

Organizers



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12th International Conference

Science & Scientist 2024

*Systems Biology: The Scientific
Understanding of Life Beyond
Reductionism*



ONLINE EVENT

**SUNDAY,
DECEMBER 8TH**

6:30 AM - 3:30 PM | **ET USA**

12:30-9:30 PM | **Germany**

5:00 PM - 2:00 AM | **India**

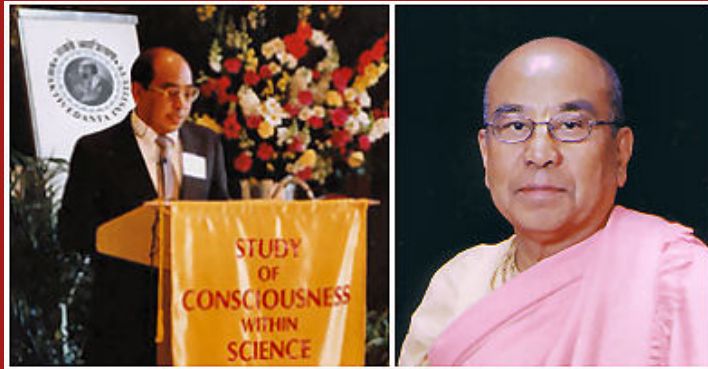
7:30 PM - 4:30 AM | **China**



REGISTRATION



This conference will be held on the day after the birthday of Bhaktisvarup Damodara Maharaja, PhD — Dr. T.D. Singh (1937-2006) — Founding Director of the Bhaktivedanta Institute.



50TH ANNIVERSARY OF HIS FOUNDING THE BHAKTIVEDANTA INSTITUTE *under the divine guidance of Srila AC Bhaktivedanta Swami Prabhupada*

Srila Prabhupada — the Gaudiya Vaishnava monk (Sannyasa) who spread the Krishna consciousness movement throughout the Western world — held that “You cannot have religion without philosophy. That is sentiment, fanaticism. And if you simply take philosophy without religion, without sense of God, this is mental speculation. So religion must be on the basis of science and logic. That is first-class religion.” Based on this position and his awareness of the underlying issues of modern science, given his background in chemistry as a practicing pharmacist in India for many years before accepting the Sannyasa order of life, Prabhupada called for the establishment of an Institute that would offer contemporary scientists an opportunity to interface with Vedic wisdom to progress beyond notions that life and consciousness originate from matter. Along with Dr. Bhaktisvarup Damodar, other scientist disciples of Prabhupada, such as our current Serving Director and inspiration behind this Science & Scientist conference series, Dr. B Madhava Puri, began undertaking this work in 1974.



Srila Prabhupada with 4/5 founding charter members of the Bhaktivedanta Institute

Conference Aims & Interdisciplinary Questions

The aims for this year's conference are:

- 1** interfacing Vedantic and Hegelian philosophies (both dialectical) with organismic and systems biology
- 2** humbly contributing to the development of a more philosophical conception of systems that will serve the progress of 21st-century biology
- 3** stimulating interdisciplinary dialogue aimed at deepening mutual understanding among the speakers' valuable viewpoints

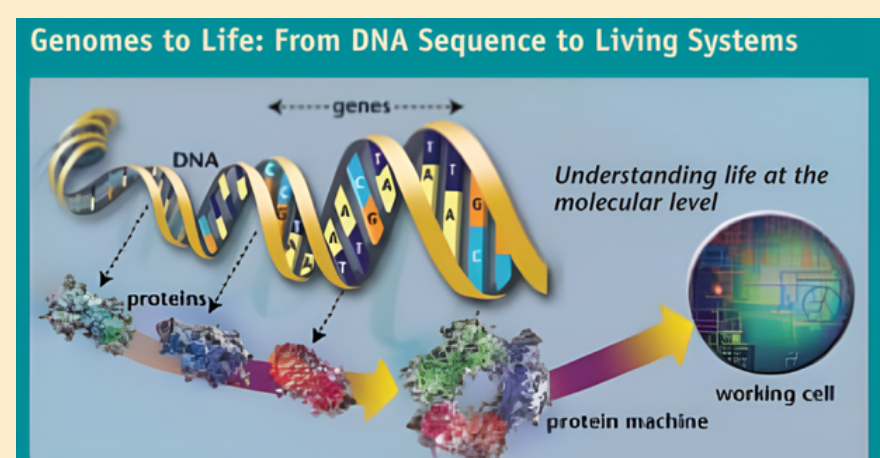
Interdisciplinary questions for the panel discussion at the end of the conference:

- 1** What experiments can distinguish between (a) the organismic level of organization exerting top-down agency on the cellular level, and (b) the cellular level exerting bottom-up agency on the organismic level?
- 2** How does conceiving living entities as irreducible cognitive systems influence evolutionary theory?

