The Agent and the Network: A Comparative Analysis of Organism-Centered and Systemic Philosophies of Life

Aravindan Neelakandan[1]

Introduction

This paper makes a detailed comparative analysis of two contemporary philosophies of biology that challenge the 20th century's gene-centric, mechanistic paradigm. They are represented by two books: '*The Organism*' (Cambridge University Press, 2025) by philosopher of science Jan Baedke and '*The Systems View of Life'* (Cambridge University Press, 2025) by Fritjof Capra and Pier Luigi Luisi. The previous one is based on an organism-centric approach and the latter is based on a network approach. The philosophies of biology presented in both the books seek to overcome the conceptual reduction of the organism to a passive object or vehicle, a mere pawn in the evolutionary game played by selfish genes.

The paper analyses the core concepts, and how much they converge and diverge, and their respective alignments with the worldview getting unveiled by modern scientific discoveries in the field of biology such as post-genomics, evolutionary biology, and complexity theory.

The 20th century witnessed a profound shift in biological explanation, moving away from the whole organism towards its constituent parts. This reductionist program, culminating in the 'century of the gene,' was remarkably successful but ultimately incomplete. It left fundamental questions about organization, agency, and the relationship between life and its environment unanswered.

The early 21st century on the other hand has been seeing the rise of powerful counter-narratives that seek to re-center biology.

'*The Organism*' represents a focused, analytical effort to restore the organism to its rightful place 'as a causally efficacious and autonomous unit'[1] in its own development and evolution. More ambitiously it also posits the organism as creating new evolutionary pathways and novel adaptive processes.

On the other hand, Capra and Luisi provide a grand, synthetic vision wherein the living systems are 'self-organizing networks whose components are all interconnected and interdependent.'[2] By placing these two seminal texts in dialogue, the paper aims to illuminate the central debates in contemporary philosophy of biology and chart a path toward a more integrated understanding of life. The intellectual architecture of '*The Systems View of Life'* has substantial elements from Capra's earlier work, '*The Web of Life*' (Anchor Books, 1996); consequently, any serious exploration of the one demand a thorough engagement with the other.

The Organism as Active Agent: Central Thesis of Jan Baedke

'The Organism' presents a robust philosophical framework aimed at reinstating the organism as the central explanatory unit in biology. The work is structured as a response to the 20th century's gene-centric paradigm, which Baedke argues led to an 'eclipse of the organism.'[3] By drawing on recent scientific advancements and proposing novel conceptual tools, Baedke seeks to define the organism as a distinct, causally potent agent that actively shapes its own existence.

The Eclipse and Return of the Organism

Baedke begins by diagnosing a historical problem: the conceptual marginalization of the organism in modern biology. He invokes the lament of developmental biologist Brian Goodwin that 'the disappearance of the organism as a fundamental unit in biology.' This 'eclipse' has been driven by the 'scientific and philosophical focus on units like genes, molecular processes, populations, species and concepts like functions and natural selection, rather than on the organism and concepts like organization, the organism–environment relation, teleology, and agency.'[4]

In this paradigm, explanatory power was vested in the parts, particularly the genes, which were abstracted from their organismic context and treated as the primary determinants of phenotype. This reductionist approach was championed by prominent philosophers of science of the 1950s like Ernest Nagel. Nagel and his student Morton Beckner considered that to study an organism studying its organization would turn out to be 'a pseudo-problem once biological phenomena were reduced to their underlying chemical and physical processes through mechanistic approaches.'[5] This mechanistic reductionist devaluing of the organism expands and is well reinforced in the neo-Darwinian framework, with the impressive strides made by molecular biology. In Richard Dawkins this mechanical reductionism becomes what can be called the gene-centric reductionism. So individual organisms are essentially vehicles for the replicators which are the genes. The organisms 'are highly integrated bundles of consequences'[6] and not at all causative agents in themselves. Dawkins declared:

Genes are replicators; organisms and groups of organisms are not replicators; they are vehicles in which replicators travel about. Vehicle selection is the process by which some vehicles are more successful than other vehicles in ensuring the survival of their replicators.... In any case,... there may be little usefulness in talking about discrete vehicles at all.[7]

Philosopher Subrena E. Smith points out how the selection-centric term 'biological individuality' is more favored amongst the biologists and philosophers of biology in lieu of 'organismality'. Making a case for 'organismality' she points out that the term 'organism' unlike 'biological individual' does not take into consideration only 'evolution-based conceptions of individuality' but also and unique from it 'draws instead on ecological and developmental biology.'[8] She also argues that the tide is turning. A 'return of the organism' is being spurred by a confluence of discoveries in postgenomic and evolutionary sciences. Fields like evolutionary developmental biology (Evo-Devo), epigenetics, microbiome research, and niche construction theory are providing compelling evidence that undermines a strictly gene-centric view. In this context Baedke sets an epistemological and an ontological vision for biology that should be 'able to highlight the organism as identifiable driver of development and evolution, without losing it as a causally efficacious and autonomous unit.'[9]

This 'return' signifies more than a mere shift in focus; it represents a fundamental inversion of perceived causality. The traditional 20th century model posited a linear, bottom-up causal chain: genes determine the organism, which then adapts to a pre-existing environment. The convergence of the new developments in established branches as well as emerging new fields of biology, challenges this linearity from multiple angles.

