Article

Consciousness, Cosmology & the Meaning of Life (Part II)

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ABSTRACT

In this article, I strive to answer the question whether life is just a meaningless rash of complexity – a planetary surface growth in a physical universe, which cares not a dot for biological or conscious survival, and in which black holes and disintegrating galaxies hold the ultimate fate of all. Conscious beings are launched by their very existence on a quest to discover the essential meaning in life that makes sense of the entire process. Effectively, the world is divided between two complementary realms, the subjective realm of conscious experience and the objective realm of physical existence which we access indirectly through the former, although we recognize physical existence, and with it our biological bodies and brains, to be essential to the existence of our conscious mental states. Central in this resolution of our sense of meaning and purpose is preserving the diversity of life and the robustness of the biosphere, so that that the future generations of life and humanity can prosper and further expand the vistas of conscious experience.

Part II of this two-part article includes: Molecular Complexity and the Origins of Life; Evolution, Diversification and the Metabolic Genome; Eukaryotes Transform the Game of Life; Sex Sneaks in at Ground Zero; Ancient Evolutionary Foundations of Consciousness; Single Celled Societies to Sappy Nervous Systems; Consciousness and Real Time Anticipation; Fathoming the Inner Dimensions of Consciousness; Unfolding the Multiverse; and The Participatory Cosmos.

Keywords: Consciousness, cosmology, meaning of life, quantum reality, free will, holographic.

Molecular Complexity and the Origins of Life

Nevertheless, the four forces of nature induce an interactive hierarchy in the quantum forms that matter and radiation can assume. After the cosmic background separated, the universe consisted mostly of atoms of hydrogen with a little helium, until the first galaxies formed by gravitational collapse and the first stars began to shine. From then on, the stars became furnaces burning hydrogen under the strong nuclear force ultimately generating the heavy elements by nuclear fusion, until they explode in a supernova. These elements are then swept up into the gas clouds forming smaller long-lived stars like the sun, which then have planets containing a spectrum of the lighter and heavier elements we find on Earth.

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The forces of nature are also prone to chaotic interaction due to their non-linear force fields, that generate extreme variety in planetary and molecular environments. Anyone who looks at images of the solar system planets and their major satellites can see how varied and different they have become. The same is the case for molecular systems. The molecules of life centre on H, C, N and O with an emphasis on the most strongly covalent elements in the first row as backbone building components that are also cosmologically abundant as light elements. These also form the strongest multiple bonds such as -C≡C-, -C≡N, >C=O, which can be found in molecular gas and dust clouds such as in the Orion nebula where new stars and solar systems are being formed.

However these strong multiple bonds are unstable, because their π orbitals are at higher energy than a single σ bond, so they polymerize to form a variety of heterocyclic CNO molecules, which turn out to be precursors of life, such as nucleic acid bases, amino acids and many other prebiotic molecules. Complex molecular precursors to life have thus been found both in interstellar gas clouds, and in carbonaceous meteorites that are associated with the primordial material on the outer edges of the solar system, which would have rained down on the early Earth in abundance, providing much of the carbon and nitrogen in the Earth's crust and supplying the Earth with a rich brew of organics.

This puts complex molecules at the top of the cosmogenesis hierarchy, because they are the cumulative interactive result of all the forces of nature acting in order of their energy interactions. You cannot find greater complexity in black holes, or the centre of stars, because the energies are too catastrophic to allow all the forces of nature to generate full complexity. Molecular complexity on the planetary surface thus becomes the Sigma of paradise on the cosmic equator - life in the universe is as significant in cosmological terms as the alpha of the cosmic origin or the omega of its final end. The interaction of the bio-elements is a thus cosmological process based on each of the chemical elements generated by nucleo-synthesis contributing unique properties, due to the non-linear nature of charge interactions, which in combination with one another under the quantum orbital periodicities, provide the boundary conditions for a structurally unstable complex quantum system to emerge.

Strong covalent bonds of the principal bio-elements H C, N and O, which as we noted have the strongest covalent bonds among the elements, provide the central backbones of complex organic molecules. This interacts with a graduated increase of electronegativity in C, N and O producing a distribution from non-polar C-H to the highly polar O-H found in the diverse quantum properties of H_2O, bifurcating the reaction medium into non-polar (oily) and polar (aqueous) phases, becoming the source of micelle, stacked double helix and membranous structures ubiquitous in living systems. The heterocyclic double and single bonded rings of the first generation molecules such as the nucleic acid bases provide unique electronic properties including photon absorption from delocalized electronic orbitals. Second row elements induce complexifying perturbations. Unique properties of P as dehydrating condensing agent in the form of $-PO_4^{3-}$ driving key molecular polymerizations and energy processes and the milder covalent S-S to S-H bonding of S provide key additional quantum properties. These are again complemented by the strongly ionic properties of Na^+, K^+, Ca^{++} and Mg^{++} along with Cl^-, in interaction with the diverse polar, H-bonding, and ionic properties of H_2O. Finally the transition elements add unique catalytic properties, due to their higher orbital transitions. One can thus

confirm that the interaction of the bio-elements is a culmination of the cosmological process that generated the forces of nature in their polarized chiral condition as a central interaction of the chemical elements expressing their graduated periodic and non-linear quantum properties in a cosmologically optimal form.

Furthermore, the fractal process of complexity doesn't stop at individual bonds. Weaker H-bonds, polar and non-polar interactions, and van der Waal forces act cooperatively to make molecules into fractal structures where catalytic energetics are a function of cooperative weak bonding, leading to molecules such as proteins and nucleic acids with complex tertiary structures based on polymer chains, helices and modifying side groups resulting in active sites with high catalytic power. In a fundamental sense, once life begins, the ultimate culmination interactively of the cosmological forces of nature is excitable tissue, an integrated dynamical quantum fractal, where complex molecules aggregate into molecular complexes, and these into cellular organelles, cells, tissues, organs and organisms, with the ultimate interactive culmination being the conscious brain.

Then there is the naked lunch of negentropic free-energy, bathing the whole process. Solar systems, by their genesis, set up a situation of negative entropy, where there is a free input of energy in stellar radiation bathing the planetary surface. This leads to all manner of secondary effects in terms of storms, lightning, and ionizing radiation, all of which can induce molecular polymerization. In addition, the chemical and geological forces are far from equilibrium, with the early Earth having massive tectonic and volcanic activity. Ultimately this becomes the source of all photosynthetic energy driving life on Earth.

