The evolution of dinoflagellates

G.L. Williams - Bedford Institue of Oceanography

Recent work on modern dinoflagellates indicates that these organisms occupy a critical position in the evolution of life, being intermediate between prokaryotes (without nuclei) and eukaryotes (having nuclei). It further shows that the photosynthetic dinoflagellates acquired plastids through a symbiotic relationship with ingested organisms such as diatoms. Two models have been proposed to explain the subsequent development of the cellulosic theca in the Dinophyceae. The first, the plate increase model, is based primarily on observations of living algae, while the second, the plate reduction model, relies mainly on paleontological evidence. However, neither satisfactorily reconcile the biological and paleontological evidence and so we propose the mosaic model as a possible solution. This model suggests that dinoflagellates with two anterior flagella and a wall consisting of two large valves were successful through much of the Paleozoic. A major evolutionary breakthrough occurred in the Triassic with the development of a transverse-longitudinal flagellar arrangement and change in swimming direction. Associated with these modifications was a fragmentation of the valves into numerous polygonal plates. We suggest these changes were related to the initial break-up of the supercontinent Pangaea which was accompanied by changing circulation patterns and an increase in continental shelf area. Subsequent evolution emphasized the influence of the two flagellar furrows over the number and arrangement of thecal plates. This led to decrease in number and stabilization of the thecal plates as seen in living dinoflagellates.