Unified Life Form Evolution Postulate

Premise:

We propose that qualitative properties transpire between matter and energy in the presence of the fundamental forces, such that energy is cumulated and transmuted in matter, resulting in the formation and propagation of material systems which increase their organizational complexity, environmental adaptation, divergence of form and reproductive capacity so as to enable this transmutation of energy with increasing efficiency and input-output capacity. This accounts for the origins and evolution of life on earth and potentially throughout the known universe.

Abstract:

We posit that the origin and evolution of life is necessitated by natural law. Energy throughput is maximized and entropy increases overall in nature (a.), which inevitably results in life forms that increase in complexity and intelligence over time. The origin of life is not a random occurrence in the universe. It is not an "accident of nature" as many suggest. On the contrary, the origin and evolution of life is mandated by the same natural laws that account for the evolutionary development of the universe itself.

In order to satisfy the second law of thermodynamics to an even greater measure, highly ordered products of nature ("exceptions" to the second law…) become favored because their end products are living systems which accelerate the rate of occurrence of the second law overall. Examples include the endergonic (b.) coupled-pair reactions that convert energy to the useable chemical form in order to produce the molecules needed for the cell structure of organisms, which ultimately lead to highly ordered living systems such as animals and humans, who release entropic bi-products into the universe at a higher rate than non-living substances.

The transition from "highly ordered" to "self-ordered" and further to "self-programming" is a continuation of the same process; driven by the second law (in the net-overall construct); but also driven by another concept; one that predicts that complex systems will behave in such a fashion as to facilitate an ever-increasing throughput of energy. Nature utilizes the "coupling" of these two processes; 1) Increased net-overall entropy AND 2) Increased net-overall energy throughput.

This net-overall increase of entropy "couples" with the property of net-overall increase of energy-throughput, leading ultimately to the emergence of self-programming living systems, which in turn accelerate the two coupled processes even further.

The findings of particle physics tend to support the notion of increasing energy-throughput as a property of nature. Authors such as Richard Feynman, Brian Greene, and Lisa Randall, who are leading theoretical physicists, have written extensive books (in layman's language) on numerous topics of modern physics, including several on particle physics. The principles and examples explained in these manuscripts are interpreted by the author of this writing, to support these conclusions.

Introduction

This paper makes the case for a unified evolution theory to integrate theory concerning the evolution of life with particle physics, thermodynamics and other physical sciences. Moreover, the case is made for the unification of evolution theory with that which concerns the initial origins of life itself. My purpose for writing the paper is to convince the scientific community that there is good reason to expect that such a unified theory can be established, so that scientists will engage in the undertaking. My purpose for establishing the theory is to enable such knowledge to further the well-being and beneficial evolution of humanity and other species of life that we share our habitats with.

Credit for the formulation of thought that leads to the ideas presented in this paper, must be given to Alfred J. Lotka (see footnote d). These thoughts are made evident in a paper authored by Lotka and presented on May 6th 1922(11). Of particular note is the concept that selection would be actionable on non-living constituents in a manner expressible in terms of "energy transformers". These transformers trigger the formation of higher complexity systems (of energy throughput) which inevitably emerge as living beings. This results from the selection process itself, which favors the increased throughput of energy through both non-living and living matter; after having triggered the formation of living matter to begin with, in ever more effective abeyance of the energy throughput selection criteria.

Currently held mainstream theory

The currently held view is that life on Earth started by random accidental combinations of chemistry in the early Earth. Proponents of this view point to the work of Charles Darwin as the inspiration for it. This seems more than a little curious when one looks at what Darwin wrote about the subject. A 2005 book entitled Endless Forms Most Beautiful by biologist and geneticist Sean B. Carroll contains the following quote from a letter Charles Darwin wrote to a botanist named J.D. Hooker. He was expressing regret for having inserted an appeasing reference to "the Creator" in the second edition of his famous volume entitled The Origin of Species. In this quoted passage of his letter to J.D. Hooker, Darwin expresses his actual thoughts on the subject of the origin of life itself. The passage reads:

"But I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process." [1]

It is the aim of this paper to make a bit less "wholly unknown" the process referred to by Charles Darwin as being responsible for the origin of life itself. A further aim is to demonstrate that the same process is involved in the ongoing evolution of life. This overarching process is what is meant by the phrase "unified evolution theory".

Not random or accidental

When we consider the physical insight into the workings of nature now afforded by the natural sciences, we can see that none of the actions that lead to living chemistry are random or accidental. Each and every one of the particle actions involved in the origin and evolution of living chemistry behave in a quantum mechanical way and are governed by properties of nature such as thermodynamics, physics, chemistry etc. The discovery of probability amplitudes in quantum mechanics does not mean that these events happen at random or by accident. They act in accordance with the operational principles of quantum mechanics. None of these actions are random or accidental and therefore neither are their results, which are the origin of life and the evolution of species.

