Gaian Science, Gaian Philosophy, Gaian Spirituality and the Rainbow Way

(Part 1)

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Dance of the Rainbow Flames

Love is not an evanescent thing.
It is a brilliant flame,
that can illumine the dark
interior of a saddened soul,
a torch that can burn away suffering
and make the inevitable pain bearable.
The human heart becomes a Fiddler's Green
when lit by the sun of Love.
Love is not bound by propriety,
it grows where nourishment is found,
where fear is conquered when time is given.
Then flames of love can leap up high,
each unique in radiant rainbow colors.
Men and women then join in loving complexities
that have not danced in this old world for an Age.
All forms of love can flourish,
familias; the force that binds clans and tribes.
Philios; the union of like minds, friends.
Agape; the spiritual power to mend the world's strife.
Hot Eros; the core of life's power, and lovely amor.
Amor; the blazing jet that warms paradise,
Amor; the heart of the troubadour's rebellion,
Amor; the secret dream of all from heroes to villains.
Our people's way of Eros and Amor is a bird on the wing
in the star glittered moonlit sky of souls at peace.
The central heart and flesh is men with women
to bring the generations of the past into the misty future.
The wings are men with men and women with women
to lift all into new yet ancient heights of brilliant, blazing love.
Gay and Saphic, hetero and bi are all one in amor.
In their multi-hued dance of wonder
the Great Houses will be born,
the Great Protectors will stretch out their hands again,
and the people will dance the old dance 'neath the pale full moon
with cookfires, torches, and bonfires all lit by love,
the Wasteland can become green once more,
and the Hoop of Many Nations will rise above the Middle Plain,
and all will celebrate the 10,000 Nations of Gaia!

"Yes, happily language is a thing: it is a written thing, a bit
of bark, a sliver of rock, a fragment of clay in which the
reality of the Earth continues to exist."

Maurice Blanchot

The Gaia Concept has been around for a while now...about 35,000 years! The idea that the earth is a living being is an old, old, old part of philosophy and religion. That's part of why James Lovelock chose the name Gaia for his scientific hypothesis when Lovelock's neighbor and Nobel laureate William Golding suggested it to begin with back in 1967. My more secular readers will be able to take the science 'straight up' but, my religious readers will be served by the metaphor, they are after all the vast majority (90 to 95%) of the population. My secular and religious readers should both also know that the philosophy of religion position used in these essays is the stance that all faiths are true if we see them as metaphors rather than as one ('mine') being literally true and all others ('yours') as false like your average fundamentalist does. In essence: God is too big to fit into anyone religion. This is the heart of the Rainbow Way.

The details of how we integrate science with philosophy will be discussed in the 2nd part of this trio of essays. The integration of this enhanced philosophy with theology is the topic of part three. This new scientific concept of Gaia, Mother Earth, is really just the latest philosophical variation on a very old theme going back to carved ivory fertility goddesses of the old stone age or perhaps, even further back.

Both the Gaian Way and the old pre-Christian, native European religions including the Wiccan Way hold this antiquity of the Goddess as a central part of their teachings about the Mother of All. The Gaian view is more philosophical about her and the Wiccan Way is more worshipful of Her. My Wiccan readers should be able to see that it's a good idea for us all to be aware of this new Gaian scientific revolution that is sweeping the biological sciences just at a time when unforeseen dangers can arise from cloning, DNA splicing and other genetic technologies.

However, I want to reassure my more traditional readers we have not forgotten the Father of All. Catholics, with their reverence for St. Mary may have an easier time using her as an Earth symbol than the more Patriarchal types of religion. His Heavenly Realm however, which we will discuss later and discover to be quite important, is not where the changes we are seeing now lie. These changes are earthly, physical but, this is the very essence of life that we've begun tinkering with here. Our alteration of God's creation, this world is the current issue.

On the other hand, if we're thinking about life on other worlds, like the discoveries about possible life on Mars in 1996 or the dozens of extrasolar planets just discovered even more recently, we are thinking of other Gaias out there, on other planets. Before we can ever hope to sail the stars and discover any other Gaias we must survive the coming 21st Century's "Big Crunch", the population explosion/resource depletion bottleneck 30 to 70 years away and fast approaching our children and grandchildren. Adopting Gaianism as an "Earth Centered Philosophy" means that it is our duty to aid everyone we can in achieving balance and harmony through this coming crisis. Developing a Gaian form of Christianity has already begun but, everyone needs to see and understand Gaian Theory first. Since Wicca is an 'Earth Religion' it should not be difficult to integrate the findings of Gaian Science. As spiritually concerned and at least compassionate individuals (the secular types) and as some of us are healers we must try to save as many lives as possible just as, one would hope, like any compassionate Christian or Muslim. In most Wiccan traditions healing people, animals and the environment is central. It is no coincidence that the true, astronomical change (c.2240 A.D.) from the Age of Pisces to the Age of Aquarius is on the other side of "The Big Crunch". As the Native Americans also say "We Must Walk in Balance on Mother Earth". This makes the 60's the first glimpse of that coming New Age, the first large scale social sighting of the light at the end of the tunnel which also is the bottleneck. Lets look at our Mother Gaia first in this new scientific way and our proper relationship to her can be made clearer, then we can talk about other possible Gaias later and the impacts on philosophy and spirituality too in parts two and three of this essay.

Gaian Science

The Gaia hypothesis came out of Lovelock's work on NASA's Viking mars probe work in the early 70's. NASA was interested in testing for life on Mars and had Lovelock consult with them at JPL (Jet Propulsion Laboratories in Pasadena) on a friendly basis. He sees his theory as another "spin-off" of space technology. Spin-offs are any technologies or materials developed for use in the space program, e.g. polyurethane foam

insulation or miniaturized computers, that are now commercially produced. There are 20 to 40,000 such items now cataloged. The space program has more than paid for itself in new products and jobs. New science discoveries are also spin-offs, the confirmation of Black Holes, X-ray astronomy and so on. Gaia Theory may turn out to be the most important space tech spinoff in the 20th Century.

