

Revitalizing the Life Sciences: Lessons for a Participatory Approach to the Study of Evolution in Schelling's *Naturphilosophie* and Whitehead's Philosophy of Organism

Matthew D. Segall

Abstract:

This essay reconstructs a participatory approach to the study of biotic evolution by tracing a philosophical lineage from Kant through Schelling's to Whitehead's process-oriented philosophy of organism. The argument unfolds in two phases. First, I argue for the inadequacy of mechanistic biology by recuperating Kant's demonstration that organisms express a self-organizing purposiveness that mechanical explanation cannot capture. I reject the oft repeated claim that Darwin is the "Newton of the grass blade" that Kant had forbidden. Second, I sketch an alternative onto-epistemic account of life's evolution by drawing on Schelling's *Naturphilosophie* and Whitehead's organic realism. My alternative account is "participatory" in the sense that it requires that the knower come to experience herself as an example of the same formative processes she is attempting to know. This participatory framework promises to point the way toward healing the Cartesian wound between mind and nature while opening new avenues for biological research that honor both scientific rigor and the excessive vitality of life.

"So long as I myself am *identical* with Nature, I understand what a living nature is as well as I understand my own life; I apprehend how this universal life of Nature reveals itself in manifold forms, in progressive developments, in gradual approximations to freedom. As soon, however, as I separate myself, and with me everything ideal, from Nature, nothing remains to me but a dead object, and I cease to comprehend how a *life outside* me can be possible."
—Schelling, 1988, p. 36

Introduction

What can philosophy still offer to advance the scientific study of Life and evolution? Whitehead, who lived through and contributed to the dramatic early 20th century transformations in the foundations of both logic and physics, argued that philosophy, far from being a relic of pre-scientific speculation, remains essential to the coherence and creative advance of human knowledge and existence. Especially amid the increasing fragmentation of scientific disciplines and the centuries long dominance of mechanistic reductionism, philosophy finds its niche not only as a "critic of abstractions" (Whitehead, 1967b, p. 59), but as a goad to the imaginative transmutation of modern civilization's entrenched materialistic common sense. "By providing the generic notions philosophy should make it easier to conceive the infinite variety of specific instances which rest unrealized in the womb of nature" (Whitehead, 1978, p. 17). Despite signs of growing dissatisfaction and various attempts at critical reassessment (e.g., Dupré & Nicholson, 2018a; to be discussed below), mechanistic materialism remains the norm in both in academia and popular consciousness as the default worldview of industrial societies. Even those with a supernatural religious understanding of human beings still generally conceive of and relate to the physical world in mechanistic terms. This techno-scientific

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

worldview, characterized by analytic detachment, disembodiment, and a general anesthetization of experience in favor of instrumental “dashboard knowledge,” (Barfield, 1965, p. 55) has effectively severed modern natural science from the original meaning of Life envisioned by ancient Greek philosophers—whether conceived in terms of *physis*, *bios*, or *psyche*.¹ Indeed, many contemporary research programs in biology deploy methods that explicitly rule out the purposive, experiential vitality of organisms, with Life reduced to abstract mathematical models of the statistical motion of molecules. Though systems biology positions itself as post-reductionist, it continues to model organisms as nothing more than complex dynamical systems whose behavior can be fully captured by differential equations derived from physics and chemistry, themselves thought to be explainable entirely in terms of efficient causation (Koutroufinis, 2014, p. 107).

According to Andreas Weber and Francisco Varela, the status of purpose in the life sciences is decisive for “the character of our whole theory of animate nature.” (Weber & Varela, 2002, p. 98) They describe how Kant, despite his allegiance to Newtonian mechanics, attempted to straddle an unstable threshold position between brute mechanistic materialism and divinely dictated teleology. He described organisms as “natural purposes” (*Naturzwecke*) whose parts reciprocally produce one another for the sake of the whole, thereby inventing the modern concept of “self-organization” (*Selbstorganisation*) (Kant, 2005, § 65). Kant’s own caution relegated this insight to a merely regulative idea to guide human judgement, and a century of Neo-Kantian and Anglo-American interpretation hardened it into a reductionist *as-if* “teleonomy” that treats living beings as mechanistic systems in disguise (Pittendrigh, 1958). Modern biology still defaults to a mechanistic conception of causality that treats organisms as externally shaped collections of purposelessly varying parts. But this stance cannot explain the origin of living form nor the conscious agency of the scientists who study it.²

In an attempt to dispel the still reigning mechanistic orthodoxy, I begin with Kant’s transcendental organicism, which despite its cautious framing still convincingly demonstrates why self-organizing purposiveness inevitably resists mechanical reduction. I follow Weber and Varela in reclaiming Kant’s “third way” (Weber & Varela, 2002, p. 99) beyond mechanism and supernaturalism; but I go further. For Schelling and Whitehead, there is no such thing as inanimate, value-neutral matter: feeling, agency, and self-organizing purposiveness are realized not only in biological organisms but at all cosmic scales. I then turn to Darwin, arguing that his theory of Natural Selection, far from explaining living organization mechanistically, presupposes the creative variations it filters. Having established this philosophical and scientific context, I retrieve Schelling’s *Naturphilosophie* and Whitehead’s Philosophy of Organism to make a case that purposive

¹ *Physis* (φύσις) is the root of “physics,” but unlike for the materialistic common sense of today, it implied a living process of growth and emergence. *Bios* (βίος) implied a qualitative form of existence with normative implications. *Psyche* (ψυχή) referred to the animating principle, form, or soul of a living being. None of these concepts are taken seriously by contemporary scientific materialism or physicalism.

² For more on an organic realist account of abiogenesis and the conditions of our scientific knowledge of it, see Damer & Segall (2024).

organization is constitutive of Nature and not merely an artifact of our judgments of it. Living organization thus shifts from *as-if* to *as-is*. This shift to affirming living organization as constitutive of Nature raises what I call the onto-epistemic challenge: since knowing and being are entangled, a biology of living agents demands a participatory scientific method. To develop such a method, I explore Whitehead's cosmic phenomenology of concrescence alongside Goethe's intuitive science and Christoph Hueck's distinction between "onlooker" and "participatory" science." I trace how this vector operates across a counterflowing "double stream of time" (Hueck, 2020), revealing organisms as "subject-superjects"—at once cause and effect of themselves, irreducible to the external relations of mechanics. Evolution cannot be understood only as a piling up of the past. Time is a counterflowing double stream, with future possibilities pulling the present forward as much as past facts push it from behind. Instituting a participatory, process-relational method in the Life sciences dissolves the Cartesian split between Mind and Nature and opens new paths for investigating evolutionary development and the cosmological significance of human consciousness.

