



## Communicative & Integrative Biology

ISSN: (Print) 1942-0889 (Online) Journal homepage: <http://www.tandfonline.com/loi/kcib20>

# Life and consciousness – The Vedāntic view

Bhakti Niskama Shanta

To cite this article: Bhakti Niskama Shanta (2015) Life and consciousness – The Vedāntic view, Communicative & Integrative Biology, 8:5, e1085138, DOI: [10.1080/19420889.2015.1085138](https://doi.org/10.1080/19420889.2015.1085138)

To link to this article: <http://dx.doi.org/10.1080/19420889.2015.1085138>



© 2015 The Author(s). Published with license by Taylor & Francis Group, LLC  
Bhakti Niskama Shanta



Accepted online: 09 Oct 2015.



Submit your article to this journal [↗](#)



Article views: 381



View related articles [↗](#)



View Crossmark data [↗](#)

Full Terms & Conditions of access and use can be found at  
<http://www.tandfonline.com/action/journalInformation?journalCode=kcib20>

# Life and consciousness – The Vedāntic view

Bhakti Niskama Shanta\*

Sri Chaitanya Saraswat Institute; Govinda Shetty Palya, Konappana Agrahara; Electronic City, Bengaluru, Karnataka, India

In the past, philosophers, scientists, and even the general opinion, had no problem in accepting the existence of consciousness in the same way as the existence of the physical world. After the advent of Newtonian mechanics, science embraced a complete materialistic conception about reality. Scientists started proposing hypotheses like abiogenesis (origin of first life from accumulation of atoms and molecules) and the Big Bang theory (the explosion theory for explaining the origin of universe). How the universe came to be what it is now is a key philosophical question. The hypothesis that it came from Nothing (as proposed by Stephen Hawking, among others), proves to be disembling, since the quantum vacuum can hardly be considered a void. In modern science, it is generally assumed that matter existed before the universe came to be. Modern science hypothesizes that the manifestation of life on Earth is nothing but a mere increment in the complexity of matter — and hence is an outcome of evolution of matter (chemical evolution) following the Big Bang. After the manifestation of life, modern science believed that chemical evolution transformed itself into biological evolution, which then had caused the entire biodiversity on our planet. The ontological view of the organism as a complex machine presumes life as just a chance occurrence, without any inner purpose. This approach in science leaves no room for the subjective aspect of consciousness in its attempt to know the world as the relationships among forces, atoms, and molecules. On the other hand, the Vedāntic view states that the origin of everything material and nonmaterial is sentient and absolute (unconditioned). Thus, sentient life is primitive and reproductive of itself – *omne vivum*

*ex vivo* – life comes from life. This is the scientifically verified law of experience. Life is essentially cognitive and conscious. And, consciousness, which is fundamental, manifests itself in the gradational forms of all sentient and insentient nature. In contrast to the idea of objective evolution of bodies, as envisioned by Darwin and followers, Vedānta advocates the idea of subjective evolution of consciousness as the developing principle of the world. In this paper, an attempt has been made to highlight a few relevant developments supporting a sentient view of life in scientific research, which has caused a paradigm shift in our understanding of life and its origin.

## Introduction

Following a reductionist approach, there is a general consensus among biologists that the body of an animal is being held up by muscles, bones, tendons, and so on. However, despite the presence of these anatomical parts, without consciousness, the body will collapse on the ground. Hence, consciousness is a force within the body and only when it is conscious it will stand up and perform its usual activities. The moment consciousness leaves, the body collapses. The concept of awareness (an activity of consciousness) is of major interest for anaesthesiologists, and in this branch of science, it is believed that unconsciousness brings the forgetfulness of pain. However, when patients undergo deep ether anesthesia, on recovery, some could not recall their surgery or the discussion, but some develop new psychological symptoms. In a while, after full recovery and under hypnosis, it is found that some patients recall the spoken word, identify speech, and interpret meaning. In some

**Keywords:** artificial intelligence, brain, consciousness, cell sentience, Darwinism, machine, mind, origin of life, organism, teleology

© Bhakti Niskama Shanta

\*Correspondence to: Bhakti Niskama Shanta; Email: bns@scsiscs.org

Submitted: 07/07/2015

Revised: 08/16/2015

Accepted: 08/17/2015

<http://dx.doi.org/10.1080/19420889.2015.1085138>

This is an Open Access article distributed under the terms of the Creative Commons Attribution-Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. The moral rights of the named author(s) have been asserted.

cases it may lead to life-threatening psychological trauma.<sup>1</sup> In other words, in a living body, it is not just the molecules, bones, tissues and so forth that are all in all. The body has a foundation upon consciousness.<sup>2</sup>

By metaphorically assuming an organism as a machine, biologists try to come to terms with many of its properties and features. Following this approach, biologists have only made an attempt to discover the physical properties and chemical processes of different biomolecules present within the body of a living organism. Such mechanical *investigations* of living organisms have always failed to provide any successful mechanical *explanations* of living organisms. Therefore, such a reductionistic analysis is just a pretension to study life, but in actuality it only deals with the study of dead matter (*abiology*). 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.”<sup>3</sup> Noble prize winner, Szent-Györgyi also brilliantly presented the outcome of the mechanistic view of an organism:

“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.”<sup>4</sup>

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 arrangement of dead atoms and molecules. In the ancient eastern philosophy based on the Vedāntic or Bhagavat paradigm, for example, the invocation of *Srī Īsopanisad*

provides the concept of ‘Organic Wholism’:<sup>5</sup> “*omī pūrnam adah pūrnam idamī pūrnat pūrnam udacyate pūrnyasya pūrnam ādāya pūrnam evāvāśisyate* – 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 or chemical processes, not living organisms.” A similar conclusion was made by Rudolph Virchow in 1858, “*omnis cellula e cellula*” (“every cell comes from a cell”).<sup>6</sup> 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. The 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. Driesch 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.”<sup>7</sup>

This spectacular realization of the concept of nuclear-cytoplasmic interaction and nuclear equivalence finally forced Driesch to reject the vision of the living organism as a physical machine. Examining natural history, researchers have also reported that many living organisms never evolved into different novel anatomical structures; rather, they continued unaltered, even over a period of hundreds of millions of years.<sup>8</sup> This non-changing aspect of an organism is known as stasis in the fossil record. In molecular genetics, organisms deliberately and aggressively act to correct or destroy random mutational changes.<sup>9</sup> Many similar observations in the literature establish that species preservation is a natural characteristic of life.

Life’s ability to preserve its own species offers a significant challenge to Darwinian gradualism. Living organisms exhibit many such overtly noticeable goal-oriented or teleological activities (self-determination, self-formation, self-preservation, self-reproduction, self-restitution and so on), which make them distinct from insentient mechanical and chemical systems. Darwin’s *Origin of Species* invokes natural selection to explain the goal-driven activities of the living organisms, but insists that random mutations are exclusively responsible for the gradual but steady appearance of more complicated organisms. This irrational inability to scientifically explain how novel body types arise in study of life and its evolution is the major deficiency of Darwinism.<sup>10</sup> Despite that, right from mid 19th century to the last few decades of 20th century, biology witnessed a complete dominance of this Darwin-imposed mechanistic insentient picture for sentient living organism. Such an incorrect representation of life (mechanistic insentient picture for sentient living organism) can be called *abiology*. On the other hand, as we will discuss in this paper, 21st century biology strongly presents the case for the sentient nature of all living organisms, thus rejecting any major role for Darwinian objective evolution and trying to understand the evolution of sentience. The present article is an attempt to elaborate how earlier ruled out concepts of genuine biology have been again substantiated by empirical evidence.

