Fantastic Role of Tiny "Second Wings," or Calypteres, in Facilitating Highly Complex Flying Patterns

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Hoverflies (Diptera: Syrphidae) are widely considered to be among the most agile and swift modern winged insects. As implied by their name, hoverflies can hover as well as perform rapid and highly precise movements in flight. Although previous studies have investigated hovering behavior in dipterans, the detailed mechanisms of hovering in this order have yet to be clarified in detail. Using a unique ‘hovering-model’ that we designed and developed, we demonstrated that a particular morphological structure, namely the calypter (or alura), enables hoverflies to perform swift hovering movements. The following novel findings are reported here: 1) the majority of winged insects (e.g., bees, wasps, dragonflies) generally have smooth, flat forewings, whereas a small additional lobe-like structure (calypter) is present at the base of the main hoverfly wing; 2) the calypter is connected directly to its own muscle via the third axillary, which enables it to move independently; 3) the hoverfly hovers when the main wing flaps at an angle of 15° and the calypter flaps at an angle of 65°; and 4) the hoverfly skillfully controls the calypter and can swiftly engage in a variety of flight maneuvers. The present discovery may contribute to further development of ‘dual-winged aircraft’.

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