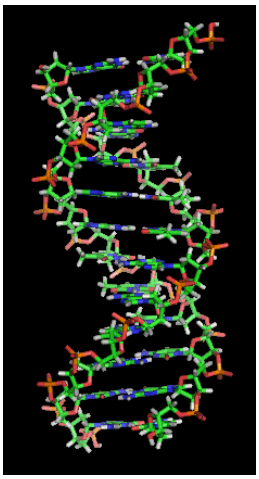
Ancient Tiri Part 4: The Bryophytes – Pioneers of the dry land.

Bryophytes are a multiphyletic group consisting of the Mosses, Liverworts and Hornworts. By "multphyletic" we mean it is rather a "dustbin" group where these three loosely related groups find their home. They do share some common features and may have had a common ancestor about 6-700Ma.

In the first three episodes of Ancient Tiri, we roamed through "Deep time" covering over 80% of the history of life on earth. Now we have arrived at the point 700Ma where multicellular life has appeared in the seas.

The land however was a barren desert of bare rock and sand. Algae and lichens coated the rocks at the waters edge and barely ventured more than a metre or two out of the water where life giving moisture was splashed by the waves – a situation exactly replicated on our modern seashores with marine algae. Look out for the seaweeds on the rocks and the deep orange/red lichens on the beach cobbles at low tide as you walk along the wharf. They are stopped in their tracks by the drying sun, wind and UV radiation at the boundary between the sea and the land.

We don't know when it happened exactly, but between 700Ma and 500Ma the first bryophyte-like plants tentatively colonised the land. It is thought that in the absence of a protective ozone layer, the land was bathed in much harsher levels of UV radiation than it is today. Once oxygen levels were high enough for ozone to form it became possible for land plants to live there. Today, this remains a problem for some of the delicate algae living in parnership with fungi as lichens, and as a result protective sunscreen chemicals are made to shield the algae giving the lichens a bright yellow (epecially *Xanthoria sp.)*, orange or reflective white colour. Look out for them on the exposed Greywacke rocks around the steep road off the wharf.



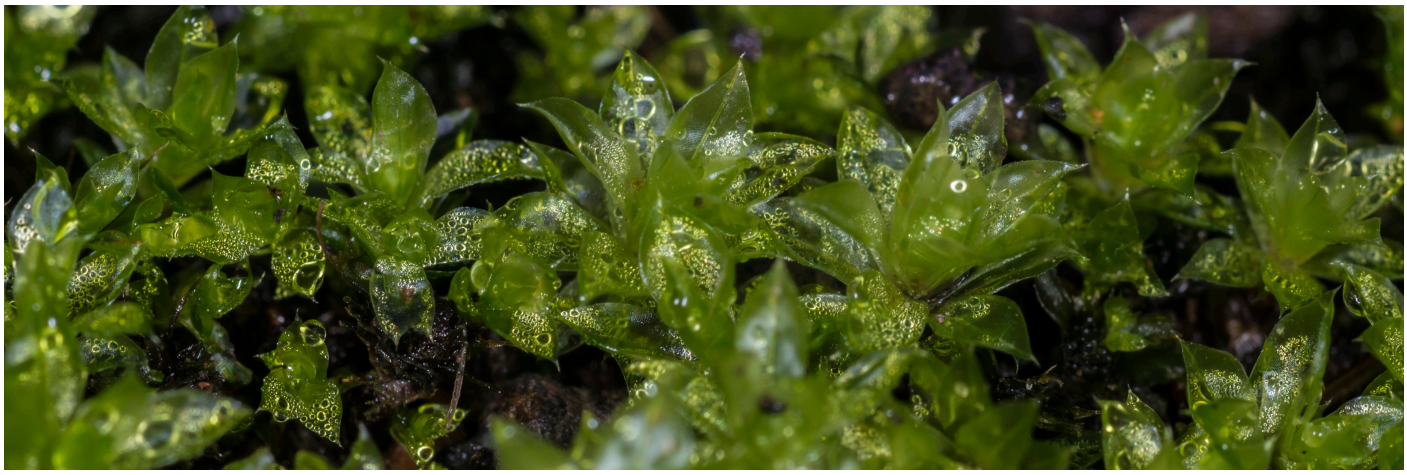
Comparative DNA studies suggest that the Liverworts evolved first, followed 20-40Ma later by the Hornworts and the Mosses. A visitor you are guiding might ask how they know this. DNA is a long molecule inside every living cell made of 4 different "bases" that form a unique "barcode" for every living species. It forms the blueprint for the manufacture of tens of thousands of proteins and other components that make up these living things. We can look at these "barcodes" and work out how closely related different organisms are to each other, and which ones evolved first. 20 years ago this was a slow manual process, but now it is automated, speeding the process up enormously. Classification *then* was based on physical appearance, anatomy and chemistry. Now, comparative DNA technology is rewriting the classification text books. It can even give approximate dates for the divergence of two different species from a common ancestor using mutations (random changes in DNA) which accumulate in an organisms genome at a steady rate. (A bit like radiometric dating which assumes the steady decay rate of certain radioactive atoms in a sample).

