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Evolution of Species

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Evolution of Species

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Abstract

The mechanism of natural selection has played a major role in imparting directionality to the process of evolution of species but there should be a driving force for a process physical or biological to proceed. Self programmability of genome provides the necessary drive to the process of evolution of species.

Keywords : Genomic consciousness, self programmability, genopsych.

The Origin of Life

The events that lead to the origin^{1,2} of life are explained as follows: (i) Formation of primary amino acids from methane, ammonia, water vapor and hydrogen past on electrical discharge. (ii) Formation of large protein molecules and inter linking of these molecules with order. (iii) Appearance of very large molecules that form and disintegrate due to dissolving forces which still take their original shapes under favorable conditions. (iv) Living organisms need continuous influx and outflow of matter and energy, without which it dies and rapidly disintegrates. (v) No new physical laws are required to explain the building of molecular order that characterizes living system. It is important to note that the statement five needs scrutiny.

Darwinian evolution of species is explained through³ the mechanism of natural selection which involved (i) production of variant types by the species and (ii) the survival of the fittest among the variants. The fittest is selected by the environment while the environment has no role in the production of the variant types which means that production of variant types is the inherent property of the species. The process of evolution is not predetermined but has directionality. Thus the production of variant types by the species is self directed/driven and is modulated by the

environment. A species is distinguished from the other by the non random change in the morphological traits of the species. A hypothetical multi modal curve is shown in figure 1 that depicts the changes in the cranial volumes of the species from Anthropoid apes to the present day humans.

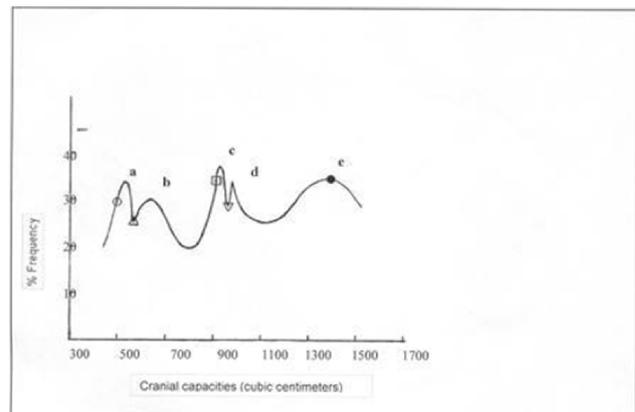


Fig. 1: Multimodal distribution (hypothetical) of cranial capacities of (a) Anthropoid apes (chimpanzee & gorilla) (b) Australopithecus (c) Java man (d) Peking man (e) Neanderthal and recent man (based on the available date of ranges)

Each mode in the figure-1, represents the variations in the cranial volumes of a species. The changes that are within each mode are random [no new information] that cause stabilizing selection and the changes that lead to the formation of the next mode are non random [creation of new information] leading to the directional selection that results into the evolution of a new species.

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The Genome

It is obvious that non random morphological changes in a newly evolved species should be preceded by corresponding non random changes in the genome. For example it is shown^{4,5} that gene complexes *bi thorax*, *BX-C* and *antennapedia*, *ANT-C* play a central role in programming the development of organism. Indeed the genome is non randomly structured. Let us look⁶⁻¹¹ at the organization of the genome. The genome of mammals and birds are reported to have a GC content varying from 30% to 60%. Further the genome may be classified into [putative] isochors [regions or fragments] with varying content of GC pairs. The isochors are non randomly arranged *ie* the genome is structured from the point of view of isochors. With stable [GC rich fragments] and unstable [AT rich or GC poor fragments] states the genome resembles an information processing device which can create³ new information that is a new genetic program. The notion that evolution is not influenced by the external environment and the production of variants by the species is self directed leads us to the idea that genome is self programmed in that there is no external agency that is responsible for the information in the genome. A system should be aware of itself if it is to be self programmable.

Genomic Consciousness

DNA molecules have³ adenine-thymine [AT] and guanine-cytosine [GC] nucleotide pairs fixed as sequences along the twisted double helix. G is bound [triple bond] more strongly to C than A to [double bond] T and hence we expect the presence of more GC pairs as favored by chemical thermodynamics which surprisingly is not the case. If GC and AT pairs are sequenced randomly then we expect GC and AT pairs to be at 50% each. This is also not the case. In fact the GC pair content in higher organism is in the range of 40% to 45%.