About the Conference Topic

The inadequacy of reductionism to describe living entities does not eclipse the importance of reduction as a mode of analysis in biology. While the former “is an ontological claim about reality” [1] presuming that wholes are nothing but the sum of their parts, the latter is a method of science that temporarily isolates phenomena at a given level of organization to ask specific questions and attain clearer details of the part in order to reintegrate this information in the context of the whole. The distinction between reductionism and reduction can be seen in nonreductionist biological disciplines like systems biology, a field that largely reaffirms the necessity and validity of the teleological (purposiveness / goal-directedness) viewpoint in biology. Systems biologists seek to “answer questions at the level to which they are most appropriate and then use that insight to probe down and up towards the other levels,” [2] such that “we should ascribe functions and purposes to the level at which they make sense, which is the level at which they constrain the interactions of the system at lower levels. This constraint is also what canalizes those interactions to serve the natural purposiveness of organisms.” [3] Examples of top-down biological purposes constraining lower levels of organization include (1) the role of the heart in the circulation of blood, (2) the role of kidney tubules in creating counter-current flow, (3) the role of Darwin’s gemmules ensuring continuity of communication of characteristics in the organism and to the inheritance of later generations, and (4) Hodgkins cycles, i.e. the electrical activity of cells in an organism. [4]

Systems biology described thus far considers systems as a “fundamental ontological category” [5] i.e. they are fundamentally more than the sum of their parts – a consideration based on empiric observation at higher levels of biological organization. This approach, which finds its roots in the philosophically informed thoughts of systems theorists and organicists throughout the mid-1900s, has come to be known as ‘systems-theoretic biology’ in contrast to ‘pragmatic systems biology.’ [6] While the former is characterized by top-down modeling, the latter prefers bottom-up models, as seen in the graphic from the U.S. Department of Energy’s Genome to Life Program which tried to frame systems biology in this way. [7]



In the wake of the Human Genome Project, ‘pragmatic systems biologists’ emerged at the turn of the century to integrate new genomic data with mathematical models of living phenomena in hopes of achieving outcomes requiring computation of large data sets, like improving the predictive capacity of medicine by identifying genetic indications of potential diseases before they develop. Since they favor a reductionist bottom-up model of whole systems that embraces the ontological claim that the whole is nothing but the sum of its parts, their use of the term “system” is a bit misleading. It is precisely due to the falsity of reductionism’s ontological claim that medical practices based on genetics, like polygenic risk scores, are practically useless; these scores are supposed to anticipate genetic-predispositions toward diseases yet they produce as many false predictions as correct ones. [8]

The function of the genome is constrained by higher-level processes in the organism, thus it's irrational to think that analyzing the genome could provide reliable predictions about that by which it is determined. Systems biology in its truest sense is concerned with living entities as wholes, whose parts must be understood thoroughly yet in the proper context. Thus, the genome must be understood in the context of the living cell, cells must be understood in various capacities within the living organism, and living entities must be understood in both their objective and subjective aspects.

Again, reduction (distinguished from reductionism) as a mode of analysis in biology is needed. Comprehensive descriptions of the mechanical and chemical aspects of life are necessary but not sufficient to fully and soberly comprehend living cognitive phenomena. Although a uniform mechanical-chemical framework may describe nature horizontally across bodily forms of living and nonliving nature, a multiform heterogeneous framework that subsumes or sublates mechanical and chemical aspects is required for describing nature vertically, plunging into the cognitive depths that determine biological function and activity. The uniformity of nature reduces all living and nonliving phenomena to mechanistic principles – the material and efficient aspects of cause, i.e. the physical constituents of and the external agency involved in changing an object – however, this understanding only reflects an immediate acquaintance (*ordo cognoscendi*) with the natural world. Conceiving the mediated development behind what immediately appears to the senses (*ordo essendi*) requires considering the formal and final aspects of cause, i.e. principles of formation/origination and that for the sake of which an object exists. This homogeneous framework, embracing all four aspects of Aristotelian causality, allows a critical appraisal of the similarities and distinctions between life and nonlife. Thus, while analyzing living and nonliving phenomena through material and efficient causality provides a uniform view of natural objects as atomic, molecular, or chemical conglomerates being determined by external forces like gravity, taking the perspectives of formal and final causality into account shows the distinctively biogenic or abiogenic origin of a natural object and whether it acts for the sake of itself (living) or is merely an object determined/utilized by things external to it (nonliving).