Epigenetics demonstrates how environmental factors, mediated through the organism, can alter gene expression in heritable ways. Niche construction theory shows how organisms actively modify their environments, thereby altering the selective pressures that act back upon their genes. This creates a reciprocal feedback loop where the organism is no longer a passive endpoint but a central, causal mediator.

The ramblings of this inversion are captured in the proposal of theoretical biologist Mary Jane West-Eberhard that 'genes often follow rather than lead in evolution and that, in fact, organisms introduce new phenotypes that genes then stabilize later.'[10] The organism is thus recast not simply as an object of evolution, but as one of its primary authors.

The Inward Challenge and the 'Overcomer'

To ground this restored view of the organism, Baedke identifies two fundamental conceptual hurdles. The first is the 'Inward Challenge,' which asks: 'What is the internal organization of the organism that constitutes its individuality in contrast to other units in nature?'.[11] The conventional answer of the biologist is based on concepts of self-maintenance, homeostasis, and organizational closure—the idea that an organism is a system that actively preserves its own structure and integrity against external perturbations. This is being called the 'persister' model. Philosopher of science Peter Godfrey-Smith considers organisms as 'essentially persisters, systems that use energy to resist the forces of decay, and only contingently things that reproduce.'[12] Subrena Smith improves upon this concept by making 'the integration of differentiated parts, which allows for phenotypic accommodation', the organisms are seen as 'whole systems.' She specifically points out that more than one individual can come together even from different taxa to form an 'organism'. Such holobiotic systems can be fruitfully regarded as 'biological systems that are organisms but not biological individuals.' Further the organisms are 'constitutively embedded' in their environment.[13]

While acknowledging the importance of this conception which also centres on the organism, Baedke argues that this model is incomplete because it over-emphasizes stability and fails to capture the more dynamic, creative, and risky forms of agency that organisms display. To address this limitation, Baedke introduces the framework of the organism as an 'overcomer'.[14]

An overcomer is an organism that does more than just persist; it possesses the capacity to actively induce, modulate, and control phases of profound organizational instability in order to explore new phenotypic possibilities and create novel evolutionary pathways. This concept redefines organismal agency away from mere survival as well as homeostatic persistence and moves it towards a capacity for creative self-destruction and reconstruction. Organisms thus display 'special agential strategies to induce, modulate, and control phases of destabilized organization' which lead to highly risky but highly beneficial rewards in challenging environments.

Baedke illustrates this with three striking biological examples:

1. **The Deep-Sea Anglerfish (***Melanocetus johnsonii***)** The parasitic male, upon finding a female, physically fuses with her. This act involves a radical de-organization of his own body; he downregulates his immune system to prevent rejection and allows his metabolic and digestive systems to atrophy, effectively becoming a permanently attached sperm-producing appendage. This is a highly risky distortion of his own organization, sacrificing his

individual persistence for a trans-generational reproductive goal.

2. **The Sea Slug (**eg. *Elysia marginata***):** This organism can perform *autotomy*, severing its own head from its body. The head can then survive for weeks, moving, feeding on algae, and incorporating their chloroplasts for photosynthesis (*kleptoplasty*), before regenerating an entirely new body. This process involves a phase of extreme vulnerability and a creative reorganisation that transcends simple repair, exploring a new endosymbiotic mode of existence.

3. **The Indian Jumping Ant** (*Harpegnathos saltator*): Usually when an ant colony's queen dies then it collapses. But in the case of Indian jumping ants worker ants engage in ritualised tournaments. The winners transform into 'gamergates' or pseudo-queens, a process involving a complete reorganisation of their physiology, a reactivation of their ovaries, and even a shrinking of their brains. This radical transformation is not a one-way street; if a gamergate is isolated from the colony, it can revert to its worker state, regrowing its brain. This demonstrates a controlled, reversible, and active exploration of a new life cycle in response to a social-environmental challenge.

Each of these instances reveals that the organisms cannot be seen as mere persisters of homeostasis. They are 'creative agents that possess genetic, developmental and behavioural repertoires and strategies to modulate and tinker with this organization, push it toward instability, control and maintain these instable periods, and then stir instability toward the production of stabilizing and possibly adaptive variation.'[15] With this risk-taking creativity, organisms as 'overcomers' trigger 'the evolution of novelties in the immune system in vertebrates, in the evolution of endosymbiosis, the evolution of reproductive strategies in colonies, and the evolution of reversible phenotypic plasticity.'[16]

The Outward Challenge and Reciprocal Causation

The second hurdle Baedke identifies is the 'Outward Challenge': 'How can we grasp the organism-environment relationship and separate the organism from its environment, even though both are deeply and reciprocally intertwined?'[17] This challenge becomes acute in light of concepts like niche construction, which emphasise the inextricable feedback loops between an organism and its environment. Many holistic and systemic philosophies respond to this by blurring or dissolving the boundary, treating the organism-environment system as a single, co-constituted whole. Baedke critiques such a resolution, arguing that it is methodologically paralysing; if the organism cannot be distinguished from its environment, it becomes 'impossible to identify the organism' as a distinct causal agent, undermining the very project of an organism-centred biology which aims to 'unambiguously individuate the organism' and 'highlight its crucial epistemic role as an active and creative agent in developmental evolution.'[18]