## Ubiquity of Consciousness

In the seventeenth century, the French philosopher René Descartes claimed that only the human body has a soul, and all other organisms are mere automatons made of meat and bones. In Descartes’ words “Animals are like robots: they cannot reason or feel pain.”<sup>11</sup> In *Introduction to Animal Rights*, Gary Francione describes the anticipated consequences of this Cartesian view.

“Descartes and his followers performed experiments in which they nailed animals by their paws onto boards and cut them open to reveal their beating hearts. They burned, scalded, and mutilated animals in

every conceivable manner. When the animals reacted as though they were suffering pain, Descartes dismissed the reaction as no different from the sound of a machine that was functioning improperly. A crying dog, Descartes maintained, is no different from a whining gear that needs oil.”<sup>12</sup>

Based on this ideology, many innocent animals are treated cruelly on a daily basis for the purpose of food, entertainment, research, and profit. Influenced by such a line of thought, most of the scientists were also thinking that only humans are conscious and all other creatures are not. However, the ubiquity of consciousness in all living organisms is an attractive alternative. The Cambridge Declaration on Consciousness in Non-Human Animals was publicly proclaimed and signed by leading scientists at the First Annual Francis Crick Memorial Conference in 2012.<sup>13</sup> Moreover, Anthony J. Trethewey and František Baluška state that “consciousness in its many forms could well be ubiquitous, even down to the simplest of organisms.”<sup>14</sup> They discuss the various published results that establish the presence of consciousness in varieties of organisms, even in those which do not have brain organ (plants and unicellular organisms like bacteria). Eshel Ben-Jacob was a pioneer in the study of bacterial intelligence and social behaviors of bacteria. Ben-Jacob has stated that all organisms, and even the most primitive (fundamental) ones, must be able to sense the environment and perform internal information processing for thriving on latent information embedded in the complexity of their environment.<sup>15</sup> He then proposed that by acting together, bacteria can perform this most elementary cognitive function more efficiently, as can be illustrated by their cooperative behavior. The fundamental (primitive) elements of cognition in such systems include interpretation of (chemical) messages, discrimination between internal and external information, and some self *versus* non-self distinction (peers and cheaters).<sup>15</sup> Unicellular organisms display learning, memory, anticipation, risk management, and other aspects of cognitive behavior.<sup>16</sup> Therefore, strong evidence from cellular biology is forcing the biologists to accept that even the smallest cells are sentient beings.<sup>17</sup>

## Individual Cell Sentience in Each Cell of Multicellular Organisms

We must note that not only the unicellular organisms display cognitive behavior, but that even individual cells in the multicellular organisms exhibit individual cognitive behavior. Gametes of the multicellular living entities display sentient-like cell-cell communication and chemotaxis.<sup>18</sup> Sperm cells and oocytes use several cognitive transmitters.<sup>19</sup> Even plant cells have the sensory perceptions and the ability to integrate these multiple sensory perceptions into adaptive actions.<sup>20</sup> The plant cells and neurons in other multicellular organisms produce sentient action potentials.<sup>21</sup> Root cells of plants exhibit sentient features at the transition zone interpolated between the apical meristem and elongation region.<sup>22</sup>

There is also ample empirical evidence that establishes cell sentience from the perspective of cell functions. Cells can cognitively read their environment, analyze the received information and then execute the necessary action to continue their survival.<sup>23</sup> This coordinated cell action is known as cell signaling, which substantiates the possibility that the cell too has a mind. Living cells regulate practically every cell function, including DNA synthesis, RNA synthesis, protein synthesis, cell division, cell differentiation, morphogenesis, and neuroendocrine regulation.<sup>24</sup> Cells cognitively monitor different cellular processes and if there is either a mistake or a damage, a cell can detect the problem. A cell activates a checkpoint and stops the entire cycle until all has been set accurately to further advance the cycle.<sup>25</sup> Cells execute programmed cell death where they perform suicide by following an organized cascade of events, known as apoptosis.<sup>26</sup> Cells of multicellular organism use various cell receptors for various functions. To coordinate the functions in cell communities, they use the integration-receptors which respond to information signals. In different environments, using intercellular signaling molecules cells can select and execute various essential actions.<sup>27</sup> Identity receptors are also known as self-receptors, or histocompatibility-receptors, and they help the cells to have individual and collective identity.<sup>28</sup> Therefore, they help

the cellular communities to collectively respond to a central command – and are used by the immune system in the multicellular organisms to discriminate the self from the invader.

We should not be under the misconception that biologists are the only ones with a monopoly on the study and understanding of life. In this regard, Schrödinger can be an inspiration for all. Although a quantum physicist and, not a biologist, Schrödinger in 1944 wrote a classic monograph entitled, *What is life?*<sup>29</sup> The structure of the material carrier of information from one life form to another (genetic information) and living organisms feeding upon their negative entropy are the 2 well known ideas of Schrödinger in *What is life?* In this essay and some other works, Schrödinger also developed his thoughts on the nature of consciousness and Self, specifically from a Vedāntic perspective. Quoting Vedānta, Schrödinger was mainly trying to explain that consciousness is only one, singular, identifiable with its universal source (*Brahman*) and he believed that the perceived spatial and temporal plurality of consciousness is merely an appearance or illusion (*māyā*). However, it is a common misconception that is found among the monists (Sripad Adi Shankaracharya's *Kevala Advaita* or *Māyāvādā* philosophy) in Indian Vedāntic tradition. The verse 2.12,<sup>30,31</sup> from *Śrīmad Bhagavad-gīta* completely refutes the idea of singularity of consciousness, where *Bhagavān* Sri Krishna says to Arjuna: “*na tv evāhaṃ jātu nāsaṃ na tvam neme janādhipāḥ na caiva na bhaviṣyāmah sarve vāyam atah param* – Never was there a time when you, I or all these kings did not exist, just as we exist in the present, so have we existed in the past, so shall we continue to exist in the future.” Therefore, according to the Vedāntic view, the plurality of individuals is an eternal fact, and it is confirmed in other Vedic sources (*Kaṭha Upaniṣad* 2.2.13 says: *nityo nityānām cetanaś cetanānām* – We are eternal, we are many, and Supreme Absolute is also eternal, but He is one) and by authentic teachers like Sripad Ramanuja Acharya and other Vaiṣṇava Ācāryas. *NPR* also reported in 2010, “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. . ."<sup>32</sup> Apart from our own individuality, we must also accept the individualities of all those microbes on and in our bodies. We cannot deny the individuality of all those microbes, by stating that their individuality is mere illusion (*māyā*). In the healthy body of a multicellular organism, every individual cell, despite having its own individuality, is meant to work for the welfare of the whole body. Similarly, Vedānta advocates that we are living in an 'Organic Whole' and every individual unit of this whole is meant to dedicate itself for the satisfaction of the Center – the *ādi-puruṣa* or primeval personal Absolute. In contrast to Darwinism, symbiogenesis proclaims that life did not take over the globe by competition, but by cooperation. In the body of an organism, there are different organs like heart, kidneys, lungs and so on, which perform different tasks 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. Evidence in symbiotic exchanges 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 many modern evolutionists.

