P435-TH

"EARLY" STERANES FROM AMITOCHONDRIATE EUKARYOTES

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Indigenous steranes in 2.7 billion year old rocks (Brocks *et al*., 1999) are interpreted here as being derived from amitochondriate eukaryotes. The discovery of genes of apparent mitochondrial origin in all contemporary eukaryotic species has led to the concept that the absence of the mitochondrial organelle in some species is a secondary trait, a derived condition favored by lowly intestinal parasites but not the original state-of-being of the ancestral eukaryotic cell. The symbiotic acquisition of mitochondria & the biosynthesis of complex sterols – those alkylated at the C-24 position - are both thought to be eukaryotic innovations, evolutionary traits selected for by rising levels of oxygen in the Precambrian biosphere brought about by the radiation of cyanobacterial oxygenic photosynthesis.

However, new genomic (Hedges *et al*., 2004), geologic & geochemical evidence (Kopp *et al*., 2005) challenges that view by placing the origin of cyanobacteria at 2.3 billion years ago. The same evidence also places the origin of mitochondria at 1.8 billion years ago, almost 1 billion years after the appearance of sedimentary steranes. At this point, some aspect of uniformitarianism must yield; either 2.7 billion year old prokaryotes could biosynthesize complex sterols, or 2.7 billion year old eukaryotes could biosynthesize sterols without oxygen.

To explain the existence of these "early" steranes, reference is made to an analogous event that occurred 112 million years ago. While evolving from a hyperthermophilic organism into a non-thermophilic organism, Cretaceous archaebacteria biosynthesized novel membrane constituents whose carbon skeletons now appears in the sedimentary record as biomarkers of that transformation (Kuypers *et al*., 2001). Steranes are the carbon skeletons of sterols, membrane constituents formed thru the fusion of thermophilic archaebacterial & eubacterial genomes in the Precambrian. By renouncing the heat-loving ways of its parents, the chimeric organism escaped from the hydrothermal vent & inherited the Earth, or at least the cool global ocean.

If the sterol-containing chimeric organism from 2.7 billion years ago was a prokaryote, & remained so for another 1 billion years until the origin of mitochondria (Emelyanov, 2003), it is difficult to believe that horizontal gene transfer (HGT) would not have spread sterol biosynthesis far & wide among bacterial populations. A survey of contemporary prokaryotes found no genes indicative of complex sterol biosynthesis (Pearson *et al*., 2003). If the sterol-containing chimera was a eukaryote, it is easy to imagine that 1 billion years of abortive attempts at symbiosis with – or digestion upon – a variety of bacteria would result in the accumulation of HGT derived mitochondrial-like genes (Chihade *et al*., 2000) in an organism that flirted with, but never actually processed a fully integrated & fully functional mitochondrion.

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