The Deductive Architecture of Life

From Boundary Mechanics to Objective Normativity

Eli Adam Deutscher

Abstract

Biological sciences have historically defined life *a posteriori*, relying on observational abstractions and evolutionary contingency (e.g., the capacity for Darwinian selection). This reliance results in definitions that fail basic edge cases—such as the sterile mule—and structurally preclude any bridge to objective value. This paper abandons observational abstraction in favor of *a priori* logical deduction. By starting with the minimal physical precondition for identity—the maintenance of a boundary against continuous disruptive interaction—we derive the exact operational mechanics of life, agency, and value. Through an eleven-step logical deduction, we demonstrate that life is the constitutively necessary cybernetic loop of comparison and action required for a bounded system to persist. This framework proves that life and minimal agency are isomorphic, deduces Darwinian evolution as a deep-time navigational strategy rather than a defining parameter, and formally dissolves Hume's Is-Ought gap by embedding normativity within the operational requirements of persistence. Ultimately, this deductive framework provides a universal, falsifiable diagnostic tool capable of distinctly categorizing living agents, natural physical processes, and artificial intelligence.

Keywords: Theoretical Biology, Agency, Cybernetics, Normativity, Derivation of Life

---

1 Introduction: The Necessity of Deduction

The effort to define life has long been trapped in a methodological loop. By looking at the complex, carbon-based organisms that happen to populate Earth and attempting to abstract a common denominator, science has continually produced definitions that are either too broad (capturing fire and crystals) or too narrow (excluding sterile organisms and dormant seeds). Furthermore, by treating life as a purely descriptive biological phenomenon, these definitions permanently sever the mechanical reality of an organism from any concept of objective value, leaving ethics and epistemology floating ungrounded.

This paper proposes a radical methodological shift: we must stop asking what living things *look like*, and begin asking what the laws of physics and logic *require them to be*.

Instead of a top-down abstraction that works backward from complex biological observations, this paper builds the definition of life from the bottom up. We derive the nature of a living system from the strict logical necessities of existence. If an entity is to possess an identity distinct from its environment, it must possess a boundary. Because any non-inert reality guarantees disruptive interaction, maintaining that boundary requires the expenditure of directed work. From this single, inescapable basal mechanic, the entire architecture of agency, cognition, and normativity unfolds not as an evolutionary accident, but as a structural mandate.

To prove this, the paper proceeds through five distinct stages:

1. The Logical Derivation: We present a self-contained, eleven-step logical chain. We will trace the strict necessity of existence from the initial distinction of a boundary, through the operational requirement for a cybernetic "comparison-action" loop, directly into the emergence of objective normativity. This sequence demonstrates that the pursuit of truth (accurate modeling) and the pursuit of the good (effective action) are the same mechanical operation.

2. Steel-Manning the Mechanics: To ensure strict operational continuity between the steps, we unpack the derivation's key concepts. We define the "cognitive minimum" in purely physical terms, isolate the constitutive push of teleonomy from the mystical pull of teleology, and deduce Darwinian evolution as a mandatory diachronic strategy for boundary maintenance over deep time.

3. Mathematical Formalization and Predictive Implications: We translate the conceptual deduction into an operational physics equation—the integral of boundary identity. By anchoring life to this exact mathematical threshold, we demonstrate how the framework provides predictive explanatory power for real-world phenomena. We will use it to resolve persistent mysteries in evolutionary psychology (the epistemology of asymmetric risk), ontology (the mandate of minimal determinism), and biology (the necessity of internal conflict resolution in nested architectures).

4. Historical Markers and Empirical Intersection: We will demonstrate that while this framework is generated through strict *a priori* logical deduction, it perfectly predicts and grounds the observations of modern science. We will map this deductive structure onto established empirical frameworks—such as Schrödinger's energetic insights, Maturana and Varela's Autopoiesis, and Friston's Active Inference. We will show how these empirical sciences corroborate the logic by observing in nature what this framework proves is structurally mandatory, while identifying precisely where these historical markers fall short philosophically.

5. Structural Vulnerability and the Crucible of Objections: Finally, we will subject the derivation to the strongest possible counter-arguments. To defeat this architecture, one cannot merely disagree with the ethical conclusions; one must prove the foundational premises false. By systematically addressing edge cases—dismantling claims of semantic smuggling, addressing the paradox of artificial intelligence, and defending the collapse of Hume's Guillotine—we will explicitly answer the strongest objection under which our core premises could be invalidated, actively testing the structural limits of the derivation.

By grounding biology, agency, and value in the undeniable mechanics of boundary maintenance, this paper aims to provide a unified, deductive proof of the minimal structure of life that holds exhaustively across all possible substrates and edge cases, unifying ontology, epistemology, and ethics under one strict logical derivation.

2 The Logical Deduction of Agency

To define life without relying on the historical contingencies of earthly biology, we must deduce it from the foundational requirements of physical existence. The following traces the strict logical necessity from the physics of boundaries to the emergence of objective value.

2.1 Proposition 1: The Boundary Precondition

To possess determinate identity, an entity must be distinct from its environment. Therefore, to "be" something requires a physical or organizational boundary that separates it from everything it is not.

2.2 Proposition 2: The Inevitability of Disruption

Bounded entities are subject to continuous interaction. These interactions degrade the integrity of the boundary over time. Degradation can occur both as a result of external interactions, such as collisions with other bounded entities or cosmic forces (e.g., entropy), and internal processes, such as metabolic waste.

2.3 Proposition 3: The Primal Distinction

The requirement of boundary maintenance creates a primal distinction in physical systems. Passive conduits (mere aggregates) are inert; they are carried along by the causal flow and unable to deviate from its course. Active engines (life) harness external energy and expend internal energy to redirect the causal flow, biasing outcomes toward their own persistence.

2.4 Proposition 4: Directed Work (Biasing Causal Flow)

Random energy expenditure accelerates disorder. To effectively maintain a boundary, the system's energy expenditure must, on net, bias causal outcomes toward its own continued persistence. Not every action need be optimal; some may be neutral or even counterproductive, provided the overall effect must sustain the boundary above the threshold of dissolution.

2.5 Proposition 5: The Cognitive Minimum

To bias outcomes toward persistence, life must be capable of discriminating between physical states that favor its persistence and states that threaten it. This discrimination requires a minimal, mechanical operation: **comparison**. The living system must compare a current state against a reference state—whether that is an internal set-point, a spatial relationship across its boundary, or a temporal shift between past and present states.

2.6 Proposition 6: The Co-Constitution of Model and Action

This act of comparison constitutes an operational *model*, and the subsequent alteration of causal flow is the *action*. These two features are logically co-constitutive. A model without action is physically inert; motion without a model is causally undirected.

Therefore, "Life" is formally defined as the capacity to model (sense and compare) and act in order to perform the directed work necessary to maintain persistence against boundary disruption.

2.7 Proposition 7: The Constitutive Imperative (*Hormē*)

Because this directed work is a physical requirement for a bounded system to exist over time, the drive to persist—*Hormē*—is constitutive and non-negotiable. A far-from-equilibrium system *must* strive to persist, or it ceases to be a system.

From this single imperative, life and agency simultaneously emerge as the exact same physical mechanism viewed from two distinct perspectives. **Life** is the internal operational drive of the system (*Hormē*) to perform the work necessary to resist boundary disruption. **Agency** is the external observation of that exact same system successfully redirecting the causal flow of its environment to achieve that persistence.

2.8 Proposition 8: The Continuous Imperative

Boundary maintenance is not a singular act; boundary disruptions act continuously. The directed work of *Hormē* must therefore be ongoing. The comparison-action loop is not a one-time event but a continuous cybernetic process—repeated sensing, comparing, and adjusting in real time. Persistence is not a state achieved but a sustained activity.

2.9 Proposition 9: The Life-Agency Isomorphism

Life is the ongoing, intrinsic operation of *Hormē*—the continuous comparison-action loop required for boundary maintenance. Because *Hormē* is the exact mechanical definition of directing causal flow for self-maintenance, life and minimal agency are isomorphic. A system is alive iff it possesses *Hormē*, and possesses *Hormē* iff it is an agent.

