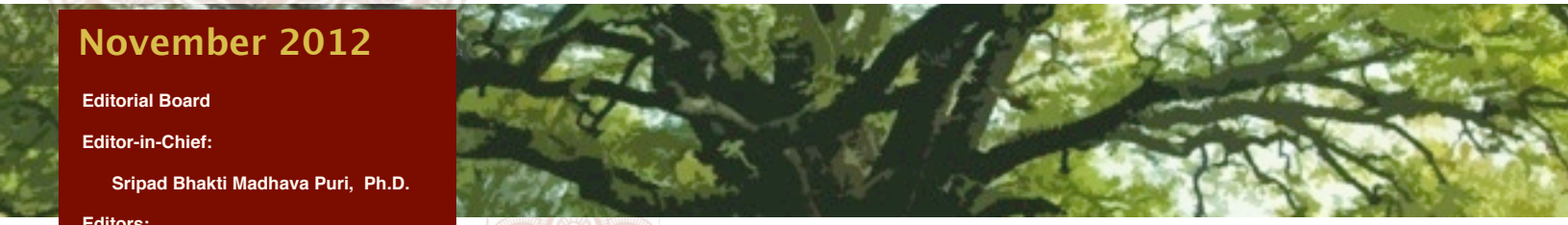
Sri Chaitanya Saraswat Math

Bhakti Vedanta Institute

THE HARMONIZER

Science, Philosophy, Religion, and Art

All Branches of the Same Tree of Knowledge



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The Science of Spiritual Biology

Bhakti Madhava Puri, Ph.D.

> Living systems are cognitive systems, and living as a process is a process of cognition.
>
> H.R. Maturana, *The Biology of Cognition* (1970/1980)

Applied mathematician, Samuel Arbesman, is an expert in scientometrics, the science of science, or metascience, and he has written a very recent book, *The Half-life of Facts: Why Everything We Know Has an Expiration Date*, (Sept. 2012), in which he investigates the frequency of changes in scientific facts, paradigms or theories. Knowledge in different fields of science evolves in systematic and predictable ways, and such changes have a powerful impact on our lives.

The massive accumulation of data on the bio-molecular constituents and processes in living organisms has really only begun in the last few decades. Powerful new instruments for better observing the microscopic world of the cell, and techniques for studying its dynamics have only recently become available. In the world of Darwin in 1853, when he wrote his *Origin of Species*, nothing was known about DNA or genes, proteins, enzymes, or cellular organelles. Even Mendel's discoveries of the heritable traits which he found in his experiments with pea plants in 1866, were unknown to or disregarded by Darwin and others at that time. It was not until the beginning of the 20th century that the significance of Mendel's work became recognized and the scientific discipline of genetics was established.

In his book, *Darwin's Black Box: The Biochemical Challenge to Evolution* (1966/2006), Michael Behe posed the question whether Darwin would propose his theory of evolution by natural selection today, if he had all the information we currently know about the living organism. Knowledge of the internal workings of the cell was almost completely lacking for Darwin, thus for him the cell was basically a "black box." His understanding of heredity was based on the vague conception of *pangenesis*, which was generally believed at that time, a blending of factors throughout the cells of both parents. This was shown to be wrong by Mendel's discoveries of what eventually became known as genes, localized discrete units produced from a DNA template.

Today, that concept of "gene" is now evolving into a more dynamic and inclusive conception. A tentative definition of a gene is now "a union of genomic sequences encoding a coherent set of potentially overlapping functional products." Gerstein Mark B. et al. (2007). "What is a gene, post-ENCODE? History and updated definition". *Genome Research* 17 (6): 669–681. The reason is that an oversimplified under-standing of living organisms in terms of discrete interacting molecules does not have any actual explanatory significance. Living

organisms are dynamically complex functional entities not reducible to simple mechanical-chemical descriptions.

Darwin wrote in his *Origin of Species*, "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. But I can find out no such case." It was on this point that Michael Behe claimed modern biology could challenge Darwin, due to the presence of "irreducibly complex" structures within living organisms, such as the bacterial flagellum, as well as numerous biological cell processes. These require the cooperative effects of a multiplicity of parts and processes in order to have any functional value for the organism, implying that a successive development would involve contingent intermediate stages that would be of little or no use to the organism.

In 1967 Arthur Kornberg first presented the elucidation of the proofreading and editing functions of DNA polymerase. The remarkable fidelity of the DNA replication process such that only one mistake is made for every 10^9 nucleotides copied, demonstrated the highly regulated and controlled nature of the cell. The reason is that random mutations generally result in debilitating or lethal effects to the cell. The existence of such tightly regulated and controlled systems not only challenges the idea of a sequential evolutionary development of life, but implies that randomness at the cellular level is deleterious or lethal to such systems. The idea that evolution could proceed by way of random mutations in the fundamental genetic makeup of the cell is thus called into serious doubt.

