

Trumpeter (1993)  
ISSN: 0832-6193  
The Planet Changer

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Trumpeter

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Half a billion years after it was born, the planet Earth was rugged and turbulent. There was no life on the planet, not one structure built by the artistry of cells. All the structures were crude and massive, reflecting the crude and massive forces that shaped them. There were millions of volcanoes, giant pores where the planet's inner heat poured through the surface and built mountains on the land and islands in the sea. There were ridges and mountain ranges where the crust had squeezed itself, and valleys where the crust had pulled itself apart. There were channels and valleys and canyons carved out by rushing water. There were mounds built of minerals sprayed from geysers. There were craters gouged out by meteorites. There were glaciers built by ages of rain and snow. There were oceans kept turbulent by a moon that was much closer to Earth, and there were beaches and cliffs formed by the massive tides. There was rock, lava, ice, sand, smoke, and moving water. There was ruggedness.

Yet amid this ruggedness something very different was beginning. A new kind of force was being born. This force would be just as powerful as volcanoes and tides, but it would be far gentler and more skilled, and this skill would transform the planet. For now the only visible sign of this force was some color in the oceans, the color of a certain kind of molecule. For ages these molecules had been swept back and forth by the tides. They had been stirred by heat venting from the ocean floor. They had been carried for thousands of miles in ocean currents. They had been tossed onto the shore and been baked by the sun. They had been absorbed into clouds and rained back to the ground. They had flowed down rivers to the sea. They had settled to the bottom of placid lagoons, they had sunk into dark canyons in the sea, and they had floated near the surface and been sapped by ultraviolet light. Through ages of being mixed and pressed together and energized, the molecules became more and more complex. The molecules began linking up to form larger structures. Most of these structures were unstable and quickly broke apart, and most of the structures that were stable were inert; they were tiny wads that couldn't do anything but sit there. But now and then the molecules formed structures that could do things. At first these structures and activities were simple, such as a molecule that could strike others and bind them together or break them apart, a molecule that could assemble a few other molecules into a copy of itself, or a sphere that could maintain an electrical tension across its membrane. These activities slowly brought about new kinds of structures, which could engage in more sophisticated kinds of activities and build structures still more sophisticated. For ages this process had gone on, and now a great breakthrough occurred. Somewhere in the sea was a cell with a lot of molecules inside, and these molecules had just the right form to carry out some complicated and delicate tasks in just the right way. They tapped out energy and used it to construct more molecules like themselves; they maintained an orderly arrangement and flow of energy as the cell expanded; they aligned themselves into two equal groups; and then the cell

split in half and became two cells. On a planet of crude forms made by crude forces, a very sophisticated force was loose, and over the ages to come it would spread across the rugged world and give it shape.

Into the night sunlight begins to seep from across the horizon, and plants and animals begin to awake. From the ocean a breeze moves across the land and stirs millions of leaves, stirs them from the outside even as they are stirring from within. In every leaf, in the huge leaves of palm trees and in the tiny leaves of wild flowers, in the dense, tangled leaves of a swamp and in the solitary blades of grass poking out of the beach, cells are preparing for a day of absorbing sunlight, gas, water, and minerals, mixing them together, and using them to renew and expand the leaves. As the sun rises, insects of every color and shape rise and begin crawling about and climbing up and down plants to eat leaves and fruit; other insects rub the dew off their wings and fly. Squirrels and other small mammals come down from trees or come up out of the ground and poke through the grass. Birds reply to the dawn in song. An eagle soars into the sky. On the marshes ducks and geese cruise, and occasionally they rise and wheel and settle elsewhere. Along the ocean shore sandpipers rush up and down with the waves. Pelicans and seagulls skim over the waters. Beneath the water fish wander about, and plants wave back and forth. Turtles and crabs and frogs emerge from the water or disappear into it. In the marshes alligators yawn and start paddling about or climb onto shore to bask in the sun. A white heron stands tall and motionless at the edge of the water, then unfurls her long white wings and lifts herself into the sky.

In the distance beyond the marshes, another white structure stands ready to lift itself into the sky, but this structure is far taller than a heron, far taller and far more massive than any tree. In many ways this structure is quite different from the living structures around it. It has no limbs, but is a giant cylinder that tapers into a cone at the top. It is made not of cells, but of metal. Its form is supported not by bones or wood, but by steel beams. Instead of organs made of tender flesh it contains huge, sturdy chambers. Instead of blood vessels or phloem it contains pipes and plastic tubes. Instead of nerve cells it contains wires. It has no leaves for getting energy from the sun and no mouth for getting energy from plants or animals, but contains massive amounts of energy in liquid form. It has no face, no eyes or nose or ears for sensing the environment, yet it can guide itself with great precision. And though it has no wings it can fly much higher and much farther than any insect or bird. As the sun rises and plants and animals stir and rise, the rocket too is slowly stirring to life, and soon it will be on its way to the moon.