2.10 Proposition 10: The Objectivity of Value

Because an agent physically *must* strive to persist, value is not a subjective projection but an objective, functional relationship. 'Good' is objectively defined as that which fulfills the system's *Hormē*, and 'bad' is that which frustrates it.

2.11 Proposition 11: The Truth-Goodness Isomorphism

For an agent, the "ought" (the imperative to persist) is embedded in the "is" (the physical state of being a bounded agent). The distinction between fact and value collapses. Epistemic error and ethical vice are functionally identical: both are failures of *Hormē* to align with the causal structure of reality. The pursuit of accurate models and the pursuit of effective action are one and the same.

3 Clarification and Steel-Manning the Propositions

The derivation presented above proceeds from a minimal set of physical premises to a unified account of life, agency, and value. Because this chain crosses the traditional boundaries of physics, biology, epistemology, and ethics, each proposition invites legitimate questions about scope, hidden assumptions, and semantic precision. This section addresses those questions directly. It is not a defense against hostile misreading; it is an anticipatory clarification—a steel-manning of the derivation's own logic. We proceed proposition by proposition, identifying the exact points where ambiguity might arise, where a reader could reasonably object, and where the derivation requires additional scaffolding to bear the weight of its conclusions.

3.1 Proposition 1: The Boundary Precondition

A boundary is a **physical or organizational barrier that separates an inside from an outside**. It constitutes the entity as a determinate "this" against an indeterminate "not-this." This is

the minimal possible definition of distinction. Without distinction, there is either a Parmenidean plenum or nothing at all.

3.2 Proposition 2: The Inevitability of Disruption

In any world that is not inert, there will be interactions. Interactions create energy transfers. These energy transfers disturb homeostasis or erode the structure of the boundary. Entropic forces in our universe are the clearest example of a universal degradation of highly ordered entities into the lower-energy background.

3.3 Proposition 3: The Primal Distinction

The term "causal flow" may suggest a commitment to hard determinism, but the distinction between passive conduits and active engines is independent of whether reality is deterministic or probabilistic. "Causal flow" refers simply to the ordered operation of physical law. In a deterministic world, active engines alter the strict sequence of outcomes; in a probabilistic world, they bias the distribution of outcomes. The core claim remains: life harnesses external energy and expends internal energy to redirect the course of events toward its own persistence.

However, this distinction reveals a strict ontological floor: any life-permitting universe must possess a minimally deterministic character. In a purely indeterminate or fundamentally random universe, there are no causal regularities or stable patterns. Without predictability, no entity can exploit environmental rules to bias outcomes toward persistence and away from dissolution. Active engines rely entirely on the premise that specific actions yield reliable physical consequences. Thus, while reality need not be strictly deterministic, minimal causal regularity is a mandatory precondition for actions to produce consequential results.

3.4 Proposition 4: Directed Work (Biasing Causal Flow)

The phrase "directed work" may invite the charge of teleology, as though every action must be purposefully aimed at persistence. The derivation intends no such claim. "Directed" describes a net functional correlation: the system's total energy expenditure must bias outcomes toward maintenance sufficiently to offset degradation. Random motion may occasionally lead to survival by pure chance, but over deep time, unguided expenditure will deplete energy faster than it can be replaced. Individual actions may be random or even harmful, so long as the overall effect keeps the boundary intact over time. The requirement is a net positive bias, not perfect efficiency. This is a **teleonomic** relation—apparent purpose arising from feedback-stabilized mechanisms—not a **teleological** one requiring a designer or conscious aim.

3.5 Proposition 5: The Cognitive Minimum

The term "comparison" risks being read as a conscious, deliberative act. The proposition intends no such mentalistic claim. "Comparison" here denotes a purely mechanical operation: a physical system's state changes differentially in response to different stimuli, such that its subsequent action correlates with persistence-relevant features of the environment. A bacterium does not "weigh options" when it compares chemical concentrations; its receptor array and signaling cascade physically instantiate the discrimination. The operation is comparison in the functional sense, not the phenomenological one.

This operation is the exact physical locus where agency and value enter the universe. Traditional philosophy typically searches for agency in the trailing execution—the "act" of moving an appendage or spinning a flagellum. But the true genesis of agency is the comparator. The moment a system measures its current state against the reference state of its own boundary maintenance, it is performing a functional evaluation. The differential between the "current state" and the "ideal boundary state" is the literal, physical reality of a value judgment. Closing this gap is operationally "good"; widening it is "bad." By locating agency squarely in the comparison step, we strip "intentionality" of its mysticism: a system's internal state is structurally "about" the external environment because the absolute stakes of the comparison are dissolution.

The discrimination need not be perfect. As with Proposition 4, the requirement is a net bias. The system's comparison-action coupling must, on average, favor outcomes that support persistence. Occasional misdiscriminations or errors are tolerable so long as the overall loop maintains the boundary above the threshold of dissolution. The cognitive minimum is a statistical edge, not infallibility. This comparative capacity scales with complexity. Humans map highly abstract, nested systems to execute extremely long-term comparison-action loops.

3.6 Proposition 6: The Co-Constitution of Model and Action

The term "model" invites philosophical objections regarding representational content and intentionality. A model, in cognitive science and philosophy of mind, is typically understood as a mental structure that stands for something else—it implies "aboutness." The derivation uses "operational model" in a strictly physical and functional sense: it is the structural coupling between sensor states and effector outputs that correlates with persistence-relevant features of the environment. No semantic content, internal representation, or conscious interpretation is implied. The physical architecture of the boundary *is* the model.

The claim of co-constitution is equally minimal. A comparison that produces no action is physically irrelevant to persistence; an action uncoupled from comparison is undirected and random with respect to the environment. In any system that persists, the two features arise together as a single functional loop. The derivation does not assert that every comparison-action pairing is

optimal or even conscious; it asserts only that the two are logically inseparable in any boundary-maintaining system.

By explicitly defining life at this threshold—the capacity to model and act to maintain persistence—strict operational utility becomes the benchmark for accuracy. Because this formulation of life is derived entirely from basal physics rather than specific chemical traits, it exhaustively resolves the biological edge cases (e.g., dormant seeds, sterile workers, synthetic biology) that traditional, descriptive definitions fail to handle.

3.7 Proposition 7: The Constitutive Imperative (*Hormē*)

The "must" in this imperative is strictly constitutive: a bounded, far-from-equilibrium system that ceases to perform the work of boundary maintenance simply ceases to exist as that determinate system. *Hormē* is the structural label for this physical necessity, not a moral duty. The term "strive" is likewise entirely functional, not psychological; it denotes the continuous expenditure of directed work, completely independent of consciousness or intent.

Furthermore, "agency" is a highly contentious philosophical term, often burdened by human-centric assumptions. The derivation presented here relies strictly on *minimal agency*—the baseline operational capacity to intervene in and alter causal outcomes. Any anthropocentric philosophy that attempts to reserve agency exclusively for complex, conscious minds now bears the burden of proof: it must demonstrate why human agency is fundamentally structurally different from, rather than merely a highly scaled macroscopic expression of, this exact same minimal biological agency.

3.8 Proposition 8: The Continuous Imperative

The term "cybernetic" may suggest a centralized controller or an externally imposed set-point. The derivation intends no such implication. "Cybernetic" here denotes a decentralized feedback dynamic: the system's own organization provides the reference state against which current conditions are compared. Persistence is inherently temporal—to persist is to maintain a boundary through time, not at a single instant. The cybernetic loop is the explicit recognition of this fact: because degradation acts continuously, maintenance must be continuous. The loop operates in time, adjusting moment by moment. No homunculus or designer is required.

3.9 Proposition 9: The Life-Agency Isomorphism

The assertion that life and minimal agency are indistinguishable often faces immediate resistance from traditional philosophies of mind, which reserve "agency" for complex, conscious entities with nervous systems. This derivation strictly rejects that anthropocentric layering. If agency is defined functionally as the capacity to genuinely intervene in and redirect the physical causal flow of the environment, then the very act of maintaining a far-from-equilibrium boundary is

the universe's most basal action. A bacterium swimming up a gradient is not a passive object being pushed by physics; it is an active engine performing directed work to bias an outcome. The minimal criteria for biological persistence are identical to the minimal criteria for causal intervention.

