The Tide and the Algae

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for Herre Stegenga

The Tide

The sun rises above the cliffs behind Roundstone, here on the south coast of Connemara in the pagan west of Ireland. The calm of low water has gone, the tide is rising fast, the mythical ocean rollers pound dully on the walls of rock and slip hissing out across the long low stone surfaces. The waves splash and growl in ravines and clefts. Tidal pools are submerged, the algae and sea anemones are rinsed clean. Everything breathes freshness. The atmosphere is infused with a salty mist. Science and the church may teach us that the ocean is not a living being, but we have the strong impression that something else is happening than passive bobbing, up and down, back and forth, wind force plus water plus resistance. Thought is in progress. Thoughts are being formed.

Can the sea think? Not if you believe this requires brain cells and human language. It can if you realise that thinking is the same thing as making. The chattering basket-weaver in the Saturday market in Clifden lets the reed stalks slip rhythmically through her fingers and weaves wordlessly complex mathematical patterns into a broad hollow shape. She realises at once if she makes a mistake. She thinks with her hands, with the rhythm of her fingers and elbows. That's how the sea thinks too, the waves are her hands. Imagine that the ocean is a living being, or if that sounds pompous, imagine that she thinks, what are her thoughts?

The greater part of her body, the deep masses of water of the five oceans and the seven seas, is more or less fixed. All that salt water moves only a little up and down in its upper regions in the surge of the tidal flow or if a storm flushes everything out. Sea currents can be

recognised from the fact that the rest of the water remains static. Only round the edges of the great currents does the top level of sea water slowly circle. The body of the ocean is a firm, transparent mass and not a length of quivering flesh with tough nerves. It is a supportive medium, a space in which sounds carry far beyond the horizon.

The body-without-organs of the ocean is activated at its periphery when the mass of water is pushed against the coasts by the tidal flow and can go no further, but flows back and the sea realises that there is a limit to what is fluid. Her body has not only depth and a flat surface, but a whimsical edge, a boundary beyond which a very different view of solidity applies.

An unstable underlayer is fatal for all local life. Pebbles and gravel grind the algae and baby crabs that have managed to establish themselves there in peaceful moments. Grains of sand grind every living body, every cell to nothing. Beach sand is sterile. Only the hard basis of a rocky coast, with its many sloping nooks and protected hollows, gives living plants the chance of establishing themselves permanently. And why precisely them and precisely there? Because they belong there. Because the tidal flow and the rocks create precisely the conditions under which they were able to emerge and to have lived undisturbed for one and a half billion years.

The moon governs the water on earth. When the primal ocean rained down on the newly created planet, the moon hung over the spinning Earth and dragged the mass of water behind it into what was now a hundred-metre-high tidal wave that surged around the globe eight times in twenty-four hours. Now, after four and a half billion years of braking by the earth and drifting away by the moon, the tidal wave is only six metres high and washes twice round the world every twenty-four hours. The movement of the tides is a cosmic phenomenon and has a cosmic regularity: 12 hours and 25 minutes per wave. Whatever planetary catastrophes have taken place, always and continuously there has still been somewhere on earth around the continents or islands a tidal strip, with its inhabitants, the algae.

The tide is full of rhythms: from the constant subsonic boom of the deep ocean and the lighter rhythm of the tidal flow to a whole succession of faster, local rhythms of waves that flow back from the surf or strike a tongue of land and hobble diagonally through the straight

pattern of waves of the open bay. Or the many rhythms that fall winds chase across the surface of the water. The rhythms of the wind are much rougher and more arbitrary than those of the sea. No wind succeeds in remaining constant for any length of time, except perhaps for the tropical trade winds. The wind modulates the constant, thrusting water of the surf, from low tide to an hour's high tide and back to an hour's resting low water.

