

Evolutionary crossroads - molluscan evolution during the early Palaeozoic

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Molluscs, present and past, are second only to arthropods in abundance, diversity, morphological disparity from the shell-less to the multi-shelled, and in environmental adaptations. While monophyly of extant molluscan classes is accepted, the relationship within these are unclear and even the origin of the group itself is murky. Possible Ediacaran candidates exist, but not until the early Cambrian, enhanced in part by preservation of hard parts, do we see a radiation of molluscan taxa in the fossil record. Clear crown group molluscs appear later in the Cambrian after an evolutionary bottleneck experienced by several groups. Arguably, the most profound effects on molluscan evolution took place during the unparalleled Ordovician radiation and diversification. A second evolutionary bottleneck came to pass during the intensified cooling of Earth that triggered the second largest mass extinction marking the transition into the Silurian. This period is signified by warming but with perturbed climatic changes and whereas the Ordovician showed a great spread of continents, these are now amalgamated in increasingly larger complexes. Against this backdrop, several key events direct molluscan evolutionary pathways. An early challenge was the Cambrian substrate revolution, whereby burrowing and bioturbation gradually replaced the prevalent early Cambrian algal mat environments. This evolutionary precipice led to extinctions but also new ecological opportunities. In concert, increased predation pressure is evident, which at the transition to the Ordovician may have facilitated the evolution of planktotrophic mollusc larvae. Another effect is the culling of certain gastropod ecomorphotypes, whereby open coiled sedentary forms go extinct. Molluscs also took to the infaunal habitat, seen through elongation (scaphopodization) of their shells and the advent of pedal burrowing in bivalves. Both gastropods and cephalopods display a rich morphological evolution during this time, and endemism is high among the benthic fauna. Centres of radiation, especially in peri-Gondwana areas, may have exerted a significant influence on the dispersal pattern, with speciation taking place in the centres of origins of groups. These are some of the evolutionary pathways of the astounding Molluscan Rhapsody during the lower Palaeozoic, of which we only glimpse so little and have yet to explore more fully.