

# Ultrastructure and taxonomy of the Families Axopodorhabdaceae and Cretarhabdaceae

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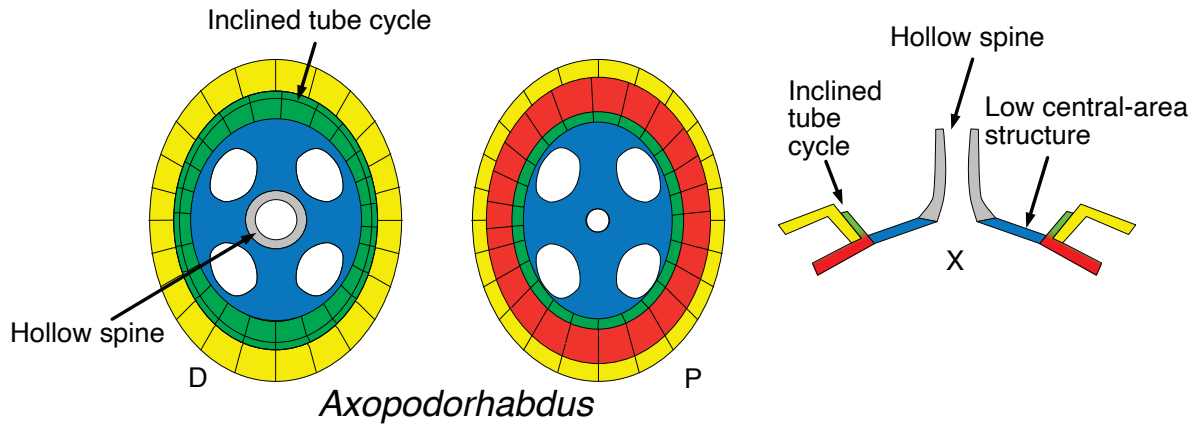
<https://doi.org/10.58998/jnr3238>

The Families Axopodorhabdaceae and Cretarhabdaceae are two placolith heterococcolith families that originated in the Early Jurassic and went extinct at the end of the Cretaceous. They are generally classified together in the Order Podorhabdales. However, although superficially similar, their ultrastructures are quite different (Figure 1). Both families have “conventional” placolith morphologies with an R-unit proximal shield, a V-unit distal shield, an R-unit tube cycle, and a central-area structure. However, the arrangements of the tube cycle and central-area structures are distinctly different between the two families, suggesting that they may not be as closely related as previously thought.