The search for unification

Physicists are searching currently for a unified field theory which will link particle physics with the theories of gravity and general relativity. Albert Einstein devoted the finals years of his life and research to finding this unified theory. He did not find it conclusively but the work he started is being carried forth nowadays by the physics community. This is very much as it should be, given the evidence pointing to it coupled with a strong intuitive conviction that such a unified theory must exist.

There are two recent books written by Brian Greene, The Elegant Universe [2] and The Fabric of the Cosmos [3] that explain the various concepts and theories being developed for a unified field theory. The outlook is very hopeful that a viable theory will be established in the near future. This is evident from the scientific advances described in these two books along with the numbers of high caliber physicists who are pursuing it. Topics covered by Brian Greene in these volumes, such as string theory and extra dimensions will provide many joyous hours of late night sleeplessness while contemplating the possibilities and implications of the soon to be realized unified field theory. Other books that deal with these topics in excellent fashion are Lee Smolin's Loop Quantum Gravity [4] and Lisa Randall's Warped Passages [5].

Evolution of life is not excluded from unified theory

So, why wouldn't we expect to be able to establish a unified theory that incorporates particle physics, thermodynamics and other physical sciences with the origin and evolution of life? Equally questionable is the notion that we would forever attribute the processes leading to the initial origin of life to either a fantastic series of accidents or as Darwin phrased it "some wholly unknown process." It is a far more reasonable conviction to hold, that we should engage in this undertaking concerning a unified evolution theory with the same commitment and confidence as held by those pursuing a unified field theory.

Emotional issues impede progress

There are unfortunately a number of emotional issues that may serve to diminish or cloud this expectation. Some of these issues are religious and some are ideological. This paper will not devote any significant amount of attention on the specifics of these issues, as they are not

scientific in nature and frankly, seem rather banal to your humble author. However they are of great concern to the advancement of the science of evolution and therefore cannot be ignored. Biologist and author Sean B. Carroll, mentioned earlier in this paper, has dealt extensively with these issues. His analysis is very enlightening and provides an advantageous launching point for the concepts explored in this paper.

In his recent (and excellent) books concerning biological evolution, entitled Endless Forms Most Beautiful [1] and The Making of the Fittest [6], Sean B. Carroll has posed an insightful question that should be of concern to us all. The quandary he challenges us to fathom is why the inhabitants of the technically advanced USA have one of the lowest rates of acceptance of evolution theory as compared to the inhabitants of other countries.

Professor Carroll points to the contrast between the progress in DNA technology (criminal forensics, medical advances) and the increasingly large sector of the U.S. population that disregards the evidence for evolution afforded by that technology. DNA research clearly identifies the operational mechanics of evolution.

Denial of evolution in the face of this evidence is rather like trying to convince an automobile mechanic that there is no such thing as the internal combustion engine. The mechanic just looks at you in disbelief, trying to imagine how you could think the engine doesn't exist, when she spends most of her waking hours up to her elbows in the mechanics of it. Like evolution, the internal combustion engine simply does exist.

From the perspective of a thoughtful individual the fact of evolution is not in question, but rather perhaps the explanation being offered for it. We must respect and admire the enduring perseverance put forth by Charles Darwin and his colleagues. We recognize and embrace the discoveries revealed by that research concerning the evolution of species from common ancestors.

Unified evolution theory diverges from the current mainstream viewpoint

What is in question is the notion that life started from accidental occurrences and that the operational principle of evolution involves nothing more than random mutations, natural selection and time. There are many of us on the planet who find that explanation less than compelling. We sense intuitively that there is more to it than chemicals randomly bumping into each other until they accidentally form living systems which thereafter compete for selection on survival and reproductive prowess, even with great expanses of time (a few billion years in the Earth's case) for it to happen.

Common ground with the conventional scientific wisdom

This questioning however does not in any way detract from the fact, made all the more obvious by writings such as those by Sean B. Carroll, that all of the life on this planet evolves from common ancestors. In fact the Earth itself which fosters our life is evolving along with everything else in the universe from a tiny speck of symmetry that exploded around fourteen and

a half billion years ago. My deepest respect is extended in memory of Charles Darwin who mapped out the evolution of species as life emerges on the planet.

Moreover, the evidence in favor of natural selection is overwhelming. For an example of the convicting nature of this evidence, I recommend the example of the peppered moth featured in Sean Carroll's Endless Forms Most Beautiful [1]. This single example demonstrates quite succinctly (over a recent span of 150 years) that natural selection works as a means of evolving the DNA code of an animal. In fact, in this example Mr. Carroll goes on to cite extensive laboratory research that reveals which specific DNA constituents of the moth's genome are involved and how they operate.