Kant's Transcendental Organicism and the Limits of Mechanism

In the *Critique of Judgment* (1790) Kant argued that no future Newton could derive the form of even a single blade of grass from mechanical causes alone (Kant, 2005, Sec. 75). Histories of biology often treat Darwin as the triumphant refuter of this claim, the forbidden Newton who finally cracked life's code (e.g., Freeman & Herron, 2007, p. 276; Sober, 2006, p. xv). Yet that celebratory narrative misreads both Kant's philosophical warning and Darwin's own scientific intentions. Before examining Darwin's humble hypothesis, we must first understand Kant's defense of living self-organization, which only makes sense in the context of his transcendental project. In the *Critique of Pure Reason* (1781/87) Kant proposes a "Copernican Revolution" in philosophy: objects must conform to the *a priori* forms of our cognition, and not our cognition to objects. This maneuver secures synthetic *a priori* certainty for the mathematical laws of physics, but at the cost of scientific realism. What physics knows are *phenomena* manufactured by the mind's categories applied to spatiotemporal intuitions. "We never know the real things," Whitehead quipped in a discussion of Kant, "but only an *édition de luxe* expurgated into rationality" (Whitehead, 2020, p. 46).

According to Kant, organisms exemplify "natural purposes," since in them the parts exist through and for one another in such a way that the organism is understood both as cause and effect of itself (Kant, 2005, pp. 162–163/§§ 64–65).³ This insight is not merely aesthetic but arises from Kant's attempt to articulate the distinctive form of organization exhibited by living beings. However, as elaborated below, Goethe found Kant's account insufficient because it still treats organic unity too much in terms of the reciprocal functional relation of parts, rather than grasping the parts themselves as expressions of the formative activity

³ For a detailed discussion of the concept of organisms as "natural purposes" cf. Huneman, pp. ____ of this volume.

of the living whole. When it came to the controversial study of the source of living form, Kant sided with the theory of epigenesis over preformationism (despite the former being associated at the time with spontaneous generation). Jennifer Mensch argues that Kant adopted epigenesis not only as a biological theory but as an epistemological model: he understood reason itself as developing organically, unfolding from its own inner principles in ways that parallel the development of living forms. Cognition for Kant is not imposed from outside; coming to know a law of nature is not simply a matter of associating given facts of experience into general rules. To know is to systematize, to unify, to hold the facts in systematic solution.⁴

The knowing scientist thus realizes a self-organizing purposiveness analogous to that of the organisms he attempts to know. But Kant cautiously remained at the level of analogy, refusing to grant organisms any real purposiveness. “However convincing our intuitions regarding nature’s organic capacities might be, however promising the advances made by science might seem,” Mensch explains,

“the operating principles of the organism would simply never be revealed in an empirical investigation. When reason saw organic activity in nature, according to Kant, what it was really looking at was itself” (Mensch, 2013, p. 144).

Kant thus inaugurated the study of self-organization as paradigmatic of the living world. Yet rather than displacing mechanism’s reign in natural science, Kant’s critical strictures confined natural purposiveness to a mere heuristic device to guide reflective judgment. While forcefully arguing that organisms are irreducible to mechanism, he refused to grant our judgments of their purposiveness genuine scientific status. When we imagine that we perceive purposes in Nature (as a whole or in its products), we are just seeing the reflection of the organization of our own rational powers. Organic purposiveness is a useful fiction, not a scientific finding.

Kant’s third critique nonetheless inspired a generation of Romantics to ontologize what for Kant remained *merely* metaphor. Chief among them was Schelling, who argued that Nature is organic through and through, that the evolution of Life is as much an artistic as a natural process. Skeptics may charge that recognizing constitutive purposiveness in organisms much less the world as a whole commits a “naturalistic fallacy.” But this criticism presupposes the very fact/value bifurcation that both Schelling and Whitehead reject. As Schelling recognized, Life is a *Grenzbegriff* (boundary concept) (Steigerwald, 2019, p. 274) that inherently transgresses the neat fact/value, is/ought, object/subject dichotomies upon which Cartesian science is founded. Living beings do not first exist as facts to which we then add values; rather, their very existence is an achievement of value-experience. Whitehead makes this explicit: “each pulsation of actuality...has some value for itself, for others, and for the whole” (Whitehead, 1968, p. 111). The organism’s self-maintenance, its

⁴ For a discussion of the question of knowledge, i.e., of explaining the organism, see Hueck’s article, pp. ____ of this volume.

striving to persevere and flourish, is simultaneously a fact about what it is and a norm governing what it ought to be. The metabolic need of a bacterium to seek nutrients is neither purely descriptive nor purely prescriptive but both at once: it describes a mode of existence that is inherently normative. To insist on separating facts from values when studying living beings is to impose an artificial bifurcation that only obscures the most essential feature of the phenomenon in question. Life as boundary concept reveals that organic nature always already exceeds any conceptual divisions we impose on it. Organisms are facts that realize and express values, beings whose existence is inseparable from their aims.

Darwin's Humble Hypothesis

Contrary to claims that he was the Newton of biology forbidden by Kant, who foolishly attempted to legislate the limits of scientific advance from his philosophical armchair, Darwin never set out to reduce living organization to mechanism. *On the Origin of Species* (1859) presupposes, rather than explains, the living being and its spontaneous variations that appear with every new generation. His genius was to notice that, if favorable variations occur, differential survival in a “struggle for existence” can gradually accumulate functional novelties. Natural selection is therefore a filter acting on developmentally produced differences, not the engine responsible for producing those differences.

Darwin was keenly aware of this limitation. In the closing summary of *Origin* he confessed that “our ignorance of the laws of variation is profound,” noted that acquired traits might sometimes be inherited, and marveled at mysterious “correlated variations” that transform whole organ systems during development. These ontogenetic dynamics, he conceded, are “not...closely checked by Natural Selection” (Darwin, 2016, p. 138). Of course, the later elaboration of genetics shed tremendous light on the laws of variation that remained unknown to Darwin. But random genetic mutation still does not begin to explain what is distinctive about living organization.

Here emerges a crucial philosophical divide. Contemporary neo-Darwinians argue that the algorithmic principle of random variation and differential selection can explain the appearance of purpose. “The overwhelming preference is to explain biological facts as the statistical results of natural selection which *post factum* give the semblance of goal-directedness,” as Weber and Varela put it (Weber & Varela, 2002, p. 98).

The neo-Darwinian account of living purposiveness faces three fundamental problems. First, it conflates the diversification of purposes with the origin of purposiveness as such. Variation and natural selection can explain why certain specialized functional arrangements are refined, persist, and proliferate—e.g., why cave fish lose their eyes while developing enhanced lateral line systems for detecting water movement (Lunsford et al., 2022)—but this presupposes that organisms already possess a generic capacity for purposive organization. Second, the account is circular: natural selection can only operate on self-producing, reproducing organisms, but self- and re-production are paradigmatic

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

examples of purposive activity. The explanation assumes what it purports to derive. Third, variation itself exhibits—at least partially—directional tendencies that cannot be reduced to random molecular motion. Variation is structured by developmental constraints, including bioelectric and morphogenetic fields capable of responding in real time to unexpected environmental changes (Levin, 2023; Laland et al., 2015).

