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## Phycological perspective on evolution of life and earth environment

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Oxygenic photosynthesis first appeared in cyanobacteria (blue green algae) should have been a key evolutionary event that caused irreversible changes to earth's environment and determined fate of subsequent evolution of life. Evolution and diversification of algae (cyanobacteria and eukaryotic autotrophs excluding land plants) as primary producers resulted in increase of oxygen concentration in the ocean and atmosphere, which may have led to the evolution of eukaryotic organisms and eventually to the evolution of multicellular organisms. As compared with early ecosystem of prokaryotes, scale of primary production should have expanded millions times before the beginning of the Paleozoic era up to the level that can feed multicellular organisms in the ecosystem of Cambrian explosion. Since the Paleozoic, the green plants have been major producers on land. In contrast, primary producers changed to new groups of algae called secondary plants (algae evolved via multiple endosymbioses between heterotrophic eukaryotes and eukaryotic algae). Secondary plants have been playing significant roles in global ecosystem and carbon cycle since the Mesozoic.

Keywords: algae, oxygenic photosynthesis, eukaryotic organisms, endosymbioses, secondary plants, global ecosystem