

A Tentative Model for a Living Universe

I Prologue - II The Planetary Genome

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Dedicated to Jonas Salk

Part One

The ancient Greek word for science was philosophy - philo sophias, the love of wisdom. This name intended to set science on a course of searching for wisdom, for practical guidance in human affairs through understanding the natural order of the cosmos to which we belong.

It was precisely this search that motivated me to study science and continues to motivate me, though only the rarest of western scientists I encountered shared it, most having abandoned that search in the belief that science should be neutral - i.e. free of values and social intent - or that the ever new technologies spawned by western science are all humanity needs to solve its problems and continue its "progress."

Jonas Salk, one of the rare scientists who never stopped pursuing wisdom and guidance for humanity through science, was marginalized in his own prestigious scientific institute. He sought me out as a kindred scientific spirit on the remote Greek Island to which I had retreated to work on my own, feeling a similar marginalization by my peers. I shall always be grateful for his recognition and encouragement.

Prologue

Western science assumed the existence of an objective material universe that can be formally modeled through objective observation and measurement. Thomas Ehrlich describes objectivity as follows:

Objectivity is commonly taken to mean, "freedom from idiosyncrasies." An idea is objective to the extent that it is unpolluted by the individual's beliefs or presuppositions; a critique is objective to the extent that the person making the criticisms and suggestions ignores their own personal feelings and biases. Objectivity in this sense is often defined as the negative of personal subjectivity, or as the opposite of personal opinion. 1

Science set out not only to eliminate idiosyncrasy and bias by decreeing the separation of subjectivity (our inner world) from objectivity (our outer world), but to create a comprehensive and detailed model of the outer world as a universe independent of any individual human conception of it (whether revelatory or observed) and independent of human participation within it - an undisputed, public model of a "reality" entirely independent of our thoughts and actions.

The word physics is taken literally from the Greek word for nature: physis. European scientists from Galileo on assumed that physics in its modern meaning, including astronomy, was the true science of nature, while life sciences from organic chemistry to biology, evolution biology, and psychology were (and still are) deemed secondary. Natural laws are still limited to the physics of a non-living universe, into which biologists are expected to fit their explanations of life. Toward this end, the concept of negentropy was coined as a kind of swimming upstream that could increase order locally within the overall river of entropy. Negentropy is credited with the descent of man, according to

Darwin, his predecessors and his followers, as the natural creature of an evolutionary process billions of years long.

Consider what might have happened had Galileo looked down through a microscope into a drop of pond water teeming with gyrating life forms instead of up through a telescope into the heavens, already conceived in his time as celestial mechanics? Might biology, rather than physics, have become the leading science into whose models all others must fit themselves? Might scientists then have seen life not as a rare accidental occurrence in futile struggle to build up syntropic systems against the inevitably destructive tide of entropy, but as the fundamental nature of an exuberantly creative universe?

Instead of projecting a universe of mechanism without inventor, assembling blindly through particular, atomic and molecular collisions a few of which came magically to life and further evolved by accidental mutations, I propose that there is reason to see the whole universe as alive, self-organizing endless fractal levels of living complexity as reflexive systems learning to play with possibilities in the intelligent co-creation of complex evolving systems.

I propose that it is actually more reasonable to project our life onto the entire universe than our non-living machinery, which is a derivative of life, a truly emerging phenomenon, rather than a fundamental one. I propose that it is possible to create a scientific model of a living universe, and that such a model is not only scientifically justified but can lead to the wisdom required to build a better human life on and for our planet Earth as the ancient Greeks intuited it should.

New Assumptions for an Integral Science

The current revolution - the impending paradigm shift - in science is forcing reconsideration of its most fundamental assumptions, that is, of the worldview described above, of the basic beliefs supporting the current scientific model of our universe or cosmos and ourselves within it. Cosmos is defined as "the universe as an orderly construct," so because I am proposing an orderly model of the universe, I will usually prefer the word cosmos.

Western science set itself the task of describing reality. In eliminating those aspects of the perceived world that are not measurable, it relegated them variously to subjective, mental, mythological, imaginary, storytelling, fictional, spiritual, and other categories identified as unreal. A few aspects of our world, such as taste, smell, and electromagnetism were shifted from unreal to real as ways of measuring them were discovered.

To contribute to an Integral Science, my model of the cosmos must include all human experience. The goal of this new version of science is proposed to be: a) to model a coherent and self-consistent cosmos as a public reality conforming as much as possible to necessarily private individual realities; and b) to interpret this model for the purpose of orienting humanity within the cosmos and thus permitting it to understand its particular role within the greater cosmos.

Toward that end, I propose:

1. The scientific definition of reality should be the collective human experience of self, world, and universe as inner and outer worlds perceived from individually unique perspectives. (We have no other legitimate basis for creating cosmic models.)
2. Consciousness (awareness) shall be axiomatic for the simple and obvious reason that no human experience can happen outside it
3. Formal experiments have as their purpose the creation of publicly shareable models of reality that permit common understanding and prediction.
4. Autopoiesis (continuous self-creation) shall be adopted as the core definition of life. Since galaxies, stars, planets, organisms, cells, molecules, atoms, and sub-atomic particles all fit this definition, this implies that life is the fundamental process of the cosmos, a self-creating living whole with self-creating living components in co-creative interaction.
5. Nature shall be conceived in fractal levels of holons in holarchy, holons defined as relatively self-contained living entities such as those listed in (4) and holarchy defining their embeddedness and co-creative interdependence on energy, matter, and information exchange.

Beginning with these few assumptions and definitions as a conceptual framework for an Integral Science, we can reassess the past findings of science based on previous models, discover past errors and redesign experiments as necessary. We can also look for new patterns of regularity. (I shall avoid the term laws because of its implication of a lawgiver.)

Reality as Direct Human Experience

The idea of defining reality in terms of human experience may seem strange to any western scientist accustomed to firm belief in a firm firmament that includes our Earth and humanity but exists separately from human experience of it. Yet the whole edifice of a separate, objective world has been built on a belief in objectivity that has been discredited by philosophers of science and increasingly by scientists themselves (see below). If the claim of basing science on reason - on experiment (a word derived from experience) and rational argument - is to be upheld, then we cannot postulate a world that is not within human experience as long as we have no way to be outside human experience.

The simplest case for conceiving reality as human experience, as stated above, is that we have no other legitimate basis for creating cosmic models. Note that this definition happily eliminates the need to define nonreality.

