SCIENCE & SPIRITUAL QUEST

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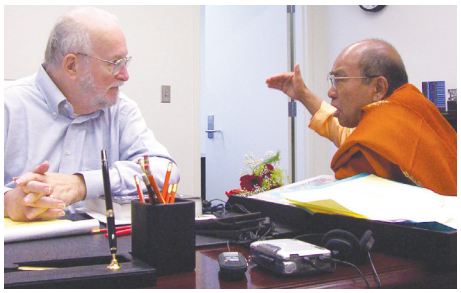
आ नो भद्राः कतवो यन्तु विश्वतोऽदब्धासो अपरीतास उद्भिदः । (ṚgVeda) *Let noble thoughts come to us from every side*

Science-Spirituality Dialogue

Can We Make a Living Cell From the Molecular Soup?



A Discussion with
Paul C. Lauterbur (left),
Nobel Laureate in Chemistry and
Dr. T. D. Singh (right);
Physical Organic Chemist,
Founding-Director of
Bhaktivedanta Institute

Dr. T. D. Singh (henceforth TDS): I have another interesting point of view. Somehow, if we come up with an experiment in which combining all the bio-molecules with the help of a suitable catalytic agent — either imprints or any other say the RNA world, RNA acting as enzymes and as an important molecule — where at some point we could see formation of a living cell or some kind of a precursor to a living cell, then the problem of either spirituality or science could be resolved. I think it's very much possible.

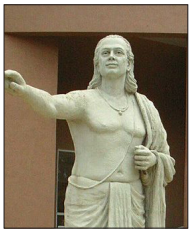
Paul C. Lauterbur [henceforth PCL]: First of all, the understanding of the kinds and conditions of the components of a living cell is still very incomplete and also the way in which things associate does often depend upon the order in which they get together. So when approaching a nucleic acid derived from a cell to be put in an artificial cell, will they interact in the way they do in the sequence of reactions in the real cell? Probably not. So you can't make people from soup. … No one has ever made a bacterium from a collection of different bottles of a little bit of this and a little bit of that and a little bit of the other thing, and put them all together and get a bacterium.

TDS: But some scientists think that one day we'll be able to do that.

PCL: If I had to be really explicit about it I would say first of all we have to show that the necessary small molecules to be assembled into fundamental constituents of living things can be formed without the intervention of living things. … If you have a basic system that has these basic biological properties, what does it take to get them a little more organized? Does that require memory? No, no, no. It requires separating some things from other things. Many hypotheses can

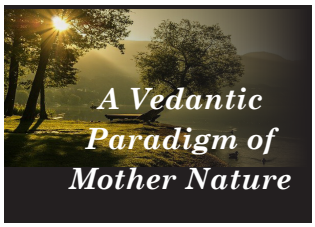
INSIDE

On the SHOULDERS of GIANTS



Āryrabhaṭa

VEDANTA and SCIENCE



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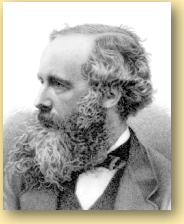

"What is done by what is called myself is, I feel, done by something greater than myself in me."

— James Clerk Maxwell
Founder of Statistical Thermodynamics

To Know about Life, Matter, and their Interactions, is called Knowledge

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be put forward … But first you have to have the opportunity of testing a specific guess for experimental validity. As I like to say, within our Western tradition in general, we personify the world as Mother Nature. You can imagine the Nature as a mother who stands over you in the laboratory and says, "Silly boy, that won't work, weren't you listening to me."

And she's there, she's always ready to say you're just being silly, you have to listen. … But subjecting ideas to the intellectual and experimental discipline, and constant contact with nature at every possible point is the only way to steer through the infinity of possibilities you have or at least as long as the number of combinations of particles in the universe is something like infinity.

TDS: It may be helpful to think seriously how nature is working.

[Excerpt from the book, *Savijnanam* vol-7— *Scientific Exploration for a Spiritual Paradigm,* Bhaktivedanta Institute, Kolkata]

On the Shoulder of Giants

Āryrabhaṭa

Mathematician-Astronomer

Āryrabhaṭa (also known as Āryrabhaṭa I) was one of the greatest mathematician-astronomers of the 5th century. He is well known for innovations of astronomical methods and enunciating his alphabetical number system. His ideas on relativity of motion and space prefigure that of Galileo. He was one of the first astronomers to thoroughly explain the planetary motions through epicycles. He laid the foundation for a new school of astronomy in ancient India called-- the Āryrabhaṭa I School and is known as the father of Indian mathematics and astronomy.

