February 21, 1915

Almost half a century ago my beginning biology class lecture was taught by a new professor from Tennessee. Science had been neglected in favor of the engineering department. But there were some new hires trying to change things. The biology department was small and underfunded, and he was doing everything he could to build it. Amidst the politics of academia, he was piecing together a proper research laboratory, on occasion building his own equipment, and teaching 500 + students in big 101 lecture halls to inspire and usher freshman and sophomore students to the life science fields. To this day, the literacy he gave me provides useful observation tools to uncover underlying realities, the basic vocabulary to understand discussions and logic to test hypothesis. My intention is to use the information gained to think clearly about process and more effectively participate in the world of consequential actions.

Starting as he did those many years ago: "if your religious beliefs puts you against evolution, your personal convictions are admirable and I wouldn't coerce your attention." Please skip over this section. Pick it up later: but don't exclude yourselves. For the sake of our common good be part of the discussion. Truth can be discovered through many channels. All perspectives should amalgamate, motivate and guide our activities.

My professor listed about six or eight criteria to define life and showed us some simple examples of reproduction. He used them as models to explain common biological mechanisms at work to maintain life. Start with a single bacteria cell put on a milky nutrient rich gel on the surface of a lab Petri dish.

In such a living entity, cells growth a swelling larger by osmoses pulling necessary or poisonous chemical compounds through the cell membrane. In its nucleus two bound up strands stretch open. Each collects a new sequence of protein blocks along the helix. A new nuclei forms and is surrounded by fluid and a wall to enclose it.

You see the tiny black spot appear and grow, slowly at first but then quickly spread. The bacteria replicates itself by mitosis forming two cells identical to the original. Then each of these cell grow and duplicate themselves. Self replicating reproduction is rapid and constant. The conditions are ideal to support the process, growth and division will drive black mass. Its expansion in 2>4>8>16>32 exponential progression. The bacteria ─ its metabolism devoted almost entirely on growth and replication ─ spreads all the way across the surface. But it doesn't make to the edge.

Just before the black covers the final edge the spread slows, stops and reverses. The yellow brown indigestible excretions from each bacteria's digestive process was insignificant when there were only a few bacteria cells. But the colony's expanded mass has transformed the milky environmental soup into something yellow and gucky. It starves and poisons living cells. The fertile Petri dish gel had provided perfect conditions for the bacteria culture to unleash growth but now the bacterial mass quickly retreats: shrinks to half, then a quarter, eight, sixteenth and on down. It breaks up into separate colonies. And the spots melt away.

The entire culture will die out unless some of the cells weren't perfectly copied from the original. In that case, if the survivors of this current colony mutated enough to resist the poison and are also able to feed off what has become of their chemical environment, it will continue living as a new strain.

The new poison resistant strain will again divide grow and replicate, and again spread across the surface. But this time bacteria won't get as close to the edge before the waste toxins causes colony collapses. And it will collapse in the same way, for the same reason. Once again death will be the fate for all the cells unless some of them have already mutated again.

The bacterium, of course, are oblivious to what is happening around them. But from outside you can watch the pattern repeatedly fluctuate between spreading and retreating. Over generations you will notice the speed of expansion and contraction slow. Also the dramatic fluctuation between spreading and shrinking becoming less extreme. In a few days, as the process for generation and regeneration continues, the strains that survive by what Darwin calls random mutation are adapting to the environment as well as producing less toxic waste. Eventually the dark living mass pulses out and back in only slightly: individual bacterial cells die and the colony expands at about the same rate. This population pattern fluctuating in a narrow range signifies the ideal biological self regulating state of balance, called homeostasis.

Such is the fate for mindless entities, swell reproduce die; a simple function based on biological impulse operating in an external environment that either supports expansion or fosters extinction. Looking through a microscope, it is obvious. Nature makes a single cell creature too simple to be conscious of anything beyond the autonomous bubbling of its bio-chemical processes. With no internal self-regulation the species cannot work out a destiny to save its own life.