Merriam Webster defines reality as:

- 1 : the quality or state of being real;
- 2 a (1) : a real event, entity, or state of affairs (2) : the totality of real things and events; b : something that is neither derivative nor dependent but exists necessarily.

The first three definitions tell us nothing as they define reality in terms of real. Only the final definition begins to tell us something meaningful, that reality "is neither derivative nor dependent but exists necessarily." The only thing fitting this latter definition is direct perception, for once any perception is reported to another, whether by a three-year-old, a scientist, or a theologian, it clearly becomes derivative.

The Cambridge English Language Dictionary adds "existing in fact; not imaginary" to its definition of reality, but a perusal of

its definition of fact tells us:

fact: something which is known to have happened or to exist, especially something for which proof exists, or about which there is information.

The only way to truly know that something has happened or exists is to have direct experience of it, as we just determined. This clearly implies that truth can only be subjective. Unfortunately, western science has denied subjective (direct) experience as a valid reality in maintaining that the objective practice of science is the only way to demonstrate it. This belief is still strong among scientists, though philosophers of science have long held that science cannot reach truth but only useful hypotheses.

The way in which hypotheses are determined to be useful or not lies, of course, is testing them experimentally. If the experimental outcome predicted by the hypothesis is found, they are considered useful. The validity of extrapolation beyond the experiment itself can only be judged in terms of consistency with our direct experience of the world.

It has now been shown in very careful research, for example by Elisabeth Targ 2,3 and Marilyn Schlitz 3,4 that remote intention and experimenter expectation clearly influence experimental outcome despite laboratory controls. The repercussions of such research have only begun to be felt, but certainly threaten to undermine the basic premises of western science if not its results.

More generally, the objectivity so sacred to western science has proved logically impossible. As Gregory Bateson noted decades ago, philosopher of science Alfred Korzybski warned us (in discussing the relationship between scientific models and reality) that "the map isn't the territory and the name is not the thing named." As Bateson himself put it, "there are no pigs or coconuts in the brain."⁵ In a Metalogue with his daughter Mary Catherine Bateson, they put it thus:

GB: ...one thing you can be sure of is that the conversation isn't about "something solid and real." It can only be about ideas. No pigs, no coconut palms, no otters or puppy dogs. Just ideas of pigs and puppy dogs.

MCB: You know, I was giving a seminar... and Wendell Berry was arguing that it is possible to know the material world directly. And a bat flew into the room and was swooping around in a panic, making like Kant's Ding an sich. So I caught it with somebody's cowboy hat and put it outside. Wendell said, "Look, that bat was really in here, a piece of the real world," and I said, "Yes, but look, the idea of the bat is still in here, swooping around representing alternative epistemologies, and the argument between me and Wendell too."⁶

No human has ever had a direct (real) experience except in the eternally present Now moment; all the rest can only be stories that weave particular and more general past experience into the present. We cannot directly experience the past or the future. Whatever we are experiencing, from whatever combination of inner or outer sources, is our in - the - moment reality. Esoteric traditions have made much of this fundamental truth - the only truth there can be - while western science has totally ignored it until now. The only exception I have found was on a scientific delegation to China (in 1974), where a Chinese scientist defined science as "the summation of people's experience."

The task of Integral Science, accepting this fundamental truth, is to sort and order reports of direct experience into an abstract public model of reality, using tools of reason, math, logic, experiment, and narrative to construct it.

Consciousness as axiomatic

Sooner of later a certain truth is brought home to you [namely, that consciousness] is the inner side of the whole, just as human

consciousness is the inside of one human being...Although it makes sense to inquire how and when consciousness developed into what we now experience as such, it makes no sense at all to inquire how and when mind emerged from matter...Once you have realized that there is indeed only one world, though with both an inside and an outside to it, only one world experienced by our senses from without, and by our consciousness from within, it is no longer plausible to fantasize an immemorial single-track evolution of the outside world alone. It is no longer possible to separate evolution from evolution of consciousness.

-Owen Barfield 7

The fundamental assumptions of my model, as listed above, have to do with human experience of the universe and human conjecture about the universe based on, or derived from, human experience of it, because these are all we have to go on in creating models - scientific or other - of that universe. Human experience includes the perception of a tangible, substantive world, but this experience of a material world, even if coming through sense organs, lies entirely within human consciousness, or awareness.

The Merriam Webster Dictionary defines consciousness as "the quality or state of being aware" and awareness as "having or showing realization, perception, or knowledge." The Cambridge International Dictionary of English calls consciousness "aware, thinking, knowing" and awareness as "knowing that something exists, or having knowledge or experience of a particular thing."

Consciousness and awareness are usually listed as synonyms of one another, though awareness is more often linked to the concept of knowledge than is consciousness.

The problem with this link to knowing is that knowledge is clearly culture bound. I shall therefore distinguish cosmic consciousness, as a universal field of awareness such as that to which Owen Barfield refers, from human consciousness in its broadest, most fundamental, cross-cultural understanding as awareness of self-in-world and world-in-self.

This human awareness of having an internal and external life perceived in images, sounds, touch, smells, feelings, thoughts, stories, etc. can be shared with others to a certain extent through verbal and other forms of language, thus giving rise to a broader cultural, or public, shared awareness of many-in-world. Once humans acquire language, this awareness arises in large part as verbal thought, which is why Descartes' stated his bottom-line of knowing as: "I think, therefore I am."

Taking Descartes' lead in seeking my most basic observations, they are:

- I experience myself and others as alive.
- I experience myself at the center of an apparently spatio-temporal "outer reality" or universe.
- I experience myself as an inner self of perceptions, feelings, and thoughts.
- I/we have no experience of the apparently spatial "outer world" outside of our conscious awareness.
- I/we have no direct experience outside of an eternal present or Now, yet I perceive my experience as though it lies on a continuum from past through Now to future.
- We can share our experiences in stories that transcend direct experience because of this timeline and our ability to communicate.

Thus we clearly perceive ourselves as existing in a physical time-space world, and are able to describe it, model it symbolically, and create other sharable stories of past (memories, histories, evolutionary trajectories) and future (forecasts, projections, anticipations) experience within it. But we have no way of knowing whether any of it exists apart from human experience.