After a while Lovelock generalized the question and asked "What is Life and how do we recognize it?". He became convinced that life should profoundly affect a world's atmosphere. It certainly has ours! If so, then you should be able to tell if a planet is alive by simply looking at its atmosphere. The Viking probes landed on Mars in 1976 and its findings in its search for microbes in the Martian soil were ambiguous. Mars, though apparently dead (Pathfinder also found no life in 1997, nor has Spirit and Opportunity in 2004) it is now known by the Mars Global Surveyor currently in Martian orbit, to have water as permafrost patches in the soil all over Mars but, wherever we have looked the atmosphere is at chemical equilibrium. If Gaia Theory is true, Mars is dead now but, may have had life in the past. The Moon has also recently been found to have ice as well by the Clemintine Probe but, only at the airless, lightless poles. Europa, a moon of Jupiter however has been found to have liquid water in a deep ocean beneath its frigid surface of ice by the recent Galileo Probe. It is now the most likely candidate for life in the Solar System outside of Earth, though it has no atmosphere.

Nearly thirty years after Viking, at the dawn of the Twenty First Century we find Gaia Theory, Gaian Philosophy and most disturbing to many people both secular and religious, Gaian Spirituality. In 1992 the "**Skeptical Inquirer**" Magazine had an article: "Gaia Without Mysticism". It carefully delineated the boundary between science, religion and philosophy. Yet it seems clear to me they are related and they interact, changes in one impact the others, and if there is one combined scientific, philosophical and spiritual idea I want to express here and if the reader takes only one concept away from this missive it is simply this: **The Earth is not Sick, She's Pregnant!** The first part of this essay will examine the Scientific Theory of Gaia: The Earth as a single living organism and how a science sensitive Gaian philosophy is now arising out of it in the next section. Finally, in the last section, we will examine how this relates to Gaian Spirituality which may turn out to be one of the oldest religious views on the planet depending on how you define things and the amazing implications it has for humanity's future.

First, lets look at the question: What is Life? Animated water? Biological minerals? That which has a soul? That which grows? That which reproduces? A wave of anti-entropy? Philosophers have struggled with this ontological question for millennia. The question is also found in ancient Greek philosophy. Ontology is the study of being and at the center of 'human beingness' is our aliveness. Their ancient 'natural philosophy' eventually evolved into modern science. Biologists and other scientists have made lists of the essential characteristics of life for centuries. They have lists of five to twenty items long depending on which scientists you want to follow.

The nineteen subsystems of a general living system with examples at the level of the biosphere, from "**The Global Brain**" by Peter Russell (1983).

#	SUBSYSTEM	EXAMPLE FROM BIOSPHERE
1.	Ingestor: brings matter-energy across boundary from outside	Atmosphere (transparent to visible and infrared), volcanoes (permitting flow of minerals through Earth's crust)
2.	Distributor: carries matter- energy around system	Temperature and pressure gradients in atmosphere and ocean, annual migrations
3.	Converter: changes certain inputs into more useful forms	Mosses and lichens converting minerals to humus; plants photosynthesizing light into chemical bonds
4.	Producer: forms stable associations among inputs or outputs of converter for growth or repair	Occurs at cellular level (chloroplasts, mitochondria, RNA, and in reproduction of each species
5.	Matter-energy storage	Dead plant and animal matter in soil; water in oceans and atmosphere
6.	Extruder: transmits waste matter-energy out of system	Sedimentation in oceans; gaseous escape through upper atmosphere
7.	Motor: moves system, or parts of it	Tides, climate change, continental drift
8.	Supporter: maintains proper spatial structure	Earth's orbit, buoyancy of air and sea
9.	Input Transducer: sensory receptors for information coming from outside	Animals and plants reacting to day and night, to seasons and earthquakes
10.	Internal Transducer: receives information about changes going on within system	Animal and plant reactions t changing climate, floods, aridity, pollution
11.	Channel and Net: routes by which information transmitted to all parts of system	Annual migration and wandering; seed dispersal in plants; availability of food
12.	Decoder: translator of information into internal meaningful code	Interspecies communication--in response to reactions of other living beings
13.	Associator: associates items of information, the first stage of the learning process	Changed habitats and behaviors
14.	Memory: saves various types of information over different periods of time	Evolutionary adaptations recorded in changed genes
15.	Decider: receives information from other subsystems and transmits to them information controlling entire system	Soil; interspecies communication
16.	Encoder: translates internal information to external messages	Changes in constituents of atmosphere
17.	Output transducer: changes information into other matter- energy forms and transmits them into environment	Upper atmosphere, gaseous loss and radiation, changed albedo (reflectivity) of planet
18.	Reproducer: gives rise to similar systems	(The biosphere has not [yet] displayed this characteristic) Interplanetary travel?
19.	Boundary: holds system to gether protects from external stresses excludes or permits various inputs and outputs	Earth's crust below; upper atmosp

Now, systems theory is putting these lists into an interrelated, interacting pattern: a system. The essential thing here is that life is a dynamic, active system, more specifically life is a C.A.S., a Complex Adaptive System. It has dynamic boundaries both external and internal, and complex energy flows in and out as well as intricate internal physiologies and so on. So, lets talk about systems in general to get a basic idea to begin with.

Systems Theory is a big subject but I hope I can give the reader a quick working idea of what's going on here. Essentially all these systems work and interact in six basic ways. Converging, steady-state and diverging negative feedback loops as well as converging, steady-state and diverging positive feedback loops, we will discuss these details in a more in-depth essay. These six system types are to be found in three basic states: they can be growing, shrinking or be pretty much stabilized. This corresponds to plus-sum, minus-sum, and zero-sum games respectively in Games Theory. The idea is to see how components of any system interact in changing conditions. These systems are in what is called a dynamic equilibrium or homeostasis, and environmental change can put a stress on that balance, forcing it to respond in one direction or another. Gaia's internal systems on the other hand are whole ecologies, huge groups of organisms, all interacting systematically among themselves and their surroundings. Each organism in and of itself is a huge collection of organic, biochemical and biophysical physiological systems composed of tens of trillions of living cells where each of then is there own Complex Adaptive System, each very much alive. Human Civilization, itself

also a system, is just one albeit rapidly growing element of the overall Gaian system which is, of course, only one planet of nine worlds, scores of moons and thousands of asteroids and comets in the Solar System.

