Coming Events

Due to COVID-19, please check to see if the listed events have been postponed or canceled.

2022

Electron Backscatter Diffraction 2022 (EBSD2022)
June 7–9, 2022
Virtual
the-mas.org/events/topical-conferences/ebsd-2022

3D MS 2022: The 6th International Congress on 3D Materials Science
June 26–29, 2022
Washington, D.C.
www.tms.org/3DMS2022

72nd American Crystallographic Association (ACA) Annual Meeting
July 29–August 3, 2022
Portland, OR
acas.memberclicks.net/future-meetings

Microscopy & Microanalysis 2022
July 31–August 4, 2022
Portland, OR
www.microscopy.org/events/future.cfm

XVI CIASEM Congress: 16th Inter-American Congress on Microscopy
October 25–28, 2022
Oaxaca, Mexico and Virtual
ciasem2022.com

Neuroscience 2022
November 12–16, 2022
San Diego, CA
www.sfn.org/meetings/neuroscience-2022

2022 MRS Fall Meeting
November 27–December 2, 2022
Boston, MA
and
December 6–8, 2022
Virtual
mrs.org/meetings-events/fall-meetings-exhibits/2022-mrs-fall-meeting-exhibit

Cell Bio 2022
December 3–7, 2022
Washington, DC
www.ascb.org/cellbio2022

2023

Microscopy & Microanalysis 2023
July 24–28, 2023
Minneapolis, MN
www.microscopy.org/events/future.cfm

2024

Microscopy & Microanalysis 2024
July 28–August 1, 2024
Cleveland, OH
www.microscopy.org/events/future.cfm

Carmichael's Concise Review

Amoeba-Size Beetle Has a Novel Method of Flying!

Stephen W. Carmichael
Mayo Clinic, Rochester, MN 55905

carmichael.stephen@mayo.edu

The morphology and mechanics of flight in insects in the millimeter range, such as fruit flies (*Drosophila melanogaster* is 2–3 mm) and mosquitos (about 4 mm), have been well-studied. In contrast, the flight of tinier insects has remained a mystery. This recently changed with an elegant study by an international group lead by Sergey Farisenkov, Dmitry Kolomenskiy, and Alexey Polilov [1]. They studied the flight of the miniature featherwing beetle *Paratuposa placentis*.

Specimens were located on fungi in the Joint Russian-Vietnamese Tropical Research and Technological Center. Farisenkov et al. constructed a morphological model based on data gained from light, confocal, and scanning electron microscopy. The beetles were less than half a millimeter in length, which is similar to the size of some unicellular organisms such as *Amoeba proteus*. The length of each of the two wings was about the same as the body length. The wings consist of a stalk (petiole) and a structure resembling a bristle, which has a narrow wing blade with a fringe of several setae covered with secondary outgrowths (Figure 1).

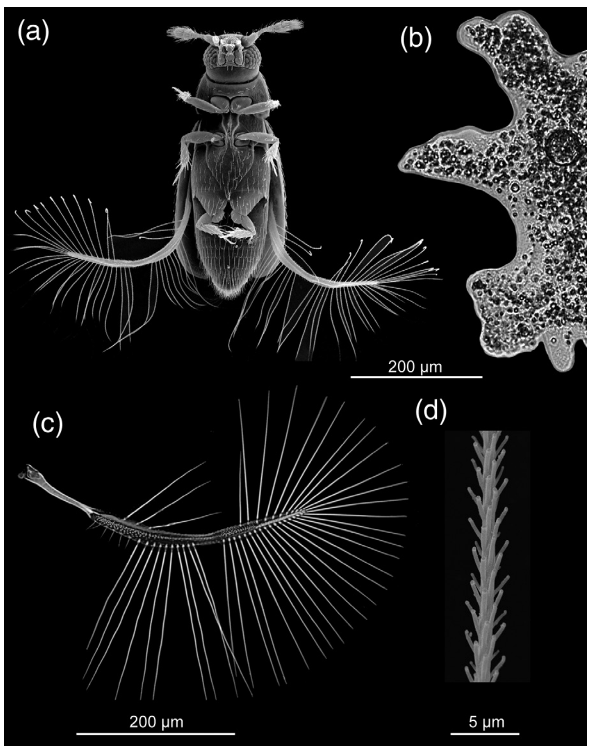

Figure 1: External morphology of *Paratuposa placentis*. Scanning electron micrographs showing relative size of *P. placentis* (a) and *Amoeba proteus* (b), wing of *P. placentis* (c), and part of a seta (d).

doi:10.1017/S1551929522000591

https://doi.org/10.1017/S1551929522000591 Published online by Cambridge University Press

The mass of the bristled wing was about 1% of the body mass of the beetle. Farisenkov et al. calculated that a wing of the same area, if membranous (as found in most flying insects), would have an approximately six-fold greater mass. The bristled wing maintained the needed aerodynamic properties because the physics of creating lift is different at sub-millimeter dimensions than it is on a larger scale. Specifically, the viscosity of air is proportionally greater than inertia at a tiny scale. This was demonstrated by the ratio of inertial forces to viscous forces (Reynolds number).

Having described the microscopic morphology of the beetle's wing, Farisenkov et al. developed a kinematic model using synchronized high-speed (almost 4,000 frames per second) videography taken from two perpendicular positions. After a three-dimensional reconstruction and sophisticated analyses of the beetle and its flight, the group discovered that the wings did not move in a strict up-and-down fashion but rather a figure-of-eight loop. The wings clapped above and below the body, just when the wings reversed direction. The unusually large horizontal and vertical excursion of the wings during flapping poses a peculiar flight dynamics problem that would destabilize the flight pattern. To limit this problematic effect on the insect's body and stabilize the beetle in flight, the modified hardened forewings (elytra) were deployed synchronously with the wing beats to counteract the destabilizing effect of lift. The authors determined that this was a novel flight style.

Farisenkov et al. also performed additional studies that demonstrated the efficiency of the design and motion of the bristled wing of *P. placentis*. This study helps to explain how extremely small insects have preserved good aerial performance during miniaturization over more than 300 million years. No doubt this is one of the factors responsible for their evolutionary success!

References

[1] SE Farisenkov et al., *Nature* 602 (2022) https://doi.org/10.1038/s41586-021-04303-7.

[2] The author gratefully acknowledges Dr. Sergey Farisenkov for reviewing this article.

MT