### Cell Sentience Challenges Neo-Darwinism

In his book, *Evolution: A View from the 21st Century*,<sup>33</sup> James A. Shapiro, Professor in the Department of Biochemistry and Molecular Biology at the University of Chicago, provided ample examples where molecular biology has recognized cell cognition from cell sensing, information transfer, decision-making processes. In this book Shapiro, thoroughly dismisses the traditional Neo-Darwinian evolution theory that is widely accepted by biologists. In Darwinism, organisms are often assumed as optimally designed machines blindly engineered by natural

selection. However, based on cell cognition, Shapiro challenges that view:

"Given the exemplary status of biological evolution, we can anticipate that a paradigm shift in our understanding of that subject will have repercussions far outside the life sciences. A shift from thinking about gradual selection of localized random changes to sudden genome restructuring by sensory network-influenced cell systems is a major conceptual change. It replaces the "invisible hands" of geological time and natural selection with cognitive networks and cellular functions for self-modification. The emphasis is systemic rather than atomistic and information-based rather than stochastic." (Page 145 in).<sup>33</sup>

In recent time Neo-Darwinian evolution theory is facing several challenges from various corners<sup>34,35</sup> and hence, it is the right time to find the proper alternative explanation for biological evolution, based on cognitive principles.

### What Algorithms Cannot Do

Even though 21st century biology has established that from humans to the smallest cells (bacteria without brain organ), all living organisms are conscious entities, several enthusiastic propositions in the field of Artificial Intelligence (AI) claim that by simulating the neuronal network in the brain, we can produce conscious machines. Often referred to as the Turing test, an imitation game proposed by Alan Turing in 1950, is taken as the litmus test of machine intelligence in Strong AI. In this test, an interrogator asks questions to a human being and a machine, and if the interrogator fails to distinguish between human and machine, then the machine is declared as intelligent.<sup>36</sup> Searle used the Chinese Room argument to establish that the Turing test is not the proper means to assess machine intelligence.<sup>37</sup> In a Chinese room, a man who does not understand Chinese language can translate the incoming and outgoing messages in Chinese by simply executing pattern replacements following the rules. Chinese observers outside the room may feel that whatever is in the room passes the Turing test by communicating in Chinese, but in reality the

man in the room has no real understanding about the meaning of that conversation. In this way Searle explained that a machine may pass the Turing test but this does not guarantee that it has developed thinking, understanding or the ability to grasp meaning. On the other hand, certain living organisms have the ability to grasp meaning and such ability cannot be produced in machines by any computer program.

With the ample empirical evidence and emphasis of the halting problem (is there a program which determines whether any given algorithm halts for a given input?), Sir Roger Penrose (a mathematician and physicist at Oxford University) has also explained the non-algorithmic nature of mind, in his book *The Emperor's New Mind*.<sup>38</sup> In his book, he continually highlights that mental processes are intrinsically more potent than computational processes. Penrose asks "Can an algorithm discover theorems like Turing's and Gödel's?" Our minds may come up with solutions to different questions for which there is no general algorithm. Therefore, we must know what algorithms cannot do.

### Consciousness Beyond Computational Modeling

The "identity theory" explains that the states and processes of the mind are alike states and processes of the brain. Therefore, scientists and philosophers following the concept of identity theory believe that the brain secretes thought like the liver secretes bile.<sup>39</sup> However, despite all their knowledge on the brain scientists still do not know how the neural correlates coalesce to produce subjective experiences. Like geneticists, neurologists also presume that there is a "neural code"<sup>40</sup> that represents the mind of the organism and helps the brain managing synaptic modulation over wide areas of the cortex. However, neurologists do not know whether coding is performed by individual neurons or by nervous system.<sup>41</sup> They believe that the complex brain function is as simple as the operation of a man-made machine – robot – and therefore they hope that in the future, they will be able to control living organisms just like robots.<sup>42</sup> In the brain, coding occurs in context and

hence, the meaning aspect should be considered strictly in the context of the subject's behavior. An individual living entity selects according to its behavior only those aspects of neural firing that make sense for its behavior. Different qualitative and quantitative stimulus attributes of sentient living organisms are represented by different neural codes – and therefore, unlimitedly, many neural codes are necessary. Apart from the behavior of organism whose brain is under study, interpretations of neural action are also very much influenced by the brain states of the neuroscientists. Eggermont explains this difficulty:

“The information encoded in a train of neural action potentials is interpreted by higher order neurons and it is also interpreted by the neuroscientist who designed and performed the experiments. There need not be any correspondence between these two interpretations. The interpretation by the neuroscientist, however, may be influenced by the ruling paradigm in the particular field of research.”<sup>43</sup>

Therefore, it is not clear whether any neural code exists in reality, or whether it is only in the minds of neurologists. As Erlich stated:

“Extensive investigation of the brain's synaptic connectivity, the presumed material basis of cognition, has failed to explain how the brain thinks. Further, the neural code that purportedly allows the brain to coordinate synaptic modulation over wide areas of cortex has yet to be found and may not exist.”<sup>44</sup>

Code, by its meaning, is a predetermined representation of information that is independent of the sender, receiver, and mechanisms of transmission.<sup>45</sup> Influenced by the concept of neural coding and decoding, neurologists think the brain as an information processing system. Tononi has tried to explain consciousness with a theoretical framework, the “Integrated Information Theory of Consciousness (IITC).”<sup>46</sup> Tononi thought that the human brain integrates information, and that is why it produces conscious behavior. The foundation of Tononi's IITC is based on 2 thought experiments: (1) the generation of information and (2) the integration with previous memories (integrated information). The main point that Tononi emphasized in his first

thought experiment is that the explanations of experience necessitate a situation where they distinguish between several possible choices; in other words, they must generate information. In his second thought experiment, Tononi explains that information alone is not enough for conscious experience. It is possible to increase the capacity of artificial smell detectors, where they can distinguish between smells much more than humans (>10,000). However, the mere producing of more information than that of a human nose cannot provide the artificial smell detectors the ability to experience the smell the way humans do. Tononi explained that the major difference between artificial detector and human experience is that in the case of the artificial detector, each aroma is detected in seclusion of every other aroma. Even if the entries of other aromas (except the one detected) are deleted from the database of the machine, we will find exactly the same response by the artificial detector. The human nose has different neurons which are specifically equipped to sense particular smells. It may be possible that by selective damage of certain olfactory receptors an individual may lose the ability to smell a particular aroma. In the case of human subjects, even though the process of detection of a particular aroma is not itself integrated, the experience of smell is thoroughly integrated concerning the type of information it records in response. When someone smells a particular aroma, the effect that it has on a subject's brain is integrated across many aspects of his/her memory and it is impossible for a neurosurgeon to eliminate the memory of that experience without affecting anything else. The reductionistic view of consciousness finds its limits here, because the changes in the memory caused by the subject's experience are not localized on any one part of his/her brain. Computation is reversible but cognition is not,<sup>47</sup> and that is why Maguire et al.<sup>48</sup> stated.

“[A] form of magic is going on in the brain, which is beyond computational modeling.”

Conscious behavior is an outcome of integrated information in the mind, and those conscious responses cannot be decomposed or disintegrated into a set of

causally independent parts. The failure to create machines that can produce integrated information is the reason why scientists in this field believe that machines can never develop the ability to have subjective experience. Consciousness is a fundamental property of animated objects – ‘living organisms’ – which distinguishes them from inanimate objects – ‘matter’.

## Self-Organization: Without a Self!

To establish the difference between machine and organism, Neil D Theise has mentioned in his article in *Nature*:

“The dominant metaphor for biological structures—biomolecules, cells, tissues or bodies—has long been that of the machine. Researchers engage in biological ‘engineering’, refer to ‘molecular motors’ and often describe cells as tissue ‘building blocks’. However, biological entities at all levels of scale are not machines. They are not described by classical, Newtonian mechanics. Their behaviors are not deterministic, but stochastic. They are self-organizing, complex, dynamic systems. As such they are creative, adaptive and alive. Success in modeling such biological systems, as demonstrated by Takebe et al., depends on letting them do what they do best. Perhaps a more accurate word to describe the generation of such models is ‘cultivation’ rather than bioengineering.”<sup>49</sup>

This is a good attempt to describe the difference between biological systems and machines, but we must realize that the concept of self-organization was first developed in chemistry and physics and its direct application to a living system is highly doubtful. In 1977, Ilya Prigogine received the Nobel Prize in Chemistry and he claimed that systems significantly out of equilibrium – “dissipative structures” – tend to spontaneously organize themselves. Prigogine cited the vortex (say a tornado in thunderstorm) as an example of self-organization.<sup>50</sup> When a stable mass of dry and cold air travels over a stable mass of humid and warm air, a severe thunderstorm or tornado can develop. The thunderstorm or tornado has a localized higher degree of organization than is present in either of the air masses alone.