Volkenshtein observes³, "if it were for thermodynamics alone, the relative G-C content in DNA should have increased during evolution." In fact

having more A-T pairs in the genome is analogous to water flowing from bottom to top which cannot happen without a conscious effort.

Thus we are compelled to think that genome has some form of consciousness essential for self programming. A conscious human being develops from a single cell, the embryo and hence it is reasonable to assume that the native form of human consciousness exists in the genome of the human embryo.

Frederic Peters¹² describes consciousness as, I-ness, Now-ness and Here-ness. In his words: As the primary reference frame of active waking cognition, this recursive I-here-now processing generates a zone of subjective self-awareness in terms of which it feels like something to be oneself here and now. What Peters referring is the consciousness related to the brain in the neo cortex. Biological rhythms in an organism are due to gene clocks¹³ which are automatically aligned with the external planetary rhythms. The alignment of bio-rhythms with planetary rhythms suggests that the gene clocks in fact sense the external environment that is the now-ness and here-ness are sensed due to gene clocks and biorhythms and the I-ness of the brain in terms of the genome is i-ness.

We know that DNA molecules [in the cell environment] show^{1,2} three extraordinary properties [a] they repair themselves [b] they produce their own replicas [c] some times during replication they produce variant types. The primary instincts¹⁴ self preservation and procreation of living organism are analogous to the basic properties of DNA molecules *viz* self repairing and replication. The self programming property of genome termed as genopsych is also responsible for the self repairing and replicating properties of DNA molecules.

The basic questions

Despite enormous advances in science the basic question of biology "what is the difference between a living system and a physical system" remains unanswered or remained as conjectures. George Wald

described¹ living organism as an intricate machine. Hanawalt wrote², “The phenomenon of life may be traced to coordinated behaviour of the molecules within the cells. The cell is the self contained, self reproducing fundamental unit of life..... The molecules in the cells are guided by the same basic laws of chemistry and physics that apply through out the universe..... The mystery lies rather in the programmed coordination of the myriad of chemical reactions necessary for the metabolic activities of the cells”. Volkenshtein³ was aware of some thing other than chemical thermodynamics that works within the cells but did not explain further.

Few eminent scientists did attempt to deviate from the orthodox science sporadically. In his presidential address [1927] to the Indian science congress Bose talked¹⁵ of unity of life and similarities in the life processes of animals and plants. He talked of the part *internal stimulus of will* may play in the determination of sensation. McClintock [1978] is quoted to have [1] believed about the presence of *innate systems* that are able to restructure a genome and [2] spoken about¹⁶ *smart cells*. Recently [2003] Anthony Trewavas described¹⁷ some aspects of plant intelligence. Hemmerhoff and Penrose brought¹⁸ consciousness into scientific studies. Though these attempts are showing their impact, a qualitative change in the scientific thoughts to define biological laws of evolution is yet to arrive.

This author has been arguing¹⁹ for a model that depicts what brain [in the neo cortex] is to human body is as genome to the cell and what mind is to brain is as genopsych to the genome. Further that genome in the cell environment, [1] has native intelligence, [2] is self programmable and [3] the spring head of consciousness is the genomic consciousness which is native consciousness.

A self programmable system as a rule must be aware of itself, that is a self programmable system is conscious. Only living forms are self programmable and the process of evolution is driven by the genomic consciousness.

Much recently Baluska and Mancusco in their brief review²⁰ discussed [1] the ability of bacteria to perform complex communications, [2] quorum the special chemical language of bacteria, [3] intelligent and cognitive behaviour of bacteria. They further discussed similar aspects of unicellular eukaryotes, plants, sessile animals, corals and trichoplax.

In a recent paper published in nature²¹ it has been shown that an artificial neural net work of DNA can show brain like behaviour that is recalling memories based on incomplete patterns. Further a DNA based devices in a test tube that are analogous to the electronic transistors on computer chips are shown to have the capability^{22,23} of calculating square root of a four digit binary number. The question that arises is can natural genomes show brain like behaviour and perform computations/intelligent acts?