So then, we have two of the three main ingredients of Darwin based evolutionary theory shown to be demonstrably operational. Natural selection was discussed just previously and time is time…even if one ponders in relativistic or even philosophical terms about what a "year" truly represents, it is widely accepted within the natural sciences that there have been around four and a half billion years gone by since the Earth was formed.

Divergence of unified theory from the conventional scientific wisdom

Although natural selection appears to be operational, the question remains as to what the selection criterion is. Classical Darwinism theorizes that the criterion is related to reproductive rate and survival of the "fittest" in a battle for food and all things related to staying alive and bearing offspring.

However the criterion is not actually reproductive survival fitness but rather the capacity for increasing rates of the transformation of energy through matter, as suggested by Alfred J. Lotka (11).

The remaining element of Darwinian evolutionary theory is that of random mutation. This element is where the question arises; are the mutations entirely random? Is this idea of random mutation complete in its explanation of the "infinitesimal changes" that are molded by natural selection over time to enable evolution?
On the surface, the preponderance of evidence would seem to say "yes", the mutations are entirely random.

Other examples of incompleteness

However there are other instances in the development of the natural sciences where overwhelming evidence is available to support a natural "law" that has subsequently been shown to be incomplete in its explanation of natural phenomena. Not wrong mind you, merely incomplete.

One such instance is Newton's Law of Gravity, for which the evidence is so convincing that this "law" is still used to calculate the trajectories of NASA space craft with remarkable precision. At the same time however, it has been shown by Albert Einstein with his General Theory of Relativity, that Newton's Law of Gravity is incomplete in its explanation. There is more than

Newton realized to the nature of gravity and its effects can be determined even more precisely using Einstein's equations for relativity from the general theory.

Einstein gave us a more precise method to calculate the effects of gravity and a more comprehensive understanding of the underlying causes of those effects. However this does not mean that Newton was wrong, or that we would have any less respect for his tremendous accomplishments. A couple of books that explain these ideas in terms graciously worded for both the physicist and non-physicist alike are Einstein's Relativity; The Special and the General Theory [7], and Brian Greene's The Elegant Universe [2] and The Fabric of the Cosmos [3].

Higher completeness similarly needed for evolution theory

Getting back to the topic of evolution, the concept of random mutation is similarly incomplete as a comprehensive explanation for the raw ingredients of evolution, even though the evidence at face value would indicate it to be the primary working mechanism. After all, Newton's law of Gravity also works, very precisely. But it has been shown to be incomplete.

We must reconsider the remaining ingredient of evolutionary theory which must be present in order for life and new species to evolve. According to Darwin (and many current day followers), this third ingredient is random mutation. In the case of the origin of life, it goes beyond random mutation to the notion of random occurrence.

Such an occurrence would have to randomly bang together something far enough along in the structuring of living things to be acted upon by selection at the DNA level. It would stretch the imagination somewhat less to speculate that natural selection could act on non-living combinations of chemicals that serve as intermediate steps between scattered raw materials and life itself, as suggested by Lotka with his concept of energy transformers.

One could speculate further (as I do) that the selection would favor combinations of chemicals that are further and further along organizationally, on the way to becoming a "living" combination by applying the criterion of energy transformation in ever increasing amounts. However at this point we have gone far beyond the traditional notion of natural selection on random mutations. A process whereby inanimate elements and molecules evolve to form living systems, involves other principles altogether that would be pertinent not only to the origins of life, but to the evolution of life as well.

The path to higher completeness of evolution theory

We may begin our reconsideration of these principles with an excerpt from one of Richard Feynman's many thought provoking books on physics; QED (Quantum Electro Dynamics) [8]:

"It appears that all the 'particles' in Nature- quarks, gluons, neutrinos, and so forth- behave in this quantum mechanical way. So now, I present to you the three basic actions, from which all the phenomena of light and electrons arise.
ACTION #1: A photon goes from place to place.
ACTION #2: An electron goes from place to place.

ACTION #3: An electron emits or absorbs a photon.
Each of these actions has an amplitude- an arrow- that can be calculated according to certain rules."

Feynman goes on to say that these three actions are responsible for the entire field of chemistry. This would include biochemistry, which means that life-forming chemical reactions are not random; they follow quantum mechanical rules. Furthermore, the quantum rules operate in accordance with the entropy law (2nd law of thermodynamics). We know this because the 2nd law applies to the natural world which is comprised of the chemistry which is in turn governed by quantum mechanical rules.