But the situation is even more auspicious for the emergence of life. There are unique chemical reactions that can induce a chemical Garden of Eden scenario out of the cosmological milieu. One of these is the reaction of alkalinizing olivine with acidic sea water in a higher carbon dioxide atmosphere than we have today. Olivine is a cosmologically abundant iron-aluminum silicate mineral, which is ubiquitous in the galaxy and abundant on rocky planets and meteorites. Olivine vents are still fizzing at the Lost City in the mid Atlantic and off the coasts of Spain and Iceland, but they would have been vastly more abundant on the early Earth. The Lost City field itself has undergone continuous activity for some 30,000 years - a hundred times longer than hydrothermal vents. It undergoes a chemical reaction with sea water, generating hydrogen and methane to form columns of carbonate full of fizzy columns, which can both concentrate organics exponentially and generate key non-equilibrium reactions supporting central oxidation-reduction pathways driving living processes.

Biogenesis is a second bridging point, where the religious try to assert that God must have intervened to set the process in motion, but this is a misconception. The key polymers, including, both the nucleic acid RNA, which can both replicate itself and also act as an enzyme-like catalyst, and the polypeptides leading to proteins, are direct products of the molecular energisations found in interstellar gas clouds, also found in carbonaceous meteorites and as products in prebiotic experiments. Adenine, one of the four nucleic acid bases, is simply $(HCN)_5$. Several new counter-intuitive routes have been discovered which help bridge the gap all the way from simple precursors to the nucleotide units making up RNA, utilizing phosphate as a dehydrating binding agent in the first polymerizations, as it is in cellular energetics today.

Moreover living polymers need to be thermodynamically unstable, or polymerization would run itself to death and life would have ended before it began in a dob of gunk, so a long period of a rich non-equilibrium environment is exactly the conditions which can bridge the gap to replicating living systems.

The geological evidence suggests that living systems emerged around 3.8 billion years ago, almost as soon as the temperatures fell enough for liquid oceans to form, only a few hundred million years after the formation of the solar system around 4.1 billion years back, although this time manifestly dwarfs the few days at most of origin of life experiments on Earth today.

Evolution, Diversification and the Metabolic Genome

Life depends critically on molecular replication provided by the double helix of nucleic acids and the complementary base pairs adenine-uracil and guanine- cytosine, which form a hydrogen-bonded zipper of stacked heterocyclic CN molecules - purines and pyrimidines. All molecular process are also doomed to 'random' entropy-increasing effects, as are all thermodynamic processes. Thus replicating life, no matter how precisely it strives to perfectly replicate, inevitably suffers mutational change, either by errors in replication, or by chemical damage to the constituent molecules. In the event such changes result in new advantageous features, selective advantage will result in their preservation, otherwise they will weaken the genome and tend to be eliminated.

This means that evolution is absolutely inevitable in all living organisms cosmologically. It isn't a theory, but a molecular fact and reality of the physical universe, which cannot legitimately be sidelined, marginalized or claimed to be unproven by religious arguments about creation. It is confirmed, both by the geological record and the now sequenced genetic trees of diverse living organisms, including humanity, where we have learned that we have not only descended from apes but interbred with Neanderthals and Denisovans. It has been observed in real life in a host of natural and experimental situations and is happening to us as we speak.

Once life became established, it fanned out into two broad categories, those living closer to mineral conditions became the archaea, and those interacting more closely with other organic systems became the bacteria. The archaea are now found living in extreme habitats such as hot pools, high-salt habitats and as the methanogens living in swamps and some animal intestines. The bacteria fanned out into a host of habitats, both becoming photo-synthesizers, such as the blue-green algae that rule today's ocean photo-fixation of energy and heterotrophic bacteria that invade, break down and utilize all manner of biological nutrients, including pathogenic and symbiotic forms as well as a wide variety of other habitats.

This divergence into all available ecological niches is universal to evolving living systems. Climax ecosystems require plants, and animals to fertilize them and control rampant competition, and evolution generates, along with the animals, carnivores and herbivores, parasites, predators and prey filling complementary niches. A climax predator such as a lion, despite living of killing the stragglers, is necessary to the survival of its prey, or the gazelles become liable to acute boom and bust, only to die en masse from starvation through eating out

the grasslands. There is thus no moral cosmology that says the lion should lie down with the lamb. Morality is not universal to cosmology but an evolutionary property of human and animal societies, as we have noted.

The divergence between the archaea and bacteria is very ancient because the ribosomes, the RNA-based protein translating factories of living systems, are structurally distinct, placing their divergence close to the evolution of the genetic code and protein translation, and the fact that they don't share key DNA enzymes or fundamental cell wall components suggests they diverged both before RNA genomes had converted to DNA and before life had fully escaped its chemical Garden of Eden to become free-living cells.

Nevertheless shortly after its initial appearance, around 3.5 billion years ago, there was an explosion of genetic diversity, probably due to a high degree of horizontal transfer of genes between organisms, resulting in most of the key metabolic pathways we find today. There was then a long epoch of single-celled life on Earth, with the largest fossils being stromatolite colonies of bacteria, which still exist on the shorelines of parts of Australia, until around a billion years ago, another event, almost as significant as the origin of life, took place.

Eukaryotes Transform the Game of Life

Somewhere between 1.4 and 1 billon years ago, a new life form emerged out of an energy symbiosis between a species of archaea and a respiring proteobacterium. The archaeote appears to have engulfed the bacterial species, but rather than digesting it, became energized because the respiring bacterium was providing about seven times as efficient a form of energy transduction than the archeote metabolism.

There is no clear trace of the immediate precursors of this event, or exactly how several of the rapid-fire changes occurred, but we can identify the archaea closest in genetic evolutionary terms with the closest set of genes and we know that it was probably a respiring γ-proteobacterum that became engulfed. Neither are there any fossils of the immediate successors of this event still in existence because the ensuing life forms were so successful that they have wiped all immediate precursors and successors off the face of the Earth.

These new life forms are the eucaryotes, the first fully nucleated cells, which are an endosymbiosis between powerful respiring bacteria, and archaea that still retained much of the more ancient RNA-based information processing. These cells, utilizing the combination of high-energy respiration and versatile genetic processing developed the nuclear envelope, the ability to manipulate many chromosomes using centrioles and microtubule spindles in cell division, a complex internal digestive system, the endoplasmic reticulum, the new forms of motile flagella we see in human sperms to this day and all the other organelles of the modern eukaryote cell, from protists such as amoeba through to multicellular plants animals and fungi.