Following such analogies and examples of self ordering molecules during an influx of energy, a few biologists have tried to explain the origin of highly complex macromolecules essential for living systems. However, such analogies have negligible bearing toward addressing the question of life, as Prigogine stated: “There is still a gap between the most complex structures we can produce in nonequilibrium situations in chemistry and the complexity we find in biology.”<sup>51</sup> Such simple analysis can never address the complexity of even a simple living cell. Prigogine confirms the same:

“The problem of biological order involves the transition from the molecular activity to the supermolecular order of the cell. This problem is far from being solved.”<sup>52</sup>

Even 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 (sentience). Can self-organization theory address all these requirements? The main problem is that a physical analysis can only elucidate the structure and function of a system as characterized from an external viewpoint. However, living organisms are conscious systems and their subjective experiences are within. Therefore, even though it is named as self-organization, this reductionistic concept has no ‘self’ at all. For the last 9 years under the guidance of our *Siksha Gurudev* Sripad Bhakti Madhava Puri Maharaja, Ph.D. (Serving Director, Bhakti Vedanta Institute: www.bviscs.org and Founder of Sri Chaitanya Saraswat Institute: www.scsiscs.org), we are trying to spread the Vedāntic concept of Life among the scientists via university outreach, seminars, conferences, publications and online discussions. One of his statements is very much relevant in the present context of self-organization:

“From the reader’s perspective, a book is composed of alphabetical letters; but the book itself did not originate from these letters. Ultimately it is from the ideas

of the author that the letters of the book come to be. In the same way, the molecules of a biological organism are the result, not the origin of life. This is the difference between the order in which we come to know things (*ordo cognoscendi*) and the order in which something comes to be (*ordo essendi*).”

### Differences Between Organisms and Artifacts: Living Organisms are Beyond Design

German philosopher Immanuel Kant explained the concept of “natural teleology” or “natural purpose” or “natural end” (*Naturzweck*).<sup>53</sup> To distinguish the living organisms from artifacts, Kant explained that for both the cases, 2 different necessary conditions are satisfied for ends. The condition applicable for ends is that “the parts. [be] possible only through their relation to the whole” or each part exists “for the sake of the others and of the whole.”<sup>53</sup> In the designer’s concept of the whole, this condition is satisfied in the case of artifacts by a linear causality. The legs and the seat of a chair or balance wheel, hairspring, gear system and so on in a watch, can exist only in virtue of designer’s concept of the whole. In other words, the legs of the chair or the hairspring of the watch exist only in order that the chair or watch as a whole exist. In the case of the living organisms (*Naturzweck*) this condition is satisfied in the form of a circular causality of the organic whole: “the parts [must] combine themselves into the unity of a whole by being reciprocally the cause and effect of one another’s form.”<sup>53</sup> External forces are the unifying principle in an artifact, but, in the case of a living organism, the unifying principle is sentience. Even though in both artifacts and living organisms, the ends are determined by purpose (a cognitive act), the difference is that in the case of artifacts, the purpose (designer) is outside the system (external teleology), and in the case of a living organism, the purpose is within (internal teleology). Following a linear logic in the case of artifacts, parts are produced and combined into a whole by the designer. On the other hand, following a circular logic, the body of the living

organism appears from another living organism by a developmental process (cell division) and not by the linear accumulation of parts – design.

Even though the attempt toward mechanization of nature served as an important driving force behind the scientific revolution, it also created an image of a clockwork universe set in motion by an intelligent first cause. Such machine analogy is also applied to living organisms. However, the view that a supernatural being, God,<sup>54</sup> is external to living organisms and that He imposes form on matter from the outside (intelligent design) is also reductionistic, and shows a logical fallacy. The logic of *extrinsically* purposive systems (machines) cannot be applied to *intrinsically* purposive systems (living organisms). The Vedāntic view offers a scientific alternative: “‘Organic Wholes’ produces ‘organic wholes’ and an ‘organic whole’ cannot arise from parts that have to be mechanically assembled. The process of externally assembling parts can only produce inorganic, mechanical machines or chemical processes, not living organisms.”<sup>55</sup> Empirical evidence shows that every living cell comes from a living cell and there is no single evidence that shows a case where a living cell appears from the external assembly/accumulation of biomolecules. The Vedāntic alternative is that an immanent subjective process within a single cell *zygote* produces varieties of cells that are necessary for different functions in the body of a particular species. Vedānta advocates that different forms originate from the *ādi-puruṣa* or primeval personal Absolute, and in the reflected material sphere, the various species of life are subject to a developing principle of evolution of consciousness.

Life (*Naturzweck*) also has a fundamental “formative force” (*bildende Kraft*) that is responsible for an organism’s self-causing character. It is impossible for a designer to produce an artifact with the 2 fundamental characters (*Naturzweck* and *bildende Kraft*) that life has. As Kant explained, “one wheel in the watch does not produce another, and still less does one watch produce other watches.”<sup>55</sup> In a living organism, the complex biomolecules are not just there for the sake of each other, but they also produce each other,

maintain each other, and are dedicating units of an organic whole. Therefore, unlike machines, the generation, properties, and functions of the parts of an organism cannot be understood independently from the organism as a whole. The empirical evidence in frontier biology also confirms Immanuel Kant's statement: "there will never be a Newton of the blade of grass, because human science will never be able to explain how a living being can originate from inanimate matter."<sup>56</sup> For confirmation, in his book *This is Biology*, 20th century's leading evolutionary biologist Ernst Mayr wrote:

"It is a little difficult to understand why the machine concept of organism could have had such long lasting popularity. After all, no machine has ever built itself, replicated itself, programmed itself, or been able to procure its own energy. The similarity between an organism and a machine is exceedingly superficial."<sup>57</sup>

Abiogenesis and the theory of evolution explain that the first life came from the accumulation of inert matter and that biodiversity is a result of random mutation and natural selection. Evolutionary theory and the principles in biology are applied directly to behavior, and they avoid psychological or cognitive level analysis. Both abiogenesis and evolution theory are outcomes of mechanistic or reductionistic thinking and that is why they cannot explain how organisms have cognitive features like thinking, feeling and willing. These concepts also do not explain how matter developed the 2 fundamental characteristics that life has (*Naturzweck* and *bildende Kraft*). Therefore, both the origin and evolution of life must be rewritten on the basis of sentience.

### A Brief Introduction to Vedāntic View on Body, Consciousness and Soul

In biology, the predominant ontological view of the organism is that of a complex machine programmed by its genetic software and decomposable into its component mechanisms. However, through her work on transposons, Nobel laureate Barbara McClintock has established that

genes are not the foundational concept of life.<sup>58</sup> Crick predicted that if a single case of unknown transfers of the central dogma is occurring in nature, then it would shake the foundations of biology.<sup>59</sup> Twenty first century biology witnessed that the foundation of biology has been shaken hard, which put the cell and the organism back to the center stage. There are no genomic or other molecular units for life.<sup>60</sup> The genetic substance itself is a dynamic structure and functions as a co-participating member in an organic whole. In contrast to Darwinism, 21st century biology accepts that life is a totality of organism, environment and nature.<sup>61</sup> It is a web of life and no organism can be considered in isolation. Continually mounting evidence thoroughly challenges the common consensus that genes determine living function.<sup>62</sup> Therefore, life must be considered from a different perspective in a call for a new biology which, to us, will be assigning a fundamental role to consciousness in order to account for its subject-object unity.<sup>63</sup> Biology must include higher concepts like intelligence, mind, desire and freewill for studying what really determines the organism and biodiversity.

