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Morphology Without Memory - Eigenzeit, Folding and the Limits of Simulation

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Morphology Without Memory – Eigenzeit, Folding and the Limits of Simulation

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Abstract

The present volume brings together six contributions that pursue a common question: under what conditions stable forms arise in natural, biological, social, and cognitive systems, and where the ontological limits of their reconstruction, control, or simulation lie. The point of departure is the observation that central contemporary debates—such as those in morphogenesis, complexity research, medicine, or artificial intelligence—are increasingly structured by concepts that treat form as in principle reconstructible: as a target state, attractor, setpoint, or as information within a state space. The volume systematically questions this implicit assumption.

The contributions develop a morphological perspective in which form is not understood as a stored structure or a retrievable goal, but as a temporary stabilization within irreversible dynamic processes. Earlier theoretical concepts such as focal points (Fixpunkte), folding, and the Bran-Spiral are genealogically reconstructed and related to later operatorial concepts such as shift of being (Seinsverschiebung), negative topology, and indimergent stabilization. From this perspective, form appears neither as the product of a plan nor as the result of linear processes, but as an emergent configuration that can stabilize only under specific historical and temporal conditions.

Against this background, central phenomena of biological morphogenesis are reread. Bioelectric regulation, regeneration, aging, cancer, or cloning no longer appear primarily as problems of genetic control or technical manipulation, but as boundary cases of emergent order. Particular emphasis is placed on the role of the Eigenzeit of living systems: the irreversible emergence-time in which form becomes genealogically stabilized. Interventions that attempt to bypass or neutralize this Eigenzeit therefore do not necessarily produce a return to earlier states, but rather temporarily stable yet ontologically displaced orders.

At the same time, the contributions show that many contemporary hopes for technical reconstruction—such as those found in regenerative medicine, bioengineering, or AI-based simulations—rest on a categorical confusion. Simulation operates within given state spaces and can reproduce formal stabilizations without participating in the ontological conditions of world-formation. Morphology, simulation, and repair must therefore be understood as three fundamentally different modes.

In the final step, this perspective is extended to a more general ontological level. If time itself is understood as the trace of irreversible loss of possibility, every stabilized world-form proves to be structurally finite. Indimergence appears here as a double boundary operation: it grounds

world-time while simultaneously carrying the condition of its exhaustion. The volume therefore does not present itself as a complete theory of morphology, but as a precise boundary determination with respect to ontologies that assume the complete availability of form, information, and world.

Keywords: Morphogenesis, Emergence, Biological Form, Eigenzeit, World-Formation, Bioelectric Morphogenesis, Complex Systems, Systems Biology, Artificial Intelligence, Artificial Life, Regenerative Medicine, Biological Self-Organization, Philosophy of Biology, Philosophy of Artificial Intelligence, Ontology of Emergence, Process Ontology, Non-Representational Ontology, Indimergence, Operator-Based Ontology, Morphology Without Memory, World-Binding, Structural Emergence

Contents

Introduction

The question of how stable forms arise and persist belongs to the fundamental problems of the natural, life, and social sciences. Whether in biological morphogenesis, the evolution of complex systems, cultural orders, or technical models of artificial intelligence, the same problem repeatedly emerges: under what conditions do relatively stable structures arise from open dynamics. Classical explanatory models have usually attributed such stability either to predefined blueprints, genetic programs, or to informational state spaces. In more recent approaches, these models are often replaced by concepts such as attractors, setpoints, or target states within a morphological or dynamical space of possibilities.

Despite their differences, many of these approaches share a common underlying assumption: that form remains in some sense preserved, reconstructible, or at least in principle accessible. Whether conceived as implicit information, a field structure, or an attractor within a state space, form appears as something that can be restored, simulated, or technically reproduced under suitable conditions. This assumption is rarely formulated explicitly in contemporary research, yet it functions as a tacit background in many discussions on regeneration, biological control, artificial life, or digital simulation of worlds.