While natural selection can certainly explain the refinement and specification of particular functions, it cannot account for the primordial appetite that makes living organization possible in the first place. As Kant demonstrated (even if insufficiently from Goethe's point of view), the concept of an organism as a natural purpose implies a mode of reciprocal formal and final causality and community of components that is irreducible to any mechanism operating among externally related parts. Darwin's hypothesis illuminates the diversification of life but not its origin. Natural selection explains the differential success of variations but not why the universe tends toward novel organization rather than sterile repetition. In short, Darwin explains the survival of the fittest but not the arrival of the fit. The organism arrives on Darwin's stage already exhibiting the very capacities his theory is sometimes claimed to explain: spontaneous variation, self-production, reproduction, and adaptive agency. Far from rendering immanent purposiveness obsolete, Darwin's theory presupposes and depends upon it.

Having clarified the limits of mechanical explanation in biology, I turn next to examine how Schelling and Whitehead reconceive cosmogenesis as an inherently self-organizing and so purposive process, before returning to the deeper enigma of the sources of evolutionary creativity.

Ontologizing Life: Schelling and Whitehead Beyond Kant

Schelling closed the eighteenth century with several groundbreaking treatises seeking a third way beyond dogmatic materialism (which tries to reduce subjectivity to mechanism) and Kantian and Fichtean idealism (which construes objective Nature as a construct of the rational subject) (Schelling, 1988; 2010: 2004). Against Kant's transcendental idealism, which left the thing-in-itself forever unknowable and relegated Nature to the status of mere appearance structured by rational categories, and against Fichte's activist idealism, which dissolved Nature entirely into the self-positing activity of the ego, Schelling insisted on Nature's autonomous reality and intrinsic purposiveness.

Schelling describes a primordial creative *Abgrund*—an originary abyss or groundless ground—from which subject and object coemerge as correlative poles of an absolute point of indifference. This *Abgrund* is neither being nor non-being, neither subject nor object, but that from which all determinate things spring through a dynamically evolving process of self-organization. His cosmological method involves the alchemical distillation of human self-consciousness down to its minimal experiential potencies, stripping away all empirical content to reach a pure activity where knower and known coincide. He then reconstructs Nature's evolutionary path upward from an original duplicity of infinitely

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

opposed forces through a series of organizational stages (*Potenzen*) of unstable equilibrium. The stages unfold from light and gravity, electricity, magnetism, and chemistry, through organic life and finally to self-conscious mind. Nature is understood to be the unconscious poetry of Spirit, with humanity positioned as its conscious self-awakening (Schelling, 1978, p. 232).

In this spirit, the natural philosopher seeks an account not of how our kind of mind might have arisen by some combination of chance and necessity from material processes, as a result of an arrangement of given facts; rather, as Schelling put it,

“to philosophize about nature means...to tear yourself away from the common view which discerns in nature only what ‘happens’—and which, at most, views the act as *a factum*, not the action itself in its acting” (Schelling, 2004, pp. 14–15).

Hovering between the imaginal activity of the “I” and their feelings of Nature, the Schellingian natural philosopher thus meta-critically affirms both that we make and are made by the world, that *to philosophize about Nature means to create Nature*, but to do so as *Nature itself* philosophizing (Grant, 2006, p. 188).

Although Whitehead accepts the modern philosophical turn toward subjectivity—as Whitehead put it, “apart from the experiences of subjects there is nothing, nothing, nothing, bare nothingness” (Whitehead, 1978, p. 167)—he radicalizes it by extending subjectivity beyond the human domain.⁵ Rather than positing transcendental subjects who construct the appearance of an objective world, Whitehead inverts, but does not wholly reject, Kant’s Copernican revolution. Where Kant sought the *a priori* conditions under which human experience is possible, Whitehead asks a more generic question: how are any actual entities possible, given the concrete relations they presuppose? Subjective consciousness, for Whitehead, is not an original structuring principle imposed upon a passive manifold of sensation, but an emergent achievement within the ongoing world-process. He thus reconceives the subject as simultaneously a *superject*—an achievement of the process of experiential unification, or “concrecence” in his terms, rather than a precondition for it. In this sense, Whitehead preserves the spirit of transcendental philosophy by seeking the structural conditions of experience, but—like Schelling, for whom “Nature IS a priori” (Schelling, 2004, p. 198)—he transposes these conditions from the formal operations of a solitary mind to the concrete genesis of nature itself. In the terms of his *Philosophy of Organism* (or what I have elsewhere called his “descendental” philosophy [Segall, 2023, p. 104ff]), “the subject emerges from the world—a ‘superject’ rather than a subject” (Whitehead, 1978, p. 88). Whitehead’s organic realism thus allows for the reintegration of what Kant had torn asunder, “ending the divorce of science from the

⁵ It is important to note Whitehead’s technical definition of “experience,” which is not synonymous with consciousness. The conscious thought and sense-perception usually associated with human subjectivity are, for Whitehead, late and derivative forms of a primary mode of subjective experience that he associates with all actualities. Experience in this sense signals the way actual entities take account of (or “prehend”) the data of their environment.

affirmations of our aesthetic and ethical experiences” (Whitehead, 1967a, p. 157) by planting the self-conscious power of Reason back into the cosmic context from which it originates. As Whitehead put it in his first lecture at Harvard University in 1924:

“The process of cognition is merely one type of relationship between things which occurs in the general becoming of reality. ... [Kant] asked, How is cognizance possible? I suggest to you the more general question, How is any particular entity possible having regard for the relationships which it presupposes?” (Henning & Petek, 2020, pp. 46–47).

This may seem to elide Kant’s meta-epistemic focus on the conditions of cognition, including whether we are justified in asking such ontological questions. Kant’s project was to inspect cognition itself before cognizing anything, to determine the conditions of the possibility of knowledge before making claims to knowledge. But this assumes one could examine the instrument of knowing prior to using it. But as Hegel argued nearly two centuries ago, such an approach is viciously circular and hardly free of metaphysical assumptions. It already presupposes that cognition is an “instrument,” for example, and it forgets that one cannot examine the instrument without using it. Hegel captures this with a helpful analogy: it is as though Kant refused to go into the water until he had learned to swim. Though Whitehead does not follow Hegel into absolute idealism, he similarly refused the residue of dogmatism still shaping Kant’s critical appraisal of knowledge.

Rather than granting human subjectivity a privileged position as the transcendental architect of nature’s order, Whitehead suggests that every actuality arising in cosmic history is a fresh differentiation within the ongoing wholeness of the cosmos, altering the pattern of relations from within rather than appearing as a merely additional part alongside others. Each entity can therefore be understood only in the context of the wider environment that shelters and conditions its emergence, supplying the systematic character intrinsic to what that entity is. Contemporary biological practice increasingly validates this insight: as Dupré and Bertolaso demonstrate, process-oriented scientists now recognize that the dynamics at any level of biological organization cannot be separated from the coupled dynamics of all other levels, including the environment within which the system is embedded. This ineliminable context-dependency reveals that organisms are not only discrete entities with properties but self-organizing nexuses of multi-scale relationships (Dupré & Bertolaso, 2018, pp. 322–323). The idea of an organism independent of spatiotemporal relations, or independent of electromagnetic and gravitational fields, is meaningless. Any attempt to classify organisms by means of special properties supposedly isolated from their physical environment obscures the fluid togetherness of things, which is to say that the essence of Life is inseparable from its cosmic history and habitat. Whitehead does acknowledge important special differences between, e.g., atomic elements and biological organisms. But his point is that, whatever living organisms are, they can exist only because the rest of nature is patient of their existence. This follows from Whitehead’s inversion of Kant’s anthropocentric emphasis on conditions of knowledge to instead search for the generic conditions of existence. The

latter conditions must include the possibility of entities capable of knowing, but does not require that the whole universe be made to revolve around the structure of the sense-bound human understanding (*Verstand*).