To solve this, Baedke proposes a 'reciprocal causation model' designed to 'unknot' these complex interactions without denying their reality. He developed this model along with developed with Alejandro Fábregas-Tejeda and Guido Prieto in 2021 to provide a methodological solution to a difficult problem. It does not deny the deep interconnection of organism and environment but offers an epistemic framework that makes this relationship empirically tractable. The model works by representing the interaction not as a single, static loop, but as a diachronic sequence of states. The organism (O) and environment (E) are treated as distinct entities whose states at one time (O_n, E_n) causally influence their states at the next moment in time (O_{n+1}, E_{n+1}). This 'unrolling' of the loop allows for the identification of specific causal pathways and the distinct contributions of each component over time.

Baedke demonstrates the model's utility with two examples.

First, in the case of reef-building corals, the model can trace the causal chain: corals at state O_{n-1} secrete calcium carbonate, which changes the environment to state E_n by creating a habitat for competitors. These competitors then impact the corals' survival, leading to a new coral state O_{n+1} The model becomes even more powerful in multi-species scenarios, such as the evolution of herbivory in ruminants. Here, the framework can distinguish between the host animal (O), its gut microbes (O'), the rumen as the microbes' environment (E'), and the external environment of the host (E). It can trace how microbes (O') construct their niche in the rumen (E'), which in turn affects the host's constitution (O), enabling it to interact with its external environment (E) in a new way (by eating plants). This analytical clarity prevents the system from being collapsed into a single, unanalysable holobiont, thereby preserving the causal roles of the distinct organisms involved.

This reciprocal relationship is fundamentally *asymmetrical*. Organisms, as agents, act as 'bounded loci of causation' with specific goals (either persistence or overcoming). In contrast, the environment is a 'causally dispersed and fragmented units, as they constitute a highly heterogeneous set of various biotic and abiotic factors.' According to Baedke this asymmetry makes the organism important in the evolution of both the organism and the environment:

In this asymmetrical connection organisms as agents are crucial driving forces, that, through their intrinsic purposiveness and repertoires to exert control over themselves and their surroundings, bias or direct the future dynamics and trajectories of the organism–environment link.[19]

The Organism and Human Self-Perception

Baedke concludes his analysis by exploring the profound socio-political and anthropological dimensions of the organism concept, demonstrating that biological theories are never divorced from human self-understanding. He argues that the 'return of the organism' and the associated rise of post-genomics, while seemingly liberating, carry their own set of societal risks.

The move away from the rigid narrative of genetic determinism has given rise to the concept of the 'embedded body' which makes humans not genetically determined machines but rather 'open, dynamic systems, deeply interconnected with their material and social surroundings... and liberated to live a life that guarantees humans 'plastic' destiny, autonomy, and self-determination.'[20] Still this may unleash new forms of determinism like 'postgenomic determinism' or 'environmental determinism' from fields like epigenetics, where parental lifestyles or socioeconomic status are framed as irreversibly 'programming' the health of future generations, creating narratives of blame and fixity that are just as constraining as their genetic predecessors.[21]

Baedke warns against the assumption that a shift from reductionism (gene-centrism) to a more holistic, organism-environment perspective is inherently progressive. There is a strong possibility of genetic racism becoming 'biosocial race' - an embodied outcome of environmental exposures and social conditions, measured through differences in DNA methylation patterns or gut microbial profiles between ethnic groups thus re-biologising race in a more subtle and insidious manner, treating complex social phenomena as fixed biological traits and reinforcing historical stereotypes under a new scientific guise.[22]

Life as a Living Network: The Vision of Capra and Luisi

In *The Systems View of Life: A Unifying Vision*, Fritjof Capra and Pier Luigi Luisi present a sweeping and ambitious synthesis that aims to reframe not only biology but all of science and society. Their core thesis is that humanity is undergoing a profound paradigm shift away from a mechanistic and reductionist worldview toward one that is holistic, ecological, and systemic. This new paradigm, they argue, is essential for understanding the nature of life and for addressing the interconnected global crises of the 21st century.

The Paradigm Shift from Machine to Network

The grand narrative of Capra and Luisi's work is that of a historic transition 'as radical as the Copernican revolution.'[23] Criticising the 'outdated mechanistic worldview' that dominates the 'Western' thought since the Scientific Revolution of the 17th century, they argue that this paradigm, founded on the philosophies of Descartes and Newton, conceptualised the universe as a great machine composed of elementary building blocks. In this view, nature was inanimate, organisms were mere clockworks, and the scientific method was one of analysis and reduction—breaking complex phenomena down into their smallest constituent parts to understand them. This approach, while powerful, led to a fragmented understanding of reality, a separation of mind from matter, an exclusion of non-quantifiable qualities like value and beauty, and a view of evolution as a purely competitive struggle.

