

# **Cretaceous fireflies reveal early evolution of insect bioluminescence**

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Habitus of *Flammarionellahehaikuni* Cai, Ballantyne & Kundrata, 2024, from mid-Cretaceous Burmese amber. Credit: NIGPAS

Bioluminescence, the ability of living organisms to emit light, is a fascinating phenomenon observed in various life forms, including deep-sea fish, glowing mushrooms, and fireflies. Fireflies have long captivated people with their enchanting light displays, sparking scientific curiosity.

Recently, Prof. Cai Chenyang and colleagues from the Nanjing Institute of Geology and Paleontology of the Chinese Academy of Sciences (NIGPAS) and their international collaborators described the second known firefly fossil from the Mesozoic, found in Burmese amber. This discovery is significant for understanding the evolution of firefly bioluminescence and key traits.

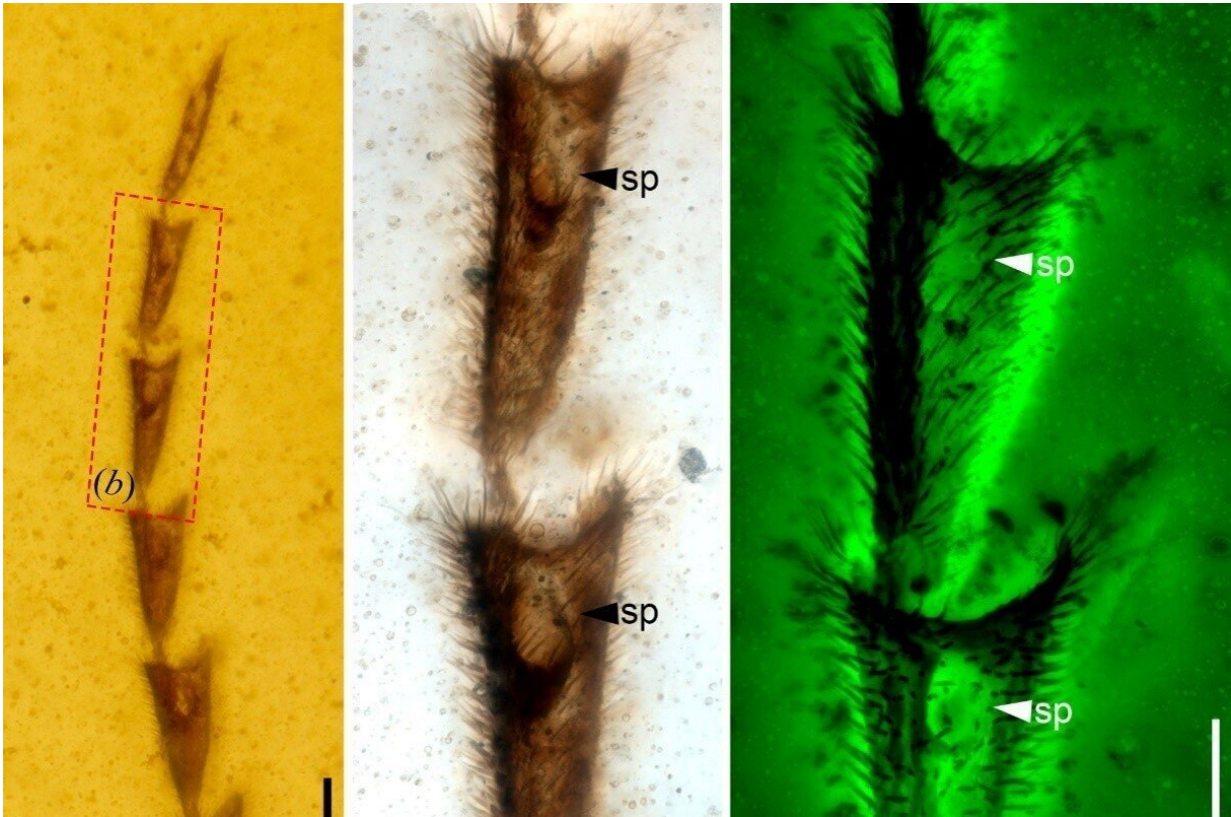
The research is [published](#) in the *Proceedings of the Royal Society B*.

In today's terrestrial ecosystems, most [bioluminescent organisms](#) belong to the order Coleoptera (beetles), particularly the superfamily Elateroidea (click beetles, fireflies, and their relatives). Among Elateroidea, a majority of bioluminescent species are part of the "lampyroid" clade, which includes the families Lampyridae (fireflies), Phengodidae, Rhagophthalmidae, and Sinopyrophoridae. Most species within these families have soft bodies, and some females exhibit neoteny, making it difficult to find fossils.

Firefly fossils from the Mesozoic era are extremely rare, with only one example previously reported. In 2021, Prof. Cai's research team discovered a new family of Elateroidea in mid-Cretaceous Burmese amber, named Cretophengodidae, representing a transitional stage in the



early evolution of lampyroids.



Morphological details of *Flammarionellahehaikuni*. Credit: NIGPAS

In collaboration with researchers from the University of Cambridge, University of Bristol, Charles Sturt University, the American Museum of Natural History, and Palacký University, Cai and his colleagues identified a well-preserved female firefly from mid-Cretaceous Burmese amber, approximately 100 million years old.

This represents a new genus and species, *Flammarionellahehaikuni* Cai, Ballantyne, & Kundrata, 2024. Based on morphological analysis, the fossil was classified within the basal lineage of the subfamily Luciolinae

(Lampyridae).

This species' antennae feature distinctive oval-shaped sensory receptors on segments 3 to 11, likely specialized olfactory organs. The light-emitting organ near the tip of the abdomen closely resembles those of modern Luciolinae [fireflies](#), demonstrating evolutionary stability in this trait.

Together with previously discovered bioluminescent beetles from Cretaceous amber, this study highlights the morphological diversity of light-emitting organs in the Mesozoic era, greatly enhancing our understanding of the evolutionary history of bioluminescence in Elateroidea.

Future fossil discoveries are expected to further illuminate the evolution and mechanisms behind insect bioluminescence in the Mesozoic.

**More information:** Chenyang Cai et al, A light in the dark: a mid-Cretaceous bioluminescent firefly with specialized antennal sensory organs, *Proceedings of the Royal Society B: Biological Sciences* (2024). [DOI: 10.1098/rspb.2024.1671](https://doi.org/10.1098/rspb.2024.1671)

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