The Enigma of Evolution and the Participatory Turn

Against Kant's restriction of natural purposiveness to mere heuristic judgment, both Schelling and Whitehead view human consciousness as an evolutionary flowering of capacities latent in the cosmic process from the beginning, opening the door to what Hueck calls participatory science: a mode of inquiry affirming the knower's co-creative relationship with their divine-natural *Abgrund*. This philosophical reorientation transforms our understanding of the problem of evolution. How are we to account for the creative novelty and purposive agency characteristic of living processes while avoiding the evident limitations of both mechanistic reductionism and idealistic essentialism? Equipped with a participatory method, we can revisit evolution's most puzzling questions in a fresh light.

"A solution to the enigma of evolution," according to Hueck, "requires the inclusion of the process of cognition and its human bearer" (Hueck, 2020, pp. 136–137). He calls for a *participatory* reimagination of the evolutionary process that includes our own conscious activity as knowers. For Hueck the enigma of evolution concerns not only the source of beneficial variation but the need of the human spirit to become aware of a continuity between what natural science outwardly observes (mediated by instruments and models) and what we experience within ourselves (including our moral freedom and aesthetic values). Modern scientific materialism has prided itself on the refinement of methods that explicitly neutralize such concerns in favor of an allegedly objective study of the facts. But there are no neutral scientific models, and every instrument is designed with a purpose in mind, based on a particular research program's sense of importance. Facts are not only found but equally well made by our interests. Consider the tacit anthropomorphism of the mechanistic metaphor for Nature: human beings make machines, and yet scientific materialism models the whole world on the machine. As a result, modern science's metaphysical commitment to mechanistic materialism has left us with an image of nature from which we do not know how we belong.

For Whitehead, the enigma of evolution is twofold. First, since evolutionary theory, taken concretely, implies "the development of enduring harmonies of enduring shapes of value [i.e., organisms], which merge into higher attainments of things beyond themselves," it follows that "a thoroughgoing evolutionary philosophy is inconsistent with materialism":

"The aboriginal stuff, or material, from which a materialistic philosophy starts is incapable of evolution [, since evolution is not reducible to] changes of the external relations between portions of matter. [...] There can merely be change, purposeless and unprogressive. But the whole point of the modern doctrine is the evolution of the complex organisms from antecedent states of less complex organisms. The

doctrine thus cries aloud for a conception of organism as fundamental for nature” (Whitehead, 1967b, pp. 94, 107).

Whitehead’s point in critiquing the Darwinian theory of evolution by Natural Selection is not to dismiss it. He celebrates it as “one of the great generalizations of science” (Whitehead, 1958, p. 6). That evolution includes a struggle for survival is an obvious fact that stares us in the face. “But,” Whitehead continues:

“there is another factor in evolution which is not in the least explained by the doctrine of the survival of the fittest. Why has the trend of evolution been upwards? The fact that organic species have been produced from inorganic distributions of matter, and the fact that in the lapse of time organic species of higher and higher types have evolved are not in the least explained by any doctrine of adaptation to the environment, or of struggle” (Whitehead, 1958, p. 7).

As we’ve seen, Darwin’s principle of undirected variation under natural selection can explain the differential survival of species but not the origination of living form as such. Here the participatory approach gains traction by returning to what is most concrete: ontogenesis, the living development we can observe from the outside in any growing organism, and from the inside through our own imaginative thinking activity. Unlike abstract reconstructions of phyla based on relatively sparse fossil records across geological time, we can directly witness and inwardly accompany the metamorphosis of seed to grapefruit, zygote to zebrafish. This observable development reveals principles of formation that mechanistic biology struggles to explain: how an organism’s many cells collectively navigate morphogenetic space to organize into the adult form.⁶

The Onto-Epistemic Challenge: From Epigenesis to Concrecence

The fundamental challenge confronting an organic natural philosophy is that living beings exhibit a mode of causality proceeding from whole to parts—a formative inwardness unfolding through time—whereas our discursive, mechanistic understanding can only explain phenomena through additive external relations of parts. In organisms, parts produce one another for the sake of a whole that transcends mere summation, at least for the duration of their lives. Once an organism dies, its physically manifest wholeness dissolves and its component parts return to a merely mineral existence. This presents natural philosophers with an onto-epistemic challenge: in determining what we can know about the nature of the organic, we are already presupposing its mode of existence, since our power of cognition is itself an expression of it. The organic is thus both the subject and object of inquiry, knower and known. To think life is to be implicated in its becoming, to participate in its self-reflection. This recursive condition challenges the detached stance of

⁶ Hueck (2020), however, suggests that the evolutionary change of organisms can also be viewed in a participatory, imaginative mode, which can reveal the formative principles that shape evolution.

mechanistic representational epistemology and demands a participatory mode of thought equal to the phenomenon it seeks to comprehend.

Whitehead's response to this challenge reveals a path forward that neither privileges epistemology over ontology nor the reverse. As we've seen, he accounts for the subject-object relationship in a way that extends beyond human cognition alone. His position is that the kinds of entities that exist should already tell us what we need to know about the nature and scope of knowledge. Knowers must be among the entities that exist, with those entities being construed as capable of the relation of knowing at least in their highest grades. In Whitehead's terms, "the epistemological difficulty is only solvable by an appeal to ontology" (Whitehead, 1978, p. 189): any coherent account of what there is to be known must also reveal how we can know it. Knowledge thereby comes to be understood as an adjunct within things known, rather than as a Cartesian-Kantian view from nowhere (Whitehead, 1967a, p. 158). Whitehead thus departs from Kant's focus on human cognition, instead seeking to understand how any relationship is possible, not just the mind-world cognitive relationship that preoccupied Kant.

Whitehead's fundamental question becomes: What is an object if to be an object is always to be internally related, that is, *subjected*, to everything else, including but creatively transcending the past as a superject? Put more simply: how can anything count as a distinct thing if it is never really isolated, but is always shaped by its relations to the rest of the world? For Whitehead, an 'object' is never a self-contained lump. It is always also a subject, meaning a moment of experience or activity that takes account of other things (however minimally), and a superject, meaning the outcome of that activity, which then becomes part of the subsequent world to be taken up by others. Whitehead affirms Creativity as the ultimate principle of nature. In this affirmation, he can be counted as an ally of Darwin's, at least when the latter is read as affirming creative variation as what is primary in nature. Jérôme Rosanvallon captures Darwin's historical break with the mechanistic materialism which preceded him: where the Newton–Galileo paradigm assumes things maintain their state of motion unless externally constrained, Darwin assumes everything tends to vary unless constrained (Rosanvallon, 2012, pp. 137–139). This variation-first approach represents a profound inversion of classical physics, replacing conservation with creativity as the primary principle.