Crucially, this is a structural isomorphism, not a definitional tautology. The terms were not defined in terms of each other; they converge on the exact same physical architecture by logical necessity. *Hormē* viewed from the internal perspective is the operational necessity to maintain a boundary by sensing, comparing, and acting (life). *Hormē* viewed from the external perspective is the capacity to direct causal flow (agency). They are two distinct epistemological lenses mapping perfectly onto the same ontological engine.

3.10 Proposition 10: The Objectivity of Value

The term "good" carries immense philosophical baggage, often treated by meta-ethicists as an irreducible, non-natural property floating free of physical reality. Proposition 10 rejects this mystification. It does not merely offer a "pragmatic" or "minimal" definition of value; it identifies the absolute structural root of value itself. "Good" is the strict operational fulfillment of a system's *Hormē*; "bad" is the causal frustration of it. This is the only logically coherent origin of the concept. Any competing definition of "good" either relies on ungrounded magical premises or ultimately collapses into a disguised, higher-order expression of *Hormē*. Value is not a subjective preference projected onto a dead universe; it is an objective, operational relation enacted by an active engine resisting its own dissolution.

This formulation yields profound explanatory power. Because value is simultaneously objective (grounded in the mechanics of persistence) and boundary-relative (indexed strictly to a specific system), it resolves the false dichotomy between moral absolutism and cultural relativism. It explains exactly why "the good" varies from species to species and across shifting contexts: individual boundaries are distinct, and therefore their operational imperatives frequently collide. What is "good" for the spider is causally "bad" for the fly. This systemic relativity is not evidence of moral nihilism; it is the exact logical consequence of a non-inert reality populated by multiple distinct cybernetic loops maintaining their own boundaries.

3.11 Proposition 11: The Truth-Goodness Isomorphism

Proposition 11 states that for an agent, the "ought" is embedded in the "is." This may be misread as a claim that all facts imply values universally. The claim is narrower: for an entity constituted by *Hormē*, the imperative to persist is not an external addition but a structural feature of its physical organization. The distinction between epistemic error and ethical vice is functional, not metaphysical. Both are states in which the system's internal loop fails to track the causal order, resulting in boundary degradation. The pursuit of accurate models and effective action are one

and the same activity viewed from two angles: modeling and acting are inseparably structurally coupled.

3.12 Darwinian Evolution as a Deductive Consequence

The derivation of life as the continuous operation of *Hormē* contains a further implication. An individual agent persists only for a finite span. For the phenomenon of life to persist beyond individual lifespans, the organizational pattern must be replicated.

Crucially, this replication *must* introduce structural variation—regardless of the specific biological mechanism involved. Because the external environment is causally non-inert and constantly shifting, any entirely rigid lineage will eventually encounter a novel disruption it cannot absorb and will dissolve. Therefore, a system capable of generating variation possesses a structural capacity to adapt. While it may appear circular to state that "only adapting systems survive," it is actually a rigorous thermodynamic constraint: over deep time, lineages capable of generating diverse operational models will necessarily out-persist static configurations.

Among these variants, those whose *Hormē*-driven comparison-action loops more effectively bias outcomes toward persistence will, on average, persist longer and replicate more. Over deep time, the distribution of patterns shifts toward those that work best. This is natural selection. It follows deductively from Propositions 1–9 combined with the physical necessity of finite lifespans and structural variation. No additional empirical premise is required. Darwinian evolution is thus not an independent theory grafted onto the derivation; it is the diachronic expression of *Hormē* operating across generations.

4 Implications of the Deductive Framework

By deriving life, agency, and value through the strictly operational mechanics of boundary maintenance, this framework provides predictive explanatory power for several persistent problems in philosophy and evolutionary biology. When biology is anchored to the operational logic of the boundary, phenomena that previously appeared as evolutionary accidents or cognitive errors are revealed to be structural mandates.

4.1 The Mathematical Formalization of the Boundary Integral

The deductive framework of *Hormē* is not merely a conceptual abstraction; it is an operational reality that can be expressed with mathematical precision. The survival of a bounded system is entirely dictated by the continuous energy balance at its boundary. We can formalize the absolute baseline requirement for biological persistence using the integral equation of identity:

$$A(t) = A_0 + \int (\Phi - N) d\tau$$

In this formulation, the variables map directly to the physical imperatives of a living agent:

- $A(t)$ represents the active organizational state of the system at time t. For the system to be considered "alive" (persistent), $A(t)$ must remain above the threshold of dissolution.
- A_0 is the initial organizational state or the inherited boundary capacity of the system at the start of the measured interval.
- Φ represents the continuous directed work performed by the system's *Hormic* loop—the energy successfully captured, metabolized, and deployed to repair structures, evade threats, or maintain internal homeostasis.
- N represents the continuous work of disruption acting upon the system—entropic decay, thermodynamic friction, physical damage, and the energetic costs of movement and processing.

This equation distills the absolute operational difference between a living agent and an inanimate object. For a rock, $\Phi = 0$; it performs no directed work, and its existence is entirely at the mercy of $\int(-N)d\tau$, guaranteeing its eventual erosion.

For a living system, the imperative of the cybernetic loop is to ensure that over any critical timeframe, the integral $\int(\Phi - N)d\tau$ remains net-positive. If Φ successfully outpaces N, the boundary persists, and the system acts as an active engine. If an environmental shift or a mapping error causes N to radically exceed Φ and the boundary lacks sufficient "fitness" ($A(t)$ is not above a dissolution threshold) of the boundary, the boundary margin is breached, and the system dissolves back into the inert causal flow. Thus, survival is not a static trait; it is a continuous mathematical operation.[1]

4.2 The Epistemology of Asymmetric Risk

Evolutionary psychology frequently struggles to classify "irrational" behaviors, such as innate phobias of snakes, spiders, or heights. When a modern human or a domesticated cat jumps violently away from a harmless shadow or a piece of string, it is typically categorized as a cognitive bias or a false map of reality.

Under the present framework, this reaction is not an epistemic failure; it is a highly accurate, compressed operational map of asymmetric physical risk. For a system maintaining a boundary against continuous disruption, a "false positive" (jumping at a shadow) costs a tiny fraction of the system's internal capacity; the boundary margin easily absorbs the waste. However, a "false negative" (ignoring an actual viper) radically exceeds the system's net work capacity, resulting in immediate boundary dissolution. Because the cost of a false negative is infinite, the most operationally accurate model of the world *must* heavily over-weight the false positive. The organism's map is not hallucinating; it is flawlessly calculating the physical cost of being wrong. Evolutionary traits are thus optimized not for visual fidelity, but for strict causal persistence.

[1] For the full derivation of the equation of identity see Eli Adam Deutscher, *The First Cut: How Boundary Logic Derives Physics*, Neo-Pre-Platonic Press, 2026, https://neopreplatonic.com/papers/First_Cut/.

4.3 The Ontological Mandate of Minimal Determinism

The requirement that life must actively redirect "causal flow" (Proposition 3) yields a profound ontological implication about the nature of the universe itself. Agency is functionally impossible in a universe of pure randomness. If physical laws are entirely unpredictable, then no expenditure of directed work can reliably bias an outcome.

An active engine requires friction; it must push against a predictable physical grammar. Therefore, the mere existence of life acting as a cybernetic loop constitutes an active proof that the universe possesses minimal determinism. While the universe need not be rigidly Newtonian, it must contain stable causal regularities that can be modeled and exploited. Life is not an exception to physical law; it is the absolute exploitation of it.[2]

4.4 Nested Architecture and Conflict Resolution

As systems grow in complexity, they rely on nested architecture—smaller *Hormic* loops (cells, organs) coupling together to form higher-order boundaries (organisms, societies).

