SORRY, DARWIN: - CHEMISTRY NEVER MADE THE TRANSITION TO BIOLOGY

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Abstract

The term biology is of Greek origin meaning the study of life. On the other hand, chemistry is the science of matter, which deals with matter and its properties, structure, composition, behavior, reactions, interactions and the changes it undergoes. The theory of abiogenesis maintains that chemistry made a transition to biology in a primordial soup. To keep the naturalistic 'inanimate molecules to human life' evolution ideology intact, scientists must assemble billions of links to bridge the gap between the inanimate chemicals that existed in the primordial soup and anatomically modern humans. Even though the proponents of a natural origin of life expressed much optimism for providing their theories, presently there is a detailed compilation of information seriously questioning this doctrine. This reductionistic ideology has always failed to answer two simple questions: (1) What is the minimum number of parts that are essential for a living organism to survive? (2) By what mechanism do these parts get assembled together? Evolutionists say a series of prebiotic processes and developments guide networks of dynamically linked small molecules and amphiphiles to form biological macromolecules, membraneous compartments, and finally primitive cells. However, none of these proposed pathways to life appears to be credible. The continuous advancement in various fields of science are not only providing major challenges to reductionistic ideology but are supplying increasing evidence for a systemic concept of life as an organic whole. Several leading researchers in the field of 'origin of life' are continually concluding that there are major scientific problems attached with all existing naturalistic 'origin of life' hypothesis. Only by taking into account all biological activities collectively as a system can a satisfactory elucidation of the living state be realized. In this present paper an attempt has been made to present a few significant challenges to the theory of abiogenesis based on the peer reviewed scientific literature. Subsequently, a non-reductionistic concept of life as a system is proposed as an alternative for resolving some of the problems inherent in origin of life research.

Introduction

The 'spontaneous generation of life' hypothesis includes a conspicuous history of unrelenting derision from several prominent personalities in science. At various times in its history, 'spontaneous generation' has been identified by two different concepts. They are: (a) abiogenesis, and (b) heterogenesis. Abiogenesis is the field of science dedicated to study how life might have arisen spontaneously for the first time from inorganic chemicals. On the other hand, the notion that life can arise from dead organic matter, such as the appearance of maggots from decaying meat is known as heterogenesis. For a long time major western thinkers like Newton, Harvey, Descartes and von Helmont accepted heterogenesis with full confidence.

Francesco Redi by his experiments demonstrated that meat placed under a screen of muslin never developed maggots. The works of Schulze, Schwann, von Dusch and Schroeder provided significant challenges to heterogenesis, and finally in 1864 Louis Pasteur's famous swan-neck flask experiment sounded the death knell for this theory. Pasteur famously stated that "*Never will the doctrine of spontaneous generation recover from the mortal blow of this simple experiment*".[1]

However, soon after establishment of Pasteur's famous biogenesis theory, the reductionist school proposed an even more intricate and incredible form of spontaneous generation – abiogenesis. This hypothesis gathered its support mainly due to the collapse of the false dilemma of organic and inorganic matter (synthesis of urea in 1828 by Wohler), and the development of the concept of conservation of energy.[2] The modern form of chemical evolution theory began to develop following the proposal by Russian biochemist A.I. Oparin.[3] According to this claim, complex molecular arrangements and functions of living systems evolved from simpler molecules that preexisted on the lifeless, primitive earth. Thus, abiogenesis provided an ideal sense of balance to Darwinian evolution theory, requiring billions of years to go from dead atoms and molecules to cells, and then, via random mutation or natural selection, from cells to the varieties of living beings present today.

Abiogenesis was popular for years as an explanatory theory of self-assembly as the starting point for chemical evolution. Recently however, the abiogenesis hypothesis has been experiencing critical shortcomings and rapid advancements in cellular biology have led biologists to seriously doubt the veracity of this hypothesis. The present article aims at summarizing a few crucial scientific facts, which are leading us towards a paradigm shift in our understanding of the ontogenesis of life.

Primordial Bombardments Dumped in Darwin's 'Warm Little Pond'

Charles Darwin (1809 –1882) proposed an elucidation for life's origin that complimented his evolution theory. In a famous letter[4] to his botanist friend Joseph D. Hooker in 1871, he stated

> *"It is often said that all the conditions for the first production of a living organism are now present which could ever have been present. But If (and oh what a big if) we could conceive in some* ***warm little pond*** *with all sorts of ammonia and phosphoric salts, light, heat, electricity etc. present, that a protein compound was chemically formed, ready to undergo still more complex changes at the present such matter would be instantly devoured, which would not have been the case before living creatures were formed."*

For more than one hundred years this idea of Darwin's was accepted dogmatically as scientists were ignorant about the primordial bombardments. In recent times however, scientists have come to believe that the earth's first billion years witnessed murderous bombardments by large projectiles.[5]-[7] Many leading scientists in the field of 'the origin of life' now feel that the hostile conditions of early earth warrant a total reconsideration of this preceding conviction. James Kasting, who chaired a Gordon Conference on the origin of life, and who was coauthor of one of the key papers dealing with the early bombardment, says that "*The field is in ferment*." An additional apparent confirmation of the same can be found from the first two paragraphs of the article ‘Goodbye to the Warm Little Pond?’[8], published in *Science* magazine:

> “*Ever since 1871, when Charles Darwin made his oft-quoted allusion to life’s beginnings in a “warm little pond,” scientists have tended to imagine the origin of life as being a rather tranquil affair-something like a quiet afternoon in a country kitchen, with a rich organic soup of complex carbon compounds simmering slowly in the sunlight until somehow they became living protoplasm.*
>
> *Sorry, Charles. Your Warm Little Pond was a beautiful image. It’s been enshrined in innumerable textbooks as the scientific theory of the origin of life. But to hear the planetary scientists talking these days, you were dead wrong. The Warm Little Pond never existed.*”

Consequently, numerous new speculations are attempting to provide different explanation for the location of the origin of life on earth. There are several suggestions ranging from life beginning in deep sea thermal vents to bacterial life arriving from other places in the universe (Panspermia). Some of these hypotheses may be more credible than others, but it is an astringent fact that scientists have no existent evidence about the possible location for the first life on earth. *Science* magazine also outspokenly substantiated that science has no concrete answer to the question of how and where did life on earth arise?[9]

Chemical Evolution Cannot Ride a Substantially Incredible Barbed Ladder

The chemistry of prebiotic worlds is used on the opposite side of the defining moment for life, when Darwinian evolution theorized it first started functioning. It is perhaps impractical that even the simplest existing cells could have evolved spontaneously, even more so that exceptionally complex modern life forms could have done so. To keep chemical evolution alive, chemists and biologists are utilizing the early earth data provided by geologists and astronomers and are proposing numerous hypotheses in support of chemical evolution. Chemists select the likely prebiotic environment projected by geologists and study probable pathways for how organic molecules and biomolecules could be manufactured in such an environment, how they might have interacted, and how this might lead to more complex living systems. Biologists more often than not see biomolecules in a slightly different context, starting from the high complexity of a modern organism and searching for the vital biological cycles and interactions and then trying to find how something alike but much more simple might have evolved. The open literature is escalating with theories on the origin of life.[10] Different theories claim different starting points. For example, some propose that life originated with template replicating polymers,[11] pyrites,[12] thioesters,[13] clays,[14],[15] polypeptides,[16]-[19] and the claims are neither complete nor ending. Also, there is an ever increasing list of speculations on the site of the origin of earth’s first life. For example, life originated in an oceanic thick soup,[16] hydrothermal vents,[12] microscopic confinements,[16]-[18], and again the speculations are neither complete nor ending. From the scrupulous reviews[20],[21] we can realize the impractical range of speculative chemical evolution theories back from the chemistry of the existent cellular metabolism to the chemistry of the prebiotic world. The sections below present the vulnerable state of the theory of chemical evolution and its failure in outdoing the steps: (1)

Prebiotic synthesis – Primordial soup, (2) Polymerization, (3) Pre-RNA World, (4) RNA world, (5) DNA/Protein world, and (6) Primitive cell.