While Darwin tended to leave creative variation up to "chance" and so theoretically underdetermined, Whitehead sought to develop the metaphysics that might account for the production of novelty in terms of what he called the process of "concrecence." By this he means the growing together of many influences into one new event of experience. Each novel actuality arises from an asymmetrical, prehensive process, whereby the givenness of the past is synthesized with relevant future possibilities. In simpler terms, every new moment takes up what has already happened, feels its inherited situation, and responds by actualizing one possibility rather than another. The creative unrest of the universe drives this iterative, cumulative process, such that "the many become one, and are increased by one" (Whitehead, 1978, p. 21) This elegant phrase captures the heart of the process. "The

many” refers to all the existing actualities in the past universe that this new experience is drawing from—every influence, every pulse of cosmic history that touches this moment. “Become one” means that all these influences get integrated into a single, unified new actual occasion of experience. “And are increased by one” means that once this integration is complete, there’s now another actual entity, a new subject-superject, in the universe that didn’t exist before and that cannot be undone. Experience, never the same twice, takes on an object-subject-superject vector character. Whitehead insists that this process is not merely additive but cumulative, not static or spatial but dynamically evolutionary, with each new member of the many containing and recapitulating the whole prior cosmic community. Consequently, the universe grows like a developing embryo, from one to many, and from many back to one, rather than beginning as pre-existing parts algorithmically assembling into larger structures. Whitehead terms this his “cell-theory of actuality,” envisioning a universe where the whole is continually iterated upon, accumulating novel wholeness actual occasion by actual occasion (Whitehead, 1978, p. 219).

For Whitehead, however, the creative advance is driven by more than mere chance. Novelty is real, and the future is not predetermined, but neither is the universe simply throwing dice into the void. Each new occasion is lured toward some way of achieving intensity, contrast, harmony, and satisfaction out of the materials it inherits. This is why Whitehead thinks creativity has an aesthetic vector. The world does not merely change; it experiments with forms of order and value. Beauty, in his broad metaphysical sense, names the achievement of a richer pattern of feeling, one that holds together diversity without collapsing into chaos. So while chance may name the openness of the process, it does not explain why some possibilities are taken up rather than others. Whitehead’s answer is that each actual occasion is oriented by an aim toward the best achievable form of experience available in that situation. Creative advance is thus neither mechanically determined nor merely accidental, but aesthetically guided. A loose analogy may be drawn here to Darwin’s account of sexual selection, where the aesthetic choices of organisms can shape evolutionary outcomes rather than leaving them entirely to chance; but space prevents this connection from being elaborated at present.

Schelling and Whitehead refuse to let reason remain an abstract legislator above the streaming life of nature. They see human thought as itself the flowering of Nature’s dynamic striving, the “I think” becoming not merely a logical condition, as it remained for Kant, but the highest potency of nature’s own self-becoming, an amplification of evolutionary creativity already unconsciously working at every scale of cosmogenesis.

Goethe, too, intuited this deeper continuity. Through careful, sympathetic observation, he identified unique archetypal phenomena in the metamorphosis of plants, colors, and animal forms, cultivating what he called “exact sensorial imagination”—a participatory mode of observation by which the observer inwardly conforms to and recreates the formative activity at work in the observed. For Goethe, to see the plant aright is to inwardly

enact the same metamorphic power shaping its growth, feeling the living archetype within one's own cognition (Segall, 2022a).⁷

Whitehead takes Goethe's participatory insight and cosmologically generalizes it. What for Kant was the epigenesis of pure reason—mind generating its own categories and forms of intuition—Whitehead recasts as the process of concrescence: the self-creative evolutionary advance of the universe itself, where each actual occasion, at every scale, is a synthesis of inherited actuality (physical prehension) and imaginal potentiality (conceptual prehension). In Whitehead's scheme, what occurs in the mind and in the routes of prehensive transmission running through our living bodies—a creative fusion of memory and anticipation, perished past and possible future—is a microcosmic intensification of a universal archetypal power. Concrescence is not merely a model for subjective thought but the fundamental mode of cosmogenesis.

In this sense, Whitehead's philosophy of organism can be said to offer a cosmic phenomenology of concrescence: an account in which the epigenetic creativity that Kant reserved for reason as the source of the necessity and universality of our discursive understanding of a merely apparent Nature is generalized into a universal principle pervading actual nature. The mind—our own imaginative thinking activity—is no longer a denaturalized transcendental demiurge manufacturing a merely apparent world whose noumenal ground we can never touch, but a direct participant in and potent expression of the creative evolution of nature itself.

Recent commentators on the Goethean method of participatory observation of Nature, including Hueck (2025), Eckart Förster (2012), and Dalia Nassar (2022), have emphasized its importance for the future of scientific research. In Nassar's terms,

“the *Urphänomen* [archetypal phenomenon] does not simply exist in nature, but it is also not merely the achievement of the knower alone. Rather, the *Urphänomen* is the achievement of the knower *in collaboration with nature*” (Nassar, 2022, p. 162).

If Goethe's archetypal phenomenon is the empirical summit where discursive explanation gives way to direct imaginative seeing, Whitehead's concrescence can be understood as the cosmological *Urphänomen*—the living form of that same summit enacted at every scale of cosmogenesis. Each actual occasion gathers a differentiated manifold of prehensions, orders them in a hierarchy of felt affinities, and subordinates them to the lure of a final, unifying satisfaction. Where Goethe invites the physicist to rest at the threshold of the sensible and hands the unveiled *Urphänomen* to the philosopher, Whitehead the speculative cosmologist shows that the threshold is potentially everywhere, continuously traversed: beheld by the sympathetic human I, the universe is forever handing itself over, moment by moment, from knowledge to being, from subject to superject.

⁷ Cf. also Hueck, pp. __ in this volume.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Concrescence is the process by which the supersensible flashes into the sensible, the imaginative means by which we catch a glimpse of the living creativity of the cosmos. To follow its movement with exact sensorial imagination is to practice the *scientia intuitiva* Goethe borrows from Spinoza: a disciplined ascent from the plural facts of experience to the unifying Idea immanent within them. Whitehead thereby furnishes Goethe's intuitive scientific method with its cosmological conditions. By showing that the mind's epigenetic power is a special inflection of cosmic creativity, his philosophy of organism entrains our imagination to the productive pulse of the cosmos.

As Hueck insists, such an entrainment of the inner rhythms of thought with the outer rhythms of being requires imaginatively penetrating into the flow of time itself: not just chronological time, but the lived temporality that weaves memory and anticipation into the pre-thetic texture of our moment-to-moment experience. Living organisms, like the act of knowing, unfold in a *double stream of time*, in which the past is not merely behind and the future not merely ahead, but both are eternally co-present as latent conditions of becoming (Hueck, 2020, p. 65ff.).

This temporal intuition has far-reaching consequences relevant to the present study. It vindicates the scientific importance of the human I, as Fichte's original breakthrough in the *Wissenschaftslehre* suggested. For Fichte, the I is a self-positing, self-intuiting being that discovers its own existence in its deed. For Schelling, Fichte's insight blossoms into a philosophy of organic Nature in which human subjectivity is Nature's self-revelation. Whitehead universalizes the same dynamic: every actual occasion is a miniature I, a momentary self-creating creature that both receives and reshapes the world. Human consciousness is thus a concentrated exemplar of a ubiquitous concrescent activity, not an anomalous spectator or transcendental imposer of form upon nature. As Nassar makes clear, unlike our physical sensory equipment, Goethe's intuitive understanding "is not a capacity with which we are born; rather, it requires the *education* of our cognitive capacities" (Nassar, 2022, p. 151).

