

## Ancient Tiri Part 2: Adventures in Deep Time.

### The Algae – Mergers, takeovers and daylight robbery from the dawn of the Eukaryote plant era.

Readers may need to refresh their memory about the difference between the *Prokaryotes* and *Eukaryotes* and the meaning of *endosymbiosis* from last months Guidelines.

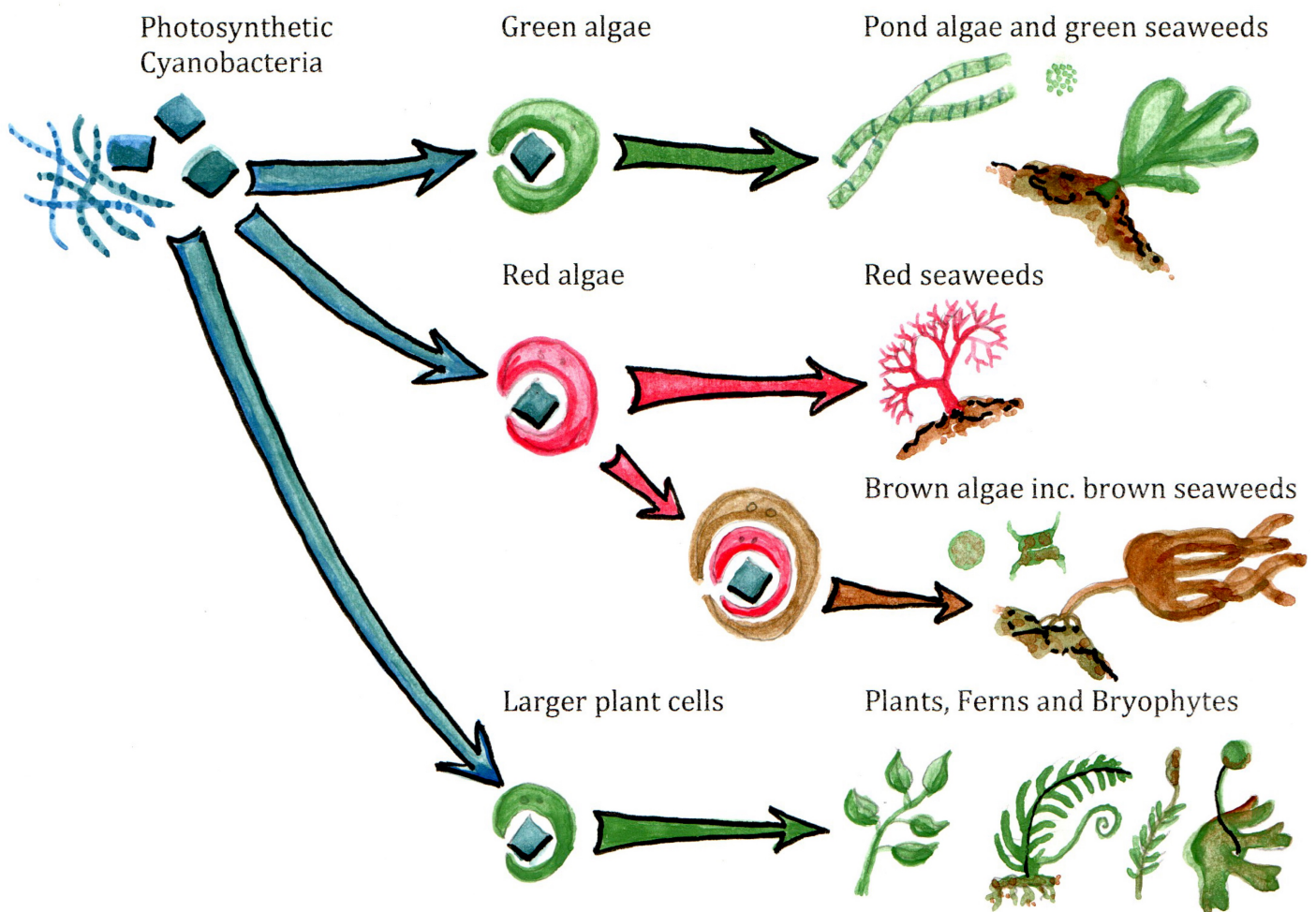
We are leaping forward in “deep” geological time to some 1.7 billion years ago (1.7Ga), when the true algae evolved. This is way before our Tiri graywacke rock was formed 320 million years ago (320Ma) – and even before the Gondwana supercontinent existed - a mere 550Ma.

Unlike the cyanobacteria, *Algae are Eukaryotes* – possessing a nuclear membrane like we do to enclose their DNA within their cells.

Modern algae constitute a *polyphyletic (many origins) group* since they do not share a common immediate algal ancestor, and although their chloroplasts *seem* to have a single origin – having merged endosymbiotically with cyanobacteria, they were acquired in *several different ways* 1.7Ga.