Localized negative entropy and the 2nd law of thermodynamics

Under some circumstances however, occurrences of negative entropy are expedient to the over-arching imperative of entropy. This makes the occurrences favored by the laws of thermodynamics. For example mammals are highly ordered chemical structures made up of less highly ordered stuff. This requires processes indicating negative entropy, but their net impact is to increase the amount of entropy in the world. They give off heat produced by their food processing, respiration, defecation etc. Their net contribution is in the form of positive entropy, in abeyance of the second law of thermodynamics.

Neither random nor predetermined

Several authors write about the notion of seemingly random actions in nature. It is theorized that these random actions "accidentally" started the processes of living biochemistry, after which time and natural selection took over to evolve cells, plants, organisms and species. But these notions of "randomness" and "accidents of nature" seem to be a substitute for understanding what is happening. We have quantum laws and thermodynamic laws which govern events in nature, which must include the so-called "random" events.

The events are therefore not random; however that does not mean that the future of everything is already decided. The determining factors interact with and influence the probabilities of one another and the results are not predetermined. An example would be the human imagination which can interact with physical reality though the actions of the person doing the imagining. Yet while it is possible to influence the human imagination, it cannot be predetermined.

Continuing toward unification

So it would seem that life is the inevitable result of certain conditions where living biochemistry and its evolution is the most expedient path for events to follow in accordance with the laws of motion, quantum mechanics, chemistry and thermodynamics. The principle of minimal action is common to the path integrals and world-lines of the mechanics of these phenomena. In these analysis and calculations, "action" is expressed in units of Joule-Sec which is a unit of energy. Energy is expended in a "thrifty" way with regard to the path taken by the elements of nature in motion. (c)

Energy is carried along expediently, efficiently, through processes of nature that transfer energy such as an electron transfer chain (ETC). Just as with a hydroelectric generator in a power plant, the higher the efficiency of the process, the higher the energy throughput. Nature behaves in a way that maximizes energy throughput. And because it behaves in this way, it also emerges and evolves in this way, which therefore leads to living systems and beings who in turn throughput more and more energy, more and more efficiently. Nature is predisposed to behave in ways that promote, lead to, support and result in life.

We can look at multiple examples of things happening in nature that involve energy throughput. For example, what happens to an electron when it absorbs a photon? It leaps to a higher energy orbit with a wave function that is higher than the previous one by a full integer increment. So what then? In some cases the electron returns to its previous lower energy orbit and emits a photon. In other cases the electron retains the higher energy orbit, giving it potential chemical energy as we will look at shortly. Either way the energy is processed onward through the matter.

Stemming from these basic actions is an infinite number of physical processes that are anything but simple. What seems common to these processes is that energy goes in and then processes back out or further on, sometimes in the same form and sometimes in a different form. This is predicted by the first law of thermodynamics, concerning conservation of energy.

Energy takes the expedient route

The energy involved in these processes does not stand still. The electron does not statically hoard the energy imparted to it by the photon it absorbs. It returns to its lowest energy state and emits the photon, or expends the resulting potential chemical energy through a further processing step. The tendency is for the energy to be processed through the matter as expediently as possible.

This is what we would expect given that this energy throughput takes place as a result of the three basic quantum actions. Feynman and others have shown that these actions have the highest probability of taking the most expedient path. So we can say that nature is predisposed to maximize energy throughput in matter.

An example found in plant-life

Let us take something very basic as an example, like photosynthesis. When photons are simultaneously absorbed by electrons in the P680and P700 variants of chlorophyll molecules, the photon's energy is transferred from the photon to the matter (the electrons) where it re-manifests as chemical energy in the form of energy excited electrons. In this case the photons are not re-emitted straight away from the electrons. Does this mean the throughput of the energy imparted by the photons stops? No.

The energy throughput continues to be sure as the energy excited electrons are passed along an electron transfer chain (ETC) by way of molecular chemistry, from the P680 to the P700 chlorophyll molecule. On its way, the energy carried by the electrons is transferred into a proton gradient, as the energy causes protons to move across a thylakoid membrane. The energy now

stored in the proton gradient reacts with ATP Synthase (ADP) to produce the energy carrier ATP. The carrier does just what the term implies, as the throughput of energy goes further.

Other energy excited electrons (yielded from the initial photon absorption) follow the ETC through chemical processes that reduce NADP+ to the energy carrier NADPH. Oxygen is externally released from these reactions as a bi-product. All of the above occurs in the part of the overall photosynthesis process known as "Photosystem II or (Light Reactions)" which take place with the P680 chlorophyll molecules.