'Primordial Soup' with an Impossible Recipe!

Following Oparin,[3] in 1929 John Haldane proposed that in a reducing primitive atmosphere and with a suitable supply of energy, such as lightning or ultraviolet light, a wide range of organic compounds might be synthesized.[22] According to Haldane, the primordial sea was the source of a vast chemical laboratory motorized by solar energy. Haldane explained that, in due course of time, the sea turned into a 'hot diluted soup' containing large populations of organic monomers and polymers. The term 'prebiotic soup' was coined by Haldane, and is well-known as Oparin-Haldane's view of the origin of life. In 1953 Stanley Miller[23] offered experimental support for the theory of prebiotic evolution. Miller experimentally produced amino acids such as glycine, alanine, aspartic acid, and glutamic acid by passing an electric discharge through a gaseous mixture of methane, ammonia, hydrogen, and water vapor. Thus, he suggested that the implausible complexity in the molecular organization of living cells might someway have been produced from nothing more than simple chemicals interacting at random in a primordial ocean. However, we will see below in the light of scientific developments that, such a claim is far from the truth.

Thermodynamics disagreement with Miller's trick

Oparin, Haldane, Miller and his successors suggested unguided energy as the means by which simple molecules can be organized into more complex molecules. However, from the law of nature or from the second law of thermodynamics we know that order that emerges from undirected external forces not only has a momentary disposition, but does not get bigger, unless a directed external exertion is supplied. Miller's explanations give us the impression that he may be ignorant about this fact. Random flashes of electricity used by Miller can transform simple molecules into more complex building blocks. But the very next moment, new electrical flashes supplied by him may destroy these same building blocks. The larger the building blocks, the faster they will be damaged. Hence, to protect building blocks from the destruction by new flashes of lightning, *intelligent* Miller guided the building blocks towards a distillation flask. In this manner *clever* Miller cooked a more and more concentrated organic soup. Who had performed this *inelegant* job of Miller's in the primordial earth?

Chemistry fails to convene the demands of biology in primordial soup

The building blocks of life formed in primordial soup exist only in extremely small amounts and decompose rapidly into a tar-like substance.[24] We know that, the ozone layer in the upper atmosphere blocks harmful ultraviolet radiation. However, ozone is composed of oxygen and is the biggest obstacle for the synthesis of building blocks of the life like the ones obtained from Miller's experiments. The chemistry does not function if there is oxygen, but if there is no ozone (O_3) in the primordial atmosphere, the amino acids would be quickly destroyed by harmful ultraviolet radiation.[25],[26] Moreover, 'chirality' in biology demands chemistry to supply 'left-handed' amino acids and 'right-handed' genetic molecules. However, most of the chemical reactions in nature (except living organism) yield 'racemic' mixtures.[27]

Reducing environment fiasco

The idea of the primitive reducing atmosphere has been severely challenged by the available data from geology, geophysics and geochemistry.[28],[29] There is no geologic evidence for either a reducing primitive atmosphere or an early earth containing large amounts of methane gas. Moreover, a quick disappearance of ammonia may take place, because the effective threshold for degradation by ultraviolet radiation is 2,250Å.[30] Also, a quantity of ammonia equivalent to the present atmospheric nitrogen would be destroyed in approximately 30,000 years.[31] Experiments confirm that irradiating a highly reducing atmosphere produces hydrophobic organic molecules that are absorbed by sedimentary clays. This indicates that the earliest rocks should have contained an extraordinarily large amount of carbon or organic chemicals. However, this is not supported by the observed data. Based on observations from the stratigraphical record, Davidson explained that there is no evidence that a primeval reducing atmosphere might have persisted during much of Precambrian time.[32] Theoretical calculation also confirms that dissociation of water vapor by ultraviolet light must have produced enough oxygen very early in the history of the earth to create an oxidizing atmosphere.[33]

Now for many decades it is well known that the primordial environment was most likely not composed of methane or ammonia, and thus would not have been favorable to Miller-Urey type chemistry. David Deamer, an origin of life theorist says, "*This optimistic picture began to change in the late 1970s, when it became increasingly clear that the early atmosphere was probably volcanic in origin and composition, composed largely of carbon dioxide and nitrogen rather than the mixture of reducing gases assumed by the Miller-Urey model. Carbon dioxide does not support the rich array of synthetic pathways leading to possible monomers...*"[34] Jeffrey Bada and his co-researchers also echoed the similar statement: "*Geoscientists today doubt that the primitive atmosphere had the highly reducing composition Miller used...*"[35] Interestingly, it is reported in *Earth and Planetary Science Letters* that chemical properties have been effectively unvarying over earth's history, and thus concludes that "*Life may have found its origins in other environments or by other mechanisms.*"[36] In 1996 Miller himself stated, "*We really don't know what the Earth was like three or four billion years ago. So there are all sorts of theories and speculations. The major uncertainty concerns what the atmosphere was like. This is a major area of dispute.*"[37] Many prominent scientists in recent time have discarded the Miller-Urey experiment and the 'primordial soup' hypothesis it claimed to support. In 1990 the Space Studies Board of the National Research Council suggested that origin of life scientists should undertake a "*reexamination of biological monomer synthesis under primitive Earthlike environments, as revealed in current models of the early Earth.*"[38] In a review, Leslie Orgel has expressed that, "*The relevance of all of this early work to the origin of life has been questioned because it now seems very unlikely that the Earth's atmosphere was ever as strongly reducing as Miller and Urey assumed.*"[39] In a recent NPR report biochemist Nick Lane states that the primordial soup theory is now expired.[40]

However, this does not lead to an end to speculation on the chemical origin of life. Many new hypothetical primitive atmospheres have been proposed.[41]-[44] It is also speculated that organic compounds required for the origin of life may have come from outer space, for instance interplanetary dust particles, comets, asteroids and meteorites.[45] However, the major question will be: was extraterrestrial organic material ever efficiently delivered intact to the Earth?[46] Scientists may continually arrive at many such alternative theories about the unknown past. However, updated science textbooks should at least inform new generations about this now-outmoded recipe of 'primordial soup'.

Polymerization Riddle

Polymerization is a necessary process for synthesizing complex organic molecules (polymers) from simple organic molecules (monomers). Biology demands chemistry to supply not just any polymers, but very specific ones. The natural synthesis of amino acids and the development of peptides under the early earth atmosphere is one of the big problems in abiogenesis.[47] The February 1998 special issue of *Earth* magazine also states that, "*And even if Miller's atmosphere could have existed, how do you get simple molecules such as amino acids to go through the necessary chemical changes that will convert them into more complicated compounds, or polymers, such as proteins. Miller himself throws up his hands at that part of the puzzle. "It's a problem," he sighs with exasperation. "How do you make polymers? That's not so easy."*"[48]

Polymerization yields water molecules as one of the end products along with polymers. Le Chatelier's Principle explains that the presence of a product (in present case, water) in the reaction medium will substantially slow the reaction. Darwinists proclaim that first life originated in water over a long span of time by a self-organization of molecules. The equilibrium concentration of biological polymers is sufficiently low and thus they have a propensity to break apart in water, not organize.[46] Consequently, an increase in time will only facilitate water to destroy the polymers. This crisis is one of the biggest headaches for the Darwinists.[49]

To overcome this problem, polymerization in primordial earth requires dehydration synthesis. Because, the polymerization process needs an input of energy, some researchers proposed heating as a means to get rid of the water. However, many researchers including Miller himself reported that a hot prebiotic environment would accelerate the breakdown of biological polymers and hence this is not a suitable option for primordial biochemical synthesis.[50],[51]

Scientists are not able to know how the earliest biopolymers were formed in the prebiotic Earth. The characteristics of such polymers are so distinctive that it is impossible to conjecture about their development. Scientists can only evidently attempt various methods to synthesize them under an assumed primordial-like environment. For instance chemists can only manufacture homopolymers or short co-oligopeptides, but not long co-polymeric chains.[52]-[57] The Merrifield method can be adopted to produce amino acid by amino acid, as identical co-polymers. However, this is not a prebiotic technique.[58] A range of remarkable reactions have been projected and considered in the prebiotic scenario. However, the questions, 'how to produce long and chain specific polymers under possible prebiotic circumstances?', and 'why a specific polymer chain was formed, and not a different one?' are still unanswered. Chiarabelli also confirms that, "*…it is reasonable to agree with the statement, proposed by the editor, that we do not know, neither conceptually nor experimentally, how to make macromolecular sequences under prebiotic conditions.*"[59] Therefore, it appears to not be viable for scientists to overcome this polymerization riddle.