Therefore:

- Science can only order and model human experience within consciousness as communicated among humans;
- We cannot prove any "true" reality other than that composed of both uniquely personal and collectively shared experience
- Recognizing our formalization of spacetime as a model of perception, rather than an objective reality, it becomes an important way of ordering shared experience.
- That human individuals can and do share considerable (though far from perfect) agreement on external reality and varying degrees of agreement on internal reality is of very significant interest as it both makes society possible and produces a larger reality than any one individual can experience independently.

The best argument we have for the existence of a "real" vast universe is the limitlessness of human conscious awareness, whether it is focused inward or outward. Every scientific or spiritual discovery can be contained within its expansive capacity. Inner focus, when sufficiently practiced through meditation and other spiritual practice gives rise to the experience of ultimate truth in a limitless Source, called I AM, Cosmic Consciousness, or God by many names across all cultures and felt as loving bliss. Outer focus, when sufficiently practiced through scientific study and reasoning gives rise to the experience of a coherent, comprehensible, though limitless universe or cosmos and recognition of arrival at its truth also produces "breakthroughs" felt as bliss. Those who practice both disciplines come to recognize the unity of these end results as a non-dual cosmic reality.

Thus, building a scientific model on the fundamental assumption of consciousness as the source of reality does not shrink the cosmos one whit. But it keeps us within that cosmos as co-creators of it, as reflections of cosmic creation at all other levels. For reality co-created by humans through a private and public collaborative process suggests a greater holarchic universe of collaborative process. All Nature can thus be elegantly conceived as conscious collaborative process, as I will try to show.

Sophisticated ancient cultures such as Vedic, Taoist, and Kotodama, along with many indigenous cultures, recognized the fundamental consciousness of all Nature, the entire Universe or Cosmos, and much in the findings and conceptualizations of physics today leads us in that direction, as I will show.

Note that as we have found no limits to human conscious awareness, our awareness is (necessarily) coextensive with any models we build of the entire universe. Anything we "discover" scientifically about the universe becomes part of our conscious awareness, and therefore of our experience.

Physics Meets Biology

One of the important requirements for an Integral Science from my perspective is to end the sharp distinction between physics and biology, to avoid having either one forced into the mold of the other. Rather, I seek out new models of cosmic physics that are naturally compatible with seeing the universe as embedded living systems. Since familiar biological life forms - from nucleic acids to bodies - take on fundamentally toroidal (vorticular) structure, which is the simplest structure meeting the definition of autopoiesis and is evident in proto-galactic clouds, galaxies and planetary energy configurations such as Earth's electromagnetic field and surface weather patterns, I gravitate toward cosmic physics models that begin with this elementary living geometry.

For me the beauty and usefulness of autopoiesis as a definition lies precisely in helping us see beyond our narrow focus on familiar life forms to their relationship with both smaller and larger entities from subatomic to galactic. The simplest entities I could find that fit the definition were a whirlpool in a river, a tornado, a proto-galactic cloud. I reasoned that any differential gradient, whether in water, our atmosphere, the supernova dust

cloud that gave rise to Earth or the earliest universe itself, would cause things literally to curl in on themselves - to form vortices that held their form as matter/energy was pulled into and spat out again by them.

This concept became extraordinarily clear to me one day on the Greek island of Kos, considered the birthplace of the twins Apollo and Aphrodite. Walking across a flat field of sand with a friend, I was contemplating the universe and the concept of auto-poiesis, picking up various seed pods and small shells as examples, each another version of the same spiraling form, musing aloud to the friend with me at how prevalent it was in the universe. My reverie took me deep into a cosmos of wheeling galaxies when suddenly the sand some twenty yards from us lifted into the air and formed a perfect funnel that swept a graceful curve and smacked directly into us.

As the day was otherwise completely calm and windless, my friend, getting the connection, asked in amazement "How did you do that?" I replied, "I didn't!" and then, on further reflection, added, "But I may have attracted it." He looked at me strangely and asked, "Does the motion in a vortex go inward or outward?" Without having thought about it for a moment, I shot back "Both ways!" I knew this with a certainty - that it had to be centripetal and centrifugal at once. Never having taken a single physics course, even in high school, I could not explain it; I simply knew it, and it surfaced in my consciousness then and there on the island of the Twins. I was sure the vortex was the real key to how the universe worked.

Gregory Bateson, speaking of a conch shell, gives us a sense of how such structures play out at the familiar biological level in saying:

This that you see is the product of a million steps, nobody knows how many steps of successive modulation in successive generations of genotype, DNA, and all that. So that's one story, because the shell has to be the kind of form that can evolve through such a series of steps. And the shell is made, just as you and I are, of repetitions of parts and repetitions of repetitions of parts... This conch is what's called a right-handed spiral, and spirals are sort of pretty things too - that shape which can be increased in one direction without altering its basic proportions. So the shell has the narrative of its individual growth pickled within its geometric form as well as the story of its evolution.⁵

As a torus is a self-contained rotating vortex, continually turning itself inside out, I was delighted, not long after, to discover the "smoke ring universe" of Sir William Thomson, later Lord Kelvin, the father of thermodynamics, who was buried next to Newton in Westminster Abbey. Dissatisfied with the prevailing theory of atoms as hard material objects, Thomson, like myself so much later, saw the essence of his vortex theory of the universe and his vortex atom in a flash, as described in a contemporary book on updated vortex theory by David Ash and Peter Hewett.⁸ His famous demonstration to the Royal Society of Edinburgh in 1867 involved the actual creation of smoke rings from a special device to demonstrate their remarkable integrity.

Thomson's next breakthrough came when he learned that his friend Herman von Helmholtz, working with vortices in liquids, had realized that vortices would be permanent in a frictionless liquid. Thomson reasoned that the ether, believed in at that time, must be such a liquid and could therefore support permanent vortex (rotating toroid) atoms. With this model, Kelvin developed a unified theory of matter and light. His vortex theory attracted leading British physicists, including James Clerk Maxwell, who developed electromagnetic theory, making possible radio, television and radar. But the popularity of vortex theory was largely forgotten in the heady excitement of the explosive new developments in physics at the beginning of the 20th century.

Nevertheless, having come to a vortex theory of an autopoietic living universe - a universe of self-creating living geometry - I continued to seek out physicists working with vorticular, toroidal models of macrocosm and/or microcosm, especially looking for

models with two-way (centripetal/centrifugal) motion. It is apparent that more and more physicists are coming to see inwardly and outwardly spiraling waves as the very essence of cosmic creation.