The throughput marches ever onward as the energy carriers (ATP and NADPH) are then used with the P700 chlorophyll molecules in the part of the overall process known as "Photosystem I or (Dark Reactions)". In these "Calvin-Benson Cycle" reactions the RuBisCO enzyme uses ATP and NADPH to fix carbon from CO2 (carbon dioxide) with hydrogen from H2O (water) to produce 3-carbon sugar phosphates (carbohydrates). The resulting glucose forms starch used in the plant's cell walls or combines with fructose to produce sucrose which allows for stable sugar storage. Either way the energy throughput keeps right on going as the plant grows and takes its place in the food chain. The RuBisCO enzyme (needed to carry on the carbon fixing) is released to be used over and over.

Follow the energy

In case you got lost in the sequence discussed here (as did I for several hours) you can get back on track by taking the advice always heard in detective mysteries. In place of the phrase "follow the money" substitute "follow the energy". You'll get there every time because the whole process is an energy throughput factory. There are even chemical reactions that take place in photosynthesis that perform a regulatory function within the process to prevent it from degrading into reverse processing mode (respiration).

The respiration cycle is carried out productively by other living organisms that carry forward nature's mandate of energy throughput. By photosynthesis, plants grow and release oxygen for animals and people to breathe, who in turn eat the plants (and/or each other) in order to grow and multiply. There is a tremendous amount of energy throughput happening here, as nature is predisposed to generate and foster.

In fact all of our life forms here on Earth, including viruses, bacteria, plants, sea life, insects, land animals and humans alike, utilize the throughput of energy into useable chemical energy (in the form of ATP) by similar adaptations of this ETC chemistry. For many life forms such as plants the activation energy is supplied by sunlight in the form of photons, which are converted into chemical energy and processed through ETC and proton gradient chemistry to produce usable nourishment. For others such as animals, the activation energy is already in chemical form and is then throughput by ETC/proton gradient chemistry into usable form. There are even forms of bacteria that can feed on rocks, below the earth's surface using this same process. Earth's biosphere is an energy throughput dynamo, a rotating, orbiting factory that never sleeps.

Chemistry drives the throughput in accordance with nature

If you treat yourself to a perusal of articles dealing with the chemical mechanics of these processes, you will find it very rewarding and revealing of some extraordinary properties. The explanations start out simple enough with electrons populating atomic orbitals according to straightforward rules. Before long however we are reading through rather complex explanations describing various means of "trickery" employed by these electrons and their orbitals, in order to configure themselves into forms that are best suited for reacting and bonding with other atoms to form molecules. The resulting molecules then utilize similar trickery to combine into more and more complex molecules of the sort needed to carry on the life sustaining processes related to ETC/proton gradients and ATP production, the vehicles for energy throughput.

These "tricks" or "behaviors" include little dandies like creating an additional P-orbital and then promoting one of a pair of S-orbital electrons into it. This is contrary to the otherwise normal inclination of an atom to fill its S orbital (with the orbital-maximum of 2 electrons) and then lodging any additional electrons in higher P-orbitals.

The resulting molecules are known to play another little game they call "conjugating" orbitals, which is a dazzling sleight of hand reminiscent of a juggler on a unicycle. The magic continues as the atoms and molecules perform acts of bonding between themselves that rival the acrobatics of flying trapeze artists.

So why do atoms and molecules carry on this way, with their clever, "quicker than the eye" shenanigans? By doing so they configure their orbitals and electrons just right for combining with one another to form molecules of even higher complexity as described above. It is very much as if the energy and matter are compelled to evolve into more and more complex structures that throughput more and more energy as they take on the forms necessary to produce and sustain life.

This chemistry of energy throughput is transpired along the most expedient path integrals in abeyance of quantum mechanics and the laws of thermodynamics. The energy is not lost or destroyed, which is in accordance with the 1st law of thermodynamics. Even though plants (for example) are highly ordered systems compared to their constituents, they are part of an ecosystem that increases entropy overall in accordance with the 2nd law of thermodynamics.

Further examples from plant-life

Let's think in broad terms about how the plants increase entropy overall. They take in photons, water and CO2 and give off oxygen and water. How does that increase entropy overall? Well, animals eat the plants and give off heat which dissipates into the world. OK so what if there were no animals? Well there were no animals but they evolved because that's how the ecosystem then achieved abeyance with the 2nd law of thermodynamics. Here is another way; the plants die and are compressed deep in the earth to form fossil fuel, which humans pump out and burn, releasing heat into the world. What if there were no humans? Well there were no humans but they evolved because again, that's how the ecosystem reaches maximum abeyance with the 2nd law.