Pre-RNA World – A Jumbled and Gloomy Pathway to RNA

The primordial synthesis of self-replicating molecules is a further and more intricate problem than that of polymerization. In the 1980s Noble-prize winner Thomas R. Cech discovered self-replicating RNA molecules, and thus scientists started believing that RNA molecules could supply the satisfactory explanations for the transition of chemistry to biology in the primordial environments. However, soon researchers observed that there are too many problems with RNA for it to have been the molecule responsible for the transition from chemical to biological. As a result, scientists are now coming up with several new proposals for a variety of mechanisms and molecules by which the transition from chemical to biological can be explained in a world existing before RNA. In recent years the pre-RNA world concept created a great interest among the origin of life researchers, in spite of the absence of direction from known metabolic pathways in biology regarding the chemical nature of a predecessor to RNA.

In 1966, Cairns-Smith came up with a drastic proposal supporting that the first appearance of life was not based on organic polymers at all, but rather on inorganic clays.[60] This model explained the partaking of inorganic clays in creating a replicating system capable of storing information. Information was represented by the distribution of charges or shapes along the surface of the clay. On the other hand, replication is meant to copy that information to newly formed clay layers. The role of natural selection comes into picture when the number of ions in a layer influences how quickly and efficiently the new layer can be made. Suggestions of these kinds not only force chemists to consider more broadly the nature of heritable chemical information, but challenge them to develop and provide experiments to investigate these proposals.

Researchers then started the search for alternative genetic materials. For example, Eschenmoser has proposed a molecule called pyranosyl RNA (pRNA) that is very much correlated to RNA but incorporates a different edition of ribose.[61] In natural RNA, ribose contains a five member ring of four carbon atoms and one oxygen atom. On the other hand, Eschenmoser's ribose structure is rearranged to contain an additional carbon atom in the ring. Eschenmoser finds that complementary strands of pRNA can unite by typical Watson-Crick pairing to give double-strand units that allow a smaller amount of undesirable variations in structure than are achievable with normal RNA. Furthermore, the strands do not twist around each other, as they do in double strand RNA. In a pre-RNA world, where protein enzymes were absent, twisting could stop the strands from unraveling cleanly in replication process. Hence researchers believe that, pRNA appears superior and more suited for replication in a primordial environment than RNA itself. However, scientists have yet to discover an effortless means for synthesizing ribonucleotides containing a six-member sugar ring. Consequently, pRNA failed to gather sufficient experimental support to be considered a strong candidate.[62]

In a very different approach, Nielsen and his team have used a computer model to design a peptide nucleic acid (PNA) that combines a protein-like backbone with nucleic acid bases for side chains.[63] Similar to RNA, one strand of PNA can combine soundly with a complementary strand. Like RNA, PNA may be able to act as a template for the building of its complement. Scientists are hopeful that perhaps PNA was involved in an early genetic system. Even though Aminoethylglycine has been synthesized in spark discharge reactions from nitrogen, ammonia, methane and water[64], to date the prebiotic synthesis of an entire PNA monomer has not been achieved. Although PNA is non-chiral, it is vulnerable to cross-inhibition of the opposing enantiomers when directing the polymerization of activated D,L-ribonucleotide.[65],[66] In addition, PNA monomers can go through an intramolecular N-acyl transfer reaction that would stop any predictable mechanism for their polymerization.[67] Both pRNA and PNA dependent on Watson-Crick base pairs as the structural element that makes complementary pairing possible.

Researchers engrossed in discovering simpler genetic systems are searching for complementary molecules that do not depend on nucleotide bases for template-directed copying. In reality, there is no encouraging evidence that polymers produced from such building blocks can replicate.

Threose-based nucleic acid (TNA) is a recent suggestion and evolutionists believe that TNA might be better candidate for pre-RNA world, compared to other possible sugar-based nucleic acids.[68] TNA is alike to DNA and RNA. In addition, it contains a simpler 4-carbon sugar called threose in its backbone instead of deoxyribose found in DNA or ribose in RNA. Threose is a simpler sugar than ribose. Advantageously, TNA also displays superior base pairing properties. Inspired by these properties of TNA, some researchers projected that TNA could be a long-lost predecessor to RNA. However, there are several technical problems attached to this proposal. In 2000 Leslie Orgel listed several of them in his paper published in *Science* magazine.[69] "*Nucleotides containing a tetrose sugar have not been considered likely components of an early genetic polymer because they cannot be joined together by phosphate groups to give a backbone with a six-atom repeat.*" Orgel further reported that, "*In the alternative gradualist scenario, ribonucleotides were at first substituted a few at a time and at random in TNA sequences. The proportion of RNA components increased over time from almost zero to 100%. The information present originally in the TNA sequence was, at least in part, preserved in the final RNA sequence. This attractive theory suffers from one major drawback. Introduction of a substantial number of ribonucleotides at random might not prevent replication of TNA, but it would almost certainly destroy the catalytic function of any particular TNA sequence and thus would render evolved TNA sequences useless when rewritten accurately as RNA.*" That means none of the existing life forms today retain any TNA. Jeffrey Bada also points out, "*TNA suffers from the chirality quandary associated with all sugar-based nucleic acid backbones. Although the presence of a 4-carbon sugar in TNA reduces this problem to 2 sugars and 4 stereoisomers, it remains a formidable challenge to demonstrate how oligonucleotides composed of only Lthreose could be preferentially synthesized under pre-biotic conditions .... the selection of chiral sugar component of TNA would have required some sort of selection process to be in operation.*"[46]

The catalytic potential of proposed predecessor of RNA (pRNA, PNA, TNA, etc) has not yet been established. Hence, every rational supposition regarding pre-RNA life must reflect on whether that preceding genetic system could have facilitated the manifestation of RNA.

The RNA World Reverie

The term "RNA World" was originally used by the Nobel Prize winner Walter Gilbert in 1986, in an interpretation on findings of the catalytic properties of different types of RNA.[70] However, the notion of RNA as a primordial molecule can be found in several old published literatures.[71]-[73] In the real RNA world observed in present available biological systems, RNA plays dynamic roles in catalyzing biochemical reactions, in translating mRNA into proteins, in regulating gene expression, and in the continuous scuffle between infectious agents trying to destabilize host resistance systems and host cells shielding themselves from infection. Even though scientists have no understanding about how it works, they have the tools to carry on their examination of this existing RNA world and distill their understanding. On the other hand, the primordial RNA world is a made-up age when RNA exhibited both information and function, both genotype and phenotype. Thus, verities of unending speculations are continually coming forward, attempting to apply the data of the present RNA world to understand the primordial RNA world.[74]

Astrobiologists investigating the origin of life on Earth struggle with the question about the nature of the molecules that were the precursors for life. The molecular basis for the storage of genetic information in existing living organisms is deoxyribonucleic acid, or DNA. The instructions enclosed in molecules of DNA are expressed by the organism with the use of RNA to make proteins that, in turn, are essential to mediate reactions in the cell. In the absence of RNA, DNA would not be translated into proteins. Similarly, without proteins, the needed reactions could not be catalyzed. This has been the chicken and egg problem of the naturalistic origin of life from chemicals – "which came first – DNA or protein molecule?"

