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A phylogenetic analysis of the heterostracan jawless vertebrate family Cyathaspididae

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The Heterostraci are a subclass of armored jawless vertebrates that were widespread in marginal marine environments around the Old Red Sandstone continent during the late Silurian to Middle Devonian. Although a number of clades have long been recognized, further analysis has been limited by lack of morphological information beyond that afforded by the armor, thus impeding understanding of early vertebrate evolution. Phylogenetic analysis of several heterostracan clades has been carried out previously and we here show an analysis of the family Cyathaspididae in which we prioritize the feature of a single branchial plate as a defining character of the family and reject a number of taxa previously included in analyses of this taxon. This analysis resolves to a single consensus tree showing that the Cyathaspididae is composed of a series of clades that are congruent with the subfamily groupings erected previously: Tolypelepidinae, Irregulareaspidinae, Poraspidinae, Anglaspidinae, and Boothiaspidinae. A trend can be seen from earlier members of the family with a dorsal shield divided into four epitega or growth areas (*Asketaspis, Tolypelepis*) to the most derived members (*Poraspis, Faberaspis*) in which the epitega are lost entirely. In addition, the earliest taxa are shown to have possessed shields composed of scale-like elements, which are lost and replaced by continuous ridges in the more derived members. This result supports the hypothesis that the earliest members of the Heterostraci may also have been scale-covered.

Key words: Pteraspidomorphi, Heterostraci, Cyathaspididae, taxonomy, phylogenetics, Palaeozoic.

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