This nesting explains the trajectory of cognitive evolution. As complexity increases, the primary threat to the higher-order boundary often ceases to be external disruption and becomes internal civil war. A lower-order loop (such as a localized drive for immediate resource acquisition) may execute its internal model perfectly, but at the expense of the higher-order boundary's long-term persistence (resulting in systemic disease or behavioral pathologies like addiction). Therefore, as agents scale, they are forced to evolve increasingly sophisticated mechanisms for internal conflict resolution. The prefrontal cortex in humans, for example, is not merely a tool for mapping the external environment; it is a higher-order cybernetic governor tasked with adjudicating conflicting *Hormic* imperatives among its own nested subsystems.[3]

5 Historical Markers and Empirical Intersection

While the architecture of this framework is generated through strict *a priori* logical deduction, any valid deductive system must ultimately map onto the physical reality it describes. Over the past century, modern physics, theoretical biology, and cognitive science have repeatedly stumbled upon fragmented pieces of this exact architecture. By mapping our eleven deductive propositions onto established empirical frameworks, we can demonstrate a crucial methodological point: when empirical science observes the mechanics of persistence at the highest level of resolution, it observes precisely what this framework proves is logically mandatory.

[2]For the complete argument for the structural necessity for minimal determinism see Eli Adam Deutscher, *Probabilistic Determinacy as a Necessary Precondition for Life: Why Agency Requires Statistical Causality and Why Hard Determinism Fails*, Neo-Pre-Platonic Press, 2026, https://neopreplatonic.com/papers/determinism/.

[3]See Eli Adam Deutscher, *Neo-Pre-Platonic Naturalism: A First-Principles Framework for Reality, Mind, and Knowledge*, First Edition (Neo-Pre-Platonic Press, 2025), Ch 6 for the evolved stratified *Psyche*

However, because these historical frameworks largely built their theories *upward* from observation rather than *downward* from logical necessity, they each contain critical philosophical blind spots. They captured the mechanics but missed the mandate. By examining these historical markers sequentially, we demonstrate how our deductive architecture not only grounds their empirical findings but formally corrects their philosophical limitations.

5.1 The Physics of Degradation and the Chemoton

The first major empirical intersection occurred in the mid-20th century, as physics attempted to describe the energetic mechanics of life. Erwin Schrödinger observed that a living organism maintains its boundary by drawing "negative entropy" from its environment,[4] and Ilya Prigogine proved that far-from-equilibrium systems must dissipate energy to maintain structural coherence.[5] In complex chemistry, Stuart Kauffman's autocatalytic sets demonstrated that minimal organizational closure is required to channel physical energy into boundary-maintaining work.[6]

A striking historical precedent to our methodological approach is found in Tibor Gánti's chemoton model.[7] Rare among biologists, Gánti reasoned deductively to create a minimal abstract model of life consisting of a metabolic cycle, a template replication cycle, and a membrane boundary. Gánti's chemoton directly instantiates Propositions 1, 2, 4, and 8, proving that the deductive requirements for life hold independent of specific chemical substrates.

However, standard physics and chemistry fell into a structural trap: they treated chemical thermodynamics as the defining parameter of life. Our framework reveals that entropy is merely how degradation manifests for carbon-based systems. The logical mandate—that any interaction between an "inside" and an "outside" will disrupt a boundary unless countervailing work is performed—holds true across any conceivable substrate.

5.2 Physiology, Cybernetics, and the Set-Point Error

As science moved to systemic organization, physiologists like Claude Bernard and Walter Cannon discovered that living systems work dynamically to maintain internal variables against external flux—*homeostasis*.[8] Norbert Wiener and W. Ross Ashby formalized this mechanically, with Ashby's homeostat proving that "purposeful" behavior is physically instantiated as a negative feedback loop.[9]

[4]Erwin Schrödinger, *What Is Life? The Physical Aspect of the Living Cell* (Cambridge University Press, 1944).

[5]Grégoire Nicolis and Ilya Prigogine, *Self-Organization in Nonequilibrium Systems: From Dissipative Structures to Order Through Fluctuations* (Wiley, 1977).

[6]Stuart A. Kauffman, *Investigations* (Oxford University Press, 2000).

[7]Tibor Gánti, *The Principles of Life* (Oxford University Press, 2003).

[8]Walter B. Cannon, *The Wisdom of the Body* (W. W. Norton & Company, 1932).

[9]W. Ross Ashby, *Design for a Brain: The Origin of Adaptive Behaviour* (Chapman & Hall, 1952).

This directly corroborates Propositions 5, 6, and 8: persistence requires a continuous comparison-action loop. However, early cybernetics suffered from the "set-point error." They treated organisms and guided missiles as structurally equivalent, failing to account for the *source* of the imperative. In an artificial machine, the set-point is engineered from the outside; in life, the set-point is an existential necessity—the boundary itself. Cybernetics captured the mechanical loop but entirely missed the constitutive imperative of *Hormē* (Proposition 7), leaving agency conflated with mere automation.

5.3 Autopoiesis, Umwelt, and the Constructivist Trap

The closest empirical allies to our deductive logic are found in biology. Jakob von Uexküll's *Umwelt* theory demonstrated that an organism interacts only with specific features of the environment relevant to its survival, corroborating the system-relative nature of Proposition 5.[10] Building on this, Humberto Maturana and Francisco Varela defined life through "operational closure"—a system continuously regenerating its own boundary. Crucially, they recognized that this structural coupling is inherently cognitive: "living is knowing."[11]

While they correctly observed the Life-Agency Isomorphism (Proposition 9), their frameworks suffered an epistemological collapse. Because Uexküll focused on subjective perception, and Maturana and Varela defined the organism as strictly operationally closed, they concluded that an organism can never know "objective reality," leading to radical constructivism. Proposition 11 corrects this: if an agent's internal operational model does not accurately track the objective physical reality of the disruptive forces outside its boundary, the structural coupling fails, and the boundary dissolves. Autopoiesis must be grounded in an objective epistemology.

5.4 Teleodynamics, Information, and the Emergence Trap

Terrence Deacon's concept of "teleodynamics" argues that agency is the physical constraint of energy to actively prevent entropic decay.[12] He correctly identifies that living systems are organized around a reference state ("absential causation"). While this corroborates the mechanics of directed work, Deacon relies heavily on "emergence," framing purpose as an emergent property rather than a deductively foundational necessity.

Similarly, at the mathematical edge of neuroscience, Giulio Tononi's Integrated Information Theory (IIT) attempts to formalize how systems possess intrinsic causal power over their own states,[13] and Karl Friston's Free Energy Principle demonstrates that any bounded entity must continuously

[10] Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans: With a Theory of Meaning*, trans. Joseph D. O'Neil (University of Minnesota Press, 1934).

[11] Humberto R. Maturana and Francisco J. Varela, *Autopoiesis and Cognition: The Realization of the Living*, Boston Studies in the Philosophy of Science (D. Reidel Publishing Company, 1980), 42.

[12] Terrence W. Deacon, *Incomplete Nature: How Mind Emerged from Matter* (W. W. Norton & Company, 2011).

[13] Giulio Tononi, "Consciousness as Integrated Information: A Provisional Manifesto," *The Biological Bulletin* 215, no. 3 (2008): 216–42.

act to minimize the difference between internal models and external states (Active Inference).[14] While both mathematically corroborate the continuous comparison-action loop (Proposition 8), they are fundamentally descriptive. They provide the immaculate mathematical engines of causal power, but require the deductive necessity of *Hormē* to explain *why* the engine is running and why its operation constitutes an objective value.

5.5 Minimal Agency and the Diachronic Stack

Contemporary philosophy of biology has increasingly recognized the necessity of bridging these physical mechanics to normative agency. Xabier Barandiaran and Alvaro Moreno define minimal biological agency as a system that regulates its internal milieu in relation to boundary conditions to maintain viability, explicitly linking sensorimotor coordination with normativity.[15] This rigorously empirically grounds Propositions 9 and 10.

Furthermore, because *Hormē* operates continuously across finite lifespans, it dictates a diachronic evolutionary reality. John Maynard Smith and Eörs Szathmáry's work on the major transitions in evolution describes how life has repeatedly crossed thresholds of complexity—from replicating molecules to multicellular organisms.[16] This empirical progression perfectly maps onto the deductive expectation that Darwinian evolution acts as a deep-time navigational strategy, layering degrees of agency into a scalar stack while remaining anchored to the fundamental mandate of boundary maintenance.

5.6 Reclaiming Objective Value

The phenomenological philosopher Hans Jonas intuited the ultimate consequence of these mechanics: metabolism is intrinsically teleonomic, and the simple act of maintaining a boundary introduces *value* into the universe.[17] To Jonas, to survive is to affirmatively "say yes" to existence.