Features of the Mosses:

They are to this day a paradox – with bodies ill-equipped in some ways to live on dry land, yet stoic survivors in periods of drought due to the posession of resistant spores. As a result they are often confined to damp, sheltered and shady environments.

To reduce water loss further they are often small (less than 20-30mm tall) in order to benefit from the humid "boundary layer" near the soil surface.

They have no vascular tissue (water plumbing tubes) inside their stems and "leaves" which are often only one cell thick. Mosses conduct water up the outsides of their delicate fronds by capillarity (Like water soaking up the outside of a bit of wet string). After a rain shower the whole plant is covered by a film of water.



They produce no flowers and bear no seeds, instead having waterbourne swimming sperm cells and eggs (like animals) for sexual reproduction. Dry spores (instead of seeds) are cloned (genetically identical) dispersal devices designed to invade and occupy as much “real estate” as possible on the offchance that a few spores might strike it lucky and sprout in favourable damp places. They have no true roots to absorb water but instead have anchoring “rhizoids”. In the photo below, these mosses on the Wattle Track are pretty much dead after a hot dry January. Their tough spores will save the day come the winter rains!

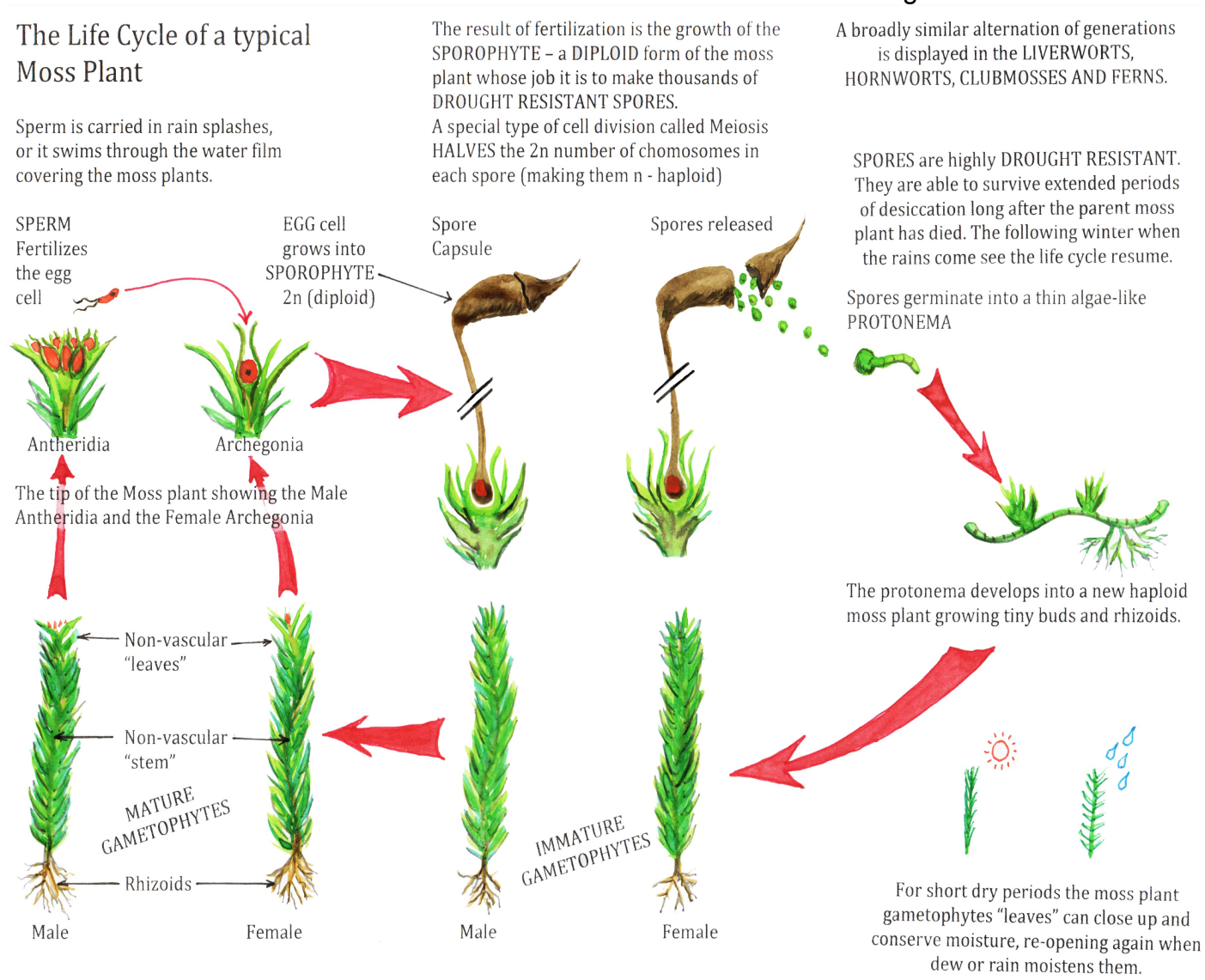
Many mosses can fold their “leaves” inwards against their stem in hot sunshine, opening them out again when a shower dampens them. You can demonstrate this to visitors using a few drops of water from your water bottle. However this is only a temporary measure, and at dry times of the year the plants themselves may perish leaving their hardy spores behind to perpetuate the species when the damp weather returns.