Life origin scenario from Earth's ancient seas

Let us consider the case, as it existed over four billion years ago, when super-heated seawater was released from thermal vents on the ocean floor. Dissolved minerals in the seawater such as iron and sulfur came together to form rock chimneys around the thermal vents. The iron and sulfur formed iron pyrite crystals with highly ordered surface structures where complex carbon based molecules in the ocean could hang out and hook up after spewing forth with the other materials from the vents [9].

According to paleobiologists, these complex carbon-rich molecules are the building blocks of life. So the stage is set but we are uncertain as to means, which choreographed these constituents into living cells. One possibility is that it happened by random chance, which is the theory held by many.

A far more plausible explanation is that the natural laws of the universe acted upon that material in a way that left no other alternative except the formation of living cells, with random chance having nothing to do with it!

Thermodynamics drive the process of life formation

The first and second laws of thermodynamics dealing with the conservation of energy and entropy respectively provide guidance and entryway into the means for the formation of life. These laws give us oversight of processes that facilitate (and necessitate) the flow of energy through systems.

Let us consider a thermodynamic system made up of increasingly complex carbon based molecules loitering about the surfaces of iron pyrite crystals contained by rock chimneys surrounding thermal vents on the ocean floor. The energy source for our system is heat coming from the super-heated water being released from the thermal vents. Heat enters the system, which is thermally connected to its surroundings, thus forming an open system where heat, work and matter can cross the boundary.

The second law relates only to the entropy generated in an isolated system, and therefore cannot apply directly to our non-isolated open system. The second law however does apply to the closed system formed by our open system and its ocean floor surroundings. This larger resulting closed system can be thermodynamically characterized as a conjugate pairing of isobaric (constant pressure) and isothermal (constant temperature) processes, as this is the relative condition in proximity to the ocean floor.

According to the principles of thermodynamics, this condition is particularly well suited for thermo-chemical reactions that undergo changes in chemical potential, which is a thermodynamic state function known as Gibbs free energy. According to the second law, spontaneous chemical reactions are only possible if the reaction is “favored”, meaning that the change in the Gibbs free energy (delta G) is negative, and entropy is increased in the surroundings.

Keeping this in mind, we now look at what types of reactions were likely to have been occurring in our system along the rock chimneys. Our system contains an abundance of complex carbon

based molecules, the building blocks for long amino acid chains, which fold up in a highly exacting fashion to configure the complex protein molecules needed for life. Other long chains comprised of amino acid base pairs are similarly configured into DNA molecules, also necessary for life.

In accordance with thermodynamic principles, many of the critical state functions involved in these reactions are not spontaneous. That is to say they are endergonic reactions, which means that the change in the Gibbs free energy (delta G) associated with these thermodynamic state functions is positive and thus not favored by the second law.

Thermodynamic coupled-pair reactions drive the energy throughput process to higher complexity

Such endergonic reactions, which produce the molecules needed for the cell structure of organisms, require that some means exist for delivering energy to them in a molecular form that is chemically useable. The means are provided by other reactions that produce an output of energy, called exergonic reactions that become chemically coupled to the energy-needy endergonic reactions. Exergonic reactions are thermodynamic state functions that have a negative change in delta G and are therefore favored by the second law.

The overall output of these coupled-pair-reactions is the complex molecules that form the proteins and DNA material needed for life. These coupled reactions become favored by the second law because the negative delta G of the exergonic reactions is greater than the positive delta G of the endergonic reactions they are coupled with.

The resulting overall negative delta G means that the system needs an energy source, because the coupled pair reactions release energy as an output. But it's not like the reactions come into being and then go looking around for an energy source. It's more like the other way around where there is an energy source which collects in a given system environment, creating a precondition for life. If the necessary potential ingredients are present as well, then everything needed for living things to develop is present.

Principles behind the coupling process drive higher orders of evolutionary development

At this point we want to understand what natural laws could necessitate that this coupling occurs, because otherwise the materials of life would not be formed. The second law itself predisposes the coupling process to take place, due to the buildup of energy within the system that tends to find and follow any available path to be throughput into the surroundings. Without the coupling process the energy going into our system does not have its optimal means for throughput into the surroundings. This results in a low entropy condition, which resists the statutes of the second law. Nature will not tolerate pockets of low entropy phenomena and thus the second law now infuses energy-flow potential into our system.

Now we seek the mechanism that locks the various reactions into place to form the life generating coupled pairs. For the possibility of such a mechanism we can take our cue from the current holder of Isaac Newton's chair as Lucasion Professor of Mathematics at the University of Cambridge, Stephen Hawking.