Capra and Luisi argue that this machine metaphor is no longer tenable. At the forefront of contemporary science, a new understanding is emerging, and at its core is a 'shift of metaphors... a change from seeing the world as a machine to understanding it as a network.'[24] In the systemic view which is the core of the new paradigm, the material world is understood not as a collection of objects, but as 'a network of inseparable patterns of relationships.'[25] The planet as a whole is seen as a living, self-regulating system, and organisms are understood as living, cognitive systems down to the cellular level. This new conception of life requires a new mode of inquiry, which is termed by the authors as 'systems thinking.'

The Principles of Systems Thinking

Systems thinking is the cognitive toolkit of the new paradigm. It represents a fundamental reorientation of scientific thought, characterised by a focus on relationships, patterns, and context. Capra and Luisi outline several key conceptual shifts that define this approach:

- From Parts to the Whole: The essential properties of the living organisms are the properties of the whole or 'emergent properties' which 'arise from specific patterns of organization – that is, from configurations of ordered relationships among the parts. This is the central insight of the systems view of life.'[26]
- From Objects to Relationships**:** In the mechanistic view, objects are primary and the relationships

between them are secondary. In the systems view, this is reversed: Instead of 'isolated building blocks' there exists 'a complex web of relationships between the various parts of a unified whole.'[27] In the words of the authors:

What we call a part is merely a pattern in an inseparable web of relationships. Therefore, the shift of perspective from the parts to the whole can also be seen as a shift from objects to relationships.[28]

- From Measuring to Mapping: The relationships cannot be studied similar to the way discrete objects are studied.

  (T)he perceptual shift from objects to relationships goes hand in hand with a change of methodology from measuring to mapping.[29]

- From Quantities to Qualities: When relationships are mapped then certain configurations will be discovered to occur repeatedly which is a pattern. Network, cycles and boundaries are all patterns and when studying living systems they take a central stage.

Mapping relationships and studying patterns is not a quantitative but a qualitative approach. Thus, systems thinking implies a shift from quantities to qualities.[30]

- From Structures to Processes: In the systems view, every structure is understood as the physical manifestation of underlying processes. The form of a living organism is inseparable from the continuous flow of matter and energy (metabolism) that maintains it. Process is primary.
- From Objective to Epistemic Science: The Cartesian ideal of a purely objective science, independent of the observer, is abandoned. Drawing on insights from quantum physics, systems thinking recognises that knowledge is contextual. In the words of Werner Heisenberg one of the founders of the now hundred years old New Physics, '*what we observe is not nature itself, but nature exposed to our method of questioning*.' Thus 'systems thinking involves a shift from objective to 'epistemic' science; to a framework in which epistemology – "the method of questioning" – becomes an integral part of scientific theories.'[31]

This set of principles constitutes a framework for understanding complex phenomena. Capra and Luisi apply this framework across disciplines, from quantum physics to ecology and social theory, suggesting that all complex adaptive systems share these fundamental principles of organisation. Their philosophy is thus far more encompassing than Baedke's, which remains tightly focused on the biological organism. They are proposing a new way of knowing for a new scientific era.

The Definition of Life as Autopoiesis

To ground their systemic philosophy in a rigorous biological definition, Capra and Luisi adopt the concept of *autopoiesis* ('self-making'), developed by the Chilean biologists Humberto R. Maturana (1928–2021) and Francisco J. Varela (1946–2001). Autopoiesis provides a precise, network-based definition of the minimal organization of the 'self' of a living system with a network core. This is called 'Santiago theory of consciousness.'

Capra cites biologist-philosopher Gail Fleischaker and highlights three criteria for autopoietic system: it should be 'self-bounded, self-generating, and self-perpetuating.'[32]

This provides the concept of *operational closure*. The autopoietic network is organizationally self-contained; its pattern of organization is determined from within and does not require external instructions or 'information' to specify its form. This grants the living system its autonomy. It is, however, *thermodynamically open*, meaning it requires a constant flow of matter and energy from its environment to continue its processes. Secondly it firmly establishes that life is an emergent property. Life is not a substance or a force, nor is it located in any single component like DNA. Instead, life emerges from the collective interactions and relationships of the molecular components within the autopoietic network. For Capra and Luisi life is not a property emanating from an enshrined single molecule butt is a property of the whole system. This directly refutes gene-centric reductionism by locating life in the pattern of organization, not in the material parts.

Autopoiesis is the expression in process, of the basic self-cognition which defines life at its fundamental level at the level of cell-membrane formation.

The Organism-Environment Dance: Structural Coupling

Capra-Luisi model for the organism-environment relationship is structural coupling, another concept drawn from the Santiago theory. This model describes a dynamic and inseparable co-evolution between a living system and its environment. The core idea is that the environment does not *determine* what happens to an organism in a linear, cause-and-effect manner. Instead, the environment merely *triggers* or *perturbs* the organism. The organism then responds with changes to its own structure, but these changes are specified by its own autonomous, autopoietic organization.

This continuous process of being triggered by the environment and responding with self-directed structural changes is the very essence of learning, development, and evolution. As the organism's structure changes, so too does its future behaviour, creating an ongoing history of adaptation. Through this process, the organism and its environment are said to be 'bringing forth a world' together; they are co-defined and co-determined in an intricate dance of mutual interaction.

