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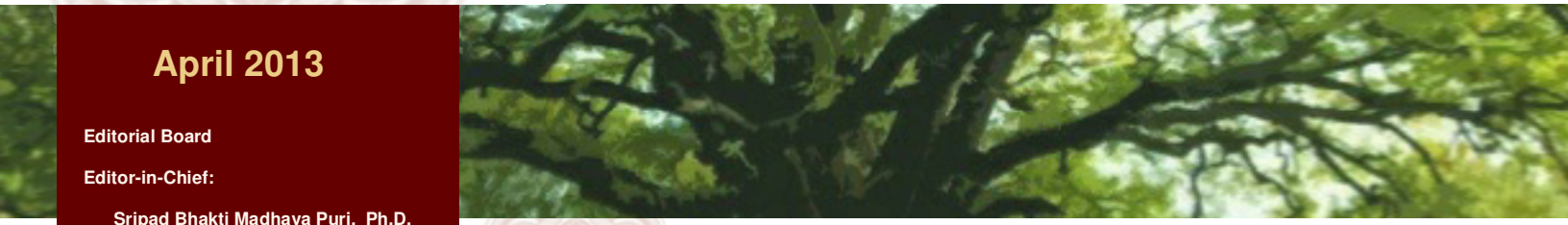

The Organic Whole: A Conception Worthy of Biological Life

Bhakti Madhava Puri, Ph.D.

Molecular Biology Subsumed by Systems Biology

All the central assumptions of the Modern Synthesis (Neo-Darwinism) have been disproven. **[1, 2]** An article with the title, "Rocking the foundations of molecular genetics," appearing in the prestigious *Proceedings of the National Academy of Sciences* at the end of 2012 **[3]** would have not been possible a decade ago. Groundbreaking experimental evidence of epigenetic maternal inheritance over several generations was published in the same journal, throwing the whole foundation of 21st century molecular genetics into question. Neo-Darwinism attributed genetic change to random events, in which physiology was assumed to play little role. "The germ line was thought to be isolated from any influence by the rest of the organism and its response to the environment. **[3]**

Darwin in 1859 wrote in his *Origin of Species*, "I am convinced that natural selection has been the main, but not the exclusive means of modification."**[4]** This can no longer be maintained in light of the experimental evidence available to us today. The Neo-Darwinian concept of random genetic mutation that was synthesized with the original Darwinian concept of natural selection has also been shown to be unsupported by the evidence. In fact, the four basic assumptions of the Modern Synthesis (Neo-Darwinism) have been refuted by modern experimental evidence.

These assumptions can be listed as follows:

1. Genetic change is random. The term "random" is generally interpreted in reference to DNA copying errors or other random events. It also assumes that influences from the phenotype, such as physiological functions or their changes in relation to environmental stresses, are not involved in such single-step errors. In general, it excludes any guidance to such changes beyond the genetic level.

2. Genetic change is gradual. Since random changes are microscopically stochastic, long periods of accumulation of such mutations would be necessary to produce any major alteration in the genome or phenome. This means that gene sequences or the protein sequences they produce would not be expected to rely on the mobility of large domains to move around or between genomes.

3. Natural selection acts on genetically mutated variants (alleles). This produces increased frequency of certain alleles in a population depending on their fitness. Thus mechanisms like genetic drift and geographical isolation can produce new species.

4. Inheritance of acquired characteristics is impossible. This assumption distinguishes Darwin (1859) from Lamarck (1809), and from any life-force that could be directing increasing complexity through evolution or adaptation. Crick's Central Dogma of Biology assumes that genetic material can be isolated from the rest of the organism and environment.

Experimental work within the field of modern molecular biology has refuted all these assumptions, more or less deconstructing its own foundations. **[5]**

Genetic change is random. Disproven.

"It is difficult (if not impossible) to find a genome change operator that is truly random in its action within the DNA of the cell where it works. All careful studies of mutagenesis find statistically significant non-random patterns of change, and genome sequence studies confirm distinct biases in location of different mobile genetic elements." **[5]** Function influences both the speed and location of genomic changes. Many examples are found within the immune system. Targeted genomic changes or "natural genetic engineering" is observed in many instances outside the immune system as well. So-called "junk DNA," the regions of the genome that do not code for proteins, has now been found to have essential functional significance in regulating genomic activity. **[6]**

Genetic change is gradual. Disproven.

Nobel Prize-winner Barbara McClintock introduced the idea of "jumping genes,"**[7]** chromosome transpositions (now called mobile genetic elements) that produce rapid changes in the genomic structure. Modern genome mapping has made it possible to see whole domains, up to hundreds of amino acids, can be shifted around to different locations in the genome.