The Bryophytes are really two plants in one. They exist mainly as a Gametophyte (Literally “sperm/egg plant”) which we call the dominant generation. As a result of fertilisation, a Sporophyte (Literally a “Spore bearing plant”) is produced which lives parasitically on top of the Gametophyte. It often looks like a lollipop or a long hair & capsule coming out of the top of the plant.

The picture below is of the top of a male moss gametophyte showing the sperm producing antheridia plus plenty of water to swim in after a rain shower!

These are the spore capsules formed after fertilisation. They are part of the moss sporophyte growing out of the top of the gametophyte plant. Thousands of spores are released when the capsule ripens. Tiny teeth sensitive to humidity open and close the end of the capsule and ensure spores are only released in dry breezy weather.
Mosses are great pioneer species. This means they love colonising freshly exposed soil or gravel paths!

On bare rocks they release acids which break the rocks down and they collect dead organic humus around themselves, which together with the rock particles form soil.
This diagram below shows the “double life” of the Mosses. It is termed the “Alternation of Generations”. Liverworts and Hornworts also show a similar alternation of generations.



In the next issue of Guidelines we will look at the Liverworts and Hornworts, and how their structures reveal tell-tale links to their algae ancestors! We will also look at some of Tiri’s animals that were about when the dry land was first colonised by the plants 700 - 500Ma.