Moreover, DNA is an extremely out-sized and intricate molecule and is more stable when two strands come together to form the double helix. It cannot replicate without the help of RNA and enzymatic proteins to catalyze the essential reactions. DNA also seeks the help of proteins to unwind its two strands for replication and to keep the strands from getting tangled up during replication. On the other hand, RNA is often observed as a single strand of nucleic acids. Its backbone structure is produced in fewer steps than DNA. Moreover, as it is comprised of a four letter alphabet, it also can restrain hereditary information. In 1983, Cech and Altman, separately revealed that ribozymes enzymes could be made exclusively of RNA instead of protein. This has lent to the notion that RNA was the primitive information-storing molecule of preference. As discussed in the previous section, some researchers also consider that there were other molecules even prior to RNA (pre-RNA world) that were used by the first life forms. Those that think that RNA was the first molecule with this function assume that RNA, instead of proteins, could catalyze all of the reactions essential for replication. They refer to the era when RNA exhibited this task as the "RNA World".

All these appear attractive possibilities, but researchers have reported a number of serious problems associated with RNA world. At the outset, the sugar molecule that is required to produce RNA molecules is ribose. In an attempt to find the chance development of organic molecules in the laboratory, scientists failed to produce a reaction that could gave rise to a high yield of ribose in place of a random mixture of sugars.[75] Even if they discover a natural reaction that can readily gives rise to ribose in large quantities, they would then have to face the issue of the fast rate at which sugars would have decomposed in primordial conditions. Stanley Miller and his research group have reported, "*ribose and other sugars have surprisingly short half-lives for decomposition at neutral pH, making it very unlikely that sugars were available as prebiotic reagents.*"[76] Finally, if somehow sugars are manufactured, how would primordial life have selected the structure of sugar out of a mixture that was exactly half "right handed" and half "left handed"? There are many such practical problems attached with both the prebiotic synthesis and the stability of ribose.[77]-[81]

One of the major assumptions of the RNA world hypothesis is that in the primordial conditions, ribonucleotides spontaneously condense into polymers to form RNA molecules. Once RNA molecules have formed, by its catalytic activity to replicate itself a population of such self-replicating molecules would arise. "*It is difficult to believe*," says RNA World research scientist Steven Benner, "*that larger pools of random RNA emerged spontaneously without the gentle coaxing of a graduate student desiring a completed dissertation.*"[82] In addition, researchers believe that even if RNA could have formed spontaneously, the spontaneous hydrolysis and other destructive conditions operational on the early Earth would have caused it to decompose.[2] Joyce and Orgel recommend that "*…myth of a self-replicating RNA molecule that arose de novo from a soup of random polynucleotides. Not only is such a notion unrealistic in light of our current understanding of prebiotic chemistry, but it should strain the credulity of even an optimist's view of RNA's catalytic potential.*"[83]

Francis Crick confirms that, "*At present, the gap from the primal "soup" to the first RNA system capable of natural selection looks forbiddingly wide.*"[84] Furthermore, RNA fails to perform all of the functions of DNA sufficiently to support replication and transcription of proteins. Consequently, Leslie Orgel pointed out the inability of the RNA world: "*This scenario could have occurred, we noted, if prebiotic RNA had two properties not evident today: A capacity to replicate without the help of proteins and an ability to catalyze every step of protein synthesis.*"[75] Orgel further acknowledged that, "*The precise events giving rise to the RNA world remain unclear … investigators have proposed many hypotheses, but evidence in favor of each of them is fragmentary at best. The full details of how the RNA world, and life, emerged may not be revealed in the near future.*" Consequently the RNA world reverie appears to be dreadfully hopeless.

DNA/Protein World Dilemma

The RNA world notion discussed in the previous section, claims that, in the beginning phases of evolution, RNA behaved as both template and catalyst. All existing biological organisms exhibit the partition of tasks between template and catalyst. In existing biological systems, the partition of tasks is an elemental property: DNA stores genetic information whereas proteins function as catalysts. However, scientists are struggling to answer major questions such as: how did the DNA/Protein world come about, why would such partition of tasks evolve in the RNA world, and which came first, DNA or Protein? Again, we find the 'chicken and egg' problem.

Proteins may seem superficially better than RNA as chemical catalysts due to their larger range of chemical moieties and structural flexibility. On the contrary, due to the nonexistence of mechanisms for template directed replication, proteins are greatly substandard to RNA for the storage of genetic information. Because of the absence of the 29-hydroxyl at its sugar moiety, as compared to RNA, DNA is usually not as much of a reactive molecule. Especially, DNA is significantly more resistant to hydrolysis than RNA[85], particularly in the presence of metal ions.[86] For this reason, time and again it is recommended that DNA has an edge over RNA as a means of genetic information storage.[87] Nevertheless, Forterre reported that the superior stability advantage of DNA could not account for the origin of DNA because the benefit of using DNA for information storage depends on the chance of evolving a longer genome, which in itself would not offer any direct selective advantage to the systems that included DNA.[88] There is also no apparent experimental confirmation indicating that DNA is substandard to RNA as a chemical catalyst.[89] The chemical properties of DNA do not inevitably support the conclusion that the function of DNA is limited to information storage. Takeuchi and his research group asked the question, "*Given these considerations, we ask: What selective advantage could there be for an RNA-based evolving system to evolve an entity that is solely dedicated to the storage of genetic information, i.e., an entity that is functionally equivalent to DNA?*"

The sequence of emergence of different types of biopolymers during primordial evolution is an extremely controversial issue.[90],[91] There is an impasse attached to both the cases: (1) proteins preceding RNA, and (2) RNA preceding proteins. In existing biological systems, DNA synthesis is fully reliant on RNA. For instance, the monomer units for DNA synthesis, 2'-deoxyribonucleotides, are produced by the alteration of ribonucleotides, and the primers utilized to start DNA polymerization are oligoribonucleotides. It is observed that the catalytic portion of the ribosome, which produces proteins, is made completely of RNA. This is the significant reason touted for proteins preceding RNA. If one accepts that RNA is an inferior and less flexible catalyst than proteins, then the immediate question would be: what is the selective pressure responsible for the evolution of RNA catalysts? Transitioning from RNA to DNA as the hereditary molecule significantly enhanced genomic steadiness. This is believed to improve the possibility that a given organism or molecule would be around long enough to reproduce. Transmission of the task of primary catalyst to proteins also presents major advantages. Both transitions provide understandable advantages to a ribo-organism, nonetheless in fundamentally different ways. Hence, both would manifest following different evolutionary pathways. If we presume RNA was the first of the three macromolecules, an unsolved dilemma is which came next, DNA or protein?