The rhythms floating past merge together, expand, dance on or clash and splash, till new rhythms emerge from the interference which reinforce or extinguish the existing ones. The rhythms vibrate through the water and give it structure. Rhythm makes form. Precisely in those water forms there is room for the algae which establish themselves everywhere again and again, wherever a tidal strip emerges on a rocky coast. The body of an alga produces exactly the right counterforces to the forces that direct the water in the tidal zone. Algae retain their outward form through the counter-pressure that they develop in their cells, but the silhouette and structure of the alga as a whole are not directed from those cells, but come from outside, from the rhythms of the environment. Plant and environment form a single trembling whole.

The tidal zone is the meeting ground of the liquid and the solid element, the unmoving earth. Two opposing principles clash and their friction produces life: many small, concrete things. The fluidity of the water joins with the hardness of the rock and the result are living bodies, tough and flexible. The algae are the thoughts of the tide. They are what the basket weaver weaves.

Porphyra umbilicalis

The Algae

About a billion and a half years ago, in the barren tidal strip around the totally dead, mountainous super-continent of Columbia, an ancient bacteria, archaea and a cyanobacteria succeeded in forming a symbiosis. Three completely different single cell organisms combine to form one multicellular plant, an alga. The bacteria are the engineers of life on earth. They devised the cell as the technical form of life, with a complete chemical structure for DNA, respiration, digestion, cell division, photosynthesis and active evolution in a direction chosen by themselves.

The tiny bacteria also work on a megascale. They established the neutral, stable, nitrogen-rich atmosphere around the planet. After the necessary obstacles the cyanobacteria succeeded in filling the top three metres of the primal ocean with the oxygen that was necessary for green plants to emerge.

The first green plants are red. They are thin threads with no branches. They stand close together on the bare rocks and form a dark-red narrow strip of lawn, just below low water level, tossed about by the waves. A flexible cylinder is of course the obvious design in water that is rolling rhythmically to and fro.

The design principle is so powerful that the same lawns are still to be found on all the coasts in the world. If it works don't fix it - that is design rule one of evolution. Which raises the question of why there is evolution in the first place. Where does the urge for better come from? It is the local rhythms round the tidal flow that drive formal development. Ordered variation produces ordered variation, and that proceeds step by step. Once you have a thread, all plant forms are possible.

The rapidly evolving red algae are able to weave their strong threads into three-dimensional plans. Hollow tubes, dividing branches, sturdy leaves, floating bushes with an adhesive root, calcareous seaweed, all in a strip of a few metres below low water level and in tidal pools. The flat leaf shape of the purple *Porphyra* is a two-dimensional response to the three-dimensional bobbing of the water, sweeping upward and falling backwards, like an evening dress.

The red algae focus their evolution entirely on their own pleasure. In their life cycle they pass through three different bodily shapes, two of which are a-sexual and third of which has two genders. They reproduce by spraying their spoors and fertilised egg-cells in the sea water, whether or not equipped with a tail. Red algae can be found everywhere on the coasts on the same spot in the tidal zone on a hard substratum from which they once emerged.

Because the red algae were the first group of sexual beings, and hence capable of much and rapid genetic variation, they were able to throw themselves to the full into the Darwinian rat-race and fill every corner of the tidal strip a hundred meters deep with more of themselves, making life impossible for all later competitors and founding once and for all the Kingdom of the *Rhodophytae*.

But no, red algae retain their lifestyle in the tide and for the last billion and a half years they have been dancing a rococo choreography whose elegance drives one to distraction, like the demoiselles de Camargo of the tidal garden. A life devoted to the study of red weeds is a life well spent for anyone who wants to be astonished and amused.

When the red algae continent of Columbia breaks up and floats apart in a number of separate floes much more coast and hence place for new life is created. Now the green weeds raise their heads, again in thread, tube, leaf and crust form. Different pigments, but the same position in the tidal strip, the same typology.

