PALEOECOLOGY OF THE PRECAMBRIAN--CAMBRIAN TRANSITION

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Small, usually non-mineralizing eukaryotic organisms occupy the base of most marine ecosystems and are thus in a position to effect major ecological/evolutionary shifts. Such forms unquestionably played a key role in the development of modern animal ecosystems through the Precambrian--Cambrian transition, if only because the necessary trophic framework could only have been constructed from the 'bottom up'. Small non-mineralizing eukaryotes are exceptionally well preserved in both the pre-Vendian Neoproterozoic and the Lower--Middle Cambrian; combined with the more conventional record of organic-walled acritarchs they provide an unusually continuous (and relatively unbiased) record of life through the Precambrian--Cambrian transition.

Neoproterozoic eukaryotes include a diverse array of unusually large (by Phanerozoic standards) acanthomorphic acritarchs, conventionally interpreted as the dormant cysts of eukaryotic phytoplankton; re-examination, however, indicates that most were actively growing *benthic* organisms. Vegetative growth on or in the sediment is unambiguous in fossils having specific adaptations for attachment (e.g., *Trachyhystrichosphaera*, *Cymatiosphaeroides*), or exhibiting 'benthos-specific' ontogenies (e.g., *Germinosphaera*). More generally, these acritarchs are unlikely to have been planktic simply because of their large size -- passive biological bodies of these dimensions (several hundred to several thousand micrometers diameter) tend to sink rapidly out of the photic zone. In this light the 'giant acanthomorphic acritarch' *Papillomembrana* (ca. 750 μm diameter) might reasonably be rehabilitated as a benthic dasyclad algae; similarly, the macrscoscopic fossils *Chuaria* and *Tawuia*, whatever their affiliations, were most probably bottom-dwellers. Plankton was nevertheless abundant throughout the Proterozoic, represented by the near ubiquitous occurrence of small (5--100 μm diameter), smooth-walled, leiosphaerid acritarchs.

The Paleozoic witnessed a rapid radiation of acanthomorphic acritarchs, essentially paralleling the Cambrian Explosion of marine invertebrates. In this instance their small size and broad distribution clearly identify them as (phyto)plankton and point to important evolutionary changes taking place at the base of metazoan food webs. The striking morphological similarity of some of these to the large Neoproterozoic acanthomorphs suggests a possible 'escape' (from benthic herbivory?) into the plankton. The pervasive appearance of spines and processes in Paleozoic acritarchs is also best explained as an adaptive response to primary consumers; i.e. filter-feeding zooplankton. In the modern oceans it is the zooplankton that link the primary productivity of unicellular phytoplankton to higher trophic levels. The recent discovery of sophisticated filter-feeding micro-crustaceans (and acritarch-bearing fecal pellets) in the Lower and Middle Cambrian Mount Cap Formation, NWT point intriguingly to an ecological motor for the Cambrian Explosion. By harnessing the vast resources of the phytoplankton, herbiverous zooplankton would have provoked major developments in the construction of a Phanerozoic ecological pyramid.