Āryrabhaṭa was born in 476 A.D in the Asmaka region (historian suggests that this could probably be somewhere in Southern India either in Kerala or in the Andhra region) during the reign of the Gupta Dynasty. He later travelled to Kusumpura (Patiliputra or present day Patna, Bihar). Patliputra was a great center for learning, and the famous University of Nalanda was situated there (an astronomical observatory was a unique feature of this University). Āryrabhaṭa was exceptionally brilliant in his scientific thinking and discovered several new laws and principles related to mathematics and astronomy. It is said that Āryrabhaṭa later became Head of a University (Kulapa/Kulapati) and was known as Acharyabhata. Amongst his direct pupils, were the pioneers such as Panduranga swami, Latadeva, and Nihsanka. He is also reputed to have set up an observatory at the Sun temple in Taregana, Bihar.

There are three works of Āryrabhaṭa known to us today, out of which only one is extant in several manuscripts. They are (i) *Arya-Siddhanta*, (ii) *Āryabhaṭiya* .and (iii) *Al-nanf* (Arabic translation of the original work). One of the interesting content of *Arya-Siddhanta* is the chapter—*Yantradhaya*, with details of several astronomical instruments such as: Gnomon (*shanku-yantra*), a shadow instrument (*chhaya-yantra*), possibly angle-measuring devices, semicircular and circular (*dhanur-yantra / chakra-yantra*), a cylindrical stick (*yasti-yantra*), an umbrella-shaped device (*chhatra-yantra*), and water clocks (cylindrical and bow shaped). Āryrabhaṭa 's only extant treatise — *Āryabhaṭiya*, is a Sanskrit treatise of mathematical and astronomical concepts presented in 123 verses (*sutras*). Some of the computational methods discussed herein include algebra, trigonometry, continued

Āryrabhaṭa (476–550 CE)

fraction, quadratic equations, sums-of-power series, and sine tables. Āryrabhaṭa gave the accurate estimate of the value of pi (π) which he concluded as 62732/20000, or 3.1416.

Āryrabhaṭa 's astronomy is one of many firsts. He is the first to describe the Earth as a sphere, and as a planet that rotates about its axis. He is the first to compute the ratio between lunar orbits and rotations of the Earth and calculate the length of the solar orbit. In measuring time, Āryrabhaṭa determined that the length of a year is 365 days, six hours, 12 minutes, 30 seconds, an extremely close calculation to the modern standard of 365 days, six hours. Thus, Āryrabhaṭa 's remarkable works have been said to have opened the doors to a scientific approach to astronomy and mathematics that continues to capture the interest of several enquirers. In honor his magnificent work in the field of astronomy, the first Indian satellite and a lunar crater carries the name of Āryrabhaṭa.

Āryrabhaṭa 's life and works also give a glimpse of the divinity of scientific knowledge. The Vedic scriptures such as *Ṛgveda*, *Surya Siddhanta* and *Sulbasutras* are a vast ocean of knowledge of mathematics and astronomy. Āryrabhaṭa based his work on the main principles laid down in the old *Surya Siddhanta* (the oldest treatise on astronomy given by Sun God himself). In *Āryabhaṭiya,* he states, "By the grace of Supreme Brahman, the precious jewel of excellent knowledge (of astronomy) has been brought out by me by means of the boat of my intellect from the sea of true and false knowledge by diving deep into it." In his commentary on the *Āryabhaṭiya*, Bhaskara I writes : " This Acarya worshipped the Supreme Brahman by severe penance. So, by His grace was revealed to him the true knowledge of the subjects pertaining to the true motion of the planets. Thus Āryrabhaṭa believed that scientific knowledge is not just about observation and experimentation but one also has to enhance his intuition (and creativity) by chastening the intellect through divine grace.

