (blade-like) barbules that lack a defined flagellum and have equal lengths on either side of the barb ramus. The barbules have wide spacing along the barb ramus and become diminutive toward the apex of each barb. Pigmentation is weak within the barbules, rami, and rachis, producing a uniform pale brown apparent colouration.

Discussion

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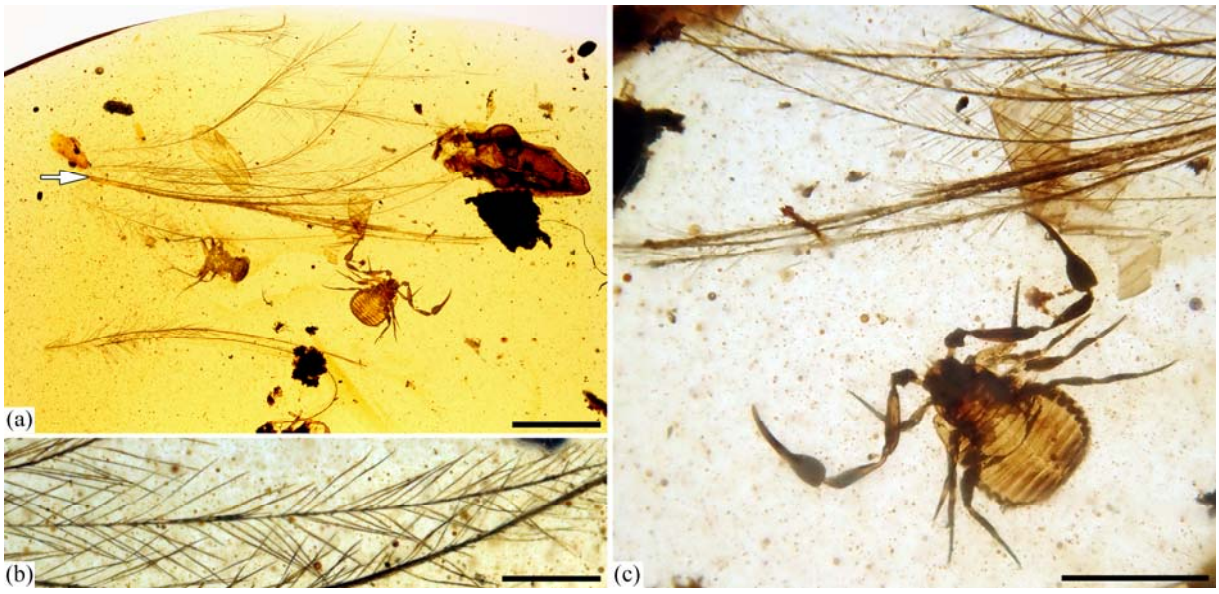

Fig. 1. DIP-V-17198 pseudoscorpion association.
(a),Ventral habitus with feather rachis indicated (arrow); (b), Detail of reduced barbules; (c), Detailed dorsal habitus of pseudoscorpion (disarticulated Psocoptera wing near attachment site is far removed from chelae); scale bar = 2 mm in (a), 0.5 mm in (b), 1 mm in (c).

The morphology of the preserved feather would have resulted in a very loosely vaned contour feather without any hooklets to connect adjacent barbs. The morphological features of the feathers are consistent with those that have been observed *in situ* on Burmese amber enantiornithines, and as isolated feathers in Canadian Cretaceous amber. However, the reduced barbules in DIP-V-17198 are slenderer than previously published examples, approaching the stylet condition. The differences between feathers of this morphotype and those of modern birds, combined with the more recent discoveries in Burmese amber, seem to point toward Enantiornithes as a source.

The family Geogarypidae currently contains three genera. Modern geogarypids occur in leaf litter, under bark, and under stones, but some are known to inhabit nests. Within the fossil record of pseudoscorpions, phoresy is found in the families Chernetidae, Cheliferidae, Garypinidae, Withiidae and may extend to Lechytiidae. Phoresy is not very common in Geogarypidae, and no previous fossil records of the family have involved phoresy.

The associations observed between pseudoscorpions and feathers in Burmese amber may capture part of the local nest-dwelling community. DIP-V-17198 also contains the fragmented remains of one barklouse (Psocoptera), and the legs and head of true bugs (Hemiptera), plus relatively abundant plant particulates or insect frass. This type of assemblage has been viewed as an indicator for forest floor amber but has also been found in association with ticks (Ixodida) living in or near dinosaur nests. Geogarypidae are known to inhabit nests, however, attachment to feather barbules points more specifically toward a phoretic relationship in DIP-V-17198.

Conclusions

Examples of phoresy are generally rare within fossil records, and previous reports have been restricted to associations between arthropods. DIP-V-17198 preserves an association demonstrating the antiquity of the relationship between Geogarypidae and primitive birds. The amber piece may have encapsulated part of a nest assemblage, but it also suggests that pseudoscorpions engaged in phoresy to move between nests as early as the mid-Cretaceous.

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