

# Earth Manifesto



## Gaia's Geological Perspective: Episodes Since Genesis

Latest Revision Earth Day, April 22, 2018

**"Well, I never!"**

--- Mark Twain

Earthlings, call me Gaia. I have been majestically speeding around the star that you call the Sun ever since the solar system formed in this remote outpost of the Milky Way Galaxy. You humans study me and call your studies "geology" or "deep ecology", but it is all existential physics and holistic biology to me.

Elemental physical forces have been fundamental in determining my nature and how I actually came to be. *Gravity* is the most obvious of these forces. I was born, along with my seven sister planets, more than 4.5 billion years ago when the accretionary forces of gravity caused matter orbiting the fiery star you call the Sun to collide together, forming large and roughly spherical masses.

My early days were wild, believe me! Matter was flinging with energetic abandon through space way back then. The entire universe had begun with an initial Big Bang more than nine billion years earlier, and fiery masses and cosmic detritus had been hurtling forth from this explosive materialization of matter for eons. Long before the solar system came into being, untold numbers of stars had existed and forged new elements from primordial hydrogen and helium, and then been blown apart in unfathomably intense supernova explosions. The atomic debris of these stars eventually contained all the elements of matter that now exist on Earth, including the elements most critical to life: carbon, oxygen, nitrogen, calcium, iron, phosphorous, sulfur and potassium.

At the dawn of the solar system, asteroids, planetesimals, meteors, comets, frozen gases, water and other kinds of cosmic "dust" existed in accretion disks orbiting the Sun. As this matter consolidated in occasionally colossal collisions, some of it eventually came to form my dense inner core and hot outer core and thick mantle and thin rocky crust, and my oceans and atmosphere as well. A similar process created all the other planets and moons in the solar system. Huge quantities of other matter still whirls around the Sun, captivated by the powerful gravity of its gigantic mass. This includes a large swath of asteroids between the orbits of Mars and Jupiter, and millions of chunks of icy debris in the far-out Kuiper Belt, and countless comets in the Oort Cloud on the outer reaches of the solar system.

Every month, as the Sun sets, a full moon appears to you humans, looming up brightly on the horizon in an easterly direction from wherever you are. The full moon's visible crater-pocked surface provides silent testimony to the impressive impacts that have taken place over the long span of the Moon's lunar history. Similar impact craters would be everywhere evident upon my terrestrial surface, except for the fact that the processes of erosion, mountain building, volcanism, tectonic plate movements and the growth of vegetation have continuously altered my landscapes and obliterated most of this evidence of impacts that took place during my formative years.

I've surely seen a lot of comings and goings in my time. I was a lifeless, inhospitable mass of matter for most of the time during my first 700 million orbits around the Sun. Then, sometime thereafter, a form of primordial life was sparked into existence in the oceans from inanimate nucleic acids and proteins that were catalyzed by

the energy of sunlight. Life proliferated into many kinds of single-celled organisms in ancient seas, and yet I made more than 3 billion additional circuits around the Sun before primitive single-celled species of life stumbled upon a way to organize together to form more complex multi-cellular forms of life. Not long after this development, a Cambrian explosion of biological diversity followed, and I have made more than 500 million orbits around the Sun since then. During this time, a marvelous variety of life forms has evolved and adapted to prevailing conditions and left genetic progeny before dying out in a wondrous eons-long kaleidoscope of evolving species of plants and animals.

More than 99% of all species of life that have ever lived in my fresh water, marine and terrestrial habitats went extinct over the eons. Nonetheless, many millions of species of living things are still alive at this very moment, and every one of them is a descendant of earlier ancestors all the way back along the figurative branches of the tree of life.

One of the fundamental physical forces of Nature that have defined my existence is the energy generated by nuclear reactions in the Sun. This heat and light energy drives my water cycle and influences my weather patterns, and allows plants to photosynthesize nutrients that feed and sustain essentially all forms of animal life in my biosphere. The key to a profound understanding of life is to be found in a clear comprehension of the physical nature of light, energy, atoms and molecules. An infinite range of conditions of soil, temperature, sun exposure, competition, food sources, water distribution and physical barriers to movements of different forms of life have all contributed to the evolving creation of a plethora of different species of life that inhabit an infinite number of ecological niches and defining ranges and distributions.

The nature of necessity has shaped all forms of life to exist in a dynamically adapted balance within the constraints of the conditions in my many habitats. Plant life has adapted to my seasonal cycles and chemical properties, and profoundly influenced them, so plants are as fundamental to my nature as the falling of the rain or the flowing and ebbing of the tides. Photosynthesis by plants is as basic to me as the erosion of mountains and the blowing of the wind. My vital ecosystems are the sum total of all the habitats and life forms created in conjunction with these natural cycles and characteristics.

My ecosystems provide "services" that are critically valuable to the human race. These services are optimally provided when my ecosystems are in a healthy state. My wild lands, forests, rivers, lakes, wetlands, riparian habitats and coral reefs provide food, fish, lumber, minerals and raw materials to human beings. These habitats serve as nurseries for wildlife on land and in wetlands, streams and seas. My forests are important in helping determine patterns of rainfall and fresh water flows, and in the regulation of concentrations of oxygen and carbon dioxide in my atmosphere. These gases help to establish and maintain global temperatures in a range that is auspicious for all current forms of life.

The single most notable feature of my land surface, when regarded from space, is the green color of an incomprehensibly vast number of tiny living photosynthetic cells that utilize water, carbon dioxide and sunlight to create providential forms of energy that serve as nourishment, either directly or indirectly, for almost every living creature. The green that you humans perceive as the color of plants is a result of the pigment in plant's chlorophyll that absorbs light in the blue and red parts of light's spectrum, and reflects the green. So the color you associate most with plants is actually a frequency of light waves for which the plants have the least use! This paradox indicates that there may be a degree of illusion in all realities, even on a physical level. Albert Einstein would have corroborated this relativity.

You human beings have imagined a lot of curious ideas about me in the course of your time on my surface, but you simply don't know the half of it. When you are being generous in heart and mind, you refer to me as Mother Earth, and you've even come up with enlightened ecological views of me that recognize that you are naturally interconnected and interdependent with my ecosystems. But most of the time your geologic studies are simplistically utilitarian, and your scientists collaborate with efforts by industrial organizations that are mainly focused on finding better ways to exploit my assets with more rapacious and often destructive efficiency. It's a veritable tragedy of the commons.

From the solipsistic perspective of you human beings, everything is all about you. You figure that you are miraculous beings that a special Creator, brazenly visualized in your own image, must be responsible for having created. You think this because of your seemingly intelligent design and the equally marvelous and complex nature of other forms of life, and of the physical Universe itself. The magnitude of miraculousness of the biochemical processes involved in plant photosynthesis, which creates carbohydrates that support all of life, are just as amazing as the processes of respiration by which mitochondria in almost all the trillions of cells in each human body transform food into the energy needed to power your every activity. Every form of plant life is essentially consuming carbon dioxide and transforming it into organic nutrients using the energy of the Sun, so you might more meaningfully picture your God as light itself, as ancient Egyptians did with their God Horus.

Those of you who gullibly cling to superstition, ideology, dogma or religious revelations of supernatural beings perplex me, though I am omniscient about motivating factors. It is also revelatory of people's character for them to advocate self-serving doctrines that rationalize selfishly short-term-oriented activities without any overarching sense of responsibility for the harmful impacts of their behaviors.

For your own good, you should give greater respect and appreciation to my providential biotic wonders. Your obsessive and damaging exploitation of my resources is myopically foolish, especially when you fail to honor a responsible stewardship of my environs. I say unto you, please feel free to gather together and ignore these words completely, oh, ye of great faith but little true understanding! Your lack of insight is really rather confounding because your collective denial of larger truths comes at your own peril, and it will prove to be detrimental to all your descendants in future generations.

You are like a self-aware kind of red blood cell that courses around the human body thinking that it is the whole purpose of existence, rather than in reality being an interdependent part of a body in a grander scheme of things. In such a state of curious misapprehension, and unfortunately for you yourselves, you are failing to recognize that my health and the well-being of my habitats and ecosystems are critically important factors for your own vitality and flourishing, now and in the future.

The impacts of your human activities have become so extensive and harmful that they could cause abrupt and practically irreversible adverse changes in my environmental conditions within the next few decades. My highly evolved natural systems are being damaged by your reliance on industrial activities, monoculture agriculture and the chopping down of vast tracts of my forests. Your mindless consumption and reckless burning of fossil fuels are behaviors that are endangering the future prospects of your kind, and of most other forms of life in my biosphere.

You humans have already usurped almost half of my land surface for crops, timber, mining, real estate development, animal husbandry and recreational activities, and in so doing, you are upsetting the vital natural balance of my ecosystems. You would be much smarter to collectively understand the important realization that my ecosystem services in a healthy state are crucially important to your well-being, and to consequently take effective steps to protect these underpinnings of your survival.

### Fish Finally Discover Water!

The British scientist James Lovelock was the first person to recognize the obvious: my existence! Lovelock wrote a book titled *The Revenge of Gaia*, which happens to contain valuable perspectives, particularly about the risks of global warming and climate change to my biological diversity and the health of my ecosystems. But the title of this book is preposterous. I am NOT a vengeful being. In fact, I am not partial to any particular species of life. I am as impersonally indifferent to outcomes as a carbon dioxide molecule. I do not feign any sort of Olympian detachment, nor do I have an inscrutably divine sense of absolute justice, and it would be a misapprehension to see my existence in such a way, for I am dispassionate and selfless beyond fathoming.

Everything takes place within me and about me in accordance with what you think of as 'laws' of Nature. This natural order is an aspect of reality, independent of your thoughts, theories, biases, subjective judgments, belief systems and quantum mental gymnastics. Every form of life has lived, adapted, and died within the

overarching context of these natural laws in every instant, through times that can be judged as good or bad from the point of view of any life form's survival. The ancestors of every plant and animal alive today have survived extinction almost forever. This is natural order.

I don't play favorites with any individual plant or animal, or with any particular species of life in my biosphere. I have developed a dynamic, almost uncanny ability to resiliently recover from biotic catastrophes by cultivating a broad diversity of life forms that have evolved through processes of natural selection to encompass many different strategies for replication, reproduction and survival in infinitely variable habitats. After a natural cataclysm takes place, like a meteor impact or a devastating volcanic eruption or a searing wildfire, the relative equilibrium is upset and new competitive forces come into play. After such disturbances, predictable natural steps of succession take place. When a forest burns or is clear-cut, the plant species that initially colonize the denuded landscape eventually give way to others in a long process that unfolds until a stable and dynamic equilibrium is finally reached in mature old-growth forests or other climax communities, and a harmonious balance is established once again.

While it's a fact that I am an entity simply not attached to outcomes, it is more precise to understand that not only is nothing good or bad to me, but nothing is right or wrong. Things can obviously be either fortunate or unfortunate from the perspective of specific individuals and groups, but to my whole self in the long term, all is relative. Think about the huge meteorite that struck the Yucatan 65 million years ago. The resulting conditions drove the dinosaurs and more than half of all other species of life to extinction, so the event was a terrible calamity for almost every living thing alive at the time, yet it created new opportunities for different plants and animals to evolve into the biotic void created by the catastrophe. This, in fact, was how the extinction of the dinosaurs allowed your mammalian ancestors to eventually come to dominance. Come what may, my biosphere has an almost eternally long history of survival, even through some terrible mass extinction events, so no matter how severe the damage you humans inflict on my biotic wonders, it is likely that life will go on, long after your own species has gone extinct.

I do not grieve for any form of life that has ever disappeared from my habitats. It is YOU for whom the bell tolls. It is you who are choosing to act in ways that are leading to resource depletion, ecological harm, habitat deterioration, population overshoot, and probable collapse of your complex civilizations. Since transformative changes in your habits and behaviors are within your individual and collective capabilities to achieve, your salvation is really up to you. Take my impersonal advice: seek a better knowledge of my true nature -- and give me more respect -- and radically reorganize your activities to be compatible with my general health and biotic diversity. Do this for yourselves, and for your own common good!

### Me, Me, Me, Me, Me

The human race never ceases to be impressed by every tremor in my interior, and every time my hot innards erupt, and each time my crustal faults are revealed. I chuckle at all the many deities you have invented in thousands of different cultures since prehistoric times back when your species first emerged from the shadows of your earlier mammalian ancestors. "Zeus did this ..."; "Goddesses did that ..."; "God did such and such ...". HELLO! I am right here! I am not a hypothesis and I am more than a mere perspective, and more than an illuminating and valuable way of looking at the world. I am natural reality.

One of your more creative thinkers, Michael Pollan, has written about "the botany of desire". In *The Botany of Desire*, he insightfully considers the fate of plant species from their point of view. He delves into the successful proliferation and transformation of various varieties of apples, tulips, marijuana plants and potatoes from their native places of origin and original genetic characteristics into, respectively, sweeter, more beautiful, more potently intoxicating, and more nutritious sustaining forms. Plants have achieved this biotic success by taking advantage of a mutualism similar to the mutually beneficial relationship between plants and pollinators. By appealing to human needs and desires, plants have manipulated people, in effect, into selectively growing, breeding, and propagating them around my entire surface. In general, the results are evolutionarily propitious for human beings as well as for the widespread dispersal of the plants themselves.

This way of looking at things from an alternate point of view should be enlightening. It should free you to perceive and envision important bigger picture perspectives. Unconventional ways of seeing the world can be more accurate and valuable, especially when they are focused on being more comprehensive and holistic. Like MY whole-istic point of view! Appreciate it!

You call yourselves *Homo sapiens ... wise humans*. 'Wise', my core! Most of your stories about me throughout history have been fanciful and astoundingly anthropocentric, and have often been mere fables and superstitions and geomyths. It is amazing how simplistically credulous and naïve you are capable of being! So many of your beliefs are transparently fueled by hope or by fear, and driven by vanity, pride, compensatory arrogance, greed, control drives, selfishness or self-centered hubris. It's no wonder that the clever Mark Twain became so famous for satirizing your far-flung foibles!

I must hand it to you, though, in one regard: modern scientists, ecologists and philosophers have made great strides in developing an ever-improving Big Picture understanding of my physical, chemical, meteorological and ecological processes. Deep ecologists have even begun to appreciate a holistic and more wholesome view of me and my biotic communities. This gives your species better hope that you may begin to act more wisely, ethically, sensibly and sanely in the future, for your own sakes!

Knowledge and foresight, not ignorance and denial, will prove to be of paramount importance to you. Your survival and prosperity depend upon it. If you are to endure and leave me habitable to your descendants for even 100 years more, or a thousand years, or a million years, you will succeed only by working in greater harmony with each other and other forms of life in my biosphere, and by refraining from upsetting the providential balance of my healthy habitats, waterways, ecosystems, atmosphere, climate and biodiversity. Get it together!

#### A Shifty Aside by the Author

You just gotta love Gaia. She's like the best of Mom and Dad, and God, and the most generous benefactor ever. While she is demonstrably indifferent to our hopes and fears, her self-regulatory processes are amazingly beneficial to our existence, and to that of all other forms of life on Earth. Ken Burns' film series about our wonderful National Parks gives us beautiful images of awe-inspiring natural places, and there are assuredly many more of them. Make no mistake about it: the processes that make the world so wonderful are a providential boon to us that is beyond full comprehension.

It may seem odd to imagine Gaia speaking to us, because Gaia is not 'a being' in the way that we think of ourselves as individually conscious and aware beings. But think about a bee community living in a hive that they have created in the cavity of a tree. Such a hive of bees cannot be fully understood in a context of individual bees alone because there is such a profound inter-dependence between the specialized functions of the colony's queen, its workers, and its drones. The entire bee society of the hive must be understood to find out how the hive is built, how food is gathered from the pollen of wildflowers, how honey is made, how the queen bee mates with drones, how the next generation of bees is fed and supported, and how swarming takes place.

The beehive community basically has an instinctive social organization that cannot be comprehended by the study of specialized individuals alone. The hive community does not think as a being, but it operates as if it is a single entity. Likewise, no species of plant or animal can really be understood independent of the habitats and ranges where it lives. Nor can it be accurately understood in any way independent from the interconnections with other species upon which it relies. The famous naturalist John Muir was making a profoundly accurate observation when he noted a similar sentiment: "When we try to pick out anything by itself, we find it hitched to everything else in the Universe."

A knowledge of genetics is helpful to understand the heritage of individuals, and of entire species, and of all of life. A knowledge of biochemistry and physics is necessary to understand the context of how life exists and how any individual is able to perform the functions required for survival. A knowledge of the hydrologic cycle, the photosynthetic process, capillary action, microclimates, soil nutrients and sun exposure are necessary to

understand how plants prosper. In turn, one fact is clear: every animal is either directly or indirectly dependent upon plants for food and survival.

So, in a sense, a Gaia-level understanding is a more accurate way of realistically comprehending the world. Gaia has wonderful capacities for resilience and spontaneous healing, especially when in a healthy state. All species are essentially actors in a co-evolutionary dance of survival, and almost all rely on the providential benefits of mutualism for continued existence.

These ideas themselves are analytical, yet we must recognize that a synthesis of knowledge often contains the truest understandings of life and the world. The most holistic conceptions are often the most valid. Our perspectives are constrained by natural physical limitations of our senses and the inextricable subjectivity of our perceptions, and by curious shortcomings in assumptions we make about reality. Existence is a wonder beyond fathoming, and one that is best understood by cultivating a more expansive awareness of the whole. We should find better ways to mindfully appreciate existence, and to accept the ephemerality and uncertainties in life, and to transcend our petty conflicts while honoring the sublime and celebrating the nature of our own spiritual essence.

The "miracle" of Earth's biosystems far exceeds what is generally understood. When we breathe, our lungs utilize oxygen that has been produced by plants and trees through the wondrous process of photosynthesis, a process that beneficially removes carbon dioxide from the atmosphere. The water cycle is driven by heat from the sun that causes evapotranspiration of moisture from plants and trees and evaporation from bodies of water. These processes contribute to the formation of clouds, and precipitation from these clouds subsequently drops life-sustaining moisture in the form of rainfall and snowfall that is crucial to most species of life.

Even the dynamics of plate tectonics are critically important to organisms over the long run. This process helps drive changes that allow our planet to achieve long-term climate stability by pulling carbon dioxide from the atmosphere and burying it in sedimentary rocks. Movements of the Earth's crust are caused by the inner heat of the Earth that percolates around in convection currents of hot magma that occasionally well up from beneath the planet's rocky crust. These actions occasionally result in earthquakes and volcanic eruptions, which can be devastating and real scary to people, and yet they are a part of necessary processes for life on Earth.

"Civilization exists by geological consent, subject to change without notice."

--- Will Durant

### Physics Is Proven to Be Tangible

Amazing advances in the science of physics have been made in the past two centuries. Scientists, one might imagine, would realize how sensational the march of knowledge has been, so I find the following story to be illuminating. In 1900, the revered Lord Kelvin reportedly told the British Association for the Advancement of Sciences: "There is nothing new to be discovered in physics now." As it turned out, he couldn't have been more wrong! This fact was revealed not long after he made this remark, when Albert Einstein, a brilliant young physicist who worked in the Swiss Patent Office, published his revolutionary theory of special relativity in 1905.

Lest any reader suppose that physics is too dry a subject to be appreciated, here is a brilliantly witty and humorous story that provides an unexpected proof to the contrary. This story was gleaned from the Internet and was included right here until my publishers proclaimed that I had plagiarized the copyrighted piece by including it verbatim. Titled *HELL EXPLAINED BY CHEMISTRY STUDENT*, it is a story that provides readers with a hearty chuckle, for it contains a classic science-informed joke about whether Hell is expanding or contracting. The folks at Snopes.com characterize the story in its many incarnations as a "LEGEND", but anyway, it has been exorcised from this essay and I encourage readers to check it out online for a good laugh.

### A Window on the World

Imagine opening an enormous window in the sky out over the middle of the Pacific Ocean and walking out onto a lofty terrace with the most marvelous vista to the west ever seen. Author Oliver Morton describes what you might see in his Introduction to *Eating the Sun: How Plants Power the Planet*.

"Here's what happened today. What really happened.

Dawn broke first in the Pacific: because our international date line is in the middle of our largest ocean, that's where the day's dawn always breaks first, its tangential light reflected from a million waves and a few container ships into an empty sky. What wasn't reflected lit up the upper layers of the ocean, a soft new light for the fish and the plants they feed on.

When it made landfall in the north, the sun swept over the tundra like water up a beach; a couple of hours later, at the other end of the world, it broke like a wave against the mountains and pastures of New Zealand. Soon it was filling the rice paddies of the Philippines and the shallows of the South China Sea. And every time the sunlight hit something green - something truly green, not something painted green or dyed green: something with a greenness that grew - the most important process on the planet began again.

When the light shined on the greenness, the greenness welcomed it, and comprehended it, and put it to use. The greenness was chlorophyll, a pigment. It was arranged in pools and the sunlight's energy bounced from one molecule to the next like a frog across lily pads before reaching the subtle trap at the pool's center, the three-billion-year-old trap where the light of the sun becomes the stuff of the earth. As the trap's jaws snapped shut on the sunlight, the spring that powered those jaws pulled electrons from a nearby water molecule, breaking it up into hydrogen and oxygen. The hydrogen was used, along with the stream of electrons that flowed up through the trap, to turn carbon dioxide into organic matter. The oxygen was discarded.

In every plant reached by the dawn this extraordinary mechanism came to life millions of times over. There are hundreds of thousands of pigment pools and sunlight traps in every green cell, hundreds of thousands of cells in full-grown leaves. And once awakened by the light, the flow of electrons through the leaves did not stop until darkness fell. The carbon dioxide to which those electrons were channeled was turned first into a sugar and then into all sorts of other molecules. Some of them were used to thicken the plants' stems, to lengthen their leaves, to enrich the soil beneath them and to colour the flowers still held tight in their buds. The rest were used to fuel the processes that make such growth possible. Light made life; that is what photosynthesis means.

If the light-driven flow of electrons stopped, on this day or any day, so would everything that evolution has wrought. The planet wouldn't stop turning; dawns would still arrive with impressive regularity. But they wouldn't matter. No more datelines. No more dates."

"... The greenness of life is so important and all-pervading that evolution has tuned our eyes to discriminate among its various hues more precisely than among those of any other colour, and so shaped our brains that we take solace in it. The green, we know without thinking, is good.

We don't just enjoy seeing the green. It shapes the possibilities of our lives. More than two billion of us will have tended to the eaters of the sun in some way today. We will have hoed the ground for them, planted them, fed them fertilizers. We will have picked their fruits, dug up their nutritious roots, fed them to our livestock and ourselves. We will have made their carcasses into fabrics and furniture and firewood. We will have tended to some of them simply for their beauty - and to others because we know no finer surface over which to run while kicking a ball.

And even if we ignore today's plants completely, if we cut ourselves off in concrete and steel, we will still rely on yesterday's. On this day we will burn over thirty million tons of fossil fuel to generate our electricity and drive our cars and fire our factories and warm our homes. And all that power and warmth comes from sunlight eaten long ago. Energy trapped 300 million years ago by trees ... ended up stored in coal; plankton

like those now blooming off the Azores were transformed into oil and gas. The carbon in the carbon dioxide we give off by burning them is carbon taken from the ancient atmosphere they breathed."

"... As the dawn moves past Hawaii, the day is almost done. On this day, and the next day, and every day, a scarcely conceivable 4,000 trillion kilowatt hours of energy reached the top of the earth's atmosphere as sunshine. Some was reflected back into space and some was absorbed by the atmosphere. Some warmed the land and the sea, its warmth driving the winds and the ocean currents. Only a small fraction of one percent of that sunlight was captured by the pools of chlorophyll. But this tiny fraction of a vast number is still vast: the scrap of sunlight eaten by the plants today represented a similar amount of energy to that stored in all the world's nuclear weapons put together. And over the course of the day, that energy served to turn hundreds of millions of tons of carbon dioxide into food and living tissue.