The central tenet of Vedānta (also known as *Vedānta-sūtra*) is that everything is dependent upon an original sentient/conscious foundation or self-knowing absolute truth. The first aphorism of *Vedānta-sūtra* states that under the guidance of a spiritually realized being, we must inquire into our true nature as spirit (*athāto brahma jijñāsā*). The second aphorism of *Vedānta-sūtra* provides the initial indication of how to begin this inquiry (*janmādy asya yatah*). *Janma* means birth, *asya* refers to everything (entire cosmos which includes both matter and life) and *yatah* means 'from whom'. Therefore, to begin the inquiry into our true nature, we must first inquire into the original source of everything. *Śrīmad-Bhāgavatam* is considered as a natural supplementary commentary on the *Vedānta-sūtra*. The first verse of *Śrīmad-Bhāgavatam* elaborated the commentary of the second aphorism of *Vedānta-sūtra* (*janmādy yato n̄vayād itarataś cārthesv abhijñāh svarāt*). "*Janmādy asya yatah*" – the origin of everything is "*abhijñāh svarāt*" – the unitary Supreme Cognizant Being. This

Vedāntic explanation that unitary Supreme Cognizant Being is the source of everything is founded on 2 scientifically verifiable axiomatic facts: (1) Life comes from Life, and (2) Matter comes from Life. Consciousness arises from consciousness, or life comes from life. Where there is life there is consciousness. Consciousness does not originate from that which is unconscious or impersonal, and life is not a product of insentient matter. The conception that life comes from life (biogenesis) is the only scientific idea that has ever been verified by experiment and observation. The second axiomatic fact 'Matter comes from Life' is apparently observable in nature. Every species produces their own chemicals necessary within their bodies. 'Life comes from Life', and 'Matter comes from Life' are 2 scientifically observable deductions from Vedānta. On the other hand, materialism (life originates from matter) is an unverified ideological presupposition that has no scientific or observation-based evidence to support it.

*Śrīmad Bhagavad-gītā* (BG) is one of the most important books in Indian philosophy and religion. BG in a capsule form describes the entire Vedāntic philosophy right from the understanding of the soul (*ātman*) to the understanding of the ultimate purpose of life. In BG<sup>30,31</sup> 13.34 it is written: "*yathā prakāśayaty ekah kṛtsnaṁ lokam imam̄ ravih̄ ksetraṁ ksetrī tathā kṛtsnaṁ prakāśayati bhārata* – O son of Bharata, as the sun alone illuminates all this universe, so does the living entity, one within the body, illuminate the entire body by consciousness." Therefore, according to BG, consciousness is the inferential proof or symptom of existence of the soul (*ātman*) or the living entity. Consciousness is absolutely necessary for the living body to be what it is and to function as it does. We can all experience consciousness and according to BG the soul (*ātman*) is the seat or the origin of consciousness. According to Vedānta, there are 2 types of consciousness (finite and infinite consciousness) that co-exist in the body of a living organism. We can witness voluntary functions (the action that are apparently under the control of our mind) and involuntary functions in the living organisms. The things that we appear to control are due to our



consciousness coming from our soul (*ātman*) and that which are not in our control (involuntary functions: complex cellular functions, heart beats, autonomous signals, and so on) are controlled by higher consciousness coming from *Paramātmā* (super soul). Hence, *Paramātmā* (source of infinite consciousness) is also known as the ground or sustainer of the *ātman* (finite consciousness).

There are terms in science that we cannot perceive directly by our senses. We cannot taste, smell, touch, see and hear entities like force, energy, electron, quarks, and so on. Scientists explain to us many such terms using inference and we accept them as scientific proof. When an apple falls down from a tree, we infer that there is a gravitational force that pulled the apple down. We never ask for a direct observation of the gravitational force itself. Similarly, although scientists cannot sensually perceive the soul (*ātman*), still they can infer its existence just from the presence of consciousness in all biological systems. As the presence of the sun can be inferred from the sunlight, similarly existence of the soul (*ātman*) can also be understood from the presence of the different varieties of consciousness in various living organisms. Doctors can keep patients survive on ventilators and even they can replace the heart with an artificial heart running with a battery. Sometimes, it is possible to keep an organism functioning by electrical equipment outside the body, but the organism is unconscious – showing no EEG activity, in a vegetative state. Remove the equipment and the organism cannot maintain even that function. Then, what is supplying the organism's energy for functioning when the machines are disconnected and it has to function independently? Vedāntic scriptures explain it is the soul (*ātman*) that does all the work of the machines in maintaining the organism's functioning, plus supplying the order and sentient awareness within the body. We can supply the energy by some machines to maintain the body but we cannot make a body conscious with those machines.

According to Vedānta, the soul (*ātman*) possesses the qualities of *sat*, *cit* and *ānanda*. All life exhibits these same qualities. Every living organism wants to

maintain its life forever (*sat*) and is willing to engage in the struggle for existence until it is forced by the laws of material nature to succumb to physical death of the body. The fact that life goes on generation after generation for thousands or millions of years is not something we would expect in chemical or physical material processes. It is sentient or conscious (*cit*) and seeks knowledge in the human form. And all life seeks fulfillment (*ānanda*) through nutrition, and various other forms according to the spiritual development of the various qualities of the soul (*ātman*) within the different bodies. All these different symptoms give evidence for the existence of the spiritual soul (*ātman*), for they are certainly not the qualities of matter. Matter, as it is known in modern science in terms of physical and chemical properties, does not have sentience or consciousness. Even though the same chemicals are present in the dead body as in the living one, we do not find life or sentient quality in a dead body or a dead cell. Even though the same biochemicals are present in both the cases, the complex biochemical reactions that occur in a living cell do not take place in a dead cell. To provide a valid explanation to these observations, the soul (*ātman*) hypothesis certainly offers a good possibility, because according to BG, the soul (*ātman*) does have the property of consciousness. Modern science has not yet approached that area of knowledge and only focused its studies on insentient matter. Due to a gross negligence to the area of sentient science, modern science finds itself at an impasse when it tries to understand biology, which deals with mind or consciousness.

Vedānta holds that different forms (species) are original archetypes that accommodate different varieties of consciousness through which the transmigration of the soul (*ātman*) takes place on the basis of the evolution of consciousness. The body is a biological illusion of the consciousness of the soul (*ātman*) and from an amoeba to a human being, all the different varieties of forms are representations of different stages of conditioned consciousness. Following an endless cycle of birth and death ('transmigration of the soul' or *Metempsychosis* in Greek), the soul (*ātman*) keeps on wandering in different

grades of conditioned states of consciousness (subjective evolution of consciousness) by obtaining a body suitable to that consciousness until it attains the pure consciousness.