The present volume intervenes precisely at this point. The contributions assembled here do not primarily investigate how forms might be technically reconstructed or controlled. Instead, they ask under which ontological conditions form can become stable in the first place—and what limits follow from these conditions for attempts at reconstruction. The point of departure is the observation that form cannot be separated from the time of its emergence. It is neither a stored object nor a retrievable state, but the result of irreversible processes in which possibilities are closed and relations stabilized.

From this perspective, morphology is understood as a dynamic relation between openness and stabilization. Earlier theoretical work introduced concepts such as focal points (Fixpunkte), folding, and the Bran-Spiral in order to describe how temporary orders arise from open fields of experience and possibility. Later work revealed that such morphological descriptions encounter an ontological boundary: certain transitions can no longer be understood as processes within a given framework but must be conceived as shifts in the conditions under which processes themselves can be meaningfully described. Concepts such as shift of being (Seinsverschiebung), negative topology, and indimergent stabilization mark precisely this boundary.

The contributions in this volume pursue this development in several steps. First, early morphological models are reconstructed, particularly the concepts of focal points, folding, and the Bran-Spiral, which describe the emergence of cultural, cognitive, and social order as the result of irreducible orientational events. In a second step, this perspective is extended to biological systems. Research on bioelectric morphogenesis shows that organisms can maintain stable forms without relying on genetic blueprints or explicit information storage. Yet these empirical findings cannot easily be integrated into classical models of information, control, or teleology.

The perspective developed here therefore interprets such phenomena not as evidence of hidden blueprints but as expressions of dynamic stabilization within irreversible spaces of possibility. Form appears as a temporary condensation within an open process whose stability must continuously be maintained. In this context, the concept of Eigenzeit—the non-transferable emergence-time of living systems—becomes central. Form is not merely a spatial configuration but the result of a genealogical temporal process through which relations become viable.

This insight has far-reaching implications for contemporary discussions of technological control, simulation, and repair. If form is bound to its emergence-time, it cannot be fully reconstructed by reproducing its visible structure or functional states. Simulations can reproduce stability while remaining detached from the ontological conditions under which form becomes possible. The contributions therefore argue that morphology, simulation, and repair must be understood as fundamentally different modes of relating to form.

In the final step, this morphological perspective is extended to a broader ontological level. If time itself is understood as the trace of irreversible loss of possibility, every stabilized world-form appears as structurally finite. Processes of world-formation carry within themselves the conditions of their own exhaustion. Indimergence thus appears as a double boundary operation: it grounds world-time and simultaneously marks the point at which its continuation becomes impossible.

The volume does not aim to present a complete theory of morphology. Rather, it offers a series of conceptual boundary determinations that reorder central notions of modern scientific thought—form, information, simulation, time, and emergence. Its aim is to make visible the conditions under which form can arise, stabilize, and eventually encounter its own ontological limits.

Form Without Blueprint
Dynamic Morphogenesis Beyond Platonic and Information-Theoretic Models

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Abstract

Recent work on bioelectric morphogenesis, particularly by Michael Levin, has shown that biological systems are capable of stabilizing robust, goal-directed body forms and restoring them after severe perturbations, without these forms being genetically or informationally fully encoded. To describe these phenomena, reference is often made to a structured space of possible forms—a so-called morphospace or "platonic space."

The present contribution situates these empirical findings within a broader theoretical framework developed over more than two decades, which addresses the emergence of order, form, and stability beyond representational, information-theoretic, and teleological models. The point of departure of this work is an operator-theoretic conception of emergence, in which form is not understood as a predefined target structure, but as a temporary stabilizing achievement of dynamic processes. In this context, a spiral-based representation of morphogenesis was already developed in 2005, which is taken up again in this paper not as a historical artifact, but as a theoretical diagram with systematic intent.

In the underlying model, morphologies do not exist as ideal forms or as stored information. They emerge as local condensations within a continuous dynamic process structured by parameters such as density, velocity, coupling intensity, and energetic binding. Goal-directedness appears in this framework not as an expression of purpose or planning, but as the operative maintenance of stable states under changing conditions.