DNA sequences that are first copied as RNA sequences, can again be inserted back into a different part of the genome using reverse transcriptase. These are called retrotransposons. The DNA molecule is now known to be so flexible that numerous manipulations of the fixed genetic sequences are possible, actually modifying the information in the DNA. Other mobile elements found in plasmids, viruses and bacteria can also transform DNA by introducing new genetic material. Darwin's original idea about a tree of life thus becomes difficult to retain in light of the extensive influences that can come from the environment in the form of mobile DNA elements.

Natural selection acts on genetically mutated variants (alleles). Disproven.

The neutral theory of evolution **[8]** makes natural selection superfluous. Selection for "fitness" makes natural selection ambiguous **[9]** as to what constitutes fitness in a given situation – what is being selected for? Reproductive success cannot be the only feature selected for, since that can also work against survival in an environment of limited resources. Drift simply refers to deviation from probabilistic expectation, but is based on sampling process, not selection. Geographical isolation is also not a selection process, but strongly influences species morphology.

Inheritance of acquired characteristics is impossible. **Disproven.**

A transgenerational effect on the transcriptome and epigenome through differential DNA methylation, as well as transgenerational disease or abnormalities hasve all been experimentally verified, **[10, 11]** Food availability to grandparents has been shown to influence grandchildren's longevity. **[12]** And care of young by the parents influences offspring's behavior later on as adults. **[13]**

The conclusion is obvious: the organism should have never been conceived as a mere order supplier for its selfish genes.

The validity of other popularly held conceptions of molecular biology that are now subject to question **[14]** are:

1. An individual's genome, his or her entire DNA sequence, is fixed at the moment of conception and, with the exception of the occasional point mutation or mutations associated with, for example, cancer, does not change throughout life. Today it is known that DNA is dynamic rather than static, being subject to a wide array of rearrangements, insertions, and deletions, as mentioned above.

2. Persons have identical DNA in all the cells and tissues of their bodies (with the exception of germ cells, red blood cells, and certain cells in the immune system). It is appearing more and more likely that the normal human condition is one of somatic and chromosomal mosaicism, that is, different genomes in different cells and tissues of the same individual.

3. Specific genes are coded for the production of specific proteins. This is now known to depend upon an assumption concerning the manner in which the protein for which the gene is encoded affects behavior.

Considering all these problems with the current gene/genome-centric view of molecular biology, a metabolically or physiologically based conception of biology has become a possible alternative. **[15]** In addition, the field of Cognitive Biology has become recognized as an important viewpoint from which to study living organisms. **[16]** Developmental Systems Theory (DST) **[17]** is now accepted as a powerful new way to deal with the massive complexity that researchers have discovered within even the simplest living cell.

Systems Biology – the next paradigm for biology?

Molecular Biology	Systems Biology
Reductionism	Holism
Mechanism	Emergentism
Homeostasis	Robustness

The fundamental concepts that constitute the foundations of contemporary systems biology include holism, emergentism, and robustness, compared to the concepts of reductionism, mechanism, and homeostasis, that form the foundations of molecular biology. **[18]** Holism is to be contrasted with reductionism which considers a system as merely composed of a sum of parts. Emergentism, the appearance of hierarchical levels of organization, is contrasted with mechanism of

independent linear events. Robustness refers to the preservation of the functionality of a system to a certain degree despite external or internal changes, while homeostasis refers to maintaining the stability of the state of a system.

Balliol College, University of Oxford announced,

"Biology is at a crossroads. We have realized that it is not genes but networks that create change and generate function – networks so rich and complex that understanding them requires mathematical and computer science methods, not only molecular biology and bioinformatics. The early promise of the genomic era has not been realized. Even the central dogma has come into question. Systems Biology is now an integral part of biology proper – modeling and simulation are standard practice. But its fundamental concepts and methods are far from settled. Even the basic aims are not precisely formulated." **[19]**

Among the different approaches to Systems Biology, what is known as an agent-oriented conceptual framework has proven to provide the best models that are consistent with empirical data. These can be divided into two categories:

"Heterogeneous computational/behavioral models have led to different forms of agent classification: examples are intelligent agents — when the agent behaviour is defined in terms of high level cognitive/mentalistic structures and processes, with an explicit symbolic representation of knowledge, interaction and related reasoning processes — and reactive agents — typically characterized by sub-symbolic (such as neural networks) or imperative computational models." **[20]**.

The Vedantic view also proposes viewing life from the Organic Whole perspective, in which consciousness forms the supporting basis. The conscious agent is an important part of that view, but the absolute conception of a unifying center is not to be omitted if a proper conception is to be achieved.