Primitive Cell – A Miniaturized Walled City at Work

Darwin suggested that algae, amoebae and other such simple living beings were blobs of protoplasm which might have just appeared in some warm little pond by the chance combination of chemicals. Darwinian ideology imagines that a small number of relatively effortless changes in this protoplasm could show the way to developmental alteration. Natural selection would make sure that better adaptation would be preserved. On the other hand, changes which led to poorer adaptation would die out. Scientists influenced by this ideology believe that natural processes produce complex life forms from simple ones, which in turn came from dead chemicals. Based on such a foundation, abiogenesis proclaims that the first life had arisen by a chance accumulation of chemicals. The same is evident from the statement of Julian Huxley, one of the most influential evolutionists, "*Evolution, in the extended sense, can be defined as a directional and essentially irreversible process occurring in time, which in its course gives rise to an increase of variety and an increasingly high level of organization in its products. Our present knowledge indeed forces us to the view that the whole of reality is evolution – a single process of self transformation.*" However, the advancements of microbiology have helped the scientists to look at life in a better way. Darwin's portrait of organisms made of a small number of simple chemicals has given way to one of astounding complexity even in the simplest living entities. The ordinary E coli bacterium has not only miniature electric motors of exceptional efficiency, but also the equipment to fabricate, repair, maintain, operate and power them with an electricity generating mechanism.

Consequently, the notion of natural origin of primitive cells in the primordial earth is being severely challenged by the modern explosion of knowledge in microbiology and cellular biology. The issues attached to the 'natural origin of life' doctrine will not come to an end, even if one assumes that the necessary chemical building blocks were accessible in the primordial atmosphere. Any theory of 'natural origin of life' on Earth needs the practical description of plausible pathways for the conversion from complex prebiotic chemistry to simple biology, understood by evolutionists as the appearance of chemical accumulation capable of Darwinian evolution. The primitive cellular life requires a certain minimum number of systems, like (1) the means to transmit heredity (RNA, DNA, or something similar), (2) a mechanism to obtain energy to generate work (metabolic system), (3) an enclosure to hold and protect these components from the environment (cell membrane), and finally (4) a unique principle to connect all of these components together (appearance of first life). It is incredulous for evolutionists to believe that all of these four systems appeared simultaneously. Hence, the majority of followers of abiogenesis hypothesis are debating on the sequence of appearance of these events in the early earth. In the light of modern scientific advancements, the subsequent subsections illustrate the major hurdles in the pathway connecting chemical building blocks and the primitive cells.

Centre of unabated conflict: 'metabolism first' or 'replication first'?

The origin of life theory should clarify the origin of the distinctive phenomena which maintains life, such as reproduction, metabolism, and their corollaries (cell division, information carriers, genetic code, growth, maintenance, response to external stimuli, etc.). Reproduction is undoubtedly crucial for the continuation of any form of life. For this reason, evolutionists believe some form of molecular replication must have been started spontaneously in the prebiotic environment as a simple, entirely physicochemical form of reproduction. On the other hand, cellular metabolism is understood as a set of chemical reactions that occur in biological systems to maintain life. This vital process helps organisms to grow and reproduce, maintain, and respond to their environments. The metabolism process is classified in two different classes, catabolism and anabolism. Catabolism process produces useful energy and the anabolism process uses that energy to build components of cells such as proteins and nucleic acids. Through metabolic pathways, in a number of steps one chemical converts itself into another chemical by a sequence of enzymes. Enzymes are essential for the metabolic processes, since enzymes permit biological systems to make necessary reactions that require energy. Hence, some researchers believe in the supremacy of metabolism[12],[13],[15]-[19] and others assume the supremacy of reproduction.[11],[21],[72],[92],[93] Once again, scientists confront the same difficulty, ''which came first, the chicken (metabolism) or the egg (reproduction)?''

The contest between proponents of 'metabolism first' and 'replication first' persists unabated with both speculations subject to criticism. The 'metabolism first' speculation has been criticized by some of the prominent researchers in the field based on the judgment that major steps in the construction of such a metabolic scheme are exceedingly doubtful.[21],[92],[94],[95] The 'replication first' notion is also challenged, considering the observation that the *de novo* manifestation of oligonucleotides is questionable, and that there is no apparent pathway from an RNA world to the existing dual world of proteins and nucleic acids.[77],[96]

How a primitive cell developed its skin?

Abiogenesis hypothesis must also supply the means and pathways for primitive cell growth and division, as well as the mechanism by which cells could take up nutrients from their environment. All existing biological cells are membrane enclosed workspaces. The cell membrane is the container which holds a cell together. It manages to retain an internal milieu different from its environment within which genetic materials can reside and metabolic activities can take place without being lost to the environment. Existing cell membranes on earth are made of composite mixtures of amphiphilic molecules like phospholipids, sterols, and several other lipids, plus miscellaneous proteins that carry out transport and enzymatic works. Modern biological membranes are pretty secure under different environments and can tolerate a wide range of temperatures, pH, and salt concentrations. These biological membranes are exceptionally fine permeability barriers, so that present cells have comprehensive power over the intake of nutrients and the evacuation of wastes all the way through the dedicated channel, pump and pore proteins implanted in their membranes. Besides, immensely intricate biochemical machinery is mandatory for the growth and division of the cell membrane in a cell cycle. How a structurally simple primitive cell could accomplish all these essential membrane functions in primordial earth is a difficult problem to address. As compared to the research efforts on replications and metabolism, the starting point of primitive membranes is one of the most neglected fields in origin of life investigations. While the unrelenting disagreements in abiogenesis have been around the 'metabolism first' versus 'replication first' issue, there have also been competing thoughts for the origin of the cell membrane. We will ascertain below that the attempts to produce biological membranes under primordial earth are also suffering from multifaceted unsolved problems.

The experiments of Oparin's[16],[97] and Fox[98] on coacervates and proteinoid respectively were accepted as a significant historical step in the field of prebiotic synthesis of cell membranes. However, neither coacervates nor proteinoid microspheres have a factual boundary membrane that can perform as a selective permeability barrier. Coacervates and proteinoid are prominently detailed in present high school biology textbooks, even though they are essentially unstable, lacking the capacity to supply a permeability barrier, and incapable of carrying metabolism. Consequently, the present concentration of research has transferred from colloid phenomena and protein chemistry to nucleic acids.[99],[100] Researchers proclaim that amphiphilic boundary structures contributed to the appearance of life on earth in primordial conditions.[101]-[103] As an expansion of this view, some scientists suggest a 'Lipid World' situation as an early evolutionary step in the appearance of cellular life on Earth. Moreover, some researchers have proposed that lipid membranes may have a hereditary potential because the majority membranes are produced from other membranes but not created *de novo*.[104],[105] However, these approaches have not received much attention, most likely due to the comparative scarcity of experimental evidence. Studies also claim that, in the middle of the abundance of the molecular variety anticipated to be originated in prebiotic Earth, lipid-like molecules have a discrete property. That is: a capability to carry out spontaneous aggregation to form droplets, micelles, bilayers and vesicles contained by an aqueous phase through entropy-driven hydrophobic exchanges.[106],[107] However, the concentration of biomolecules in the aqueous primordial Earth has been expected to be roughly 1 micromolar,[108] essentially insufficient for typical covalent chemical reactions indispensable for formation of hydrophobic and amphiphilic molecules.

Even if one ignores the difficulties in connection with the production of amphiphilic molecules in primordial earth, still we are left with several technical problems on the path of prebiotic synthesis of membranes. The physical and chemical properties of aqueous surroundings can considerably slow down self-assembly of amphiphilic molecules, perhaps significantly restricting the environments in which cellular life first emerged. For example, temperature significantly controls the stability of vesicle membranes. It has been suggested that the primitive life forms were hyperthermophiles that originated in geothermal regions such as hydrothermal vents[109] or deep subterranean hot aquifers.[110] However, under these conditions, the intermolecular forces that stabilize self-assembled molecular systems are relatively weak. Hence, such locations are not suitable for lipid bilayer membranes to assemble. There are also several similar restrictions attached with the ionic composition and pH of the environment proposed for the origin of life.[111],[112]

To escape similar impractical situations, many researchers are speculating that amphiphilic compounds existed in carbonaceous meteorites. These compounds might have self-assembled into membranous vesicles under suitable circumstances and were latter delivered to the early Earth from outer space by meteoritic and cometary infall.[113],[114] Even though lipid-like materials were claimed to be detected in the Murchison meteorite,[115] successive research suggested that those compounds were contaminants, rather than endogenous materials.[116] The fabrication of appropriate biomolecules in the interstellar medium is of no significance to the origin of life unless these biomolecules can be delivered unharmed to habitable planetary surfaces. The major question would be: can these noble biomolecules withstand the brutal, scorching delivery to a planetary surface? Even if in some way membrane building blocks landed safely through extraterrestrial resources, decomposition through hydrolysis, photochemical degradation, and pyrolysis would have drastically diminished the quantity of such materials.[34] Hence, we remain with the unanswered question: how did a primitive cell develop its skin?