Professor Hawking and his colleagues are working with a principle of quantum theory introduced by the famous physicist Richard Feynman (now deceased) known as "sum over histories" to predict and explain how quantum particles behave [10]. Their work broadens the interpretation and application of Feynman's theory, demonstrating the possibility that (sum over histories) may also explain how the universe operates at it origin and destination points and at all times in between. They envision a finite universe, yet without boundary conditions (without beginning or end) that would otherwise result in mysterious singularities where the known laws of physics break down.

The operational mechanisms of the theory are somewhat difficult to grasp for the non-physicist (like the author for instance) but in the hands of those capable of working with the complex calculations, the theory provides probabilities and predictions that take into account every possible space time that could ever exist relative to the universe, its natural laws, and results thereof including intelligent life forms.

If we apply this principle to our thermodynamic system of potentially coupled, life producing, thermo-chemical reactions, the entropy powered coupling function has a viable trigger. We now have an intolerably negentropic system that is resiliently biased by the power of the second law, and "coupled" with it, the operational mechanism of the theory of "sum over histories".

This facilitates a high probability that due to the power of the second law, the irresistible urge of universal entropy combined with the sum-over-histories spectrum of possible outcomes, will "select" the optimum condition for the increased throughput of energy to occur. This optimum condition consists of the coupled pair reactions in our thermodynamic system, which is now catapulted into high-gear action, producing a tremendous abundance of complex life producing molecules.

This overall process, driven by the "coupling" of second law entropy with quantum mechanical sum over histories, continually repeats itself, acting on the newly produced complex proteins and nucleic acids to heighten their order and complexity, thus advancing and optimizing their biochemical processing capacities. As the process builds upon itself to produce higher and higher levels of organization, capable of ever increasing energy throughput, the inevitable result is the formation of living cells.

Unifying quantum mechanical principles with universal-scale evolution and origins of life

When second law entropy is given the mechanism to "have its way" with the building blocks of life in a thermodynamic system, the sum over histories driven outcome is life itself, because that most efficiently satisfies the relentless drive to achieve the optimal flow of energy through the system.

Consider the following quote from the tenth anniversary edition of Professor Hawking's book entitled "A Brief History of Time".

"Each history in the sum over histories will describe not only the space-time but everything in it as well, including any complicated organisms like human beings who can observe the history of the universe" [10].

Conclusion

Because the sum-over-histories quantum mechanical principle describes everything including human beings, we can now apply the second law/sum-over-histories coupling to explain every evolutionary step from single cell organisms, to our current evolutionary state of the human race. At each successive juncture, the next species or advancement of an existing species is the inevitable sum over histories option that best accommodates the entropy power of the second law and the energy throughput imperative. Therefore these evolutionary steps must occur!

Afterward; thoughts on benefits and applications

Your humble author is hoping that by now you are thinking about how a unified evolution theory should be structured, even if it involves changes to, or outright abandonment of the ideas presented above. The point after all is not to be deemed "right" or for anyone else to be deemed "wrong", but rather for the best theory to be found. This is because only the best theory can be maximally beneficial to humanity.

The potential benefits of such a theoretical understanding are not difficult to imagine. Once science masters a unified theory we can engineer and design evolution to the advantage of humanity and to the disadvantage of the pathogens that threaten life on the planet. Diseases that we cannot find treatments for can be subjected to rapid reverse evolution until they are extinct. Human beings along with companion life forms can be augmented with "fast forward" evolution that equips us with immunity to the pathogens.

The immune system capabilities that are achievable through such self deterministic evolution will also include the ability to reverse the rogue propagation of cancerous cell growth within the body. Furthermore it will be possible to greatly accelerate the healing processes of the immune system to rapidly recover from any number of common and life threatening injuries that befall people from disease, malnutrition, poor health care, accidents and criminal acts.

Another crucial benefit is the ability to target specific features for particular purposes, by means of fast forward evolution. For example we may very well have to deal with another ice age and if so, the ability to fast forward our evolution to equip us with antifreeze in our bloodstream could be critical to our survival as a species. If this sounds farfetched as it sounded to me at first, consider the species of Antarctic and Arctic fish that already possess this feature along with several other features that make them well suited for extremely cold water temperatures. You can read all about these species of fish and the evolutionary steps that gave them this physiology in The Making of the Fittest by Sean B. Carroll [6].

An ice age is but one example of changes in climatic and environmental conditions that will necessitate rapid targeted evolutionary advancement within our species. Ozone depletion and irreversible pollution may also be conditions that we must adapt to in the event that environmental protections and improvements are insufficient to maintain inhabitable conditions on the planet. This is a grim prospect that will hopefully never occur but it would be unrealistic to disregard the possibility.