The most radical implication of the entire framework is the identification of life with cognition. For Capra and Luisi, the process of living—the autopoietic dance of self-maintenance and structural coupling—*is* the process of knowing. A cell 'knows' how to repair its membrane; a forest 'knows' how to regulate its water cycle; an animal 'knows' how to navigate its world. Here cognition is not 'as problem solving on the basis of representations; instead, cognition in its most encompassing sense consists in the enactment or bringing forth of a world by a viable history of structural coupling.'[33] Mind is not a mysterious substance, the infamous '*res cogitans*' that appears only in brains and in thinking; it is the process of life itself, an immanent property of any autopoietic network. In the words of Capra-Luisi:

Cognition, then, is not a representation of an independently existing world but rather a continual bringing forth of a world through the process of living. The interactions of a living system with its environment are cognitive interactions, and the process of living itself is a process of cognition.[34]

This is a far more profound and holistic philosophical claim than Baedke's more circumscribed focus on organismal agency, extending the concept of mind to the entire web of life. The network perspective of life finds its ultimate expression in the Gaia hypothesis, which posits that the entire planet is a living, self-regulating system. In the Gaian view, the biosphere's living components (plants, animals, microbes) and non-living components (atmosphere, oceans, rocks) are tightly interlocked in a vast network of feedback loops that maintain the conditions for life. Life does not merely adapt to a passive Earth; life actively creates and regulates its own planetary environment.

Comparative Analysis: Individuation, Agency, and Interconnection

While both Baedke's *The Organism* and Capra and Luisi's *The Systems View of Life* mount a powerful challenge to the 20th century's mechanistic and gene-centric paradigm, they do so from distinct philosophical standpoints. Baedke's project is fundamentally analytical, seeking to restore the ontological and causal primacy of the bounded individual organism. Capra and Luisi's project is synthetic, aiming to describe the universal principles of interconnected networks in which any individual is but a transient pattern. This core divergence manifests in their treatment of individuality, the organism-environment boundary, and the nature of evolutionary creativity.

The Unit of Life: Individuated Agent vs. Autopoietic Network

The most significant point of departure between the two philosophies lies in their definition of the fundamental unit of life. For Baedke, the central task is to rescue the organism from its dissolution into either its genetic parts or its environmental context. His entire framework—from the 'overcomer' to the 'reciprocal causation model' aims at the re-establishment of organism as a discrete, bounded, and causally efficacious individual. The organism is the primary agent, the locus of action and creativity.

For Capra and Luisi, the fundamental unit is the autopoietic network itself. Their philosophy consistently emphasizes that life is a non-localized, emergent property of a collective configuration which in turn has a fractal nature:

All living systems are networks of smaller components, and the web of life as a whole is a multilayered structure of living systems nesting within other living systems – networks within networks.[35]

The concept of 'networks within networks' suggests a reality where clear boundaries are provisional. In this view, 'what we call a part is merely a pattern in an inseparable web of relationships'. This may give the appearance of a philosophical position where the individual organism is ontologically secondary to the network of relationships that constitutes it. This creates a profound ontological tension.

Baedke is engaged in a project of biological individualism, seeking to justify the organism's status as a distinct entity. Capra and Luisi stand for the centrality of network, for whom the system of relationships is paramount. Baedke's organism is a discrete noun; Capra and Luisi's living system is a continuous verb.

The Organism-Environment Boundary

This fundamental difference in ontology, more perceived than real, directly shapes their approaches to the organism-environment boundary. Capra and Luisi's concept of structural coupling describes a process of co-constitution where the organism and environment are so deeply intertwined that they are effectively inseparable; they 'bring forth a world' together. Organism and environment are in a deep sense, one unified system. The boundary is fluid and relational.

Baedke, while acknowledging the deep reciprocal interactions, views the conflation of organism and environment as a methodological error that makes scientific analysis impossible. His 'reciprocal causation model' is therefore an epistemic tool designed to analytically distinguish between the two for the purpose of tracing causal influence. It allows science to treat the organism as a distinct unit of analysis without denying its profound embeddedness.

These two approaches, however, may not be mutually exclusive. But they are actually operating at different levels of description. Capra and Luisi describe the ontological reality of connectedness. Baedke provides the methodological framework necessary to scientifically investigate the dynamics of that reality. One could argue that to understand the mechanics of 'structural coupling', a scientist needs a tool like the 'reciprocal causation model' (the epistemic method) to map the diachronic interplay of influences. Baedke's analytical rigour may be precisely what is needed to empirically ground the holistic vision of Capra and Luisi. Conversely autopoiesis provides the basis for the centrality of the organism and helps a scientist trace the creative pathways evolved by the 'cognitive process' that defines the organism.

The Mover of Evolution: Creative Agency vs. Systemic Creativity

The two philosophies also locate the source of evolutionary novelty with an apparent difference (and a deeper convergence). For Baedke, the defining feature of an organism is its ability 'to actively and creatively tinker with themselves and with their environment in ways that allow them to maintain themselves and to explore new developmental and evolutionary pathways and forms of existence.'[36] Thus the organism is the artist of its own evolution.