A bright light might trigger a chemical generated response somewhat akin to a reflex shrinking from an assault. But it can do nothing to enhance survival or avoid its demise. Can a bacteria sense its own life, even barely? These single cell organisms have no perception. Nothing in the way their physiognomy of anionic fluid is organized to perceive or respond to any change in the fluid outside their thin membrane wall. The bacterial form has no capacity to be aware of, or interact with its surroundings. Life is only experience of fluid seeping in and out past its outer membrane: the sack swelling: the gene strands breaking apart: all the ends pulling new coded protein matches from fluids: again and again. Until environmental conditions stops the process and cells dissolve.

In biological determinism that is the end of the story. Any form and phenomena of life is always controlled by instinctive behavior. Life's continuation is never guaranteed. In a sense we are not different. Our life is basically confined to what exists in nature. Like all life forms, we survive, or not, as dictated by random or cyclical conditions. Whatever change effects the composition and behavior of liquids, solids and gases in nature also decides whether our species perishes or continues.

But in our case, reaching the biological limit does not have to be our end of story. We are not just a bigger version of a mindless microbe. Our cells are aggregated into organ colonies and connecting systems. These systems coordinate: exchanging nutrition, ventilation and hydration to keep all the cells healthy, treat sickness and slough away dead cells and waste. Moreover, we are born with brains which we use to perceive, analyze and manipulate our environment.

How magnificently complex a creation we humans are! Our lives are filled with amazing achievements and meaningful discoveries. We are beings of perception. Our senses are aware of the surrounding forces at play. We can accumulate composites ─ take in moment by moment through our senses layer upon layer ─ of experience, which each of us processes through our mind; into the wisdom. The really valuable knowledge from our lives, our civilization will eventually leave behind for our children.

This capacity to be aware of our perceptions and to process our neurological signals into meaningful experiences distinguishes our species. And this makes our perception a powerful force in nature. We sense heat and sound and light and whatever else emanates in our proximity. Our big brains make understanding of those emanating forces and controlling them possible.

Human population expands and generates the supporting culture over long time spans. My people have myths and legends that trace our culture almost six thousand years, less than four hundred generations. That is only a third to halfway back in time to the reemergence of organized human activity; following at least a hundred thousand years of ice and a good twenty thousand years of ice retreating. The humanoid species at the end of the Ice Age was barely hanging on. But consider for a moment that versions of our kind go back in time three to six million years. Is this the first time the earth saw humans bloom? When did the story begin? Who truly knows what forms human life had taken long before masses of ice had ground everything into dust?

There are many missing chapters to the great saga encompassing homo sapiens on earth. Our progenitors had brains that processed how life is meant to work, communicated with each other and organized activities. Our particular kind developed group organization culture as a tool very soon after our appearance on earth. Our distant ancestors ranged across hills into valleys and along lakes and rivers. Before the ice age glaciers crushed their vestiges to dust, what our more distant progenitors might have accomplished in their lifetimes has been completely erased.

Even before the frozen world had fully retreated, say about twelve or fifteen thousand years ago, conditions on earth became much more hospitable. Paleolithic humankind lived in small but foraging groups. But they were not without culture. Today archeologists are unearthing proof that we had already started to produce remarkable tools and weapons, rituals, stone circles and talisman carvings. By the time my people's history started their ancient sacred record; larger clusters of populations were blooming across all the continents. Archaeologists everywhere are only beginning to discover evidence of the depth and longevity of humanity's flowering in abundance.

Our own generations finds itself placed in time to be a crucial, perhaps, the vital link to what follows for human kind. Up ahead, just over the future horizon approaches the moment when human life will reach the natural limit earth can accommodate. Homo sapiens have arrived at our stage of development, whether by divine grace, sages' wisdom or natural selection. We now have the mental capacity to calculate the likelihood and consequences of environmental degradation which we have induced. And the chance to change the course of our future. The fate of all our progeny, issuing throughout the rest of time, will hinge upon how well we prepare it for them.