Āryrabhaṭa 's devotion to the Supreme Brahman was indeed of a high order. Like many other Vedic sages and scholars, Āryrabhaṭa opined that the goal of every discipline of knowledge is the attainment of the Supreme Brahman, and the study of astronomy could help achieve this. In the closing stanza of the *Dasagitika-sutra*, he says : "Knowing this *Dasagitika-sutra*, the motion of the Earth and the planets, on the celestial sphere, one attains the Supreme Brahman after piercing through the orbits of the planets and the stars." Thus Āryrabhaṭa 's scientific quest was not just an intellectual journey but a sacred duty to serve the highest purpose of life.

Vedanta & Science

A Vedantic Paradigm of Mother Nature

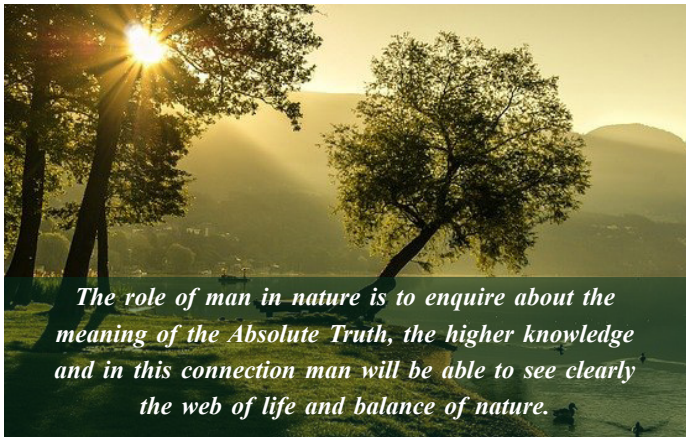
From the dawn of civilization man has always been interested in the mysteries of nature. But what is nature? The definitions of nature will be as variegated as nature itself. For generations, many thinkers have contemplated about nature with their own limited conceptions. Pascal, the French mathematician and philosopher stated, "Nature has perfections in order to show that she is the image of God." The American theologian Edwards remarked, "Nature and revelation are like God's books; each may have mysteries, but in each there are plain practical lessons for every-day duty."

The ancient view of nature has been dominated by the religious concept that nature is a product of God and one should respect nature and its variegated manifestations. However, with the advent of scientific revolution from around the sixteenth century, man's thinking about nature has changed significantly. The discovery of the gravitational law, the laws of physics and chemistry, the laws of mechanics — classical as well as quantum — and the laws of genetics, conceiving the big bang theories of the origin of the universe, life and so on are all attempts to find a deeper grasp of the hidden principles of nature. However in his deep-rooted quest for finding secrets of nature, man has faced immeasurable paradoxes and puzzles based on thought experiments and scientific experiments.

A characteristic feature that has emerged out of this long historical development is the recognition that there is a need to add to the modern epistemological equation other factors such as will, faith, morality, hope, intuition, forgiveness and many other non-mechanistic elements of nature. Being beyond empiricism, these have to be derived from spiritual experiences.

According to Vedantic paradigm there are two aspects of nature — material nature, which is composed of non-conscious entity or matter, and spiritual nature, which is composed of conscious entities, i.e. living beings, including man. Science tries to reduce the higher to the lower, the reductionist approach.

The dominant Western scientific and philosophical paradigm made its best effort to achieve this goal for the last two thousand years. Unfortunately, nature does not yield to the dictates of the scientific mind. The unanimous concern of theists and atheists, materialists and spiritualists, machinists and non-machinists worldwide, about the eco-system, is a clear indication that the mechanistic paradigm needs a drastic change.



In the phenomenal cosmos, nature is a whole and everything else including man is a part. In this paradigm, the Supreme Being is the cause of all causes, *sarva-kāraṇa kāraṇam*, and therefore nature is a teleological system.

In the *Bhagavad-Gitā* (9.10) Lord Krishna explains:

mayādhyakṣeṇa prakṛitiḥ sūyate sa-carācaram
hetunānena kaunteya jagad viparivartate

Translation: This material nature, which is one of My energies, is working under My direction, O son of Kunti, producing all moving and non-moving beings. Under its rule this manifestation is created and annihilated again and again.