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21st Century Biology Takes Evolution Beyond Darwin

Bhakti Niskama Shanta, Ph.D.

Biological novelties are independent of natural selection

Scientific Humility

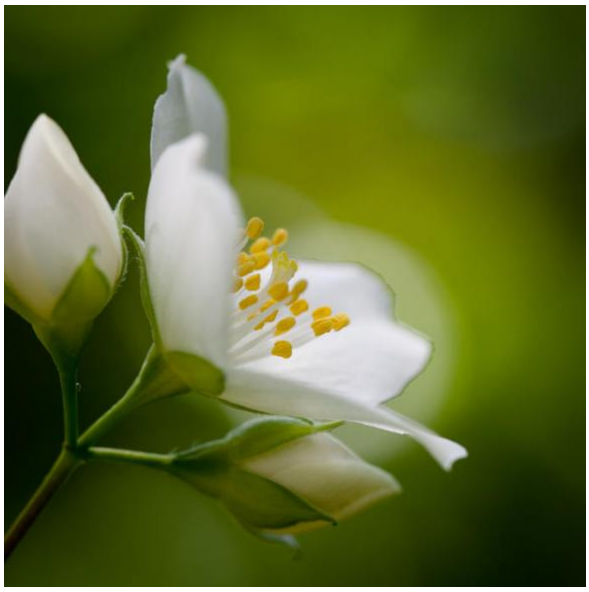
No matter how grand a scientific venture may be, it certainly cannot capture the entire scope of reality. Modern science cannot control cosmos, suns, planets, seasons, and so on and so forth. Hence, science is forced to confine itself to an insignificant fraction of complete reality. As Sir Isaac Newton said, *I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.* At times the scientific schemes are exceedingly fruitful and many concepts appear to be firmly established in science. However, as time progresses, and with the development of new information, the same science recognizes new phenomena, which often fail to accommodate the firmly established old concepts. In such situations a portion of the scientific world tries to powerfully, and sometimes emotionally, preserve their belief in the old concepts. However, the empirical observations compel science to embrace the truth in the face of all such antagonism. 21st century biology is witnessing a movement of this nature, where the empirical evidence is forcing many prominent scientists to reject the old, widely used, Darwinism. Some biologists, engrossed in the old disposition of Darwinism or *abiology,* want to preserve it at any cost. In such attempts, often they cannot recognize the blinkers they enforce on themselves due to their idealistic obligations rather than empirical inevitabilities. However, we must recognize the fundamental strength of science as rightly stated by Taylor **[1]** in a recent News article:

"*The fundamental strength of science is that it compels its practitioners to confront their own fallibility…Science is not always right – very far from it. What marks it out from other fields of human endeavor is that, because of its formalized humility, it's always ready to correct itself when it makes a mistake.*"

What is the Difference Between Matter and Life?

Throughout the history of modern science, repeated attempts to establish a set of essential and satisfactory properties for life — to come up with a basic definition of life — have been unsuccessful. **[2, 3]** It is necessary to recognize why such endeavors to come up with a distinctive and crucial definition of life have been failing. Over a period of more than one hundred and fifty years, biologists have attempted to discover the physical properties and chemical processes of the different biomolecules present within a living organism. Such reductionistic analysis is only a pretension to study life because, in actuality, such research only deals with the study of molecular matter that is devoid of life. As we know very well, "an organism is something which the scientific method cannot deal with; it is a hard, round, smooth nut, which experimental analysis can neither crack nor lever open at any point. As soon as a hole is made in it, it explodes like a Prince Rupert drop and vanishes away." **[4]** Noble prize winner, Szent-Györgyi also brilliantly presented the outcome of the mechanistic view of an organism **[5]**:

"*As scientists attempt to understand a living system, they move down from dimension to dimension, from one level of complexity to the next lower level. I followed this course in my own studies. I went from anatomy to the study of tissues, then to electron microscopy and chemistry, and finally to quantum mechanics. This downward journey through the scale of dimensions has its irony, for in my search for the secret of life, I ended up with atoms and electrons, which have no life at all. Somewhere along the line life has run out through my fingers. So, in my old age, I am now retracing my steps, trying to fight my way back.*"