Jonas arrived at the conclusions of Propositions 10 and 11, but his reliance on existential phenomenology left his arguments vulnerable to charges of anthropomorphism. Our deductive framework gives Jonas's intuition structural teeth. By uniting the chemical logic of Gánti, the mathematics of Friston, the operational closure of Maturana, and the agency definitions of Moreno beneath the substrate-independent logic of boundary disruption, we derive objective value without human projection. Truth and goodness are mathematically and logically fused at the boundary of existence. The pursuit of the good and the mechanics of persistence are physically identical.

---

[14] Karl Friston, "The Free-Energy Principle: A Unified Brain Theory?" *Nature Reviews Neuroscience* 11, no. 2 (2010): 127–38, https://doi.org/10.1038/nrn2787.

[15] Xabier E. Barandiaran et al., "Defining Agency: Individuality, Normativity, Asymmetry, and Spatio-Temporal Dynamics in Action," *Adaptive Behavior* 17, no. 5 (2009): 367–86.

[16] John Maynard Smith and Eörs Szathmáry, *The Major Transitions in Evolution* (W. H. Freeman/Spektrum, 1995).

[17] Hans Jonas, *The Phenomenon of Life: Toward a Philosophical Biology* (Harper & Row, 1966).

6 Objections and Deductive Rebuttals

6.1 Proposition 1: The Boundary Precondition

- **Objection 1.1 (Circularity):** Defining identity in terms of a boundary presupposes an inside and outside, which already assumes a determinate entity.
  - **Rebuttal:** The boundary is a first principle of distinction, acting as a regress-stopper. In ontology, to be determinate requires delimitation. Distinction is the foundational act of existence; without it, there is only an undifferentiated background.
- **Objection 1.2 (Fields/Wavefunctions):** Gravitational fields or quantum wavefunctions lack sharp boundaries but are determinate physical entities.
  - **Rebuttal:** Even fields possess spatial and temporal extent, as well as causal limits (a domain of influence). They are not infinite, undifferentiated plena. The principle of distinction still applies.
- **Objection 1.3 (Vagueness):** If "boundary" applies to any pattern, it is trivial; if restricted to physical walls, it is false.
  - **Rebuttal:** The broadness of the definition is structurally necessary, not a flaw. Because the principle governs *all* determinate entities across all substrates, it must be elastic enough to cover biological membranes, conceptual categorizations, and systemic limits.
- **Objection 1.4 (Observer-Dependence):** Boundaries (like clouds) are often conceptually imposed by observers, not intrinsic to the object.
  - **Rebuttal:** This reinforces the proposition. The very act of cognition or identification requires imposing a limiting boundary. Epistemology demands boundaries just as much as physics does.
- **Objection 1.5 (The Holobiont and Symbiosis):** Biological observation reveals that organisms are rarely isolated individuals. A human relies on a microbiome of trillions of independent bacteria; a lichen is a composite of fungi and algae. If identity requires a distinct boundary, where does one agent end and another begin? Does the "holobiont" falsify the idea of a singular, bounded identity?
  - **Rebuttal (Nested Organizational Boundaries):** This objection assumes the boundary must be a single, impermeable physical skin. Proposition 1 explicitly allows for *organizational* boundaries. In a symbiotic relationship, multiple distinct loops of *Hormē* structurally couple together to form a higher-order, nested cybernetic loop. The boundary of the holobiont is the functional limit of that combined network's directed work. Biology's physical "messiness" is simply nested *Hormē* operating at multiple scales simultaneously; it does not violate the requirement of boundary maintenance, it exemplifies its modularity.

6.2 Proposition 2: The Boundary Disruption

- **Objection 2.1 (Static Equilibrium):** Crystals in a saturated solution maintain their boundary indefinitely without energy expenditure.
  - **Rebuttal:** This objection artificially constrains the timescale. Crystals are in a metastable state. Over deep, cosmological time, interactions with their environment will degrade them. Equilibrium is always temporary and local.
- **Objection 2.2 (Closed Systems):** In a perfectly closed system, no work is needed to maintain a boundary.
  - **Rebuttal:** A perfectly closed system with zero internal or external interaction does not map to our reality; it describes a lifeless, inert universe. Furthermore, biological boundaries are *nested*, meaning forces of dissolution often exist *internally* as well.

6.3 Proposition 3: The Primal Distinction

- **Objection 3.1 (False Dichotomy):** Dissipative structures (hurricanes, whirlpools) actively maintain patterns but are not alive.
  - **Rebuttal:** Dissipative structures are merely faster-moving aggregates. Their organization is transient and externally imposed, lacking an internal constitutive drive. Over deep time, they degrade indistinguishably from rocks.
- **Objection 3.2 (Begging the Question):** A hurricane redirects causal flow—why does this not count as biasing outcomes toward persistence?
  - **Rebuttal:** A hurricane *is* the causal flow. It is the pattern of external forces equalizing a gradient, not a bounded entity harnessing external forces to actively resist its own equalization.
- **Objection 3.3 (Energy Source Ambiguity):** Machines (solar panels, turbines) harness energy but are not alive.
  - **Rebuttal:** This derivation operates sequentially. At this step, machines *are* categorized as active engines. Subsequent propositions (specifically Proposition 7 regarding intrinsic *Hormē*) will separate human-engineered tools from self-constituting biological agents.

6.4 Proposition 4: Directed Work

- **Objection 4.1 (The Flame):** A flame creates convection currents that draw in fuel, maintaining its reaction zone.
  - **Rebuttal:** A flame biases outcomes toward its own *extinction*. It accelerates the depletion of its fuel source until it dies. It possesses no self-limiting regulation and performs no net maintenance.
- **Objection 4.2 (Teleonomy vs. Teleology):** Calling it "teleonomic" doesn't explain the mechanism behind the correlation.

  - **Rebuttal:** The apparent "direction" of the work is derived from the system's evolved architecture (historical persistence), not from forward-looking, conscious purpose.
- **Objection 4.3 (Threshold Vagueness):** "Net bias" is unquantifiable and unfalsifiable.
  - **Rebuttal:** The threshold is rigorously quantifiable via the integral equation for net maintenance: $A(t) = A_0 + \int(\Phi - N)d\tau$, where Φ is the work performed to maintain the boundary and N is the work of external dissolution. If the integral falls below the threshold of dissolution, the entity ceases to exist.
- **Objection 4.4 (The Spandrel Problem):** Evolutionary biology demonstrates that many biological traits are "spandrels"—architectural byproducts of other structural constraints, rather than directed adaptations for survival. Furthermore, organisms carry vestigial organs and junk DNA. If life is strictly defined by directed work and *Hormē*, the existence of neutral or non-adaptive traits falsifies the claim that biological organization is universally directed toward persistence.
  - **Rebuttal (Net Threshold vs. Perfect Optimization):** This objection conflates the requirement of "net functional bias" with "perfect pan-adaptationism." Proposition 4 explicitly states that not every action or physical trait must be optimal. A system can carry neutral traits (spandrels) or even slightly counterproductive traits (vestigial organs subject to infection), provided the *overall net effect* of the system's directed work offsets degradation. The integral equation ($A(t) = A_0 + \int(\Phi - N)d\tau$) mandates that the total system remains above the threshold of dissolution; it does not mandate architectural perfection. Spandrels do not refute *Hormē*; they merely hitch a ride on it.

6.5 Proposition 5: The Cognitive Minimum

- **Objection 5.1 (Semantic Inflation):** A mousetrap "compares" tension and "acts." Is a mousetrap cognitive?
  - **Rebuttal:** A mousetrap is a tool operating on an external agent's *Hormē*. It possesses no intrinsic drive for its own persistence.
- **Objection 5.2 (Panpsychism by Stealth):** Labeling physical state-discrimination "cognitive" smuggles in mentality.
  - **Rebuttal:** The objection is merely terminological. "Cognitive minimum" is simply the functional label for the operation of comparison required for directed bias. The underlying physical logic remains identical regardless of the semantic label.
- **Objection 5.3 (The Reference State Origin):** Where does the "set-point" come from without prior cognition?
  - **Rebuttal:** This commits a category error, confusing a logical derivation with an evolutionary history. The derivation dictates the necessary conditions for persistence; discovering the historical origins of those set-points is the domain of empirical biology.