Barbara McClintock, Nobel Laureate in Physiology and Medicine in 1983, was a distinguished cytogeneticist who made many fundamental discoveries in her early years. By the 1950's she discovered what are now known as transposons and the theories that explain how genetic information is used to turn physical characteristics on or off. The implications of her research led her to conclude that the cell was able to 'sense' when changes to its own DNA were necessary under stress. This led to much skepticism and alienation from the scientific community but she persisted, basing her views on her research rather than the consensus prejudices. Thus she concluded:

> Organisms can do all types of things; they do fantastic things. They do everything that we do, and they do it better, more efficiently, more marvelously…. Trying to make everything fit into set dogma won't work…. There's no such thing as a central dogma into which everything will fit…. So if the material tells you, 'It may be this,' allow that. Don't turn it aside and call it an exception, an aberration, a contaminant…. That's what's happened all the way along the line with so many good clues.

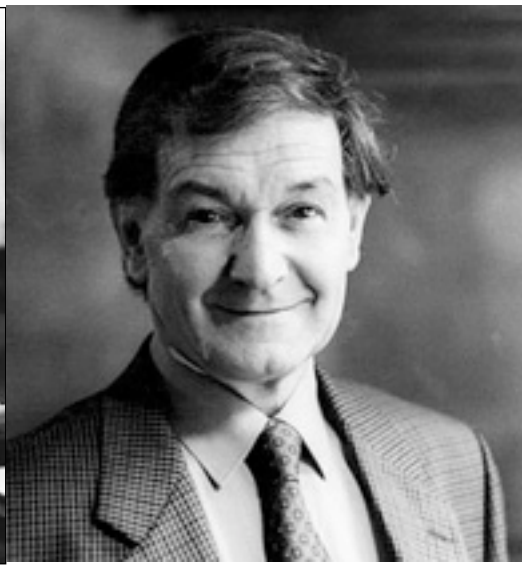
Today, the multidisciplinary field of Cognitive Biology has become an established scientific discipline. Mathematical physicist Roger Penrose wrote in 1994:

> If we are to believe that neurons are the only things that control the sophisticated actions of animals, then the humble paramecium presents us with a profound problem. For she swims about her pond with her numerous hairlike legs — the cilia — darting in the direction of bacterial food which she senses using a variety of mechanisms, or retreating at the prospect of danger, ready to swim off in another direction. She can also negotiate obstructions by swimming around them.

Pictured:

Barbara McClintock 1902-1992 (Right)

Roger Penrose 1931- (Far Right)



> Moreover, she can apparently even learn from her past experiences — though this most remarkable of her apparent faculties has been disputed by some. How is this all achieved by an animal without a single neuron or synapse? Indeed, being but a single cell, and not being a neuron herself, she has no place to accommodate such accessories.
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> *Shadows of the Mind: A Search for the Missing Science of Consciousness* (1994) p.357]

Pamela Lyon, cognitive biologist at the University of Adelaide in Australia reported:

> …what is believed to be the simplest metazoan visual system yet discovered was recently characterized in the larvae of a type of jellyfish, one species of which (the box jellyfish) is the sometimes-fatal scourge of swimmers of the northeastern coast of Australia (Nordstrom et al. 2003). The visual system does not rely on neurons or axonal connections between different cell types or tissue layers. In short, there does not appear to be a mechanism for the exchange of information between cell and tissue types characteristic of animals with nervous systems, yet the behaviour of the larvae is indistinguishable from that of related cnidarians possessing neuron-based vision. The adult form of the box jellyfish has neurons but no brain; nevertheless, it is capable of surprisingly complex differential behaviour. Now we can declare, as did Lamarck, that nothing without a nervous system or a brain can be genuinely cognitive, but whereas this claim previously could be made without argument, I suggest this is no longer the case.
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> Pamela Lyon, "The Biogenic Approach to Cognition," *Cognitive Processing* (2005)

Scientific work on a wide range of cognitive functions in animals, plants, and bacteria can be found online in the recent book, *Cognition and Decision in Non-Human Biological Organisms* (2011). Günther Witzany, *Life: The Communicative Structure, a new philosophy of biology* (2000) provides a perspective on the essential role of communication at all levels of life. These bold new approaches to scientifically understanding life spurn the eliminative materialism of the reductionist school, and try to understand life as it is observed, rather than attempting to fit it into an artificially contrived, presupposed conception.

Oxford University Press has recently published a book by atheist philosopher, Thomas Nagel, entitled, *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False* (2012). The description reads:

> The modern materialist approach to life has conspicuously failed to explain such central mind-related features of our world as consciousness, intentionality, meaning, and value. This failure to account for something so integral to nature as mind, argues philosopher Thomas Nagel, is a major problem, threatening to unravel the entire naturalistic world picture, extending to biology, evolutionary theory, and cosmology.

A concise presentation of how traditional views of evolution are inadequate to explain the latest research findings, can be found in molecular biologist James Shapiro's book, *Evolution: A View from the 21st Century* (2011). This important new book presents the evidence that leads to an interpretation of life as characteristically intelligent, cognitive systems. All these revolutionary perspectives come from scientists working within the scientific community as colleagues, and not from the theistically-oriented section.