Though it at first appears as a speculative idea, in following the onto-epistemic process of concrescence we do not leave the empirical behind; we trace experience to its living source and, with Goethe, take the final result as the starting-point for a new kind of natural philosophy and science. The human I, awakened to its own concrescent power, becomes both the laboratory and the lantern for an intuitive science.

A participatory theory of Life must find another route to experiential knowledge not limited by the discursive understanding and the immediate impressions of physical sense organs. Building on Goethe's method, Hueck argues that the formative forces we experience in our willful imaginative recreation of organic processes bears a similarity to the real formative forces at work in the organism. He quotes Rudolf Steiner:

"... one discovers that through this formation of the life of the imagination one grows together with that which is the formative forces of the human body itself; after a

time one makes the discovery that the life of thought is, so to speak, nothing other than the diluted life of force of human growth. What forms us inwardly plastically in the physical body from birth to death is...in a 'diluted' state...our imaginative life in ordinary consciousness" (Steiner, 1998, GA 297a, p. 93–94, 17.01.1922).⁸

Whitehead's concept of prehension similarly allows for a participatory identification of what occurs in our imaginative recreation with what is instantiated by the actual occasions composing plant, animal, and other organisms. At whatever scale, from single cells to human selves, the same process of prehensive unification is occurring. While it is only in the human mind that this process attains full self-consciousness, the real formative forces are nonetheless non-consciously experiential in Whitehead's technical sense, meaning they include subjective forms and superjective aims.

Whitehead's account of non-conscious experience as prehensive feeling can be fruitfully illuminated by comparison with Schelling's critique of the Newtonian concept of force. "You can in no way make intelligible what a force might be independent of you," Schelling writes, "for force as such makes itself known only to your feeling" (1988, p. 18). Whitehead's doctrine of prehensive feeling may be read as a speculative reworking of what mechanistic science treated abstractly as force: not as externally imposed motion among inert bodies, but as the concrete, internally felt transmission of efficacy from one occasion to another. He thus makes good on what Schelling's *Naturphilosophie* was calling for.

If philosophizing about nature means participating in nature's own self-creative activity, then we must examine more closely the temporal structure of this participation. Hueck's "empirical vitalism" (Hueck, 2025) can be fruitfully compared to what Whitehead called "organic empiricism." Even though this phrase appears only in Whitehead's Fall 1925 Harvard lectures (Whitehead, 2017, pp. 9ff., 52ff.), rather than his published works, it designates perfectly the method implicit in *Process and Reality*: an imaginal empiricism that does not arrest itself before sensory facts but dares to follow life's own *modus operandi* into the depths of concrescence. These convergent approaches seek to overcome the onto-epistemic limitations in modern Kantian understandings of organic processes by transforming our mode of cognition from representational detachment to co-creative resonance.

Human cognition can be brought into deeper resonance with living organisms. If the world is made of events whose essence includes non-conscious experiential aims, then the task of knowledge is to learn how to think *with* rather than merely *about* those events. In this sense Hueck's call for an empirical vitalism and Whitehead's invitation to an organic empiricism converge: both seek to resituate cognition inside the very processes it aims to illuminate.

⁸ Quoted and translated by Hueck (2020, p. 179).

Whitehead provides an admittedly abstract metaphysical constellation of categories capable of cosmologically justifying otherwise merely assertive claims derived from extraordinarily expanded modes of perception. Clarifying the import of his metaphysical scheme may be aided by an examination of the phenomenology of self-awareness. When I say or think to myself “I am,” I simultaneously perceive and conceive myself in a unique act of cognition. It is *crucial* to comprehend why this experience differs fundamentally from all other cognitive processes. When perceiving external objects, a stone or a rose, concept and percept remain distinct: the percept arrives from beyond me as given, and then I apply a concept after the fact. But in the exceptional condition of actively thinking “I am,” perception and conception, reality and theory coincide, unifying subject and object in a seamless intuition. In his *Philosophy of Freedom*, Steiner quotes Schelling’s line that “to know Nature means to create Nature” not to criticize it but to develop further what it implies from the point of view of our own thinking process:⁹

“What is impossible for us with regard to nature [perceived as an objective product rather than participated as a creative process akin to our own thinking], namely creating before knowing, we achieve in the case of thinking. Were we to refrain from thinking until we had first gained knowledge of it, we would never come to it at all. We must resolutely plunge right into the activity of thinking, so that afterwards, observing what we have done, we may gain knowledge of it. For the observation of *thinking*, we ourselves first create an object; the presence of all *other* objects is taken care of without any activity on our part. ... This then is indisputable, that in thinking we have got hold of one corner of the whole world process which requires our presence if anything is to happen” (Steiner, 2011, pp. 39–40).

Steiner’s ontology of thinking translates elegantly into Whitehead’s cosmological scheme through the latter’s dipolar understanding of concrescence. Every moment of experience inherits a past that is not merely a chain of dead causes but a felt inheritance. Whitehead calls this *physical* prehension: the way the body and mind receive the weight of what has already happened. The sting of an old humiliation, the muscle memory of a practiced gesture, the taste of a madeleine cookie that suddenly returns one to childhood, all show how the past is carried forward not as bare information but as feeling-toned influence. At the same time, experience is not confined to replaying what has already been. Whitehead’s *conceptual* prehension names our intuition of what is possible but not yet actual: the sense that a melody could turn this way rather than that, that a conversation, a life, or a species might become something other than it has so far been. The past is thus never given to the present alone. It arrives haloed by unrealized alternatives, by a penumbra of possibilities contrasting with what in fact occurred. In this way, each actual

⁹ Schelling’s point is that we can only know Nature as an active process in which we participate: “To philosophize about nature means to heave it out of the dead mechanism to which it seems predisposed, to quicken it with freedom and to set it into its own free development” (Schelling, 2004, p. 14). In other words, to know it through the participatory activity of our “I” rather than in a merely reflective or representational way, as an objective product only.

occasion of experience is shaped both by the pressure of what has been and by the lure of what might yet be.

Human thinking is one especially vivid place where this entanglement of past and possibility becomes available to direct intuition. When we think, we can feel both the inertia of what we have already become and the pull of new forms trying to emerge. Anyone struggling to find the right word, making a moral decision, or trying to break a destructive habit has encountered this polarity from within. Time is not then a mere sequence of vanished instants, nor is eternity a static realm beyond the world. Eternity is present as the living pleroma of forms and meanings that can be taken up here and now, while time continually involves us in the process of giving one such possibility concrete expression.