Yet if the rocket is different from the plants and animals around it, these differences are quite superficial compared to what they have in common. The rocket clearly was made by the same force that formed the plants and animals. The rocket's precision of form, its perfect geometrical lines, its maze of chambers, its network of tubes for carrying liquids, its intricate system for carrying electrical

impulses, its ability to release energy and channel it in a highly controlled way, its ability to guide itself—this whole systems of millions of parts all contributing to the function of the whole, this metal organism could only be the work of life. No other force on the planet could shape matter so finely, not volcanoes, not rivers, not wind, not rain, not tides, not glaciers, not moving continents, not sedimentation; nothing could come remotely close. Of all the forces at work in the entire universe, only one force possessed this craftsmanship. The universe was full of ruggedness and turbulence, but on Earth this force emerged and set to work sculpting the planet, turning the ruggedness into sophisticated systems of wood and flesh and metal.

Four billion years after life began, the planet Earth is covered with millions of kinds of intricate shapes. At first life could build only molecules and simple cells, but it gradually became more skillful. It learned how to combine single cells into larger structures, how to reproduce complicated forms, and how to support larger and larger forms. It developed ways of moving about in the water, on land, and in the air. It developed ways of grasping and handling things. The empty seabed was covered with plants. The blindly flowing waters were joined by fish flowing with will. The rugged land turned into meadows and forests and jungles. A sky that held only wind and rain was filled with wings and voices. Then, after eons of developing its skills, life suddenly acquired enormous new skills. In one particular species life developed a brain that was especially good at figuring things out, and hands especially good at manipulating things. Through this species life began shaping the planet in wholly new ways. The force that once could build only simple cells is now building Saturn V rockets. The force that once could release and focus only the tiny amount of energy locked in a few molecules can now control enough energy to lift millions of pounds into the sky. Four billion years of giving shape to the planet Earth has enabled life to shape a rocket to carry it to another world.

As the day went on, the plants and animals of the marshes, the beaches, the woods, and the sea went about their lives, just as their species had been doing along these shores for millions of years. And amid these ancient ways of life, life did something very new. Smoke began pouring from beneath the rocket, then flame, fierce and brilliant. The flame beat against the ground; the smoke billowed into the sky; the rocket rose. With more force than the hurricanes that often swept across this shore, the rocket slowly pushed itself off the ground. It slowly picked up speed and rose higher and higher, fire and smoke streaming beneath it. And as it rose, the ground shook and the air roared with a thunder no storm could match. As the rocket carried life away from the planet Earth, the life beneath it registered this bold event. Trees and grass vibrated, animals ran for shelter, hundreds of birds rose from the marshes and wheeled and scattered, and hundreds of thousands of humans were ecstatic.

The moon was grey and rugged. The moon's features were crude and massive, reflecting the crude and massive forces that shaped them. There were volcanoes,

giant pores where the moon's inner heat had once poured through the surface and built mountains. There were ridges and mountains where the crust had been squeezed, and valleys where the crust had been pulled apart. There were billions of craters; many craters were miles wide and miles deep, with mountainous rims. There were vast plains where the crust had been shattered and lava had poured out. There were boulders and stones and pebbles formed and hurled about by meteorite impacts. There was dust worn off of rocks by meteorites and the solar wind. For billions of years there had been only ruggedness.

But now, from a sky from which meteorites had fallen and torn holes in the ground, something different appeared. It too fell towards the surface of the moon, but it fell more slowly than a meteorite. While meteorites were rough and battered, this object was made of perfect geometrical forms. While meteorites were dark, this object gleamed in the sunlight. While meteorites were inert, this object poured energy from beneath it. Meteorites fell helplessly in the grip of gravity, but this object controlled itself and maneuvered this way and that. As it neared the ground it fell more slowly, drifting over the boulders and the craters. It hovered above the ground, its rocket stirring the dust, and then it settled onto the moon.

The spacecraft sat motionless for awhile, and then a door opened and a human emerged. He climbed down a ladder on one of the legs of the craft, and stepped onto the footpad at its base. He reached out his foot and set it onto the thick grey dust of the moon, and when he lifted the foot away there remained an impression like none that had ever been made on the moon before, an impression shaped something like a cell.

Four billion years ago Earth had been as rugged as the moon, but a new force appeared and gave the planet shape. Now this force had transported itself across space to another world and begun giving shape to it. On Earth life's first work was a cell, and from this cell everything else had developed. On the moon life's first work was a footprint, and this footprint might begin a transformation as large as that which happened on Earth.

Another astronaut emerged from the spacecraft, and as the two humans walked back and forth they printed shapes into the formless dust. With tools the astronauts dug small trenches and drilled into the ground. They lifted rocks and put them in bags and carried them back to the spacecraft. They touched the moon and rearranged it with more skill than any force that had ever worked on it before. They gave the moon shapes more precise than any it had known. Yet these skills and these shapes were very crude compared to what life was capable of doing. Right now life made only footprints on the moon, but in the future life might shape the moon into machinery and spacecraft and dwellings, and into structures in which the formless dust would be given water and seed and turned into plants, into the intricate structures of cells, roots, leaves, flowers, and seeds. And through these plants the dust of the moon would be turned into humans and become aware.

Beginning with a single cell life had transformed a world, and now it had spread to another world to transform it. Beyond the moon there were other worlds just as rugged, and life would spread there also and set to work crafting them. Life would spread throughout the solar system, and even when the outermost stone has been touched and changed by life, life still may only be beginning its great work. For beyond the solar system is a galaxy full of rugged worlds, and perhaps they too will one day be touched and transformed by the force that began very quietly on Earth.

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**Citation Format**

Lago, Don (1993) *The Planet Changer Trumpeter*: 10, 3.  
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