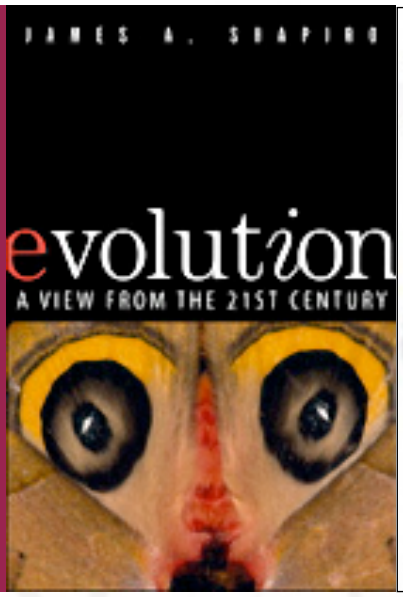
Carl Linnaeus set forth in his *System Naturae* in 1735 a particular form of biological classification. This rank-based taxonomy classified life forms into three kingdoms (Animal, Vegetable, Mineral), divided them into classes, which were further divided into orders, genera and species, following the ideas developed by Plato and Aristotle. It was only later that this system of classification was considered from a new perspective: the ancestral relation of species that was introduced with the idea of evolution. Thus the concept of a Tree of Life was born. At first, the classification scheme was primarily based on morphological and behavioral similarities which were then interpreted as related to evolution. Latter developments in microbiology introduced the field of comparative genetics into what became known as the neo-Darwinian theory of evolution. In many cases, relations established on the basis of morphological similarities were contradicted by the comparative genetic data.

In addition, the discovery of the importance of horizontal gene transfer from the environment undermined the whole concept of the linear descendants of species being understood through progressive internal changes in cells that were thought to explain the branches of evolutionary development. Now species had to be understood as related to each other more as a bush or network, a delicately balanced web of life, in which originally unsuspected micro-organisms played a

Pictured:

James Shapiro, *Evolution: A View from the 21st Century* (Right)

"Why Darwin was wrong about the tree of life," Graham Lawton, *New Scientist, 21 January 2009* (Far Right)



central role in all of life, and under a set of rules unique to them. There is no idea more central to Darwinian evolution than the tree of life, yet this icon of evolution is now gradually being replaced by the concept of a web of life due to the discoveries of the enormous role of bacteria. ["Why Darwin was wrong about the tree of life," Graham Lawton, *New Scientist, 21 January 2009*. "Uprooting Tree of Life," W. Ford Doolittle, *Scientific American, February 2000*.] It is now known that a large percentage of the human organism is composed of bacteria, as is essential for most multicellular organisms. It is the extensive biocommunication network within the biosphere that is the essential factor in keeping us all alive, as Witzany explains in his previously mentioned book. As an English poet wrote, "No man is an island, entire of itself. Each is a piece of the continent, a part of the main." [John Donne, *Devotions upon Emergent Occasions* (1624)]

Just as the cell has gradually come to be understood as a highly regulated and functionally integrated whole, so too is the biosphere now recognized as a finely balanced ecological whole in which local disturbances can create world-wide climatic catastrophe. The oversimplified ideas of biology that characterized the field in its immature beginning led to the theories of a progressive cumulative development or evolution to explain the present state of Nature. However, today, a more mature understanding of biology has brought with it the realization that Nature can not be the product of a gradual development, based only on the reductionist principles of chemistry and physics. In an ideal situation, where there are no strong interactions with the environment, isolated and purified chemicals may react in a mechanically simple manner, but in a living organism there are no isolated molecules. Everything within the cell interacts with everything else. The constituents of a cell are produced by the cell as much as they produce the cell itself. As the German philosopher Immanuel Kant understood, the unique judgment that allows us to identify a living organism as distinct from non-living matter, is that a living organism is both the cause and effect of itself. Thus, the life of a cell, as much as the life of the biosphere, can only be properly understood as an integrated organic whole.

The ancient aphorism of the ***Sri Isopanisad***, *om purnam adah purnam idam*, gives us the root idea of how the creation of Life and Nature comes about through the production of wholes from wholes, and of life from life. It is these empirically verified principles that form the basis of the true science of spiritual biology. And biology should be the scientific study of dynamic life, not merely an analysis of the mechanisms of inanimate matter. Chemistry provides some idea of the processes of material Nature, but insentient matter can never rationally be expected to explain the sentient nature of life. Empirical science is easily applied in trying to understand the object-world or positive pole of reality, but has fared poorly in attempting to comprehend the subject or the negative pole. It would be considered poor science to know about only one pole of a magnet without knowledge of the opposite pole. Yet the subject can also be made object of itself by what is called introspection. This important field of knowledge has been known and carefully studied for centuries in India, but forgotten by modern scientific positivism.

Today, many biologists are being trained in outdated conceptions of biology, by teachers who know nothing else. A 21st century revolution in biological education is needed if this vicious cycle is to be broken. Progress in scientific knowledge benefits by following the sage advice of those like the Bengali saint, Srila Bhaktivinoda Thakur, who wrote in a poem, "The Jiva Soul," *Saragrahi Vaisnava* (1874): "Forget the past that sleeps, and ne'er the future dream at all. But act with times that are with thee, and progress thee shall call."

Srila Bhaktivinoda Thakur