Gary Schwartz has made an interesting model of the universe as a giant intelligent memory-encoding device based on recurrent (circular) feedback loops of radiation among objects in the universe.⁹ In essence it points out that everything in the cosmos continually emits its wave pattern of radiation (in-formation) outward to everything else, each object absorbing information reaching it from others, its own radiation thus being continually modulated. Any two objects "reflecting" each other in positive feedback loops store their own histories or memories including these interactions.

Everyone is familiar with the example of looking into the night sky, absorbing historic photons from stars of different ages past in the same moment as our own radiation, however much weaker, goes continually outward toward them. Carl Sagan played with the same idea in having Hitler's historic radio speech picked up again on Earth by a radio telescope in his book and movie *Contact*.

Milo Wolff states that there are no spherical solutions for e-m waves but posits spherical quantum waves to build a very similar and much more formal geometric picture of the interactive Wave Structure of Matter^{10,11} in which quantum objects emit spherical outward waves the interactions among which actually generate the zero point energy field that gives rise to them in turn - an elegant model of co-creation at the quantum level from which he derives the classical laws of physics, though there is no mention of consciousness.

Nassim Haramein, building on Walter Russell's^{12,13} and others' models of spherical interactive wave models, extends them significantly by positing a universe of galactic, stellar, planetary, cellular, molecular, atomic and particulate "wholes" that are simultaneously dynamically rotating white holes radiating (electromagnetic energy) infinitely outward from their centers and equally balanced dynamic black holes collapsing (gravitationally) infinitely inward through that same center.^{14,15,16}

This perfect balance of radiation and gravity in all universal objects of all size levels including the universe itself permits us to see all objects as continually and dynamically re-creating themselves in the zero point energy field, and is a strong candidate for the long-sought unification of gravity with electromagnetic energy. It also eliminates the need to postulate strong and weak nuclear forces, dark matter and dark energy, all of which Haramein proposes were invented to fill gaps in previous models.

His solution to the problem of the one-way degradation of entropy lies in balancing it with gravity's generative centropy (close to my biological term, syntropy), thus eliminating the need for the imbalanced concept of negentropy to explain life. This model permits me to compare radiation/gravity or entropy/cen(syntropy) with the biological metabolic process of anabolism/catabolism toward an integral science model of a self-creating universe filled with self-creating entities.

Further, Haramein provides a living geometry of wave interactions that co-creatively build complex entities and their histories-as-memory similar to Schwarz's "living energy universe", but in the more complete framework of creative recycling dynamics at all scalar levels of size. He sees the feedback looping quantum wave interference among co-creating objects at all fractal levels of size (read holarchy) up to the whole universe as both the source of scale generating structure in the vacuum (from microcosm to macrocosm) and as consciousness itself (private communication).

In the next section I shall refer to Haramein's model with parallels to a living systems model of the universe built up from human experience because it is the most complete and most compatible physics model I have encountered.

The basic data of experience I listed above imply that "I" exist as a kind of boundary between infinite inner and infinite outer

worlds - a boundary Haramein would call, in the language of physics, the "event horizon" of the black/white whole generated by my singularity. Since I observe that this seems true of every other human "I" as well, while each of us has an apparently different perspective on these inner and outer worlds, we seem to be both boundaries (event horizons) and unique points of perspective, quite as is required by Haramein's model.

This biological perspective on the universe beginning with any particular observer agrees very well with Haramein's abstract physical model of an integral omniscient universe that extends both outward and inward via every object's singularity in the vacuum.

Part Two, Conclusion

The Planetary Genome

The human genome project made it clearer than ever before that our DNA is part of a planet-wide genomic language common to, and interchangeable among, all Earth's life forms. Scientists involved in the project expressed surprise at how close our genomes were to those of "vastly lower life forms," at how much "biological activity" goes on in our genomes, and at discovering ancient bacteria living within them.³⁶

Much of what we know about bacterial evolution comes to us from the work of microbiologist Lynn Margulis and her research teams and students. Among their discoveries are that the diversity of form and function in the microbial world is far greater than that of all fungi, plants and animals put together.^{23, 24} Bacteria are still the first and last steps in the complex food chain - more properly called a recycling food cycle - that came to include all single and multi-celled creatures. This is because bacterial metabolism includes both the ability to live directly on minerals and the ability to break complex molecules down to simpler ones.

Half of Earth's life was devoted solely to the evolution of bacteria, in which they not only experimented with countless versions of themselves and their lifestyles, inventing amazing technologies and infrastructures in the process, but also rearranged the Earth's entire crust dramatically, creating everything from pure mineral veins to continental shelves as they moved minerals about, oxidized metals, ate into rock, created soils and altered the entire chemistry of seas and atmosphere. A living planet can make huge evolutionary progress without ever going beyond bacterial life.

As part of their massive and complex role in evolving Earth's life, ancient bacteria set up what may be appropriately called the first WorldWide Web of information exchange.²⁵ To this day, as Lynn Margulis and her followers demonstrated, every bacterium of Earth can exchange DNA directly with any other, for which reason they cannot be classified as species, but only as genome shifting strains. ³⁷ In addition to exchanging DNA by direct contact, bacteria seem to have devised plasmids, bacteriophages and viruses for launching DNA snippets and genome packets abroad in a world that is literally permeated by a vast system of exchangeable DNA information.

The staggering pervasiveness of DNA in the biological world is memorably depicted by Jeremy Narby.³⁸ Narby pointed out that if the six inches of DNA packed into the invisibly small nucleus of each of our one hundred trillion cells were stretched out end to end, a jet plane traveling one thousand kilometers per hour would fly more than two centuries to reach its end. After this surprising result, Narby calculated that a single handful of living soil contains more DNA than that of our entire bodies, bacteria being packed far more closely in soil than cellular nuclei are in us. The human genome project results, however, update Narby's DNA measurement to six feet of DNA per human body cell, which leaves the jet pilot flying continually for over 21,000 years! If we revise the handful of soil accordingly into something between a handful and a garden wheelbarrow load at the most, we still see that literally everything in the natural world is permeated by a living DNA web of unimaginable complexity

(mostly living, some fossilized), extending via the bacteria into the deepest seas, beneath polar ice, as far into the crust as we have been able to drill and high into the atmosphere, as well as throughout every cell and body in all "kingdoms of life."