What collectively linked the components in the first living cell?

Despite the massive advancements in the field of cellular biology, the changeover from microscopic chemical mechanisms to the macroscopically evident emergent properties that illustrate life remains unanswered. Even if creation of an enclosed vesicle is achieved, it does not assure functionality of a primitive cell. In order to be practical as a mechanism implicated in abiogenesis, membranes must be linked with all the materials indispensable to instigate life. A membrane must be capable of transporting material in and out of the boundary. Some type of transport system for nutrients and wastes would be compulsory to uphold the metabolism of the primitive cell. Moreover, both a primordial replicator and metabolic system must be interconnected in the primitive cell. Hence, such an arrangement would manipulate, generate and release the necessary chemicals during each cycle. However, it is uncertain what sort of equilibrium would ultimately need to be accomplished to make a transition from chemical system to a biological system. In a purely physicochemical sense, if a stable membrane is synthesized, passive transport systems can be easily arranged. However, such a provision would robotically attain equilibrium, making continuation of further transport impractical.[117]

Even insignificant unicellular living entities are self-guided and are utilize millions of special molecules dedicated for specific responsibilities within a functional cell. Advanced cellular biology now confirms that a functional cell is made up of a sophisticated network of co-dependent biomolecules. Many of these biomolecules are only observed in biological cells and not anywhere else in nature. Robert Shapiro stated in one recent publication in *Nature*,[118] "*In June 2005, an group of international scientists clustered around a small, near-boiling pool in a volcanic region of Siberia. Biochemist David Deamer took a sample of the waters, then added to the pool a concoction of organic compounds that probably existed 4 billion years ago on the early Earth. One was a fatty acid, a component of soap, which his laboratory studies suggested had a significant role in the origin of life.*


Biochemist David Deamer poured chemicals into a hot pool in 2005 to see if primitive cells would form.

Over several days, Deamer took many more samples. He wished to see whether the chemical assembly process that he had observed in his laboratory, which eventually produced complex 'protocell' structures, could also take place in a natural setting. The answer was a resounding no. The clays and metal ions present in the Siberian pool blocked the chemical interactions."

Hence, those claims appear perverse which suggest a prebiotic existence of these biomolecules, which are only created by life. Such stubborn ideologists ignore the fact that biological systems display astonishing accomplishments not because of an exceptional form of chemistry, but because a conscious creature can control chemical processes and subordinate them to a purpose intrinsic to the self-guided living being. Scientists are only making futile attempts at the moment to synthesize separately all the essential biomolecules by purely physicochemical means. The further and more complicated steps towards synthesizing functional cells are certainly beyond their thinking. A purely physicochemical transition from chemistry to biology is impossible.

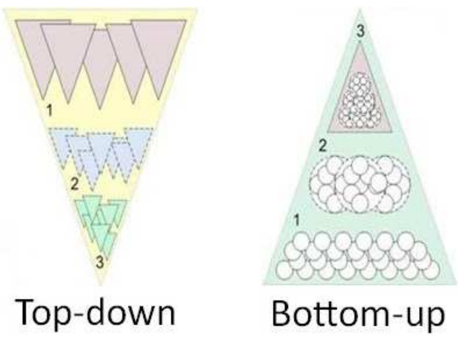
Recent experiments have already revealed a biological system containing in excess of 7 million protein sequences and over 50,000 protein structures.[119] Rapidly advancing cellular biology, especially metagenomics, assures that countless further molecular components are in the pipeline to be revealed. Biologists must give careful thought towards the principle that unites these large bio-molecular networks. It is suggested by scientists that the potential resources of energy for primitive cells are heat, chemical, and light energies.[34] However, the major impasse is: how can unguided physical energies manufacture a state of such massive complexity and specificity as a living cell? Srila Bhaktisvarupa Damodara Maharaja (Dr. T.D. Singh) once asked molecular evolutionist Stanley Miller at one of his lectures on the origins of life at the University of California, Irvine, "*Suppose you were given all the necessary cellular chemicals. Could you create a living cell in the test-tube?*" Miller's immediate answer was, "*I do not know.*"[120] Sripad Bhakti Madhava Puri Maharaja, Ph.D. further made it more overt in an online discussion forum, "*Anyone can take a single cell and put it into a sterile test tube with all the necessary ingredients to sustain its life. If you then puncture that cell with a sterile needle, the contents of the cell will pour out into the solution. Even if you wait for hundreds of years, life will not be generated from those original biochemicals of the cell. This tells us that life is not simply cellular in nature. The life principle is the apriori formative cause of the cell or the body of any multi-cellular creature. We can see this in action by watching any seed or egg or embryonic zygote go through its development to maturity. Science cannot explain this development by simple reference to chemical activity.*"[121] Hence, to seek the truth, sincere thoughtful scientists should make an attempt to understand the fundamental nature of life and thereby should reject the tradition of producing endless reductionistic speculation under the banner of the chemical evolution of life.

Future Research Suggestions to Prevail Over the Fundamental Mistake

Biology is misconceived as an amalgamation of physics and chemistry

What is the most fundamental particle that our universe made up of? The reductionistic school has not yet figured that out. In the past, the atom was considered the most fundamental indivisible unit. However, later it was found to be made up of three particles: electron, proton and neutron. These days scientists are talking about further finer subatomic particles. Hence, there is serious doubt about the prospect of scientists settling down to a lasting finish regarding the most fundamental particle that our universe made of. Moreover, from the most fundamental particle (if ever scientists can manage to find one) to the functional primitive cell level, life forms handle extreme parallels and interactive courses of actions over several orders of magnitude of size. Without a proper understanding of the life principle, biologists captured by the ghost of the naturalistic origin of life believe that they can explain this scale of complexity through purely physicochemical means. Biologists conclude that it doesn't matter what takes place within the organisms, for they can reduce all of that to chemistry and physics.

Using physics and chemistry, scientists try to explain the building of matter from atoms and molecules. The atomic relations are illustrated by chemistry. On the other hand, the lump of matter produced from an accumulation of atoms is explained by laws of physics. Based on this, biologists may argue that the whole matter of which a life form is composed does fit into the dominion of physics and chemistry. Based on this impression, they visualize that the protein–protein, protein–DNA or other bimolecular interactions within a living cell are merely the outcome of physical processes. However, anyone can understand the distinction between living (animate) objects and non-living (inanimate) objects through a simple observation of their movements. The trajectory of motion of an inanimate object like a satellite can be predicted in terms of laws of mechanics. However, the motion of an animate object like a bird cannot be understood with the same principle. This is because an animate object is self guided. To stress the same idea we would like to present one more example: Newton's first law of motion is applicable to a marble (inanimate object), but it cannot be applied to a tortoise (animate object). The motion of inanimate objects is determined by an external force. We need an external force to move a marble at rest. On the other hand, animate objects display a self driven spontaneous movement. A tortoise at rest can decide when it wants to move and no law in physics can determine that decision. By a simple observation of an organisms' growth, irritability, reproduction, metabolism, etc. one can make out remarkable distinctions between animate and inanimate objects. Hence, biologists must inquire about the deeper question: what automates the animate or living objects.