The critical thing is that all eukaryote cells have endosymbiont mitochondria genetically related to proteobacteria, which perform the energy-rich functions of respiration and electron transport in the eukaryote cell. Even very primitive eucaryotes such as giardia have been found to have

vestigial mitochondria which have atrophied due to their anaerobic habitat, placing the endosymbiosis event right at the origin. Among the eucaryotes there are several major families, broadly divided into the unikonts (one flagellum), including amoebae, animals and fungi; and dikonts, including plants and the other unicellular groups. Plants and animals separated close to the root, so characteristics common to both plants and animals are probably also primal.

Careful analysis shows that the majority of reactive enzymatic genes in the eukaryote nuclear genome probably derived originally from the mitochondria, while the information processing nuclear genes originated from the archaeal genome. Gradually, with migration of mitochondrial genes to the nucleus, only a bare minimum of essential mitochondrial genes remain on the mitochondrial chromosome. In turn the RNA processing function of the archaeote provided a richer repertoire for gene regulation than the ultra-compact fast tightly-linked operon-based gene regulation of bacteria, and the modular functional architecture of non-coding spacers called introns which separate the functional exon regions of active coded enzymes provided for a more flexible framework for gene evolution involving modular components of genes, facilitated by the RNA processing which enables differential gene expression from the same messenger.

A species very close to the root of the eukaryote radiation is *Naegleria gruberii*, a free-living ocean organism belonging to the excavata, which include some of the most primitive eucaryotes such as *Giardia* and *Trichomonads*. Nevertheless it is capable of both oxidative respiration and anaerobic metabolism and can switch between amoeboid and ciliated modes of behavior, regenerating complete centrioles and flagellae as needed. Its genome sequence includes 'muscular' actin, microtubule cytoskeletons, mitotic and meiotic machinery, suggesting cryptic sex, and a rich repertoire of signaling molecules, which become pivotal to brain function in higher animals, including G-protein linked receptors, histidine kinases and second messengers including cAMP. One *Naegleria* strain investigated is a composite of two distinct haplotypes, indicating sexual hybridization. Although sexual mating has not been observed, the heterozygosity found in the Naegleria genome is typical of a sexual organism, with perhaps infrequent matings.

We thus see that founding eukaryote lines already had essentially all the organelle and functional components necessary for multi-celled animals to evolve, including receptors and signaling molecules necessary for nervous system function, the capacity for sexual reproduction and the full suite of genes involved in cellular architecture and motile activity.

Sex Sneaks in at Ground Zero

Sexual recombination transforms the evolutionary process in two intertwined ways. Firstly sexual recombination aligns genes resulting in natural selection being able to respond to single gene changes, rather than the major chunks of the genome coupled together in bacterial replication. Secondly crossing over means homologous genes from the two parents are crossed over to provide novel genomes, which nevertheless contain a full viable gene complement.

This provides endless variety in the offspring, which enables them to resist catastrophic attacks from parasite organisms, as well as enabling a form of 'Muller's ratchet' preventing the gradual

accumulation of mutations in a large genome to lethal levels. Resistance to parasites and diseases provides an immediate survival advantage to sexual organisms in the first generation, helping to explain how sexuality could become established before any evolutionary advantages accrued over time. Because all the offspring are genetically diverse, even if some contain deleterious or lethal mutations, some others will not and become the survivors who have eluded the mutational change. Sexuality also allows extremely rapid uptake of a new advantageous mutation, through selective sweeps, which confer a significant advantage to the reproductive power of offspring containing the new characteristic.

Contrary to the idea that sexuality and sexual recombination are late adaptions of advanced eucaryotes, investigation of meiosis-related genes produces evolutionary trees showing the occurrence of these genes across the eucaryotes from *Giardia* to *Homo sapiens*, implying sexuality is a founding characteristic of all extant eucaryotes. Forms of both unikont amoebozoa and dikont rhizaria and excavates show trends consistent with founding sexuality, later lost in some branches. Both amoebozoa and rhizaria show confirmed evidence for sexuality, such as meiosis, showing it is a likely founding characteristic.

The early origin of sexuality is attested to by research into the extended family tree of amoebae, which shows that sexuality is likely to have arisen in their common ancestor and been subsequently lost in asexual protist species. Unequivocal evidence for sex in the primitive excavate Giardia implies sexuality arose in the last common ancestor of all eucaryotes, very early in evolution, suggesting it may have been a founding characteristic of the archaeote partner in the endosymbiosis, from which most of the information processing genes are derived.

The Ancient Evolutionary Foundations of Consciousness

Excitable membranes are universal to eucaryote cells, as is the need to sense electrochemical and nutrient changes in their milieu. Edge of chaos dynamics is a natural consequence of excitability, providing arbitrary sensitivity to disturbances caused by predators and prey in the active environment. It is a function critical for survival in both single-celled and multicellular organisms. It is thus easy to see how chaotic excitability became a sensitive sense organ in single celled eucaryotes constituting a form of cellular ‘consciousness’ in such species.

It should also be noted that the biological sense modes of vision, hearing, smell, touch and electrical sensitivity are really the available fundamental physical quantum modes, which the electrical sensitivity of the excitable cell can help bring into play. Vision for example is membrane excitability primed by photon absorption, and the photoreceptor molecule in human vision is rhodopsin. The extremely ancient origin of the rhodopsin family of heptahelical receptors can be seen from the ultra-primitive photosynthesis in archaeote Halobacteria, which lack any form of electron transport, relying only on the direct coupling between photo-stimulated H^+ pumping and chemiosmotic ATP formation universal to life, based on bacteriorhodopsin, which shares genetic sequence homology with vertebrate rhodopsins, uses a form of retinal as in human vision, and has the same heptahelical membrane-spanning structure as G-protein-linked receptors for neurotransmitters such as serotonin, suggesting these receptors, also found in *Naegleria*, first arose in archaea.