The giant nucleic acid molecules RNA and DNA can be seen as the means that the complex protein structures of cells and bodies use to encode and reproduce themselves, while RNA and DNA can be seen as using protein to express themselves as cells and bodies. These life forms found as part of the living Earth almost certainly exist on countless other planets that succeeded in coming to life for the same reasons - just described - that Earth did.

Like cosmic seeds, planets that come to life will be those found under similarly favorable circumstances. These life forms, as just proposed will thus occur midway between the microcosm and the macrocosm, a scalar level as critical to their evolution and continued existence as are the Earth's distance from the Sun and the composition and mobility of its crustal materials. In any case, the nucleic acid and protein partnership is universal among all Earth's creatures.

Little was known about DNA when its basic structure was deciphered in the mid 20th century. In time it became apparent that only a small portion of DNA (now measured as a mere 1 1/2%) could be identified as different genes-sequences coding for specific proteins. Together with their copies, the genes account for about 5% of DNA, though we continue to refer to the entire DNA sequence in any cell as its genome.

Still in the mid 20th century, a vastly larger portion of DNA was identified in Nobel laureate Barbara McClintock's pioneering work on transposable elements (TEs). McClintock showed that TEs not only move about, but also do so in response to stress on the organism.³⁹ Her results have been supported by many later researchers, including Temin and Engels.⁴⁰

We now know that our human genomic system of DNA and proteins can edit and repair itself, and that it has huge numbers of genes available in its own nuclear libraries. It is not impossible that it could even draw on the flow of plasmids, viruses and bacteria available, through our lungs and digestive tracts, in our blood streams should it need genes it has not stored over its long evolutionary history. Certainly it behaves as an intelligent hive of activity.

Nuclear DNA twists, turns, shimmies and is constantly rearranging into hugely complex loops, knots and other yet undocumented configurations. In addition to packaging and structural proteins that are involved in creating these configurations, DNA-binding proteins travel rapidly along DNA throughout the nucleus seeking sequences to be copied, then helicase proteins unzip the relevant DNA sequences so that RNA polymerase proteins can transcribe the DNA to RNA, after which still other proteins provide transport around the cell to where new proteins are actually to be synthesized.⁴¹

Even in its standard, helical form, DNA is throwing up surprises. The molecule has long been known to form intimate relationships with proteins that help it to fold, and trigger or subdue gene activity. Until recently, these liaisons were thought mostly to be fixed, or to change only slowly with time. But this idea has collapsed, as improved cellular imaging technology has allowed biologists to watch living cells in real time...The resulting videos exposed an unexpected hubbub in the activity of proteins buzzing around DNA...Many researchers now believe that almost all nuclear proteins are scuttling constantly back and forth, moving at speeds that would allow them to traverse the nucleus in as little as five seconds.⁴²

All of this activity continues to be seen as sheer mechanics, some proteins being described as motors because science has no way of seeing them as living entities in their own right. There is no sense that a fast-moving, gene-seeking protein could possibly know what it is doing, and no alternative explanation is offered.

Genetic expression - the translation of genes into proteins - is also far more complex than scientists expected when depicting it in neat textbook models. One-to-one correspondences between genes and proteins is a fiction of these models and is probably

rarely, if ever, the case in reality. There are several levels of re-arrangement and editing ('editing', is a metaphor implying intelligence) of the DNA code in the process of creating messenger and transfer RNAs for final protein production. The same genes have been shown to express in as many ways as the number of contexts in which they have been placed experimentally, just as the cloned seeds of one plant produce very different looking plants in different soils and climates. Even Gregor Mendel pointed out that flower color and one seed coat characteristic were the only traits he ever found in his pea plants that gave reliable predictions on inheritance.⁴³

The worldwide organization, repair, rearrangement and trading of DNA suggests that evolution is based on something far from the Darwinian model of genetic changes through mutations selected along ancestral genetic lineages. In her latest work, Margulis documents how the evolutionary record is revealing the apparent trade of entire genomes, most obviously in cases of metamorphosing creatures such as many insects.⁴⁴

Half a century of evidence, since DNA's discovery, indicates that evolution does not proceed on the basis of selected random gene mutations. Rather, genomes have the capacity - and no doubt the imperative - to detect and repair such accidental changes, just as they have the ability to choose appropriate genes as needed to build complex new metabolic pathways in response to the challenges of stress on their organisms.²⁵

Once we comprehend the extraordinary complexity of nuclear and cellular activity, we begin to see that it requires at least as much intelligence as it takes to run human technological societies. In fact, cellular technologies are more sophisticated than our own. Each of our one hundred trillion cells requires some 30,000 recycling centers, which feed obsolete or damaged proteins in at one end and issue healthy new proteins to replace them.⁴⁵ Even beyond individual cells and organisms, the planetwide DNA system is clear evidence of self-organizing intelligence, for if genomes did not know what they were doing, life would quite likely revert to chaos in very short order (more on intelligence below).

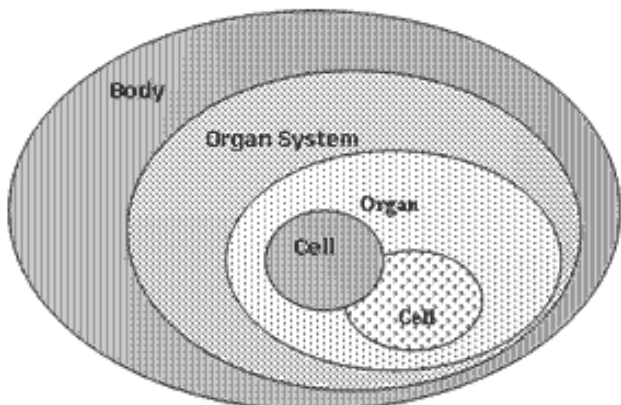
Holarchy and The Evolutionary Vortex

Our understanding of the world is built up from innumerable layers. Each layer is worth exploring as long as we do not forget that it is one of many.

- Erwin Chargaff 46

The fifth and last of the assumptions I listed for an Integral Science stated that Nature shall be conceived in fractal levels of holons in holarchy, with holons defined as relatively self-contained living entities such as galaxies, stars, planets, organisms, cells, molecules, atoms and sub-atomic particles. Holarchy defines their embeddedness within each other, as well as their co-creative interdependence on energy, matter and information exchange.