A heterogeneous conceptual framework that accommodates the similarities and differences between life and nonlife, as well as life's objective and subjective aspects, proves to be a dialectical approach. The utility of dialectical thinking is seen in the historical development of how 21st-century biologists view the dynamic between form and function. The history of morphology in general – around the late 18th and early 19th century – saw a dichotomy between the formalists and functionalists, where the former were focused solely on morphological structure as the defining feature of organisms while the latter were concerned with the function shaping form. [9] This dichotomy also concerned architects. In 1908, Frank Lloyd Wright – designer of the Guggenheim Museum in New York City – explained that “[f]orm follows function – that has been misunderstood. Form and function should be one, joined in a spiritual union.” [10] Significantly, Wright is known for being inspired by organic design principles allowing him to conceive of form and function dialectically as a heterogeneous unity or unity-in-diversity. Contemporary biologists have also begun thinking about living structures in this way. Proponents of embodied physiology view living structures as processes or activity, just as much as functions are, thus the rigid distinction between form and function dissolves. [11]

So, despite the immediate opposition between them – between the extended body’s particular properties (form) and the process that such determinations are meant to support (function) – the mediation of dialectic thinking reveals the fundamental unity that underlies form and function such that they can be viewed as distinctive moments of a singular dynamic organic activity. Dialectical thought facilitates transcendence from the rigid compartmentalized understanding that underlies reductionism.

Liberation from Neo-Darwinian reductionism is leading cutting-edge scientists to recognize the cognitive basis of evolution, where problem-solving, decision-making (including capacities to tolerate uncertainty and harness randomness), and cooperation with others play crucial roles in the purposeful evolution of living entities. [12] The volitional, cognitive, and emotional continuity observed throughout animals and humans – where “there are transitional stages among species, not large gaps; and that the differences among many animals are differences in degree rather than in kind” [13] – is comprehended as a spectrum of increasing individual autonomy (self-determined maintenance of organismic form and function through time) [14] where organisms become more independent from – “emancipat[ed] from direct influences and fluctuations [of]” [15] – the environment, as their sophistication gradually enhances reaching the height of the human form of life. These conclusions regarding the evolution of consciousness are based on the exponentially growing body of empirical and experimentally demonstrable evidence of 21st-century biology.

While these trail-blazing scientists recognize the fundamental connection between life and cognition and some of the implications this has on evolution, the actual origin of cognition remains ever-elusive. Even the notion of a cellular basis of consciousness does not explain how the objective and subjective mix with each other, even at the cellular level. Hegel’s philosophy offers a robust dialectic conceptual framework to comprehend this – such that the objective is determined by the subjective and the subjective knows itself through the objective – as well as a deeper fundamental knowledge of systems as a telescoping series of syllogisms.

This year’s Science & Scientist conference hopes to (1) interface Vedantic and Hegelian philosophies [both dialectical] with organismic and systems biology, (2) humbly contribute to the development of a more philosophical conception of systems that will serve the progress of 21st-century biology, and (3) stimulate interdisciplinary dialogue aimed at deepening mutual understanding among the speakers’ valuable viewpoints. We’d also like to consider questions such as (1) what experiments can distinguish between [a] the organismic level of organization exerting top-down agency on the cellular level, and [b] the cellular level exerting bottom-up agency on the organismic level? and (2) how does conceiving living entities as irreducible cognitive systems influence evolutionary theory?

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Schedule & Speakers' Abstracts