Likewise the neurotransmitters that give us the sappy biochemical brain have an ancient origin in single celled-eucaryotes as signaling molecules. The elementary neurotransmitter types, many of which are fundamental amino acids (glutamate, glycine, GABA) or amines derived from amino acids (serotonin, catecholamines nor-epinephrine and dopamine, histamine, and choline) have primordial relationships with the membrane, as soluble molecules with complementary charge relationships to the hydrophilic ends of the phospholipids, which later became encoded in protein receptors. The serotonin 5-HT1a receptor for example is estimated to have evolved up to a billion years ago, concomitant with the eucaryote emergence. Receptor proteins, second signaling pathways and key neurotransmitters including norepinephrine, epinephrine, and serotonin occur widely in single-celled protists. Species of *Entamoeba* secrete serotonin and the neuropeptides neurotensin and substance P, a neuropeptide associated with inflammatory processes and pain in humans, and release and respond to catecholamine compounds during differentiation. The metabotropic (protein-activating) glutamate and GABA receptors likewise go back to the social amoeba *Dictyostelium discoideum*, along with the cAMP signaling pivotal in aggregation of some 100,000 partially differentiated cells on impending starvation to form an asexual fruiting body, although it is also capable of sexual reproduction.

This leads to a picture where the essential physiological components of conscious brain activity and sensory awareness arose in single-celled eucaryotes, both in intra and intercellular communication, and in the chaotic excitability of single cells in sensing and responding to their environment. These include ion channel based excitability and action potentials, neurotransmitter modulated activity based on specific receptor proteins, membrane-nucleus signaling and precursors of synaptic communication. We can thus see that the neurodynamic processes underpinning subjective consciousness are evolutionarily ancient and originate in single-celled protista long before the emergence of multi-celled animals and nervous systems.

Single Celled Societies to Sappy Nervous Systems

With the emergence of multi-celled organisms, the evolutionary features that enabled sensory excitability and social signaling became adapted to internal signaling within the organism as well as sensory receptors for the active environment. The adaptions driving this change arose in the era of single celled eucaryotes from sophisticated cells with active social signaling acting with a relative degree of autonomy to form active colonies.

A key idea about the evolution of consciousness is thus that it first evolved in single celled eucaryotes as a combination sensory and anticipatory excitation, occurring at the edge of chaos, which the cell maintained energetically to keep a sensory model of its electrical and sensory environment to detect food but above all to guard against sudden attack by predators. As this is the most pressing filter on survival of the organism and its species, anticipatory modeling of the active environment via chaotic excitation continued to be pivotal as social single celled species became colonies and then organisms, with the central nervous system becoming the key organ of anticipatory modeling by chaotic excitation, utilizing both direct membrane excitation, and the modes of molecular social signaling in the form of modulating neurotransmitters.

The coelenterate hydra illustrates a point on the transition from autonomous colony to organism. It has one of the first nervous systems, which is essentially a neural subnet pervading the tissues with no imposed central organization. The organism is still essentially a colony and if the hydra is turned inside out the individual cells of the endoderm and ectoderm can migrate and reorganize themselves to reform the active organism. Nevertheless, the behavior of the hydra is highly sophisticated. It can detect and kill prey surrounding it with stinging tentacles and drawing resisting prey into its stomach and it also has up to twelve different forms of locomotion, involving central coordination, including snail-like sliding on its base, rising to the surface on air bubbles and attaching to the surface tension, and even somersaulting onto its tentacles and rolling over to adhere again at its base. This helps make it clear that the sophistication of its behavior is very much a function of the neural plasticity of its individual neurons and the extent of behavioral programming in its genome. Serotonin signaling in ectodermal neurons is also known to cause metamorphosis in coelenterates.

The diversification of neurotransmitter receptors into the forms we find in humans today also occurred early in the metazoan radiation, with the serotonin 5HT1 and 5HT2 receptor families diverging before the diversification of molluscs, arthropods and vertebrates. All metazoan central nervous systems are also sappy, with pivotal roles for diverse neurotransmitters modulating activity through metabotropic receptors such as a vast G-protein linked family that includes all the major neurotransmitters including both amines and polypeptides and diverse sensory receptors for chemical sense including smell, as well as vision. Arthropods for example have a very similar repertoire of neurotransmitters including serotonin and dopamine in evolutionarily similar roles to vertebrates with octopamine and tyramine being used in place of nor-epinephrine. Psychedelics and stimulants are known to have behavioral effects in arthropods distinct from but related to those in vertebrates.

Looking at the roles of serotonin, dopamine and other neurotransmitters from oxytocin to endorphins in humans and their functions in mood and motivation, combined with their predilection for ‘abuse’ as recreational and psychotherapeutic drugs demonstrates that humans, although having an electrically excitable nervous system, depend on the same sappy signaling molecules to maintain their overall emotional tone and sense of motivation, direction and their survival that social signaling has achieved for single celled social species, such as *Dictyostellium*, in ensuring their survival.

The profound affects that psychoactive molecules can have on consciousness, especially the psychedelic serotonin agonists, shows there is a deep connection between this sappy biochemical aspect of brain function and major changes of coordinated activation associated with changes of consciousness that may be a key to understanding how consciousness actually arises. This association is also confirmed by the changes in brain function associated with wakefulness and sleep cycles where the onset of sleep and dreaming REM states is likewise associated with changes in modalities of excitation via serotonin, nor-epinephrine and dopamine secreting neurons in basal brain centres such as the substantia nigra, and locus coeruleus.

Consciousness and Real Time Anticipation

Running counter to the reduction of consciousness to a combination of deterministic laws and random perturbations, are approaches in which consciousness is seen as fundamental to the existential condition, and even complementary to physical phenomena and processes. The nature of this complementarity has been highlighted by the "Hard Problem" in consciousness research, - "explaining why we have qualitative phenomenal experiences, contrasted with the "easy problems" of explaining our ability to discriminate, integrate information, report mental states, focus attention, etc. Easy problems are easy because all that is required for their solution is to specify a mechanism in the brain that can perform the function. For example identifying conscious states accompanying attentive processes with higher frequency EEG signals in the gamma range. The dilemma of the hard problem implies that no purely objective mechanism can suffice to explain subjective consciousness as a phenomenon in its own right.

This leads ultimately to a cosmology in which consciousness and the physical universe are complementary. Existential reality thus presents as a complementarity paradox. While we acknowledge our subjective consciousness is somehow a product of our biological brain, which is in turn a fragile product of physical forces on a cosmological scale, all our experiences of reality, including our perceptions of the physical world, as well as dreams memories and reflections, come exclusively and totally from our subjective consciousness. This suggests that existential cosmology is a complementarity between subjective consciousness and the physical universe, in which both are fundamental.

In the veridical way existential reality is generated, subjective experience is primary. In the consensual overlap of our subjective experiences we gain a common experience of the physical world, which we then interpret as containing biological brains, which may also be able to have subjective experiences. However, attempted construction of reality from the physical universe and its brains remains incomplete, because there is no explanation of how the brains can also have subjective conscious experiences.