- **Objection 5.4 (The Intentionality Trap):** Calling a semi-permeable membrane or a reflex arc "cognitive" is a categorical error. True comparison and choice require consciousness or "intentionality" (e.g., Searle's philosophy of mind).
  - **Rebuttal:** This objection commits a fatal anthropocentric error. It assumes that human phenomenological experience (consciousness) is the prerequisite for choice, rather than a highly evolved, later-stage expression of it. A bacterium repairing a membrane or swimming up a chemical gradient is physically comparing two states (current vs. reference) and initiating an action specifically to increase the mathematical probability that the *next* comparison will be favorable to its persistence. This is the exact, operational definition of intentionality: directed action aimed at altering a future state based on a current model. The framework does not redefine cognition to steal the word; it strips cognition down to its verifiable physical roots. To demand that the bacterium 'feel' the choice consciously is to impose a mystical, top-down requirement on a strictly operational, bottom-up physical reality.
- **Objection 5.5 (The Anthropomorphic Projection of Value):** Defining the comparator's physical differential as the genesis of "value" or a "value judgment" is merely poetic anthropomorphism. A chemical gradient across a membrane or a voltage differential in a cell is a purely descriptive physical fact. When a biological mechanism acts to close that gap, it is just chemistry following thermodynamic laws. To call this blind physical discrepancy "good" or "bad" is to project human normative concepts onto an inert physical process.
  - **Rebuttal (The Existential Stakes of the Differential):** This objection treats the biological comparator as if it were an isolated, inert chemical reaction. It ignores the absolute physical *stakes* of the differential. For an isolated chemical soup, a gradient is indeed just a descriptive fact. But for a far-from-equilibrium bounded system, the reference state is the strict energetic condition of its own continued existence. If the comparator fails to trigger action to close the gap, the system literally dissolves. Therefore, the "value" is not projected by an external human observer; it is the constitutive, operational reality of the system itself. "Good" and "bad" are not mystical auras layered over the physics; they are the absolute physical stakes of the comparison. The differential *is* the value judgment because it dictates the survival or erasure of the agent making it.

6.6 Proposition 6: The Co-Constitution of Model and Action

- **Objection 6.1 (Model as Metaphor):** A river "models" topography, but we don't call rivers models.
  - **Rebuttal:** The term "model" here is strictly defined by Proposition 5 as the functional, operational capacity to compare states. A river is a passive aggregate flowing down a gradient, not a bounded entity comparing states.

- **Objection 6.2 (Inert Models):** A book or an AI contains a model without action.
  - **Rebuttal:** This proves the proposition. A book's data is entirely inert until it is functionally coupled to an agent's comparison-action loop. A model separated from action is physically irrelevant to persistence.
- **Objection 6.3 (Action Without Model):** A reflex arc is hardwired action without comparison.
  - **Rebuttal:** A reflex *is* a hardwired model. It is an evolutionary comparison operation (stimulus crossing a threshold) coupled to an action that aids persistence at high speeds. It is comparison without deliberation, not action without comparison.

6.7 Proposition 7: The Constitutive Imperative (*Hormē*)

- **Objection 7.1 (The Is-Ought Gap):** The "must strive" conflates a physical "must" with a normative "ought."
  - **Rebuttal:** The "must" is strictly constitutive, bound by the integral equation ($A(t) = A_0 + \int(\Phi - N)d\tau$). If the system does not perform the work (Φ), it ceases to be an "is." The imperative is a physical boundary condition.
- **Objection 7.2 (Suicidal Agents):** Organisms can sacrifice themselves, violating the imperative to persist.
  - **Rebuttal:** *Hormē* is scale-invariant and highly nested. Self-sacrifice (e.g., Socrates drinking hemlock, or kin selection) is a higher-order expression of *Hormē*, where the individual boundary is sacrificed to ensure the net persistence of a larger, nested boundary (the polis, the gene pool, or a conceptual ideal).
- **Objection 7.3 (Redefining "Strive"):** If strive just means "expends energy," a river strives.
  - **Rebuttal:** "Strive" is the label for the constitutive imperative to perform net-positive, boundary-maintaining work. Rivers do not perform boundary-maintaining work; they passively follow physical laws.
- **Objection 7.4 (Terminal Reproduction and the Mayfly):** Certain organisms, such as the adult mayfly or spawning salmon, are biologically programmed for terminal reproduction (semelparity). They often lack mouthparts or digestive tracts, physically preventing them from importing energy. They deliberately burn out their physical structures in a single mating event and rapidly die. If *Hormē* mandates continuous boundary maintenance, an organism architecturally designed to stop maintaining its boundary is a falsification of the imperative to persist.
  - **Rebuttal (Diachronic Optimization and Somatic Expenditure):** This objection conflates the indefinite maintenance of a temporary physical vehicle with the persistence of the system's operational pattern. The mayfly does not violate the integral equation ($A(t) = A_0 + \int(\Phi - N)d\tau$); it executes an extreme optimization of it. During its lengthy nymph stage, the organism performs standard directed work (Φ) to build

a massive energetic margin (A_0). In its adult phase, it halts somatic maintenance—intentionally allowing disruption (N) to overwhelm work (Φ)—to convert its entire accumulated A_0 into a single burst of reproductive output. The somatic vehicle is terminally expended to maximize the probability of structural replication. This is not an abandonment of Hormē, but its ultimate diachronic expression: sacrificing short-term somatic durability to ensure the deep-time persistence of the organizational boundary.

6.8 Proposition 8: The Continuous Imperative

- **Objection 8.1 (Dormancy):** A seed or tardigrade performs no metabolic work and has no active comparator loop, yet is alive.
  - **Rebuttal:** Dormant systems retain the *capacity* to sense and act. They are in a low-energy holding pattern, not a dead state. They continuously monitor their environment; when favorable conditions trigger their sensors, the action loop reactivates.
- **Objection 8.2 (Persistence Without Adjustment):** "Continuous" is overstated.
  - **Rebuttal:** "Continuous" means iterable and perpetually available. Even in dormancy or between active metabolic cycles, the structural readiness of the sensors *is* the ongoing loop. The system is never physically inert to its environment.
- **Objection 8.3 (The Ship of Theseus / Molecular Turnover):** Metabolism requires the constant intake of new matter and expulsion of old matter, replacing almost every atom in a living system over time. If the physical substrate composing the boundary is constantly dissolving and being replaced, the original entity does not actually persist. Therefore, "persistence" is an illusion.
  - **Rebuttal (Pattern vs. Substrate):** The framework defines life as the *activity* of boundary maintenance (the active engine), not a static collection of specific atoms. What persists is the operational continuity of the comparison-action loop (*Hormē*). The system maintains its formal identity (its boundary) by actively managing the flux of its material constituents. The "Ship of Theseus" is a paradox only for inert objects; for far-from-equilibrium systems, continuous material turnover is the exact physical mechanism *by which* identity is sustained.

6.9 Proposition 9: The Life-Agency Isomorphism

- **Objection 9.1 (Viruses):** Viruses redirect causal flow to replicate but aren't alive.
  - **Rebuttal:** Viral entry is largely passive. More fundamentally, viruses operate as extensions of the host cell's *Hormē* (e.g., as evolutionary tools of communication or competitive warfare). They are not autonomous agents, but fragments of nested biology.

- **Objection 9.2 (Chess AI):** An AI exhibits minimal agency (comparison to win) but isn't alive.
  - **Rebuttal:** The AI lacks intrinsic *Hormē*; its "goals" are externally engineered. It is a sophisticated tool wielding derived agency, not a self-constituting living system.
- **Objection 9.3 (Life Without Agency):** A metabolic mutant with no sensory apparatus would still be alive.
  - **Rebuttal:** Even a mutant cell possesses a semi-permeable membrane. The physics of passive and active transport across a selective barrier *is* a minimal form of physical comparison and action.
- **Objection 9.4 (Definitional Circularity):** Defining agency via *Hormē* and life via *Hormē* is circular.
  - **Rebuttal:** They are isomorphic by convergence, not definitional fiat. Life describes the *internal* constitutive loop; agency describes the *external* observation of redirected causal flow. They are two perspectives of the exact same physical operation.

