Ancient Tiri Part 3: Adventures in “Deep Time”.

The appearance of Multicellular Plants and Animals.

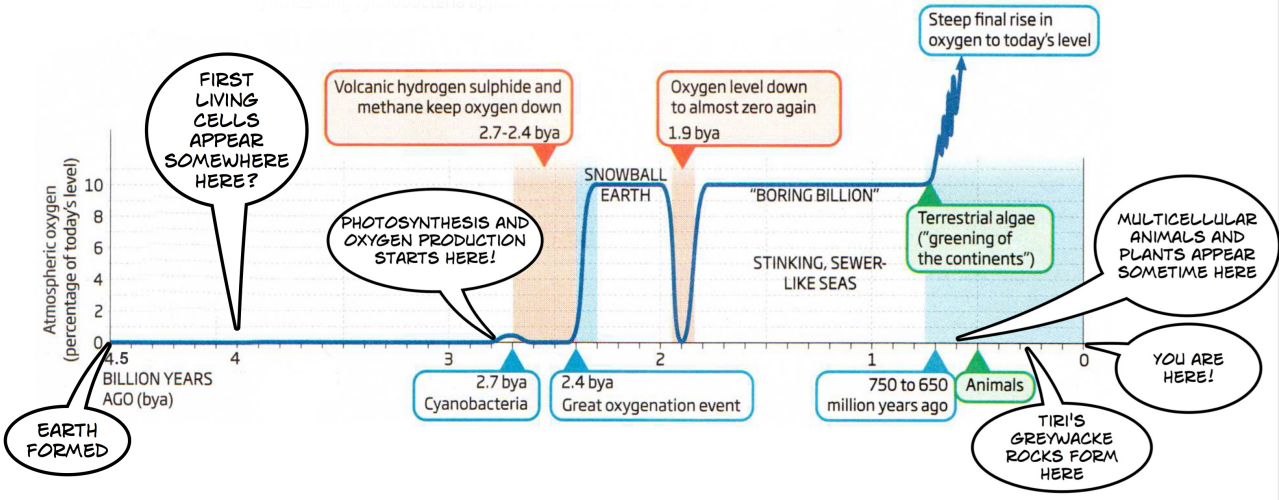
For nearly a quarter of the history of the Earth it is thought that there was no life present at all. We can’t be sure when the first living cells appeared as they don’t fossilise well. However they often produce certain signature chemicals that remain in rocks and the present estimate for the appearance of the first living cells is about 4 billion years ago (4Ga). The first living cells were undoubtedly *chemosynthetic* – obtaining their energy from chemicals like hydrogen, iron or sulphur in the early seas.

Throughout the first 80% of this 4 billion years, the only life on Earth was bacterial forming at most small colonies of cells – no more than a slimy scum on water surface and the rocks of the early seashore. No complex plants and animals existed, and it took a climate disaster to get them kick started.

The first photosynthesising cyanobacterial cells appeared about 2.8Ga, and began producing oxygen. They mopped up the CO_2 and other greenhouse gases in the early atmosphere, and the temperature began to plummet to freezing point as a result.

We can detect this rise in oxygen levels by looking at chromium compounds in sediments formed at the same time. The blue line on the chart below shows the levels of oxygen on Earth over time.

The story of the Earth’s atmosphere and the role oxygen had to play in the rise of multicellular animals and plants



Adapted from New Scientist

So the Earth cooled and became covered in ice from the poles to the equator. This period is sometimes called “Snowball Earth” and it lasted for about 400 million years (4Ma). Later there were other “Snowball Earth” events but they were of much shorter duration.

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Eventually the Earth started to warm again, but it wasn’t plain sailing, and the warming immediately caused oxygen levels to plummet almost back to zero again. It is thought that the seas would have been reduced to smelly oxygen poor “sewers” as much of the single celled life died at this point.

Recovery took about 100Ma and the oxygen levels once again rose to about 10% of what they are today. This freezing and oxygen crisis followed by recovery did one thing that was extraordinary - it triggered the evolution of multicellular organisms about 700Ma and the first true plants and animals appeared at this time.

It is now thought that perhaps multicellular lichens and terrestrial algae were able to boost the meagre oxygen levels generated by the cyanobacteria, and around 750Ma the oxygen

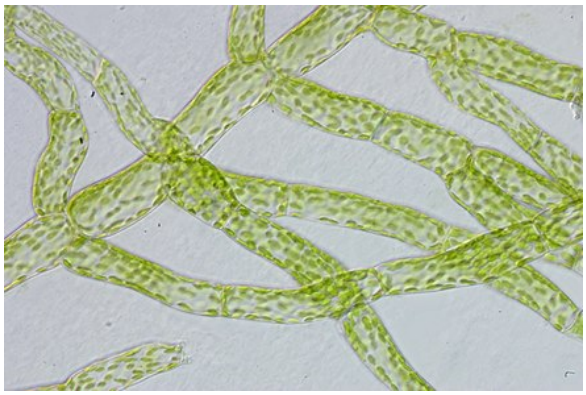
in the air rose rapidly to present day levels. Only now could larger organisms exist, their evolution previously prohibited by the low oxygen/anoxic conditions.

John Sibley

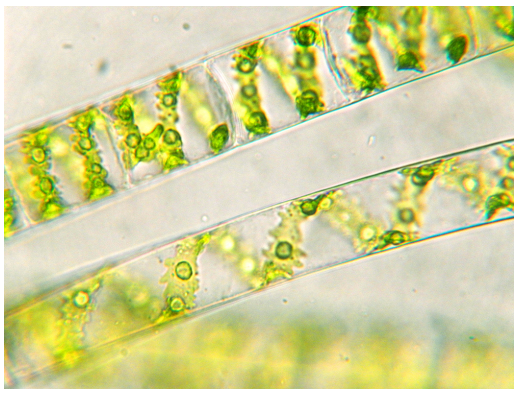
The earliest multicellular animals that appeared are thought to be marine sponges and “comb jellies” (more on these later) that we often see today washed up on our beaches. Their soft bodies leave few fossils but they have left trace chemicals called sterols in ancient rocks dating back to 660Ma. Today, living sponges may be seen on the legs of Tiri wharf as purple or yellow blobs at extreme low tide level.

John Sibley

Look out for our Tiritiri Greywacke rocks visible on the beach and as you ascend the tracks. They were only formed about 27Ma, but are shot through with evidence of an oxygen rich atmosphere (causing the rusty orange veins wherever the oxygen rich air reacted with the iron minerals in them during their formation).
The first multicelluar algae were not true plants but they would in time give rise to the first mosses, liverworts and hornworts (together called the Bryophytes). All mosses, and some liverworts begin life as a spore which germinates into an algae-like filamentous structure called a Protonema. You can see the similarity in the photos below.



A Moss protonema
Wikimedia Commons



Filamentous green algae
John Sibley

We will explore the rise of the Bryophytes in the next few issues of Guidelines!
John Sibley 2019