Subjective consciousness involves coordinated whole-brain activity as opposed to local activations, which reach only the subconscious level. Attempts to find the functional locus of subjective consciousness in brain regions have arrived at the conclusion that active conscious experiences are not generated in a specific cortical region but are a product of integrated coherent activity of global cortical dynamics. This implies that the so-called Cartesian theatre of consciousness is a product of the entire active cortex and that the particular form of phase coherent, edge-of-chaos processing adopted by the mammalian brain is responsible for the manifestation of subjective experience. This allows for a theory of consciousness in which preconscious processing e.g. of sensory information can occur in specific brain areas, which then reaches the conscious level only when these enter into coherent global neuronal activity, integrating the processing.

To discover what advantage subjective consciousness has over purely computational processing, we need to examine the survival situations that are pivotal to organisms in the open environment and the sorts of computational dilemmas involved in decision-making processes on which survival depends.

Many open environment problems of survival are computationally intractable and would leave a digital antelope stranded at the crossroads until pounced upon by a predator, because they involve a number of factors, whose computation increases super-exponentially. Open environment problems are intractable both because they fall into this broad class and also because they are prone to irresolvable instabilities, which defy a stable probabilistic outcome. Suppose a gazelle is trying to get to the waterhole along various paths. On a probability basis it is bound to choose the path, which, from its past experience, it perceives to be the least likely to have a predator, i.e. the safest. But the predator is likewise going to make a probabilistic calculation to choose the path that the prey is most likely to be on given these factors i.e. the same one. Ultimately this is an unstable problem that has no consistent computational solution.

There is a deeper issue in these types of situation. Probabilistic calculations, both in the real world and in quantum mechanics, require the context to be repeated to build up a statistical distribution. But real life problems are plagued by the fact that the context is endlessly being changed by the decision-making processes of the active players in the survival game. Finally, in many real life situations, there is not one optimal outcome but a whole series of possible choices, any or all of which could lead either to death, or survival and reproduction.

Key to the role of consciousness is that survival is often a matter of split-second reaction to foreboding, just in advance of a strike. The critical point is that consciousness is providing something completely different from a computational algorithm, it is a form of real time anticipation of threats and survival that is sensitively dependent on environmental perturbation and attuned to be anticipatory in real time just sufficiently to jump out of the way and bolt for it and survive. Thus the key role of consciousness is to keep watch on the unfolding living environment, to be paranoid to hair-trigger sensitivity for any impending hint of a movement, or the signs, or sound of a pouncing predator - an integrated form of space-time anticipation.

It is this question, above all which consciousness evolved to resolve because the survival of the organism depends on it. This goes a good way to explaining why humans, despite having some 10^{11} neurons and 10^{15} synapses can manage only a digit span of around seven. We are superb at split-second integrated reactions but most of us are relatively lousy at numbers by comparison even with a pocket calculator, let alone a personal computer.

This immediacy is the basis of an innovative theory of consciousness. The Attention Schema theory suggests that consciousness arises as a solution to the environmental informational overload problem: Too much information constantly flows in to be fully processed, so nervous systems evolved increasingly sophisticated mechanisms for deeply processing a few selected signals at the expense of others. Consciousness is the ultimate result of this evolutionary sequence. The cortex gains its abstraction by constructing a constantly updated perspective that describes what covert attention is doing moment-by-moment and what its consequences are. This first evolved as a model of one's own covert attention, but once in place, it adapted to model the attentional states of others, to allow for social prediction. Not only could the brain attribute consciousness to itself, it began to attribute consciousness to others.

We understand other people by projecting ourselves onto them. But we also understand ourselves by considering the way others might see us. Thus the networks in the brain that allow us to

attribute consciousness to others overlap extensively with the networks that construct our own sense of consciousness. And this process can become hyper-tuned defensively. It's better to be safe than sorry. If the wind rustles the grass and you misinterpret it as a lion, no harm done. But if you fail to detect an actual lion, you are taken out of the gene pool. So paranoia is the name of the game and a key to the conscious condition. This doesn't solve the hard problem, but it does suggest a path into the centre of the cyclone. The question remains as to how the brain can anticipate reality in a universe full of chaos and uncertainty.

Fathoming the Inner Dimensions of Consciousness

In discovering the foundations of existence, understanding the inner dimensions of conscious experience forms a critical complement to the discovery of the natural universe. There is an urgent need in the cosmological discovery process for a full exploration of the diversity and depths of the conscious condition, a process that, in the scientific era, is lagging far behind understanding of the objective world, yet is completely central to the existential condition.

Subjective experience comes in a spectrum of conscious states that extend far beyond our everyday experiences of the world around us and the immediate processes of memory and reflection about our past and future waking existence. They include meditative and contemplative states, common to both Eastern and Western spiritual traditions, utilizing complex forms of visualization, one-pointedness and emptying the mind of the internal dialogue that manifests in the default circuit activation of the brain as we rehearse situations we may face in real life, also encompassing forms of sensory deprivation and trance states induced by shamanic practices of diverse cultures. These mental states show distinct patterns of coherent activation when explored using EEG and MEG. There is also a spectrum of conscious states associated with sleep, from daydreaming reverie, through deep sleep to the paradoxical states of REM (rapid eye movement) dreaming sleep, and lucid dreaming, to OBE ('out of body') experiences sometimes associated with semi-consciousness states or sleep paralysis. Going further, they include hallucinatory, psychotic and delirious experiences and the NDEs (near death experiences) of people in major physical existential survival crises, from heart attacks, to traffic accidents.

Finally, they include psychedelic experiences, both using synthetic drugs like LSD and natural psychedelic species, ranging from sacred mushrooms to peyote and ayahuasca, all of which have been used for millennia as ceremonial sacraments by traditional cultures to understand the inner nature of existence. Alongside dreaming states, these induce some of the most profound changes in consciousness known including kaleidoscopic visions, eo death and extra-corporeal experiences. One should also include the dissociative experiences associated with consciousness-altering agents such as ketamine, salvia and ibogaine. Cannabis has likewise been used as a sacred consciousness-altering herb, from the Ganga of the Shiva Sadhus to the Rastafarians of Jamaica.

The journey of inner conscious exploration that has always been integral to the Eastern meditative tradition, is also central to shamanic traditions of diverse ethnic cultures who have preserved a spiritual relationship with natural forces as integral to their cosmology of existence.