6.10 Proposition 10: The Objectivity of Value

- **Objection 10.1 (Moore's Open Question):** Even if X fulfills *Hormē*, one can ask, "Is X *actually* good?"
  - **Rebuttal (Transcendental Refutation):** Moore's test assumes a reflective agent who can neutrally survey a proposed definition without already being committed to the very standard under scrutiny. But the agent asking the question is a far-from-equilibrium, bounded system whose continued existence depends entirely on the fulfillment of its own nested *Hormē* at every sub-personal level—metabolic, neural, and cellular. To ask "Is *Hormē*-fulfillment really good?" is to deploy cognitive capacities that are themselves funded by the automatic, non-optional treatment of persistence as an end. The question is parasitically open only because the asker abstracts away from the constitutive architecture that makes reflection possible. Once that architecture is revealed, the question closes: the asker is already, at the most fundamental physical level, living as if the answer is "yes." The open question is thus not a demonstration of a semantic gap but a cognitive illusion produced by ignoring the physical preconditions of its own asking. For a far-from-equilibrium system, the very possibility of normative inquiry presupposes the constitutive endorsement of its own *Hormē*, collapsing the distinction between the questioning self and the standard being questioned..[18]
- **Objection 10.2 (Relativism):** Value becomes system-relative. Cancer is "good" for cancer but "bad" for the host.

[18]This transcendental argument is developed in full detail in Eli Adam Deutscher, *The Transcendental Closure of the Open Question: Why Moore's Challenge Cannot Touch a Hormē-Based Definition of Good*, Neo-Pre-Platonic Press, 2026, https://neopreplatonic.com/papers/Transcendental_Closure/.

  - **Rebuttal:** This demonstrates the power of nested boundaries. Because the cancer relies on the host, its localized "good" (unchecked proliferation) ultimately destroys its own boundary when the host dies. *Hormē* resolves apparent relativistic conflicts by revealing deeper structural interdependencies.
- **Objection 10.3 (The Nihilist):** A person can consciously assign no value to their own persistence.
  - **Rebuttal:** The nihilist commits a physiological performative contradiction. To argue that life has no value, the nihilist must burn ATP, regulate cellular pH, and continuously resist entropy. They do not refute *Hormē* with their words; they demonstrate it with their metabolism.
- **Objection 10.4 (The Naturalistic Fallacy):** Deriving "good" from physical mechanics violates Hume's law.
  - **Rebuttal:** The derivation does not derive a universal moral "ought" from a bare physical "is." It derives a *constitutive necessity* for a specific class of physical systems, and stipulates that this necessity is the only non-mystical anchor for the term "good." It redefines the meta-ethical target rather than committing a logical fallacy.

6.11 Proposition 11: The Identity of Truth and Goodness

- **Objection 11.1 (Pragmatic vs. Correspondence Truth):** Evolutionary biology shows that organisms often survive by acting on "false" maps. For example, a prey animal that hallucinates every shadow as a predator survives, while the accurate animal calculating the shadow gets eaten. This implies survival (Goodness) actively selects for falsehood.
  - **Rebuttal (Operational Compression and Asymmetric Payoffs):** This objection relies on a category error that confuses symbolic fidelity (high-resolution visual rendering) with causal fidelity (accurate tracking of the environment's impact on the boundary). In evolutionary game theory, this scenario is formalized as an asymmetric payoff matrix. A False Positive (fleeing a harmless leaf) incurs a trivial metabolic cost. A False Negative (ignoring a hidden predator) results in total boundary dissolution.
  - Because the causal cost of a False Negative is catastrophic, the mathematically rigorous, expected-value-maximizing model *must* heavily weight the probability of danger. An internal model that labels this shadow as "danger" is not a hallucination; it is a flawless calculation of asymmetric causal risk. Conversely, the "accurate" animal that maps the shadow as a "harmless leaf" while ignoring the 5% probability of a predator is the one possessing a mathematically false map. It has prioritized a secondary symbolic attribute (visual shape) over the primary causal reality (lethal expected value). Because the isomorphism between Truth and Goodness is grounded in causal tracking, the "paranoid" reaction is revealed to be the objectively accurate epistemic state. The map is not "false"; it is operationally honest about the physics of the boundary.

- **Objection 11.2 (Cruelty as Epistemic Error):** A sadist may have perfectly accurate models and simply prefer cruelty.
  - **Rebuttal:** The sadist's model is critically incomplete. It may serve their immediate individual boundary, but it fails to map the higher-order nested reality (social retaliation). When society places the sadist in the electric chair, the isomorphism between their behavioral mapping error and their boundary dissolution becomes absolute.
- **Objection 11.3 (Asserted Is-Ought Collapse):** The collapse of facts and values is asserted, not proven.
  - **Rebuttal:** Hume's Guillotine assumes a static ontology where an "is" is an inert object. For a far-from-equilibrium agent, to exist is to act. The physical state of being alive intrinsically contains the physical imperative to perform directed work. The gap is an illusion caused by treating biology like inert physics.
- **Objection 11.4 (Martyrdom):** Dying for a cause is an ethical good but an epistemic failure of individual *Hormē*.
  - **Rebuttal (Nested Architecture and Epistemic Failure):** This apparent paradox is resolved by recognizing two distinct operational realities. First, martyrdom is often an expression of nested *Hormē*. The martyr sacrifices the individual physical boundary to ensure the persistence of a larger, higher-order boundary (a social structure, a genetic lineage, or a conceptual ideal). In this case, the action is a highly accurate mapping of a broader, systemic biological imperative.
  - Second, the framework perfectly accounts for the alternative: the martyr may simply be operating on a fundamentally false map. If an agent's internal model becomes catastrophically decoupled from causal reality—believing a sacrifice will yield a result that physics or society does not provide—the framework dictates exactly what must happen: the boundary dissolves. An organism acting on a bad map and dying does not violate the Truth-Goodness isomorphism; it is the ultimate physical proof of it. Severe epistemic error guarantees physical failure.
- **Objection 11.5 (The Successful Psychopath):** If a tyrant or sadist subjugates others, is never caught, and successfully maintains their boundary until natural death, their model was "accurate" for their survival. The framework must therefore classify successful cruelty as functionally "good."
  - **Rebuttal (The Fallacy of Extrapolation):** This objection commits two errors. First, it demands that a framework defining the *basal mechanics of life* immediately resolve higher-order human sociological dilemmas. The derivation establishes the foundational hierarchy of *Hormē*; extrapolating this to complex human social contracts requires additional axioms regarding highly nested, multi-agent systems that are outside the scope of this baseline physical derivation.
  - **Rebuttal (Biological Anomalies and Niches):** Second, within a purely biological context, the survival of a statistical anomaly does not invalidate the operational rule.

A system that survives *despite* possessing suboptimal or globally destructive traits does not redefine what is "good" for the system; it merely proves that biological environments occasionally tolerate immense mapping errors if the baseline threshold for persistence is still met. Furthermore, in highly complex nested systems, traits that appear locally destructive (like psychopathy) may occasionally provide a frequency-dependent competitive edge in times of extreme stress. They are a feature of a highly complex, nested strategy, not a refutation of the foundational equation of persistence.