And as a result the world stayed alive. That's what really happened today."

### A Surprising and Provocative Insight

The Creation myth in the Old Testament of the Bible is a vividly imaginative tall tale that happens to contain a daunting cautionary message. It tells us that God can intervene directly in our lives and punish us harshly for sinful behaviors like disobedience to his commandments. The epic Noah's ark Flood story in *Genesis* is also an ominous story because it says the LORD God got so disappointed at mankind's "wickedness" that "it grieved him at his heart" and he decided to destroy man and all other life from the face of the earth. What if this vengeful God comes back for an encore?

Cautionary tales can be valuable, and there is one such story that is more sensational -- and intrinsically compelling -- than any other such narrative in all of world history. Evidence in the fossil record tells us that the worst mass extinction event ever to occur in the incomprehensibly long history of life on Earth was the Permian Extinction. In this extinction episode, which took place about 250 million years ago, fossil evidence shows that "about 95 percent of marine species, and an uncountable but probably comparable percentage of land species, went extinct in a geological heartbeat." This catastrophic paroxysm of species loss was a terrible biotic calamity that brought the Paleozoic Era to an end, and the Mesozoic Era began.

Inquiring minds want to know what the causes of this crippling blow for life on Earth may have been. This story is intriguing and scary, because the proximate cause of this biotic calamity appears to have been an extreme shift in environmental conditions that was characterized by a combination of an excessive concentration of carbon dioxide in the atmosphere and correlated increases in ocean acidity and water temperatures.

The ultimate cause of these changes in biotic conditions is sensational. Speculation centers on a devastating meteorite strike like the one that later caused the Cretaceous Extinction that wiped out the dinosaurs and a big proportion of other forms of life about 65 million years ago. This theory of the Permian Extinction holds that the biggest asteroid to hurtle into Earth's atmosphere and slam into the planet in the last 500 million years did so 250 million years ago in the vicinity of Wilkes Land in East Antarctica. This impact caused a long series of volcanic eruptions at the antipodes of the impact site in Siberia, on the opposite side of the planet. These voluminous flows of lava formed the Siberian Traps, an extensive stair-like hilly region in northern Russia that consists of more than one million cubic miles of basaltic lava that was ejected from the Earth over a long period of volcanic eruptions. Along with this epic outpouring of volcanic flood basalt, enormous quantities of carbon dioxide and other greenhouse gases were emitted by the volcanic activity that created this largest igneous province on Earth. Note that one million cubic miles of lava would cover the entire continental U.S. to a depth of more than 1,500 feet. That's a lot of molten rock!

This understanding is daunting because today humankind is spewing the heat-trapping gas carbon dioxide into Earth's atmosphere at a faster rate than those Siberian volcanoes did long ago, and these greenhouse gases are having similar impacts on the biosphere. We are thus collectively causing the web of life in the seas to fray by upsetting the providential conditions to which all life forms have adapted, and we seem to fail to recognize that our own well-being depends upon this healthy ecological balance. This realization should make us see how utterly



insane it is to continue burning fossil fuels -- especially coal and the dirtiest sources of oil -- at the rate we are currently doing. It also tells us that we are practically crazy to continue causing a proliferation of "dead zones" in formerly vital marine habitats, or to overfish the seas by effectively strip-mining them of fish and shellfish, and to engage in other equally insensate exploitive and damaging practices like the "finning" of millions of sharks. It also helps us see how obscene it is to be obtuse about our role in causing mounting harm to extraordinarily beautiful and vitally important coral reef communities and the biological diversity of life they support in warm water locales around our lovely Blue Planet. And the Living Planet Report 2016 makes it clear how urgent it is for us to take courageous and responsible steps to stop assaulting biological diversity.

A Big Picture understanding of these things could help save us from a collectively disastrous fate in the not-so-distant future. For more information on the mass extinctions that wiped out so many species of life on Earth, see writer Ben Fishler's thought-provoking online book, *SOLVING THE MAJOR EXTINCTIONS: A New Theory of Antipodal Impact Effects Answers the Extinction Questions of the Past 500 Million Years*.

Oceanographer Dr. Sylvia Earle engagingly urges humanity to take heed of how disruptive our activities are, so she would no doubt nod genially to hear Ambrose Bierce's astute definition of improvidence as "the provision for the needs of to-day from the revenues of tomorrow." It is improvident, to be sure, for humans to destroy the biological underpinnings of our prosperity just to try to maximize profits in the short run for corporations, CEOs and investors today. This is an extreme example of a Tragedy of Activities Contrary to the Common Good.

### Meanwhile, Back at the Ranch: The Evolution of the Theory of 'Continental Drift'

The geologic history of our home planet is fascinating. It is also curious how a heretical theory surprisingly became proven fact almost overnight. Continental drift was a phenomenon proposed by German geologist Alfred Wegener in 1915. Wegener was vilified and ridiculed for this theory for the rest of his life. But then suddenly in the mid-1960s, scientists studying the magnetic alignments of crystals in volcanic basalts on the floors of the world's oceans discovered that the rocks had moved substantially from their initial position at the time of they formed. This discovery was confirmed by the fact that iron crystals in molten magma basically lock in position as they cool, pointing to magnetic north. Rocks that are now oriented in a different direction than what was north at the time of formation have therefore moved subsequent to the time they cooled.

This revelation led to more discoveries and corroborating facts, and then the puzzle of the dynamics of the Earth became much clearer as the new and now universally accepted mega-explanation of Plate Tectonics came to be understood as the cause of earthquake movements, volcanic activity, the orogenies of mountain ranges, and the creation and eventual subduction of the earth's oceanic crust. Eureka!

### Rocks Speak

Countless layers of rock have been exposed by the forces of erosion in the amazingly colorful and awe-inspiring Grand Staircase region of the American Southwest. These rocks are more than one billion years old in the deepest exposed places of the continental crust. A rudimentary knowledge of geology and of the geophysical genesis of rock formations gives anyone who ponders it a profound appreciation of the age of the Colorado Plateau, and of the processes by which it was formed over the eons. Travelers who visit the National Parks of southern Utah are familiar with the colorful sandstones, siltstones, mudstones, limestones and shales of this variegated stone staircase, which extends down from the most recent rock formations through what geologists identify as rocks from the Tertiary, Cretaceous, Jurassic, Triassic, Permian and Carboniferous geologic periods back to the Paleozoic Era and before that to the Pre-Cambrian.

The Grand Staircase consists of high plateaus that break into cliffs crumbling down into talus slopes, alluvial fans, outwash plains and canyons with numerous remnant rock towers, pinnacles, arches and natural bridges. Volcanic ranges intrude into this fascinating geologic jumble, providing viewers with a revelation of slow-motion evolutionary change that is characterized by a "punctuated equilibrium" of more rapid physical changes in which mountain building and erosion take place most dramatically during epic event episodes like earthquakes, volcanic eruptions, flash floods, landslides and rockfalls.

Geologists and naturalists have learned a lot about planet Earth. Erosion-exposed layers of sedimentary rock, angled askew from the horizontal plane of their formation, tell a compelling story of the physical processes of lithification and uplift that have taken place over unfathomably long periods of time. Curvilinear striations of lithified sand dunes, stream-rounded pebbles that are embedded in uplifted conglomerate sandstone, ancient seashells of long-since extinct species of marine life that are found in exposed sedimentary rocks, white veins of quartz in granite, beautiful crystalline structures in exotic minerals, lateral and terminal glacial moraines, and the impressive evidence of ancient volcanic eruptions all contain their own secrets of their genesis long ago. The knowledge that can be gained from studies of the natural world can provide us with a provocative understanding of who we are and how we fit into this marvelous world, and of how we would be well-advised to live in better harmony with natural processes, healthy ecosystems and other forms of life on Earth.

"Those who contemplate the beauty of the earth find reserves of strength that will endure as long as life lasts. There is something infinitely healing in the repeated refrains of nature -- the assurance that dawn comes after night, and spring after winter."

--- Rachel Carson

Geologic understandings expose the archaic nature of *misunderstandings* that characterize pre-scientific myths and superstitions and fictions that underlie the ideas of the men who wrote the holy books in various cultures. It is curious and astonishing that some people still literally believe in the Biblical stories of Genesis and the genealogies of the Old Testament from the time of Adam and Eve to the time of the legendary Great Flood to the time of Jesus. Those who cling to these stories in light of better understandings of the actual age of the Earth and its geophysical evolution are deluded, as proven by the overwhelming fossil evidence of the biological evolution of life in its multifarious niches and ranges. Ancient creation stories are simply not credible as accurate explanations of the world.

The known facts of geology are awe-inspiring, so it's odd that some people prefer to cling stubbornly to improbable stories in "holy scriptures". The forces and processes and time spans involved in rock formation, mountain uplift and erosion, and eons-long punctuated equilibrium episodes of earth movements and volcanic activity are nearly incomprehensible. It is a marvel to gain knowledge of the basically infinite and eternal causes and effects that have resulted in tectonic plate movements of continents and the physical evolution of mountain ranges, outwash plains, volcanic peaks, glacial moraines, U-shaped valleys, large lakes, verdant meadows and deep ocean trenches.

Irony sure is an entertaining damsel. The state of Utah contains some of the most extraordinary and beautiful eroded landscapes in the world, including those found in National Parks like Zion, Bryce, Capitol Reef, Arches and Canyonlands. Nonetheless, the Mormon religion flourishes in Utah, which is one of the most conservative states in the Union. Mormons promulgate a dogma that denies an ancient age to the Earth. The rock formations found in Utah provide cogent evidence of rocks and fossils that definitively contradict the fallacious doctrinal conceptions of the Bible and the Book of Mormon. When Mormons marry their retrogressive dogmas to social conservatism, it often impedes solutions to serious global problems that face humanity today -- problems like resource depletion, overpopulation, habitat damages and global climate disruptions that are being caused by the burning of fossil fuels, which spew voluminous emissions of heat-trapping gases into the atmosphere.

On the southern edge of beautiful Ouray in western Colorado, there is a viewing area above Box Canyon Falls that points out a dramatic "angular unconformity" of rock layers in which billion-year-old layers of black slate and white quartzite have been uplifted into a vertical position, and on top of them many layers of sandstone from another much later period of sedimentary rock deposition have been formed. Anomalously, the sandstone layers are almost perpendicular to the older layers of rock. This angular unconformity provides cogent evidence of more than a billion years of rock layers exposed by faulting of the Colorado Plateau and later erosion by streams and glaciers along the Ouray Fault.

Only three or four miles away, there is an intriguing vista point along the "Million Dollar Highway" that runs from Ouray to Silverton through these San Juan Mountains of southwestern Colorado. There, a curious visitor

can see a 16,000-year-old glacial moraine that has been deposited at the bottom of the Bear Creek watershed, where a hanging valley is cut off by the deep chasm of the Uncompahgre River and Bear Creek Falls plummets down an impressive 200 feet. Directly across the canyon, one can see rock more than one billion years old that clearly has pronounced ripple marks of an ancient sandy sea floor that have been preserved in the lithified rock. This sandstone has been uplifted at a rakish angle from the horizontal plane in which it was deposited, and these slate ripple marks, metamorphosed, have been exposed by glaciation and erosion in a fascinating here-and-now diorama.

From this roadside stop, one also can see a great view of beautiful Mt. Abrams to the south, a prominent volcanic peak that has a very distinctive profile towering 4,000 feet in elevation above the viewer. Mt. Abrams is a volcanic cone that was spewed forth about 30 million years ago, which is like yesterday compared to the billion-year-old rock upon which the volcanic rock was emplaced. A good photo that I took of Mt. Abrams looming above Ouray in "the Switzerland of America" can be seen on the back cover of Book Eight of the Earth Manifesto.

The first time I visited this the narrow gorge in Box Canyon, an evangelizing white-shirted Mormon man approached me and tried to convince me of the absolute truth of Mormon doctrines, which dogmatically deny that the Earth is much older than 6,000 years, as the faithful think is revealed by the Book of Mormon and the Bible. Honestly! There was, at one time, a colorful billboard-sized painted diorama along an interpretive Nature Walk in Box Canyon. The diorama depicted an evolutionary continuum of various species of life from the ancient Paleozoic Era and the Mesozoic Era, as well as more recent forms of life from the Cenozoic Era. That exhibit has been removed, possibly to satisfy the sensitivities of dogmatic religious fundamentalists. This diorama, along with the nearby geologic evidence, provides an astonishing contrast to the myopic and absurd doctrines of established religions. As Galileo's father Vincenzo once pointed out, the search for truth should involve freedom of questioning, rather than a reliance on the weight of strict authority or slavish obedience to it.

It is likely that no Native Americans had yet come across the Siberian land bridge to inhabit the North American continent at the moment in time during the last Ice Age when the Bear Creek glacial moraine was deposited. At that time, the continent was home to a plethora of megafauna that is awe-inspiring to imagine -- mammoths, dire wolves, saber-toothed cats, giant ground sloths, huge short-faced bears and native American camels and horses -- a list that includes more than 40 species of large mammals. Many of these species of mammals disappeared from the American fossil record within a period of less than a thousand years beginning about 11,000 years ago, according to radiocarbon techniques of dating. The cause of these extinctions may have been a relatively sudden change in climate, possibly caused by an extraterrestrial asteroid striking the Earth, along with the pressures of predation by early human hunters.

Only a few miles southeast of Box Canyon, Bear Creek plummets over a waterfall some 200 feet down into a deep gorge of the Uncompahgre River, and one can see a glacial moraine deposited at the top of the Bear Creek "hanging valley" that dates from glacial activity about 16,000 years ago. It falls into this gorge across from lithified rock that is more than one billion years old and clearly shows ripples in sandstone that was deposited at the bottom of an ancient sea, long before it was metamorphosed into rock and uplifted at a sharp angle to the horizontal angle of its deposition. To the south, along the Million Dollar Highway, one can see Mt. Abrams, a volcano emplaced somewhere around 35 million years ago.

### Another Perspective

"Experience of the way of all flesh might lead you to think that hard rocks, high mountains and broad continents would be stable and lasting, while the tiny molecules of life are fleeting; biology *brevis*, geology *longa*. In fact, over the history of the planet, the reverse is true. Mountains are worn down to sea beds, continents pulled asunder and ground together; oceans open and close. As a result, only a tiny fraction of the earth's early crust is still available for inspection today. ... Yet molecules from those shattered days are all around us today, in the form of DNA sequences. Many of our genes are billions of years old; some date

back to the universal ancestor itself. While the winds and waves of entropy erode earth's heights, life maintains its inner order across cosmic spans of time."

--- Oliver Morton, *Eating the Sun*

### The Curious Genesis of Geomythology

Long before science gave human beings real good explanations for natural phenomena, our ancestors sought to explain geophysical events with stories they made up. These stories were grounded in observation, legend, myth and anthropocentric interpretations, and they reflect the powerful affect on our imaginations of inexplicable events and awe-inspiring landscapes.

Such legends probably had positive value for survival. Consider, as an instance, the wary trepidation of the ancestors of the Native American Klamath tribe in the vicinity of Crater Lake in the Cascade Mountains of what today is southern Oregon. Only 8,000 years ago, a mere moment in the vast expanse of geological time, Mt. Mazama towered over the surrounding landscape. This volcanic mountain was about 12,000 feet tall, and it had been formed by a multitude of eruptions from a number of volcanic vents over the previous 400,000 years. Flows of lava from these hot vents had created a broad mountain that was one of the tallest in the Cascade Range. Then about 7,700 years ago, a climactic eruption of Mt. Mazama took place during which an estimated 12 cubic miles of magma were ejected, probably in just one week's time. This led to a sudden collapse of the mountain peak into the enormous empty magma chamber, creating a hole so deep that when it eventually partially filled with water, it became the deepest lake in North America.

The remnant rim of this volcanic caldera is 4,000 feet lower in elevation than Mt. Mazama was, and it is 33 miles in circumference. The slope is so steep from the encircling rim down to the incredibly pristine deep blue waters of the lake that there is only one route for hikers to get down to the lake, where they embark on extraordinary boat excursions around the lovely waters and out around the beautiful setting of Wizard Island.

The ancestors of the Klamath tribe understandably regarded the mountain as very dangerous. Having witnessed the fiery explosions that resulted in the disappearance of more than a half mile of the summit of this towering mountain, they created a story of Mt. Mazama as the home and battleground of powerful spirits. In their legends, Llao was the chief spirit of the "below world" beneath Mt. Mazama, and Llao had fought many battles with Skell, the chief sky god spirit of the "above world". In a final conflict, Skell was said to have killed Llao and thrown him into the mountain, which crashed in upon him. The impressive cliffs of an imposing volcanic feature known as Llao Rock on the northwest rim of the caldera is named for this vanquished spirit.

Geomythology is the study of oral traditions that have been created by pre-scientific cultures to explain geologic phenomena like volcanoes, earthquakes, floods, fossils and other natural aspects of the planet. A folklorist named Adrienne Mayor notes that people in these ancient cultures often used mythological imagery and poetic metaphor to explain events. She states, "Some geomyths are simply fanciful stories based on imagination or popular misconceptions, such as tales of humans or creatures that were magically transformed into rock to explain the shapes of landforms. Many geomyths, however, contain surprisingly accurate insights into geological processes, as well as important eyewitness data from the distant past. Modern scientific investigations have revealed that much ancient folklore about the earth was based on rational speculation and understandings grounded in careful observations of genuine physical evidence over time."

Many ancient cultures in places such as China, India, Greece, the Americas and Australia told tales of dragons and monsters to account for fossils of skeletons and footprints of animals that they had never seen alive. These geomythological explanations are rooted in direct evidence of prehistoric creatures, but they are not nearly as plausible as modern scientific explanations about the evolving tree of life and the physical processes by which forms of life now extinct have left fossilized remains and imprints in sedimentary rocks. These ideas reinforce my conjecture that our best hopes for creating a better world are to be found in accurate understandings, not in superstitions or myths, and definitely not in ideological deceptions and denials of crucially important perspectives.

## The Extraordinary Saga of Alexander von Humboldt

Alexander von Humboldt was the father of environmental awareness. He was a Prussian naturalist and intrepid explorer who was one of the first persons to see nature as a web of life. Because he intimately experienced nature as being profoundly interconnected, he recognized the threats posed by human activities, and he thus came up with the idea more than 200 years ago of human activities having impacts that change the climate.

Thirty-two years before Charles Darwin set off on his famed voyage on the HMS Beagle, which led him to extraordinary insights about biological evolution, Alexander von Humboldt set sail on the ship Pizarro from Spain to Venezuela on the first leg of what turned out to be a five-year-long voyage of discovery around the world. As he crossed the Atlantic, he saw a scene of brilliant bioluminescence that presaged the brilliant illumination of his understandings that would include a heightened awareness of the interconnectedness of the web of life around the world and an incipient awareness that human beings even then, in the opening years of the 1800s, were severely impacting natural habitats.

One of the first great insights on his expedition came when he visited the beautiful Lake Valencia region of Venezuela. There, he recognized that deforestation was making the land barren, and he saw that the lake's water level was falling and torrential rains were washing away the soils on surrounding slopes. He was the first person to explain the fundamental functions of the forest for the ecosystem and climate: the ability of trees to enrich the atmosphere with moisture, and their cooling effect, and their importance for water retention and protection against soil erosion. He also talked about the impact of trees on the climate through their release of oxygen. He warned that humans were meddling with the climate and that humanity's impacts were already "incalculable", and that this would have an unforeseeable, potentially catastrophic impact on future generations, if such disturbances in the natural world continued so "brutally." Today, serious pollution is further degrading Lago de Valencia, and the lake is being afflicted with algal blooms caused by a continual influx of untreated wastewater from urban, agricultural and industrial land uses in the area, all of which contribute to ongoing eutrophication, contamination and salinization of the lake.

As with Darwin's voyage on the HMS Beagle 32 years later, all of Humboldt's work was founded on a single momentous journey, which is the centerpiece of Andrea Wulf's fascinating biography, *The Invention of Nature*. Humboldt traveled in the Americas with a botanist, Aimé Bonpland, and together with some hard-working natives they paddled by canoe into the botanic richness of rain forests, ascending the Upper Orinoco River that flows north to the ocean through Venezuela. They sought the river's common source with the Rio Negro, a tributary of the Amazon that flows to the south and east. Humboldt was thus the first to map the Orinoco's union in the Casiquiare Canal area with a tributary of the Amazon -- a juncture that defied contemporary assumptions, which held that two watersheds could not share the same source.

Continuing on a nine-month, 1,300-mile trek along the northern Andes, the two men traversed a switchback of snow-swept passes and then into humid jungle, through regions unseen by any naturalist before. Humboldt was boundlessly energetic, climbing some of the highest volcanoes in the world. Not only did he see the profoundly interconnected nature of the natural world, but he also discovered similarities between climate zones across the world, and saw that humanity was already causing changes in the climate in the early years of the 1800s.

Humboldt's "scientific passion all but blinded him to danger. When an earthquake broke around him, he calmly set out his instruments to measure and time it; his experiments with electric eels might well have killed him. In the plateau lands of Peru, he discovered the magnetic equator and soon afterward studied the cold nutrient-filled waters of the future Humboldt Current, whose rainless air has the effect of parching the coasts of northern Chile and Peru."

"But Humboldt's biggest achievement lay less in geographic discovery than in the insights that the journey sparked." With such observations, Andrea Wulf strives to establish Humboldt's relevance to us today, and her fluency in German facilitates the sifting of his massive oeuvre for impressive data and reveals the extent to which Humboldt was one of the most famous scientists of his age, and how his restless life was packed with

adventures and discoveries. "Humboldt reached his epiphany on the slopes of Mount Chimborazo in today's Ecuador, a mountain then considered the highest in the world. Climbing to more than 19,000 feet, he attained a mountaineering record unsurpassed for 30 years, and he gazed with awe at the vast landscape spread before him. Here, Wulf asserts, he was struck anew by his founding conviction: that the world was a single, web like, interconnected organism."

"It was five years before Humboldt returned to Europe, via Cuba and Mexico. In North America, which he loved, he hobnobbed with a delighted President Thomas Jefferson." The only subject they avoided was slavery, for Humboldt was revolted by its inhumanity, and he detested colonial greed that perpetuated it. His sensitivity to environmental degradation found its voice in two well-researched books published after his return.

Humboldt turned scientific observation into poetic narrative, and his writings inspired naturalists and poets, including Darwin, Wordsworth and Goethe as well as world leaders. Andrea Wulf argues in *The Invention of Nature* that it was Humboldt's influence that led John Muir to his ideas of ecological preservation, and that shaped Thoreau's *Walden*. She also traces Humboldt's influences through the great minds he inspired in evolution, ecology, conservation, art, literature and revolutionary zeal, and thereby brings this lost scientific hero and almost forgotten father of environmentalism back to life.

"The transcendentalism in much of Humboldt's writing deeply affected Whitman, Thoreau, Poe and the English Romantics. In South America, the liberator Simón Bolívar, whom Humboldt had known in Paris, asserted that the German's vision had awakened the South American people to pride in their continent. Later, environmentalists from George Perkins Marsh to John Muir saw Humboldt as their spiritual ancestor."

Inspiration is a marvelous thing, and the awareness of our vital connection to the natural world is so important that understandings like those gained and shared by Alexander von Humboldt are highly commendable. "This is the most remarkable story about the most colorful, captivating man I have ever heard of," writes Andrea Wulf. Her biography reveals details of the extraordinary life of this visionary naturalist, and how he created the way we understand nature today. "If I could invite only one person from the past to a dinner party, it would be him." Personally, if there is any world exploration I would rather have gone on, other than Darwin's voyage on the HMS Beagle, it would have been Humboldt's journey around the world, despite the hardships he endured, which are reminiscent of Theodore Roosevelt's arduous journey down the "River of Doubt" a century later.