Barbara McClintock wrote²⁴, “The conclusion seems inescapable that cells are able to sense the presence in their nuclei of ruptured ends of chromosomes and then to activate a mechanism that will bring together and then unite these ends, one with another. And this will occur, regardless of the initial distance in a telophase nucleus that separated the ruptured ends. The ability of a cell to sense these broken ends, to direct them to each other, and then to unite them so that the union of the two DNA strands is correctly oriented, is a particularly revealing example of the sensitivity of the cells to all that is going on within them”. The conclusion drawn by Barbara McClintock amounts to saying that cells/ chromosomes are “self aware” or conscious and are intelligent.

Which organ or the part of the body is responsible for intelligent behaviour of an organism? We relate intelligence to neo cortex which is known as the logical brain. The neo cortex is the organ responsible for our logical thinking. This author defines: intelligence is the property that empowers an organism to find a solution or a number of alternative solutions to a problem. Amygdala which is also located²⁵ in the head is the organ responsible for emotional behaviour and hence is called the brain of emotions. Reportedly²⁶ the enteric

nervous system [ENS] acts as brain of tubular animals which as such does not have a head. ENS is said to be responsible for gut feelings. The bacteria *E. Coli* change the surface property²⁷ of its outer skin from hydrophilic to hydrophobic when exposed to 5% sodium chloride solution. As *E. Coli* does not have a formal brain, it is imperative to think that the DNA might have guided its behaviour intelligently. The structure and operating mechanism of neo cortex and genome are quite different but their function is same the intelligent behaviour in the same way as the construction and operating mechanism of NP junction diode and thermo ionic diode are quite different but their function is same, one way flow of electrons.

Which processes have primacy?, genomic processes (which happen within the genome) or cell processes (which happen out side genome but within the cell)? Transplantation of the synthetic genome²⁸ of *Mycoplasma mycoides* into *Mycoplasma capricolum* replacing the genome of *Mycoplasma capricolum* resulted into the creation of new *Mycoplasma mycoides* cells that are controlled only by the synthetic chromosome. Under the conditions of Venter's experiment the genome of *M. mycoides* acted as a system that is not influenced by its surrounding environment [the cell environment of *M. capricolum*] but dismantled the surrounding environment to build and control its own surrounding environment [the cell environment of *M. mycoides*] as per its genetic programs. The behaviour of synthetic genome of *Mycoplasma mycoides* is indeed brain like that requires not only calculating capabilities but also engineering abilities. Thus the genomic processes have primacy over cell processes.

Thermodynamics and a living system

Living things are in fact living systems. A system is a group of parts²⁹ that come together interacting and interdependent to form a more complex whole unit. A system is more than the sum of its parts. A system exhibits emergent properties which can not

be reduced to its individual parts. A system is said to be complex if its emergent properties are unpredictable.

From the stand point of molecular statistics it may be stated³⁰, "the self compression of a gas is not absolutely impossible". For the study of statistical behavior of thermodynamic systems Gibbs proposed the method of ensembles. According to Gibbs³⁰, an ensemble is a sufficiently large set of microstates which are compatible with a particular thermodynamic or macroscopic state. More clearly the thermodynamic state of a macro system [say ensemble] if in equilibrium does not change in time but the constituent myriad elements [say individual reactions] of the system may be in continuously changing microstates but in such a way that the macro state remains unaltered. Ensembles are classified as [1] micro canonical, [2] canonical and [3] grand canonical ensemble. The grand canonical ensemble is in both thermal and material equilibrium with the surroundings and can exchange both energy and matter.

A living cell may be analogically visualized as grand canonical ensemble and a macro system. The myriad chemical reactions that go on in the cell may be viewed as a family of reactions in micro states which allows us to presume that the entropy change of these reactions follow normal distribution, hence follow hierarchy without disturbing the thermodynamic equilibrium of the cell with its surroundings but a living cell dies if isolated from its environment indicating that the living cell is in steady state. Obviously some reactions at the extreme tail end of the distribution curve will have to move towards decreased entropy. It must be noted here that cells age over time that is they do change though very slowly.

The genome [a discrete sub system] of higher organism with higher percent of A-T pairs than thermodynamically favored G-C pairs indicates that genomic processes are non spontaneous that take entropy [change] to less than zero and to maintain this state cell processes are

directed by the genome to expend work. Recent experimental work of Craig Venter and his team clearly proves²⁸ that genomic processes have primacy over cell processes so much so that cell structure and functions are reorganized as per the genetic programs. Thus a living cell is self controlled and self directed.