Unless a designer or an external agent interferes, a machine always consists of the same material stuff. Unlike a machine, a living organism displays a transitional material identity. The constituent materials of the body of the living organism are under constant change, yet the organization of the whole and its identity remain. The body of a living organism is in a state of continuous flux in which there is creation, maintenance (replacement) and destruction of its constituent material stuff by the processes of anabolism, metabolism and catabolism. Dr. Jonas Frisé, a stem cell biologist at the Karolinska Institute in Stockholm used carbon dating to estimate the age of human cells.<sup>64</sup> He used Carbon dating method on tissues instead of individual cells, because a single cell does not have enough <sup>14</sup>C to signal its age. Scientists believe that the DNA is stable after a cell has gone through its last cell division. Therefore, they use <sup>14</sup>C level on the DNA as a date mark for when a cell was born.<sup>65</sup> In his experiments, Jonas Frisé used the assumption that most molecules in a cell are continually being changed but the DNA is not. Dr. Frisé's experimental data suggested that our body is many years younger than our age – for instance, a middle aged person's body may be just 7-10 years old or less.<sup>66</sup> As the body is under constant replenishment, Vedānta explains that bodily identity of self is illusory. Verse 2.13 of BG explains that there is soul within the body, which is unaffected by the bodily changes:

*dehino 'smin yathā debe  
kaumāraṁ yauvanaṁ jarā  
tathā debhāntara-prāptir  
dhīras tatra na muhyati*

Translation: As the embodied soul continuously passes, in this body, from boyhood to youth to old age, the soul similarly passes into another body at death. A self-realized soul is not bewildered by such a change.

Our body was in the state of a single cell zygote when it first came into existence and by miraculous embryological development it has acquired a child body.

By several changes, it has acquired its present state and it will further change to acquire its future state. Therefore, our body is in a constant state of flux, like a river. The Vedāntic view of the principle of reincarnation (*metempsychosis*) can be found in its nascent form in the changing of our body, from the child body, to the youth body, to the old body. We can scientifically observe that our body is already changing several times in our lifetime itself, and in a similar manner at the time of death, the eternal soul (*ātman*) will go to another body under certain conditions.

According to *Saṅkhya* philosophy, there are 2 types of bodies: (1) *Sthūla-deha*: The gross body—the body that can be sensed by hearing, smelling, tasting, seeing, and touching, and (2) *Sūkṣma-deha*: The subtle body (within the gross body) – mind (*manasā*), intelligence (*buddhi*) and false ego (*ahaṅkāra*). In the gross body, the senses are primary and if they are removed, no world is apparent to us. Above the senses is the mind (*manasā*) and it is the supreme ruler of the senses. If we are not mindful of the sense objects, then even though something is moving in front of our eyes we cannot see it. The mind basically deals with acceptance (*saṅkalpa*) and rejection (*vikalpa*)—the faculty of understanding, or holding thoughts in their separation/distinction as either/or. And, above the mind is the teleological reason or intelligence (*buddhi*), which is the inferential faculty determining if/then. The mind can determine something, but it is the intelligence that helps an individual to come to a decision to accept something or not. The false ego (*ahaṅkāra*) is the identification of the self with the body and the bodily identities (nation, cast, color, creed and so on). The mind, intelligence, ego are dependent on the soul (*ātman*). The soul (*ātman*) consciously experiences and interacts with the gross matter through a subtle body (mind, intelligence and false ego).

BG states that at the time of death, the soul (*ātman*) leaves the gross body, but it does not leave the subtle body. The transmigration of the soul (*ātman*) is described in BG 8.6: *yamī yamī vāpi smaran bhāvāni tyajaty ante kalevaram tam tam evaiti kaunteya sadā tad-bhāva-bhāvitaḥ* – “The soul (*ātman*) obtains a body in next life

based on the consciousness in which it left the previous body.”

Considering a machine analogy of the living organism, abiogenesis and evolution theory in biology do not include these subtle elements when it studies living organisms. It excludes mind, intelligence and false ego. Obviously, consciousness is untouched in those theories. Vedāntic literature explains that wherever life is present, the soul (*ātman*) is there within and following the ‘laws of karma’ the soul (*ātman*) in human body may obtain bodies of nonhuman species and vice versa. By advancement, the soul (*ātman*) can obtain the human form, and by degradation it can also go back to other forms of life. The soul (*ātman*) is endowed with freewill and by misutilizing freewill, a soul (*ātman*) may do many misdeeds. The acquired reactions from those misdeeds are known as karmic reactions. ‘Laws of karma’ check the freewill of the soul (*ātman*) by providing new bodies and throwing into different suffering conditions. This ancient theory of evolution is based on the subjective evolution of consciousness<sup>67</sup> and the Darwinian objective evolution theory of bodies is a perverted representation of this ancient wisdom. In Darwinism, evolution means transformation of bodies, and in Vedāntic view evolution means transformation of consciousness. Twenty first century biology also 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.

## Conclusions

1. In a living cell proteins can distinctively catalyze a chemical reaction or identify an antigen not only because their amino acids are arranged in a particular manner, but also because their 3-dimensional structure and function are controlled by sentient living cell. Cell functioning cannot be explained by reducing it to any single

molecule like, DNA, RNA or Protein. The reductionistic view in biology finds its limits and biology should shift its lens from the parts to the whole.

2. Science has witnessed that biology has evolved from DNA-centrism (central dogma) to cell-centrism, where cells operate in a sentient manner which a few biologists are trying to compare with information processing, while on the other hand, some try to see it as computational result. However, none of these explanations include the sensory feature of how cells act. All these developments give the impression that cells possess a mind which is the essential character of cognition. In contrast to genetic determinism, scientific evidence is forcing the scientists, philosophers and other scholars to reconsider the explanations of cognition as traditionally associated with life. In his book, *Evolution: A View from the 21st Century*, James A. Shapiro has stated: “The selected cases just described are examples where molecular biology has identified specific components of cell sensing, information transfer, and decision-making processes. In other words, we have numerous precise molecular descriptions of cell cognition, which range all the way from bacterial nutrition to mammalian cell biology and development. The cognitive, informative view of how living cells operate and utilize their genomes is radically different from the genetic determinism perspective articulated most succinctly, in the last century, by Francis Crick’s famous “Central Dogma of Molecular Biology”.(Page 24 in<sup>53</sup>)
3. Consciousness is ubiquitous in all living organisms, starting from bacteria to human beings.
4. The individual cells in the multicellular organisms are also individually cognitive entities.
5. The scientific confirmation of the existence of consciousness in unicellular organisms and plants certainly establishes that the brain is not the source of consciousness. Several decades back, research in medical science has also proven

that the brain is not the source of consciousness. In 1970, Robert White and his team successfully transferred the head of a rhesus monkey to the headless body of another monkey. The monkey survived for 8 days.<sup>68</sup> Researchers are also attempting to perform the same scenario with human beings.<sup>69</sup> It is reported that if a human head has been detached under controlled conditions, it must be reconnected to the circulatory flow of other person's body (which is conscious or living) within one hour.<sup>70</sup> Therefore, brain-based analysis for understanding consciousness (neuronal analysis) does not have very bright prospects.

6. Using the brain analogy, some scientists consider the cell nucleus (because DNA and genes are within the cell nucleus) as an equivalent to the brain of a cell. Cells can sustain an enucleation operation (the operation in which a cell's nucleus is removed). In fact, cells are found to be more robust toward brain removal than multicellular organisms. It has been reported that enucleated cells continue to survive and display a regulated control of their biological processes for up to 3 months.<sup>71,72</sup> Therefore, for both single-cell and also multicellular organisms, the brain is not the source of consciousness.
7. The information approach and self-organization principles are not sufficient to explain life and its origin.
8. Proposals like "artificial life," "artificial intelligence," "sentient machines" and so on are only fairytales because no designer can produce an artifact with the properties like internal teleology (*Naturzweck*) and formative force (*bildende Kraft*). In other words, a machine will never do things for its own internal purpose and it cannot build itself.
9. The material origin of life and objective evolution are only misconceptions that biologists must overcome. Biologists should instead find the proper tools to explain the origin and

evolution of life from the realm of sentience.