### An Arcane and Previously Untold Story

I once got lost for more than 24 hours in tall mountains in a remote part of Nepal. I had just spent a few days in the Annapurna Sanctuary, a high basin surrounded by five peaks of the Annapurna Massif that all tower above 24,000 feet in elevation. From within the Sanctuary, the views of the extraordinarily beautiful "fish-tail" mountain Machapuchare to the east are stunning. The native Gurung people in this region believed this mountain was the home of the "Great God" Shiva and other deities.

The gods did not seem to smile upon me as I descended from the Sanctuary. I had decided to make my way through a maze of terraced hillside fields up to a poorly marked route across a towering ridge, in hopes of getting to the deep canyon of the Kali Gandaki to the west. One's best-laid plans can be waylaid by unforeseen circumstances, and sure enough, I became lost and was engulfed by a disorienting whiteout of heavy fog. Being adequately prepared with food, a tent and a sleeping bag, this wasn't too big a problem, but the next day I still didn't know where I was, or which way to go. So I followed an old dictum: When lost in mountains, follow a stream downward. I did. After several hours, I was confronted by an extremely steep, treacherous and impassible canyon, so I adroitly made a new plan and headed back in a different direction, which is surprisingly often a very good thing to do when faced with seemingly insurmountable obstacles.

Extrapolating this truism to aggregate American dilemmas concerning our involvements in costly wars with poorly defined objectives, or with huge amounts of deficit spending and record levels of national debt -- or with gaping contrasts in prosperity and economic security between ultra-rich people and the bottom half of the world's adult population who own only 1% of global wealth -- one would be forced to conclude that it would be

wise to undertake a radical rethinking of our current directions and national policies and priorities. Flexibility, open-mindedness, and adaptive wisdom are, after all, the keys to providential resilience. Bernie Sanders convincingly suggests that positive peaceable revolutionary change is required.

Back in Nepal, I eventually found my way to a point where I had originally gotten lost. I retraced my steps until I discovered the rough route I had earlier missed at a stream crossing, and it led up to the ridge summit that lay between where I was and my intended destination. After climbing up to the top of the commanding ridge, I descended far down to the small village of Tatopani, located at an elevation of 8,000 feet and nestled between 26,000-foot mountains in a gorge that is, by some measures, the deepest in the world. A tributary of the great Ganges River flows down this canyon, and there are a number of natural hot springs. Immersing oneself in soothing hot waters is an activity known to make one feel perfectly relaxed, and at one with the world. I did.

Some might say that it sometimes sounds as if Tiffany Twain is disoriented, but I'd hasten to remind them, "All who wander are not lost."

### Entrenched Meanders

There is actually a river in southwest Turkey named the Meander River. It follows a very convoluted path along its lower reaches. This river has given its name to the geophysical phenomenon of rivers everywhere that meander. Rivers that cross gentle slopes or plains tend to create watercourses that are sinuous because the force of moving water erodes sediments from the outside of bends and deposits them on the inside. Wikipedia proffers: "The result is a *snaking* pattern as the stream meanders back and forth across its down-valley axis."

One of the most astonishing geological phenomena I have ever seen is the "entrenched meander" of the feature known as the *Goosenecks* of the San Juan River in southeastern Utah. The river had once flowed along a meandering course across a broad plain, long ago, and then the Colorado Plateau began to be uplifted, and the river cut down through the limestone and shale as it was uplifted, maintaining its meandering course. It thus managed to cut an impressive 1,000-foot deep canyon that flows 5 or 6 sinuous miles to make approximately a single mile of headway downstream. Outstanding photos of this entrenched meander can be seen online, and on the cover of Book Three of the Earth Manifesto.

Entrenched meanders in a river course are impressive. Nature, without biases or preferences, can teach us the lesson that flexibility, resilience, perseverance, open-minded understanding, and free-spirited inquiry are the best keys to honestly see the most propitious ways forward.

### Expansive Gaian Perspectives

The most holistic big picture understandings are best informed by a simultaneous awareness of the most precise details possible and the broadest possible perspectives. One of my main goals in this manifesto is to seek to understand and accurately interpret the myriad ways that we are interconnected and interdependent with the biotic fabric of life on Earth, and with the health and equilibrium of natural ecosystems and natural processes like the hydrologic cycle and the carbon cycle. Stephan Harding, a Holistic Science Coordinator at Schumacher College in the United Kingdom, makes some valuable observations (paraphrased for relevance):

"A Gaian approach opens new doors of perception and opens up our vision of the inter-dependence of all things within the natural world. There is a symphonic quality to this interconnectedness, a quality that communicates an unspeakable magnificence. When you stand on a sea-cliff in winter, watching masses of grey clouds rolling in from the ocean, a Gaian view helps you understand the clouds in their global context. The clouds have formed due to massive climatic forces and have manifested within a small part of the whole -- the part you happen to be standing in. The water in the clouds is circling through the water cycle, from rain to river to sea to cloud again. As you experience this dynamic and ever-shifting reality, you may suddenly find yourself in a state of meditation, a state in which you lose your sense of separate identity, and become totally engrossed in the life process being contemplated. The contemplated and the contemplator become one. From this oneness there arises a deep appreciation of the reality of inter-dependence, and

from this comes the urge to be involved in *opposing all sorts of ecological abuses*. Here arises the feeling that what is happening in evolution has great value and a meaning impossible to articulate or to detect via reductionist scientific methodology. This highly developed sensitivity, this experience of radical interconnectedness, is the hallmark of supporters of the Deep Ecology movement, and it is the basis for the elaboration of ecological philosophies such as the pioneering work of Norwegian philosopher Arne Naess, who first coined the term 'deep ecology'."

"A culture that was deeply aware of experiencing oneness with the natural world would be a healthier one. It can be argued that truly great scientists had this connection, this sense of the greater whole of which they were a part. Without educating people to feel this sensitivity, we churn out scientists without philosophy, who are merely interested in their subject, but not thoroughly awed by it. We churn out clever careerists, whose only concern is to make the grade, be the first to publish, to be the first to be head of a department or to split the atom."

"It is this kind of training that leads to the mentality that is responsible for the massive social and environmental mistakes of Western-style development. Trained to shut down our perception of the world so that we see it as a mere machine, we are perfectly free to improve the clockwork for our own ends. We are perfectly free to build huge dams that flood vast areas, perfectly free to chop down old growth forests, perfectly free to promote economic growth at all costs or to alter the genetic make-up of any organism for our own ends. Gaian perception helps to remedy this great mental and spiritual plague, a malaise which has arisen in the West and which is now claiming millions of victims, human and non-human, throughout the world. Gaian perception connects us with the seamless nature of existence, and opens up a new approach to scientific research based on scientific institutions arising from scientists' personal, deeply subjective ecological experience. When the young scientist in training has sat on a mountain top, and has completed her first major assignment to 'think like a mountain', that is, to dwell and deeply identify with a mountain, then mechanistic thinking will never take root in her mind. When she eventually goes out to practice her science in the world, she will be fully aware that every interconnected aspect of it has its own intrinsic value, irrespective of its usefulness to the economic activities of human beings."

### Global Warming Is Neither Myth nor Hoax!

#### ***Fiat Lux!* -- Let There Be Light, for Better Illumination!**

Our home planet is a marvelous place. Like many a good thing, we should respect and appreciate it rather than taking it for granted or mindlessly exploiting it. For an interpersonal relationship to be healthy, people need to be responsible in working to maintain the relationship in good condition. We should not abuse relationships without regard to the best ways to keep them mutually beneficial. One vital aspect of appreciating the natural world is the cultivation of comprehensive understandings about our interconnectedness and interdependencies with the health of natural systems.

I highly recommend that everyone watch the stunning aerial images of planet Earth in the film *Home*, which was created by the photographer and ecologist Yann Arthus-Bertrand. It can be viewed on YouTube right now. The visually stunning and ecologically sound messages conveyed in this film are vitally important to the future well-being of humanity.

Everyone alive is privileged to be living at a time blessed with Peak Resources, and are enjoying relatively good fortune, collectively, though the resources and wealth generated from them are extremely poorly shared around the world. We are lucky to be living under these conditions, before severe resource depletion sets in, and before the number of people on Earth without access to adequate supplies of fresh water increases from about 750 million people today to over 3 billion people within 15 years, and before the damaging impacts of human activities seriously reduce the carrying capacity of Mother Nature for our kind.

Nature provides us with a cornucopia of things to eat and materials to use in our daily pursuits, and the ecosystem services we derive from nature are critically valuable. We surely should take steps to assure that



the growth of our human population and our consumption do not, in aggregate, exceed the carrying capacity of the Earth to support us. We should in particular heed the warnings of the United Nations Intergovernmental Panel on Climate Change about the dangers of global warming, for it is "the defining challenge of our age". We should take bold steps to mitigate increases in atmospheric carbon dioxide, and make sure we do not severely damage the health of the ecosystems upon which we depend. Hopefully, the international accords reached in Paris in December 2015 and signed by 170 countries at the United Nations on Earth Day 2016 will be successful in accomplishing this necessary goal. This despite Trump's subsequent rejection of the common good.

Scientists have determined that the concentration of carbon dioxide in the atmosphere was about 280 parts per million at the end of the last ice age, some 12,000 years ago. At that time, so much water was locked up in glaciers, ice fields and ice sheets that sea level was 300 feet lower than it is today. Carbon dioxide has now increased to more than 400 ppm, largely due to human activities of cutting down millions of trees, raising animals for food on cleared land, and spewing out tens of billions of tons of carbon dioxide into the atmosphere every year by burning colossal quantities of fossil fuels. This concentration is increasing by about 2 ppm every year. Many scientists think that 350 ppm is the upper limit of safe carbon dioxide levels in the atmosphere, yet 'conservatives' ironically strive to sow doubt about whether global warming is even occurring, and whether human activities could possibly be a causative factor.

A graph of carbon dioxide concentrations in the atmosphere shows annual fluctuations, including net decreases during times that vegetation is rapidly growing in the spring and summer in the northern hemisphere, where two-thirds of all land masses on Earth lie. But this annual decrease is followed by bigger net increases as leaves fall and decay there in the autumn and winter, and one thing is perfectly clear: this graph shows that carbon dioxide levels have been increasing every year from each prior year. Google the "Keeling Curve" to see a graph of carbon dioxide measurements that have been made continuously since 1958 at an observatory near the lofty summit of remote Mauna Loa on the Big Island of Hawaii. The year-on-year increases roughly match the amount of carbon dioxide given off in the process of burning fossil fuels each year. There is little doubt about this, and the implications are ominous.

The trend of global warming is adding up to increasingly risky impacts. It is thus puzzling that people can be opposed to precautionary principles that advise us to pursue less reckless collective behaviors. Without more concerted actions to reduce increases in the amount of greenhouse gases accumulating in the atmosphere, a point of no return may be reached where feedback loops will kick in. One such outcome could be a thawing of Arctic tundra, which would release large quantities of methane into the atmosphere. The danger in this is amplified by the fact that methane is a greenhouse gas many times more potent than carbon dioxide in trapping heat. Such feedback loops are processes in which effects amplify causes, and such loops could cause global warming to spike and melt all of Earth's ice fields and glaciers, raising sea levels catastrophically and making storms more severe, and causing more flooding and crop failures in many places.

We humans would be wiser to embrace a "no regrets" stance of precautionary principles to promote the common good of all, particularly those in future generations. See [350.org](http://350.org) for some insights into issues related to carbon dioxide and other greenhouse gases in the atmosphere.

UC Berkeley physicist Richard Muller was one of a small minority of scientists around the world who had been skeptical of assertions that global warming is being primarily caused by human activities. But in July 2012 he surprised knowledgeable observers by changing his mind. He pointed out that he had become convinced by evidence from 36,000 observation stations worldwide that show an overall trend of significant warming since the Industrial Revolution began some 250 years ago. These findings confirm that this warming is strongly correlated to emissions of carbon dioxide from the burning of fossil fuels. Periodic volcanic eruptions like that of Krakatoa in 1883 spewed so much sunlight-blocking particulate matter into the air that they had short-term global cooling effects, but the overall trend of warming has been unmistakable, and accelerating.

Ironically, Richard Muller had been the beneficiary of funding from the Charles Koch Foundation, which denies that industrial activities are contributing to an overall warming of the planet's oceans and atmosphere. The

billionaire Koch brothers and their giant Koch Industries are staunch foes of climate initiatives, because they are big beneficiaries of being allowed to pollute the atmosphere without offsetting the costs to society associated with this "privilege". These billionaires give record sums of money to politicians who promise to continue to allow corporations to avoid including costs of mitigating global warming in the prices of their products. The Kochs are corrupting our politics to defend the status quo, and this should anger all Americans.

Carly Fiorina, when she ran as a California Republican candidate for the U.S. Senate in 2010, mocked Senator Barbara Boxer's concern that climate change could be a serious national security issue, even though personnel in the Pentagon had declared this to be true. Fiorina said, "Terrorism kills -- and Barbara Boxer is worried about the weather." This was blatant pandering to the right-wing base of the Republican Party. Then, in December 2015, when Fiorina was running for president, she was the only Republican woman in the anti-progressive field, but she offered ideas that were little better.

Mark Twain would likely have told us that mockery is most convincing and effective when it comes from an unassailably incisive perspective, rather than from seriously shaky ground. It is curious to me that Carly Fiorina seems to have been so willing to irresponsibly suck up to the lunatic fringe in environmental matters. It is as if she believes conservatism has no other choice than to ally itself with vociferous demands of disaster capitalists and resource exploiters and moneyed interest groups. It is as though corporate executives prefer to maximize profit-making in the short run by proceeding like the Captain of the Titanic, "full-speed-ahead in treacherous waters", and damn the risks to all, and the costs.

Decision makers at International Climate Conferences year after year -- in Copenhagen in December 2009, in Cancun in December 2010, in South Africa in December 2011, in Doha in December 2012, in Warsaw in December 2013, and in Lima in December 2014 should have taken more responsible heed of these perspectives. They should have found some way to choose a more courageous approach to limiting the increasing concentration of greenhouse gases in the atmosphere. Let's all individually and collectively strive to find ways to alter our wasteful and polluting ways! Incentives and disincentives are the best way to put this change into effect. An historic climate agreement was finally reached at the 2015 Conference in Paris, and it has become even clearer that the need is tremendous to find ways to translate the agreements reached in Paris into truly effective actions that will reduce emissions and mitigate the harms being done. Betraying this understanding, Republican politicians are banking on stupidity to push an egregiously irresponsible agenda that allows profit-making on fossil fuels instead of championing the true greater good.

All the insights of the Earth Manifesto essay, *Climate Change Considerations, Carrying Capacity, and Ecological Overshoot*, are included here by this reference, and especially those related to climate injustices that harm poorer nations disproportionately, even though they are not big contributors to greenhouse gas emissions.

#### Another Way of Looking At It

In his 2009 book *The Vanishing Face of Gaia: A Final Warning*, James Lovelock says humanity is "Earth's infection." While in theory it would be extremely difficult to truly destroy this planet, it's not such a stretch for some scientists to imagine us making it a place that doesn't support humans. The planet would go on, the thinking goes, but it'd get rid of us much like we shake the flu.

The notion that human activity, or the activity of any organism, can affect Earth on a planetary scale is still a hard one for many people to swallow. And it is this kind of disbelief that fuels much of the public skepticism surrounding global warming.

Human-caused global warming -- also called "anthropogenic" global warming -- is the latest example of life altering Earth, but it is not the most dramatic. That distinction probably goes to the oxygenation of Earth's early atmosphere by ancient microbes as they began to harness the power of sunlight through photosynthesis.

"What we need to be thinking of as humans causing changes to the Earth system is what the consequences will be to us human beings," said Katrina Edwards, a geo-microbiologist at the University of Southern California.

"The Earth could care less. We will be recorded as a minor perturbation in the Earth system. The Earth will go on. The question is: Will we?"

### A Carbon Dioxide Emissions Budget

Scientists have affixed a cumulative upper limit on how much carbon pollution could be put into the atmosphere from the beginning of the industrial era through the end of this century. To avoid calamitous conditions that would result if global warming exceeds a temperature rise of more than 2 degrees Centigrade (3.6 degrees Fahrenheit), the IPCC now agrees that 1 trillion metric tons is the absolute maximum amount of carbon pollution that the planet can withstand without intolerably costly consequences.

We've already used up over half of this carbon emissions budget in the last 250 years, and with our current habits, we're on course to blow through the rest in the next 25 years. In twenty-five years! We have enough experience already with the devastating economic costs of climate change to know that we should start living within stricter carbon emissions limits. We cannot violate this target limit on emissions if we want to carry on living in a hospitable world. The extraordinarily powerful hurricanes that hit Texas and Florida and the Caribbean in 2017 gave emphasis to this contention. So did the terrible wildfires in Northern California in October 2017.

The estimated fossil fuel reserves still in the ground represent more than 3 trillion tons of potential carbon emissions. The simple fact is that we collectively need to leave most of these fossil fuels where they are, in the ground. That's a precautionary good idea. Unfortunately, "conservative" U.S. politicians are unwilling to lead a global solution on climate change, and many of them staunchly oppose seizing the most compelling economic opportunity of our time: clean energy technology. Many American politicians on both sides of the aisle are intent on developing every source of fossil fuels, despite the fact that such plans are setting us on an even faster course to disaster. And Trump's EPA Chief Scott Pruitt announced his intent to repeal the Clean Power Plan, leading us on a stupidly backwards path.

The drive to drill and mine anywhere, on more public lands and in the Arctic, is a disastrous substitute for a coherent energy policy. If we drill the remaining oil in the Arctic and allow fracking of oil and gas around the country, and blow the tops off mountains to more profitably get at coal reserves, and set out to pump all the oil in Alaska and mine all the coal in the Powder River Basin of Montana and Wyoming, we will have no hope of avoiding catastrophic changes in the climate. Based on estimates by the World Bank, the fossil fuel infrastructure already built will consume the remaining carbon budget, so we should not build more projects like pipelines carrying dirty tar sands and liquefied natural gas export facilities.

We need only look at the Arctic to understand why a radical shift in energy policy is necessary. This northern polar region is warming more than twice as fast as the global average, causing destabilizing perturbations in jet stream winds that are driving extreme weather in the mid-latitudes, including heat waves and droughts, AND heavy snowfalls like those in harsh noreasters and "bomb cyclones" experienced in the Spring of 2018.

Scientists today are observing glaciers melting faster than before, contributing to sea level rise and increased incidences of extreme weather events around the world. The IPCC projects sea-level rise of 5 to 6 feet by the year 2100, an increase that would be devastating to coastal communities around the world, including in the U.S., as waters rise and storm surges reach further inland. Climate expert James Hansen and other scientists indicate that their models suggest that sea levels could rise by a devastating 10 feet as early as 2050. That may be excessive alarmism, but the costs will be so high that greater concern may be a key to sensible and responsible action.

A recent study estimates that average annual losses from flooding in the world's biggest coastal cities -- including New York City, Miami, New Orleans and Boston -- could rise to \$1 trillion per year by 2050. Remedial measures are needed NOW!

### Some Ominous Stories Concerning the Destabilization of Geophysical Streams

Queue up the scary music. Here is another cue for better understanding.

We humans are seriously messing with Mother Nature and her geophysical character. This is an elementary story of three great streams, two in the atmosphere and one in the Atlantic Ocean.

First, let's think about the Gulf Stream. This is a current of warm and swiftly-moving water in the Atlantic Ocean that originates in the Gulf of Mexico and follows the eastern coastlines of the United States and Newfoundland, and then splits in two. The northern stream, known as the North Atlantic Drift, crosses the Atlantic Ocean to Northern Europe and the southern stream, the Canary Current, recirculates off West Africa.

The warm water of the Gulf Stream influences the climate of the east coast of North America and the west coast of Europe, making weather patterns in Western Europe and Northern Europe significantly warmer than they would otherwise be due to the North Atlantic Drift. And there is growing evidence that the Gulf Stream is slowing down because of climate change, according to a team of scientists. This weakening of the Atlantic Ocean circulation that carries warmth into the Northern Hemisphere's high latitudes is due to disrupting flows of cold water from melting glaciers and ice sheets in Greenland. This development is a result of the buildup of greenhouse gases in the atmosphere and resultant anthropogenic global warming, which ironically contributes to extreme weather events that could cause more frequent cold snaps in Europe as the climate changes in response to changes in the circular system of ocean currents that is collectively called the North Atlantic Gyre.

What this suggests is that one of the most feared consequences of warming temperatures is already coming to pass. Understand this. Global warming could cause an ice age in Europe, with average temperatures plunging and weather conditions running amok! The system of currents in the Atlantic Ocean is known as the "Atlantic meridional overturning circulation" -- AMOC -- which is characterized by both the northward flow of warm, salty water in the upper layers of the Atlantic, including the Gulf Stream, and a southward flow of colder, deep waters that are part of the "thermohaline circulation". This "large-scale ocean circulation is driven by global density gradients created by surface heat (thermo-) and freshwater fluxes" and salt content (haline) that together determine the density of sea water. Thermohaline circulation is sometimes called the ocean conveyor belt, the great ocean conveyor, or the global conveyor belt.

The AMOC ocean currents have declined in strength by 15 percent since the mid-20th century to a "new record low," according to the scientists in a peer-reviewed study published in the journal Nature. "That's a decrease of 3 million cubic meters of water per second, the equivalent of nearly 15 Amazon rivers."

The currents that compose the North Atlantic Gyre include the Gulf Stream in the west, the North Atlantic Current in the north, the Canary Current in the east, and the Atlantic North Equatorial Current in the south. This gyre is particularly important for the central role it plays in the thermohaline circulation, bringing salty water west from the Mediterranean Sea and then north to form the North Atlantic Deep Water.

The second categories of great streams that humankind is inadvertently altering are the jet streams in the atmosphere. These are the polar front jet stream and the subtropical jet stream, and they are fast flowing, narrow, meandering air currents in the atmosphere that directly affect our weather systems in the Northern Hemisphere. The polar front is the boundary between the cold North Pole air and the warm equatorial air. The polar jet sits at roughly 60°N latitude, because this is generally where the polar front sits. The subtropical jet is at roughly 30°N latitude because of the temperature differences between air at mid-latitudes and the warmer equatorial air. The polar and subtropical jets are both westerly, meaning they come from the west and blow toward the east. Both jets move north and south with the seasons as the horizontal temperature fields across the globe shift with the areas of strongest sunlight.

The polar jet stream is a continuous gale, "as wide across as the Amazon, that blows west to east in a ring around the Arctic, between four and eight miles above Earth's surface."

The polar jet stream's fluctuating path and speed exert a powerful influence on weather in the Northern Hemisphere. When it snakes south over North America during winter, it brings extended periods of

cold. When it snakes north, warm weather prevails in northern climes.

### A Reckless Form of Planetary Socialism Masquerading as Laissez-Faire Capitalism

The externalization of significant costs related to health adversities and environmental damages are called *negative externalities*. These aspects of laissez-faire capitalism are a form of global socialism at its worst. This is particularly true of the issue of anthropogenic climate disruptions and the impacts of human activities on Earth's many microclimates. As we spew billions of tons of greenhouse gases into the atmosphere every year, weather patterns around the planet are disrupted and tens of thousands of temperature and storm-intensity records have been shattered. And this is just the beginning of much worse developments to come.

The average American emits 20 tons of carbon dioxide every year. Each European emits an average of about 10 tons per year. The poorest four billion of the 7.5 billion people on Earth emit an average of 1 ton of carbon dioxide each year. Altogether, humanity emits around 40 billion tons of carbon dioxide into the atmosphere annually. Most scientists agree that we need to reduce these global greenhouse gas emissions by 50% by the year 2050 to prevent serious damages to economies and ecosystems.

Voluntary individual actions will never be enough to achieve this goal. Effective collective action is necessary. To rely on people to individually choose to reduce emissions is a strategy that distracts us from this overarching necessity. When communities at large are forced to pay the price for these global disruptions, there is not an adequate incentive for individual people to take bold steps to prevent them.

"Self-interest, not self-sacrifice, is what induces noticeable change. Only the right economic policies will enable us as individuals to be guided by self-interest and still do the right thing for the planet."

