Metamorphosis and Neoteny – alternative pathways in the life history of branchiosaurids (Temnospondyli)

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The branchiosaurid amphibians from the Permo-Carboniferous of central Europe are exceptionally well preserved with hundreds of specimens, many of them showing delicate structures such as skin shadows, external gills, and stomach contents. Moreover, a wide range of ontogenetic stages are preserved offering a rich source of ontogenetic data that is rarely available in the fossil record. Branchiosaurids have an overall salamander-like appearance with external gills and weakly ossified skeletons. These attributes are commonly found in larval or neotenic individuals of extant salamanders. In contrast, the external gills are lost in metamorphosing salamanders and skeletal changes occur that are associated with a more terrestrial locomotion and lifestyle. Despite the extensive fossil record of branchiosaurids, representatives of large, metamorphosed specimens with an adult morphology appeared to be lacking altogether and therefore the status of branchiosaurids as neotenic (perennibranchiate) forms has long been accepted.

Recently two adult specimens have been identified in a rich sample of *Apateon gracilis* collected in the nineteenth century from a locality near Dresden, Saxony. These specimens show a unique high level of ossification, including skeletal elements that were previously unknown in branchiosaurids. They display the successive formation of features associated with a terrestrial locomotion and feeding on larger prey items, indicating a switch of habitat from the larvae to the adults. These specimens are contrasted by large, neotenic adults of the branchiosaurid *Apateon caducus* from the Saar Nahe Basin of Western Germany. Despite their large body size, these neotenic adults lack the features found in the adult *Apateon gracilis* specimens altogether.

The presence of both, neotenic as well as metamorphosed morphotypes, in populations of the Paleozoic branchiosaurids clearly show, that these life history strategies have already been established in branchiosaurid amphibians 300 Million years ago. Moreover, the finding offers new insights into patterns and timing of metamorphosis (morphological transformation) in branchiosaurids that are believed to be correlated to a change of habitat.