10. Our attitude is shaped by the way our education has conditioned us to think about the world. To teach that Man is simply an enclosed membrane of chemicals affects how people think about themselves as spiritual beings, and thus it influences the way they think about such concerns as abortion, euthanasia, bioethics in research and medicine, cloning, genetic modification of food, animal rights, and so on. The Vedāntic scholars, Aristotle, Kant (using the argument of teleology) and Hegel have all claimed that biological systems (organisms) are distinct from inanimate objects (mechanical and chemical systems). Purpose and meaning are inseparable aspects of life, similarly as consciousness. We cannot expect those in dead molecules. We do not give any moral and ethical importance to an accumulation of dead molecules, but such a consideration is a must for the life principle. Hence, abiogenesis is an insult to the life force. To understand life and its origin, one must also give a proper attention toward the ancient Eastern Vedāntic philosophical concept of *ātman*, Aristotle's concept of Soul, and Hegel's explanation of the Concept.

#### Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

#### Acknowledgments

The author's *Diksha Gurudev* Srila Bhaktisvarupa Damodara Maharaja (Dr. T.D. Singh, Founding Director – Bhaktivedanta Institute) inspired him to work on the most fundamental topics in science such as 'Origin of Matter and Life', 'Origin of Universe', and 'Consciousness'. The author sincerely acknowledges the blessings and guidance of his *Siksha Gurudev* Sripad Bhakti Madhava Puri Maharaja, Ph.D. toward developing the concepts to prepare this paper. He is also thankful for valuable inputs of Sripad Bhakti Vijnana Muni Maharaja, Ph.D. (President, Sri Chaitanya Saraswat

Institute) and Samuel Buchoul during the preparation of this paper. Sincere thanks also to the Editor-in-Chief of the Journal and the reviewers for their valuable comments and suggestions toward the improvement of the presentation of this paper.

#### Funding

This work is partially supported by: Prof. Kanchan Chowdhury, Head, Cryogenic Engineering Center, Indian Institute of Technology, Kharagpur, India; Dr. Ashok K. Mishra, Assistant Professor, Glenn Department of Civil Engineering, Clemson University, USA; Bharath Cherukuri, Sri Ramachandra Medical College and Research Institute, Chennai, India; Yasheswari Didi, Leiden, Netherlands; Pradyumna Prabhu, Mumbai, India; Sandeep Krishna Prabhu & Damayanti Didi, Hyderabad, India.

#### References

1. Levinson BW. States of awareness during anaesthesia. *British J Anaesthesia* 1965; 37:544-6; <http://dx.doi.org/10.1093/bja/37.7.544>
2. Maturana HR. Biology of cognition. In *Autopoiesis and cognition* (eds Maturana HR, Varela FJ), Dordrecht, The Netherlands: Reidel, 1970; 1-58
3. Needhama J. The skeptical biologist. London: Chatto & Windus, 1929; page 82
4. Szent-Györgyi A. What is life? In the Physical basis of life. Del Mar, CA: CRM Books, 1972; page 5
5. Prabhupada ACBS. Śrī Īsopanisad. Bhaktivedanta Book Trust, 1969
6. Tan SY, Brown J. Rudolph Virchow (1821–1902): Pope of pathology. *Singapore Med J* 2006; 47:567-78; PMID:16810425
7. Driesch H. Analytische Theorie de organischen Entwicklung. W Engelmann, Leipzig 1894
8. Williamson PG. Morphological stasis and developmental constraint: real problems for neo-Darwinism. *Nature* 1981; 294:214; <http://dx.doi.org/10.1038/294214a0>
9. Fijalkowska IJ, Schaaper RM, Jonczyk P. DNA replication fidelity in *Escherichia coli*: a multi-DNA polymerase affair. *FEMS Microbiol Rev* 2012; 36(6):1105-21; PMID:22404288; <http://dx.doi.org/10.1111/j.1574-6976.2012.00338.x>
10. Wagner GP, Vincent JL. Evolutionary novelties. *Current Biol* 2010; 20:R48-52; <http://dx.doi.org/10.1016/j.cub.2009.11.010>
11. Proctor HS, Carder G, Cornish AR. Searching for animal sentience: A systematic review of the scientific literature. *Animals* 2013; 2:882-906; <http://dx.doi.org/10.3390/ani3030882>
12. Francione G. Introduction to animal rights: Your child or the dog? Temple University Press, 2000
13. The First Annual Francis Crick Memorial Conference: <http://fcmconference.org>
14. Trewavas AJ, Baluška F. The ubiquity of consciousness: The ubiquity of consciousness, cognition and intelligence in life. *EMBO Rep* 2011; 12:1221-5; PMID:22094270; <http://dx.doi.org/10.1038/embor.2011.218>
15. Ben-Jacob E, Shapira Y, Tauber AI. Seeking the foundations of cognition in bacteria: from Schrödinger's negative entropy to latent information. *Physica A* 2006;

