

ON THE SKIMMING HYPOTHESIS OF INSECT FLIGHT ORIGIN

(talk)

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Skimming hypothesis of the insect flight origin (MARDEN & KRAMER 1994, MARDEN 1995) gains growing popularity (RUFFIEUX *et al.*, 1998, SHCHERBAKOV 1999, WOOTTON & KUKALOVÁ-PECK 2000). It suggests that the insect flight was preceded by, and developed directly from, the stage of skimming locomotion. The latter implies that the immediate pterygote ancestor (i) gained support from the water surface film due to hydrophobic properties of their legs (like in gerrid bugs); (ii) its locomotion was resulted from the aerodynamically efficient movements of wing precursors (like in some extant short-winged stone- and mayflies); (iii) wing precursors were limb appendages (e.g., epipodite) inherited movable from an aquatic ancestor (SHCHERBAKOV 1999 admits that epipodite might be incorporated temporarily into pterothoracic paranotum to be later re-mobilized upon necessity of skimming locomotion).

Skimming locomotion hardly originated in direct transition from subaquatic to epiaquatic environments: an intermediate stage of epigeal existence (with support from solid, even if wet, matter above the water level) should be inferred. Otherwise the ancestor was not able to break the water surface film, nor to acquire hydrophobic integument. Direct transition through the surface film occurs now in advanced amphibiotic insects with hydrophobic adult eclosing afloat from a hydrophilic immature: this is most probably a secondary adaptation. So skimming should start from a shore, but the reason for a wingless pre-ptyergote ancestor to enter water surface film is problematic. It would find little attraction there, if any. Extant surface dwellers live mostly on the flying insects either fallen onto water surface or emerging afloat from aquatic immature: nothing of these existed before pterygotes diversified themselves. Plant fragments floated on the water surface could hardly provide pre-ptyergots with any food better or easier available than shore (or floating algal mats which were land equivalent for small creatures) could do. So the only food related reason why pro-Pterygotes might move to on-film way of life were probably macrophytes emerging through water. Travelling between plants by water surface is beneficial, but water-striding is well enough and skimming unnecessary there.

Shcherbakov (1999) relates origin of the skimming locomotion to upstream migration of adult ephemeral pro-pterygotes in running water to compensate downstream drift of immature. This resolves the food problem but adds others. To compensate downstream drift an insect should travel kilometers, a hard task for a short-lived glider using primitive pro-wings. Ephemeral hypothesis *per se* has no paleontological support: even mayflies were mandibulate in Paleozoic.

Surface film was a dangerous habitat threatened by wind, by chelicerates abundant in Paleozoic, and by underwater predators. To live there and particularly to execute dispersal and courtship (Shcherbakov 1999), the thrust generating machinery must be efficient. This is unlikely because apterygotes have already paranota, so the winged insects should have their pro-wings as secondarily re-mobilized from paranota and so starting their propulsatory function from zero.

It might be instructive that man-made air-driven boats, like extant insect skimmers, have thrust machinery once designed for real flight and only secondary modified for gliding on water.

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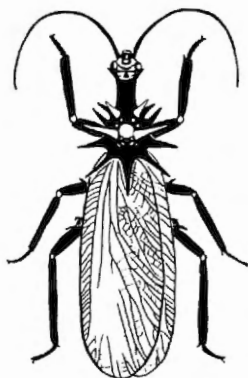
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Second International Congress on Palaeontomology

FOSSIL INSECTS



**5 – 9 September, 2001
Kraków, Poland**

ABSTRACTS VOLUME

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Kraków 2001