On a more optimistic note, space travel will be an outstanding area to apply rapid targeted evolution, particularly when we attain the ability to conduct it intra-generationally. As part of their training and development for space missions, astronauts will be rapidly evolved to adapt their physiology for extended space travel and to accommodate the atmospheres of the planets they will visit or colonize, in addition to the Earth's atmosphere. Rapid targeted evolution at the intra-generational level will also in invaluable for the medical applications discussed above. Cancer patients for example will be rapidly evolved to equip themselves with immune system capabilities that will reverse cancerous cell growth expeditiously enough to cure their condition and live long healthy lives.

Indeed as demonstrated by the work of Charles Darwin and numerous colleagues past and present, and most recently by pertinent sections of Sean B. Carroll's Endless Forms Most Beautiful [1] and The Making of the Fittest [6], the occurrence of dramatic climatic and environmental change is the prime "selector" for evolutionary advancements within evolving species. The achievement of a unified comprehension of evolutionary theory and the self deterministic evolution it will afford us represents the highest form of positive mutation possible for our species. Certainly there is nothing random or accidental about such deliberate and maximally advanced positive mutations. The scientific process that will deliver the vehicle to facilitate these beneficial mutations demonstrates better than any other evidence that there are processes at work which go far beyond random chance and accidental happenstance.

Perhaps the most useful of the benefits to be afforded by the self-determining potential of a unified evolutionary theory will be the enhancing of our brain's capabilities. The possibilities in this area are truly astounding and challenge even our imagination to conceive of the potential advances. The establishment of a comprehensive unified evolution theory coupled with a viable engineering structure with which to apply it to our lives will have tremendous and enduring benefits to humanity. The few examples cited above of possible advantages to this technology barely begin to describe the future potential. In terms of the evolution of the human species, certainly the best is yet to come!

[1] Sean B. Carroll, Endless Forms Most Beautiful, 2005, 9, 226-227, 11, 292-297

[2] Brian Greene, The Elegant Universe, 1999

[3] Brian Greene, The Fabric of the Cosmos, 2004

[4] Lee Smolin, Three Roads to Quantum Gravity, 2002

[5] Lisa Randall, Warped Passages, 2006

[6] Sean B. Carroll, The Making of the Fittest, 2006, 1, 24-27

[7] Albert Einstein, Relativity; The Special and the General Theory, 1916

[8] Richard Feynman, QED (Quantum Electro Dynamics), 1985, 3, 85-86

[9] Neil deGrasse Tyson and Donald Goldsmith, Origins, 2004, 15, 245-247

[10] Stephen Hawking, A Brief History of Time, 2005, 8, 137-146

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[11] Natural Selection as a Physical Principle
By Alfred J. Lotka
School of Hygiene and Public Health, Johns Hopkins University
Communicated May 6, 1922

Footnotes:

(a.) Energy (and/or "Energy Throughput") is not intended as a common term with Entropy; obviously they are completely separate phenomena. It is widely accepted that entropy increases in nature as a general rule (2^{nd} law of thermodynamics). This paper advances the notion that "Energy Throughput" increases in nature as a general rule as well.

(b.) In chemical thermodynamics, an **endergonic reaction** (also called a **non-spontaneous reaction** or an **unfavorable reaction**) is a chemical reaction in which the standard change in free energy is positive, and energy is absorbed. In layman's terms the total amount of energy is a loss (it takes more energy to start the reaction than what you get out of it) so the total energy is a negative net result. Under constant temperature and constant pressure conditions, this means that the change in the standard Gibbs free energy would be positive

$$\Delta G^\circ > 0$$

(For an overall gain in the total energy net result, refer to Exergonic Reaction)

(c) Credit for the formulation of the **principle of least action** is commonly given to Pierre Louis Maupertuis, who felt that "Nature is thrifty in all its actions", and applied the principle broadly:

> "The laws of movement and of rest deduced from this principle being precisely the same as those observed in nature, we can admire the application of it to all phenomena. The movement of animals, the vegetative growth of plants ... are only its consequences; and the spectacle of the universe becomes so much the grander, so much more beautiful, the worthier of its Author, when one knows that a small number of laws, most wisely established, suffice for all"

movements.

—*Pierre Louis Maupertuis*[15]

(d) Credit for the formulation of thought that leads to the ideas presented in this paper, must be given to Alfred J. Lotka. These thoughts are made evident in a paper an authored by Lotka and presented on May 6th 1922(11). Of particular note is the concept that selection would be actionable on non-living constituents in a manner expressible in terms of "energy transformers". These transformers trigger the formation of higher complexity systems (of energy throughput) which inevitably emerge as living beings. This results from the selection process itself, which favors the increased throughput of energy through both non-living and living matter; after having triggered the formation of living matter to begin with, in ever more effective abeyance of the energy throughput selection criteria.