--- Gernot Wagner, *Going Green but Getting Nowhere*, The New York Times, 9/8/11

A compelling documentary film titled *The Island President* won the best documentary award at the 2011 Toronto International Film Festival. The film followed then-President Mohamed Nasheed of the Indian Ocean island nation of the Maldives and his struggle to heighten awareness of the dangers of global warming and related increases in sea levels that are being caused by thermal expansion and melting glaciers, ice sheets and polar icecaps.

The Maldives consist of almost 1,200 islands that have an average ground level less than 5 feet above sea level. It is the nation with the "lowest highest point in the world" -- less than 8 feet above sea level. President Nasheed understandably spoke out boldly on the need for worldwide efforts to reduce global deforestation and emissions of carbon dioxide and other greenhouse gases. Without such efforts, his entire country could be submerged like a modern-day Atlantis under rising sea levels within the next century.

President Nasheed famously held a cabinet meeting underwater with scuba gear to highlight the existential threat that global warming poses to his low-lying nation of beautiful atolls. Later, after the failure of the 2010 Copenhagen Climate Change Conference to replace the Kyoto Protocol with a more effective mechanism to limit greenhouse gas emissions, Nasheed declared that the nations of the world must act soon to prevent catastrophic climate change. "We do not have the luxury of time to meet year after year in climate negotiations", he said. "We cannot cut a deal with Mother Nature." Trump may pretend to think different, but he is wrong.

Another cautionary tale can be found in the failure of the native peoples of Easter Island in ancient times to heed the dangers of their deforestation activities and population growth. They depleted their resources by cutting down every tree on their home island, and this led to the collapse of their civilization, as related by Jared Diamond in *Collapse: How Societies Choose to Fail or Succeed*. Rats!

Another island calamity is related in *Chapter #2 - The Astonishing Parable of Nauru* in the Earth Manifesto's *Comprehensive Global Perspective: An Illuminating Worldview*. These understandings provide clear insights into past follies, along with advisory stories about the need to heed the risks of ignoring this most consequential challenge in the history of human existence. These narratives make it clear that the pursuit of business-as-

usual activities is far more foolhardy than working together to make far-reaching fair-minded changes in the status quo. And to go backwards is downright dumb.

Coastal flooding and other ecosystem disruptions caused by global warming are bringing on much more dangerous and costly security risks than any conceivable terrorist threats. The number of refugees from environmental disasters in the world will probably exceed 50 million people in coming decades as food shortages caused by climate change, drought and flooding take place in a world that is becoming increasingly crowded. Seeing this, we would be wise to shift our national priorities from an emphasis on spending trillions of dollars on the military to helping finance efforts to mitigate climate change, reduce desperate poverty, and encourage family planning. This course of action would be a much truer form of security in our homeland than efforts made since 9/11.

### Manifesto Interruption - May 2010

A terrible oil spill began fouling and poisoning a large area of the waters of the Gulf of Mexico on April 20, 2010. This ecological disaster was caused by an explosion on an oil rig that had been drilling a well 5,000-feet-deep in the ocean floor of the Gulf. The energy giant BP had been taking big risks and short cuts in order to make larger profits. BP had made nearly \$200 billion in profits in the previous decade, but despite such huge profits, the company decided not to install a relatively inexpensive safeguard device known as "a remote-control shutoff switch on a blowout preventer" for the oil well where a subcontractor, Transocean Ltd., was using a deep water drilling rig to "drill, baby, drill" for oil. Such devices are required by Brazil and Norway to protect the environment from oil spills, and such a mechanism might have prevented this disaster.

BP did not install this safety device so that it could save \$500,000 on the drilling project. The lack of such a safety device contributed to the explosion that destroyed the \$350 million 'Deepwater Horizon' oil drilling rig, so it was not only a reckless environmental gambit but also a very costly business decision. The total costs to BP of this environmental disaster will probably be around \$20 billion. These facts make it abundantly clear that short-term-oriented profiteering can be terribly irresponsible. Risky deep-water drilling projects obviously should be subjected to more thorough and sensible rules and oversight.

This environmental debacle exposed oil industry deceptions and their inadequate concern for technologies related to safety and oil spill clean-ups. It also revealed poor government oversight and the egregious extent to which industry has had too much sway with rule-making by federal agencies. The Minerals Management Service is an arm of the federal Interior Department that had already been known to have serious conflicts of interests in its responsibilities. It had previously been embarrassed by its Denver office, whose employees were found to have accepted gifts from representatives of energy companies and even partied with them and used drugs and had sex with some of them during the years of the Bush administration. Now that's some conflict of interest!

It is highly ironic that a corporation that gives itself a company name of "Beyond Petroleum" adheres to such bad practices as skimping on safety devices and manipulating environmental rules to produce bigger short-term profits from the rashly wasteful exploitation of fossil fuel resources. Revelations by investigative journalist Greg Palast show that BP had a role in the Exxon Valdez oil spill and in other spills in Alaskan waters and on the trans-Alaska pipeline. This casts a much different light on BP's true character than their public relations spin attempts to portray.

The cynical character of the Goddess of Irony reveals that she just seems to love poetic justice, even if it is dirty. The Gulf oil spill was an ecological disaster that came on the heels of a national tragedy in which 29 coal miners died when a West Virginia coal mine exploded on April 5, 2010. This coal mining tragedy was caused by lax worker safety concerns and violations of rules by giant conglomerate Massey Energy, another bad actor in the energy industry and on the political stage. Don Blankenship, the CEO of Massey Energy at the time of the calamity, spent one year in prison for his culpability in the coal mine explosion. Specifically, Blankenship was convicted of conspiracy to violate mandatory federal mine safety and health standards, conspiracy to impede federal mine safety officials, making false statements to the Securities and Exchange Commission and securities fraud. Fast forward to 2018, and Blankenship is a staunch Trump supporter and crony who is running

to be a U.S. Senator from West Virginia despite his complicity in conservative swindles against the common good.

Concerns for workers and the environment often take a back seat to making big profits, and governmental entities are often too cozy in their collaboration with industry, especially when they allow environmental damages and harm to workers to be externalized onto taxpayers. The costs of reasonable protections for workers and the environment should be borne by industry, and thus included in costs of products and services, instead of being allowed to be externalized onto society. We simply should not allow CEOs and investors to benefit in the short term by foisting large costs onto taxpayers and workers and people in future generations.

Our national and international dependence on oil and coal involves costs that significantly exceed the price we pay for gasoline, heating oil and electricity generated by burning oil, natural gas and coal. Some of the costs not included are the adverse health impacts of particulate pollution and expensive environmental impacts associated with global warming gases generated when fossil fuels are burned.

Corporate propaganda denies the common sense obligation of corporations to bear these costs. When we allow harms to people and damages to the biosphere without requiring the corporations that cause the damage to pay the resulting costs, we effectively subsidize product prices and distort buying decisions, and also contribute to a wide variety of social and ecological problems.

Ever more costly environmental tradeoffs are involved with our society's increasingly wasteful demands for more fossil fuels. Drilling for oil on U.S. lands gave way to drilling in shallow waters as oil reserves were depleted, and this has given way to riskier drilling in deeper waters. In 1985, only 6% of oil in the Gulf of Mexico came from wells drilled in water more than 1,000 feet deep. In 2009, more than 75% of oil in the Gulf came from such deep-water wells. The inescapable conclusion is that we should use engineering smarts to figure out good ways to use less energy and develop cleaner and 'greener' alternatives rather than riskier, dirtier and more environmentally harmful technologies.

Many people deny that human well-being is tied intricately to the health of Earth's biosphere. They do this mainly due to motives of greed and narrow self-interest. Those who make such denials are perpetuating a deception that should be rejected. Expedient courses of action are often too short-term oriented to be consistent with the best plans for the greater good. We simply should stop allowing so many costs to be externalized onto society and future generations.

"Drill, Baby, Drill" has served as a snappy, cheer-engendering electioneering slogan for the Republican Party, but conservative politicians have simplistically ignored larger issues and deeper complexities. This environment-bemadened slogan was used to rally faithful diehard conservatives who applauded wildly at the Republican National Convention in Minnesota in 2008, but the slogan was stupid from standpoints of more rational and broadminded thinking. Two years later in May 2010, in the aftermath of the ecological disaster in the Gulf of Mexico, a newspaper headline conveyed a funny understatement: <'Drill, baby, drill' has lost its luster>. This slogan represents a lustily mindless and irresponsible attitude toward drilling for oil with a minimum of common sense regulation, in light of the real ramifications of such activities.

The whole idea of allowing Big Oil companies and other huge corporations and multinational banks to take environmental and financial risks, and to then saddle taxpayers with cleanup and bailout costs, is too unfair, shortsighted and foolishly wrongheaded. Republicans in the Senate like Mitch McConnell and Lisa Murkowski have made tortured arguments to defend the paltry \$75 million limit on liability that legally pertained at the time of the Gulf oil spill for companies involved in environmental disasters caused by offshore oil drilling. But their dogmatic assertions begged a question: Why should fishermen and tourist industries along the Gulf Coast, and taxpayers, be saddled with crippling costs, instead of the cash-rich oil companies whose activities are the direct cause of such ecological harm?

Republicans tend to obstruct progressive initiatives for political reasons. But it is sensational that "conservatives" seem to champion rash risk-taking as a central tenet of their doctrines, rather than supporting

more responsible and truly conservative approaches. The human race will have burned practically all of the remaining one trillion barrels of known reserves of oil on Earth within the next 50 years, and huge amounts of dirty coal, with uncertain but likely catastrophic impacts on Earth's ecosystems and the global climate and normal sea levels. This could become the ultimate cause of extinction of a large proportion of all species of life on Earth, with far-reaching implications, including a serious threat to our own future well-being and maybe even the survival of our kind.

A prudent and responsible course of action would be to begin making a concerted Apollo-mission-type national effort to jump start an inevitable and necessary transition to alternative cleaner renewable forms of energy to power our civilizations. Simultaneously, we should implement bold conservation and efficient-use measures rather than squandering fossil fuels at nearly the fastest possible rate.

Our best national strategy would be to follow an honest and reasonable "no regrets" approach to energy policies. This approach should be focused on actions and behaviors that are consistent with the common good, and with social responsibility, shared prosperity and ecological intelligence. This 'no regrets' idea is the basis for the Precautionary Principle, as enunciated in Principle 15 of the 1992 Rio Declaration on Environment and Development. It states: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The insightful book titled *The Corporation - The Pathological Pursuit of Profit and Power*, and also the provocative Canadian film "*The Corporation*" that is based on the book, both provide compelling understandings of the sometimes-*psychopathic* character of corporations in their dealings with people and their employees and the environment. In the film, a psychologist and FBI criminal profiler named Dr. Robert Hare describes the many ways that corporate behavior closely corresponds to a checklist of characteristics that the World Health Organization uses to define psychopathic personalities in individuals. These characteristics include a callous unconcern for the feelings of others, a reckless disregard for the public safety, deceitfulness, repeated lying, conning others for profit, an inability to experience guilt or remorse, and a failure to conform to social norms regarding lawful behavior. When disasters strike, corporations like BP and Massey Energy are revealed to have been manifesting these sociopathic and ethically pathetic characteristics.

"Accidents happen", say apologists for the recklessness with which the human race is treating Mother Earth and Gaia's ecosystems. Just after the record oil spill began in the Gulf of Mexico, politician Joe Lieberman said exactly this to rationalize more offshore drilling. Such people are, of course, quite right. Accidents do happen, and they are much more likely to happen when precautions are valued less than profits, and when ecological integrity is valued less than short-term goals, and when people are valued less than the money that can be made and the power and privileges that can be gained by following greed-driven strategies and ideological deceptions. We should find ways to minimize risks to workers and reduce the extensive damages being caused to ecological habitats.

Images are often more impactful than words. Certainly the images of an oil rig exploding in a fireball were evocative. So were the images of big quantities of oil spewing out of a deep pipe, and beaches being fouled, and wildlife dying, and wetlands being damaged, and the livelihood of fishermen being compromised. Images of bodies being pulled from coal mines where safety regulations were notably lax were also viscerally compelling. Images like this are more powerful than words about corporate responsibilities and precautionary principles. Since images are so emotionally influential, they force us to consider the complexities involved in the defense of the status quo, and the lack of wisdom in allowing profit-prepossessed corporations to unduly influence our national decision-making.

See *The Reality and Ramifications of Peak Oil* in this manifesto for further perspective on the issue of our addiction to fossil fuels. Environmental, political and economic concerns like these are echoed throughout these writings, even rather repetitiously, I reckon. A modern incarnation of Mark Twain would have said so! But it is one of the main purposes of these writings to bring close attention to such problems, so I will repeat them over



and over again in the hopes that such understandings will reinforce the potential for this manifesto to become a force for positive change in altering our economic and political systems, which foolishly allow and even encourage such madness.

### Accolades Galore for Galileo Galilei

Myopia is a narrow view of something that is caused by a lack of foresight or discernment. The vital importance of seeing a bigger picture, rather than clinging to myopic worldviews, has inspired me to speculate that Galileo Galilei could be considered one of the most important scientists in history.

Two of the most revolutionary instruments ever invented were far-seeing telescopes and infinitesimally small-seeing microscopes. Both of these instruments have helped humankind to see the world in a new light, and in a much more expansive way. Galileo Galilei was the scientist who improved these optical technologies more than any other person. His vast improvement of primitive optical glass lenses from the Netherlands early in the 17th century allowed him to confirm the earlier hypothesis of Niccolo Copernicus, who had asserted that the Earth is not the center of the Universe, and that in fact it is a planet orbiting the Sun.

This helped explain why there were "wanderers" in the night sky that did not conform to the pattern of all other bright objects in the sky -- the stars -- because the wanderers were planets that were also in orbit around the Sun, and therefore did not hew to the seemingly otherwise fixed nightly procession of all the stars traversing the night sky around the North Star. It wasn't long before the idea was conceived that the Sun was not the center of the Universe either. Then in the 1920s, humble Missouri native Edwin Hubble discovered that the Milky Way is not even the whole Universe, and that instead there are billions of other galaxies, and that the center of the Universe is billions of light years away from us, presumably where a Big Bang inception took place almost 14 billion years ago.

Galileo's invention of a compound microscope also gave us an expanded ability to see. He called it "occholino" or "little eye", and one of his friends coined the term *microscope* for this revealing instrument. Today, an even more important instrument is evolving into existence, and Galileo pointed the way to this third epic invention with these words: "I do not feel obliged to believe that the same God who has endowed us with senses, reason and intellect has intended us to forgo their use and by some other means to give us knowledge which we can attain by them."

This third tremendous technological advance is now being heralded on planet Earth, and it will be known as a **MACROSCOPE**. One of the great marvels of this new instrument is that it's free, and available immediately! In addition, no special knowledge or training is required to use it, in theory. It is a virtual instrument that is a type of Instantaneous Lucidification device that allows anyone using it to focus sharply on any issue of interest.

It is being marketed as *Super Spectacles* that have three fabulous features. First, they allow anyone to see any issue with vastly improved clarity. These glasses work on a principle similar to an integration of the optics of a high-resolution telescope and a powerful electron microscope. You put these hyper-reality glasses on, and look around ... and see startling clarity in every issue.

These Super Spectacles also provide a brilliant big picture perspective of the true nature of any contention. And these ingenious optical instruments let you see through flimsy thinking, straight to the heart of a matter, and to do so instantaneously, without need for a studious analysis. They accomplish this feat by utilizing an optional Humor Mode adjustment that provides a simultaneous appreciation of irony and absurdity, mixed in with the profound perspective. This marvelous feature can make the viewer laugh right out loud, and thus it is ideal for assessing a situation and then galvanizing an attentive viewer's ideas into a powerful response capable of motivating millions of people to join in and help change the staunchly staid status quo in vitally positive ways.

The first time I put on my *Macroscopic Super Spectacles*, I was immediately transported into an earlier version of myself in my twenties, and I saw myself snorkeling through a coral reef community surrounding Treasure Island in the western part of the Fiji Islands archipelago. A Giant Grouper the size of a Volkswagen Beetle

swam slowly past me, and colorful Parrotfish were going about their rounds feeding near the corals. I could clearly see that the Parrotfish had a symbiotic relationship with the corals in the reef, and that their activities incidentally benefitted the health of the entire coral reef community. A small school of squid sailed past me through the water in a profusion of activity, revealing their own fascinatingly unique mode of propulsion. Suddenly my heart almost stopped as a Great White Shark loomed into view from out of the depths below, where the coral reef that fringes the island drops off into deep obscurity despite the excellent visibility of the stunningly clear waters. The shark seemed to look askance at me with its steely eyes, but it apparently thought my svelte bikini-clad body looked like an unappetizing mortal morsel, and there were plenty of other delicious fish in the sea.

I blinked hard as the scary shark slowly cruised past, and presto! -- my Macroscope lenses instantaneously transported me like one of those old ViewMaster Slide Shows to a different scene in the tropical rainforest of Costa Rica. Here I was in a new habitat that was even more biologically diverse than the coral reef community. The rainforest has a riotous diversity of life forms, but I saw only one: two feet in front of my nose was a Red-Eyed Tree Frog. You really should view this species of amphibian online to appreciate their colorful markings -- it is as if they had been painted by a masterful but rather unhinged creative artist who had little sense of moderation in her wanton use of the brightest colors in her artist's palette. The Super Spectacles provided a very nicely illuminated understanding that this frog is an important indicator species that happens to be affected by environmental changes in tropical rainforest habitats much sooner than other types of wildlife. Sadly, these beautiful frogs are on the brink of extinction. In contrast, humanity itself is a lagging indicator; our human numbers continue their robust growth despite the fact that this is NOT a sign of ecological health. In fact, our numbers are a contra-indicator because, as our human numbers grow and grow, the fates of almost every other species on life on Earth are adversely affected. This insight made me reflective, but then the brilliant feature of the Humor-mode of the Macroscope modified my perception and allowed me to see that today is the first day of the rest of our lives, and that NOW is the best starting point for appreciating life AND for making a positive difference to create a healthier world in the future.

The next shift was peculiar, but once again sensational. All of a sudden I saw myself sitting in a lecture hall listening to a talk on "The Tragedy of the Political Commons". A foremost authority on trickle-down theory was speaking, and Voila! -- I saw the real nature of this ideology. Curiously, this perspective was highly contradictory to the one provided by an expert parroting Fox News points-of-view who declared that the only way to a better world is to give rich people more of the benefits of the economy so that some crumbs will trickle down to the masses. The masses, you know -- you and me! Instantly, I realized that this is a rude rationalization for a slick swindle, a tawdry trick, and a dogmatic justification for deficit-financed low tax rates that are exceedingly generous to the rich at the expense of other taxpayers and all people in future generations, i.e., those who will be forced to pay for the interest costs on borrowings that finance this generosity. The Super Spectacles, in effect, reveal the folly of allowing wealthy people to rig the system to give themselves huge slices of sensationally rich desserts so that a few crumbs might fall to the hungry huddled masses below.

The expansive vision of the Macroscope allowed me to see as clear as day, as if I was again on top of a vaulting mountain peak on one of those exceptionally clear winter days when you can see more than 100 miles in every direction. I saw that there are many types of thefts, scams, swindles, petty frauds, Grand Thefts, and Ponzi schemes. Prisons are crammed full of people who have been caught red-handed engaging in small-time versions of these illegal behaviors. The big-time cheats, however, are much more shrewd, and they live in mansions, not prisons. They use their money to manipulate the rules of the system so that they are actually encouraged to commit their mega-crimes, and these crimes are ones that reckon ill-gotten gains in the billions, not in chump change. Their crimes additionally cause widespread hardship and havoc when the game is finally up, and then, astoundingly, instead of the perpetrators being forced to pay, or to be thrown in jail for fraudulent activities, it is taxpayers who are stuck with very high costs in the form of multi-trillion dollar bailouts. This is socially irresponsible disaster capitalism at its worst. Much better design is possible!

## Mark Twain's Perspective

Mark Twain regarded with awe the 70,000-pound iron meteorite called Ahnighito (Ah-na-HEET-o) that had been brought from Greenland to the Museum of Natural History on the Upper West Side in New York City, and he also marveled at the museum's dinosaur skeletons. According to his friend and biographer Albert Bigelow Paine, "To him, these were the most fascinating things in the world. He contemplated the meteorites and the brontosaur, and lost himself in strange and marvelous imaginings concerning the far reaches of time and space whence they had come down to us."

Interestingly enough, the world's leading scholar of mythology, Joseph Campbell, had been inspired as a boy in this same Museum of Natural History that had so intrigued Mark Twain's imagination. Joseph Campbell had been excited by trying to understand who had made the totem poles and mysterious masks from British Columbia, and exactly what they may have meant to the native people.

Visualize the Earth during the 90% of its 4.5 billion year history before there were any terrestrial habitats because no form of life had yet ventured out of primordial seas. All landscapes were crumbling rock like that of high alpine peaks or rock detritus in outwash plains. No vegetation or trees had yet evolved on land, so there was no organic soil. In the steepest places on mountains, rock has a propensity to erode down precipitous declivities, forming steep talus slopes that reveal the physical principle known as "the angle of repose".

I evoke this visual picture obliquely, because the Earth Manifesto is vaguely haunted by Rodman Ward, a character in Wallace Stegner's famous book, *The Angle of Repose*. "Like other Berkeley radicals, Rodman is convinced that the post-industrial post-Christian world is worn out, corrupt in its inheritance, helpless to create by evolution the social and political institutions, the forms of personal relations, the conventions, moralities, and systems of ethics (insofar as these are indeed necessary) appropriate to the future. Society being thus paralyzed, it must be pried loose. He, Rodman Ward, culture hero born fully armed from this history-haunted skull, will be happy to provide blueprints, or perhaps ultimatums and manifestos, that will save us and bring on a life of true freedom."

Sometimes I feel like I too am a Berkeley radical from the late Sixties rather than an earnest gal from Hannibal, Missouri who is following the vanguard of the Baby Boom. This manifesto, after all, is an ambitious and somewhat quixotic endeavor designed to save the world and liberate our thinking from complacency and the blinders of corporate propagandists, narrowly-focused entrenched interest groups, self-serving politicians and stubbornly faithful believers in fundamentalist religions.

Look at it this way. At the Gaia level in the scheme of things, humanity is quite expendable. In fact, from the standpoint of most other forms of life on Earth, it would actually be a boon if we were gone already! But our conscious awareness is surely an astounding aspect of existence, because it reflects so perceptively on the physical universe and life and evolution and the practically unfathomable expanses of time and space in which we find ourselves. Our extinction would be a terrible tragedy because this pinnacle of reflective perception would be snuffed out forever. And it would of course be a tragedy of the most stupendous proportion for ourselves. Our big brains have helped us succeed, but if we want to survive indefinitely into the future, we simply must begin to figure out how to live in ways that are less damaging and more truly sustainable.

Many people believe that technology will save us, and that "the market" with its laws of demand and supply will always deliver substitutes as we deplete non-renewable resources. These people tend to play down the risks of our continuing to exploit renewable resources like fresh water aquifers at rates that exceed natural rates of replenishment. Unfortunately, most technological advances are geared mainly for more efficient exploitation of resources, not for more intelligent courses of action like conservation or frugal usages.

Some new technologies are naturally focused on creating better alternatives. Again unfortunately, established interest groups often oppose new innovative technologies. New inventions are also often useful for "evil purposes" -- like wars of aggression -- instead of "good purposes" like ecologically sane initiatives to make our

civilizations indefinitely sustainable. Our curious collective failure to see how shabbily we are treating our descendants in the future surely defies good understanding!

This largest of contexts, involving our legacy to future generations, is the main concern of the Earth Manifesto. See *Comprehensive Global Perspective, An Illuminating Worldview*, along with prescriptions for saner actions in *Common Sense Revival*, for visionary and positive proposals that would help assure better future outcomes for humanity. This has been the underlying motivation for the writings in this save-the-world manifesto. Read on!