REGISTRATION



INTL. TIMES	SPEAKER	TALK TITLE
6:30-6:45 AM ET USA 12:30-12:45 PM Germany 5:00-5:15 PM India 7:30-7:45 PM China	B Madhava Puri (USA)	Conference introduction: 50 years of Bhaktivedanta Institute (1974-2024)
45 min talks + 15 min Q&A for all speakers		
6:45-7:45 AM ET USA 12:45-1:45 PM Germany 5:15-6:15 PM India 7:45-8:45 PM China	B Madhava Puri (USA)	A Conceptual Foundation for Deeper Insights into Living & Nonliving Systems
7:45-8:45 AM ET USA 1:45-2:45 PM Germany 6:15-7:15 PM India 8:45-9:45 PM China	Michael Levin (USA)	Bioelectricity as an interface to unconventional intelligence: from philosophy to biomedicine
8:45-9:45 AM ET USA 2:45-3:45 PM Germany 7:15-8:15 PM India 9:45-10:45 PM China	Rasmus Haukedal (China)	The Dialectics of Life: Towards a Unification of Biology and Philosophy
9:45-10:45 AM ET USA 3:45-4:45 PM Germany 8:15-9:15 PM India 10:45-11:45 PM China	B Niskam Shanta (India)	How can Sankhya perspectives be utilized to enhance scientific understanding of life's origins and the material world?
10:45-11:45 AM ET USA 4:45-5:45 PM Germany 9:15-10:15 PM India 11:45 PM -12:45 AM China	B Vijnan Muni (India)	Philosophy of Super-soul from Paramatma Sandarbha
11:45 AM - 12:45 PM ET USA 5:45-6:45 PM Germany 10:15-11:15 PM India 12:45-1:45 AM China	James Shapiro (USA)	Why Evolution Works: Biological Genome Rewriting
12:45-1:45 PM ET USA 6:45-7:45 PM Germany 11:15 PM - 12:15 AM India 1:45-2:45 AM China	Bernd Rosslenbroich (Germany)	Properties of Life – Proposal for an integrative concept
Interdisciplinary Dialogue 1:45-3:15 PM ET USA 7:45-9:15 PM Germany 12:15-1:45 AM India 2:45-4:15 AM China	(30 min) – What experiments can distinguish between (a) the organismic level of organization exerting top-down agency on the cellular level, and (b) the cellular level exerting bottom-up agency on the organismic level? (30 min) – How does conceiving living entities as irreducible cognitive systems influence evolutionary theory? (30 min) – Audience Q&A / Free discussion amongst speakers	
3:15-3:30 PM ET USA 9:15-9:30 PM Germany 1:45-2:00 AM India 4:15-4:30 AM China	Conference conclusion by Krishna Keshava Das	



B Madhava Puri, PhD
Princeton Bhakti Vedanta Institute

Received PhD in Quantum Chemistry from Georgetown University. Postdoc at the National Bureau of Standards in Washington DC. Published technical papers in The Journal of Chemical Physics. Turned to Indian school of yoga to learn about consciousness. Started GWFHegel.org. Serving Director of the Princeton Bhakti Vedanta Institute. Visionary behind this annual conference series since 2013.

A Conceptual Foundation for Deeper Insights into Living & Nonliving Systems

Systems biology necessarily concerns relational processes constituting all levels of organization of life, from the molecular to the cellular, organismic, and ecological, due to the energy exchange and feedback connecting these levels. Understanding the conceptual distinctions between mechanical, chemical, organic, and human bodies, determined by the interdependent dialectic dynamic between self and other (an individual and its environment), is fundamental to a deeper comprehension of such relational processes as well as distinguishing between life and nonlife. Based on G.W.F. Hegel's philosophy, we will show how the identity of each kind of natural body is found in its other and that the extent to which a particular body unites with otherness, where this union is the claiming of its identity, determines its kind. The limitations that one type of body encounters while attempting to connect with its other sets the necessary standard for the determination of a new type of body. This conceptual development logically connects mechanical, chemical, organic, and human bodies, where the human is the most capable of integrating otherness thus truly claiming its identity. We will offer familiar empirical examples demonstrating the validity of this perspective in hopes of encouraging further applications.



Michael Levin, PhD
Tufts University

Michael Levin is the Vannevar Bush Distinguished Professor of Biology at Tufts University, an associate faculty at Harvard's Wyss Institute, and the director of the Allen Discovery Center at Tufts. He has published over 400 peer-reviewed publications across developmental biology, computer science, and philosophy of mind. His group works to understand information processing and problem-solving across scales, in a range of naturally evolved, synthetically engineered, and hybrid living systems. Dr. Levin's work spans from fundamental conceptual frameworks to applications in birth defects, regeneration, and cancer.

Bioelectricity as an interface to unconventional intelligence: from philosophy to biomedicine

All embodied intelligence is collective intelligence - made of parts that work together to create an emergent mind with memories, goals, preferences, and competencies that none of the individual parts have. Each of us starts life as a quiescent egg cell - a little blob of chemistry and physics - which slowly, gradually self-assembles into a complex being with exquisite form and function. In this talk, I will describe our work to understand the self-construction of minds and bodies, and the mechanisms by which cognition scales and projects into new spaces. One of our model systems is groups of cells, which form a collective intelligence that solves problems in the space of anatomical possibilities. We have discovered some of the ways that all cells, not just neurons, use natural bioelectric networks to store the memories of this collective intelligence. We have developed new ways to re-write that information for applications in birth defects, regenerative medicine, and cancer, using the bioelectric interface to communicate with, not micromanage, the cellular behaviors. Finally, I will describe how our work on synthetic bioengineering is uncovering inputs into emergent cognition beyond heredity and environment, and speculate on a future of diverse intelligence and freedom of embodiment.