Lovelock, in his first book, "**Gaia, a New Look at Life on Earth**" (1979) shows how organisms can interact in such a way as to maintain the environment in dynamic equilibrium. The reasons he took this hypothetical leap are as follows:

1. Life began about 3.5 billion years ago and compared to the other planets the climate has changed very little. Yet the output of the sun, the surface conditions of the planet and the composition of the atmosphere have changed considerably.
2. The atmosphere of Earth, unlike Mars and Venus is in sharp chemical disequilibrium. It is a metastable DYNAMIC equilibrium that must be ACTIVELY maintained by something: Life. If life as a whole did not maintain the atmosphere the oxygen would be gone in a matter of a few thousand years. While that seems a long time compared to a single human life, it is an eyeblink in geological time. This may not be a mere byproduct of life but an actual construction, like a wasp nest or beaver's dam.
3. This dynamic equilibrium hovers around values that are optimum for life, and considering all the external changes the Earth has experienced, the probability of this happening by random chance over 3.5 billion years is awfully small. New research has pushed the advent of bacterial life back to 3.8 billion years ago leaving very little time for bio-geochemical evolution to operate.

In addition to atmospheric composition, there are many other planetary parameters that Gaia controls. The oceans are not nearly as salty as they would be on a "chemical equilibrium world" where life is not operating, the sealevel has been quite stable for millennia when the tides are averaged out. Also the general environment is not nearly as acid as it "should be" geochemically speaking. Something is working to maintain a comfortable environment for life, that is of course life as a whole: Gaia. The key to understanding Gaia scientifically is the cybernetic concept of Feedback Loops. In the chart below we see a basic example of a negative feedback loop in a zero-sum simple system of a common kitchen stove. It is zero sum because the oven does not grow nor does it shrink, it is in a steady state which is obviously what we want in a stove.

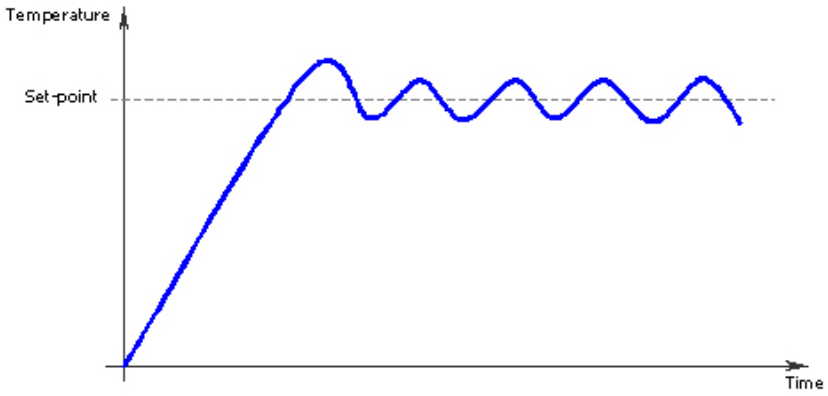

Figure 1. The termostat (continuous) process

Lovelock looks at cybernetics in detail to see how biological systems communicate with each other in order to respond to changes in the environment. The above graph of an oven thermostat shows how a negative feedback loop works. Once turned on the temperature rises until it passes the thermostat's set temperature. The oven then turns off. The oven begins to cool until it drops below the set temp and then the thermostat turns the oven on again. This results in the actual temperature oscillating around the set temperature. There are also positive feedback loops where energy is added to the cycle rather than subtracted as in the negative feedback loop diagram above.

Some examples of positive feedback loops are birth, a sneeze, or an orgasm. Positive feedback loops are often designed to bring us to a new system state or new equilibrium. These loops are a rare example of legitimate Circular Logic.

Fritjof Capra, well known as author of "**Tao of Physics**" (1975) also wrote "**Turning Point**" (1982) and most significant for us here "**The Web of Life**" (1996). In that book he describes how the main theoretical battle of biology since its development has been between the vitalists (a life force or morpha-genic field animates the chemistry of organisms or activates their biochemistry) and the mechanists (the chemistry of an organism is a biochemical machine) has now been transcended by systems theory, that biology is now undergoing a

revolution as is all of science. Capra sees a paradigm shift from the old views to a new systems theory view. The principle elements of a biosystem being the material substrate (chemo-physics and biochemistry), the process, its functioning or physiology, and the relationships, the dynamic interconnectivity of the various parts, the structure or anatomy and it's various system's integration patterns. He discusses this and more on his website www.fritjofcapra.net. In "**The Next Fifty Years**" (2002) edited by John Brockman we find John H. Holland's "What is to Come and How to Predict It". The article, beginning on p.171 is principally looking at computer science and psychological systems but, is being also applied to biology as Capra pointed out. Holland discusses, among other things, how Complex Adaptive Systems (CAS) are being used in more and more ways. These integrated, interactive collections of systems interlocking with each other via various co-ordinated feedback loops, the simplest of which we described above are a hot new commodity in theoretical studies.

The Gaia Hypothesis becomes a Theory

In his first book Lovelock was confident in Gaia's ability to respond and deal with human pollution so he's not very worried about the effects of pollution. It turns out that even Gaia has limits, and the CFCs (Chloro-Floro Carbons) that are being produced and released too fast for Gaia to process, and so the Ozone layer continues to thin. NASA discovered the hole via satellite in 1985 and continues to use satellites to monitor the problem. Happily, as of 2003 the Montreal Accords (signed in 1987) appear to be working as NASA reports the first overall shrinkage in the Antarctican Ozone Hole for that year.

In "**The Greening of Mars**" (1984), with Micheal Allaby, he has a fictional character, Travers Foxe, launching rockets to Mars loaded with CFCs to begin "Terraforming" Mars into a second Earth. The project is successful and Mars slowly becomes habitable and the CFC's are not a problem in this story. By 1988 however, in the light of new NASA data on the Ozone Hole Lovelock realizes that he was wrong about CFC's and the ozone. He now believes it is very possible to overload Gaian systems and seriously threaten our environment. Gaia taught him and now, chastened, he teaches us.