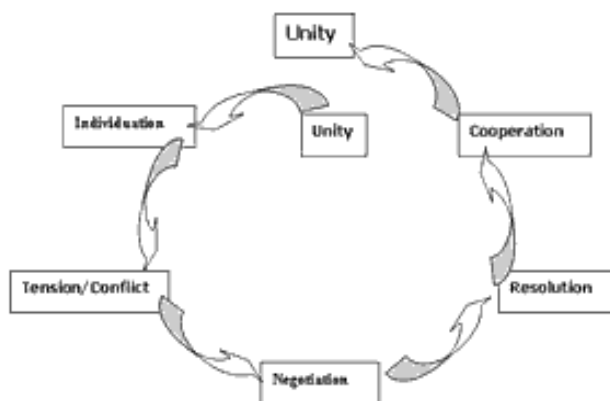
Holons in Holarchy



A more inclusive holarchy would show the body within a family, community, ecosystem, nation, planet etc. as well as levels of holarchy within the cell down to particles. In any holarchy, the situation at any level is co-determined by other levels through interactions among them. This distinguishes holarchy from hierarchy with its unidirectional command and control organization. To understand a holarchy's evolutionary process, and see the essence of biological evolution as a whole, one further concept is required.

In studying evolution, I was able to abstract a cycle that appears to hold for all levels of cosmic holarchy - a cycle of evolution. This cycle may be seen as a vortex with angular momentum. Each turn of the vortex is an open loop along which some unity individuates and the individuals go through successive stages of tension and conflict that may involve aggressive competition, then some tentative negotiations, followed by conflict resolution, cooperation and collaboration up to the weaving of a new unity if the cycle is completed, as shown in the second diagram.

Cycles Of Evolution



This cycle played out on early Earth as cellular evolution from individual archebacteria (which had differentiated from a uniform crust) to the formation of cooperative nucleated cells, the greatest leap we know in all biological evolution. In the course of their tensions and conflicts, the ancient bacteria were pushed to creativity and a diversity of lifestyles by various crises they created, including global hunger and later global pollution, but eventually they negotiated their way into cooperative ventures culminating in colonies with a division of labor so successful that they evolved into the nucleated cell - the only kind of cell other than bacterial ever to evolve on our planet, the very cell that gave rise to the whole world of animals, plants and fungi visible to us.

This evolutionary cycle is especially apparent in different types of ecosystems. Immature ecosystems (called Type I ecosystems) are populated by immature species, while mature ecosystems (called Type III ecosystems) are populated by mature species that have learned to feed their competitors, thus turning them into collaborators. This makes it easy to see that all species not extinguished in their youthful competitive phase can mature from evolutionary competition to collaborative maturity. In the case of our human species, if we see the cycle reflected in our current struggle with today's crises, we seem to linger in the tension/conflict phase while engaging in many negotiations and some cooperative resolutions in the forms of global communications, transport and travel, international treaties, etc. with more in negotiation among religions, scientists, economists and so on.

Seeing evolutionary events mirror each other at different holarchic (fractal or scalar) levels thus helps us see that the process of creating the nucleated cell through collaboration following a long competitive phase is the same process humanity is now going through in seeking ways to build global community in place of political and economic rivalries.⁴⁷ French chemist and computer scientist Joel de Rosnay also sees a cellular fractal bio-

logy of bacteria, nucleated cells and a currently forming planetary human/technological cybiont,⁴⁸ the latter in place of my concept of emerging global community. The cycle can also be compared with human developmental models, both individual and cultural, such as self-actualization or Spiral Dynamics.⁴⁹

De Rosnay uses the term “symbionomic evolution” for a general theory of self-organization and the dynamics of complex systems, in particular the evolution of human societies toward his “cybiont” - a hybrid biological, mechanical and electronic superorganism that includes humans, machines, networks and societies. His big question concerns the organization of our planet for the good of all, which he sees as requiring “regulating the regulators, monitoring the cybiont’s real-time functions” in a world where “politics has been appropriated by those with a desire for power.” Religion and science have not escaped the same motives, yet he feels that the vision and construction of this new “life form” can unite us if our religion, too, evolves into something new with values that guarantee human freedom and encourage us to take on responsibility to make the cybiont serve human needs.

This is, at least, a refreshing switch on the “sci-fi” predictions of others that it will take over its designers and force our species into its own service or even destroy us and take over the Earth. Like Darwin, de Rosnay seems to feel that humans must go beyond Nature’s struggle-for-survival issues into a more ethical mode, which I propose is not new to Nature, but is its normal maturation mode.

Current evolution theories have all centered on competition, but have become divided about the ‘locus’ of competition. As described in my book *EarthDance* 28, Darwinian evolution itself is assumed to happen through random mutation and natural selection among competing organisms, but observations of within-species altruism led to an alternative neo-Darwinian view in which species compete in the search for ecological niches. A third alternative, proposed by Richard Dawkins, proposes that evolution is driven by competition among selfish genes seeking maximum expression in the gene pool.

My holarchic variant includes all of these positions in a single model proposing that self interest at each level of organization - genome, organism, species and ecosystem - causes tensions among the levels. The self-interest of every level at once is the evolutionary driver that pushes the system in one of two directions: self-destruction of the holarchic system or negotiations and cooperation toward the mutual benefit of all levels - the thrival of the system as a whole, a unity. Thus currently competitive evolution theories can be reconciled by seeing them holarchically. If the dynamic negotiations result in holarchic balance, the system survives, as in mature ecosystems such as rainforests and prairies. The same dynamic process occurs within the mature cellular ecosystems of bodies, among the levels of cells, organs, organ systems and bodies as wholes, most notably in our own one-hundred-trillion-cell collaborative bodies.

The Darwinian model of descent, or evolution, persisting as neo-Darwinism since the discovery of DNA, still prevails, but is stuck in the competitive phase of the evolution cycle. Though Darwin himself believed humans should go beyond the “lower creatures” and practice ethics in human relationships, as mentioned earlier, that part of his thought was not scientifically persuasive because it ran counter to his whole theory that Nature was set up as nothing more than a ruthless competitive game. He failed to see the evolutionary maturation cycle, with its inherent natural ethics.