Traditionally, in both Eastern and Western philosophy, life is understood as a cognitive or sentient principle. Sentience cannot be manufactured artificially by any noble mechanical and chemical arrangements of inanimate atoms and molecules. Ancient Eastern philosophy, based on the *Vedāntic* or *Bhāgavat* paradigm, provides the concept of 'Organic Wholism', as found, for example, in the invocation of *Śrī Īśopaniṣad "oṁ pūrṇam adaḥ pūrṇam idaṁ pūrṇāt pūrṇam udacyate pūrṇasya pūrṇam ādāya pūrṇam evāvaśiṣyate*–The 'Organic Whole' produces 'organic wholes'. An 'organic whole' cannot arise from parts that have to be assembled. That process can only produce inorganic, mechanical machines or chemical processes, not living organisms." **[6]** A similar conclusion was made by Rudolph Virchow in 1858, "*omnis cellula e cellula*" ("every cell comes from a cell"). **[7]** In 1864, Louis Pasteur also demonstrated that life cannot arise from non-life (abiogenesis is impossible) and with experimental evidence established the theory of biogenesis: *Omne vivum ex vivo* — life comes from life.

Moreover, zygote to adult embryonic development of every species also follows a fixed unique blueprint leading to the production of an adult organism of that particular species only. Driesch **[8]** explained this in a sequence of results where embryological growth progressed by the interactions of the nucleus and cytoplasm:

"*Insofar as it contains a nucleus, every cell, during development, carries the totality of all primordia; insofar as it contains a specific cytoplasmic cell body, it is specifically enabled by this to respond to specific effects only. . . .When nuclear material is activated, then, under its guidance, the cytoplasm of its cell that had first influenced the nucleus is in turn changed, and thus the basis is established for a new elementary process, which itself is not only the result but also a cause.*"

This spectacular realization of nuclear-cytoplasmic interaction and nuclear equivalence finally forced Driesch to reject the vision of a living organism as a physical machine. Examining natural history, researchers also reported that living organisms never evolved into different novel anatomical structures; rather they continued unaltered, even over the period of hundreds of millions of years. This non-changing aspect of an organism is known as stasis in the fossil record. Many similar observations in the literature establish that species preservation is a natural characteristic of life. Life's ability to preserve its own species over the period of hundreds of millions of years ("stasis" in the fossil record) offers a significant challenge to Darwinian gradualism. Living organisms exhibit many goal-oriented or teleological activities, which make them distinct from insentient mechanical and chemical systems.

Darwin's *Origin of Species* utterly ignores these goal-driven activities of living organisms, insisting that natural selection is exclusively responsible for the gradual but steady appearance of more complicated organisms. This irrational obliteration of the role of teleology in the study of life and its evolution is the major deficiency of Darwinism. **[9]** Despite that, right from the mid-19th century to the last few decades of the 20th century, biology witnessed a complete dominance by Darwin's mechanistic and insentient picture for sentient living organisms. In the last few articles **[10]** of *The Harmonizer,* we termed this incorrect representation of life as *abiology* and showed that several major conceptual changes have lead to the breakdown of Darwinism or *abiology*. Rejecting Darwinian *abiology*, 21st century biologists are now forced by the evidence to reconsider such rejected ideas as a realistic foundation for understanding life.

Darwin Under Siege

In *The Origin of Species,* Darwin speculated that a series of minute developments in reproductive success would progressively lead to major alterations that discriminate one species from another. Darwin adopted this gradualist assumption from the uniformitarian theory proposed by his geology professor, Charles Lyell. Admirers of Darwinism who followed the same line of thinking, proclaimed that natural selection boosts fitness (optimization of reproductive success) and thus, generates new life forms, including their sophisticated and complex adaptations. Darwin stated in Chapter 6 of his *Origin of Species* "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. But I can find no such case." This concept throughout history has suffered from various technical shortcomings, but now, in the present era, genome sequence data has completely invalidated the foundation of Darwinian evolutionary theory. In a very recent article Raoult and Koonin **[11]** stated:

"*At the time of the publication of the* Origins of Species *in 1859 (Darwin, 1859), Darwin's vision of evolution revolutionized the scientific worldview and even the human perception of the world beyond science. However, a century later, with the consolidation of the Modern Synthesis (neo-darwinism), evolutionary biology has adopted a rather rigid, somewhat dogmatic framework.*"

With molecular genetics, genome sequencing and many such powerful empirical testing tools, scientists are rigorously questioning the validity of Darwinian evolutionary theory. However, the invalid assumptions of Darwinan *abiology* are still commonly recognized and used in the scientific literature on objective evolution. In reality, we now have enough scientific evidence, which not only disproves this *abiology*, but also provides adequate substantiation for developing a scientific concept about 'evolution of sentience' or "subjective evolution of consciousnesses."

