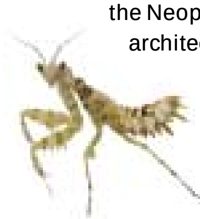
Journal Club

A macroevolutionary fondness for Neoptera

J.B.S. Haldane is famously supposed to have remarked that the Creator had an inordinate fondness for beetles. In evolutionary biologists' minds, beetles have been basking in the warm glow of God's favour ever since: but are they really the chosen ones? Peter Mayhew [1] has now addressed this issue using data on species richness, taxon age and phylogenetic relatedness of hexapods (the Entognatha, e.g. Collembola, plus the insects) and concludes that the Creator's fondness had wider taxonomic bounds.

Mayhew compared the species richness of sister clades and found that the Neoptera (insects with wing flexion) are significantly more diverse than the Entognatha plus the non-neopteran insects (dragonflies, damselflies, mayflies, silverfish and bristletails). The Neoptera comprise the Polyneoptera (e.g. grasshoppers, crickets, stick insects, earwigs, termites, mantids and cockroaches) and the Eumetabola [the Paraneoptera (true bugs, thrips and lice) and the Holometabola (insects with complete metamorphosis, such as lacewings, wasps, caddisflies, butterflies, flies and beetles)]. It appears that there was an important shift in diversification at or after the origin of the Neoptera, and certainly before the origin of the Holometabola, and that this shift accounts for at least 95% of all modern insect species. Second, Mayhew estimated radiation rates within clades and compared between them: although beetles have diversified faster than either of their sister lineages, they have not done so significantly faster than most other holometabolan insects.

Because events occurring after an event cannot have caused it, the evolution of complete metamorphosis did not therefore lead to this major shift in diversification: but what did? One possible candidate is wing flexion, which might have allowed the Neoptera to radiate into architecturally complex niches. However, wing flexion evolved independently in an insect order that later went extinct, and there are other morphological candidates, such as ovipositor modification, which could explain the shift in diversification, plus a suggestion that some interaction between a novel morphology and phytophagy might be responsible.



In sum, it appears that the rest of the Eumetabola, and possibly all of the Neoptera, supped with the beetles at the Creator's high table all along.

Personally, I find this pleasing, because I have an inordinate fondness for Hymenoptera (e.g. wasps, ants and bees) and Mayhew's findings counter, to some extent, Darwin's doubts that 'a beneficient and omnipotent God would have designedly created the Ichneumonidae [a hymenopteran family] with the express intention of their feeding within the living bodies of caterpillars'. Whatever God's intended role for the Hymenoptera, it appears that he created their species (and also species of their caterpillar victims) with as much fondness as he lavished on the beetles.

1 Mayhew, P.J. (2002) Shifts in hexapod diversification and what Haldane could have said. *Proc. R. Soc. Lond. Ser. B* 269, 969–974

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Arthropods hit the beach early

New evidence from rocks exposed near Kingston, Ontario, Canada suggests that some animals might have journeyed onto land earlier than was previously thought [1]. Rocks from the Potsdam Group of Late Cambrian to Early Ordovician age (500–470 million years before present) preserve fossil trackways of at least three distinct forms. The oldest previous reports of terrestrial tracks were from the Middle Ordovician, some 40 million years later.

Individual trails range from 8 to 13 cm wide and show impressions of a multitude of arthropod feet. Some trackways display a distinct medial line, which researchers interpreted as the drag of a tail spine. The significance of the fossil tracks hinges on the interpretation that the Potsdam sediments were deposited on land, rather than in the sea. Several features support this conclusion: The sandstones are very well sorted and have simple cross-bedding. They show ripples with low amplitude relative to wavelength, which are characteristic of dry, wind-blown sand, as is found on sand dunes. Adhesion structures – features produced when a thin film of water coats sand grains, sticking them together like sandcastle walls – suggest that the dunes might have been moistened periodically, but were never saturated. Although the tracks themselves tell few tales about their makers, MacNaughton and colleagues believe they were produced by an extinct group of arthropods, the euthycarcinoids, which had a head, a segmented midsection with pairs of simple legs, and an abdomen tipped with a spiny tail.

What were these critters doing on land? MacNaughton and colleagues suggest that they were just visiting. The Potsdam dunes show no evidence of terrestrial vegetation, suggesting that the arthropods probably returned to the sea for sustenance. However, their foray on shore demonstrated that they had evolved mechanisms for breathing air and preventing fatal dehydration, features that primed their lineage to permanently colonize land later in the Paleozoic.

1 MacNaughton, R.B. *et al.* (2002) First steps on land: arthropod trackways in Cambrian–Ordovician eolian sandstone, southeastern Ontartio, Canada. *Geology* 30, 391–394

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