Capra and Luisi, go into the organism's pathway of creativity and establish it as a systemic property. The entire process of evolution thus becomes creative:

> Evolution is no longer seen as a competitive struggle for existence, but rather as a cooperative dance in which creativity and the constant emergence of novelty are the driving forces.[37]

Novelty is an emergent property arising from the autopoietic pathways within an organism and connects it to the entire web of life. It arises from the non-linear dynamics of the network itself, through processes like symbiosis, where new forms of life emerge from the coming together of previously separate systems. This keeps the individuality of the organism and shows creativity as a systemic property permeate the entire web of life.

So, the *locus of creativity* is still the organism. In Baedke's view, creativity is an intrinsic capacity of the individual agent. For Capra and Luisi it is an emergent property of the interactions of the networks and configurations. Again Capra and Luisi provide how the individuality of the organism and its dynamic relations to the web of life are connected through creativity. Baedke also shows how through niche construction the organism actively participates in the co-evolution of the web of life which includes its environment. This again reflects how what appears to be fundamental philosophical divergence, converge in a complementary way at the deeper level: Baedke's focus on the agent and Capra and Luisi's focus on the network provide a view of life as intrinsic emergence.

Evaluation Against the Worldview of Modern Science

Both frameworks of life are deeply rooted in contemporary scientific discoveries, using them as an empirical foundation to challenge the older mechanistic paradigm. This section evaluates how each framework aligns with specific findings from fields like postgenomics, complexity theory, and cognitive science.

The Scientific Case for the Active Agent (Baedke)

Baedke's philosophy of the organism as a causally efficacious agent finds strong support in several key areas of modern biology.

- **Epigenetics and Evo-Devo:** These fields provide direct evidence for the organism's role as a mediator of causality. Epigenetic mechanisms, such as DNA methylation, show how environmental signals (diet, stress, etc.) are translated by the organism's physiology into changes in gene expression that can be heritable. This places the organism -not as genome carrying vehicle but as a creative interacting phenomenon with its niche- at the centre of the gene-environment interaction. Similarly, Evo-Devo highlights how developmental processes and constraints within the organism bias and direct evolutionary pathways, making the organism an active participant in generating form, rather than a passive recipient of genetic instructions.
- **Niche Construction Theory:** This theory offers perhaps the most explicit validation of Baedke's agential view. It demonstrates that organisms are not simply adapting to static environments; they are actively engineering them. The case study of the red flour beetle (*Tribolium castaneum*) is a powerful illustration. These beetles secrete quinones that alter the microbial flora of their flour environment. Baedke discusses an experiment showing that beetle populations engaging in this niche construction evolved stronger resistance to a pathogen than populations prevented from doing so, and they achieved this resistance through different genetic pathways. This is a clear demonstration of the organism as an agent whose behaviour modifies its own selective pressures and drives its evolutionary trajectory. Baedke

shows the far reaching evolutionary implications of this niche construction:

This study shows how microbiota interaction of organisms and their niche construction can have various feedback effects on their development, reproduction, and evolution of adaptive traits. In addition, since *Bacillus thuringiensisis* used commercially as biopesticide to control insects in agricultural and public health context, these evolutionary effects on beetles' immunity may have a larger societal relevance.[38]

This shows how an organism's niche construction can trigger changes in the pathways of evolution – by affecting the resource utilisation and behaviour of another important species in the web of life – here the humans. This provides a basis for understanding inner workings of Gaia.

- **Microbiome Research:** The existence of the microbiome challenges the notion of a discrete biological individual. But reciprocal causation model handles this complexity without abandoning the organism as an analytical unity. The discussion of ruminant herbivory shows how the model can distinguish the causal contributions of the host organism, its symbiotic microbes, and the external environment, preventing an epistemologically weak 'holobiont' collapse and preserving the analytical integrity of the host as a bounded, interacting agent.

The Scientific Case for the Living Network (Capra & Luisi)

The grand synthesis of life as a self-organising network, put forth by Capra and Luisi, evolves out of a convergence of discoveries from physics, mathematics, and biology.

- **Complexity Theory:** The mathematics of non-linear dynamics, chaos theory, and fractal geometry provides the essential language for the systems view. Concepts like *strange attractor*s show how complex, ordered, and patterned behaviour can emerge from simple, deterministic rules in non-linear systems, providing a mathematical basis for self-organisation. *Fractal geometry* describes the patterns of self-similarity found throughout nature, from the branching of trees to the structure of lungs, revealing underlying principles of organization that are network-based and scale-invariant.
- **Thermodynamics:** The theory of *dissipative structures*, developed by Nobel laureate Ilya Prigogine, is a cornerstone of the systems view. It explains how open systems, which include all living systems, can maintain and even increase their internal order by importing energy from their environment and exporting entropy (disorder). This provides a firm physical basis for the phenomenon of self-organization far from thermodynamic equilibrium, resolving the old paradox of how life's order could arise in a universe governed by the second law of thermodynamics. Entropy and dissipative structures become the catalysts of creativity as an emergent property.
- **Cognitive Science:** The *Santiago theory of cognition*, with its concepts of autopoiesis and structural coupling, provides the biological and philosophical foundation for the most radical claim in this view of life: the identification of life with cognition. It grounds the mind in the body and in the very process of living, offering a scientific framework that finally overcomes the Cartesian mind-matter dualism without falling into the trap of physical or idealist monism.
- **Quantum Physics:** While a metaphorical parallel, the worldview of quantum physics lends strong support to the systems view. Quantum theory revealed a universe where fundamental 'particles' are not isolated objects but interconnections in an inseparable web of relationships, where the whole determines the behaviour of the parts, and where the observer is inextricably linked to the observed. This resonates deeply with the systemic principles of interconnectedness, non-locality, and contextual knowledge.