Green algae are tougher in construction. They do not build their bodies from separate threads but from layers of massive cells. They are also immensely strong: a strip of sea lettuce at the foot of the sea dyke or a trail of gutweed tubes growing a few metres from the cliff wall and in that way calm the surf a little better than the red algae on their own.

After some to-ing and fro-ing for a billion years a new supercontinent, Rodinia, emerges and around its coast the brown algae appear as the last in the series. They bring a fifth structural plan to the tidal strip. Above the low water-line they establish a zone of brown-yellow, slimy, tough flat tree-trunks often equipped with bubbles. These Fucusses can lie in the sun for hours twice a day at low water, a gain of living territory of several metres.

Another group of brown algae, the Laminarias, establish themselves on the rocks below the tidal turbulence, in the deeper water. Starting from a firm, branching and securing base, they send up a long slim, massive stem, which just below the surface unfolds into a broad crown of one large leaf or a series of narrow leaves. The brown algae combine the four principles of crust, thread, tube and leaf of their predecessors into a new idea, that of the tree and hence that of the forest, kelp forests in calm, clear sea water.

The coastal algae build their ecosystems out of four layers. A crust of blue, red or green algae covers the bare stone. An enclosed lawn of thread-shaped red or green algae is laid on top. From the lawn arise protected clumps of leaf plants and bushes, red, green and brown algae. And above all this float the wide leaves of the tree-shaped Laminarias that make the whole into a shady, protective sea forest.

With these four layers of tough plants, which all in their own way react to the movement of the water, the ecosystem of the tidal zone moderates to a maximum extent the power of the swell and the pounding waves. It creates peace where unrest prevailed and in that way creates the stages for the smaller epiphytic weeds and especially for the animals. For a billion years the algae were just the only green plants on earth), there were not yet any animals. Nothing nibbled at or bored into them. They did not need to protect themselves against animals, which explains why they embody in such a pure form the rhythms of the sea alone.

When the evolution of animals explodes half a billion years ago, the first filter-feeders like sponges and sea anemones appear among the algae, together with arthropodal creatures that come to graze and hunt, molluscs and sea urchins. Large fish in the kelp forest. Of course they also look for the light of the tidal strip, where there is most oxygen and the water pressure is at its lowest. But what binds the creatures to the coast are the algae, their providers of food and protection, their natural environment. The algae make animal life possible with their stalks and leaves. If the algae are the thoughts of the tide, the coastal creatures are the thoughts of the algae.

With their four zones of algae and animals the rhythms in the tidal strip build a garden that is completely perfect, that cannot be improved upon, it simply needs to grow by itself where

a new habitat emerges, to grow to its fullest extent and go on and on, like the tidal flow itself.

From a billion years ago on, after the emergence of the brown algae, the evolution of the algae is complete: no new group is added to them, or dies out, everything goes on as before in the face of geological disasters and mass-extinctions. They were adequate and were never improved upon, as there was no need: the tidal flow in which they live comes by as regularly as the sun and moon day after day. Their environment did not change, so neither did they, or scarcely at all. The algae embody the principle of continuity, not wanting to do things better but continuing with what is good enough.

At every stage of their evolution plants develop a new sense in order to better understand the world they inhabit. The pigments of the algae - besides red, green and brown there are four additional tints among the monocellular algae, a construction type in itself -, the seven pigments of the algae are seven different filters for observing sunlight in seawater.

Each of them demonstrates an aspect of the ocean’s body that remains invisible for the other pigments. They complement each other to form a total awareness. And after millions of years of reflection the algae understand simply: above the level of the tide there is still a world in which one can live.

And go ashore. At least one group of green algae does. They form an alliance with the thread-shaped moulds that crawled out of the water previously and feed themselves by sucking molecules from the bare rocks. Together they form the lichens and undertake the adventure of life above sea-level. All the other green, red, and brown algae remained behind in the tidal strips along the coast and never again stopped their swaying dancing, down to the present day. The ocean comprehends, the tide can think, the algae can tell their whole story.

Colophon

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