SILTings by Dr Anna Freeman

At the bottom of every estuary lies a kaleidoscope of particles. We often call them – mud. Examining this mud under the microscope reveals a complex and fascinating picture.

Some particles are microscopic crystals born when wind and water fractured tiny parts of rock, moved them along the channel and built-up a sediment.

Other particles are the remains of microscopic organisms that lived on the Earth millions of years ago in oceans and seas. Today, their remains are reminders of our planet's dramatic tectonic and climate experience.

The most fascinating particles, however, are still alive and are waiting for the right moment to reproduce, putting their life cycle into the spiral of a rivers' continuum.

Diatoms

Diatoms are hidden gems of the natural world. They begin their life in silt or on the surface of submerged rocks and water plants. When early spring light touches the water's surface they start to develop into reproducing cells. Diatoms appeared on Earth over 150 million years. Their bodies are encapsulated inside grafted nano-glass shells (Silicon Oxide). A living ancient greenhouse with mesmerising form. Diatoms inhabited our world before the first flowering plants sprouted their roots in the ground. Like plants, they convert the energy from light and carbon dioxide into food, storing their supplies in the form of sugars and lipids, which play a crucial role in the nourishing of fish, molluscs, and microscopic animals that feed upon them. They also contain carotenoids which help to protect cells from harmful UV light and give diatoms a golden-brown tint. Diatoms around the world are responsible for producing a large part of the oxygen that we breathe in today.

To reproduce, a single cell divides in half creating two daughter cells of the same shape, but always different in size. Eventually, cells divide so many times that they become too small, and switch to sexual reproduction. Certain diatoms produce specialised cells known as auxospores, which later grow to become a full-sized cell.

Centric diatoms are suspended in water, whilst elongated cells attach to the rocks and plants and form a slimy coating which scientists call biofilm. After a few weeks in a river, the number of individuals in one drop of water can reach thousands, giving the river a brown hue.

When living conditions become hard, diatoms switch to sexual reproduction, release a sticky sugary coating, glue to each other, and settle to the bottom of the river. To the human eye, descending diatom flakes resemble snowfall, so scientists called this 'marine snow'.

Coccolithophores

Diatoms feed on nutrients dissolved in water. In the Thames estuary, they have numerous competitors some of whom arrive from the marine world. Coccolithophores are spherical microbodies enclosed by chalky plates called coccoliths. Like plants and diatoms, Coccolithophores carry chloroplasts and produce food using the sun's energy, water, carbon dioxide, and dissolved nitrogen, phosphorus, and other minerals. When nutrients are abundant, coccolithophore numbers increase rapidly through the division of each cell into two daughter cells. Soon after consuming most of the available food, they switch to sexual reproduction and invest more heavily in fewer offspring allowing successful competition for limited resources. This means Coccolithophores can form massive blooms which are visible even from outer space. These blooms contribute to carbon storage, by absorbing carbon from water, eventually resulting in chalky sediments.

Coccolithophores first appeared on the planet 55 million years ago. They learned to build their external skeleton from a crystal of calcite. Scientists are still solving the puzzles of just how these crystals grow into perfect shapes because under the skeleton hides a very fragile single-cell body. Millions of years ago, when Britain was under sea, billions of coccolithophores bloomed and sank to the ocean floor, forming a dense layer of chalk. Today these micro-fossils manifest a colossal work of the natural world. The intricate imagination of evolution is embedded in the white cliffs of Britain. Coccolithophores are here to stay.