Points of Tension and Synthesis

While the two philosophies have different focal points—the agent versus the network, a deeper analysis suggests they can be viewed as complementary descriptions operating at different, but interconnected, levels. Baedke's organism, as a creative agent, interacting intimately with the environment, has to be seen as a deeper level manifestation of the underlying network dynamics described by Capra and Luisi. In other words, Capra and Luisi provide a deeper ontological basis for Baedke. While Capra and Luisi toy with the idea of applying autopoiesis to larger systems they acknowledge that 'the defining feature of an autopoietic system is that it continually recreates itself *within a boundary of its own making.'* In the case of cells this is clear. However, in the case of ecosystems 'the situation is less clear-cut.'

Hence, it may be argued that the atmosphere constitutes a boundary in the sense of autopoiesis. However, whether this notion can be applied to a particular ecosystem and the portion of atmosphere above it seems debatable; and whether a similar argument can be made for the soil between a terrestrial ecosystem and the Earth's crust is even less evident.[39]

This pathway from organism to the environment can be studied with the epistemological tools provided by Baedke – particularly the niche formation and reciprocal causation.

While an autopoietic network of Capra and Luisi becomes a 'persister,' for Baedke's terminology, autopoiesis that arises is the 'overcomer'. The 'overcomer' nature of autopoietic network which in turn can be traced back to the cognition at the very basic level of life, when it enters what is a 'bifurcation point'. The bifurcation points mathematically 'mark sudden changes in the system's phase portrait.' Physically, they correspond to points of instability at which the system changes abruptly and new forms of order suddenly appear.[40] In other words, creative emergence of the organism has a basis in thermodynamics. point, the system must spontaneously *self-organize* into a new, qualitatively different state of order.

From this perspective, the 'creative agency' that Baedke attributes to the overcomer can be reframed as the emergent, exploratory behaviour of a complex, adaptive network navigating a phase transition. The organism's ability to 'tinker' with itself is a property of the network's non-linear dynamics. This synthesis bridges the two views: the agent's creativity (Baedke) is the phenomenal expression of the network's inherent self-organizing dynamics (Capra & Luisi).

Baedke's framework provides the rich, empirical description of agential behaviour at the organismal level, while Capra and Luisi's framework provides the underlying physical and mathematical principles that make such behaviour possible.

Alignment of Philosophical Concepts with Modern Scientific Discoveries

The table summarizes the core concepts of each view of life with discoveries in the biological domains that support each of them:

Scientific Field / Discovery	Relevance to Baedke's *The Organism*	Relevance to Capra & Luisi's *The Systems View of Life*
Epigenetics / Evo-Devo	The organism as a causal mediator that contextualises genes and actively participates in generating heritable variation.	Demonstrates the non-linear feedback from the environment to the organism, illustrating a key aspect of structural coupling.
Niche Construction	Prime evidence for the organism as an active, bounded agent that shapes its own evolutionary pressures, validating the reciprocal causation model.	Concrete individual core of the co-evolutionary structural coupling, where organism and environment co-create a world: Foundation to Gaia.
Complexity Theory	Potential mathematical framework to understand how 'overcomers' navigate phases of instability and creatively reorganise.	The core mathematical language for the entire philosophy: self-organisation, emergence, and the behaviour of complex networks.
Thermodynamics (Dissipative Structures)	Explains the physical basis for how an organism (both homoeostatic 'persister' and creative 'overcomer') can maintain or radically change its organisation while remaining far from equilibrium.	Defines the fundamental thermodynamic nature of all open, living systems, explaining how order arises and is maintained: 'Today, the spontaneous emergence of order at critical points of instability is one of the most important concepts of the new understanding of life. Emergence is one of the hallmarks of life.... In other words, creativity– the generation of new forms – is a key property of all living systems. And since emergence is an integral part of the dynamics of open systems, open systems develop and evolve. Life constantly reaches out into novelty.'[41]
Cognitive Science (Santiago Theory)	Underpins the concepts of organismal autonomy, goal-directedness, and agency, which	Provides the core definition of life as a cognitive, autopoietic process, unifying mind, matter, and life.

	are central to Baedke's framework.	
Microbiome Research	Poses a challenge to classical individuality, which is addressed by the analytical power of the reciprocal causation model.	Exemplifies the principles of symbiosis, co-evolution, and 'networks within networks,' where one living system contains others.