Certainly it is necessary for all elements of a healthy living system to be in good health. In the holarchy of a body, its economy cannot remain healthy if significant numbers of individual cells lose their health. (Nor can a human world economy be healthy at the expense of local economies.) We now know that mutations in DNA are identified and repaired in very complex and specific ways, that 30,000 recycling centers keep every cell clear of damaged proteins and that cells in which either DNA or protein is damaged beyond repair and threatens other cells’ health will commit cell suicide, known as apoptosis, to promote the survival

of the body as a whole.^{50,45}

One would expect a similar system at the level of ecosystems - a system working to promote each species’ health. Predator - prey relationships are one obviously cooperative means to this end, with prey feeding predators that maintain their prey species as a healthy food supply by recycling the least healthy, rather than going for the ‘prime rib.’ Indigenous cultures that depend on a single species, such as caribou in the far north, for food, clothing, housing, snowshoes, kayaks, sacred objects, etc., actually worshipped such species or at least respected and honored them as brothers, doing everything possible to ensure their health.

Indigenous peoples recognize consciousness to be inherent in all aspects of Nature and participate in their communion at non-physical levels. An Integral Science that understands this will promote better understanding of predator-prey relationships, not to mention all the other co-creative communications of Nature. It will also help us change our attitudes, for example, honoring the creative intelligence of the recycling centers in our cells, rather than referring to them as “Cellular chambers of doom,” as did the *Scientific American* in announcing their discovery,⁴⁵ or referring to the huge portions of our DNA we do not yet understand as “junk” or “desert” DNA.³⁶

In seeing competition among individuals as the sole driving force of evolution, Darwin was seeing ‘rabbits in habitats’ rather than ‘rhabitats’. Perhaps ecosystems as wholes were not yet understood well enough to recognize their evolution into mature cooperative systems. Darwin also failed to see that the Malthusian analysis of human reproduction and farming on which he had based his scarcity model was very unlike the rest of Nature. In human food production and consumption, one species grows and consumes the others of its choice with tremendous wastage, while in Nature all species together are balanced reciprocally as food producers, and food consumers, including recyclers. What we call a food chain is actually a loop in which the bacterial ‘bottom’ of the chain consumes the ‘top’ species upon death, and predator-prey relationships insure health. Nature’s complex scheme permits awesome diversity and newness together with equally awesome health and stability.

While young species indeed compete hard for their ecological niches, mature species give up antagonisms in favor of cooperation. Had this lesson not been learned long ago in early Earth evolution, there could never have been any evolution of nucleated cell cooperatives or multi-celled creatures functioning as huge collaborative collectives. Mars may have been a case of a planet coming to life at the bacterial level, but without completing the cycle to build larger life forms. Earth, having come to the point of human evolution, now risks her life because of our own destructive species immaturity.

Consciousness, Intelligence, Life

Franklin Harold, in bringing us up to date on cellular biology with a good deal of soul searching on the meaning of what we have learned, says:

There can be no simple answer to the question of “What is Life?” It is an invitation to explore the successive levels of biological reality... It would be a gross mistake to brush off the higher levels of biological order as if they were secondary or derivative; on the contrary, how the parts come together must be key to any inquiry into the nature of life. 51

Harold epitomizes the contemporary situation in biology without an Integral Science. His “successive levels of biological reality” are limited to the scientific framework provided by a physics of matter and energy now extending into the ZPE realm, but falling short of recognizing consciousness and the intelligence of life throughout the cosmos. His quest for “how the parts come together” is based on a model of assembly from the bottom up, in which accidental particle collisions - rather than intentional particle collisions - must ultimately account for the emer-

gence of life from non-life, intelligence from non-intelligence and consciousness from non-consciousness. Yet Harold recognizes that something is missing in this science, when he says:

...the problem remains that entities capable of converting energy into organization are not predictable from laws established by classical physics. This suggested to Schroedinger that organisms stand outside physics in some essential respect; or else, that physics contains additional principles that pertain to organized systems, which remain to be discovered.⁵¹

Schroedinger speculated that the study of life would uncover other laws of Nature than those of physics, but that these would then be incorporated into physics itself. But if Schroedinger was right in suggesting that organisms stand outside of physics, perhaps the error of science lay, and still lies, in making biology subservient to physics - forcing the investigation of life into a non-living, entropic framework - rather than beginning with a science of life and seeing physics as a way of explaining life's cosmic order, as I proposed in the Prologue. What we need is a very serious and open-minded collaboration of biologists and physicists within the new framework of Integral Science, where they can see each other's work as complementary.

Many scientists are religious, with a strong belief in God as Creator of the physical universe. They are less likely than Descartes to conceive God as the Grand Engineer, and may leave their description to terms as vague as Mystery, but with only rare exceptions they are dualists separating religion from science, God from Creation.

Very few prominent western scientists have acknowledged something like conscious intelligence or mind as inherent and ubiquitous in the cosmos. Harvard University's Nobel laureate biologist George Wald assumed cosmic mind operating throughout biological evolution as he could make sense of it in no other way, and he cited several of his predecessors and colleagues including astronomer/physicist Sir Arthur Eddington and biologist Carl F. von Weizsäcker, as having reached the same conclusions.^{52, 53, 54}

More recently, physicist/biologist Eshel Ben Jacob, studying bacterial colonies responding to stress as wholes, concluded that the genomes of bacterial colonies function like group minds able to respond intelligently to stresses on their colonies.^{55, 56}

While this statement is far from assuming mind inherent in all Nature, it is a big step for a microbiologist. Similarly, on completion of the human genome project, Gene Myers, the Celera computer scientist who actually assembled the genome map, said:

The system is extremely complex. It's like it was designed. There's a huge intelligence there. I don't see that as being unscientific. Others may, but not me.⁵⁷

Physicist David Peat, who has long studied and written about the history of physics and collaborated with David Bohm⁵⁸ noted, in a seminar on the letters exchanged by psychologist Carl Jung and physicist Wolfgang Pauli, that a number of the great pioneers of 20th century physics were frustrated in their own deep quests to comprehend the true Source of the physical universe - the deeper meaning of things they intuited but could not bring into their grasp. In a sense, they were going back to Newton's quest to harmonize physics with alchemy and kabbalistic mysteries, which were ultimately about soul transformation. Even Einstein tried to integrate consciousness into his theory, acknowledging his deep faith in an intelligent universe by saying that what he really wanted to know was what God thinks, the rest being detail.

Wolfgang Pauli attempted to create a neutral language for physics and psychology with the express hope this would lead to bringing soul back into science, but died with a sense of failure and serious regrets. Werner Heisenberg, too, was depressed by his sense of failure to understand the quantum world's deep my-

stery. Neils Bohr, trying to relate complementarity in physics and in psyche concluded that our language, developed at the level of the visible world, was simply inadequate for understanding the quantum world. David Bohm spent many years in closest collaboration with the mystic Krishnamurti on the assumption this would help him gain direct access to Source, beyond language, but eventually he despaired of doing so and fell into his own deep depression before he died. All of them sought an intelligence they were certain lay behind the appearances of the physical world; none finding it to their satisfaction.