Most of his next book, "**The Ages of Gaia**" (1988) deals with Gaian Theory. Lovelock's working definition of life now is that which can produce and sustain a decrease in entropy locally. He goes into detail about how the Thermodynamics of Gaia Theory works. Thermodynamics is the science of the flow of energy inside systems, from one system to another, and changes from one kind of energy to another; it's a very important area for a clear understanding of how Gaia works. Clear definitions as to the boundaries of the system in question are crucial (see point 19 above). The first Law of Thermodynamics is the Law of Conservation of Energy (Q=dU+W), that is when energy (Q) is added to a system, some will increase the amount of internal energy of a system (dU), the rest will leave the system as it does work (W). Energy is not created or destroyed, it only changes form and spreads out. For Gaia it means She has a "fixed" amount of energy available from the sun (it has actually increased slowly over the last 4.5 billion years by about 30 to 50% according to astrophysicists, this will be important later) and she must use that set amount (1370 W/m^2 at the top of the atmosphere) as efficiently as possible.

The Second Law is the Law of Entropy Increase (dS=Q/T or in Lovelock's "Ages" S=k(lnP)). Entropy (S) is the level of "rundownedness" of a system. A high level of entropy is a high level of disorder. When energy (Q) is added to a system the entropy will always increase, you get the number by dividing by the absolute temperature (T). At first glance, this conflicts with the definition of life as a decrease in entropy; that is an "increase" in order. That's only local though. The decrease in entropy represented by life is more than offset by the increase in entropy in Gaia's main energy source, the sun, which will run out of nuclear fuel about 8 billion years from now. That's a big gas tank folks. S=k(lnP) is the Boltzmann form of the second law, named for the German physicist Ludwig Boltzmann. It ties entropy (S) with probability (P), the lower a thing's probability is, the lower its entropy. Life is very improbable. No other planet in our star system currently has it as far as we can tell. And armed with Gaia theory we can tell better than ever for no other planet save Earth, has an atmosphere in chemical disequilibrium. Most stars are also unsuitable for Gaian type planets as well. The so called 'Scientific Creationists' of fundamentalist Christianity frequently try to claim Evolution Theory contradicts Entropy but we see here the huge amount of energy supplied by the sun is more than enough support for life and evolution.

So how does this improbability called life decrease entropy locally, that is, how do we grow and reproduce? The second law of thermodynamics is talking about equilibrium reactions, that is, processes that are reversible. When a given process cycles through and does work, some energy is lost and must be replaced; living organisms eat and the Earth receives sunlight. "Ages" talks about the different phases in the quality of

Gaia's integration and efficiency in the use of the sun's energy. First, however, Lovelock talks about the nature of that integration. As an example he created and tests Daisyworld, a fictional computer construct that regulates a single important parameter: temperature. As mentioned above, astronomers are now quite sure the sun's energy output has steadily increased by a factor of two, the sun was only 2/3rds as bright as it is now when the solar system was born. The Earth ought to have been much cooler in the beginning, ice bound even! Yet it was warm, with liquid oceans of water from the start! This has been known for sometime and is called by astronomers and other scientists "The Faint Sun Paradox". This defines the solar output parameters. In the computer model, Gaian regulation of temperature is to be controlled by black, gray, and white daisy populations on Daisyworld.

This computer model of a ridiculously simple Gaia works! The temperature is regulated for the comfort of life until the sun grows so hot that the system finally crashes. But when the sun is cool, black daisies predominate warming the planet, and when the sun is hot, white wins out, cooling Daisyworld. The models were published in the Journal "Tellus" in mathematical detail. He modified and expanded the models, including herbivores that ate the daisies (rabbits), and carnivores that ate the herbivores (foxes), and the occasional plague that killed off 30% of the daisies just to make it interesting. It still worked, the temperature stayed under control. It is, as scientists say, a "robust" model. "It takes a licking and keeps on ticking" to use an old commercial slogan. The faint sun paradox is solved and the Gaia hypothesis has taken another step towards full theory status. An interesting response of the model is that when periodic perturbations were introduced at times of high system stress (the start, when Daisyworld fights cold and the finish when it fights high heat), those perturbations had a much greater effect than when Daisyworld was not under such high stress. This effect models actual systems in the field and was not "built in" to the computer program. It is apparently another sign of the effectiveness of Gaia Theory.

In stressed systems the oscillations around the set point of whatever factor is under study (temperature, acidity, salinity, etc.) and gets wider and wider as the system destabilizes. It soon reaches a point where a widest swing becomes a crash into a new system state that may be uninhabitable by humans. When the old system crashes there is often a new system established around a new equilibrium however, that new equilibrium would be expected to have significantly lower bio-diversity. The singular system of a pregnant woman shifts into the dual system of a lactating woman and new born infant. Sometimes there is a total collapse. The woman could die, the child could die, both could die.