Consciousness

We have used the term consciousness here several times. Consciousness is essentially self awareness³¹. The criteria for self awareness of a system is: A “system” to be aware of it self must exist in two interacting/ communicating/ sensing states that can act in tandem. Sekhar has been arguing^{32,33} for the genomic consciousness based on the thermodynamic state of the genome of higher organism for example the existence of higher percent of A-T pairs which are less favored thermodynamically. We know that genome contains repeated genes. And we also know that genes act as complexes and net works which means that genes communicate among themselves. A gene and its exact replica can communicate. The capacitor like intra electronic structure of DNA³⁴ allows us to think that a gene can sense the other particularly its replica which indeed can make a gene and its replica “self aware”. Importantly the gene, its replica and other genes in the complex/network/genome are physical. Thus the genome not only satisfies the criteria “A system to be aware of it self must exist in two separate states that can sense/interact/communicate with each other and act in tandem” for self awareness/consciousness but also the two separate states are physical unlike brain [physical] and mind [virtual] and this leads to the conclusion that the genomic self say “i” is the real self and is the origin of self awareness/consciousness.

Life

We do not find a clear answer to the question, “what is life”. This author has been arguing that life is a state of a system of matter³⁵ with primary emergent properties consciousness, self programmability and free will. Vangelis Stamatopoulos summarized³⁶ as,

“Atheism is often portrayed as being materialistic so when I came across a debate on life or life essence or life force or whatever you want to call it, I was immediately intrigued. Here were two engineers, one based in the US and the other in Jordan discussing the nature of life. The two “protagonists” are Libb Thims an American chemical engineer, electrical engineer, and thermodynamicist known for his work and research in the development of the newly emerging sciences of human chemistry, the study of reactions between human molecules, and human thermodynamics, the study of energy, work, and heat aspects of systems of human molecules and DMR Sekhar a Mineral Process Engineer at JPMC Ltd.

So let’s start with Libb Thims’ argument. You can find a pdf of his letter that I’m quoting from here: http://www.humanthermodynamics.com/JHT/Life_-_a_Defunct_Scientific_.... He makes a compelling argument for the materialist point of view - claiming that the concept of “life” is a defunct theory. Quoting the pertinent paragraph from his letter:

“You agree with me that the single atom is not alive. What about two atoms? What about three? Does a bound state of atoms have to have a certain movement to be considered alive? What if we heat a system of four atoms, do they suddenly become alive? What if we subject a system of atoms to both gravitational and electromagnetic forces, does that suddenly make them alive? What if the two forces act to move smaller atoms through the cavities of larger atoms on a cyclical basis, thus activating reactions in the process, does that make them alive? What if the two forces begin to arrange the atoms into hierarchies, and that smaller atoms and bundles of atoms begin to move between the hierarchies, does that make them alive? What if a structure of atoms, begin to turnover their internal atoms, with those of the surrounding space, on a cyclical basis, does that make it alive?”

A very logical, rational and totally convincing argument indeed. When I first read it, it certainly made me think about my views and understanding of the experience of existence or consciousness (ie life?) that

I began to doubt my understanding of it.

Next, I came across Sekhar's response to Thims' argument and I have to say that is just as compelling and maybe even a bit more so. You can find the full transcript of his short "thesis" on the subject here: <http://knol.google.com/k/dmr-sekhar/the-paradox-of-life/3ecxygf1lxc...> (this knol is shifted to <http://genopsych.wetpaint.com/page/The+paradox+of+life>) He gets straight to the point in his first paragraph:

"Let us consider an experiment where a jar of water and a conscious man were placed on two hot plates of two feet by two feet size and let us switch on the hot plates. What we will observe is that in the first case the jar remains on the hot plate and the water will become hot. In the second case the man will jump out of the hot plate trying to preserve himself and hence he is alive unlike the water molecules."