- **Objection 11.6 (The Paradox of Addiction and Akrasia):** If models and actions are inseparable, how does the framework account for self-destructive behaviors like addiction, where an agent possesses an accurate cognitive map of harm yet still acts toward its own dissolution? This implies the model and the action can be decoupled.
  - **Rebuttal (Structural Hijacking):** This apparent paradox is resolved by the fact that complex biological agents are not monolithic; they are composed of nested boundaries and nested comparison-action loops. Addiction represents a structural hijacking, not a decoupling of map and action. A highly potent, localized, lower-order loop (e.g., a neurochemical reward pathway) overrides the higher-order, long-term cognitive model. The lower loop successfully executes its narrow functional map (immediate chemical satiation), but it does so at the catastrophic expense of the organism's global *Hormē*. Furthermore, this dynamic rigorously defines exactly *why* addiction is objectively "bad." Under this framework, "bad" is not a moralistic judgment of character; it is the physical fact of macro-boundary degradation. Because the rogue lower-order loop cannibalizes the energy and integrity of the whole, it operates functionally like a disease. It is objectively bad because it actively drives the highest-order boundary toward dissolution.
- **Objection 11.7 (The "Fitness Beats Truth" Paradox):** Evolutionary game theory mathematically argues that "fitness" and "truth" are entirely distinct variables, and that evolution actively tunes organisms away from objective reality in favor of raw fitness.
  - **Rebuttal (Historical Necessity and Boundary Margin):** This objection fails because it treats "fitness" as an independent, ungrounded variable. Fitness is not magic; it is the historical accumulation of successful comparison-action loops. To be "fit" implies that a system's lineage has *already* successfully mapped the causal flow of reality well enough to persist. Furthermore, "fitness" in this framework simply denotes the durability of the boundary—the margin of error a system possesses. A highly fit boundary can afford the energetic waste of minor false positives (like running from a leaf). However, if the map fundamentally fails to track a hard physical limit (e.g., ignoring gravity at a cliff edge), the boundary dissolves instantly. Fitness merely dictates how many minor mapping errors an agent can temporarily afford; ultimate survival remains strictly governed by causal truth.

6.12 Darwinian Evolution Deduction

- **Objection D.1 (Replication is Not Deduced):** Natural selection requires empirical premises (replication/variation) not present in Propositions 1–9.
  - **Rebuttal:** Correct. Replication and variation are empirical facts of the universe. However, *given* those facts, the framework deductively proves that natural selection is mathematically inevitable. Natural selection is the diachronic expression of *Hormē* across generations.
- **Objection D.2 (Origin of Life Gap):** The derivation explains survival, but not abiogenesis.
  - **Rebuttal:** The framework defines the necessary logical conditions for life, not its historical genesis. It proves that any life-permitting universe must be minimally deterministic (allowing patterns to be exploited).
- **Objection D.3 (Lamarckian Possibility):** If traits are acquired and inherited directly, Darwinian selection is undermined.
  - **Rebuttal:** The deductive framework is substrate-agnostic regarding the mechanism of inheritance. It requires only that patterns of *Hormē* expression vary and replicate. Whether variation is achieved via genetic mutation, epigenetics, or cultural transmission, differential persistence remains a strict logical mandate over deep time.
- **Objection D.4 (Reproduction as Death / The Somatic Limit):** The derivation claims organisms must strive for their *own* persistence. But reproduction often requires sacrificing the individual (e.g., a cell dividing and ceasing to exist as the original parent, or an organism expending fatal energy to mate). If *Hormē* mandates individual persistence, reproduction should be viewed as a failure, yet it is the definition of biological success.
  - **Rebuttal (Diachronic Persistence):** The objection falsely equates the organism's formal operational pattern with its temporary physical vehicle. Because boundary disruption acts continuously, any localized physical substrate will inevitably accumulate structural damage beyond repair. Therefore, the only mathematical way for the operational pattern to fulfill the continuous imperative across deep time is to replicate. Reproduction is not a failure of individual persistence; it is the ultimate strategy of *Hormē* escaping the inevitable dissolution of a single physical substrate. It is persistence successfully extended diachronically.

7 Conclusion: The Mandate of the Boundary

For centuries, the biological sciences and philosophy have operated across a fractured landscape. Biology cataloged the descriptive mechanisms of survival, cognitive science debated the emergence of mental models, and ethics searched in vain for an objective anchor for value. This fragmentation is the inevitable result of building frameworks *a posteriori*—attempting to abstract universal laws from the messy, contingent history of terrestrial evolution.

This paper has demonstrated that when we abandon descriptive abstraction and instead deduce the mechanics of life from the strict physical preconditions of identity, the fragmentation disappears.

By starting with a single, undeniable axiom—that to exist as a determinate entity requires the maintenance of a boundary against continuous disruptive interaction—the entire architecture of agency, cognition, and normativity unfolds by strict logical necessity. The cybernetic loop of comparison and action is not a biological accident; it is the mandatory operational engine of persistence.

This eleven-step deduction yields three definitive resolutions to historical philosophical problems:

1. **The Definition of Life:** Life is not a checklist of carbon-based traits. It is the continuous, active instantiation of *Hormē*—the directed work required to bias causal flow toward persistence.
2. **The Nature of Agency:** Life and minimal agency are structurally isomorphic. To maintain a boundary against continuous disruption *is* the basal definition of an action. Therefore, the operational distinction between a living agent (an active engine) and an inanimate object (a passive conduit) is absolute, requiring no appeal to mysticism or consciousness.
3. **The Grounding of Value:** The Is-Ought gap is a phantom created by treating biological agents as inert physical objects. For a bounded system, the imperative to persist is physically constitutive. Truth (accurate modeling) and goodness (effective action) are mathematically and physically identical operations. Epistemic error and ethical failure are thus revealed to be the same functional misalignment with reality.

Ultimately, we prove that life is not a fragile anomaly clinging to a hostile universe. It is the inescapable operational consequence of a bounded entity refusing to dissolve. Meaning and value do not emerge from the void; they are forged in the friction at the boundary of existence.

References

Ashby, W. Ross. *Design for a Brain: The Origin of Adaptive Behaviour*. Chapman & Hall, 1952.

Barandiaran, Xabier E., Ezequiel Di Paolo, and Marieke Rohde. "Defining Agency: Individuality, Normativity, Asymmetry, and Spatio-Temporal Dynamics in Action." *Adaptive Behavior* 17, no. 5 (2009): 367–86.

Cannon, Walter B. *The Wisdom of the Body*. W. W. Norton & Company, 1932.

Deacon, Terrence W. *Incomplete Nature: How Mind Emerged from Matter*. W. W. Norton & Company, 2011.

Deutscher, Eli Adam. *Neo-Pre-Platonic Naturalism: A First-Principles Framework for Reality, Mind, and Knowledge*. First Edition. Neo-Pre-Platonic Press, 2025.

Deutscher, Eli Adam. *Probabilistic Determinacy as a Necessary Precondition for Life: Why Agency Requires Statistical Causality and Why Hard Determinism Fails*. Neo-Pre-Platonic Press, 2026. https://neopreplatonic.com/papers/determinism/.

Deutscher, Eli Adam. *The First Cut: How Boundary Logic Derives Physics*. Neo-Pre-Platonic Press, 2026. https://neopreplatonic.com/papers/First_Cut/.

Deutscher, Eli Adam. *The Transcendental Closure of the Open Question: Why Moore's Challenge Cannot Touch a Hormē-Based Definition of Good*. Neo-Pre-Platonic Press, 2026. https://neopreplatonic.com/papers/Transcendental_Closure/.

Friston, Karl. "The Free-Energy Principle: A Unified Brain Theory?" *Nature Reviews Neuroscience* 11, no. 2 (2010): 127–38. https://doi.org/10.1038/nrn2787.

Gánti, Tibor. *The Principles of Life*. Oxford University Press, 2003.

Jonas, Hans. *The Phenomenon of Life: Toward a Philosophical Biology*. Harper & Row, 1966.

Kauffman, Stuart A. *Investigations*. Oxford University Press, 2000.

Maturana, Humberto R., and Francisco J. Varela. *Autopoiesis and Cognition: The Realization of the Living*. Vol. 42. Boston Studies in the Philosophy of Science. D. Reidel Publishing Company, 1980.

Maynard Smith, John, and Eörs Szathmáry. *The Major Transitions in Evolution*. W. H. Freeman/Spektrum, 1995.

Nicolis, Grégoire, and Ilya Prigogine. *Self-Organization in Nonequilibrium Systems: From Dissipative Structures to Order Through Fluctuations*. Wiley, 1977.

Schrödinger, Erwin. *What Is Life? The Physical Aspect of the Living Cell*. Cambridge University Press, 1944.

Tononi, Giulio. "Consciousness as Integrated Information: A Provisional Manifesto." *The Biological Bulletin* 215, no. 3 (2008): 216–42.

Uexküll, Jakob von. *A Foray into the Worlds of Animals and Humans: With a Theory of Meaning*. Translated by Joseph D. O'Neil. University of Minnesota Press, 1934.