### Insights Related to Easter Island

Think about the geographically most remote inhabited place on Earth. It is an island in the South Pacific two thousand miles west of the South American continent. Its original inhabitants knew it as Rapa Nui. It had taken the human race more than 100,000 years to find Rapa Nui after spreading out from Africa to the Middle East and Europe and China and Southeast Asia. Many millennia after early explorers had found North America and South America, courageous Polynesian adventurers sailed the vast expanses of the Pacific on large wooden sailing canoes using 'dead reckoning' to navigate (this was at a time long before the invention of modern navigational instruments). A small contingent of them had discovered Rapa Nui about 1,600 years ago, and they settled down and lost contact with their ancestors who lived on islands hundreds of miles to the northwest. They set about building an agrarian culture that became obsessed with building monumental stone statues.

When Dutch sailors discovered the island of Rapa Nui on Easter Sunday in 1722, they named it Easter Island. The island has an area of about 64 square miles, and consists of a number of volcanic cones that vault up from an ancient hot spot deep below the surface of the Earth's crust on what is known as the East Pacific Rise. All of the tall stone statues had been carved from volcanic rock in a crater named Rano Raraku on the northeast side of the island. The largest of hundreds of stone statues that were carved and transported out of this crater weighs an estimated 87 tons. Some apparently megalomaniacal chieftain had managed to have a statue carved that would have weighed more than 200 tons, but it was too large to transport out of the crater. Were the Rapanui short on foresight?

The people of Rapa Nui knew nothing about birth control, so their population increased steadily until they depleted their food and forest resources over a period of about 1,000 years. This ecological destruction eventually led to the complete collapse of their civilization. One might extrapolate and say that many modern human endeavors are almost equally obtuse in their disregard for the implications of their depletionary impacts and the extent to which they cause damages to vital natural systems. We are not much different in the USA today, or around the globe, than the Rapanui people. We are all somewhat like the Roman Emperor Nero, who figuratively fiddled while Rome burned.

The geology of Easter Island is interesting. A heavy basaltic chunk of the Pacific Plate called the Nazca Plate is splitting away from the Pacific Plate along the East Pacific Rise. Molten lava erupted forth from this fissure until volcanoes there rose above sea level and formed what we know today as Easter Island. On the far boundary of the Nazca Plate to the east, the plate is colliding with the South American Plate and subducting into the deep Peru-Chile Trench. As this rock has subducted beneath the South American continent, plunging under the continental crust and melting into magma, it has created 67 active volcanoes that tower in the awesome Andes Range, inland from the coast and parallel to it. The Andes Mountains stretch thousands of miles from Colombia to Ecuador, Peru, and the southern tip of Chile. This is one of the oldest mountain ranges in the world, and yet its volcanoes are still very active today.

The North American continent also has an interesting geophysical genesis. Old sedimentary rocks of the ancient Colorado Plateau can be seen to have been uplifted long after their deposition and lithification. This uplift has exposed rocks that are dated to be more than one billion years old. Lithified footprints can be found in these rocks that are revealing remnants of creatures that lived before the biotic catastrophe known as the Permian Extinction, which took place 250 million years ago.

In contrast to the old age of the Colorado Plateau, the beautiful mountains of the Sierra Nevada in California have been uplifted within geologically recent times -- within the past 5 million years or so. The granite of the Sierra Nevada formed when the Pacific Plate subducted deep into the Earth and melted into a vast pool of magma that cooled slowly under what is today eastern California. This cooling and hardening process took place over a period of maybe 100 million years. Then, relatively recently, the 400 mile-long and 50 mile-wide and indeterminately deep granitic batholith began to be uplifted. Older metamorphic rock that covered it has mostly been eroded away, exposing this wondrous granite that evocatively exfoliates according to its physical nature. Likewise, the dramatic volcanic peaks of the Cascade Range in Washington, Oregon and northern California have also been formed geologically recently, in the past several million years, in an active tectonic and volcanic process similar to the process that created the Andes.

### Geologic Consequences of Plate Tectonic Activities

Mt. St. Helens is an active stratovolcano in the Cascade Range about 100 miles south of Seattle in the state of Washington. This volcano underwent a catastrophic eruption in May 1980. In an instant, the top 1,300 feet of the summit of the mountain, and the entire north face of the volcano, were blasted off. Fifty-seven people were killed and large swaths of forest were blown down like matchsticks. Hundreds of homes and many miles of highways were destroyed.

I climbed to the summit of this beautiful 8,365-foot tall volcanic mountain from the south side in 1998, eighteen years after this eruption. A knowledgeable gal friend accompanied me who has hiked to the top of all 54 of Colorado's mountain peaks that are taller than 14,000 feet. We ascended through dense forest and then up through a jumble of jagged volcanic rocks that clearly were extruded in a molten state and had solidified into all manner of fantastic shapes. When we reached the crater rim, the view was spectacular. To the north, the top 5,000 feet of the mountain's flanks are missing. A new dome is building in the bottom of the eviscerated cone as the magma chamber underneath the mountain is being slowly replenished with more molten magma. The 1980 eruption had poured huge quantities of lava and ash, together with thousands of trees, into once beautiful Spirit Lake, just to the north of the volcano. Almost instantly, the surface level of Spirit Lake was raised by 200 feet. The landscape in the vicinity has been slowly recovering since then, as wildflowers and vegetation and trees grow back in the mineral-rich volcanic soil.

Mt. St. Helens is geologically quite young. Geologists say it formed through a series of eruptions over a period of the last 40,000 years. This compares to the older volcano fifty miles to the north, the spectacular 14,412-foot Mt. Rainier, whose lava flows date back to beginnings more than 850,000 years ago. The entire range of the Cascades, which extends from British Columbia to northern California, has been created by the forces of movements of Earth's tectonic plates. A relatively small portion of the oceanic crust known as the Juan de Fuca Plate lies between the giant Pacific Plate and the large North American Plate, and this small plate is slowly subducting beneath the North American Plate. As it does so, the oceanic crust and some seawater that accompanies it are forced down under the continental crust at an angle of 30 to 45 degrees. As it dives down, the basalt rock and overlying sediments melt with the heat and pressure, and supercritical fluids rise into the overlying mantle. This causes the rock to melt and rise, creating large reservoirs of magma that are the source of all the volcanoes in the Cascades. Similar processes are responsible for the volcanic activity all around the Pacific Ocean's "Ring of Fire", where more than 90% of the world's active volcanoes are found.

*The Really Big One* is an exceptionally informative, intriguing and revealing story about the tectonic forces building in the Pacific Northwest. This brilliant article is one of the best examples of geologic sleuthing ever published. It is the story of the powerful earthquake that will someday strike the Pacific Northwest, and likely in the not distant future, as the Juan de Fuca Plate continues its slow subduction under the North American Plate. One of the most interesting insights in the article enlightened me with regard to the intensity of earthquake shaking. I have felt a fair number of earthquakes during my lifetime, and I would generally think that when I felt a moderate earth tremor, it was either 5-ish on the Richter scale if the epicenter was not far away, but 9-ish if it was many hundreds of miles away. It turns out that such a speculation is not strictly the

case. The power of an earthquake is correlated to its duration, so an earthquake that is less than 30 seconds in duration is not a real big one, while one that persists for four minutes or more is likely very powerful.

It also turns out that the potential maximum magnitude of any earthquake is strongly correlated to the length of an earthquake fault, so to the great surprise and chagrin of people living in the Pacific Northwest, the potential biggest Big One on the Cascadia fault that stretches from northern California to northern Vancouver Island is more intense than the biggest Big One possible on the infamous San Andreas fault in California.

### Astonishing Occurrences in the Physical Evolution of Planet Earth

Imagine traveling through the islands of Indonesia in the late 1970s. You land on the southern tip of Sumatra, the sixth biggest island in the world, and you take a rough bus ride for 24 hours from the southern end of the island to an inland body of water known as Lake Toba. This is the largest lake in a volcanic caldera in the world. It is 50 miles long and 15 miles wide, and it has a large island in the middle named Samosir Island. The boats that once took locals and a few tourists out to the idyllic island were so dilapidated in that era that the crew would bail water out of the 200-passenger ferries during the entire trip across the lake. It was a real adventure! The local Batak people live in the small communities on Samosir Island in colorful houses that have a distinctive architecture resembling the hulls of ark-like boats.

Lake Toba is an ancient volcanic caldera that has partially filled with fresh water, similar to Crater Lake in Oregon. Geologists say that the Toba caldera is a remnant of the largest volcanic explosion on Earth in the last 25 million years. This eruption took place about 75,000 years ago. The explosive eruption of hot magma that eventually resulted in the deep crater that became Lake Toba is estimated to have ejected about 670 cubic miles of lava and ash. For perspective, the 1980 explosion of Mt. St. Helens ejected less than one cubic mile of material, and as mentioned above, Mt. Mazama is estimated to have ejected about 12 cubic miles of lava and ash when it underwent its climactic eruption.

The Toba explosion threw so much volcanic particulate matter into the atmosphere that it caused many years of 'volcanic winter'. This stressed all forms of life to such an extreme degree, as Bill Bryson states in his fascinating book *A Short History of Nearly Everything*, that "The event, it is thought, may have carried humans right to the point of extinction, reducing the global population to no more than a few thousand individuals. That means that all modern humans arose from a very small population base that survived in the Rift Valley area of Africa, which could explain our lack of genetic diversity."

Another famous lake-filled caldera is Yellowstone Lake in Wyoming. Covering 136 square miles, this is the largest freshwater lake above 7,000 feet in elevation in North America. The Yellowstone vicinity, like the Big Island of Hawaii, lies over a hot spot in the middle of a tectonic plate. A hot spot is a "stationary thermal plume rising from deep within the earth's mantle". According to Wikipedia, 142 or more caldera-forming eruptions have occurred from the Yellowstone hotspot within the past 17 million years. Yellowstone Lake itself lies in three discernable overlapping calderas that were created by violent eruptions above the hot spot within the past 2 million years. It is estimated that these enormous eruptions spewed out ash and lava in quantities exceeding 2,500 times that of the impressive eruption of Mt. St. Helens in 1980.

Bill Bryson states that supervolcano eruptions in Yellowstone have averaged "one massive blow every 600,000 years. The last one, interestingly enough, was 630,000 years ago. Yellowstone, it appears, is due." Bryson also notes that an early eruption from the hot spot below Yellowstone took place about 12 million years ago that caused so much ash to be deposited a thousand miles to the east, in what is now eastern Nebraska, that it killed many kinds of animals there. Fossils found at the Ashfall Fossil Beds State Historical Park in northeastern Nebraska include astonishing mammals from the early Pliocene like species of rhinoceroses, zebra-like horses, saber-toothed deer and camels. Saber-toothed deer in Nebraska! Rhinoceroses! Camels! Oh, my! Geological history sure is amazing!!

### Visualize This!

The most violent volcanic eruption in modern recorded history took place on August 27, 1883. This was the notorious explosion of the pointed conical island known as Krakatoa, which lies in the Sunda Strait, south of Sumatra and west of Java. Most of the island of Krakatoa was blown away in the eruption. Tsunami waves were generated that killed more than 36,000 people on the coasts of nearby Java and Sumatra. It is estimated that this phenomenal explosion ejected about 6 cubic miles of magma.

There are 21 active volcanoes on the island of Java alone, and 87 in the archipelago that includes the thousands of islands of Indonesia and the Philippines. Volcanoes occur in this area because the Indo-Australian Plate is subducting into the 25,000-foot-deep Java Trench and moving down under the Eurasian Plate. As the oceanic crust below the Indian Ocean subducts under the continental crust of Sumatra and Java, it melts in exactly the same natural processes as those that are creating the Cascade Range and the Andes Mountains. As molten magma rises towards the surface under Indonesia, it creates dangerous stratovolcanoes. This region has been prone to the most explosive volcanic activity in modern times of anywhere on Earth. Check out the informative book *Krakatoa: The Day the World Exploded* by Simon Winchester for an interesting description of this event and related facts.

### A Brief Interlude on Geological Understandings and Plate Tectonics

'Shield volcanoes' exhibit different types of eruptions of molten rock than stratovolcanoes. Shield volcanoes tend to pour forth streams of hot lava above 'hot spots' in the middle of Earth's crustal plates, instead of at the edges. Shield volcanoes tend to be less explosive than the Indonesian or Cascade stratovolcanoes that occur near the edges of converging plates. The volcanoes of the Hawaiian Islands are classic examples of shield volcanoes. Consider these mountains for a moment.

Mark Twain wrote an article titled *The Great Volcano of Kilauea* that was published in the *Sacramento Daily Union* in November 1866. He observed: "Occasionally the molten lava flowing under the superincumbent crust broke through -- split a dazzling streak, from five hundred to a thousand feet long, like a sudden flash of lightning, and then acre after acre of the cold lava parted into fragments, turned up edgewise like cakes of ice when a great river breaks up, plunged downward and were swallowed in the crimson cauldron."

Mark Twain was a man with a deep curiosity and a vivid imagination. He also had a keen capacity for insightful observation. He would have loved to have been able to gain a fuller understanding of the geological forces at work in Hawaii. But, alas!, the science of geology was still mired in relative ignorance, and many people were in denial of new ideas. Fervent embraces of dogmatic beliefs in biblical literalism still persisted widely in those days. Such convictions are a barrier to the open-minded attitude that allows us to see reality in more accurate and comprehensive ways. Those who cling to literal beliefs in Bible stories regard modern understandings as heresy, instead of seeing them as corresponding much more accurately to reality.

Charles Darwin published his controversial book *On the Origin of Species* in 1859, when Sam Clemens was just 24 years old. This was four years before Sam began calling himself by his famous *nom de plume*, Mark Twain. At the time, people who faithfully believed that the earth is the center of the universe were still firmly entrenched in determining humankind's worldviews. Knowledge of the actual nature of the geophysical processes involved in the physical evolution of Earth was still many decades away. In fact, the marvelous scientific theory of 'plate tectonics' was not clearly articulated until the 1960s. The natural processes were still largely unexplained in Clemens' time that cause "continental drift", earthquakes, seafloor ridges, seafloor spreading, and mountain building through 'basin and range' faulting and folding of Earth's crust. Native Hawaiians, for their part, attributed all volcanic activity to the roiling whims of an awe-inspiring goddess named Pele.

The geologic saga of the Hawaiian Islands makes an amazing story, and one that is too good to ignore. Though it was not well understood in Mark Twain's times, we can easily picture it today. Imagine looking down from a satellite onto a Pacific Ocean that has been completely drained of water. This visualization will help to fully understand the whole of a surprise that scientists discovered when the bottom of the Pacific Ocean was

charted after World War II. If you Google a seafloor map at "National Geographic Pacific Ocean Map", the ideas in this discussion will become clearer.

The mightiest range of mountains on the planet extends from just south of the Big Island of Hawaii to the Kamchatka Peninsula between Alaska and Japan. This mountain range begins abruptly just southeast of the Big Island of Hawaii, and extends to the island of Kauai to the northwest, and then it continues as tall underwater seamounts on the abyssal ocean floor all the way to the deep Kuril Trench to the north. The Kuril Trench is one of the deepest canyons in the world at more than 34,000 feet below sea level at its deepest point.

Mauna Kea, on the Big Island of Hawaii, is the tallest mountain in the world, as measured from its base on the Pacific Ocean floor to its summit, towering more than 33,000 feet above the deep Pacific plateau. All the mountains in this 4,000-mile long range are volcanic cones with steep profiles from top to bottom. This chain of volcanoes runs in what is a more-or-less straight line all the way across the Pacific seafloor, except for a "kink" in the line at a point northwest of Midway Island where the line of seamounts suddenly veers in a more northerly direction. This "kink" in the line of mountains has a fascinating genesis, as does the entire mountain range itself. Read on!

Our home planet, enveloped by a life-supporting oxygenated atmosphere, has a surface that is more than two-thirds covered by oceans. Earth is like a massive ball of rock 25,000 miles in circumference that has an extremely dense inner core, a molten outer core, a highly viscous mantle, a rocky outer crust, and a large amount of salt water covering much of its surface. Earth's outer crust is relatively thin, comprising only about one percent of the volume of the planet. It is composed of a number of enormous slabs of rock, called 'tectonic plates'. These plates basically float on the hot mantle below. The entire crust of the planet consists of about a dozen major plates, and twice as many minor ones. The Pacific Plate is the largest of these plates.

Earth's crust consists of two kinds of plates: continental crust, which averages 25 miles thick and is as old as 4,000 million years in places, and oceanic crust, which averages 5 miles thick and is nowhere older than 180 million years. There is a very good reason that the oceanic crust is so much younger than the continental crust. The maximum amount of time it takes for rock that spews forth at the leading edge of any of the oceanic crustal plates to move away from the fractured rift zones where they form, and to travel at an average rate of two inches per year all the way to where they subduct back into the Earth, is about 180 million years. Oceanic crust is denser than continental crust, so it generally subducts under the continental crust in slow-motion collisions at plate boundaries. Thus, the recycled rock of the oceanic crust disappears, while the continental crust survives much longer.

The Hawaiian Islands have been created by molten magma coming up from a hot spot in the Earth's crust in the middle of the Pacific Plate. This hot spot is located below the abyssal floor of the Pacific Ocean, which lies more than 15,000 feet deep. Since the oceanic crust beneath the Pacific moves about two inches to the northwest each year, new volcanic islands keep being created above the relatively stationary Hawaiian hot spot over the long span of geologic time. The volcanoes become dormant after sufficient movement away from their hotspot source of flowing lava, and then they become extinct. The older the islands get, the more dramatically eroded they become. The beautiful island of Kauai lies furthest to the northwest in the current chain of islands, so it is the oldest of the Hawaiian Islands, and as visitors can see, it is the most sensationally eroded.

The hot spot is currently under the Big Island of Hawaii. Lava flows out from the hot spot almost continuously through the crater of the volcanic mountain Kilauea, just as it did when Mark Twain visited in 1866. Volcanic activity is also taking place in a new fissure that is building a volcanic seamount just to the southeast of the Big Island. This mountain has already been named the Loihi Seamount. It towers more than 10,000 feet above the sea floor, but is still about 4,000 feet below sea level. Scientists estimate this seamount will become a new Hawaiian island in about 100,000 years, when the flowing lava finally makes the volcano tall enough to reach sea level. But "the rest of the story" is even more interesting. Kudos to the late Paul Harvey, who entertained us for so long with his radio broadcast explanations of *The Rest of the Story!*



Natural processes of weathering and erosion wear mountains down. Once any mountain stops being uplifted or replaced by volcanic flows, erosive processes begin to reduce it to a mere remnant as the long geologic eons pass. The chain of seamounts found in the Hawaiian Ridge, and in the Emperor Seamounts that continue further to the north, consist of former Hawaiian islands that have been eroded down and whose weight has pressed into the ocean bottom until they no longer reach the surface of the sea. At its farthest northern end, this chain of mountains is slowly subducting back into the Earth in the deep trenches of the northern Pacific, at the far edge of the Pacific Plate.

As noted, the most explosive volcanic activity on Earth takes place at plate boundaries, not at the more unusual 'hot spots' in the middle of tectonic plates like that under Hawaii. Boundary volcanoes are of basically two types: ones at the formative edges of plates, where new oceanic crust is being created in undersea ridges, and ones just inland of the boundaries where oceanic plates subduct under continental plates. During the process of subduction, oceanic crust at 'convergent' plate boundaries melts down into hot pools of magma under the edge of the continents. This is why earthquakes and volcanoes are common there, in this Ring of Fire around the coasts of the Pacific Ocean where subduction occurs. Alaska, the Pacific Northwest, South America, New Zealand, Indonesia, and Japan all have active volcanoes just inland from these plate boundaries of this Ring of Fire.

### An Aside Concerning Simple but Accurate Understandings -- and the "Kink"

I love simplistic understandings. In other words, I love relatively accurate ways of seeing things, as opposed to simple-minded and preposterous ones like those contained in ancient holy books that basically theorize that Presto! -- a Supreme Being made things the way they are, and that's the way they have been ever since! Mark Twain loved to tell tall tales, but he also loved deeper truths. He was known for his irreverent skepticism, and he would have been eager to know more about the actual geological processes that affect our planet. Many such things have become far better known in the century since his death in 1910.

The simplistic understandings that I value most are those that are rudimentary versions of underlying greater complexities. I highly recommend watching *How the Earth Was Made*, a video presentation of History Channel that provides provocative insights and valuable perspective concerning Earth's physical evolution from its formation about 4.5 billion years ago until the current day.

Most scientists are not good at clearly communicating their understandings. Some, however, like writer John McPhee and physics professor James Trefil, are known for being able to explain complex topics in simple terms to non-scientists and a general audience. James Trefil, for instance, tells readers in *Meditations at Sunset* exactly why the sky appears to us to be blue on a sunny day.

In his enlightening book *Basin and Range*, John McPhee relates stories about his travels and talks with expert geologists as he traveled with them around the American West, where they explored rock formations that naturally revealed compelling insights. He explains how geological understandings were deduced from such explorations, and how this led to a greater comprehension of how Earth geophysically evolved. In doing so, he explores the scientific evolution of geologic knowledge. He writes about James Hutton, "the father of geology", who discovered and named the revelatory phenomenon known as an 'angular unconformity' in England in 1787.

Recall that an angular unconformity is a place where two contrasting layers of sedimentary rock formations lie at different angles to each other, revealing that different eras of rock formation have taken place. The lower layers of rock in angular unconformities had been displaced out of horizontal positions of their deposition long after their formation. This was followed by a new era of submersion and sedimentation and lithification in layers askew from those of the earlier era, and this assemblage was later uplifted into the position where they are found today. This discovery led to the confirmation that the age of the Earth has been very, very, very long, and definitely NOT merely Biblically short. Hooray, Ouray!

A period of intellectual ferment followed this discovery by James Hutton. During this time, the entire Geologic Time Scale was fleshed out, with its Eras and Periods and Epochs. Later, rock dating methods were developed that determined how long ago the various layers of rock found around the world were formed. Geologic time is

still classified into these broad categories. This is big thinking, indeed! The three Eras of geologic time are demarcated by the two most severe mass extinction events in geologic history, the Permian Extinction 250 million years ago and the Cretaceous Extinction 65 million years ago.

This Geologic Time Scale resonates with evocative terms. The last 540 million years of geologic history or so, in which all evidence of multi-cellular forms of life are found, is divided into three parts. The Paleozoic Era, or 'old life' era, consisted of the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian Periods. This Era ended with the Permian Extinction, the worst mass extinction ever. Most forms of life in existence at the time were snuffed out. Revealingly, however, ancestors of every form of life now alive somehow clung to survival through those harsh millennia.

Next came the Mesozoic Era, or 'middle life' era. This was the "Age of Reptiles", consisting of the Triassic, Jurassic and Cretaceous Periods. This era ended with the Cretaceous Extinction 65 million years ago. Since then life has persisted throughout the Cenozoic Era, or 'recent life' era. This "Age of Mammals" includes the Tertiary and Quaternary Periods and the Oligocene and Pleistocene Epochs.

Some say that the relatively rapid extinctions taking place today are likely to wipe out so many species that we are now entering another age, the Anthropocene. We're making history! And it is NOT exactly something to crow about.

The Living Planet Report 2016 makes this fact crystal clear, with its findings that almost 60% of the global number of animals in 10,000 representative species of mammals, birds, reptiles, amphibians and fish have died off in the years from 1970 through 2012. The bell is tolling for us!

#### Remember This One Thing at Least

John McPhee writes in *Basin and Range* that if readers are going to remember only one thing from his book, it should be that the visible stripes of rock on the face of Mt. Everest, the highest mountain in the world above sea level, consist of marine limestone. This ancient rock was formed by the 'biological precipitation' of the remains of calcium-shelled marine organisms onto the bottom of the Indian Ocean, hundreds of millions of years ago. These sediments accumulated into deep layers as the eons passed, and they were subsequently compressed and lithified into rock. Then, about 50 million years ago, when the subcontinent of India began to crumple into the landmass of Tibet on the Eurasian tectonic plate, the seafloor rock was driven upwards, earthquake by earthquake, eventually creating the highest mountains on Earth in the immense Himalaya Range. A devastating earthquake occurred in the mountains of the Kashmir region of Pakistan in October 2005 that killed more than 86,000 people; it was just one in an unfathomably long string of such severe upthrust events that has accompanied the uplift of these mountains.