Going Beyond Parent-to-Progeny Heredity

Darwinism explains that biodiversity is a result of evolution from a universal common ancestor to anatomically modern humans, and that such evolution occurs by gradual accumulation of many successive, small modifications. It is often assumed in Darwinian *abiology* that each and every heredity transmission takes place from parent-to-progeny only. In ideological debates on evolution, following a gradualist, uniformitarian thinking, Darwinists continuously insist on the blind parent-to-progeny hereditary variation. In the first decades of the 20th century, heredity was understood more narrowly as the transmission of genes. **[12]** Originally the gene was just a theoretical unit but it finally obtained a material foundation in the DNA molecule. Inheritance thus meant the transmission of germ-line DNA sequences (gene alleles). **[13]** This hard heredity succeeded throughout the 20th century in the guise of Mendelian genetics and Neo-Darwinism or Modern Synthesis. **[14]** Neo-Darwinian theory emphasized the significance of random genetic mutation and variation within a population, and natural selection became the mechanism that altered the frequency of genes within a population. Darwinian abiology still maintains this as the only vision for evolution that generated biodiversity on our earth.

However, now we know that living organisms have the capacity to modify their own heredity (natural genetic engineering). In 21st century biology it is now well established that genome alteration did not happen by gradual change and natural selection. Evidence confirms the transfer of genetic material among non-mating species, and even between parasitic invertebrates and some of their vertebrate hosts. In the following subsections, several cases are presented to show the demise of this 'parent-to-progeny hereditary only' creed in Darwinism. Completely defying Darwinian abiology, such remarkable non-Darwinian transfers of genetic material are commonly observed among living organisms (both mating and non-mating) and such transfers are both advantageous and disadvantageous in nature. However, most importantly, none of such transfers could produce a new species. Both Darwinian and non-

Darwinian alterations do occur in nature, but they always produce only minor changes within species. We cannot find a single case in the literature where either Darwinian or non-Darwinian alterations successfully lead to the appearance of a new species. Recently Kuhn explained this in his article 'Dissecting Darwinism' **[15]**:

"*In all fairness, there is convincing evidence, that is widely acknowledged, that random mutation and natural adaptation (Darwinian evolution) does occur within species, leading to minor changes in areas such as beak size, skin pigmentation, or antibiotic resistance. Some of these changes involve a simple biologic survival advantage for a population, without a mutation in DNA. Others might be influenced by a single deletion or insertion within the DNA strand. However, the modern evolution data do not convincingly support a transition from a fish to an amphibian, which would require a massive amount of new enzymes, protein systems, organ systems, chromosomes, and formation of new strands of specifically coding DNA. Even with thousands of billions of generations, experience shows that new complex biological features that require multiple mutations to confer a benefit do not arise by natural selection and random mutation. New genes are difficult to evolve. The bacteria do not form into other species.*"

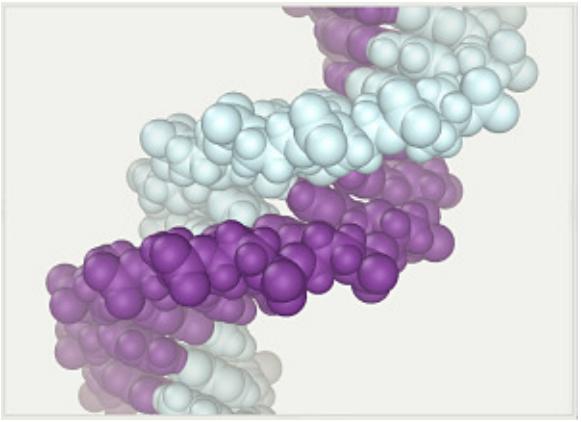
1. Viruses can install new genes within the infected organism (Transduction)

All living organisms are vulnerable to virus contagion and these viruses can effortlessly provide the means for new genes to become part of the infected organism's genome. Viruses fix to the host cell and the host can receive the entire virus into its cytoplasm where the virus's defensive cover is taken out. On the other hand, a few bacteriophages employ a special attack technique, in which they stay outside the cell and a chemical trigger helps them to insert their genome into the host's cytoplasm. In both cases, after entering into the cytoplasm, the virus manipulates the host cell to undergo either one of two cycles: (1) the lytic cycle, (2) the lysogenic cycle.

