

## **15. The conquest of land - plants**

All organisms in the Cambrian period were ocean based and needed water for their survival. Normally 50 to 90 percent of body mass is water, so living in the sea was the optimum solution for life. Water was a very benign environment where living organisms were protected from large temperature variations and ultraviolet radiation.

So why did life, in spite of this ideal environment, moved onto dry land? Land at that time was an alien and hostile environment. It was dry with occasional rain. The soil lacked nutrients and was sterile. Moving onto land was not a natural choice for organisms because it required significant changes to their body structure. Living on land did not provided any striking benefits.

The first problem of living on land was the intermittent water supply. Water on land was delivered by rain which could be unpredictable and infrequent, therefore plants would need water retention facilities and protection against dehydration. All plants that live on land have adapted to dry conditions through the development of a waxy water repellent protective layer to prevent drying out. They needed structures to absorb and transport water throughout their bodies, and rigid internal support to remain erect without the buoyancy available in water.

The first plants on dry land did not have roots and absorbed water through their outer layers and transferred it to adjacent cells by direct contact. These plants were similar to present day mosses and had to live in wet areas. They lacked strong structural tissues, therefore to support themselves in air they used an ingenious system based on the water pressure inside their cells. These cells when pressurized had a very rigid structure. Since the cells were linked together this resulted in a firm and rigid assembly.

However, larger land plants needed a different system to transport fluids within themselves and to provide support for their tall structures. For the transport of fluids they used special micro pipes creating a vascular system. This system consisted of two types of vascular tissues. One tissue transported water and solutes from the roots to the leaves, the other tissues transported sugars and nutrients from the leaves to the rest of the plant. The first type of tissue had a tubular shape which allowed a continuous column of water to flow upwards. This flow took place through capillary action. When water in the leaves evaporated, more water was pulled from

the roots.

The other tissues were composed of living cells that transported sap. Sap is a water based solution rich in sugars and other ingredients made by the photosynthetic areas. The vascular system was a giant step in the development of plants. It provided a dual flow system similar to the way blood flows in animals. All energy processes and transformations took place in the leaves which contained chlorophyll enabling the production of sugar.

Rigidity of plants is provided to a large extent by the cell wall which is composed of cellulose, a complex carbohydrate and lignin, a phenolic compound. Put together these features allowed plants to grow much larger and considerably reduced their dependence on moist habitats.

The plants reproductive system had to be adapted to function on land. Plants during their reproductive cycle produce eggs and sperm. When water is present, sperm swim and fertilize the eggs. Therefore plants living on dry land had to have such a construction so as to guarantee the presence of water needed for fertilization.

To summarize, plants had to be protected against drying out in the air, able to absorb nutrients from the soil, grow upright without the support of water, and reproduce on land. Each of these systems required substantial changes in the body design and functions of plants. These new features had to be operational from the beginning. When we consider all these impediments it is amazing how big the leap was for plants in moving from water to land.