Following a reductionistic ideology, scientists in general invent novel laws using either a top-down or a bottom-up approach. External observation is the beginning point in the top-down approach. Scientists by intuition envision a set of elements, a set of relations and a mathematically describable structure (equation) to unite the two. Elements are intertwined into a mental map, and experiments are premeditated to validate or invalidate the model. A law is established when the experimental observations repetitively substantiate the model under a set of different environmental conditions. The top-down approach (from imagination to observation) is frequently used in physics. Newton's laws of motion are the examples, which are developed following a top-down approach. On the other hand, the bottom-up approach starts by accumulating data on each and every element. Properties of components are experimentally examined in segregation and in alliance with other interrelated elements. Data collection is done under different environmental conditions and patterns are studied. To confirm observations, experiments are repeated to determine consistent patterns. A law manifests when there is a substantiation of a consistent link among interacting components in different environmental conditions. Both bottom-up (from observation to imagination) and top-down (from imagination to observation) approaches are commonly used in chemistry.

Searching for a consistent pattern is the common means in both top-down and bottom-up approaches. In non-biological systems we observe a consistent behavior of elementary particles, which is not the case in a biological system. Cellular interactions are inconsistent and irreproducible.[122] A living cell is a milieu of pure dynamic activity.[123] Due to this reason we cannot apply top-down and bottom-up approaches to develop laws for a biological system. We may observe some consistent patterns of behaviors in living organisms. For example, by listening to the clap of our hands a bird close by will certainly fly away with a reliable degree of predictability. However, it is impossible to explain this repeatable pattern in terms of a bird microarray profile before and after the clap. The modern researchers should recognize the fact that the molecular level explanation is undoubtedly insufficient to elucidate the complex activities of living organisms.

21st century biology – View of organism as a sentient system

A bottom-up approach as discussed before was used by Mendel to deduce the laws of inheritance in biology.[124] Mendel attempted to provide a molecular reason for the inheritance of traits, which is now known as the concept of genes. The modern synthesis of Darwinian evolution along with Mendelian genetics is known as Neo-Darwinism. Following in Mendel's footsteps modern biologists attempted a total reduction of an organism to its genes. They are under the impression that knowledge of genes is the knowledge of the organism. However, it is a fact unnoticed in modern science that Mendel's genetics meticulously overlooks vital features of the biological system, or life principle. Mendelian genetics attempts to provide an explanation of an organism by treating it as a combination of evidently distinct, unchanging traits. It does not address the developmental potential of the biological system, which allows it to interact with its environment and alter itself depending on varying conditions. Modern genetics fails to incorporate the plastic propensities of a living organism. Moreover, Mendel used the traits "yellow seed" or "violet flower" etc., which are nothing but abstraction from the whole (pea plant). Mendel envisaged the responsible factors for inheritance in the form of inanimate objects. Like mechanical objects, these factors don't have any internal relations. They have a superficial external relation. Hence these discrete entities cannot explain the inherent process of transformation that occurs in the plant right from germination of the seed until the death of the plant.

With the advancement of molecular biology the concept of chromosome, DNA, RNA, gene, etc came into the picture. Biologists believe that the gene is made up of a specific number and sequence of nucleotides. Furthermore, they consider that the sequence of nucleotide reveals the message of a gene. The central dogma of molecular biology was first formulated by Francis Crick in 1958.[125] This central dogma attempts to provide a mechanism by which genes could decide traits through protein synthesis. This wishful thinking of rigid mechanism for a biological system can be sensed from the words of Crick: "*a boundless optimism that the basic concepts involved were rather simple and probably much the same in all living things.*"[126] It is a vision of oversimplification of the transfer of sequential information in an organism. According to this concept, sequential information in biological systems can only flow from the gene to the proteins and it cannot be transferred back from protein to either protein or gene. Following this idea, geneticists proclaim that by the assistance of RNA, structure of DNA can decide the structure of proteins.

Central Dogma: DNA → RNA → Protein (Enzyme) → Trait

However, soon biologists recognized that the transmission of biochemical specificity within the cell is fundamentally circular rather than linear. The 'chicken and egg' problem became the biggest challenge to this dogma.[127] It is observed that RNA is altered by enzymes prior to its information being translated into protein. Hence, there is no one to one communication between DNA sequence and proteins.[128] Researchers further confirmed that genes also switch their positions. Additionally, based on the new position of the gene, its function might alter. Consequently, the position effect on genes revealed that genes are not as rigid to their context as had been contemplated.[129] The dynamic nature of genetic functioning is further confirmed from the works of Barbara McClintock. Her studies revealed that, the nature of emergence of different traits are greatly influenced by the movement of the gene.[130] Genes are considered to be located in the chromosomes. To come up with an explanatory model, by considering DNA as the material foundation of the genes, some researchers concentrate on the structural aspect of DNA. To construct the double-helix representation of DNA, its x-ray crystallography pictures are necessary. To achieve this, they place DNA in a crystalline form to produce such pictures. However, it is an unrealistic conception of the real scenario. DNA does not undergo crystallization in the watery environment of a living cell. In an organism, DNA is constantly constructed and broken down during the process of cell division, growth and death. Thus a few biologists have now begun to believing that a gene cannot be conceived as a mere molecule located in the cell. Thus, they think that the gene is a function that a cell has to achieve. Hence genes cannot be studied as objects or as molecules separate from the whole organism.[131] A reconsideration in modern genetics is essential and biologists should overthrow the dogmatic believe that an organism can be reduced to its genes.

Reductionists misconstrue the organism by identifying it as the organs within the organism, the tissues inside the organs, the cells contained by the tissues, cell nucleus manufacturing the chromosomes, various substances in the chromosomes and finally the DNA. In such an approach they lose the context of the whole which is irreducible to simply the component parts. A biological system is a dynamic whole and is not a mere accumulation of parts. It is an inseparable unit of dynamic participants. Modern biology is an exceedingly valuable means to attain narrow, nevertheless very precise knowledge. Considering the boundaries of this limited approach biologists should overcome the habit of conceiving biological systems as a mere substances. They must know precisely the answer for the question: where does the real biology begin? In 1944, directed by the question 'what is life?', Schrödinger explained that biological systems cannot be nourished on energy as are artificial machines.[132] Considering the energy, matter and thermodynamic imbalances offered by the surrounding atmosphere, Schrödinger claimed that consuming negative entropy is a central necessity for the existence of life. Recent findings in cellular biology and advanced research on the behavior of bacterial colonies confirm that besides Schrödinger's criterion of 'consumption of negative entropy', 'consumption of latent information' is an additional basic necessity of Life.[133] Hence all biological systems have to sense the environment and carry out internal information processing for surviving on latent information rooted in the complexity of their environment. Astonishingly, insignificant bacteria can effortlessly transfer inorganic substances into organic matter. To achieve this task bacteria employ chemical communication to create hierarchically structured colonies, made of 10^9–10^{13} bacteria each.[134]-[136] Through cooperative action, they are capable of using any accessible resource of energy and imbalances in the environment to manufacture the spontaneous path of entropy creation. Thus they produce life sustaining organic molecules for themselves and for the usage of all other organisms. The essential elements of cognition in such sentient biological systems can take into account the interpretation of chemical messages, distinction between internal and external information, and also the ability to discriminate between self and non-self.[133] These cognitive acts of bacterial colonies include coordinated gene expression, regulated cell differentiation and division of responsibilities.[137],[138] Communally, bacteria can collect information from the environment and from other organisms, interpret the information in a meaningful way, build up common knowledge and learn from past experience. The bacterial colony works very similarly to a multicellular organism[139] or a social community.[140] Due to high complexity and plasticity, the colony can exhibit superior adaptability to any encountered growth circumstances.[138] In order to attain the appropriate balance of individuality and sociality, bacteria communicate by means of a large collection of biochemical agents.[141] Each individual in the colony also possesses complicated intracellular signaling mechanisms which include signal transduction networks[142] and genetic language.[143] These capabilities are employed to produce built-in meaning for contextual interpretations of the chemical messages and for creating suitable responses.[138] Biochemical messages are also utilized to exchange meaningful information throughout the colonies of diverse species, and also with new organisms.[141] Ben Jacob and his research group thus state that, "*…we reason that bacterial chemical conversations also include assignment of contextual meaning to words and sentences (semantic) and conduction of dialogue (pragmatic) – the fundamental aspects of linguistic communication. Using these advanced linguistic capabilities, bacteria can lead rich social lives for the group benefit. They can develop collective memory, use and generate common knowledge, develop group identity, recognize the identity of other colonies, learn from experience to improve themselves, and engage in group decision-making, an additional surprising social conduct that amounts to what should most appropriately be dubbed as social intelligence.*" Ben Jacob and team also outlined how intra-cellular self-organization jointly with genome plasticity and membrane dynamics might, in principle, offer the intra-cellular mechanisms required for these fundamental cognitive functions. They stated that, "*In regard to intra-cellular processes, Schrödinger postulated that new physics is needed to explain the conversation of the genetically stored information into a functioning cell. At present, his ontogenetic dilemma is generally perceived to be solved and is attributed to a lack of knowledge when it was proposed. So it is widely accepted that there is no need for some unknown laws of physics to explain cellular ontogenetic development. We take a different view and in Schrödinger's foot steps suggest that yet unknown physics principles of self-organization in open* *systems are missing for understanding how to assemble the cell's component into an information-based functioning "machine"*."[133]