- 359:495-524; <http://dx.doi.org/10.1016/j.physa.2005.05.096>
16. Baluška F, Mancuso S. Deep evolutionary origins of neurobiology. *Communicative Integrative Biol* 2009; 2 (1):60-5; <http://dx.doi.org/10.4161/cib.2.1.7620>
  17. Shapiro JA. Bacteria are small but not stupid: cognition, natural genetic engineering and socio-bacteriology. *Stud Hist Phil Biol Biomed Sci* 2007; 38:807-19; <http://dx.doi.org/10.1016/j.shpsc.2007.09.010>
  18. Hu JH, Yang N, Ma YH, Jiang J, Zhang JF, Fei J, Guo LH. Identification of glutamate receptors and transporters in mouse and human sperm. *J Andr* 2004; 25:140-6
  19. Bray C, Son JH, Kumar P, Meizel S. Mice deficient in CHRNA7, a subunit of the nicotinic acetylcholine receptor, produce sperm with impaired motility. *Biol Repr* 2005; 73:807-14; <http://dx.doi.org/10.1095/bioreprod.105.042184>
  20. Trewavas A. Response to Alpi et al.: Plant neurobiology – all metaphors have value. *Trends Plant Sci* 2007; 12:231-3; PMID:17499006; <http://dx.doi.org/10.1016/j.tplants.2007.04.006>
  21. Fromm J, Lautner S. Electrical signals and their physiological significance in plants. *Plant Cell Environ* 2007; 30:249-57; PMID:17263772; <http://dx.doi.org/10.1111/j.1365-3040.2006.01614.x>
  22. Baluška F, Mancuso S, Volkmann D, Barlow PW. Root apices as plant command centres: The unique brain-like status of the root apex transition zone. *Biologia* 2004; 59:9-14
  23. Brandman O, Ferrell JE, Li R, Meyer, T. Interlinked fast and slow positive feedback loops drive reliable cell decisions. *Science* 2005; 310:496-8; PMID:16239477; <http://dx.doi.org/10.1126/science.1113834>
  24. Hartwell LH. Twenty-five years of cell cycle genetics. *Genetics* 1991; 129:975-80; PMID:1783298
  25. McAdams HH, Shapiro L. System-level design of bacterial cell cycle control. *FEBS Lett* 2009; 583:3984-91; PMID:19766635; <http://dx.doi.org/10.1016/j.febslet.2009.09.030>
  26. Bursch W. The autophagosomal-lysosomal compartment in programmed cell death. *Cell Death Differ* 2001; 8:569-81; PMID:11536007; <http://dx.doi.org/10.1038/sj.cdd.4400852>
  27. Lane N. Marine microbiology: origins of death. *Nature* 2008; 453:583-5; PMID:18509414; <http://dx.doi.org/10.1038/453583a>
  28. Langman RE. Cell-mediated immunity and the major histocompatibility complex. *Rev Physiol Biochem Pharmacol* 1978; 81:1-37; PMID:417392; <http://dx.doi.org/10.1007/BFb0034090>
  29. Schrödinger E. *What is life?* Cambridge University Press, Cambridge, 1944
  30. Sridhar BR. Śrīmad Bhagavad-gītā: The hidden treasure of the sweet Absolute. Sri Chaitanya Saraswat Math 2006
  31. Prabhupada ACBS. Bhagavad-gītā as it is. Bhaktivedanta Book Trust, 1972
  32. Bacterial bonanza: Microbes keep us alive. NPR; <http://www.npr.org/templates/story/story.php?storyId=129862107> Accessed 07 July 2015
  33. Shapiro JA. *Evolution: A view from the 21st century*. Upper Saddle River, NJ: FT Press, 2011
  34. Raoult D, Koonin EV. Microbial genomics challenge Darwin. *Front Cell Infect Microbiol* 2012; 2:127; PMID:23091803; <http://dx.doi.org/10.3389/fcimb.2012.00127>
  35. Kuhn JA. Dissecting Darwinism. *Proc Bayl Univ Med Cent* 2012; 25:41-7; PMID:22275784
  36. Turing AM. Computing machinery and intelligence. *Mind* 1950; LIX(236)
  37. Searle JR. Minds, brains, and programs. *The Behavioral and Brain Sciences* 1980, 3:417-57; <http://dx.doi.org/10.1017/S0140525X00005756>
  38. Penrose R. *The emperor's new mind*. Oxford University Press, 1989
  39. Place UT. Is consciousness a brain process? *Brit J Psychol* 1956; 47:44-50; PMID:13304279; <http://dx.doi.org/10.1111/j.2044-8295.1956.tb00560.x>
  40. Bialek W, Rieke F, de Ruyter van Steveninck RR, Warland D. Reading a neural code. *Science* 1991; 252:1854-7; PMID:2063199; <http://dx.doi.org/10.1126/science.2063199>
  41. Barlow H. The neuron doctrine in perception. In *The Cognitive Neurosciences*, Ed Gazzaniga MS, MIT Press, Cambridge, MA, 1995; 415-35
  42. Delgado JMR. *Physical control of the mind. Toward a psychocivilized society*. Harper and Row, New York, 1969
  43. Eggermont JJ. Is there a neural code? *Neuroscience Biobehavioral Rev* 1998; 22:355-70; PMID:9579325; [http://dx.doi.org/10.1016/S0149-7634\(97\)00021-3](http://dx.doi.org/10.1016/S0149-7634(97)00021-3)
  44. Erlich VM. Cognition without a neural code: How a folded cortex might think by harmonizing its own electromagnetic fields. *Einstein J Biol Medicine* 2011; 27 (1):34-47
  45. Kreiman G. Neural coding: computational and biophysical perspectives. *Phys Life Rev* 2004; 1:71-102; <http://dx.doi.org/10.1016/j.plev.2004.06.001>
  46. Tononi G. Consciousness as integrated information: a provisional manifesto. *Biol Bull* 2008; 215:216-42; PMID:19098144; <http://dx.doi.org/10.2307/25470707>
  47. Bringsjord S, Zenzen M. Cognition is not computation: The argument from irreversibility. *Synthese* 1997; 113:285-320; <http://dx.doi.org/10.1023/A:1005019131238>
  48. Maguire P, Moser P, Maguire R, Griffith V. Is consciousness computable? Quantifying integrated information using algorithmic information theory. In: Bello P, Guarini M, McShane M, Scassellati B (eds), *Proc 36th Ann Conf Cogn Sci Soc. Cognitive Science Society, Austin, TX, 2014*
  49. Theise ND. Assessing the potential of induced liver regeneration. *Nat Med* 2013; 19:1096-7; PMID:24013747; <http://dx.doi.org/10.1038/nm.3325>
  50. Prologine I. *The end of certainty*. The Free Press, New York, 1996; page 3
  51. Prologine I. *The end of certainty*. The Free Press, New York, 1996; page 71
  52. Prigogine I, Stengers I. *Order out of chaos*. New York, Bantam Books, 1984; page 175
  53. Ginsborg H. *The normativity of nature: Essays on Kant's critique of judgement*. Oxford University Press, 2015; page 318
  54. Scott EC, Matzke NJ. Biological design in science classrooms. *Proc Natl Acad Sci USA* 2007; 104(Suppl 1):8669-76; PMID:17494747; <http://dx.doi.org/10.1073/pnas.0701505104>
  55. Ginsborg H. *The normativity of nature: Essays on Kant's critique of judgement*. Oxford University Press, 2015; page 319
  56. Kant I. *Kritik der Urteilskraft*. 1790; <http://gutenberg.spiegel.de/buch/3507/85>
  57. Mayr E. *This is biology: The science of the living world*. The Belknap Press of Harvard University Press, 1997
  58. McClintock B. *The significance of responses of the genome to challenge*, Nobel lecture, Carnegie Institution of Washington, Cold Spring Harbor Laboratory, New York, USA, 8 December, 1983
  59. Crick F. Central dogma of molecular biology. *Nature* 1970; 227:561-3; PMID:4913914; <http://dx.doi.org/10.1038/227561a0>
  60. Shapiro JA. *Genome informatics: The role of DNA in cellular computations*. *Biological Theory* 2006; 1 (3):288-301; <http://dx.doi.org/10.1162/biot.2006.1.3.288>
  61. Noble D. *The music of life: Biology beyond the genome*. Oxford: Oxford University Press, 2006; page 176
  62. Ford BJ. Are Cells ingenious?. *Microscope* 2004; 52(3/4):135-44
  63. Stern DS. *Essays on Hegel's philosophy of subjective spirit*, State University of New York Press, 2012; Page 206
  64. Spalding KL, Bhardwaj RD, Buchholz BA, Druid H, Frisén J. Retrospective birth dating of cells in humans. *Cell* 2005; 122:133-43; PMID:16009139; <http://dx.doi.org/10.1016/j.cell.2005.04.028>
  65. Spalding KL, Arner E, Westermarck PO, Bernard S, Buchholz BA, Bergmann O, Blomqvist L, Hoffstedt J, Näslund E, Britton T, et al. Dynamics of fat cell turnover in humans. *Nature* 2008; 453:783-7; PMID:18454136; <http://dx.doi.org/10.1038/nature06902>
  66. Heinrichs A. Age discrimination. *Nat Rev Mol Cell Biol* 2005; 6:672; <http://dx.doi.org/10.1038/nrm1730>
  67. Sridhar BR. Subjective evolution of consciousness – The play of the sweet Absolute. Sri Chaitanya Saraswat Math 1989
  68. White RJ, Wolin LR, Massopust LC, Jr, Taslitz N, Verdura J. Primate cephalic transplantation: neurogenic separation, vascular association. *Transplant Proc* 1971; 3:602-4; PMID:4999463
  69. Canavero S. Heaven: The head anastomosis venture Project outline for the first human head transplantation with spinal linkage (GEMINI). *Surgical Neurol International* 2013; 4:S335-42; <http://dx.doi.org/10.4103/2152-7806.113444>
  70. White RJ. *Head Transplants*. *Scientific American* 1999; 10:24-6
  71. Hämmerling J. Nucleo-cytoplasmic interactions in Acetabularia and other cells. *Ann Rev Plant Physiol* 1963; 14:65-92; <http://dx.doi.org/10.1146/annurev.pp.14.060163.000433>
  72. Chapman CJ, Nugent NA, Schreiber RW. Nucleic acid synthesis in the chloroplasts of *Acetabularia mediterranea*. *Plant Physiol* 1966; 41:589-92; PMID:5932403; <http://dx.doi.org/10.1104/pp.41.4.589>