Anyway, back to the "kink" in the line of volcanoes in the Pacific. Think again about the seamounts that extend from the archipelago of the Hawaiian Islands to the deep North Pacific trenches. These seamounts extend northwest in a more-or-less straight line halfway across the Pacific from the current position of the Hawaiian Islands along the Hawaiian Ridge to a point past Midway Island, but then they continue in a more northerly direction up through the Emperor Seamounts. Why the kink? The distance from the hot spot to this kink in the underwater ridge is equivalent to the distance that the Pacific Plate has moved in the last 50 million years. It seems probable that the reason for this change in direction of the motion of the Pacific Plate is due to a jamming of Earth's tectonic plates that was caused as the collision began between the massive Indian island continent and Tibet on the Eurasian Plate, some 50 million years ago. Hmmm ... it all seems to fit together!

As Albert Einstein once said, either everything is a miracle, or nothing is!

#### A Little More Geology, and Some Correlated Biology

The plot thickens; Mark Twain would have loved this! Consider for a moment what is happening at the formative edges of tectonic plates. These 'divergent plate boundaries' are where intrusions of hot magma are forcing the tectonic plates to move slowly apart in a process known as seafloor spreading. Upwellings of hot rock from the

Earth's mantle create this movement by means of 'thermal convection'. A similar process can be observed when one looks at the action of fresh ginger chopped up and tossed into a pot of boiling water. Distinct convection currents can be seen rising from the source of heat, moving the ginger around in interesting patterns.

Recipe: Add a mixture of cinnamon, cardamom, coriander, nutmeg, pumpkin pie spice, turmeric, black pepper and a pinch of cayenne to the ginger concoction for one of the healthiest alkaline-forming beverages ever invented. Add Chocolate Malt Ovaltine and some milk or vanilla soymilk to include other nutrients and vitamins, and you'll have a tasty and healthful beverage that is much better for you than coffee! Add honey if you like sweetness in your hot drinks.

When hot magma spews forth as lava at spreading centers of oceanic plates, forcing the plates apart, this creates a conveyor belt of oceanic crust that moves away from the rift zones in both directions from where they formed. It provokes the imagination to visualize the Mid-Atlantic Ridge, because it is part of the longest mountain range on Earth. Geologists indicate that this spreading center has driven the European continent and North America apart as the supercontinent Pangaea broke apart, creating the Atlantic Ocean itself.

### An Aside Concerning Ideas

One time as I was writing some of these words, absorbed in ideas, I was startled by the sudden crumbling of a trailside rock upon which I had been seated for some time. In my surprise, I wondered if this might have been some sort of mysterious sign from the Universe. Almost immediately thereafter, I realized that, as usual, there was a pretty good explanation for this occurrence. The rock was a sedimentary rock that looked like a kind of mudstone. I gave the rock a gentle kick, and it shivered and a whole slab crumbled to the ground. A few more swift kicks and the entire rock fractured into a beautiful natural pattern, shadowed in its crevices by the angular rays of the sunshine, and appearing as if it beckoned deeper understanding. Nearby lichens were thriving on a more durable variety of rock, a greywacke sandstone, and I could just imagine the lichens chortling about the importance of sensibly choosing an ecological niche that is durable and secure.

The origin of this greywacke sandstone was the subject of turbulent scholarly discord. It is a bit of a mystery why this rock contains a mixture of gravel and sand and mud that are not normally laid down together during the processes of sedimentation. Geologists scratched their heads about this for decades, and then finally realized that greywacke rock was formed by submarine avalanches or turbidity currents on the continental shelves of oceans. These events churn sediments and create slurries with mixed sediments. Eventually, these sediments lithify into contrasting layers of rock. This is why greywacke sandstone is found on uplifted edges of the continental shelves and the bottom of deep-sea trenches where underwater landslides and turbidity currents occur.

Submarine avalanches are punctuations in the general equilibrium of slow change in geologic time. They are just one aspect of on-going processes of sedimentation, lithification, uplifting and erosion that have been continuous since the beginning of time. Greywacke sandstone is found in some of the same vicinities as Franciscan chert, a rock formed deeper in the ocean by a process in which countless gazillions of skeletons of microscopic ocean animals have precipitated to the ocean floor over periods of millions of years. Layers of Franciscan chert rock are composed of tiny silicate shells of these Radiolaria protozoans, and these distinct layers can be seen in intriguing uplifted contortions along the Pacific coast of North America.

Not long after Charles Darwin published his world-shaking tome on evolution *On the Origin of Species* in 1859, a German biologist and artist named Ernst Haeckel published an illustrated book about these minuscule single-celled marine organisms whose mineral skeletons, when magnified, exhibited beautiful patterns of symmetry. In *Radiolaria*, published in 1862, Haeckel created "an image-laden monograph on these microscopic organisms, turning his eye and exquisite line to their intricate and varied forms." Marvelously, Haeckel's beautiful drawings of the forms and structures found in nature, such as these silicate skeletons of radiolarian protozoans, helped inspire the lovely Art Nouveau style, and artists began to utilize natural shapes to harmonize their art with the natural environment.

Interestingly, there have been many species of radiolarians in Earth's oceans over the past 500 million years, ever since the beginning of the Cambrian Period in the Paleozoic Era, and their variety over time in the fossil record makes them excellent diagnostic "index species" for dating rock formed in various geologic periods and epochs. Indeed, it was the observation that certain fossils were associated with various rock strata around the planet that led early geologists to recognize that life on Earth has existed over the course of an unfathomably long geological timescale, rather than a short biblical timeframe since a special Creation. Again, this fascinating history in the unfolding understanding of geologic history is explored in John McPhee's *Basin and Range*.

After the crumbling rock episode, I was thinking some curious thoughts about the fact that ideas have great potential power. An ideologue like Adolf Hitler, for instance, used his supremacist ideas, ruthless propaganda and the manipulative force of his authoritarian personality to launch a terrible war of aggression and genocidal assaults that resulted in tens of millions of people being killed. In contrast, ideas can also be powerful forces for the greater good, and this realization has driven the creation of this manifesto. When we understand the nature of ideas and their impacts, such insights can energize or inoculate us against foolishness or even tyranny, and heal us or give us valuable perspective. In theory.

Discrimination, hate and genocide all share common origins. An art exhibit at the Contemporary Jewish Museum in San Francisco in 2010 explored these roots. The exhibit was titled "Our Struggle: Responding to Mein Kampf", and it contained submissions from more than 400 different people who used pages torn out of a copy of Adolph Hitler's infamous book *Mein Kampf* to create haunting emotional responses to the narrowly ideological words the book contains. One of these responses was a compelling cartoon that showed a hand pushing a section of a page filled with words down into a food-processor-like head with a human face. Bits and pieces of people in the forms of miniature skulls and limbs spewed out of the mouth. Ideas can be powerful, for sure!

Fervent ideological convictions can range the gamut from terrible to wonderful. The difference is determined to a large extent by how honest and moral the ideas are, as seen from perspectives that take consequential ethics and big picture perspectives into account. And make no mistake about it, as Albert Einstein once said, "Force always attracts men of low morality."

Adolph Hitler wrote *Mein Kampf* (*My Struggle*) while imprisoned for political crimes in Germany in 1925. Hitler basically advocated the domination and subjugation of the weak by the strong. *Mein Kampf* became popular in a Germany ravaged by hyper-inflation and large debt obligations for war reparations owed to the victors in the First World War. *Mein Kampf* became a bible of Nazism, and it facilitated militarism and atrocities like the holocaust genocide against Jews. We should strive to find better ways to inoculate our nations against the impulses that allow such terrible despotism!

Donald Trump seems to be a terribly unempathetic con man who resembles Hitler, and the fact that he kept a copy of Hitler's speeches by his bedside gives credence to such concerns. In 2016, I advocated, "Reject his bid for power!"

It is good for a society to strongly encourage beneficial behaviors in individuals, and to discourage ones that are socially harmful. Collectively, people in nations everywhere have a profound need and obligation to establish economic and political systems that maximize the freedom and safety of individuals while ensuring they act responsibly toward other people and natural ecosystems. In light of the certain mortality of each individual, and the fleeting nature of each of our lives, and of moral considerations inherent in our being, it is our serious duty to leave a legacy to our descendants that is more auspicious.

It is precisely because good solutions to problems require a clear understanding of the real nature of the problems that we should rightly delve into root causes, and avoid merely addressing symptoms. With a much greater emphasis on the common good, we could and should create healthier societies.

Philosophy North of the Golden Gate

I could, and shall, tell you a lot more things that I don't know. My mind digresses, but it is curious to follow. About 10 miles south of where a beautiful bridge was built across California's Golden Gate in 1937 and painted an iconic International Orange color, the San Andreas Fault plunges into the Pacific and forms a northerly line through Stinson Lagoon, the Olema Valley and Tomales Bay. Geologists say that the entire Point Reyes peninsula to the west of this rough line will become an island in less than a million years, due to periodic movements of the Pacific Plate along this fault. Those who walk along the Point Reyes Earthquake Trail see an old fence that runs down a hillside and then abruptly continues its trajectory 16 feet to the north. This discontinuity was caused in the span of 60 seconds time by the epic 1906 earthquake rupture in this area. This abrupt and rare periodic earth movement makes it cogently clear how long the arc of time will be that will lead to Point Reyes peninsula becoming an island.

Nearby, deep canyons and steep ravines are found that feature towering Coast Redwoods whose far-flung ancient range is now restricted to valleys near the Pacific Ocean that extend from the central coast of California near Big Sur to the Oregon border. Tall Douglas fir trees also inhabit these canyons, and streams cascade there enthusiastically in springtime, making riparian areas alive with the sound of cataracts of flowing water. Above these canyons, brilliantly green hills are festooned with riotously colorful wildflowers, those lovely ephemeral emblems of Springtime. Among the dozens of varieties of wildflowers found there are California Poppies, Lupines, Gold Fields, and rare, endangered, inconspicuous but pretty purple Jewelflowers on serpentine barrens. God must have been an aesthete, and practically a poet!

Milkmaids, Hounds Tongues and Shooting Stars are the suggestively-named triumvirate of early wild flowers in these hills. They are all but gone by the vernal equinox, but under the canopy of tall Douglas firs, numerous Calypso orchids bloom in late March and early April. These wildflowers are singular little things some six inches tall that have one solitary pinkish purple flower crowning a naked stem, its dappled orchid lip insolently outspread as if it believed it was the whole darned purpose of existence. Later, under mossy and lichen-encrusted oak trees, beautiful flowers called Chinese Houses bloom in pagoda-like whorls in late April and early May. These are indigenous lavender-and-white wildflowers that are pollinated by bees that enter the flowers seeking nectar. When the insects alight on the lower lavender landing-pad petals, their weight pushes the petals down, exposing a protectively-encased anther. The anther is the male part of a flower that produces pollen. Some of the pollen adheres to the bee, and by such a subtle process, the pollen is transferred to the receptive female part of other flowers of the same lovely species. Botanical sex!

This mutual benefit to flowers and bees offers either confirmation of the dogma of Intelligent Design, or it provides proof of the amazing co-evolution of flowers and bees through a long process of natural selection. One's perspective on this question depends on the particular belief projection of the beholder. Personally, I find this intertwined adaptation of flowers and pollinators to be a marvelous aspect of Gaia and her evolutionary biology. The idea of biological change over unfathomable spans of geologic time is a compelling and marvelous story, and far more elegant and sophisticated -- and probable! -- than simple-minded explanations that God made everything the way it is, according to "His" inscrutable divine plan, and it hasn't changed since.

Many species of pollinators are being driven to extinction by pesticide use, industrial farming practices, habitat destruction, introduced pathogens and warming average global temperatures. A scientific report by the United Nations warned that bold actions need to be undertaken to alter the increasingly adverse consequences of this state of affairs. This report was approved by a congress of 124 nations that met in Malaysia in February 2016. As with the Paris Accords on climate change, the next steps must be taken SOON to deal effectively with this challenge, before it's too late.

Fascinatingly, a curious proof that Darwin was correct about biological evolution came to light in early 2015. Scientists found ancient communities of bacteria that have remained virtually unchanged for more than 2.3 billion years in muddy sediments beneath the deep sea. Researchers say these microscopic organisms are an example of "extreme evolutionary stasis", and that they represent *the greatest lack of evolution ever seen*. Since evolution involves an adaptation to changes in the physical and biological environment, there is

naturally not any evolutionary change when no changes take place in the surrounding environment. A paleobiologist at UCLA named J. William Schopf calls this the "null hypothesis", and says it proves that Darwin was right about evolutionary change by means of natural selection.

Pretty native Crimson Columbines grow in the same ecological niches as Chinese Houses. They seem to trumpet this miracle of botanical design. Invasive Italian thistles strive to crowd out the native profusion of lavender and white, as if mimicking the competition between the contrasting theories of genesis. Nearby a cataract of rushing water makes its way down a steep ravine toward the Pacific Ocean. A colorful butterfly flutters by, seeming not to know where it is going, but it soon alights exactly where it wants to be on some sweet flowers or mineral deposits. Huckleberry bushes abound on partially shaded slopes; their small fruit, come the hot, dry days of late August, will prove to be delicious, but only occasionally plentiful. Moss covers oak trunks and rocks, and though it gets lushly soft during rainy episodes, it soon becomes scraggy as it survives the long dry season, stoically awaiting wetter days. As I hiked in these hills, I drank all of this in, in a speechless rapture.

In such environs, a vital spirit of place flourishes. It should come as no surprise that, not far below this natural scene, the entire spectrum of human indulgences is given full rein in our hyperactive culture. Revolutionary ardor thrives; and so does contemplative spiritual practice; culinary appreciation and pleasure-filled indulgences are widespread, and so is ascetic denial, I mean at least hypothetically; hot tub free-spiritedness commingles with dedication to work duty; sophisticated artistic endeavor coexists with down-home simplicity; and creative social action also thrives, in contrast to scattered pools of a withered civic sense. Shut up!

Serpentine outcroppings on the ridges above these canyons have been colonized by unique species of cypress and manzanita. Serpentine is the greenish State Rock of California. It weathers into rocky metallic soils that inhibit plant growth because they contain low amounts of minerals essential to plant growth, and high levels of metals like nickel and chromium that are toxic to most plants. The plant species found in serpentine soil environments tend to be endemic and uniquely adapted to such challenging conditions. Almost every naturalist gleans revealing knowledge from evidence for the adaptation of various kinds of plant life to the soil conditions and precipitation patterns of the habitats, niches and ranges in which they're found. What does it reveal? Adaptation!

"I calmly chewed my food in the sun and felt a deep physical happiness, as if I was floating on the cool, green waters of the sea. I did not allow my mind to take possession of this carnal joy, to press it into its own molds, and make thoughts of it. I let my whole body rejoice from head to feet, like an animal. Now and then, nevertheless, in ecstasy, I gazed about me and within me, at the miracle of this life: What is happening? I said to myself. How did it come about that the world is so perfectly adapted to our feet and hands and bellies?"

--- The 'boss' in *Zorba the Greek*, by Nikos Kazantzakis

How did it really come to be that pollinators like honey bees are specifically adapted to the plants they pollinate? How did it come to be that predators are adapted to their prey, and that parasites and commensals coexist in parasitic or symbiotic relationships? How did it come about that animals inherit instinctual behaviors from their parents? Charles Darwin and his theories were significant forces in Mark Twain's times, and his thinking is valuable, coupled with honestly better understandings of these questions. The more we understand of the 'genetic blueprints' of every life form, and of hormonal influences in mammalian brain development, the more we can come to understand and appreciate the complexity and sophistication of the wide variety of life processes. And the better prepared we will be to make the right choices in adapting to changing conditions.

#### Insights Elucidated by an Oreo Cookie

Our world is miraculously knowable. As Albert Einstein once noted: "The eternal mystery of the world is its comprehensibility", and "The fact that it is comprehensible is a miracle." And, "One cannot help but be in awe when one contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if

one tries to comprehend only a little of this mystery every day." I like trying to understand our wondrous world, and this is one reason for my setting forth these words to share some insights that have come my way.

Biological evolution is intimately intertwined with the even more basic physical evolution of our home planet. Serpentine rock, for instance, has an impressive genesis: it is magma from Earth's mantle that spewed forth long ago deep in the ocean at an oceanic crust spreading center. The intensely hot magma cooled rapidly in the cold water, as one can well imagine, and it became the newest rock of the oceanic crust. The fact that this rock is now found in outcroppings on top of coastal hills at the western edge of the North American continent, far from where it formed, is testament to the conveyor-belt-like movement of the oceanic crust, and to the not quite comprehensible physical processes that have been involved in its emplacement on continental shores. This, along with outcroppings of 150-million-year-old blueschist metamorphic rock not far away on Ring Mountain, provides mute testimony of the inscrutably long periods of time involved in geologic changes.

When oceanic crust subducts beneath continental crust, some of the heavier oceanic crust ends up being accreted onto the continental shelf during these slow-motion collisions. Geologists have been known to give students on field trips a simple and demonstrative analogy. They liken this process to what happens when you take two halves of an Oreo cookie that has been twisted apart, and push one half at an angle against and under the other half; some of the white frosting from the 'subducting half' ends up on top of the other half. Similarly, some of the subducting serpentine and chert rocks have piled up onto the continental crust rather than plunging slowly beneath it. This hard rock has subsequently been uplifted into coastal mountain ranges. Eons of erosion have sculpted these hills and removed softer overlying sedimentary rock. All of the Oreo, incidentally, ends up in the mouths of students after this illuminating experiment!

For a vivid understanding of the creation and accretion of island arcs onto continental land masses, read John McPhee's book *Assembling California*. Or, alternatively, Google 'Plate Tectonics' at Wikipedia, and you will find a good high-level summary of information.

#### Further Considerations Concerning the San Andreas Fault

I also recommend reading the entry for the Farallon Plate in Wikipedia. It provides a good general overview of some of the awe-inspiring concepts of geologic evolution. A vast amount of stress tends to build up along the edges of tectonic plates that move against other plates, and this leads to periodic earth movements that release the stress on any given fault. The average time between such shocking ruptures is known as the *recurrence interval* of that fault. The 1906 earthquake along the San Andreas Fault had a devastating effect on San Francisco. The recurrence interval of that fault in this region has historically been between 80 and 200 years. In its southern reaches in the Tejon Pass area, the recurrence interval is estimated to be shorter than this. People wonder when the next Big One will strike!

The San Andreas Fault is a deep rupture along the tectonic boundary of the Pacific Plate and the North American Plate. It runs more than 800 miles from the Salton Sea in the southern part of California up through the Carrizo Plain and dramatic Pinnacles area, and then through the Santa Cruz Mountains and the western edge of San Francisco and Bolinas Lagoon, the Olema Valley, Tomales Bay and Bodega Bay up to the Mendocino Junction where the Gorda Plate meets the Pacific and North American Plates.

The Gorda Plate is a northern remnant of the Farallon Plate that is subducting under the northern part of the state of California, contributing to the creation of towering Mt. Shasta and Mt. Lassen to the east. These are towering volcanic peaks that were formed in a similar manner to the way the beautiful Cascade Mountain Range in Oregon and Washington has been created by the subducting movement of the Juan de Fuca plate. For the enthralling story about the Juan de Fuca Plate, which involves the mystery of a drowned "ghost forest" of red cedars near the Washington coast, read the article referenced earlier *The Really Big One* that was published in the New Yorker in 2015 and can be read online right now.

The last major eruption of Mt. Lassen took place in 1915, when an explosive eruption devastated nearby areas. As dense oceanic plates subduct under the North American Plate, high temperatures and pressures cause some

of the earth's pliable mantle to melt, and the hot magma rises toward the Earth's surface where it periodically bursts forth in such volcanic eruptions.

An ancestral San Andreas Fault complex extends 1,000 miles to the south of the Salton Sea. It is responsible for the creation of the Gulf of California, also known as the Sea of Cortez. This gulf began to be created about 5 million years ago when tectonic forces started shearing off the Baja California peninsula from mainland Mexico. Near the middle of the Sea of Cortez, an undersea escarpment forms a submarine cliff that plunges nearly 6,000 feet in places. At its deepest, the basin is almost 10,000 feet deep, so the elevation difference between the sea floor and the highest peak in Baja California to the west is more than 20,000 feet. These tectonic processes not only created the deep Gulf, but they also gave expression to intense compressional forces to the north that thrust mountain ranges skyward, including mountain ranges like the San Jacinto, Santa Monica, San Gabriel and San Bernardino Mountains.

Interestingly, all visible rock that can be seen is just the weathering exterior surface of all the rock beneath it. This part of the landscape changes very slowly on a geologic time scale that seems much slower than the one affecting the living coverings of forests, shrubbery, lichens and the like. Many generations of plants live and die, after all, while hard rock shows little sign of weathering away.

A shift in perspective reveals that exposed rock is veritably melting away like butter in a microwave compared to all the rock beneath it, when considered from the relative standpoint of geological time. Unexposed rock has been not yet been subjected to forces of erosion. Even exposed granite in mountains like the beautiful Sierra Nevada is weathered down an inch or so every 10,000 years. Mountains seem permanent to us in the context of our relatively short lives, but this perspective is revealed to be an illusion. While physical change is continuous, the principal changes that are perceptible to our notice are sudden and remarkable ones like rockslides, landslides, earthquakes and volcanic eruptions. These events are accurately seen as punctuations in the geologic equilibrium of practically eternal change

A gust of wind ruffles tall trees in a deep ravine below the mountain ridge where I sit, changing the appearance of the vista as I behold it. Flowers dot the hillsides in the springtime, decorating this image with festoons of ephemeral aspiration, cyclical birth and death, and perhaps even frivolity.

#### The Revelations of "Variable Magnetic Field Direction in Rocks of Differing Ages"

Another feature of geologic activity is noteworthy. The Earth has a powerful magnetic field that is created by electrical activity generated by the planet's dense core. This magnetic field creates patterns similar to those that a simple bar magnet manifests when it is placed below a sheet of paper with lots of iron filings on top of it. On a grand scale, this magnetic field is revealed by the Aurora Borealis, a phenomenon also known as the Northern Lights. Charged particles from the Sun are pulled down toward the North Pole by Earth's magnetic field, and when these charged particles collide with gases in the atmosphere, they create a fabulous natural light display that is thrilling to watch, as anyone will attest who has beheld the eerie shimmering lights.

Curiously, Earth's north magnetic pole occasionally reverses, switching places with its south magnetic pole. This has occurred about once every 800,000 years for hundreds of millions of years. This fact helps explain a discovery that confirmed the Earth's crust does indeed consist of continuously moving tectonic plates. As mentioned earlier, the wild hypothesis known as 'continental drift' had largely been discounted as impossible prior to the 1960s. This was a simplistic theory that posited a speculation that the continents of Europe and North America, and Africa and South America, were once part of a mega-continent, and that they had drifted apart. The mechanism for this theory, and its surprising and astounding corroboration, was finally found when the bottom of the world's oceans was mapped and studied after World War II. When the volcanic ridge was discovered that runs down the middle of the Atlantic Ocean from points north of Iceland to the vicinity of the Antarctic in the south, this finding was a key confirmation in the development of the sophisticated theory of Plate Tectonics.



Hot magma was found to be spewing forth at 'spreading centers' in the Mid-Atlantic Ridge, creating new oceanic crust that thrusts outward from this ridge and causes the rock of the North American Plate to move further and further from the rock of the same age on the Eurasian Plate in the North Atlantic. The same effect is driving the South American Plate apart from the African Plate in the South Atlantic. When the rock initially wells up into the ocean, it quickly cools and the iron in the rock leaves its magnetic orientation figuratively frozen into place, marking the specific orientation of "north" in Earth's magnetic field at the moment in time the rock cooled.