Meditative and contemplative traditions tend to stress ordered states of mind, requiring mental control and thoughts and actions defined by the religious doctrines and beliefs of the tradition. This tends to restrict the domain of inquiry to those conscious states that reinforce the tenets of the tradition, rather than the free pursuit of knowledge and wisdom. There is thus a need to foster a full investigation of the inner and outer limits of conscious experience, in the same free spirit of inquiry that is the hallmark of scientific discovery and is the central principle guiding the vision quest.

Psychedelic and dissociative agents provide unique opportunities for exploration of deep states of consciousness that are confounding to our every day notions of the conscious condition and introduce completely new insights as to what consciousness is. They may provide the best clues we have to the ultimate question of what the actual relationship is between brain activity and conscious experience in the "hard problem".

The psychedelics have been subjected to a completely counter-productive cultural, legal, and criminal repression by Western governments, that has deep parallels to the witch-hunts and inquisition of the middle-ages, in which alternative beliefs and practices were seen as an existential threat to Christianity. There is an immense contradiction, that in the scientific age, Western governments, despite knowing that psychedelic agents have been used traditionally for millennia as visionary sacraments, acted to taboo them out of a similar fear they posed an existential threat that could precipitate a breakdown in the fabric of our dependence on domestic consumer society, and so classified them as schedule one prohibited substances under pain of extreme criminal penalties for possession or supply.

I have pursued experience of the Eastern meditative traditions at their roots as well as experience of psychedelic shamanism at its sources, from the peyote ceremonies of the Native American Church, through the use of sacred mushroom species to partaking in ayahuasca ceremonies in the villages of Amazonian Peru. In my view the psychedelic path has significant advantages over traditional meditative traditions, because it is an inner journey of discovery, which is free of doctrinal assumptions and is the most direct route to a mind-expanding investigation of the foundations of consciousness available. Its effects on consciousness are both profound and provocative to the core quest to discover the inner nature of subjective experience in understanding the meaning of existence.

They also have a potentially unique relationship with our sappy neurotransmitter-saturated brain that appears to be modulating the very brain processes through which subjective consciousness is generated. Psychedelics are super-agonists of serotonin 5HT2a receptors, which appear to cause a confirmation shift which may activate associated metabotropic glutamate mGluR2 receptors, initiating a cascade of modulations to brain activity in which internal brain processes, including fractal excitations evoked by the substances, allow aspects of unconscious or sub-conscious processing to reach the conscious level.

Studies of dreaming states are also highly provocative to the discovery quest of subjective consciousness. The role of REM dreaming sleep still remains enigmatic. Although it has been associated with forms of memory consolidation and reprogramming, the amounts of REM and deep sleep in diverse mammals species remain enigmatic and highly varied. Dreams evoke

existential situations, which challenge our ideas of how the existential universe is composed. Like deep psychedelic experiences, they include paradoxical states ,which it can be difficult or impossible to rationalize afterwards.

Some people also report prescient dreams which appear to become realized afterwards, leading to the possibility that the dream state may be a key to understating how conscious anticipation relates to time and space. They are also part of the continuum, in the dreamtime, of a collective, or empathic, consciousness between widely separated individuals who may be closely related or intimate partners.

The key to exploring the subjective condition more deeply may be that rather than seeking verification from others, we can each discover for ourselves in the first person the deeper nature of our conscious existence and only then come together to compare notes and establish a cultural consensus of what these states contain and imply. These are all questions which take us to the boundary of where verification and proof become contradictory to the subjective nature of the realm being explored, just as we have seen with the escalating forms of indeterminacy in the quantum universe, leading to the potential roots of both enigmas.

Unfolding the Multiverse

So where does this journey take us in terms of how conscious experience links back to changes in the world around us that make the changes in history we associate with meaning and purpose? What is the actual relationship between consciousness observing and subjectively acting on the physical world and changes in the world itself?

We have noted that the interactive cosmological process set off by the symmetry-breaking of the forces of nature culminates in molecular matter where all the forces gain expression in order of their interaction strengths, and that this process doesn't stop at individual bonds, because weaker H-bonds, polar and non-polar interactions, and van der Waal forces act cooperatively to make molecules into fractal structures leading to molecules such as proteins and nucleic acids with complex tertiary structures, cellular organelles, cells, tissues, organs and organisms, with the ultimate interactive culmination being the conscious brain. The ultimate seat of consciousness in the universe thus lies in the biota and nowhere else. The buck thus stops with us. There is no other place, from the gravitational core of black holes through the nuclear furnaces of stars to the cold outer reaches of galactic dust clouds that interactive complexity reaches its ultimate culmination. Thus we can be relatively certain that consciousness lies pivotally in the biota of the universe and that any pretensions to a conscious divinity in the heavens are a delusion just as a heaven in the clouds populated by winged angels are fantasies. Without being in any way anthropocentric, we can thus realize that the conscious brain is the ultimate interactive expression of the forces of nature which broke symmetry in the big-bang – paradise on the cosmic equator becomes our conscious condition and our living responsibility to fulfill in protecting the living diversity of the planet, in the closing circle of the biosphere, for the conscious generations to unfold into the living future.

So we finally trace our journey back to discovering how intentional will may be able to alter the course of physical history, giving us the means to apply our conscious awareness to change the world and to sustain and replenish it for life to follow.

Two experimental studies supporting the observer having a critical role in collapse of the wave function include the delayed-choice quantum eraser. The quantum eraser is an arrangement of entangled particles where we can separate them in such a way as to make a quantum measurement, but can then subsequently re-unite them in such a way that the collapsed measurement is erased. In the delayed choice quantum eraser, this process occurs by an observer after the quants have traversed the apparatus.

The experiment uses a careful arrangement of detectors generating a particle pair which are simultaneously entangled with another pair whose paths are only detected later which then pass through a detector which cannot distinguish their paths, leading to a superposition. However the later detection of their entangled siblings in a manner which can also be subsequently erased shows that it is the observers later knowledge of the pair, not whether there was a detector at one of the slits that determines collapse.

A second experiment involves delayed-choice entanglement swapping. Here, entanglement can be produced after the entangled particles have been measured and may no longer exist. A third observer by making a choice of detector determines which arrangement two other observers experience of an entangled pair, shows decisively that a change induced by a third-party observer can alter the (earlier) observation of an entangled pair.

Thus a critical role of subjective consciousness may be that it is a way the universe can solve the super-abundance of quantum superposition probability multiverses where the cat is both alive and dead, to bring about a natural universe in which some things do happen and other things don't. Hence the title ‘unfolding the universe’ through consciousness collapsing the wave function because history is unfolded by consciousness collapsing the multiverse.