Among all products of nature, man is given the highest importance. The first aphorism of *Vedānta-sūtra* states, *athāto brahma jijñāsā*, 'In the human form of life one should inquire about Brahman, the Absolute Truth' — implying that the importance of man in nature is to enquire about the nature of Absolute Truth. The role of man in nature is to enquire about the meaning of the Absolute Truth, the higher knowledge and in this connection man will be able to see clearly the web of life and balance of nature. Then solutions to ecological problems could be conceived. Thus, there is a need for synthesis of science and religion or science and spirituality in the study of nature. As Einstein stated, "science without religion is lame, religion without science is blind."

[Excerpt from the book, *Man and Nature — Scientific and Vedantic Perspectives*, Bhaktivedanta Institute, Kolkata)

Book

Online Store:
https://store.binstitute.org/product/life-matter-and-their-interactions/

Man & Nature

Scientific and Vedantic Perspectives

Softbound: Rs. 125
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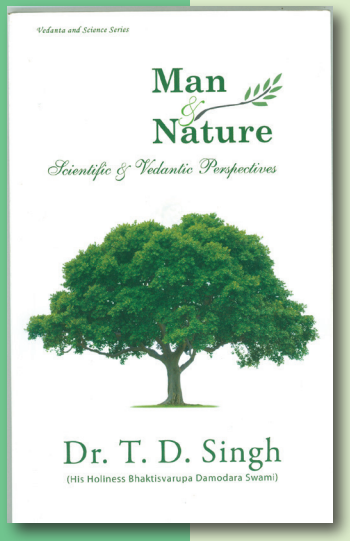

This book is a serious attempt to closely reexamine our evolving views of nature and their limitations. Taking insights from Vedanta, it further endeavors to grasp the deeper meaning of man's relation with nature. Dr. T. D. Singh, who personally witnessed the evolution of modern science for over half a century, presents in this volume some notable reflections easily accessible to the scholar and the layman alike.

Announcement

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Visionary: Dr. T. D. Singh , Founding Director, Bhaktivedanta Institute

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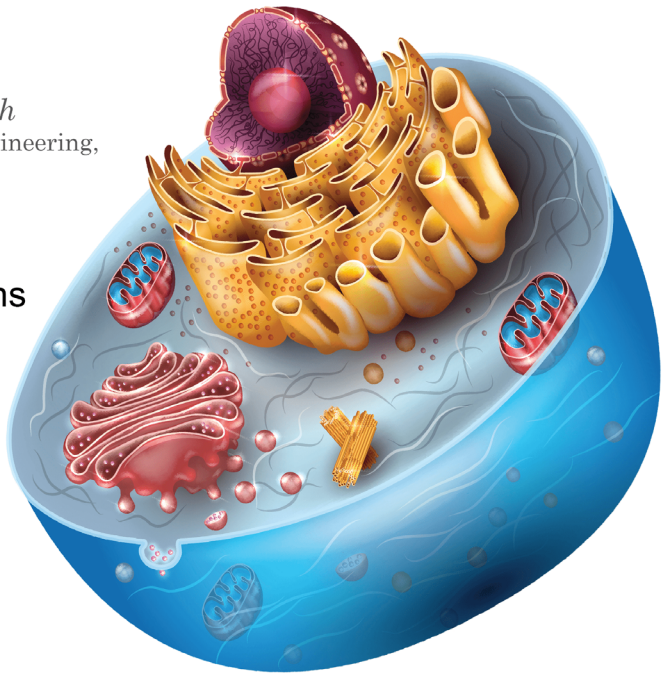

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Topics

- Chemistry of Life's Origin
- Origin of life in the light of Physics
- Numbers & Probabilities: Mathematics of Life's Origin
- Environmental Challenges in Prebiotic World
- From Primordial Soup to Primordial Being
- Cellular Automata & Simulation Experiments
- Life from Outer Space

Invited Speakers

- Prof. James Tour, Rice University, USA
- Prof. Chandra Wickramasinghe, University of Buckingham, UK
- Prof. Nick Lane, University College London
- Prof. Manoranjan Sinha, IIT Kharagpur
- Dr. Hare Krishna Mohanta, BITS Pilani
- Dr. Jaynaryan Tudu, IIT Tirupati
- Dr. Sai Phani, Northwestern University, USA
- Dr. Shashi Kotagiri, University of Texas, USA
- Srikant Chandragiri, MPI, Germany
- *and many more*

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