Rasmus Haukedal, PhD
East China Normal University

Rasmus Sandnes Haukedal is a postdoctoral researcher at East China Normal University. He earned his PhD from Durham University in 2023. In his thesis, he employed an organisational perspective to argue that the current expansion of evolutionary biology represents a dialectical turn. Building on this foundation, his postdoctoral project explores philosophy of mind, developing an organisational understanding of cognition. During his PhD, he was a research fellow in the Marie Skłodowska-Curie programme, 'Real Smart Cities', and he co-convened the reading group at the Centre for Culture and Ecology. He is currently an editorial member of Dialectical Systems and Salongen.

The Dialectics of Life: Towards a Unification of Biology and Philosophy

This talk will provide central insights from my work on the philosophical implications of the Extended Evolutionary Synthesis (Chiu 2022). First, I will outline the history of modern evolutionary thinking, and how the current shift incorporates views that were previously marginalised. Building on this, I describe the dialectical background of organicism and its modern-day iteration: the organisational approach, which emphasises the organisational closure and energetic openness of organisms, allowing them to self-determine (Montévil and Longo 2015). I claim that this perspective aligns with – and can contribute to – the current extension. Further, I argue that the emphasis on unpredictability within the organisational view resonates with Hegel's idea that nature is inherently contingent (Hegel 2010). This so-called impotence of nature imposes restrictions on philosophy and science, thereby challenging the notion that Hegel believed one could logically deduce the instances of nature. Based on this, I outline the dialectical naturalism proposed in these perspectives and how it opens the door to a new relationship between natural science and the humanities. In summary, I argue that current shifts in thinking indicate a new kind of science – built around the ecological and historical view of nature – towards unification without subsumption or eradication of differences.



B Niskama Shanta, PhD
Sri Chaitanya Saraswat Institute

Received PhD in Coastal Hydrodynamics from the Indian Institute of Technology - Kharagpur. Postdoc at the Korea Ocean Research and Development Center. Published numerous papers in international/national conferences and journals like Springer Link and Communicative & Integrative Biology (PMC). Main organizer of this Science & Scientist conference series. Vaishnava monk. Sevaite-President-Acharya of Sri Chaitanya Saraswat Math in Narashimpalli (Nabadwip Dham), West Bengal, India.

How can Samkhya perspectives be utilized to enhance scientific understanding of life's origins and the material world?

Modern science offers the explanation that matter resulted from an imbalance between matter and antimatter. However, the fundamental cause of this imbalance and the primary source of matter and antimatter are not adequately addressed within modern science, aside from ambiguous claims. Likewise, the origin of life remains unclear, with scientists continuing to explore its point of origin and the mechanisms underlying life's emergence from matter, a challenge that persists due to modern science's struggle to define the boundary between matter and life. According to Samkhya philosophy, the universe evolves from the subtle Mula Prakriti due to its interaction with Purusha. Although inherently disparate, their proximity initiates evolution, not through direct contact, but via Purusha's presence stimulating Mula Prakriti. This disturbance of the gunas' equilibrium prompts the manifestation of subtle matter into gross material objects. Samkhya posits one supreme Purusha, yet individual jiva souls are also referred to as multiple Purushas, exciting Mula Prakriti to create material complexities. This presentation aims to elucidate the limitations of conventional perspectives on modern science regarding the origin of matter and life, offering an alternative paradigm rooted in Samkhya philosophical thought.



B Vijnana Muni, PhD
Sri Chaitanya Saraswat Institute

Received PhD in Chemical Engineering from the Indian Institute of Technology - Kharagpur. Published peer-reviewed papers and book chapters in international conferences and journals like Springer Link. President of the Sri Chaitanya Saraswat Institute based in West Bengal, India. Vaishnava monk.