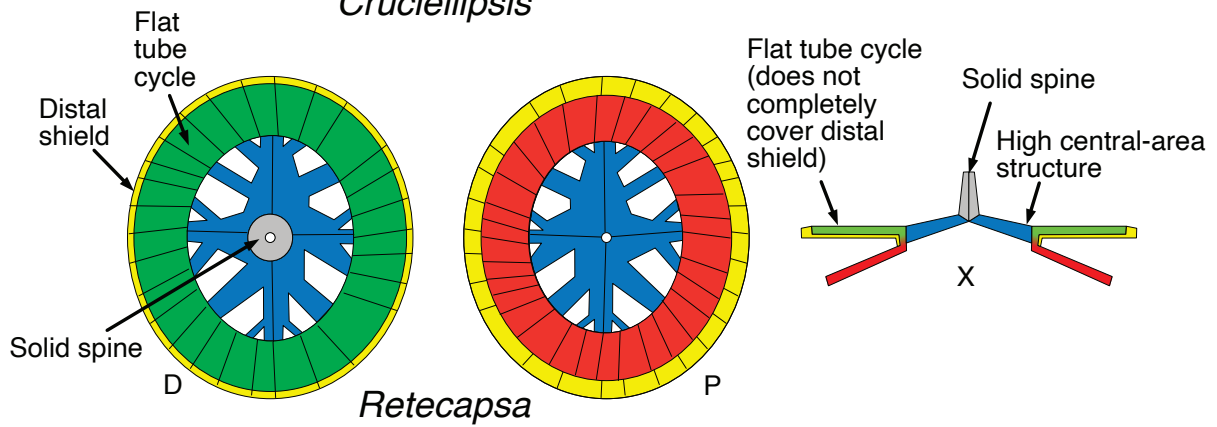
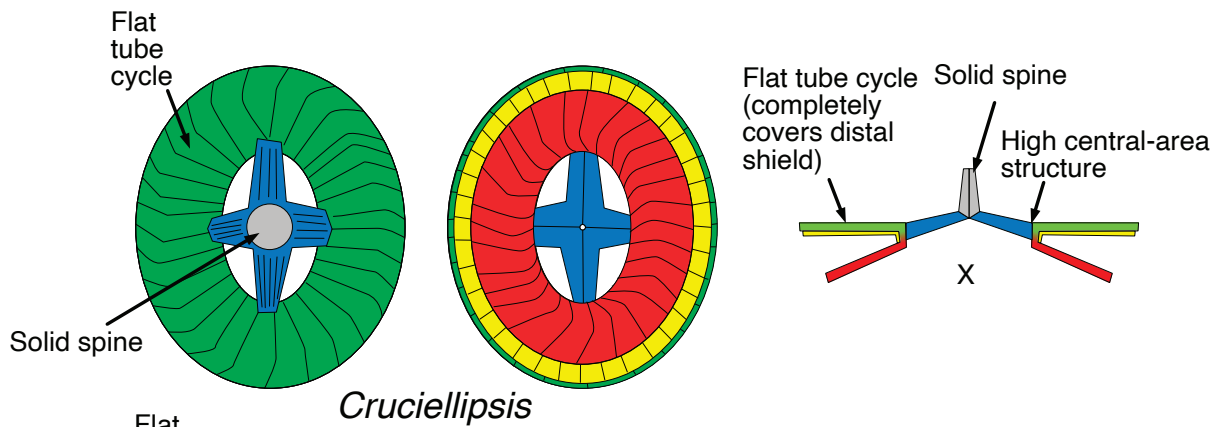
Electron microscope (EM) images of typical Axopodorhabdaceae species show a steeply inclined petaloid (i.e., non-imbricate) tube cycle lining the central area. Because the tube-cycle elements are steeply inclined and non-imbricate, they are generally bright in cross-polarized light (XPL) with a characteristic “beaded” appearance. The central-area structure grows inwards and upwards from the base of the tube cycle. Where a spine is present, it is always hollow with a distinct central cavity present the entire length of the spine. Because the central-area structure grows from the base of the tube cycle, it is referred to here as “low”.

In EM images, typical Cretarhabdaceae species appear to have three shields, which has led to much confusion on their taxonomic position. However, what appears to be a distal third shield is actually the tube cycle. Unlike in the Axopodorhabdaceae, this tube cycle grows (sub)horizontally, fully or partly covering the top of the V-unit distal shield. Although it is composed of petaloid R-units, because the tube cycle is flat lying, its vertical thickness is low, resulting in relatively low birefringence in XPL. Because the tube cycle may fully (e.g., *Cruciellipsis*) or partly (e.g., *Cretarhabdus*) cover the distal shield, some species have an apparently unicyclic or bicyclic appearance under XPL. Where a spine is present, it is always solid, unlike the hollow spines of the Axopodorhabdaceae. The central-area structure is raised because the tube cycle is also raised up to cover the distal shield and is referred to here as “high”.

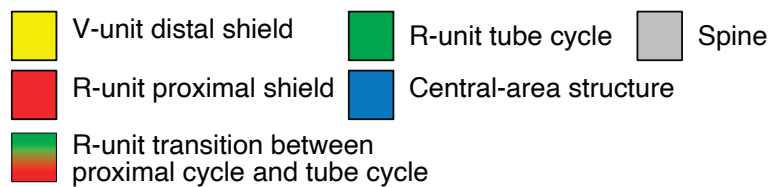
With a clear understanding of the ultrastructure of the two families, it is possible to show that several species have been incorrectly assigned to either the Axopodorhabdaceae or the Cretarhabdaceae. It is essential to properly characterize the tube cycle, the relative height of the central area, and the nature of the spine to correctly assign taxa to either family.



## AXOPODORHABDACEAE



## CRETARHABDACEAE



**Figure 1.** Schematic ultrastructure of the Axopodorhabdaceae and Cretarhabdaceae. D = distal side, P = proximal side, X = cross section.