Conclusion: Towards an Integrated Philosophy of the Organism in its Environment

The comparative analysis of Jan Baedke's *The Organism* and Fritjof Capra and Pier Luigi Luisi's *The Systems View of Life* reveals two powerful, complementary responses to the limitations of 20th -century biological reductionism. While Baedke meticulously reconstructs the organism as a bounded, causally potent agent, Capra and Luisi paint a grand vision of life as an interconnected, cognitive network. A truly comprehensive philosophy of life for the 21st century must integrate both perspectives, recognizing the organism as an emergent agent within a self-organizing network.

Reconciling the Agent and the Network

A complete philosophy of the living world requires both the agent and the network. Baedke's focused defence of the organism as a discrete individual provides the necessary concept of a bounded unit of selection, action, and creativity. This is crucial for empirical science, which needs identifiable entities to study, and for understanding evolution, which acts on individuals. This focus on the agent can be lost in a purely relational philosophy where boundaries are seen as arbitrary.

Conversely, Capra and Luisi's network perspective provides the deep, underlying principles of self-organization, emergence, and cognition that explain *how* such a complex, autonomous agent can arise and maintain itself in the first place. It answers the question of what makes the organism's internal organization and creative agency possible, grounding it in the physics and mathematics of complex systems. The synthesis, therefore, is to see the agent as an emergent property of the network. The organism is a localized, temporarily stable, but dynamically creative pattern within the larger, inseparable web of life.

The Future of Biology

Adopting such an integrated view has profound implications for the future of biology. It calls for a science that is simultaneously rigorous in its analysis of individual agents and their causal contributions—as Baedke's model facilitates—and holistic in its understanding of the systemic context and emergent properties—as Capra and Luisi's framework demands. This approach moves beyond the dichotomous debate of reductionism versus holism. It advocates for a multi-level, multi-causal science where explanations flow both bottom-up (from the interactions of parts) and top-down (from the constraints and organizing principles of the whole).

The future of biology lies in its ability to navigate these different levels of description and to understand how the creative agency of the organism and the self-organizing dynamics of the network are two sides of the same coin.

From Biological Theory to a Philosophy for Living

Finally, both the books offer more than just scientific theory; they point toward a new philosophy for living that responds to the alienation and fragmentation of the mechanistic worldview. The work of Baedke provides a compelling scenario to go beyond both the reductionist genetic determinism and non-rigorous holobiotic boundary dissolving. The organism becomes a creative agent. The autopoietic network of Capra-Luisi does not dissolve and subordinate the individual organism to a collective network but harmonises the individual creativity as the important driver of the network.

Baedke's critical exploration of the socio-political dimensions of the organism concept serves as a vital warning. It forces a self-conscious reflection on how we use scientific concepts to define ourselves and others, reminding us that no biological theory is politically innocent. It calls for a more critical and responsible engagement with the social implications of scientific paradigms. At the same time the systemic view of life presented by Capra and Luisi which calls for 'deep ecology' framework, argues that a systemic understanding of our interconnectedness naturally leads to an ecocentric ethic, grounding responsibility not in abstract rules but in the spiritual experience of belonging to the universe. The centralised organism is embedded in the network. The network is driven by the creativity of the organism.

Together, these two works chart a path toward a future where a more sophisticated, nuanced, and integrated understanding of life informs a more responsible, critical, and meaningful way of living on this planet. They restore the wonder of the organism not as a machine made of genes, but as a creative agent born from a self-assembling configuration which in turn drives an expanding intricate network- life as a tinkerer and a dancer in the grand, unfolding story of life.

Here one needs to look into how such discussions on the philosophy of biology can involve students of Indian *Darśanas*. In fact Santiago theory of consciousness that plays a crucial role in the view of life presented by Capra and Luisi, has a Buddhist philosophical influence - *Nagarjuna* and the *Madhyamaka* tradition.[42]

Capra while discussing the organism 'bringing forth a world' in context discusses how this resonates with the Hindu conception of *Maya* and the divine play (*Leela)*.

It is also instructive to compare the notion of bringing forth a world with the ancient Indian concept of maya. The original meaning of *maya* in early Hindu mythology is the 'magic creative power' by which the world is created in the divine play of Brahman. The myriad forms we perceive are all brought forth by the divine actor and magician, and the dynamic force of the play is karma, which literally means 'action.'

Over the centuries the word maya—one of the most important terms in Indian philosophy—changed its meaning. From the creative power of Brahman it came to signify the psychological state of anybody under the spell of the magic play. As long as we confuse the material forms of the play with objective reality, without perceiving the unity of Brahman underlying all these forms, we are under the spell of maya.

Similarly, it is not hard to for a student of Indian philosophy to discern the metaphysical space for *Satkāryavāda* in the reciprocal causation that Baedke discusses.

As advancements in biology unveils phenomena that require a plurality of epistemological and ontological viewpoints, it creates a space for non-Western philosophical systems to contribute meaningfully. The frameworks developed within the Vedic, Buddhist, and Jain *Darśanas* provide alternative and perhaps more appropriate conceptual tools that can be applied to these contemporary challenges, thereby forging new paths and deepening our collective understanding of the biological world.

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