Lytic cycle causes the cell degradation, where the host cell starts following reproductive instructions in the attacking virus's genome. Thus, becoming the slave of the invader, the host cell stops all other things and starts producing replicas of the virus. Constant accumulation of many viruses leads to fatal cell rupture and the accumulated viruses are released. On the other hand, in the lysogenic cycle the host cell does not produce additional viruses, but integrates the whole viral genome into its own genome. In the case of RNA virus, the RNA first undergoes a reverse transcription to produce DNA. Despite the presence of a viral genome within the host cell, the cell can grow and multiply normally, transporting the new information safely along with it. Avrani et al. **[16]** states, "How hosts and viruses coexist in nature remains unclear, although the presence of both susceptible and resistant cells may allow this coexistence." Even in such latent transport of virus, some of the virus's genes can be expressed. **[17]** At times following lysogenic addition of the entire viral genome into the host cell's DNA, an induction event can make the viral infection go back to the lytic cycle. This makes numerous new viruses that can then infect several new cells and they may again go back to the lysogenic cycle. This cycle of lytic infection in one host cell followed by lysogenic infection in another is known as transduction. Viral genome manipulations are reported for a wide range of organisms from bacteria **[18]** to vertebrates **[19]**. Moreover, studies show that some viral genome manipulations have an advantageous role **[20]** for the host organism and hence can be useful in gene therapy techniques. **[21]**

2. Organism can pick up DNA from the environment (Natural-Transformation)

Natural-transformation is the process by which an organism can pick up naked DNA **[22]** from the environment. Natural competence for genetic transformation or the capability of being able to take up DNA from the environment and harmlessly incorporate it within an organism's own genome is well known. **[23]** Natural-transformation processes can be explained in five discrete steps: (1) Competence induction, (2) DNA binding, (3) DNA fragmentation, (4) DNA uptake, and (5) Integration of incoming DNA. Natural-transformation is helpful for survival of bacteria in unfavorable circumstances, like nutrient insufficiency **[24]** and extreme temperatures **[25]**. In recent years, natural competence for DNA transformation is recognized as an important mechanism establishing genome plasticity. **[26]** Natural-transformation is generally observed for different phylogenetic and trophic groups, and more than 40 bacterial species are reported undergoing natural transformation. **[27]** The natural-transformation is found abruptly spread at all phylogenetic levels in bacteria and hence its evolutionary origins are ambiguous. **[28]** Furthermore, it is important to note that natural-transformation is not limited to bacterial DNA alone. Natural transformation also involves transfer of transgenic plant DNA to bacteria and hence, is considered as a most flexible mechanism of DNA transfer. **[29]**



3. Horizontal (Lateral) DNA transfer

In the past, scientists were ignorant about the ability of bacteria to quickly develop complex resistance. Now it is well known that lateral DNA exchanges are common in bacteria and indispensable for swift adaptation to environmental and physiological challenges (like antibiotics). Using two powerful natural genetic engineering systems, transposons and integrons, bacteria can acquire and transfer antibiotic resistance. The segments of DNA that can move (transpose) from one position

in a genome to another are known as transposons. **[30]** An antibiotic resistance sequence becomes a part of a transposon, when it is surrounded by two copies of an existing transposon. Such moving antibiotic resistance sequences can easily be added into a plasmid and is thus transferable to other cells. Hedges and Jacob **[31]** observed that the resistance sequence can transpose between plasmids and from plasmids to other parts of the bacterial genome (chromosome or viral DNA). **[32]** Integrons are genetic elements and unlike transposons they are unable to move themselves. However, they have gene cassettes that can be transferred to other integrons or to secondary locations in the bacterial genome. These gene cassettes can gather and develop several multi-resistance DNA sequences. Fluit and Schmitz **[33]** reported that, "Integrons form an important source for the spread of antibiotic resistance, at least in gram-negative bacteria but also potentially in gram-positive bacteria."

Horizontal DNA transfer is observed commonly among microorganisms. A few may think that the source of variation is irrelevant to Darwinism because natural selection can act on any kind of variants. However, organisms which can only alter their own genomes cannot accomplish the same swift adaptation to environmental and physiological challenges as organisms that can pick up DNA from outside. Hence, unlike their counterpart (organisms that have obtained a resistance plasmid) these organisms definitely cannot build a rapid resistant population before encountering the selection.

Moreover, evidence also establishes inter-kingdom horizontal DNA transfer and it is a two-way process. Shapiro **[34]** states, "*We know from real-time observations that bacteria can transfer DNA to multicellular organisms. Such transfer is a normal part of the tumor-forming life cycle of the plant pathogen,* Agrobacterium tumefaciens*, and other bacteria can carry out similar transfers. Laboratory experiments show that* E. coli *carrying an antibiotic resistance plasmid can transfer it to Chinese Hamster ovary (CHO) cells. In other words, the same apparatus bacteria use to exchange genome segments with each other also works to transfer DNA to the cells of multicellular eukaryotes.*

"*From the symbiosis literature, we also know about many intimate associations of bacteria with animal genitalia. This means there is no physical barrier to DNA exchange between bacteria and animal germ line genomes. The capacity for such transfer was confirmed when investigators found virtually the whole genome of an endosymbiotic bacterium integrated into the chromosomes of its insect host. Similar cases have been reported since*."