Evolution, on this view, is not simply a heap of accidental material changes filtered from outside, but a creative process in which the settled past is repeatedly taken up and transformed in light of still-unrealized possibilities. We can glimpse this in embryonic development, in learning, in artistic creation, and in the slow maturation of character. Purpose and value are intrinsic to life because living beings do not merely struggle to survive but strive to thrive. A plant grows toward sunlight, an animal seeks nourishment, a human being pursues truth, beauty, and goodness: life at every level desires intensity of experience. This purposiveness need not imply an externally imposed blueprint. It can be understood instead as an inward appetite, an immanent lure toward richer, more complex, and more harmonious forms of feeling.

Conclusion: Revitalizing the Life Sciences

Kant's distinction between divine archetypal and human ectypal intellect need not be absolute. While we ordinarily operate through discursive understanding—laboriously assembling parts into wholes—Schelling and Whitehead affirm that human consciousness can transcend this limitation. Even Weber and Varela grant our embodied minds a privileged archetypal intuition enabling in us a “basic evidence” of organic purposiveness in nature (Weber & Varela, 2002, p. 120). Through disciplined practice and a hint of grace—whether through Schelling's sense of the human soul becoming “conscientious of creation” (Schelling, 2000, p. xxxvi) or Whitehead's “peace” as the intuition of a “harmony of harmonies” (Whitehead, 1967a, p. 284ff.)—we can learn to participate in the archetypal mode of knowing. This is not merely an epistemological achievement but an ontological transfiguration. When we develop the capacity for intuitive understanding, we don't simply know *about* cosmic creativity; we partake in it, the human “I” becoming transparently involved in cosmogenesis. As Schelling recognized, to truly philosophize about Nature means to create Nature, not because we impose our categories upon it, but because in the act of intuitive knowing, we join the very creativity through which nature eternally brings itself forth. This participatory knowing is thus both our highest cognitive achievement and our deepest communion with the cosmic life at play in all things. In developing from ectypal to archetypal modes of cognition, we do not so much gain supernatural powers as allow natural seeds to flower into Art.

Thus, I suggest that the path forward for the life sciences requires more than new conceptual frameworks, theories, or technologies. It demands a fundamental shift in scientific consciousness itself from detached observation to intimate participation, from viewing organisms as objects to recognizing them as subject-superjects, from measuring and modeling nature's products to also imaginatively engaging nature's productivity. By standing at the perpendicular intersection of time's double stream, where imaginations from the past meet inspirations from the future, we can begin to comprehend evolution as a creative advance: not a blind mechanism but a self-forming, purposive metamorphosis, not a struggle for mere survival but a cosmic appetite for ever richer depths of experience, not random variation but cosmic creativity actualizing itself through the decisions of countless creatures across time.

In this view, the emergence and evolution of biological organisms reveals itself not as a fugitive offshoot from otherwise mechanically determined laws of motion, but as evidence of the excessive abstraction of those laws. While mechanical accounts can clearly function as powerful heuristics and give us some practical grip on things, closing the explanatory gap between matter, life, and mind requires overcoming the restrictions Kant placed on scientific knowledge by expanding classical conceptions of physical ontology to make room for the formal and final causes characteristic of self-organizing processes at whatever evolutionary scale they occur.

A participatory approach to evolution promises to heal the Cartesian wound between mind and nature while opening new avenues for biological research that honor both scientific rigor and the excessive vitality of life. The wound cannot be healed by better models. It requires a metamorphosis in our thinking, such that we might become apprentices to nature's own creativity. In studying the unfolding of Life we study not merely our ancient ancestors but our own future potentials. Evolution's enigma resolves when we awaken to ourselves as not just its products but as its growing edges. The life sciences, revitalized by this awareness, might yet fulfill their higher promise: not merely to predict and control organic life but to contribute to its flourishing, thus becoming conscious of evolution's aim.

References

Barfield, O. (1965). *Saving the appearances: A study in idolatry*. Harcourt, Brace & World.

Becker, C., & Manstetten, R. (2004). Nature as a you: Novalis' philosophical thought and the modern ecological crisis. *Environmental Values*, 13(1), 101–119.

Cobb, J. B., Jr. (1975). *Christ in a pluralistic age*. Westminster Press.

Segall, M. D., & Damer, B. (2024). The cosmological context of the origin of life: Process philosophy and the hot spring hypothesis. In A. M. Davis & R. Faber (Eds.), *Astrophilosophy, exotheology, and cosmic religion: Extraterrestrial life in a process universe* (63–134). Bloomsbury Academic.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Darwin, C. (2016). Origin of species. In P. H. Barrett (Ed.), *The works of Charles Darwin*. Routledge.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Continuum.

Di Paolo, E., Thompson, E., & Beer, R. (2022). Laying down a forking path: Tensions between enaction and the free energy principle. *Philosophy and the Mind Sciences*, 3.

Dupré, J., & Bertolaso, M. (2018). A processual perspective on cancer. In D. J. Nicholson & J. Dupré (Eds.), *Everything flows: Towards a processual philosophy of biology* (pp. 322–340). Oxford University Press.

Dupré, J., & Nicholson, D. J. (2018a). A manifesto for a processual philosophy of biology. In D. J. Nicholson & J. Dupré (Eds.), *Everything flows: Towards a processual philosophy of biology*. Oxford University Press.

Eastman, T. (2021). *Untying the Gordian knot: Process, reality, and context*. Lexington.

Esposito, J. L. (1977). *Schelling's idealism and philosophy of nature*. Bucknell University Press.

Förster, E. (2012). *The twenty-five years of philosophy: A systematic reconstruction*. Harvard University Press.

Fracchia, J., & Lewontin, R. (2006). Does culture evolve? In E. Sober (Ed.), *Conceptual issues in evolutionary biology* (3rd ed., pp. 514–531). MIT Press.

Freeman, S., & Herron, J. (2007). *Evolutionary analysis* (4th ed.). Pearson.

Gare, A. (2008). Approaches to the question ‘What is life?’: Reconciling theoretical biology with philosophical biology. *Cosmos and History: The Journal of Natural and Social Philosophy*, 4(1–2), 53–94.

Gilbert, S. F., Bosch, T. C. G., & Ledón-Rettig, C. (2015). Eco-evo-devo: Developmental symbiosis and developmental plasticity as evolutionary agents. *Nature Reviews Genetics*, 16(10), 611–622.

Goethe, J. W. von. (1988). *Scientific studies* (D. Miller, Trans.). Suhrkamp Publishers.

Grant, I. H. (2006). *Philosophies of nature after Schelling*. Continuum.

Henning, B. G., & Petek, J. (Eds.). (2020). *Whitehead at Harvard, 1924–1925*. Edinburgh University Press.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Hueck, C. J. (2020). *Evolution and the double stream of time*. Temple Lodge Publishing.

Hueck, C. J. (2025). Empirical vitalism: Observing an organism's formative power within an active and co-constitutive relation between subject and object. *History and Philosophy of the Life Sciences*, 47(9), 1–9.

Jaeger, J. (2016). The fourth perspective: Evolution and organismal agency. In M. Mossio (Ed.), *Organization in biology* (History, Philosophy and Theory of the Life Sciences, Vol. 33, pp. 159–184). Springer.

James, W. (1935). *The thought and character of William James* (R. B. Perry, Ed.). Little, Brown, and Co.

Kant, I. (2005). *Critique of judgment* (J. H. Bernard, Trans.). Dover Publications.