Contemporary physicist Fred Alan Wolf explicitly defines that source as "primal consciousness" and traces its creative actions in the "temporal"⁵⁹, while engineer/physicist Norman Friedman draws on the Perennial Philosophy and the highly unusual "channeled" Seth material of Jane Roberts, now archived at Yale University, to expound a model of the conscious universe expressing in electromagnetic energy and matter.^{60, 61}

A major inspiration in the development of both Milo Wolff's and Nassim Hamein's physics was the extraordinary scientific work of Walter Russell, a painter, sculptor, musician, architect, philosopher, corporate consultant and scientist known as The Man Who Tapped the Secrets of the Universe.⁶² Russell worked out a very detailed and elegant model of a wave universe in which a spiritual "field of knowing" - a pure unitary light of ultimate truth, life, love, power, intelligence - gives rise to the universe as a duality of "simulated light" in its opposite extensions of expansion and contraction, radiation and gravity:

In this two-way universe, light which is inwardly directed toward gravity charges mass and discharges space. When directed toward space it charges space and discharges mass. All direction of force in Nature is spiral.⁶³

Russell's wave universe, with its duality springing from divine unity reflects the ancient Vedic, Taoist and Kotodama philosophies of the East. His physics model of continual creation, through the inward and outward motions of contraction (gravity) and expansion (radiation) with angular momentum, is reminiscent of the vortex model first proposed by Lord Kelvin and takes it to new levels. In turn, Russell inspires further development of the model in physicists such as Wolff and Hamein, cited earlier.

Of fundamental importance in Russell's work is the absolute conviction that the universe can only arise from a deeper intelligence that gives it life and that this source Oneness remains within the individuated Universe, appearing as a longing of everything in it to return to this source. Further, everything from the smallest particle has the desire, the intelligence and the power to create harmony with all else. In Russell's words:

Every...thing in Nature reflects the vibrations of every other thing, to fulfill its desire to synchronize its vibrations with every other thing...This is an electrically conditioned wave universe. All wave conditions are forever seeking oneness. For this reason all sensation responds to all other sensation.⁶³

Where Newton, Einstein, Heisenberg, Bohr and Bohm failed, Russell succeeded. Not only did he tap directly into the "spiritual universe of knowing" (as opposed to the wave universe of matter and motion), but also he demonstrated this direct connection in his own life by achieving unparalleled feats of creative genius in every field he touched, including those in which he had no prior training and achieved immediate acclaim.⁶²

Russell's universe of "desire" for synchronization and oneness among mutually reflecting things (individualized being) in our universe is very close to Jane Roberts' Seth material in which consciousness units (CUs), conscious singularities expanding infinitely outward and inward at once) express their free will in associating with other CUs to build intentional patterns by transforming into electromagnetic energy and matter in turn.⁶⁴

In ancient eastern cultures, scientific techniques for merging individual consciousnesses not only with each other but also with the ultimate field of Cosmic Consciousness were developed over many centuries; some of them have now gained acceptance

in western culture as meditation and yoga. Integral Science will look seriously to these inner ways of exploring the cosmos.

My own experience with non-western philosophies and indigenous cultures has made it very clear that western culture took an unusual turn in human history when its science - the authority of which replaced religious priesthods - decreed an objective and non-living universe in which such natural human experiences as telepathy, dreams, communion with angels or the dead, remote viewing and dialogue with other species were simply dismissed as unreal. J. Allen Boone, an early film producer and correspondent for the Washington Post put it elegantly:

It is interesting to recall that people of certain ancient times appear to have been great virtuosos in the art of living, particularly skilled in the delicate science of being in right relations with everything, including animals. These people recognized the inseparable unity of Creator and creation. They were able to blend themselves with the universal Presence, Power and Purpose that is forever moving back of all things, in all things and through all things... They refused to make any separating barriers between mineral and vegetable, between vegetable and man, or between man and the great Primal Cause which animates and governs all things. Every living thing was seen as a partner in a universal enterprise... Everything lived for everything else, at all times and under all circumstances. Those were the days when 'the whole earth was of one language and one speech... and all was one grand concord.'

-J. Allen Boone

Kinship With All Life, author's Foreword 65

The tentative Integral Science model presented here holds the promise of restoring the birthright of such communion to all humanity, with all the explanatory power of scientific reasoning and evidence behind it. A truly Integral Science, of course, will have to include far more (e.g. philosophy, logic, psychology, economics, etc.) than the physics and biology for which I have suggested a path toward unification.

In an Integral model, the cosmos is a conscious intelligent self-organizing system in which all entities are alive, autopoietic (self-creating) and creatively collaborative. From smallest to largest, whether relatively simple or complex, they function by metabolic dynamics of radiation/ gravity, cen(syn)trophy/entropy, anabolism/catabolism. Further, all living entities are self-reflexive, conscious, able to learn and inextricably connected within an overall field of Consciousness within which each exists with a unique perspective and a unique role. Familiar cellular and multi-cellular Earth life forms, as well as the living Earth itself, are a special case of particularly complex living entities in the mid-size range between the microcosm and macrocosm of a conscious, intelligent self-creating living universe.

In such a science, specialties would focus on various physical levels or temporal spans (e.g. chemistry, astronomy, evolution) and particular research areas (e.g. behavioral psychology, spiritual psychology, ecological psychology) with a view to evolving such categories into more meaningful ones as the science itself evolves. The cosmic model would be learned by all new scientists and would always provide the context for their specialty as well as providing a framework for studying its interconnections with other areas of specialty and with the cosmic whole.

By building our science on the assumption of a conscious rather than non-conscious universe and seeking in it the patterns of life rather than non-life and intelligence rather than non-intelligent accident, we stand to gain nothing less than a scientific model that conforms better to human experience and offers guidance in building a thriving and sustainable human future. This would fulfill the ancient Greek intent to find guidance in human affairs through scientific understanding of the natural cosmos.

Editor's Note: You can find more work by Dr. Sahtouris at
<http://www.sahtouris.com>

<http://via-visioninaction.org/html/sahtourispartone.html>

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