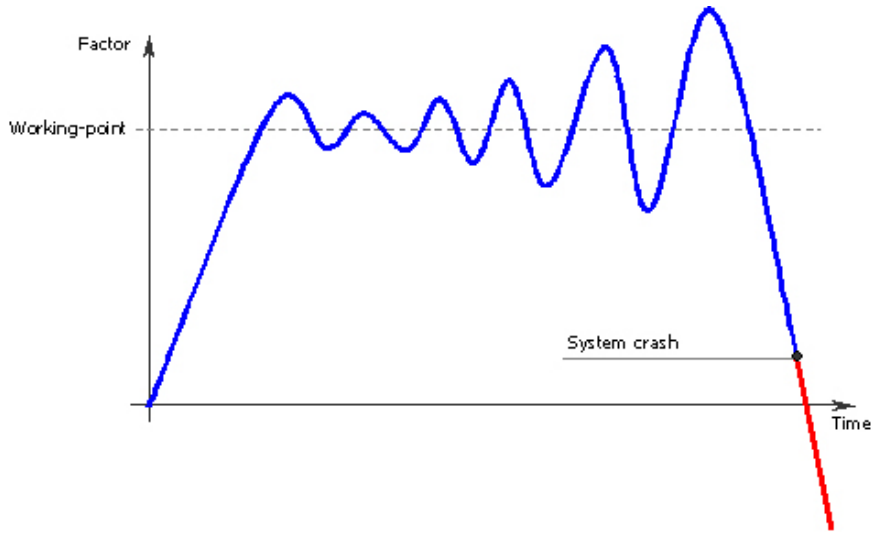

Figure 2. Stressed systems

The period of system state transition is a risky and delicate time. Which is of course, precisely where we are now with respect to Gaia. This pattern, widening oscillations around a set point that only moves near the end oscillations of an approaching crash is what we have seen in our strange weather for the last couple of decades rather than a slow, steady increase in background temperature as predicted by the old models. Nay sayers to Global Warming have used this to deny the Greenhouse effect but, now we have a theory that serendipitously includes it. No more excuses!

Gain theory is as effective in a computer as it is consilient but, to be a full fledged scientific theory it has to be identifiable and traceable in the real world. Consilence is clear coherence between different scientific disciplines and Gaia Theory has plenty of that. It melds physical chemistry with oceanography, meteorology and geology through the powerful summed impacts of biology and ecology and systematizes those effects through comparative planetology and cybernetics. While that is a mouthful and big pile of intellectualizing, is it real? Gaia Theory when first formulated in 1968 predicted a dead Mars and Venus by Atmospheric Composition and after many attempts no life has yet been found on either world. It also predicted the life would control elemental distribution and in 1973 it was discovered that dimethylsulfide (DMS) and methyl iodide (MI) are made by algae and blown inland. It also predicted in 1981 that climate may be controlled in part by life in rock weathering as well as rock formation. While it has been known for over a century that algae are key in carbonate rock formation in 1989 it was found that certain micro-organism can greatly increase rock weathering under the right conditions. It also predicted in 1987 the climate control via planetary albedo (darkness or brightness of the Earth) is under biological control through emissions of sulfur gases. It seems the answer again is yes, in 1992 Robert Charlson and Stephen Warren have demonstrated that when dimethylsulfide is oxidized in the atmosphere the resultant sulfuric acid droplets are the key nuclei for water droplet formation and the creation of clouds in low dust areas, principally over the oceans. Dimethylsulfide (DMS) is produced by algae, there seems to be no other source, most types of silicate dusts make poor cloud condensation nuclei on top of that. Cloud formation largely matches the algal distribution. Cloud formation and so general control of the Earth's albedo and global temperature and climate is principally under the control of life. These discoveries are just the first of many, many more biogeochemical loops theoretically identified in the biosphere now under going testing.

Computer models are one thing, reality is another. How does geology and the fossil record affect and reflect all this? Well, first off, the fossil record and geology only go back so far (3.8 billion years) on the surface of the earth. Lunar rocks, brought back by JFK's Apollo program are dated at 4.0 billion (Mare rocks) and 4.3 billion years (Highland rocks). It is now hoped by some scientists that just as we have found rocks on Earth that came from the Moon and Mars perhaps, in similar fashion we may find Earth rocks older than 3.8 billion years as meteorites on the Moon! Some meteorites found on Earth on the other hand go back to 4.5 billion years, apparently the beginning of our solar system. Since most scientists date the beginning of life at about 3.6 billion years we have about 900 million years where there is no life at all on the Earth. Now that has also just been pushed back to 3.8 billion years due to new bacterial fossil finds, reducing the pre-biotic period to only 700 million years. This is called the Hadean Age on Earth. Constant meteoric bombardment is attested all throughout the solar system by the vast numbers of craters found on all small planets and moons. Radiation levels were much higher then if we trace back the level of radioactive decay we see today. There are even a few known natural fission reactors that were radiating at this time! Life began in a very radioactive environment. The oceans condensed during this period and the moon formed near the beginning of it in a cataclysm of incredible proportions. Hadean (from the Greek Hades) is an apt name.

The Archean is the second Age and it begins with the beginning of life. Since we can be pretty sure the sun was cooler, Owens, Cess, and Ramanathan calculated in 1979 that the Earth's level of CO_2 must have been 200 to 1000 times what it is now in order for water to be liquid. A lot depends on how much Nitrogen there was in the air, and that's very difficult to determine. The CO_2 would have come from volcanoes, just as it does today. Back then volcanism would have been much more active. It is estimated that the Earth's interior produced three times as much heat then as it does today due to the higher level of radioactivity. The exact nature of the origin of life (biogenesis) is a very difficult problem but it seems clear that the very first organisms fed on the naturally produced organic chemicals of the time; they produced carbon dioxide (CO_2) and methane (CH_4) as waste products, hence their name: the methanogens. The descendants of these bugs today live in the oxygenless muds of swamps (methane is also known as swamp gas) and in the anoxic environment of the guts of land animals such as us. When these supplies of natural organics ran low the first Cyanobacteria (Blue-green algae) show up. They use CO_2 and sunlight in photosynthesis to produce their food. They formed coral-like structures called stromatolites that are very evident in the fossil record. They can still be found on the coast of Northern Australia.

Gaian thinking solves an old evolutionary problem of the Archean era. Without oxygen there could be no ozone layer to protect the surface from ultraviolet radiation. But the Methane that the methanogens produced would have absorbed the UV radiation and created a high atmospheric layer of complex hydrocarbons, that is, a natural smog! This process is occurring on Saturn's moon Titan and was observed by NASA's voyager probes. Thus, Gaia's skies back then were pink like Titan, not blue! The Cassini Huygens probe which entered Saturn orbit 06-30-04 may solve many problems after its arrival at Titan January of 2005. Keep your eye on www.saturn.jpl.nasa.gov/index.cfm for updates. Those Cyanobacteria produced oxygen though, a deadly poison for the Methanogens. The methane they produced soaked it up some of the oxygen ($CH_4+2O_2=CO_2+2H_2O$) before it could build up to dangerous concentrations. The Archean continued for

about 1.3 billion years. 2.3 billion years ago something happened. It wasn't just the methane that absorbed oxygen, it was also the naturally produced organics dissolved in the oceans too. Those supplies were eventually used up and the methane began disappearing.