The present engineering tactic is to construct the mechanical systems following a pre-designed plan to achieve fashionable and financially viable ways of satisfying the predetermined preferred objectives.[144] Such machines can execute a narrow range of definite odd jobs by connecting the parts that are accurately pre-designed and manufactured based on a particular plan. The design plan aims to achieve the maximum accuracy by utilizing minimum essential parts, without any scope for randomness and errors. Although such an approach is effective and prevailing in modern engineering applications, it cannot be used to assemble cognitive biological systems (living cells or organisms). Biological systems are excessively complex. Participants in a biological system are flexible, with a high degree of randomness, and might be uneconomical from the current engineering prospective. Nonetheless, scientists in the recent past began realizing that authoritative properties exist that provide the necessary complexity and allow biological systems to execute novel jobs as necessary. These special tasks are unattainable by existing engineering means.[138] To comprehend properly life and its origin, scientists have to overcome this reductionistic mindset. At the moment they are under the false notion that biological systems are also governed by the same laws of logic that are applicable to mechanical and chemical systems. It is therefore essential to properly grasp the distinction between mechanical, chemical and biological objects. What is the difference between a rock, a salt and a living cell? Sripad Bhakti Madhava Puri Maharaja, Ph.D. has given a cogent presentation of this difference in his article "The logic of life".[123] In conclusion of this present section we are presenting those differences in a tabular format below.

	Mechanical System	**Chemical System**	**Biological System**
System analysis	Mechanical system has separable, independent parts. Parts are fully understandable outside their connection within the system of which they are parts.	Parts of a chemical system are both independent as well as dependent. Parts can be isolated separately and then can also be added together. Parts cannot be understood without its relation with another part.	Those parts that can not be separated from a system without destroying it as a working system, can no longer be called parts but are participants or members of a dynamic whole.
Relationship between system constituents	(1) Parts are related externally. (2) Parts do not have an internal relation. Example: Planets relate to each other	(1) Parts are related internally. (2) External relations are formed due to the intrinsic properties of the individual parts of a chemical reaction.	Participants of a biological system exhibit an internal teleological relation. Example: In the absence of RNA, DNA would not be

	externally by gravitational force in the solar system. Gravitational force is also dependent on mass of the planet and not on the composition of the planet.	Example: An acid (say HCl) is intrinsically related to an alkali (say NaOH), which combine to form a neutral salt (say NaCl).	translated into proteins. Similarly, without proteins, the needed reactions could not be catalyzed.
Identity	(1) Parts retain the same identity when connected within and isolated from the system. (2) Parts are complete in itself without reference to another part. Example: The identity of a planet is not dependent on other planets of the solar system.	(1) Parts display singular identity when connected within and isolated from the system. (2) Part's identity or definition as an isolated entity is incomplete and can only be understood in its relation with another part. Example: A substance is acidic only in relation to alkaline substances.	(1) Participants do not possess isolated identities. (2) Participants are identified only in their mutual relations. Example: The constituents of a living cell (DNA, RNA, Protein, Enzymes, etc) only retain their identities when they are the participating members of a functional cell and not otherwise.
Unifying principle	External forces	Chemical bonds	Sentience

Conclusions

A biological system is not a machine-like a gathering of superficially assembled parts. A serious attempt is very much essential towards a new comprehensive understanding of the concept of the biological system as a whole. In a biological system the participants are dedicated to the whole, and the whole too, survives in each of its participants. As explained above, many contemporary researchers have already started recognizing each organism as a sentient unit or organic whole. This can be understood as the scientific confirmation of the ancient Eastern *Vedantic* philosophical concept of *atma*, Aristotle's concept of Soul and Hegel's explanation of Concept. *Vedantic* scholars, Aristotle, Kant (using the argument of teleology) and Hegel all claimed that biological systems (organisms) are distinct from inanimate objects (mechanical and chemical systems).[123] Purpose and meaning are inseparable aspects of life. We cannot expect those in dead molecules. We don't give any moral and ethical importance to an accumulation of dead molecules, but such a consideration is a must to the life principle. Hence, abiogenesis is an insult to the life force. There are several ethical problems attached to abiogenesis.[145] Scientific recognition of sentience in the organisms has seriously dented the reductionistic picture of the organism as a mere accumulation of biochemicals. Advanced scientific research is continuously providing an abundance of new scientific data. However, all of that has failed to provide any tangible elucidation as to what actually constitutes consciousness and what are its factual characteristics. Abiogenesis, Darwinism and post-Darwinism do not have sufficient tools to accommodate cognitive phenomena in a sentient biological system and hence they do not have very promising prospects. Therefore, both origin and evolution of life must be rewritten on the basis of sentience. Objective evolution is a misconception that biologists must overcome and should instead find the proper tools to explain the evolution from the realm of sentience. The book *Subjective Evolution of Consciousness*[146] composed by Srila Bhakti Raksak Sridhar Dev-Goswami Maharaja will be an appropriate guide for this endeavor.

The participants in a biological system come into view or grow out of the germinal organism and reveal the manner in which the biological system as a whole relates to its environment. This establishes that life can only come from life. Moreover, evidently each species of life produces their unique biochemicals. The inanimate objects (dead chemicals) don't display sentience. Sentience is a unique property observed only in biological systems (animated objects). This in turn establishes the fact that there must be an original sentient being from whom the life forms and their related matter have emerged. This is also a confirmation of the *Vedantic* conclusion depicted in the second aphorism of the *Vedanta sutra* and its commentary in the first verse of *Srimad Bhagavatam*: *janmady asya yato 'nvayad itaratas cartheshv abhijnah svarat* – the origin of everything is "*abhijnah svarat*" – the unitary Supreme Cognizant Being. These interesting advancements in modern science are leading us towards an authentic scientific understanding of the reality of nature and origin of life. For the benefit of humanity, sincere scientifically minded scholars should overthrow the misconceived reductionistic ideology of deep rooted materialism, and should carry forward further studies on these purely scientific, rational explanatory viewpoints.

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