He develops his argument by examining the behaviour of a "living" being just before the moment of death and just after the moment of death. Even though Sekhar doesn't explicitly state so, I'm assuming that these points in time are compared since it can be said that the material state of the body just before death and just after death can ostensibly be considered that same. There are the same number of atoms, molecules and cells just before death as just after. However, the behaviour of the body is different. In fact, he uses the following equation to describe the behaviour:

$$f(L) - f(D) = f(g)$$

where:

$f(L)$ = the state of a being that is alive

$f(D)$ = the state of a being that has just died

$f(g) = 0$ to x

Now, if the behaviour of a live being equates to that of a dead being, then $f(g) = 0$, otherwise, it could be any other value. A value of 0 would support Thims' contention that there is no such thing as "life" - there is only the material world. However, we have observed in our theoretical experiment that a living

object will display different behaviour to a recently dead object therefore it is abundantly clear that $f(g)$ is not in fact equal to zero.

Hence, Sekhar has conclusively shown that there is some sort of life out there (call it consciousness, mind, etc) but science cannot as yet quantify or observe this "substance". Yes, it is life, Jim, but it remains unknown to science".

For argument sake it may be said that even water escapes by evaporation! But this is accompanied by the change of state of water to vapour. What if we replace bowl of water with an iron block?

True, a physical system resists the change of state when acted upon by external factors/forces but yields after a threshold limit as a rule. On the other hand a living system also resists change of its state and responds to external factors/forces in either fight or flight modes in that it has a choice exercised by *internal stimulus of will* to survive.

Discussion

The mystery of a living cell indeed lies² in the programmed coordination of the myriad of chemical reactions necessary for the metabolic activities of the cells. Unfortunately the known laws of physics and chemistry can not explain the "programmed coordination" without resorting to genopsych, genomic consciousness and internal stimulus of will which are the primary properties of a living system say a cell in a living state. Biological phenomenon can't be understood without stating laws of biology that help distinguish a living system from that of a physical system.

Can a computer (a physical system) perform like the brain (a living system)? Syamala Hari explains³⁷ that the brain has the ability to use inductive logic also which a computer can not. Biologists need to state the laws that govern the living systems.

Closing Remarks

[1] Self programmability is the biological property of all the living beings which originates from the

genome and is termed as genopsych. A system cannot be self programmable unless it is conscious and the spring head of the consciousness of the living beings is the genomic consciousness. At the genome level internal stimulus of will acts as free will which probably is responsible for processes such as recombination, DNA repair processes to correct errors during replication and already set genetic programs as bound will which are necessary for the survival of the species. Thus it may be concluded that genopsych, consciousness and internal stimulus of will are the primary properties of a living system.

- [2] The mechanism of natural selection has only imparted directionality albeit to a major extent to the process of evolution of species but it is the primary properties of the living system that provided the necessary drive to the process. After all no process physical or biological can proceed without a driving force internal or external! Unmistakably the driving force behind the process of evolution of species is internal that is from within the species.

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References

1. George Wald, 1980, The origin of life, Molecules to living cells, W.H. Freeman and Company, San Francisco.
2. Philip C Hanawalt, 1980, Protein Structure and Function: Assembly of Viruses and Ribosomes, *ibid*.
3. Volkenshtein, M.V., 1983, Bio physics, MIR Publshers, Moscow.
4. Lewis, E.B., 1978, A gene complex controlling segmentation in Drosophila, Nature, Vol.276, 565-570.
5. Lewis, E.B., 1992, Clusters of Master Control Genes Regulate the Development of Higher Organisms, JAMA, Vol. 267 No. 11, 1524-1531.
6. Bernardi, G., et al, 1985, The mosaic genome of warm blooded vertebrates, Science, 228: 953-958.
7. Bernardi, G., 2000, Isochores and the evolutionary genomics of vertebrates, Gene, 241: 3-
8. Arndt, P.F., Hwa, T., Petrov, D.A., 2005, Substantial Regional Variation in Substitution Rates in the Human Genome : Importance of GC content, Gene Density, and Telomere-Specific Effects, J. Mol. Evol. 60 : 748-763.
9. Cohen, N., Dagan, T., Lewistone and Graur, D., 2005, GC-composition of the Human Genome : In search of Isochores, Mol. Biol. Evol. 25 (5) : 1260-1272.
10. Galtier, N., Piganeau, G., Mouchiroud, D., and Duret, L., 2001, GC-content Evolution in Mammalian Genomes : The Biased Gene conversion Hypothesis, Genetics. 159 : 907-911.
11. Meunier, J., and Laurent Duret, L., 2004, Recombination Drives the Evolution of GC-content in Human Genome, Mol. Biol. Evol. 21 (6): 984-990.
12. Frederic Peters, <http://precedings.nature.com/documents/2444/version/1>
13. Okamura, H., 2006, CIRCADIEN AND SEASONAL RHYTHMS – integration of mammalian circadian clock signals: from molecule to behavior, Journal of Endocrinology, 177, 3-6.
14. Ernest Jones, 1960, Life and work of Sigmund Freud, Vol. 2, Basic Books Inc. New York.
15. Bose, J.C. 1927, The Unity of Life, [as reproduced in], Every man's Science, Vol. XXXIX, NO.4, Oct.-Nov. 2004.
16. Jorgensen, RA. "Restructuring the Genome in Response to Adaptive Challenges: McClintock's Bold Conjecture Revisited", Cold Spring Harbor Symposia on Quantitative Biology, Volume LXIX. 2004, Cold Spring