One of the most central experiences of our lives is that there is a line of actual history, in which each of us is embedded and in which we are able to change the world in ways that we consciously intend. However insignificant our lives, we are participating in bringing the world into actual being historically. This means that the passage of the generations is able, through making decisions about our lives and the circumstances around us, as well as ensuring our own survival is at the same time discovering ourselves more deeply as conscious beings, in reaching towards a state where the universe comes to consciously understand itself ever more deeply and completely.

The notion of the brain using entanglement provides a paradigm for resolving many of the contradictory situations that arise when classical causality is applied to anticipatory processes. A premonition being either a cause of a future event or caused by it leads to contradiction, which is resolved in the space-time hand-shaking of the entanglement shrouded in quantum uncertainty.

The process goes something like this: Memory systems are used to form a model of the quantum collapsed history already experienced, which is sequentially stored in the hippocampus and then

semantically re-encoded into the cortical feature envelope, so that it can be interrogated from any contingent perspective in future. The conscious cerebral cortex contains a dynamical system of entangled states, which together envelop a space-time region extending a limited distance into both the past and future - the quantum-delocalized present. The cortical envelope thus maintains a state of context-modulated sensitively-dependent dynamic excitation which generates our conscious sense of the present moment by encoding the immediate past and future together in a wave function type of representation entangled within discord in the globally coherent dynamic.

The quantum present would extend over the lifetime of the coherent excitations, incorporating quantum-encrypted information about the immediate past and future of the organism into the current state of subjective experience. The quantum present provides the loophole in classical causality that permits intentional will to be free enough to perturb unstable and hence formally unpredictable brain states and hence physical states in the world, through our behavior. The experiencing subject perceives they are making an autonomous decision. An external observer will simply see a brain process sensitively dependent on quantum uncertainty bifurcating into a defined but unpredictable outcome.

It may also be possible for the brain to encode entangled states in more permanent forms. Highly active brain states have been shown in fMRI studies to elicit changes in cerebral activation lasting over 24 hours. Long-term potentiation and memory processes are in principle permanent and may involve epigenetic changes.

The notion of the conscious mind acting on the body to induce actions and complex behavior has been described by founding brain researchers, from David Eccles to Roger Sperry, as an 'act of psychokinesis.' Eccles followed Karl Popper's triune notion of a three-aspect cosmos in which mental experiences and decisions, physical systems composed of quantum and molecular structures, and abstract knowledge, form three interacting components. Initially Sperry agreed with Popper and Eccles, like them, rejecting materialism and reductionism about the mind and brain. In 1966 he began referring to himself as a "mentalist."

Sperry's idea of emergent downward causal control gave the subjective experience of consciousness (regarded as an emergent property of brain activity) a causal role in the control of brain function. While this was still a causal deterministic model and did not involve quantum uncertainty, it did centrally involve mind as experienced by the observer acting on matter in the form of physical brain dynamics. Investigating split brains, Sperry found what he considered science-based examples of ideas, not just chemical events, running the show. From this he developed the idea that the conscious mind and the physical brain were really part of "a single unified system extending from sub-nuclear forces at the bottom up through ideas at the top. Mind and consciousness are put in the driver's seat, as it were: “They give the orders, and they push and haul around the physiology and the physical and chemical processes as much as or more than the latter processes direct them.”

What this meant to Sperry was that free will, and responsibility, were no illusion. "It is possible to see today, an objective, explanatory model of brain function that neither contradicts nor degrades but rather affirms age-old humanist values, ideals, and meaning in human endeavor" - the notion that we are autonomous conscious beings capable of exerting a mental control over

our own and other people's fates. We can see that quantum uncertainty and chaotic sensitive dependence do provide a loophole for mental decisions to induce physical outcomes in the form of a bifurcation of an unstable brain state, which from the subjective point of view, is perceived to be the conscious experiencer coming to a decision under salient circumstances and choosing a course of action, which is then played out in brain function, and ultimately physical behavior.

A theory which is in effect a description of how the entanglement within the cosmic wave function might contribute to a fundamental form of free-will has been proposed by Scott Aaronson, who advocates the unpredictability description of free-will and uses it to develop a description of the universe explaining how the early universe may have given rise to unpredictable degrees of freedom which could open another quantum basis for free-will:

I advocate replacing the question of whether humans have free will, by the question of how accurately their choices can be predicted, in principle, by external agents compatible with the laws of physics.

He cites a form of unpredictability, which is more fundamental than mere statistical uncertainty, which he calls "Knightian freedom" after the economist Frank Knight, who wrote about uncertainty that can't be quantified with probabilities. The presence of such "freebits" with quantum-mechanical degrees of freedom preventing their cloning makes predicting certain future events - possibly including some human decisions - physically impossible, even probabilistically and even with arbitrarily advanced future technology. Our ignorance about the freebits would ultimately need to be traceable back to ignorance about the microstate of the early universe. Thus it's possible that humans will never become as predictable as digital computers, because of chaotic amplification of unknowable microscopic events.

Another cosmological description by Martin Green involves a hidden "Bare World" which he sees as the ultimate reality. The Bare World precedes all ordinary notions of the "Real World" that people perceive and study in physics. The Real World emerges from Bare World as a description dressed up in Newtonian, Einsteinian or quantum clothing. Observers, matter, and time, all come into existence within Real World. None of these exist within pre-physical Bare World. It is the "foundation for all that might ever be perceived in the universe". Since it contains much more information than Real World can ever accumulate, the laws of Real World do not constrain Bare World from introducing surprises. Human free will is therefore not constrained by the laws of physics - which simulate, and thus represent, aspects of emergent reality and apply only to Real World, not Bare World. Free will is a manifestation of the ability of conscious observers to influence the order in which previously unknown information about Bare World is consistently incorporated into their reality.

The Participatory Cosmos

We actively participate in our perceived reality. We control our bodies and the world we inhabit sufficiently to collectively investigate, formulate, record, and debate fundamental ideas regarding the world. We refine our models by acting on the world and sensing its response. And so the future is not strictly determined by the past. Humans can shape it. Within bounds - consistent

with our limited present knowledge, a prohibition on revising history, and severely limited scope and capacity - we are able to consciously influence our future.

Contrasting with the perception that we can act independently on the world is the obvious requirement for mutual consistency of the perceptions of all observers. Such consistency can be understood only if consciousness is actually a single, global phenomenon.