The Proterozoic begins with the first free oxygen in the air. Considerably less than today but, it's a start. Gaian theory predicts that without the greenhouse gas methane, the Earth's temperature would fall. A massive glacial age at the boundary of the Archean and Proterozoic in the fossil record has been known for a long time but not understood, until now. With the methane gone, the sky becomes blue as the pink smog layer can no longer be produced. Oxygen derived ozone takes its place. Thus the ozone layer is "only" a 2.3 billion year old Gaian structure. The big event in this era is the evolution of Eukaryotes (large cells having a nucleus with a membrane) and then later the metazoans, the first multicellular organisms.

The fourth Age begins about half a billion years ago and is called the Phanerozoic Age. This is the period most familiar to students of Geology and Paleontology. It begins with the Cambrian, and proceeds to the present day. Here the oxygen level is comparable to today's, about 20%. It is this period which sees all the modern ways of Gaian controls developing. Very recently (the last few million years or so!) new types of plants have developed using the C-4 photosynthesis pathway that works at even lower CO2 concentrations than today's (preindustrial) level. The implication being that Gaia is working towards a lower CO2 level and a cooler climate, and we're burning fossil fuels, releasing fossil CO2 and "working" towards a hotter climate that is, global warming. In 1997/98 a chunk of ice half the size of Rhode Island broke off an Antarctic Ice sheet, the following year another double chunk the size of Connecticut has broken off the Ross Ice Shelf! The breakups will continue! Scientists have now measured both a definite rise in sea level and background temperature. Both are slight but, both are very significant. The National Geographic issue for September 2004 "Global Warning" summarizes most of the problems associated with Global Warming. A new threat has now been added to the list: Methane Hydrate. Discover Magazine of May 2004 asks the question "when will the bubble burst?". Its headline article "20K Microbes Under the Sea" by Robert Kunzig outlines the chaotic danger of methane bursts from deep under the ocean floor may cause sudden, erratic spikes in global warming as well as disrupting sea and air shipping. Soon some low-lying South Sea Islands like Tuvalu and Nauru as well as the Maldives in the Indian Ocean will have to evacuated. No more excuses!

Lovelock, in "**Ages...**" then goes into the problem of industrial pollution, including acid rain and the ozone layer. He admits his earlier position on CFCs was "...one of my greatest blunders." p.164. He then goes into what he considers to be one of the greatest threats to Gaia: the loss of bio-diversity: that reserve of organisms that can respond to new environmental stresses. Since Gaian science can be called geophysiology, he finishes this chapter by asking is there a doctor in the house? Lovelock's science of geophysiology has also been called 'Biospherics' by Dorian Sagan and Lynn Margulis, who has a website www.bio.umass.edu/faculty/margulis. Sagan's book "**Biospheres: Reproducing Planet Earth**" (1990) agrees that biodiversty loss is a critical threat and also outlines the development of Biospherics from Vernadski's theories to Lovelock's Gaia Theory to the Hanson 'Ecospheres' of Arizona's Ecospheres Associates to the huge complex of the University of Arizona's Biosphere II, now extended by the NASA 'Biotrons' of the Johnson Research Center and KSC. Dorian Sagan (Carl Sagan's son) sees this developmental series as Gaia learning to form eggs or seeds: 'propagules' to use the proper biological term.

Lovelock doesn't go into the greatest natural threat to the diversity of Gaia discovered by Louis and Alverez. I'm referring to asteroid or comet impacts now generally accepted by scientists as the prime candidate for the demise of the dinosaurs at the end of the Cretaceous. The crater has even been found off the Yucatan peninsula of Mexico: Chixilub. Other Great Extinctions have now been blamed on these billion year old leftovers of planetary formation rolling around our solar system. Some scientist believe these impacts help drive evolution along with plate tectonics, the well demonstrated theory that the continents actually move around ever so slowly on the surface of the earth. However, the Permian Die Off some 225 million years ago destroyed 90% of all life! It too is now often blamed on an asteroid or cometary impact and a crater of the correct age and size may have been found off the Falkland Islands near Argentina. This is Gaia's greatest known mass extinction. Evolution wasn't driven, it had to practically start over from scratch. What this does show is the robustness of Gaia's foundation of microbial ecologies. All advanced multi-cellular organism ecologies however are highly vulnerable. It maybe that humanity's function is to protect Gaia from impacts by developing a interplanetary fleet to stop comet and asteroid impacts! A sort of dynamic interplanetary 'shell'. Arthur Clarke, scientist (inventor of the Geosynchronous comsat) and S.F. writer ("**2001: A Space Odyssey**"), now says the dinosaurs died out because they didn't have an effective Space Program! Check out his website www.clarkefoundation.org.

The same could easily happen to us. Remember the impact of comet Schumaker-Levy 9 with Jupiter back in the summer 1994? In "**Rare Earth**" (2000) by Donald Brownlee and Peter Ward evidence is presented that many if not most solar systems in our galaxy would have a much higher rate of asteroid and meteor impacts.

Our solar system was 'cleaned up' for us by Jupiter. It still functions that way as Schumaker-Levy 9 dramatically shows us. Ironically that may also be how life arrived at Earth. Francis Crick (co-discoverer of the spiral structure of DNA with James Watson) thinks there is insufficient time in the history of the Earth for chemical evolution from organic molecules to achieve biogenesis, then develop the first bacteria. That time span has been steadily dropping, it is now only 700 million years as opposed to nearly 1 billion when Crick first proposed his alternative: panspermia, back in the 50's. Panspermia means literally 'all or everywhere seeded', his idea is that the first life arrived here on the proto-earth via comet or meteor already evolved from other nearby albeit older worlds. The famous Mars meteorite ALH 84001 that may hold micro-fossil Martian life that was unveiled in 1996 shows such interplanetary journeys are possible. An elder Gaia already some 2 billion years old or more may have shed encysted archeobacteria infested meteorites into our proto-solar system at its formation in the solar nebula some 4.5 billion years ago.