- Harbor Laboratory Press, 0-87969-729-6/04. Pp349-354.
17. Anthony Trewavas, 2003, "Aspects of Plant Intelligence", *Annals of Botany* 92:1-20.
 18. <http://www.quantumconsciousness.org/penrose-hameroff/consciousevents.html>
 19. http://en.wikiversity.org/wiki/User_talk:DMR_Sekhar
 20. Frantisek Baluska and Stefano Mancuso, 2009, "Deep evolutionary origins of neurobiology", *Communicative & Integrative Biology*, Vol.2.Issue1.
 21. Lulu Qian, Erik Winfree and Jehoshua Bruck, Neural network computation with DNA strand displacement cascades, *nature*, Vol. 475, 368 – 372, 21 July 2011.
 22. Qian, L. and Winfree, E., *Science* **332**, 1196-1201, 2011.
 23. Zoe Corbyn, A molecular calculator, *nature news*, <http://www.nature.com/news/2011/110602/full/news.2011.343.html>
 24. Barbara McClintock, The significance of Responses of the Genome to Challenge, *Science* 226, 792- 801, 2009.
 25. Daniel Goleman, *Emotional Intelligence*, Bantam Books, New York, 1996.
 26. Michael. D, Gershon, Alcmene Chalazonipis, Taube. P, Rothman, From Neural Crest to Bowel: Development of the Enteric Nervous System, *Journal of Neuro Biology*, Vol. 24, No. 2. 1993.
 27. Gaudin, AM, Flotation of Micro Organisms, Froth Flotation, 50th anniversary volume, Ed. D. W. Fruestnuea, AIME, New York. 1962.
 28. Daniel G. Gibson, *et al*, Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome, / www.sciencexpress.org/20May2010/Page1/10.1126/science.1190719.
 29. http://www.systemsbiology.org/Intro_to_ISB_and_Systems_Biology
 30. Yeremin, E.N., *Fundamentals of Chemical Thermodynamics*, MIR Publishers, 1983, Moscow.
 31. Sekhar, DMR., Reality of the Self, <http://dmrsekhar.wordpress.com/article/reality-of-the-self-3ecxygf1lxcn2-81/>
 32. Sekhar, DMR, genomic consciousness, In "The Philosophy of Evolution", (Transcience Transactions Vol.1. Eds. UVS Rana, K.Srinivas, NCAery, AK Purohit), Yash Publishing House, Bikaner, India, 2010.
 33. Sekhar, DMR, Genopsych: A coinage in the foundry of Biology, (Transcience Transactions Vol.2, Ed. AK Purohit) Scientific publishers, Jodhpur, India, 2011.
 34. Sekhar, DMR., Capacitor like electronic structures of DNA. <http://dmrsekhar.wordpress.com/article/capacitor-like-electronic-structures-of-3ecxygf1lxcn2-33/>
 35. Sekhar, DMR., The paradox of life, <http://genopsych.wetpaint.com/page/The+paradox+of+life>
 36. Vangelis Stamatopoulos, http://www.atheistnexus.org/profiles/blogs/its-life-jim-but-not-as-we?xg_source=activity
 37. Syamala D Hari, The Living and The Lifeless, <http://genopsych.wetpaint.com/page/The+Living+and+The+Lifeless>.

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