Old biology confidently maintained that mammals acquire genes only vertically, or via parents to offspring. On the other hand, 21st century biology establishes that horizontal DNA transfer can strongly influence the genes of complex multicellular organisms like mammals. As *Science Daily* reported **[35]**:

"*The long-held theory is that mammals obtain genes vertically, or handed down from parents to offspring. Bacteria receive their genes vertically and also horizontally, passed from one unrelated individual to another or even between different species…Millions of years ago, tranposons jumped sideways into several mammalian species. The transposon integrated itself into the chromosomes of germ cells, ensuring it would be passed onto future generations. Thus, parts of those mammals' DNA did not descend from their common ancestors, but were acquired laterally from another species…The actual means by which transposons can spread across widely diverse species has remained a mystery.*"

4. Organisms with fused genomes (Symbiogenesis)

Lynn Margulis believed that long-stable symbiotic associations between two or more organisms can result in noble transformations that are favorable for all of them. Her research highlighted the importance of cell fusions and symbiogenesis in swift genetic alterations (which is a direct challenge to the Darwinian belief of gradual alteration). Margulis explained genomic mergers as the most important cause of genetic variability. Many examples of symbiogenesis are explained by Margulis and Sagan **[36]** in the book *Acquiring Genomes: A Theory of the Origins of Species*. A species of green slug is a fascinating example of symbiosis. This green photosynthetic animal (*Elysia viridis*) never eats throughout its adult life; it acquires carbohydrate-rich molecules by simply bathing in the sunlight. It carries photosynthetic algae in its tissues, and to receive the necessary carbohydrate-rich molecules it simply crawls along the shore in hunt of sunshine. A species of 'glow in the dark' squid is also an example of symbiosis and it has an organ which accommodates light-emitting bacteria. Cows have microbial symbionts in their rumen which help them to digest grass. We humans receive B-vitamins with the help of gut-dwelling bacteria. In fact *NPR* reported **[37]** in 2010,

"*There are trillions upon trillions of microbes living on and in the human body…To put this in perspective, Jeffrey Gordon, a professor at the Washington University in St. Louis School of Medicine, who studies the microbes that live on and in us, offers this factoid:*

'We think that there are 10 times more microbial cells on and in our bodies than there are human cells. That means that we're 90 percent microbial and 10 percent human. There's also an estimated 100 times more microbial genes than the genes in our human genome. So we're really a compendium [and] an amalgamation of human and microbial parts.'"

Lichens, the moss-like forms that live on rock surfaces are typical examples of symbiogenesis involving the fused genome. Lichens have fused algal and fungal genomes (kingdoms *Protista* and *Fungi*). Some lichens even include the genome of a third kingdom *Monera*. In lichens we can find both fungus and algae simultaneously growing in a joint life cycle. Thus lichens have both the fungus' skill to grow by expanding adherent filaments over the rocks and the photosynthetic facility to produce carbohydrate-rich molecules

from sunlight. Symbiogenesis (the appearance of new facilities in organisms from the merging of two separate organisms) is undoubtedly a fundamental factor in creating genetic variation without any mutation. In contrast to conventional evolution theory, symbiogenesis establishes that life did not take over the globe by competition, but by cooperation. Darwinism is externalist because it considers the external environment including other life forms as its explanatory reference device, which is independent of organisms. However, disproving these unscientific concepts of Darwinism, advanced biology is continually confirming that every species has some sort of important symbiotic relation with other species, without which the living organism cannot survive. The verse 1.13.47 of *Śrīmad Bhāgavatam* also states that, "*jīvo jīvasya jīvanam* – the general rule of the nature holds that one living being is dependent on another for its survival." Furthermore, symbiotic cooperation can certainly help organisms to succeed in the struggle for existence. Most importantly, *Natural Selection has nothing to do with such origins*.

Margulis and James Lovelock developed the Gaia hypothesis which explains that life as a whole appears and advances by creating a complimentary environment on Earth for its continuity. According to Gaia hypothesis both life and its environment must exist simultaneously and is in disagreement with abiology – 'first life came from dead matter and biodiversity is a result of gradual evolution of first life'. Symbiogenesis establishes the harmony among life forms and the Gaia hypothesis explains the harmony of the whole ecological bioshpere on Earth. These observations are similar to the concept of 'Organic Whole' explained in the *Vedāntic* or *Bhāgavat* paradigm. The founder of our organization (Sri Chaitanya Saraswat Math) Srila Bhakti Rakshak Sridhar Dev-Goswami Maharaja stated that,