This magnetic orientation operates on a similar principle to that of a compass, an instrument that functions by freely balancing an iron needle so that it points to the north pole of a magnetic field. When Earth's magnetic North Pole switches places with the South Pole, this flipping is duly recorded, frozen in parallel bands of rock extending out from the Mid-Atlantic Ridge. Since the Eurasian and North American Plates move away from their spreading center at a rate of about one inch per year, widening the Atlantic Ocean, the bands with magnetism pointing north are about 800,000 inches wide (12 miles!) and then the next band of similar width has its iron magnetized pointing the opposite direction. These bands are mirrored on both sides of the rift zone at similar distances, all the way across the Atlantic. This is an abstruse but remarkable confirmation of crustal plate movements!

### How the Gold Got in "Them Thar Hills"

An awe-inspiring aspect of our world is that there are good explanations for almost everything, and it is just a matter of finding them. The brilliant trajectory of science has been to reveal ever better explanations, slowly but surely, and it is a strength of science that it is flexible and cumulative. When better understandings come along, they are eventually accepted. There just happens to be a very good explanation for how gold came to be found in veins and localized deposits in places worldwide.

It turns out that molecular compounds of gold and silver are water-soluble at high temperatures, and they seem to have a distinct affinity for themselves, so they percolate around and gather together in hot batholiths of molten rock as it cools. Hot magma forms crystalline structures of various kinds of rock as cooling takes place. Minerals like gold and silver tend to concentrate together with quartz, which is one of the last minerals to harden. This is why gold and silver in hard rock deposits are generally found associated with veins of other minerals like quartz. This is also the reason why other elements like copper, lead, zinc and sulfur end up concentrated together as rock hardens from cooling magma.

Geologists discovered that long ago much of the land that is now California and Nevada had been accreted onto the North American Plate back when the Farallon Plate was subducting under it. "Island arcs" and parts of the Pacific oceanic crust were accreted onto the North American continent in a manner similar to the way that the subcontinent of India has been accreted onto Tibet. John McPhee's book *Assembling California* provides extensive evidence for this geologic history.

During the eons that oceanic crust subducted under the North American plate, the rock that was being subducted melted as it slowly plunged deep into the Earth under the continental crust and magma found its way to the surface in boundary volcanoes like the lovely Dardanelles in the Sierra Nevada, but most of it cooled beneath the surface over a period of tens of millions of years. This is how the Sierra Nevada granitic 'batholith' came into being. Anyone who has visited areas like Yosemite or the ten "fourteeners" of the southern Sierra has seen the top of this batholith in exposed peaks like Pyramid Peak, Half Dome, Mt. Starr King and Mt. Whitney, or in areas scraped bare by glaciers like the beautiful granitic lake area known as Desolation Wilderness just west of Lake Tahoe.

When the Sierra Nevada batholith was uplifted in relatively recent geologic time, long after its formative period and its subsequent eons-long slow cooling, the rock of the mountains was subjected to erosion and weathering, and thus the gold and silver were exposed at the surface in places, and it became concentrated in river gravels that were part of sediments being carried down from the mountains.

Gold was mined in California beginning in 1848 in three ways. First of all, it was found in rivers, and it was mined with pans and sluices in river gravels. This was how the Gold Rush of the Forty-Niners began. The source of gold found in the rivers was quartz veins that had been exposed by the erosive power of rushing water and the grinding weight of glacial ice.

A few years later, gold began to be mined using hydraulic mining methods in "placer deposits". What are these? They are gravel deposits of ancient rivers that are found in current day hillsides. The technique of hydraulic mining involved the channeling of river water into miles-long flumes and then into hoses, from which the water was blasted under high pressure from iron "monitors" against the hillsides. This washed the gravel down into sluice boxes where the gold could be captured and then gleefully sold, resulting in huge profits. This method of mining had extremely negative environmental impacts, as discussed in *Huckleberry Finn, the California Gold Rush, and Sensational Related Reflections*.

The third method of gold mining was hard-rock mining, an activity that reached a technological epitome in the Empire Gold Mine and North Star Mine under Grass Valley and Nevada City in the foothills of the Sierra Nevada. Hundreds of miles of mines were bored into the rock there, with shafts reaching down as deep as 11,000 feet as they followed veins of quartz and gold. Great fortunes in gold were extracted from the Empire Mine before it finally closed in 1956. A visit to the Empire Mine State Historic Park is fascinating for its insights into the technological innovations sparked by this fever for gold.

It makes the head spin to try to grok all the devastating impacts that mining has had and will continue to have around the world. Mountaintop coal mining is only one of the most destructive of these widespread activities. When will we learn that addiction to misguided consumerism and population growth Ponzi-like schemes and ecologically damaging activities are dangerously risky and foolishly unsustainable?

### Speculation and Metaphysics

Anyone who ventures very far into the extensive and convoluted labyrinth of ideas explored in this manifesto will discover its natural philosophic bent. Philosophy literally means the love of wisdom. It is a dispassionate passion that gives existence a close inspection, then strives to achieve a clear and objective interpretation of perceptions and events and the nature of existence. Philosophy makes committed efforts to be open-minded in its investigations of the causes and propensities and laws of physics that underlie reality. It is a synthesis of all learning.

The marine biologist Ed Ricketts was made famous by his friendship with John Steinbeck. 'Doc' Ricketts was also an ecologist and a philosopher. He was calmly amazed that most people appear to not really want to know the truth. This insight was cogently brought home to him in connection with legal proceedings that followed a fire in November 1936 that destroyed his biological laboratory along Cannery Row in Monterey, California. This fire was caused by a surge in electrical current. A jury in the case eventually decided that the electric company was entirely blameless in the fire. John Steinbeck cynically concluded that the disaster obviously must have been just "an Act of God".

Doc Ricketts took a great interest in the court proceedings, and afterwards said with equanimity and a certain measure of wonder, "You see how easy it is to be completely wrong about a simple matter." He noted that, because each side wants to win in any dispute, it generally turns out that opposing interests have widely differing points of view, especially when money is involved. Vested interest groups with differing goals thus have little interest in the truth, and they even seem to abhor it.

Facts and truth are like wily trout, a bit slippery and hard to catch. But it is growing to be ever more vitally important for all of humanity to gain honest, holistic and farsighted understandings. And in light of them, we need to demand that our societies and institutions be restructured in ways that are consistent with the greater good over the long term. We must in particular strive to find ways to ensure that our collective purposes and activities are organized in new ways so that they are more consistent with holistic social and ecological understandings. An overarching wise philosophy is needed to provide these understandings. We should stop

trusting the assertions of entrenched interest groups and people with narrowly partisan purposes, like shrewdly manipulative politicians and dogmatic religious authorities and biased pundits in the media, and "conservative" billionaires or other self-interested apologists for the status quo -- or even worse, for retrogressive changes in national policies and priorities.

"Perhaps truth is only the common denominator of our delusions, and perhaps certainty is merely an error  
in which all men agree."

--- *The Pleasure of Philosophy*, Will Durant

The adjective "philosophical" connotes calmness, equanimity and detachment. I suppose it means this because, in the largest context, any striving to understand the world's ways transcends individual lives and every preference for outcomes. A larger perspective tends to approach Gaia's impersonal and cool point of view, in which nothing is absolutely good or bad, or evil, or right or wrong.

One of the salient influences of Earth Manifesto writings has been the compelling philosophical exploration of ideas by John Fowles in *The Aristos*, and by John Steinbeck and Doc Ricketts in their "speculative metaphysics" together on Cannery Row and on their 1940 voyage to the Sea of Cortez. I enthusiastically recommend that readers check out my entertaining exploration of ideas in the story *Tall Tales, Provocative Parables, Luminous Clarity, and Evocative Truths*. Among a variety of motivations that has led to the creation of all the stories, essays and epistles in this manifesto, I want to again emphasize my conviction of the vital importance of the ideas in *Common Sense Revival*, and in Part Four of the online Earth Manifesto. I encourage readers to review the comprehensive compendiums of ideas outlined therein. Let the bright light of an evocative full moon figuratively illuminate our understandings.

#### Indulgence or Abstinence, That Is the Question: Competition vs. Cooperation

The indigenous Piaroa people who live along the banks of the Orinoco River in Venezuela have an interesting worldview. They laud cooperation and view competition as spiritually evil. They support individual autonomy, and are staunchly egalitarian and strongly anti-authoritarian, and are opposed to hoarding of resources. Experts with knowledge of these people regard them as one of the most peaceful of human societies, with murder a concept that is both unknown and entirely nonexistent. "The Piaroa shaman in each community gathers children together when they reach six or seven years of age for lessons on personal responsibility, self-restraint, and respect for others."

These attitudes present a dramatic contrast to ones that characterize American society. Curiously, many people regard the United States as a pinnacle of civilization, yet we can be seen as unwitting slaves to ruthless competition and propaganda, and many people are victims of hard-nosed social attitudes, record rates of incarceration, statistically unprecedented levels of gun violence, vulnerability to getting involved in far-flung wars, irresponsible budget deficits, and extreme disparities in social, economic and healthcare well-being. Think about it!

We all grapple with conflicting drives and emotions in a variety of arenas. We do this in our striving for competitive advantages and in selfish behaviors, practical moral dilemmas, materialistic impulses, sexual drives, greedy compulsions, the consumption of food, the imbibing of alcoholic beverages, urges to gamble, uses of drugs, and even in our spiritual perspectives.

People frequently yield to temptations that are likely to cause harm to others. Alternatively, each of us sometimes more honorably chooses to abstain from such courses of action. Genetic and hormonal impulses may drive us in one direction, while conscience and understandings of ethical right action and moderate discipline may compel us in a different direction.

Freedom to choose is often complexified by such conundrums, and by the curious affliction known as "choice congestion". This phenomenon can transform a simple choice into a paralyzing decision among too many options.

A wide range of choices may even cause us to invest an absurd amount of time and energy in undertakings that create "no small amount of self-doubt, anxiety and dread"!

John Steinbeck may have sensed something similar when he expressed this observation in *Sweet Thursday*: "It was Fauna's conviction, born out of long experience, that most people, one, did not know what they wanted; two, did not know how to go about getting it; and three, didn't know when they had it."

All of these individual quandaries and conflicts add up to a challenging societal conundrum. Given the wide range and profound complexity of motives, and the difficulty of optimally managing large numbers of needy people and a sizeable complement of excessively greedy ones, how can we adopt goals that are truly consistent with the greater good, and enforce moral understandings, and prevent tragic harm to the global ecological commons?

A filmmaker named Tom Shadyac was seeking to understand what is wrong with our world, and what we can do about it, so he created a documentary film titled *I Am*, in which he stated that hunger, poverty, greed, war and the environmental crisis are merely symptoms of a deeper endemic problem whose root cause is found in the exaltation of competition and individualism over cooperation and working together to achieve common goals. Interestingly, Shadyac found good cause to believe that cooperation may be the most basic operating principle for many species of life on Earth.

Cooperative problem solving would be far superior for our societies than hyped-up polarization and acerbic partisanship. Competing interest groups should seek more fair-minded compromises, and we should not allow religious supremacism to dictate national policies, or those with the most influence to improperly abuse their power. United we may prosper, but divided, only the few who divide us do, making out like ruthless bandits.

The film *I Am* is about the aftermath of a life-threatening accident that caused Tom Shadyac, who achieved significant success in making Hollywood films, to question the entire ethos of 'success', consumerism, and compulsive impulses to acquire ever-more possessions. As many homeowners have discovered, possessions can come to possess people -- and this can have adverse effects on personal well-being!

Some superbly sensible people say that, in many respects, "less is better". Since obsessions over possessions can negatively affect one's life, 'success' can lead to a diminishment in the quality of life and personal freedom. Compulsive needs to buy things can seriously diminish the quality of life, especially when purchases are financed with bondage-inducing levels of borrowed money.

Many costs are being incurred due to people's indulgence in hyper-consumerism and the mindless subjugation of nature to human ends. Errors of perception and understanding are causing us to fail to see and appreciate the things that contribute to a truer quality of our lives, for ourselves and for our descendants.

Many people are beginning to suspect that what youthful bohemians in the 1960s called "the rat race" may be a competition whose goals are ultimately a chimerical and unfulfilling illusion. Furthermore, it can become clear upon honest introspection that some of our defining drives are insanely and unsustainably eroding many of the basic qualities that make life meaningful, fulfilling and enjoyable.

The prodigious biological insights of evolutionary change driven by natural selection were discovered and published more-or-less simultaneously in 1858 by Charles Darwin and Alfred Russell Wallace. The way they interpreted this understanding, however, curiously diverged. Darwin's harsh view of "survival of the fittest" led to Social Darwinist ideologies, skewed economics, eugenics societies and the idea of the "selfish gene". Wallace, in contrast, focused on the tendency of evolutionary change to generate a world of complex co-dependence, and he became an activist for social justice. Let us see more feelingly, and cultivate better understandings of these issues -- and find better ways to co-create the greater good!

Pro-corporate apologists and "conservatives" have hijacked the vocabulary of Jeffersonian liberalism and turned words like "progress", "opportunity" and "individualism" into tools for making the plunder of America sound like a divine right. Ideological proponents of anti-government laissez-faire economics have distorted Charles Darwin's theory of evolution so much that politicians and even judges passionately promote the notion that the greater

good is best achieved by enacting trickle-down economic policies that create extreme inequalities and inequities between financially successful people and everyone else.

Impulses to abandon the most vulnerable people in society are gaining traction as our huge national debt mounts, and partisan politicians are becoming increasingly intransigent. We need to be able to see more clearly that spending and tax decisions reflect moral values, and accordingly find new ways to deal with the challenges we face without abandoning under-represented people and those who are the most vulnerable. And we should stop allowing our political representatives to place top priority on further enriching the already wealthy.

"Committing to what is right, what is just, and what is good will bring you fulfillment."

--- Coretta Scott King, quoted in Joyce Tennyson's *Wise Women*

Moderation is desirable in almost all things. Moderation is a healthy attribute for society in many arenas, and a more propitious one than either excessively undisciplined indulgences or harsh prohibitions. This is true in things as diverse as budgetary decisions, fiscal policies, sexual relationships, and the use of intoxicants. Discipline, moderation and self-denial may be hard to achieve in the face of many temptations and alluring self-indulgences and escapist pursuits, yet it would be desirable if we all began to see bigger picture perspectives and committed ourselves to making our societies healthier by demanding that the incentives in our economic system be restructured to encourage broader, fairer and healthier perspectives and activities.

#### Developing a Big Picture Bearing - A Short History of North America

The Bering Strait is about 50 miles wide at its narrowest point. This waterway lies between Alaska and the most easterly point of Siberia in Russia, and it connects the Bering Sea to the south (part of the Pacific Ocean) with the Chukchi Sea to the north (part of the Arctic Ocean). The depth of this narrow strait is no deeper than 200 feet at any point, so this is why scientists believe that humans migrated from Asia to North America across a land bridge when ocean levels were lower.

And this is no mere Aleutian illusion! The first human beings to discover North America likely came by way of the Bering Strait some 15,000 years ago during the last Ice Age because so much water was locked up in continental ice sheets and glaciers that sea levels in oceans at the time around the planet were 300 feet lower than they are today, so a land bridge connected what is now Alaska with the eastern part of Siberia. Over the millennia, these first explorers and early settlers prospered and managed to proliferate across the North American continent, eventually consisting of hundreds of various tribes of Native Americans.

Fast forward 14,000 years to the 10th or 11th century CE, and we see Norse Vikings exploring and settling land areas in regions of the North Atlantic that included the northeastern fringes of North America. From the vivid perspective of conventional European versions of history, the American continent was discovered much later, when Christopher Columbus arrived in the Caribbean in 1492. The city of St. Augustine, Florida was founded by Spain in 1565, so it is the oldest continuously inhabited city in the present-day United States. But "white man" did not arrive from Europe in significant numbers to explore, conquer and colonize the continent until the 17th century. About 100 English colonists arrived in 1607 along the west bank of the James River in Virginia to found Jamestown, the first permanent English settlement in North America. Then in 1620, the first Pilgrims arrived in Plymouth, Massachusetts. Many millions more were to follow these immigrants, seeking better opportunities and freedom from religious oppression, among a myriad of other individual motives.

Relations between the colonists and the natives did not go well, partly because the religions of the colonists regarded the natives as "heathens" who did not believe in the right God. So, many Indians were slaughtered, and millions of others died from diseases that they had no immunity to, having evolved separately from the rest of humanity for so many millennia.

These Europeans, and many other immigrants who came from Europe and Asia and other parts of the world in the next several centuries, were ancestors to most of the people living in North America today, along with large numbers of black slaves kidnapped in Africa and brought to America for sale. The original immigrants had

formed 13 colonies on the East Coast in the 150 years before 1776, and they had begun to bridle at Britain's exploitive mercantile economic system and its policies of taxing the colonists without fairly representing their interests. Revolutionary dissatisfaction had grown so intense by 1776 that a courageous group of colonial leaders got together and issued a Declaration of Independence, and then colonial militia forces were organized under General George Washington to fight a Revolutionary War to throw off the hegemony of British tyranny. It took six years, but the Americans finally won this treasured independence, and the Treaty of Paris was signed to end this war in September 1783.

The fractious colonists then laudably organized themselves to hammer out a Constitution and Bill of Rights to guide this new experiment in democratic governance, and all of the competing interests managed to find enough common ground to create a brilliant system of checks and balances within the federal government and between it and the new States.

The infinitely variegated saga of the ensuing two centuries is an extraordinary one of westward and southern expansion, massacres of the natives, internal strife, a terrible Civil War, industrialization, urbanization, and the progressive evolution of fairer representation and rules of law designed to balance changing interests. A succession of gold rushes, mining claims, trappers, homesteaders and exploitation of the homelands of the Native Americans led to many travails. A Gilded Age of gaudily conspicuous consumerism and robber barons unfolded, with a Progressive Movement of reforms in reaction, and then World War I and the Great Depression and World War II and dozens of lesser foreign wars took place.

The economic history of the United States in the years since the calamitous economic collapse of the 1930s is a fascinating one, and one that contains many important lessons for us today. Rash speculation and extremes of economic inequalities had reached such a peak by the end of the Roaring Twenties that this bubble frenzy finally burst, causing a worldwide economic depression. To deal with the terrible social ills associated with inadequately governed business activities, President Franklin Roosevelt's administration instituted a flurry of changes that were focused on three primary initiatives: (1) economic relief for unemployed people and the poor; (2) recovery of the economy to help banks, railroads, industry, farmers and investors; and (3) reform of the financial system to prevent a repeat depression. New labor laws were passed, and banking/securities legislation was enacted, and great public works were undertaken, and a New Deal social safety net was put in place.

The period from the end of World War II until 1980 was characterized by significant economic expansion and big increases in productivity, the benefits of which were surprisingly fairly shared with working people. But rich people and speculators had finally had enough of this fair sharing of the benefits of the capitalist system with workers, so beginning with Ronald Reagan in 1981, wholesale changes were made to slash taxes on the wealthy and significantly reduce the collective bargaining power of workers. Regulations on Big Business were reduced, and defense spending was radically ramped up and America indulged in a stunning and increasingly risky binge of federal deficit financing. The smart protections that were established during the Depression were dismantled, and the safety net was undermined, and the rich got richer. Big Money served to further corrupt our political system, and it became less fairly representative and increasingly vulnerable to systemic shocks and fraudulent schemes. A high-tech stock market bubble grew and grew, and then burst in 2001, and then a real estate bubble was inflated and then subsequently burst in 2008, causing another global financial crisis.

Now, as 2016 has slipped into history and 2017 is approaching conclusion, a new bubble is being inflated again by means of historically low interest rates, low marginal tax rates on high incomes, and new record levels of national debt every day. The Federal Reserve strategy of buying assets to stimulate the economy in the absence of fairer national policies has finally lapsed, and we have learned a lot about best practices and worst practices, but we are still allowing vested interest groups to continue to rig the system for their own narrow short-term self-interests at the expense of the soundness and safety of people worldwide. And with the electoral coup by Trump Republicans, terrible abuses of power are taking place, as evaluated at length in *See Clearly: Sanity During Insane Times - Book Twelve of the Earth Manifesto*.

It is our duty now to alter this state of affairs! When in the course of human events, grievous risks and adversities arise, it is the right of the people to institute new measures of governance so as to ensure their safety and happiness. The need is becoming urgent, and we should act in accordance with best understandings of Solon-wise statesmen and ecological economists and common people using common sense.

### A Journey from the Infinitesimal to the Infinite

Modern microscopes reveal entire worlds in a drop of water. Even a hand-held magnifying glass can present us with a perspective of insects feeding on a wildflower that provoke our imaginations with new insights into a seemingly whole other world. Likewise, expansive insights can be gained by looking through a good telescope at the night sky, which reveals astonishing things to our imaginations.

With thoughts like these impinging on my mind, I took another walk one day in the coastal hills of Northern California. Bright wildflowers grow there in the early springtime beside weathered lichen-encrusted rocks, and wild grasses sprout exuberantly, reaching skyward alongside the taller skeletal stocks of last year's wildflowers. I recalled the 1977 Powers of Ten video that takes viewers on a sensational journey from a picnic on a blanket expansively up to an entire view of the universe and then back down to the picnic spot and on down to the subatomic level of electrons and the nuclei of atoms and their constituent quarks.

The grass is new, I thought to myself at the time, and I am somehow more than 60 years old -- my, how the long years seem, in retrospect, to have flown! The serpentine rock found in outcroppings on these coastal hills is about 100 million years old. The source of the bright sunshine that impinges upon my skin on a lovely day is a fiery furnace more than 4.5 billion years old.

Not far away, a natural rock arch on the north end of beautiful cliff-encircled Tennessee Cove suddenly collapsed onto the beach on December 29, 2012. This arch had been a focus of thousands of photographs over the years, especially near sunset in the summer when the Sun would shine through the hole in the rock and cast an evocative beam of sunlight through ocean mists onto the beach. An engineering geologist with the California Geological Survey happened to be at the lovely cove when the collapse took place. His son, Robert Wills, a graduate student at the California Institute of Technology was with him, and he took a marvelous succession of photographs of the event. They can be seen online.

This occurrence provided direct evidence of the punctuated equilibrium nature of geologic change. The large pile of crumbled rock and boulders on the beach (shown in the photograph on the cover of Book Two) would initially have filled about 12 heaping dump truck loads. In the 3 months that followed the arch collapse, most of the rock had disappeared, succumbing to the periodic high tide onslaught of the incessant waves onto the reddish sand beach. Sensationally, one year after the collapse, the only remaining evidence of the rockfall onto the beach consisted of a dozen smallish boulders in the sand. A month later, more than twice as many rocks surprisingly appeared just after full moon high tides, and it became apparent that one way the rocks disappear there is by settling deeper into the tide-shifted sand.

I just happened to sit on one of these remnant rocks on the last day of 2013, as another year lapsed into history. The tide was relatively low, and the ocean swell transferred its rhythmic energies to gathering and crashing waves. The sun glinted off the sea to the southwest, and I contemplated the import of the pending discovery of the Earth Manifesto, practically mature and hiding in plain sight, no one yet aware of its existence. Hmmm ... To use a word judged to be one of the most annoying, overused words in the past 7 years, "Whatever!"

When the Marist Institute for Public Opinion published its annual survey of the most annoying and overused word of 2013, sure enough, it was once again, "Whatever!" This word was originally a quizzical expression of "inexpressive ignorance", but has evolved to be a "facile dismissive exclamation".

Mark Twain liked to be precise in his use of words, even as he promiscuously exaggerated some of the details of his tall tales. As he once said, "The difference between the right word and the almost right word is the difference between lightning and a lightning bug." Aha!