Through an operator-theoretic rereading of current findings in bioelectric morphogenesis, it is shown that the concept of morphospace discussed today implicitly refers to precisely the dynamic logic that has been elaborated in the author's long-term work on emergence, non-objectivity, and world-stabilization. The spiral representation thus functions not as a metaphor, but as a structural description of a space of possibilities from which morphologies arise, without recourse to blueprint assumptions, informational storage, or ontological Platonism.

This perspective clarifies the ontological status of morphospace, limits information-theoretic overextensions, and positions intelligence not as the origin of form, but as a secondary stabilizing achievement of emergent order. In doing so, a theoretical connection is established

between dynamic morphology, bioelectric regulation, and a non-representational theory of emergence and intelligence.

The aim of this contribution is not the elaboration of a complete theory, but the conceptual repositioning of a current empirical problem.

The perspective outlined here is part of a larger, modularly structured research framework:

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Speed, T. (2025). The All–Nothing Paradox - Ontological Openness as a Condition of World-Formation - Why Closure – Not Complexity – Marks the Limit of Artificial Systems (2 English). Zenodo. https://doi.org/10.5281/zenodo.18000820

1. Introduction: The Problem of Goal-Directed Form

The question of how stable, goal-directed forms arise in biological systems belongs to the most persistent problems of modern natural and life sciences. While classical explanatory models primarily conceive of morphology as the result of genetic programs, molecular signaling pathways, or information-processing mechanisms, empirical findings increasingly challenge this perspective at a fundamental level. In particular, phenomena of robust regeneration, error correction after severe perturbations, and the coordination of biological processes across scales cannot be adequately described as the execution of a predefined blueprint.

A prominent expression of this challenge can be found in current research on bioelectric morphogenesis, for example in the work of Michael Levin. Here it is shown that cells and tissues are capable of steering toward and reconstructing collective target states even when local information, genetic structures, or causal pathways are destroyed or experimentally manipulated. The stability of form thus appears not to be bound to individual components, but to a higher-order organizational logic that eludes direct localization.

In order to theoretically capture these findings, reference is often made to the notion of a structured space of possibilities within which biological systems "find," "navigate," or "restore" forms. Terms such as morphospace or platonic space are intended to express that form does not arise solely from local causality, but from a global order of possible states. At the same time, however, it often remains unclear what ontological status such a space possesses: Is it a really existing reservoir of forms, an abstract description of functional relations, or a metaphorical bridge between dynamics and goal-directedness?

It is precisely at this point that the present contribution intervenes. It understands current debates on morphospace not as an isolated novelty, but as the empirical manifestation of a deeper problem that has been systematically addressed in the author's work for more than two decades: the question of how order, form, and stability can arise without recourse to representational models, informational storage, or teleological assumptions of purpose. This work initially developed outside classical disciplinary contexts, within the framework of artistic and neurodivergent research, but from the outset aimed at a general theory of dynamic order.

At the center of this theoretical framework stands an operator-theoretic conception of emergence. Order is not understood here as an object, structure, or information, but as the effect of an operative response to structural non-identity. Form does not arise because it is given, stored, or planned, but because dynamic processes under certain conditions develop a sufficient degree of self-binding to become stable. Goal-directedness, in this sense, is not an expression of purpose or intention, but a consequence of successful stabilization.

Already in 2005, a spiral-based representation of morphogenesis was developed within this framework, describing form formation as the result of continuous dynamics. This representation is not to be understood as a metaphor or visualization, but as a theoretical

diagram: it models a space of possibilities in which morphologies emerge as local condensations and temporary attractors, depending on parameters such as density, velocity, coupling intensity, and energetic binding. Forms do not appear as target points, but as holdable states within a flow.

The aim of this paper is to explicitly relate this dynamic conception of morphology to current empirical findings on bioelectric regulation and to examine the implicit ontological assumptions of the morphospace concept. It is argued that many of the phenomena observed today become conceptually coherent only if morphospace is understood not as an ontological space, but as the operative reachability of dynamic stability. In this reading, intelligence does not appear as the origin of form, but as a secondary capacity for navigating and maintaining emergent order.