But just how far does the notion of mental causation go? If we can exert psychokinetic control over our arm movements to give the thumbs up to personal autonomy, or just to wave out to a friend, are there potentially other manifestations of this mental-physical interaction?

The lessons of entanglement as a possible central process in anticipating threats to survival extends readily to other such effects, but at the same time places potential limitations on their action. The key lesson of pair-splitting experiments is that, while entangled states are correlated, we can't use them to send locally-Einsteinian causal information between the entangled components. Thus we might well find ourselves having an ad-hoc evolutionary survival advantage through our conscious experience, while never being able to prove this in a set of causally verifiable experiments.

By the same token any other effects of mental causation on material phenomena would not be causally controllable because, although changes to the entanglement arising from a mental decision might ramify throughout the cosmic wave function, a change in one component, i.e. one's mental state, cannot necessarily be used to causally induce some other physical manifestation, because of the barrier to causal determinacy in the entanglement.

This could mean that our mental decisions might potentially have other effects, both on other people's mental experiences, and on diverse physical states in the universe across space-time, but not necessarily in a way we can determine or demonstrate conclusively. Thus notions of mental action, from telepathy and prescience to poltergeists and other 'super-natural' phenomena, would remain unverifiable anecdotal occurrences, which could not be replicated scientifically to produce an experimental verification of a causal effect.

This however does not mean that we should conclude that all such phenomena are ephemeral or non-existent and that such non-ordinary phenomena are just wishful fantasies. The evolutionary emergence of conscious sentience in organismic brains itself suggests that seemingly materialistic interactions among genetic and other molecules in simple living systems have somehow given rise to an emergent phenomenon having existential status even more immediate than the material phenomena from which it emerged, since we access the material world only through our conscious sensory experience.

I have had during my lifetime several riveting experiences of prescience, which generated my interest in the question of space, time and consciousness. In the 1920s, J W Dunne wrote a book "An Experiment with Time" outlining a double blind experiment where he found subjects dream records tallied as closely with future as with past events. Shortly after reading the book, I had a double nightmare that I was being stung and told my wife about it when she got up to feed our

infant daughter. About an hour later I was stung wide awake by a wasp that flew in the window she had opened after getting up.

A month before the Twin Towers were bought down in the 9-11 catastrophe, I composed a song, which contained words uncannily prophetic of the events "Can we fly so high we'll pass right to the other side and never fall in flames again" … Then I watched live in prescient horror as one of the two planes struck the tower and passed right through, coming out in a burst of flames on the other side. The lyrics include a lament for the dark canyons of lower Manhattan 'walking in the twilight, down in the valley of shadows … when will you comprehend the damage you have wrought in your indiscretion, can we undo the death trance you have set in motion?' The last line closed with 'Can we bear it all again?' It thus presciently echoed the Mayor of New York Rudi Giuliani's words on TV 'This will be more than any of us can bear".

Critics of such influences cite Bayes theorem on conditional probabilities, claiming people who see such effects are selectively picking the times when something appears prescient while ignoring the many other situations where nothing happens, which effectively reduce the probabilities to chance. My own experience contradicts this claim. Both the two examples above were verified in real time by reporting the dream and by publishing the lyrics and the latter is too climacteric an event to reduce to Bayes formula in anyone's mind. Nevertheless I don't 'believe' in prescience either, I just live in the unfolding reality and watch carefully, using whatever subtleties I can summon to further my own survival and understanding of the world.

Biogenesis likewise remains an enigma whose processes, from simple high-energy molecules such as HCN, through RNA and proteins, to the first organisms depends on emergent properties hidden in the non-linear interactions among the four forces of nature that occur at the quantum level. The same goes for many of the emergent properties in the evolutionary epoch. Evolution, while we conceive it as a molecular process of conservation and mutation of genes, is also threaded through the life and reproductive investments of participant organisms and in the context of higher animals in all the (conscious) decisions they make to the extent that what appears to be simply an adventitious molecular dance improbable in the extreme, a little like a monkey playing Beethoven's Moonlight Sonata, is an emergent manifestation of a universe coming to know itself ever more deeply in a redemption of the mechanistic fallacy that we are merely a meaningless collocation of atoms.

Likewise the evolution of emotional experience and expression in mammals has given rise to a new paradigm in sociobiology leading to human culture, which broadens the narrow genetic bases of genetic selfishness, moderated by kin and reciprocal altruism into a complex social interplay of nuanced extremes from love to hate, happiness to despair, intimate trust to jealousy and paranoia, contempt, anger, disgust, fear, excitement, intimacy, compassion, forgiveness and all the social interactions they provide, giving not just humans but mammals generally a more oceanic form of social participation. Despite the seven deadly sins and our reluctance to be ruled by our worldly desires, and our susceptibility to sometimes coercive moral eschatologies, it is precisely these emotional nuances that have made the world a place in which love and caring form a basis of resolution of our belonging in an often perilous world of tooth and claw, and it is the higher virtues of these emotions which people define as the guiding light of spiritual illumination.

Central in this resolution of our sense of meaning and purpose is preserving the diversity of life and the robustness of the biosphere, so that that the future generations of life and humanity can prosper and further expand the vistas of conscious experience. We have already reached a level of awareness where we can grasp the cosmological dilemma, but this is not the end of the road and we need above all to be compassionate to the life which follows our own demise and for the genetic diversity which has taken a third of the universe's own lifetime to manifest.

It may be that the very conscious decisions we make as individuals, not only through our survival and reproduction, nor just the examples they set for others and the knowledge they provide us all in the cultural epoch, but also through the unseen effects of the entanglement, extending far and wide through space-time, may be a key part of the way the universe as a whole comes to unfold its capacity for knowing. This may both aid the flowering of life in the universe over time and a deeper meaning in space-time that stands, even when the Earth, the human race and our future forebears, become extinguished in the nemesis of the solar system as the sun transforms into a red giant, or on a cosmological scale, as the universe itself enters the eventual big crunch, or heat death.

In this sense, what is achieved may ultimately be achieved eternally in space-time by having occurred at some phase in the life of the universe, rather than life gaining meaning only because it will lead to further exponentiating outcomes in future. In a fundamental sense, space-time is both eternal in the relativistic reality and temporal in the quantum events that unfold. Consciousness appears to be able to capture both these aspects and in its cosmological manifestation may be as eternal as the quantum universe is temporal.

(*The End*)