Kant, I. (1998). *Critique of pure reason* (P. Guyer & A. W. Wood, Trans.). Cambridge University Press.

Koutroufinis, S. (2014). Beyond systems theoretical explanations of an organism's becoming. In S. Koutroufinis (Ed.), *Life in process: Toward a new biophilosophy* (pp. 99–132). De Gruyter.

Laland, K. N., Uller, T., Feldman, M. W., Sterelny, K., Müller, G. B., Moczek, A., Jablonka, E., & Odling-Smee, J. (2015). The extended evolutionary synthesis: its structure, assumptions and predictions. *Proceedings. Biological sciences*, 282(1813), 20151019.

Levin, M. (2019). The computational boundary of a 'self': Developmental bioelectricity drives multicellularity and scale-free cognition. *Frontiers in Psychology*, 10, Article 2688.

Levin M. (2023). Darwin's agential materials: evolutionary implications of multiscale competency in developmental biology. *Cellular and molecular life sciences : CMLS*, 80(6), 142.

Lowe, V. (1990). *Alfred North Whitehead: The man and his work, 1910–1947* (Vol. 2). Johns Hopkins University Press.

Lunsford, E. T., Paz, A., Keene, A. C., & Liao, J. C. (2022). Evolutionary convergence of a neural mechanism in the cavefish lateral line system. *eLife*, 11, e77387.

Majorek, M. B. (2007). Origins of consciousness and conscious (free) intention from the viewpoint of Rudolf Steiner's spiritual science (anthroposophy) in relation to Husserl's transcendental reduction. In A.-T. Tymieniecka (Ed.), *Phenomenology of life from the animal soul to the human mind* (pp. 301–320). Springer.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Mensch, J. (2013). *Kant's organicism: Epigenesis and the development of critical philosophy*. University of Chicago Press.

Nagel, T. (2012). *Mind and cosmos: Why the materialist neo-Darwinian conception of nature is almost certainly false*. Oxford University Press.

Nassar, D. (2022). *Romantic empiricism: Nature, art, and ecology from Herder to Humboldt*. Oxford University Press.

Novalis. (1960). *Schriften* (Vol. 3; P. Kluckhohn & R. Samuel, Eds.). Kohlhammer.

Offord, C. (2021, May). Can single cells learn? *The Scientist*.

Pittendrigh, C. S. (1958). Adaptation, natural selection, and behavior. In A. Roe & G. G. Simpson (Eds.), *Behavior and evolution* (390–416). Yale University Press.

Price, L. (1977). *Dialogues of Alfred North Whitehead: As recorded by Lucien Price*. Greenwood Press.

Rosanvallon, J. (2012). Pure variation and organic stratification. *Progress in Biophysics and Molecular Biology*, 110(1), 137–144.

Scheler, M. (2008). *The human place in the cosmos* (M. Frings, Trans.). Northwestern University Press.

Schelling, F. W. J. von. (2000). *Ages of the world* (J. Wirth, Trans.). State University of New York Press.

Schelling, F. W. J. von. (2004). *First outline of a system of the philosophy of nature* (K. R. Peterson, Trans.). State University of New York Press.

Schelling, F. W. J. von. (1988). *Ideas for a philosophy of nature* (E. E. Harris & P. Heath, Trans.). Cambridge University Press.

Schelling, F. W. J. von. (1856). *Sämmtliche Werke* (Division 2, Vol. 1: Einleitung in die Philosophie der Mythologie). Cotta'scher Verlag.

Schelling, F. W. J. von. (1978). *System of transcendental idealism* (P. Heath, Trans.). University Press of Virginia.

Schelling, F. W. J. von. (2007). *The grounding of positive philosophy* (B. Matthews, Trans.). State University of New York Press.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Schelling, F. W. J. (2010). On the world-soul (I. H. Grant, Trans.). In *Collapse: Philosophical research and development* (Vol. 6, pp. 58–95). Urbanomic.

Segall, M. (2023). *Crossing the threshold: Etheric imagination in the post-Kantian process philosophy of Schelling and Whitehead*. Integral Imprint.

Segall, M. (2022a). Goethe and Whitehead: Steps to a science of organism. In *Dialogue: Journal of Holistic Science*, 2, 45–63.

Segall, M. (2013). *Physics of the world-soul: The relevance of Alfred North Whitehead's philosophy of organism to contemporary scientific cosmology*. Process Century Press.

Segall, M. (2022b). [Review of the book *Untying the Gordian knot: Process, reality, and context*, by T. Eastman]. *Process Studies*, 51(2), 261–270.

Sober, E. (Ed.). (2006). *Conceptual issues in evolutionary biology* (3rd ed.). MIT Press.

Spinoza, B. (1996). *Ethics* (E. Curley, Trans.). Penguin Classics.

Steigerwald, J. (2019). *Experimenting at the boundaries of life: Organic vitality in Germany around 1800*. University of Pittsburgh Press.

Steiner, R. (1965). *Correspondence and documents, 1901–1925* (GA 262). Rudolf Steiner Verlag.

Steiner, R. (1983a). *First steps towards imaginative knowledge* (GA 227). Rudolf Steiner Verlag.

Steiner, R. (1988). *Goethe's scientific consciousness* (GA 3). Anthroposophic Press.

Steiner, R. (1985). *Letters, Volume I: 1879–1890* (GA 38). Rudolf Steiner Verlag.

Steiner, R. (1983b). *The boundaries of natural science* (GA 322). Anthroposophic Press.

Steiner, R. (1998). *Erziehung zum Leben* (GA 297a, 1. Aufl.). Dornach.

Steiner, R. (2011). *The philosophy of freedom* (M. Wilson, Trans.). Rudolf Steiner Press.

Thompson, E. (2007). *Mind in life: Biology, phenomenology, and the sciences of mind*. Harvard University Press.

Weber, A. & Varela, F. (2002). Life after Kant: Natural purposes and the autopoietic foundations of biological individuality. *Phenomenology and the Cognitive Sciences* 1, 97–125.

Published in *Cognizing Life: Historical, Epistemological, Idealistic, and Goethean Perspectives*, ed. By Christoph Hueck (Springer Nature, forthcoming 2026), Ch. 9.

Weber, M. (2006). Whitehead's onto-epistemology of perception and its significance for consciousness studies. *New Ideas in Psychology*, 24, 117–133.

Whitehead, A. N. (1967a). *Adventures of ideas*. The Free Press.

Whitehead, A. N. (2017). *Harvard lectures of Alfred North Whitehead, 1924–1925* (Vol. 2; P. A. Bogaard & J. Bell, Eds.). Edinburgh University Press.

Whitehead, A. N. (1968). *Modes of thought*. The Free Press.

Whitehead, A. N. (1978). *Process and reality: An essay in cosmology* (Corrected ed.; D. R. Griffin & D. W. Sherburne, Eds.). The Free Press.

Whitehead, A. N. (1967b). *Science and the modern world*. The Free Press.

Whitehead, A. N. (1985). *Symbolism: Its meaning and effect*. Fordham University Press.

Whitehead, A. N. (1958). *The function of reason*. Beacon Press.