In the early solar system smaller Mars sized bodies would have been more comfortable than the hot, Venus-like forming Earth. It is now considered highly probable our moon was formed by a huge collision with a Mars sized 'planetismal' some 4.3 Billion years ago. This would have shocked away the first thick, CO2 rich atmosphere of Earth. If that Mars sized proto-moon was as warm and wet as astronomical theory now suggests, its oceans, rivers and lakes may have been teeming with early bacteria and as the fragments rained down on the re-cooling Earth, it was inoculated with life. Brownlee and Ward believe that this rare collision moon formation is a requirement for a stable yet tectonically active Earth as is a Jupiter in a more distant circular, heliocentric orbit to create a stable enough environment in order for multi-cellular life: fungi, plants, animals and humans to evolve. Both of these, Jupiter in a circular orbit and a large moon around a planet also in a circular orbit are astronomically very rare. The vast majority of solar systems so far discovered are highly elliptical and unstable. This leads Brownlee and Ward to believe that Earthlike worlds or 'animal worlds' are very rare and 'slime worlds' with only microbial life are more common. Now, a new mode of life transplantation or Gaian reproduction may be evolving here, on this world.

Lovelock pursues the possibility of Terraforming Mars in the next chapter of "**Ages**" and suggests it'd be a good way to test our understanding of Gaia. He re-emphasizes that the Gaia hypothesis is a "spin-off" of the Space Program; that by going into space we can, for the first time in the history of Gaia (let alone Humankind) see the entire planet as a single entity, what Frank White called the "Overview Effect". She, through our eyes, can see Herself as a whole being. I see it as holding aloft a mirror for Her either way it has had a powerful and increasing spiritual impact as we will see and discuss later. Lovelock still sees CFCs as the fastest way to warm up Mars and get the atmosphere to naturally thicken up. Delivering ice asteroids (Iceteroids: a term coined by space artist David Egge) for additional water, N2 & O2 seems inevitable. Here we shift from science to technology and engineering. Here is where Gaian Philosophy will have a significant impact. It is the evolutionary utility of Human Intelligence that is being tested here. Can human consciousness achieve sufficient Gaian consciousness in time to avert the coming doom? If we don't wake up, we go extinct and Gaia tries again with a new species.

Buckminster Fuller's (1895-1983) metaphor of "Spaceship Earth" he coined in 1927 (!) is indeed transcended by Gaia Theory but, it is very valuable as a teaching tool for beginning Biosystems Theory. His basic outline of the systems of Spaceship Earth are an excellent starting point for the Complex Adaptive Systems of the cells, organisms, ecologies that integrate to form Gaia as a whole. He has done more than anyone person in getting recycling, sustainability and other environmental technologies of the ground. You can find out lots more about this unique genius who was way ahead of his time at www.bfi.org The Gaian CAS we are just beginning to understand is in dramatic transformation due to the summed activity of 6 Gigahumans, soon to be 12 Gigahumans, and what is the nature of the situation we're just waking up to? At the risk of being redundant, I'll say again what I think it is in all caps and bold...

THE EARTH ISN'T SICK, SHE'S PREGNANT!!

It isn't just a geophysiological doctor we need as Lovelock says, its an interplanetary midwife we need, as Sagan suggests in his "**Biospheres**". The fetus of Human Geo-bio-politically Conscious Solar Culture is nearly full term. Gaia's back hurts, so do her feet. She has to pee every 20 minutes. She has morning sickness sometimes. She's too hot and uncomfortable. Village midwifery was once the province of Wicca in the West but, the Church and the witch burnings ended that and all male controlled medicine was established in the early modern era, what Wiccans call the Burning Times. Now modern doctors are researching tribal medicine to discover native cures before the forests are destroyed by our rapacious industries. We have come full circle here as well. In 1986 the UN Population Bureau said Global Population growth's 3rd derivative had finally

gone negative. That means that the rate of population increase is slowing down. If no global catastrophe intervenes the human population of Terra (Earth) will level off at 11 or 12 billion in the 2nd half of this century. Boy is that a big if. If the collective body of humanity can integrate its behavior with current Gaian systems, we live. If humanity can't, we die by the billions. It's that simple. This means however our current, fractured Human Geopolitical Consciousness of International Politics must become an integrated Gaian Global Consciousness of all life, not just fiercely competing human nations. It's that complex, and it clearly involves spiritual issues as well as political, economic, scientific, historical, technological and philosophic, as many wars are fought over religion as anything else. Before we look at devising a philosophy capable of unifying this mess however, we need a few more science items.

Gaia has yet to manifest only one characteristic of life: the reproductive ability (item 18 on Russel's list above) shared by all living beings. What would Gaia give birth to? Peter Russel wanders off into philosophical and mystical speculations in his book about new forms of consciousness. We'll briefly look at those in the next section. Lovelock, ever the scientific materialist, has a straight forward answer: Terraforming. This is the same answer as Dorian Sagan. I obviously agree. Gaia reproducing herself in space and on other worlds through human activity in interplanetary space. As mentioned above, Gaia will colonize the other lifeless planets in our solar system via the intelligent activity of Homo sapiens: us. He does not go into detail about this but many others have, both in science fact and in science fiction. Gerard K. O'Neill sees a key preliminary step in Space Habitats, what Gene Roddenberry (creator of TV's "**Star Trek**") called Planettes. These are very large rotating pressure vessels that are large enough to contain a closed ecology, a biosphere as a life support system for the inhabitants. O'Neill and others first demonstrated their theoretical capabilities in "**The High Frontier**" by O'Neill (1976) and "**Space Colonies**" by T. A. Heppenheimer (1977). The Science Fiction TV show "**Babylon-5**" among others is set on one of these giant space habitats. Building these giant space stations before terraforming would demonstrate the ecological technologies, the biosperics required. Science Fiction writer Larry Niven discusses other pre- and post- terraforming structures in his essay "Bigger Than Worlds" in his book "**A Hole in Space**" (1974). New books on this topic come out every few years or so.