It seems that the *plants* and the *red* and *green algae* have **primary chloroplasts** – directly “stolen” as a result of an endosymbiotic merger with cyanobacteria (see last Guidelines), while *diatoms* and *brown algae* are examples of algae with **secondary chloroplasts** derived from the wholesale “kidnapping” of endosymbiotic *red algae* who themselves had previously obtained their chloroplasts from the cyanobacteria!

### ENDOSYMBIOSIS – DNA evidence suggests mergers and takeovers!



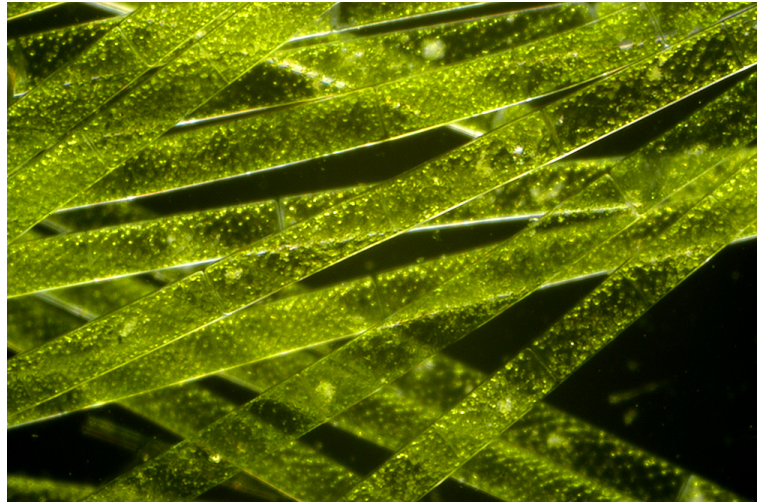
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So what algae are you likely to encounter as you lead a guided walk? The Hobbs Bay track gives you good views of marine brown algae visible at low tide, and the green filamentous algae below were found in a ditch on the Totara track. It is thought that aquatic algae produce the lions share of the oxygen produced on earth today. They are at the bottom of most food chains too, sustaining life in oceans and lakes everywhere on earth.





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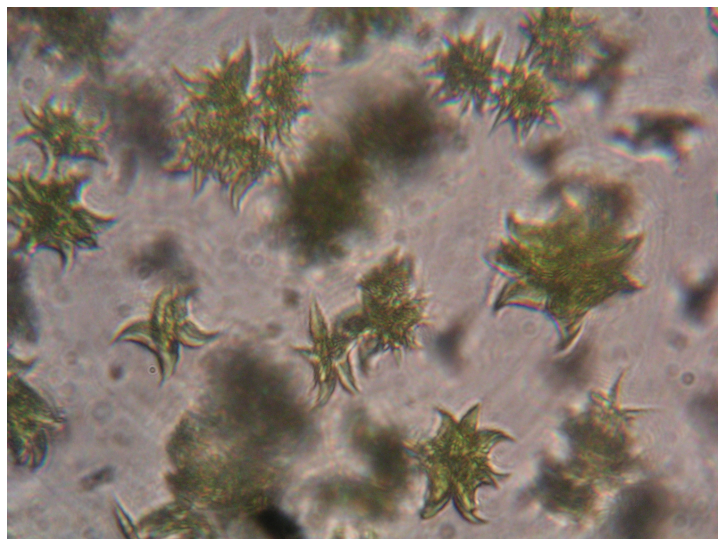


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The wharf dam always looks brown and murky because it is teeming with brown algae called *diatoms* (below). The spiky projections on their cells stop them sinking too quickly. The Pateke love to eat them, filtering them out with with the serrated “pecten” structure at the edges of their beaks.



John Sibley



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Algae lack the various structures that characterize land plants, such as roots stems and leaves. Some of the advanced marine seaweeds do look more plant like though.



John Sibley

Some groups lumped in with the algae - like the *Dinoflagellates* below, have bizarre feeding adaptations. Some are *photosynthetic* (autotrophic), while others are “*mixotrophic*”, getting energy *both* from *photosynthesis* and by *actively hunting* other things, swallowing them whole or piercing them with a hollow “straw” and sucking out the contents. Sometimes “robbed” chloroplasts are incorporated into their bodies as functional food making structures. Inside the huge 1mm diameter marine dinoflagellates pictured left (Bioluminescent *Noctiluca scintillans* caught off Tiri – the source of the green sparkling “phosphorescence” in breaking waves.) you can see tiny stolen chloroplasts alongside other recently eaten items such as fish eggs.

Evidence suggests that the only inhabitants of earth between 3Ga and 650Ma were single celled aquatic organisms such as the bacteria and algae. Multicellular plants and animals as we know them had not yet appeared. They would have to wait until after the catastrophic freezing of “Snowball Earth” 650Ma, followed by the Cambrian Explosion 540Ma. But that’s another story for the next issue of Guidelines!