"*We are living in an organic whole, so every point must be true to the organic Center... The real world is where every unit is dedicating itself to the whole, represented by the Centre, just as in a healthy body every atom will work for the welfare of the whole body. If an atom works for itself, it exploits to the extreme, and such local works for local interest are clearly bad. Every part of the body, and every atom, is to work for the welfare of the whole system. There is a Center, and by the guidance of that it will work.*"

It is also explained in *Upaniṣad*, "*yasmina jnate sarvvamidam vijnatam bhavati yasmina prapte sarvvamidam praptam bhavati tad vijijnasasva tadeva brahma*–There is a central point by knowing which, everything is known, by attaining which everything is attained. The long and short of the entire *Vedic* advice is to try to find out that Centre."

Conclusions: Biological Novelties are Independent of Natural Selection

From the above discussions it is obvious that the graph of evolution of life is not a tree with ever-diverging branches; the sphere of life is a network that forms a systematic whole. By revealing amazing genome variation mechanisms like transduction, natural-transformation, horizontal DNA transfers, symbiosis, hybridization, genome repair, natural genetic engineering and so on, 21st century biology is continuously defying the seqentially-based conventional evolution theory. The various processes that are described above are not evolutionary processes, yet they do explain the dynamic adaptability of species within their relation to the environment, as well as challenge the neo-Darwinian paradigm of species origination through lineal mutation in genetic heredity. Evidence confirms that the sphere of life is like a net, with the different species representing the nodes of that net (network). If changes occur in the network as a whole, then the various nodes (species) change accordingly, to maintain the harmony of the network of life. This viewpoint is completely ignored by the modern evolutionists.

Furthermore, we have witnessed an evolution of our understanding of heredity from a series of accidents randomly changing the ROM (read-only memory) of a genetic heredity system to the non-random restructuring of a RW (read-write) genomic storage system by the sentient cell. Natural selection can work only when variation is gradual and small. Influenced by uniformitarianism, Darwin expected that all alteration must occur gradually in small steps. However, as we have seen from a few examples of commonly occurring genetic variations in nature, changes are both non-gradual and can occur very rapidly. Both the fossil record and the genome sequence record are also establishing the existence of rapid alteration in all kinds of organisms. Hence, we now have very strong evidence which establishes that biological novelties are independent of natural selection. At present biologists are completely perplexed by the complexity of *life.* In *Bhagavad-Gita* it is stated in the verse 2.29:

ascarya-vat pasyati kascid enam
ascarya-vad vadati tathaiva canyah
ascarya-vac cainam anyah srnoti
srutvapy enam veda na caiva kascit

Translation: Some see the soul as astonishing, some describe him as astonishing, some hear of him as astonishing, while others, even after hearing about him, cannot understand him at all.

21st century biology teaches us that we should not inflict our ideas on nature; let nature reveal herself to us. Life and its evolution cannot be understood by imposing simplistic Darwinian mechanistic reductionism on sentient biological systems. Evidence is forcing biologists to go beyond physics and chemistry to properly comprehend the science of consciousness. We know that each species of life has its own unique gene regulatory network, such that from its initial stage to maturity the particular species develops in accord with processes unique to that species only. This developmental process is magical and cannot be understood without comprehending properly the science of organic whole. In the body of an organism there are different organs like heart, kidney, lungs and so on, which perform different functions to serve the function of the body as a whole. One organ does not try to become another. In the similar manner different living entities and also their environment are related to each other like an organic whole. From an atom to the universe, everything in this cosmos is an organic whole. We cannot artificially synthesize in our laboratory even the smallest hydrogen atom by combining a proton and an electron. We have already seen

that life is extremely complex and cannot be understood by simplistic approaches that are commonly practiced in physics and chemistry. Scientific methods are only trying to find the causes from a finite perspective by following a reductionist approach. However, we have seen that evidence is forcing us to develop a systemic approach to properly comprehend the cause of all causes. In the verse 5.1 of *Śrī Brahma-saṁhitā* it is stated that: *anādir ādir govindaḥ sarva-kāraṇa-kāraṇam*–The Supreme Absolute Kṛṣṇa is the origin of all and He is the prime cause of all causes. A superficial study of the physics and chemistry of the body of a living organism will never give us complete knowledge about life. A sincere attitude and proper humility can only guide an individual towards the perfect knowledge.

"So sincerity—sincere hankering after the truth—is needed if we are to go further. And that is made of *sukriti* and the grace of the divine agents who, by their nature, are wandering through this cursed land to help others who may not even know they are being helped." – Srila Bhakti Rakshak Sridhar Dev-Goswami Maharaja

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