Humans will not build space habitats and terraform planets for Gaian 'Superconsciousness' reasons but from very human reasons. The California Energy Crisis of 2000 is but a prelude to the coming Energy Crisis that will pale the 1973 Oil Crunch to insignificance. The last Iraqi/US war was Oil War III (2003-4), it will happen again somewhere in the world as Oil War IV soon, then again and again until we get off oil and coal. But that won't be the reason to build habitats though, morally speaking, stopping Oil War ought to be enough. As long as we burn fossil carbon global warming will continue. Yes, it's true melting ice shelves on the Antarctic seas won't raise the ocean level world wide any more than melting ice cubes in a glass of water raises its level. However, it is also true that melting glaciers and ice caps on land will. They are clearly melting too. Glacier National Park, established in 1910 had 250 glaciers back then, there are less than 50 today. Only when the water starts to wash over Wall Street and Pennsylvania Avenue will the politicians and the Multi-national Corporations do something. The Corporate Masters of Bush Sr.'s 'New World Order' will want sea walls and Nuclear Power. Even at France's safety levels this is still a Chernobyl/ Three Mile Island waiting to happen again and again, add to that the terrorist treat plus the fact that Radwaste lasts over 100,000 years but, the Nuke Corporations will try and shove it down our throats anyway. Nor should we be surprised when well meaning environmentalists accept what is painted as 'inevitable' because they don't know about the following technologies. Nor should you expect to hear much about what we've discussed here in the soundbites of Corporate owned Media.

It appears that, technologically speaking only, only Solar Power Satellites (SPS) and/or Magnetic Induction Power Satellites (MIPS) for electricity and Ethyl/methanol fuels in electro-hybrid vehicles or perhaps SPS/MIPS derived Hydrogen vehicles will stop Global Warming. Dr. Peter Glaser developed SPS in 1968 and MIPS came out of applications of tether technology. If fuel-cells can become less expensive so much the better. It will be a tough sell politically and the fight over spending on sea walls, welfare, nukes, the military and SPS will be fierce. This mixed system plus as much other alternative energy (such as OTEC and wind generators) wherever feasible can stop Global Warming and support the coming 10 to 12 billion people when conservation & increased energy efficiency are integrated in. With the first space habitats building SPS power stations the energy/CO2 pollution crisis will stabilize. If however, the Earth stays at 10 to 12 billion for very long, that is if we only pursue ZPG, Zero Population Growth and allow families 2 children for parental replacement then thermal pollution will grow as well as Biodiversity shrinking and other unknown pollution types will buildup and over load the system leading to a crash in 100 - 150 years or so after stabilization. We must either 1) dramatically reduce the Earth's population through NPG, Negative Population Growth in 1 or 2 generations through only allowing 2 billion families out of six one child each (chosen how?) and literally killing all other children or 2) Emigration or 3) a combination of emigration and a less severe, general 1 child per family law. I prefer number 3.

Emigration using shuttles would be very expensive and polluting even with all closed cycle LHY/LOX rocket engines, the cleanest possible. Later this century, with new materials and technologies developed in the freefall of space, mass emigration via 'geovators' or 'space elevators' (geosynchronous elevators, see 'Discover' July 2004 'Going Up?') to a large halo of future O'Neill type space habitats built in high Earth orbit out of lunar and asteroidal material then becomes possible. Gigadeath is not inevitable. The SPS can power microwave ships to other worlds, then its easy to stop rocks and comets from hitting the earth, thus Gaia's shell and babies can then come naturally out of human economic and environmental motivations. Those later space habitats will also plant biospheres across the solar system. Terraforming Mars and Venus will then follow naturally in then next century. Lovelock's position in his books is that we are essentially fruit flies in a jar and my position is that we need to pop the cork and find or build more jars. Our telescopes and various space probes have shown us plenty of potential 'jarstuff' out there.

James Lovelock has evidently not heard of this option. On May 28th, 2004 Professor James LOVELOCK's web site went online and the debate has heated up. This site links to another site that offers a book titled "**Environmentalists For Nuclear Energy**" (2004) by Bruno Comby on how environmentalists must embrace nuclear power or billions will die. He correctly points out the conventional set of alternative energy systems put forward by Greens are inadequate to replace our current primary sources, they can only supplement them. Comby et. al. go further and say only nuclear power can replace fossil fuels. James Lovelock apparently accepts this conclusion. I respectfully disagree. Even an upgraded French style system will add massive thermal pollution as well as radwaste to the biosphere and is still very vulnerable to terrorist attack and makes the terrorist bomb threat more possible not less.

However, if we merely transplant the current International Geopolitical System (it inequities being a key producer of terrorists on the ground) into space, war will inevitably follow. If we wish to prevent this, new social technologies will also have to be developed along with the physical technologies described here. Green Christians and Muslims must become Gaian Christians and Muslims. The Gaian Philosophy we begin to develop in part two can help. Wicca, among other nature religions, is already perfectly poised to help lead the rest of the world into this new, yet terrifyingly risky future by demonstrating various social innovations that can be useful to future societies. It is well known that Stewart of Janet and Stewart Farrar arguably two of the most famous witches in the world, was a science fiction writer by trade and that Neopagans and witches frequent science fiction conventions. This philosophizing about the future is not yet a formal philosophy, it is more 'scientific speculation' or 'Futurism'. Or it could even be prophecy depending on your definitions. We will get more formally philosophical and connect it with spirituality in general and the Religions of the Book as well as the Nature Religions in particular and apply these to the new social technologies in the next sections. Don't take my word for what I've talked about here, use the Internet, check out what I've said, better still, join the debate!

End open part 1

Want to share your thoughts with us, about Mother Earth's pregnancy, human expansion into space, continuation of Human Civilization, Space Age Philosophy? You have several possibilities:

participate to the forum/newsletter of SRI.
https://groups.google.com/forum/?hl=en#!forum/space-renaissance-initiative

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