Philosophy of Super-soul from Paramatma Sandarbha

Paramatma means supersoul and sandarbha means a scripture which reveals a deep conception of related transcendental reality. Paramatma is indwelling within the heart, is the transcendental master of maya shakti, is ontologically a plenary expansion of Chit-shakti and guides the movement of all jivas. He is pure and transcendental and yet He sees properly the activities of Maya and also the antahkarana and is Immanent in all Existence (आविष्ट). Paramatma relates to Nature and living entities. Jiva shakti is marginal potency (tatastha) of Sri Bhagavan, and the paramatma is their shelter. Paramatma is the witness and giver of the results of actions of the jivas. As indweller, paramatma is primary knower of the sum-total of the entire field of jiva-shakti (samasti khestrajna) unlike the individual jiva, who is a knower of only his field of activity (vyasti khestrajna). Paramatma is one of the purusha incarnations (svamsa). Paramatma is akuntha (unlimited), He is bhu (fully capable) and yet as He is a limb of Bhagavan and jagat-gata. Jiva can distinguish between itself and others by its ability called Prakash. Maya is trigunamayi, is multifarious and has threefold forms: adhyatmika, adhibhautika and adhi-daivika. Jiva is not a pratibimba (or reflection of brahma).



James A Shapiro, PhD
University of Chicago

James A. Shapiro is Professor of Microbiology emeritus in The Department Of Biochemistry And Molecular Biology at the University Of Chicago. He received his Ph.D. in Genetics from Cambridge University in 1968 under Prof. W. Hayes, FRS. At the University of Chicago since 1973, he was Darwin Prize Visiting Professor at the University of Edinburgh (1993). In 2001, he received an O.B.E. for services to the Marshall Scholarship Program. He is a founder of www.TheThirdWayofEvolution.com, intended to raise awareness of scientific alternatives to Intelligent Design and Neo-Darwinism. His pioneering books are on mobile genetic elements, natural genetic engineering, and bacterial multicellularity. His complete CV can be found at <https://shapiro.bsd.uchicago.edu/cv.shtml>.

Why Evolution Works: Biological Genome Rewriting

The conventional evolutionary wisdom is that genomic changes are random replication errors and natural selection guides the emergence of novel adaptive traits. However, cytogenetic and molecular biological studies since the 1940s established that virtually all genome changes result from action by specific cellular biochemical systems. For example, multiple antibiotic resistance in bacteria generally does not arise mutationally but results from cell-to-cell transfer by genome elements that carry multiple inserted DNA sequences encoding proteins that inactivate or expel specific antibiotics. Barbara McClintock discovered transposable “controlling elements” in maize that move from one genomic location to another (transpose) in the 1940s, and DNA sequence analysis has shown eukaryotic regulatory networks are formed by the insertion of transposable elements carrying similar expression sequences near genetic loci encoding network components. Recently, the capacity of germ line cells from almost all eukaryotes to undergo multisite chromosome rearrangements within a single cell division cycle has been widely documented and labelled “chromoanagenesis.” What we do not know is whether these powerful tools for biological innovation operate blindly or are somehow biased towards functional novelties. This is a question to answer experimentally. Knowing some of the triggers for evolutionary genome change allows us to find the answers.



Bernd Rosslenbroich, PhD

Witten/Herdecke University

*Bernd Rosslenbroich is head of the Institute of Evolutionary Biology and Morphology at Witten/Herdecke University, Germany. Research interests are patterns and processes in macroevolution, organismic and systems biology, and philosophy of biology and medicine. Author of *On the Origin of Autonomy: A New Look at the Major Transitions in Evolution* (Springer 2014), and *Properties of Life: Toward a Theory of Organismic Biology* (MIT Press 2023).*

Properties of Life – Proposal for an integrative concept

The life sciences are largely dominated by an analytical approach that attempts to reduce life phenomena to their underlying factors. Much valuable knowledge has been gained in this way. However, the synthesis of these phenomena and the understanding of the integrated organismic functional context is still a challenge to grasp scientifically. This means that the phenomenon of life is not yet truly understood in its ontologically autonomous existence. It will be necessary to further develop ways of biological thinking and research approaches in such a way that the specific characteristics of living beings can be described. Empirical research is developed far enough today to reveal by itself the material and prerequisites for a new integrative understanding. Such a concept is presented here as an organismic approach. It is proposed that an organismic understanding of the living would also change our way to treat Nature. In addition, an organismic view can lead to new aspects for understanding the evolution of the living world.

REGISTRATION



Masters of Ceremonies (MCs):



Sumangala Didi, PhD
Sri Chaitanya Saraswat
Institute



Krishna Keshava Das
Princeton Bhakti
Vedanta Institute

**We welcome all thoughtful
questions, comments, or concerns
regarding this conference. Contact:**

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