A Fossil Bee from Early Cretaceous Burmese Amber

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Bees are among the most important insect pollinators (*1*). The origin of bees, with their numerous morphological and behavioral adaptations for pollen collection and transport (*2*), contributed to the rapid diversification of angiosperms in the Early to mid-Cretaceous (*3*). Understanding the role that bee pollination played in angiosperm diversification requires an accurate estimate of bee antiquity as well as an understanding of the early evolutionary history of bees.

We report here fossil evidence of bees in the Early Cretaceous. The fossil bears several derived features of bees as well as morphological structures (e.g., branched hairs) presumed to be associated with pollen collection. The specimen originated from an amber mine in the Hukawng Valley (26°20′N, 96°36′E), Kachin state, northern Myanmar (Burma). Palynomorphs obtained from the amber beds where the fossil originated have been assigned to the Upper Albian [~100 million years ago (Ma)] of the Early Cretaceous (*4*). The male holotype is deposited in the Poinar amber collection (accession no. B-Hy-7) maintained at the Oregon State University Insect Collection.

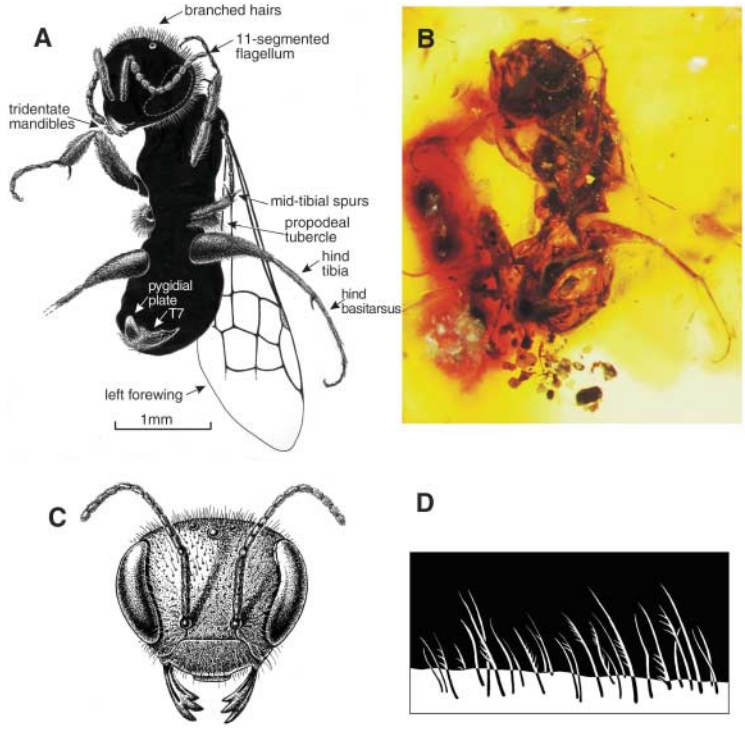

Fig. 1. *Melittosphex burmensis*. (**A**) Ventral view of fossil with key features labeled. (**B**) Photograph of fossil as seen in ventral view. (**C**) Reconstruction of head based on details visible in fossil and information from modern bees. (**D**) Morphology of branched hairs on the hind femur.

Superfamily Apoidea

Melittosphecidae new family

Type genus: *Melittosphex*

Type species: *Melittosphex burmensis*

Melittosphex burmensis new species

The male specimen of *Melittosphex burmensis* measures 2.95 mm in length (Fig. 1B) and bears branched, plumose hairs on the undamaged portions of the thorax, legs, abdomen, and head (Fig. 1, A and D). The heart-shaped head (0.24 mm in length) bears antennae that originate low on the face [below the midline (Fig. 1A)]. Each antenna bears 11 flagellomeres, establishing that this is a male. The mandibles are elongate and acutely tridentate (Fig. 1, A and C).

The mesosoma (1.45 mm in length) is partially compressed, but the legs and wings are clearly visible. The propodeum bears two distinct posterolateral tubercles (Fig. 1, A and B) with scattered branched hairs. The forewing venation is typical of many small bees, with a distinct stigma, two submarginal cells, and a weakly arcuate basal vein (Fig. 1A), and is unlike that of any extant or fossil apoid wasps. The hindwing is not visible. The hind leg has an elongate, slender hind tibia [lacking distinct tibial spines characteristic of apoid wasps (Fig. 1A)], a narrow hind basitarsus [a characteristic of apoid wasps (Fig. 1A)], and a weakly developed basitibial plate. The hindleg strigil is absent (Fig. 1A). There are two hind-tibial spurs [as in most bees (*1*)]. The midtibia bears two spurs [a groundplan feature of apoid wasps (*1*) (Fig. 1A)]. The male specimen bears several pollen grains between the hairs on the first and second metatarsal segments and adjacent to the antennal cleaner on the left foretarsus.

The metasoma (1.26 mm in length) is slightly compressed, but T7 (the last visible metasomal tergum in males) is undamaged (Fig. 1B). The specimen bears a well-developed pygidial plate (Fig. 1A) on T7, a character that unites bees with crabronid wasps (*5*). Cerci are absent.

Analysis of available morphological data indicates that *Melittosphex* represents an extinct lineage of pollen-collecting Apoidea sister to the modern bees [Supporting Online Material (SOM) text].

M. burmensis establishes that many traits of extant bees were present by ~100 Ma, near the time of the origin of the eudicots [120 to 125 Ma (*3*)]. Other known bee fossils are 35 to 45 million years younger. The small size of *Melittosphex* indicates that at least some of the earliest bees were minute. This is consistent with the small sizes reported for some Early Cretaceous flowers (*6*). Several extant lineages of bees include small species (~3 mm in length), including Colletidae (some Euryglossinae), Halictidae (Nomioidinae), Andrenidae (some Panurginae), and Apidae (Meliponini and Neolarrini) (*1*). *M. burmensis* exhibits traits unique to bees (branched hairs, absence of hind-leg strigil, and absence of hind-tibial spines) as well as groundplan features of apoid wasps (paired mid-tibial spurs and slender hind basitarsus). This mosaic of wasp and bee traits is to be expected from an early, transitional form that bridges the gap between extant bees and crabronid wasps.

References and Notes

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Supporting Online Material

www.sciencemag.org/cgi/content/full/314/5799/614/DC1
SOM Text
Fig. S1
References

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