Waves in Tennessee Cove tend to come in sets that alternately run up the beach between 10 feet and 50 feet. Periodically, regardless of whether the tide is coming in or ebbing out, a much bigger swell occasionally manages to amplify itself into a sneaky rogue wave, which makes the old adage about never turning your back on the sea particularly vivid with import. The sign seen upon arriving at this beach is similarly precautionary. It reads, TSUNAMI HAZARD ZONE, and it has a cascading wave graphic along with the words: In Case of Earthquake, Go to High Ground or Inland. This is good advice, since the San Andreas Fault runs north just a few miles offshore.

Since I'm a gal that almost libidiously likes to extrapolate concepts into altogether different ideas, you could probably have seen this observation coming: The importance of not turning our backs on the oceans has never been more urgent, because our global exploitive impacts and polluting ways, in aggregate, keep getting worse as every year experiences another global net increase of more than 70 million people. Our failure and collective disinclination to slow human population growth, along with our apparent inability to responsibly limit greenhouse gas emissions, is causing ocean warming as well as a decrease in the overall weak alkalinity of the world's seas. Catalyzed by carbon dioxide, this "acidification" is having lethal impacts on corals and other forms of marine life. We must figuratively face the waves, seeing clearly.

Long before the arch collapse, here is a description of the Cove and its locally famed arch:

"Some of the most eloquently sculpted sea cliffs in the Headlands are at Tennessee Cove. The high sheer wall on the north side of the cove is primarily chert, hollowed by millennial waves into shallow caverns under layered arches that are greenish on the surface, except near the cornerstone of the wall, where the contorted layers are yellow-gold. Some 75 feet up the cliff is a "keyhole" -- a 10-foot clerestory window in the wall affording a view of the sky. It is a result of waves from both sides of the wall cutting into a fault zone and undermining the wall until it broke through at its narrowest point, creating the window."

--- *Marin Headlands: Portals of Time*, by Harold and Ann Lawrence Gilliam (1993)

As I was looking at the sedimentary rock in this vicinity, at the north end of this beautiful National Park beach, these ideas were spilling sideways into the curiosity center of my consciousness. Within twenty-five feet of the rockfall area, the greenish and reddish rock layers have been almost vertically uplifted into impressively distinct striations that are twisted at amazing angles. The contortion of the rock layers in these uplifted marine terrace cliffs attests to the effects of elemental formative forces on this continental edge of the North American tectonic plate.

I tried to imagine the existence of this rock in every moment from the process of its deposition on the floor of the Pacific Ocean until pressure and heat fused it into thousands of layers of lithified rock and it was slowly but continuously moved on the Pacific tectonic plate of Earth's crust until it was emplaced on the North American continental shelf and later uplifted into its present position, all of this over the eons-long course of geologic time. While these towering rock cliffs seem permanent from the standpoint of a single human lifetime, they were uplifted almost yesterday from the perspective of geologic time, and here again it can be seen that all exposed rock is melting away like butter under the continuously operative mechanics of weathering and erosion. On a human time scale, things seem real different, yet relatively long-term considerations are increasingly desperately needed in our national policy planning.

This train of thought reminded me of the stunning visual beauty of the coastline of Oregon, which is punctuated in many locales by rugged "sea stacks" just offshore. These natural rock islands are a result of what geologists call "coastal geomorphology". Sea stacks are rock island remnants of headlands along coastal cliffs that have been worn away by the relentless action of the sea as it erodes the coast by the actions of chemical weathering, wind, rain, thrashing storms and crashing waves.

Easter Island, which lies 4,500 miles south of Tennessee Cove, is famous for its mysterious volcanic rock monoliths. The Rapanui islanders curiously placed all these mystifying monumental statues looking inland, with their backs to the sea, and the idea of this peculiar insularity transforms my conceptions of reality into



metaphysical thoughts and mystical imaginings. Let us not similarly turn our backs on the vital seas! Antoine de Saint Exupéry's words come to me, from *The Little Prince*:

"Here is my secret. It is very simple: one sees well only with the heart. The essential is invisible to the eyes."

#### Further Reflections from Nearby

Immediately to the north of Tennessee Cove, there is a prominent peak that provides some sensational vistas on a clear day. From this spot, three rocky points can be seen jutting out into the swell-sculpted Pacific Ocean further to the north. The first rocky point is Muir Beach Overlook, and the second is Bolinas Point, and the one in the distance is Point Reyes, about 30 miles distant. To the south of this peak, Point Bonita Lighthouse is visible, and then Land's End in San Francisco beyond the Golden Gate, and Ocean Beach stretching south down to distant Point Montara. I slyly mention this visualization because I like the evocative symbolism of these place names ... John Muir would have approved!

This particular vantage point above Tennessee Cove lies within a few miles of the infamous San Andreas Fault that runs offshore from Mussel Rock, just south of San Francisco, north to Bolinas Lagoon, Tomales Bay and Bodega Bay. When the next Big One hits, if you were on the top of this cliff, it would be like riding a bucking bronco. It would be frightening, and dangerous, but impressive in its startling scale and punctuated equilibrium import. As I returned to my car along Coyote Ridge on this occasion, the year 2013 was approaching its end, and an awe-inspiring orange ball of illumination arose over the Tiburon Peninsula to the east, announcing the rising of the last full moon of the year.

The driest year ever recorded in this area took place in calendar year 2013. Never since records have been kept beginning in 1849, at the beginning of the California Gold Rush, had so little rain fallen in a 12-month period here. Less than 5 inches of rain fell in nearby San Francisco, compared to a normal of about 21 inches. I use the word "normal" hesitantly, because precipitation averages these days tend to deviate from normal more than usual, and this is true in many locales around the world. This trend happens to coincide with predictions made by climate scientists who use computer models to assess the probable destabilizing effects of global warming on weather patterns.

The record dry weather in the West was caused by a "ridiculously resilient ridge" of atmospheric high pressure that kept storms from reaching California by driving the jet stream to the north. This weather pattern was correlated to a polar cyclone that dove down into the Midwest and Northeast in early 2014, causing bitter cold temperatures. In Hannibal, as an example, frigid temperatures set a record low of 14 degrees below zero on January 6, 2014 according to data from the Board of Public Works Water Filter Plant in Riverview Park along the banks of the Mississippi. People on the East Coast in the winters of 2015 and 2016 also experienced this impressive phenomenon.

The cause of these blasts of cold air are a disturbance of the normal polar vortex, a spinning vortex of very low atmospheric pressure that generally hangs around polar regions more religiously. This weather contrasted in an extraordinary way to the warm and sunny days that were experienced almost every day in January 2014 in Tennessee Valley, during the normal cool wet season, without a cloud in the sky, day after day after day.

The fact that precipitation and storm patterns worldwide seem to be shifting so much is beginning to make those who deny the extensive evidence of climate change look like complete fools. And denial can be dangerous.

The balmy record dry weather in California in the winter of 2013-2014 caused severe drought conditions, and coastal hills that are usually a lovely green during that time of year stayed brown until a "Pineapple Express" storm finally broke through in February 2014 to deliver heavy rains for a few days. Snow accumulations in the Sierra Nevada only reached about half of normal that year, and an all-time record paucity the following year, providing ominous signs for water supplies later in the hot and dry summers. Nearly 40 million people and some of the world's most productive farming areas were affected by the record dry warm weather. These conditions of severe drought intensified throughout 2015, and the good El Nino storms in January 2016 inspired hope that

a fifth consecutive year of drought would be avoided. February 2016, however, featured unusually dry weather, and some record warm temperatures, so some locals began to do rain dances in hopes of propitiating the rain gods. And maybe it finally worked, for after five years of below normal precipitation, an amazingly wet winter arrived in 2016-2017. A rain gauge at Lake Lagunitas just north of Marin's Mt. Tamalpais that records an average of just over 50 inches of precipitation recorded an astonishing 96 inches in the 2016-2017 rain year. But then the 2017-2018 year reverted to subpar rainfall with less than 40 inches.

Something is definitely going on here, and what it is, is becoming increasingly clear. It is a bad plan to obtusely mess with Mother Nature. Failing to exhibit any collective discipline in our activities is foolhardy. There is evidence that even conservative folks in Missouri are beginning to wonder how wise it is to believe denials by cunning billionaires Charles and David Koch and big oil companies that the burning of fossil fuels is a serious problem, unworthy of concern or remedial actions. Smart green taxes and effective incentives are needed to help us mitigate or avoid the much worse conditions that are to come in the future due to the on-going destabilization of global weather patterns that is being caused by increasing concentrations of greenhouse gases in the atmosphere.

Like towering cliffs crumbling slowly into the sea, the tide of progressive change could overcome the bulwark of head-in-the-sand opponents of effective action, and might even help mitigate the severity of the anticipated impacts of a changing climate. Let's heed Precautionary Principles! We should specifically begin to find ways to live within a "carbon budget" that is required to keep planetary warming below the threshold of extreme risk. The time for remedial action is now!

Those far-seeing words were written well before reactionary Republicans seized one-party control of the government and put Mammon greed on a high altar, looking down on Mother Nature and disparaging her as a creature unworthy of respect or protection. It seems impossible that such incredibly irresponsible politicians have grabbed near-monopoly power in Congress, the White House and the Supreme Court, and that they are being so successful with a long litany of assaults on protected lands, endangered species, clean power, the Paris Climate Accords, the best interests of working people, people's health care, regressive tax schemes and the like. May we live in interesting times, but THIS interesting!

The fact that "conservatives" are making these ultimate sacrifices to maximize short-term profits is astonishing, as is the fact that, by design, these profits will be funneled up to rich people who have no conceivable need for the largess. These treacherous sacrifices are being made for no higher purpose than satisfying the greed, ambition, ego, status-seeking compulsions and sick pleasure of power-abusing rich folks, and it is time that the American people stood up and demanded that these condemnable people stop being allowed to succeed at corruptly abusing the power afforded them by their Big Bucks.

These are times that try men's souls, as Thomas Paine declared when revolutionary zeal was washing across the thirteen colonies. Today, men's souls are being tried, and guilty verdicts are in the process of being rendered.

### An Interim Conclusion

Billions of years have passed since the Earth formed, and billions more will come before the bright Sun finally burns out. These realizations, together with accurate geophysical understandings and the extensive evidence of biological evolution, provide us with factual proof that our home planet is ancient beyond fathoming. It is NOT merely Biblically young! Understandings like this should give religious leaders cause to reform their founding Creation myths. Mystery is a powerful and potent motivating force, but it should be cultivated for positive and meaningful purposes, not for suppressive and ignorance-embracing purposes, or even worse, to promote divisive, discriminatory, destructive or conflict-fomenting actions or policies that exacerbate overconsumption and ecological overshoot.

To understand the natural world, it helps to understand the nature of change. Make no mistake about it: time seems to slip slowly but surely past. Change and motion are continuous at every level from the subatomic to the macrocosmic. Change is essentially eternal and infinite, and it generally takes place in imperceptible increments,

like a rivulet carrying mud into a stream during a gentle rain. But sometimes change takes place with sudden exclamation, like a cloudburst following a searing bolt of lightning suddenly sundering a sultry sky full of darkly towering cumulus clouds. To doubt that change is a cumulative evolutionary lapse of the old into the new is to deny the most basic of observable understandings. And to further make the supposition that evolutionary change is guided is to make the mistake of misunderstanding the nature of both cause-and-effect and random chance in galactic, geologic and biological change.

The science of geology studies the physical reality of the Earth and reveals that continuous physical change has been occurring throughout eons of geologic time. The most profound insight of geology is that we exist at a moment in time that is merely an infinitesimal portion of an incomprehensibly long saga of the planet's existence. Marvelous geological processes have been occurring throughout the history of the Earth. While understandings of plate tectonics and the causes of volcanoes and earthquakes are relatively new, the processes they comprehend have been taking place for millions of millennia. Constant forces and processes act in accordance with natural laws of cause and effect. Forces that cause the uplift of mountains are opposed by countervailing forces of erosion that wear them down. While mountains have the illusion of permanence in the span of a single human lifetime, it is clear that landscapes change with the passage of time. Rivers and glaciers move in response to the pull of gravity, and they combine with wind, chemical actions and freezing and thawing to erode entire mountain ranges to mere remnants once they are no longer being uplifted. Dramatic places like Yosemite Valley, Zion Canyon, Arches National Park and the ancient 'Cedar Mesa' sandstone formations of Natural Bridges National Monument provide mute but beautiful and awe-inspiring testaments to such forces.

Geophysical changes in Earth's crust that occur in dramatic spurts are much more obvious to us than continuous gradual ones. We witness these forces with awe. Floods, earthquakes, tsunamis, volcanic eruptions, landslides, rock falls, hurricanes and tornadoes shock us with their impersonal power. When scientists characterize this natural aspect of the physical evolution of our home planet as a punctuated equilibrium, they are expressing the simple fact that extraordinary geophysical events are like a dramatic punctuation of regular continuous but barely perceptible change. Superstitious folks say these events are the result of angry gods who are forsaking or punishing people for various sins. This seems, however, to be just SO inadequate an explanation! What is really happening here is that Nature is taking its natural course, folks!

The science of geology tells us that earthquakes are ruptures that take place when tension builds up between tectonic plates and then is suddenly released. Stresses build up as the plates either collide with other plates or move laterally against them. Rather than having a well-lubricated motion, friction causes the plates to get stuck, until they finally snap in energy-releasing earthquakes.

While people in California are wondering when the next Big One will strike along the San Andreas Fault, there is a near certainty that there will be more than 100,000 'Big Ones' in the next 15 million years. These earth movements will be the cause not only of making beautiful Point Reyes peninsula an island in less than a million years, but also the cause of the area where Los Angeles is now, on the Pacific Plate, eventually moving north of San Francisco, which is on the western edge of the North American Plate. This will occur within 15 million years. Unimaginable? Check the science! Here's the math: The Pacific Plate averages a movement of about two inches per year in punctuated equilibrium jumps, so in 15 million years it would move 30 million inches, or 2.5 million feet -- about 475 miles. Yep, the place where Los Angeles is now will be just northwest of San Francisco's current location!

### The End Is NOT Near

Human beings have evolved a consciousness capable of understanding and appreciating the Earth with a rich awareness. In the long span of geologic time, we will eventually become extinct. In some ways, human beings are like a cancer in Earth's biotic arena, harming the whole, much more than we are like vibrant white blood cells that propitiously act as parts of the immune system to defend the whole body from infection or disease. Dr. Leonard Shlain makes this point compellingly in his book *Sex, Time and Power: How Women's Sexuality Shaped Human Evolution*. He writes that, when considered in biological terms used to describe the animal kingdom,

*Homo sapiens* began as a "symbiotic prey" and managed to evolve into a highly successful "symbiotic predator". But then our species has since degenerated into a kind of "very large parasite". And now, with our pollution, deforestation, strip mining, overgrazing, overfarming, overfishing and other extinction-causing activities, we have transformed ourselves into a "planet-devouring pathogen".

"Think of the entire planet with its blue oceans and pristine mountains, as a host," he writes. "We have arrogated many of the earth's resources simply to satisfy our craving for material comfort. While we have been congratulating ourselves on our species' unrivaled domination, alarm bells are figuratively beginning to sound in all regions of the planet. From the perspective of most other life-forms, we have transmogrified into the planet's most virulent pathogen, and our frenzied degradation of our host, Earth, signals that we may be just another stupid parasite too feeble-minded to realize that one should never bite the hand that feeds one."

The average duration of a species in the long arc of time has been maybe 5 million years. As noted by Gaia above, so much time has elapsed since the genesis of the Earth that 99% of all species ever in existence have long since gone extinct. The main goal of humanity should be to try to ensure that we survive and flourish indefinitely. Such a goal would improve our chances of leading higher quality lives while also helping ensure that we would have some glimmer of hope for us to make it the long, long ways to the average species' duration of 5 million years.

How will we accomplish this? How will we survive another one thousand years/ Think about this! The human race must focus on the goal of long-term survival by better understanding the self-regulating systems of Mother Earth. We must manage our activities more sensibly, and organize more effectively, and plan ahead further, and cooperate together better to avoid the depletion of resources, the destruction of habitats, the serious risks associated with anthropogenic climate change, and the dangers of war-without-end that diminish the future prospects of humanity.

Worst-case scenarios should be honestly evaluated, and intelligent steps should be taken to mitigate the severity of outcomes that threaten the survival of the human race. We must think in terms beyond pessimism and beyond optimism. Desperate need and unmitigated greed are powerful forces that stand in opposition to wise planning, but the human race is finding it imperative to develop a less destructive and less rancorous way of making crucial decisions than we do in our current distinctly dysfunctional, money corrupted and short-term-oriented political and economic systems.

I highly recommend that readers consider Professor Jared Diamond's insightful observations about political and environmental instability in nations around the globe that are contained in *Collapse: How Societies Choose to Fail or Succeed*. See Chapter 16, "The World as a Polder: What Does It All Mean to Us Today". Professor Diamond summarizes the 12 most significant environmental problems facing us in the world today, and he points out the parallels these difficulties have with challenges that contributed to the collapse of some earlier civilizations. Diamond also provides an objective assessment of the weaknesses of talking points adduced by those who oppose protections of the environment, and he evaluates the ideologies of vested interest groups that are arrayed against bold efforts to address environmental challenges. His perspective is immensely important.

It seems clear that, in addition to courageously addressing overarching problems, an effective means needs to be found to mitigate sources of extreme inequities and conflicts between various peoples and constituencies. It would be a good idea to find ways to reduce injustices and to prevent levels of inequality from increasing to an ungodly worsening extreme.

"It is curious that physical courage should be so common in the world and moral courage so rare."

--- Mark Twain

Since some of the worst sources of conflict and retrogressive impulses lie in narrow-mindedness of parochial religious beliefs, it is becoming increasingly important for us to allow more tolerant and ecumenical worldviews to gain ascendancy. We should honor the resilience of our human spirit, and ground our attitudes in a healthy embrace of the noble aspects of our beings, rather than in the competition for supremacy of parochial beliefs.

We should get over our conviction that 'our God' is better than someone else's God. My own personal belief is that more honest religious leaders must step forward to help ensure that their doctrinal traditionalism reflects fair-minded moral systems rather than claims of literal absolute truths and dogmatic dictates. It may well be that a more honest and noble spirituality will prove to be key to survival for our species. I beseech all adherents of the various denominations of Christianity and Islam, in particular, to heed these words!

When it comes to religion, let us adopt a 'live and let live' attitude. Let us adhere to the Golden Rule. And let us strive to make sure we begin to live in ways that will result in a fair and healthy legacy to all people in future generations. Let us strive to make sure we do not leave our heirs a legacy of conflict, destitution, debt, and a feverishly devastated and unstable home planet!

Truly,

Dr. Tiffany B. Twain

Earth Day, April 22, 2018 (First published in November 2009 and revised periodically since then).

---

### A Sprig of Philosophy

"It is not our place to complete the task; it is ours to begin it." As the Chinese philosopher Lao-tzu wrote long ago, "A journey of a thousand miles begins with a single step." Even the longest journey begins where we now stand, and it seems obvious that the most intelligent and sensible plan is to head in the right direction. That means forward, not backward!

This is a new aspect of the "fierce urgency of now", a phrase coined by Martin Luther King while preaching in the year before he was assassinated. If we are unable to prevent the human species from upsetting the healthy and providential balance of natural ecosystems, we will surely be unable to save ourselves. There will never be a convenient time for the inconvenient need for us to begin boldly addressing the overarching challenges related to economic injustices, excessive debt, climate change, and growing risk factors associated with overpopulation. We have been avoiding the solutions to these problems, and our partisan and vituperative haggling over these and other issues is a tragic example of figuratively fiddling while the empire burns.

Everyone who lives in an environment should be an environmentalist, as David Brower once said. In Hebrew, there is a phrase, *tikkun olam*, which means, "mending the world." In Judaism, this concept of *tikkun olam* requires that a practice be followed not because of Biblical law, but because it is consistent with the greater public interest. *Tikkun olam* implies that we should all work to make the world a better place and to relieve human suffering, and to create conditions in which people coexist peacefully and protect the biological diversity of life on Earth. Hallelujah!

The people that I respect most are those who are passionate advocates of good causes. Perhaps I'm just a "meshuga shiksa"? (A "crazy young non-Jewish woman".) Honest civic virtue and public service, it seems to me, are at the core of civilized behavior. Firsthand experiences of inequities and injustices in our society lead people toward transcending self-centeredness, and breaking through to ethical values. These are the seeds of humane and just societies. All too many inequities and injustices exist, so I am impatiently waiting for the anticipated break through! Help out!

Before the 2016 national elections, I wrote this: "Renowned poet Robert Frost once ruminated philosophically about The Road Less Taken, remembering about having stood before two roads that diverged in a yellow wood. Today we are collectively reaching a defining national moment, an abrupt juncture, and are faced with a choice of taking a right fork or a left fork. It seems abundantly clear to me that the best plan would be to avoid taking the fork that veers sharply to right into the undergrowth that likely leads to a Slough of Despond and Unnecessary Discord. A better course to take would be to take a path that meanders off to the left towards a providentially propitious destination that offers salvation and solace in old-growth forests of Ecological Sanity, Precautionary Virtue and Sustainable Prosperity."

"Perhaps the truth depends on a walk around a lake", Wallace Stevens once poetically opined. Maybe the real truths lie in introspective circumambulations around more interior bodies of water -- like our brains!

### What Makes a Great Geologist

Humility. The Earth is greater than all of us. Up until now it has provided the basis of our everything. And equally it can take it all away in a flash.

The ability to imagine. What you see now in our world is not necessarily what has come before and the Earth System has a track record that goes back 4.6 billion years.....but has only preserved a portion of its tale. The rest we have to infer.

Ability to handle uncertainty. Unless you can pick up something in your hand and sample it, then you'll always be relying on stand-off (second-hand) analysis of what it is. Often, you will be sampling no more than a trillionth of the bigger picture.

Synthesis. You will pull from a myriad of sources of information from the nanometric to the galactic. And you may voyage through this universe in a single day.

Grace. You will tap into all the other grand sciences which peer down at you, but you will have a wry smile to yourself that without you no-one would understand Home.

Passion. How can you not be excited by the Earth? This is a subject you never need to switch off from and keeps giving for as long as you ask questions.

A Story-Teller. You are suspicious of dogma for you know that too much is unknown, but there is still much meaning to be gleaned from careful and fair observation.

Patience. You will never likely have all the facts. But you are adding to a Great Story.

A capacity to never stop learning. Your "office" will be the grandest thing you're ever likely to encounter and you will only ever discover a proportion of what there is to know about it.

I therefore tend to believe that a Good Geologist has many of the qualities of a Good Human Being.

### Conceptual Art Looms Majestically in Our Collective Imagination

Visualize vividly in your mind's eye a brilliant new permanent art installation on Easter Island that will resurrect twelve of those huge iconic bigheaded Rapanui stone statues known as moai ("mow eye"). These volcanic monoliths will be positioned on rock platforms facing outward across the beautiful South Pacific and toward the horizon where the sun rises, instead of facing inward, the way the insular natives had placed their statues. This positioning will evocatively commemorate far-sightedness, in distinct contrast to the Rapanui's myopia in depleting the natural resources on Easter Island that led to the collapse of their civilization.

This impressive line of solemn human-faced statues will be dedicated to the great civilizing accomplishments of our venerable ancestors, and to a transcendent concern for the prospects and well-being of our descendants. Two golden plates will declare these noble dedications, one honorably commemorating the courage of the early Polynesian colonists who had intrepidly crossed vast expanses of open ocean to discover this most remote island on Earth, and the other declaring our respectful commitments to all human beings in future generations by proclaiming a collective intention to leave them a legacy of wise governance, protected lands and oceans and biological diversity, and enough resources to ensure indefinitely sustainable civilizations.

Come, come, whoever you are  
Wanderer, worshiper, lover of leaving, it doesn't matter.  
Ours is not a caravan of despair.  
Ours is the portal of hope.  
Come, even if you have broken your vow a thousand times.

Come, yet again, come, come.

--- The poet Rumi