2. Bioelectric Morphogenesis and Target States

The empirical challenge motivating the present contribution becomes particularly clear in research on bioelectric morphogenesis. In the work of Michael Levin, it is shown that morphological order in living systems does not arise solely from genetic regulation or molecular signal transduction. Instead, spatially distributed bioelectric states—particularly membrane potentials, ion gradients, and electrical coupling between cells—play a central role in the stabilization and reconfiguration of body forms.

These bioelectric patterns do not function merely as local signals, but as global coordination structures. They enable biological systems to return to stable, functional forms after major interventions—such as tissue loss, cellular rearrangement, or experimental manipulation. Crucially, this return cannot be explained as a renewed genetic "execution" of a blueprint. Rather, the systems appear to possess a form of target reference that remains effective independently of the specific local material configuration.

Levin frequently describes these target references as *morphogenetic target states*. These target states are not punctually localized and are not fully stored in individual components. Instead, they manifest as collective tendencies of the system to detect and correct deviations. Morphological order thus appears not as a one-time result of a developmental process, but as an ongoing achievement of self-regulation.

In order to capture these phenomena, Levin draws on the notion of a structured space of possibilities in which different forms are laid out as realizable states. The commonly used concept of *morphospace* or a "platonic space" is intended to indicate that biological systems do not respond arbitrarily, but operate within a limited space of stable organizational forms. Forms are not constructed within this space, but rather approached or rediscovered.

It is precisely at this point, however, that a conceptual tension becomes apparent. On the one hand, it is explicitly emphasized that target states do not exist as genetically encoded instructions or as stored information. On the other hand, it remains unclear what it means for such states to "exist" or to be "addressable" at all. Morphospace thus often functions as a necessary but underdetermined theoretical instance: it is indispensable for describing the empirical findings, yet resists a clear ontological determination.

This underdetermination is not a shortcoming of the empirical research, but points to a categorical boundary. The bioelectric experiments show that systems can act in a goal-directed manner without specifying how this goal-directedness is to be ontologically located. If morphospace is understood as a really existing space of ideal forms, a regression to Platonic ontologies threatens. If, by contrast, it is read merely as a heuristic construct, it loses its explanatory force.

The present contribution proposes not to resolve this tension by further ontologizing morphospace, but by shifting the question itself. Rather than asking what morphospace *is*, the question becomes under which operative conditions target states can be stably addressable. Goal-directedness then appears not as access to a predefined inventory of forms, but as an effect of dynamic stabilization within an open space of possibilities.

In this perspective, bioelectric states do not function as representations of forms, but as operative media of self-binding. They hold the system in a condition in which certain morphological configurations remain reachable and reproducible. The focus thus shifts from the existence of target states to the conditions of their durability.

This shift prepares the ground for the dynamic reading of morphology developed in the following section. There it is shown that the spiral-based representation of morphogenesis developed at an early stage explicates precisely the operative logic that becomes empirically visible in bioelectric research, without being conceptually fully articulated there.

3. Dynamic Morphology Prior to Morphospace

The empirical findings on bioelectric morphogenesis described in Section 2 suggest that morphological order can be understood neither as a linear developmental sequence nor as the execution of a coded blueprint. Forms instead prove to be stable yet in principle revisable states within an open dynamic process. This insight, however, is not solely the result of recent biological research, but was theoretically anticipated much earlier within the work underlying the present contribution.

Since the early 2000s, the author's work has maintained a continuous focus on the question of how order, form, and stability can arise from dynamics without recourse to representational, information-theoretic, or teleological models. The point of departure was not biology in the narrow sense, but a more general investigation of creative, social, cultural, and natural systems that exhibit similar patterns of self-organization. Within this framework, morphology was from the outset understood not as a property of things, but as an effect of dynamic processes.

A central expression of this perspective is the spiral-based representation of morphogenesis developed in 2005, which is for the first time explicitly situated in a natural-scientific and theoretical context in the present contribution (Fig. 1 / 48/47). The graphic emerged within the framework of artistic and neurodivergent research, yet was from the beginning conceived as a structural model rather than a metaphorical illustration or aesthetic symbolism.

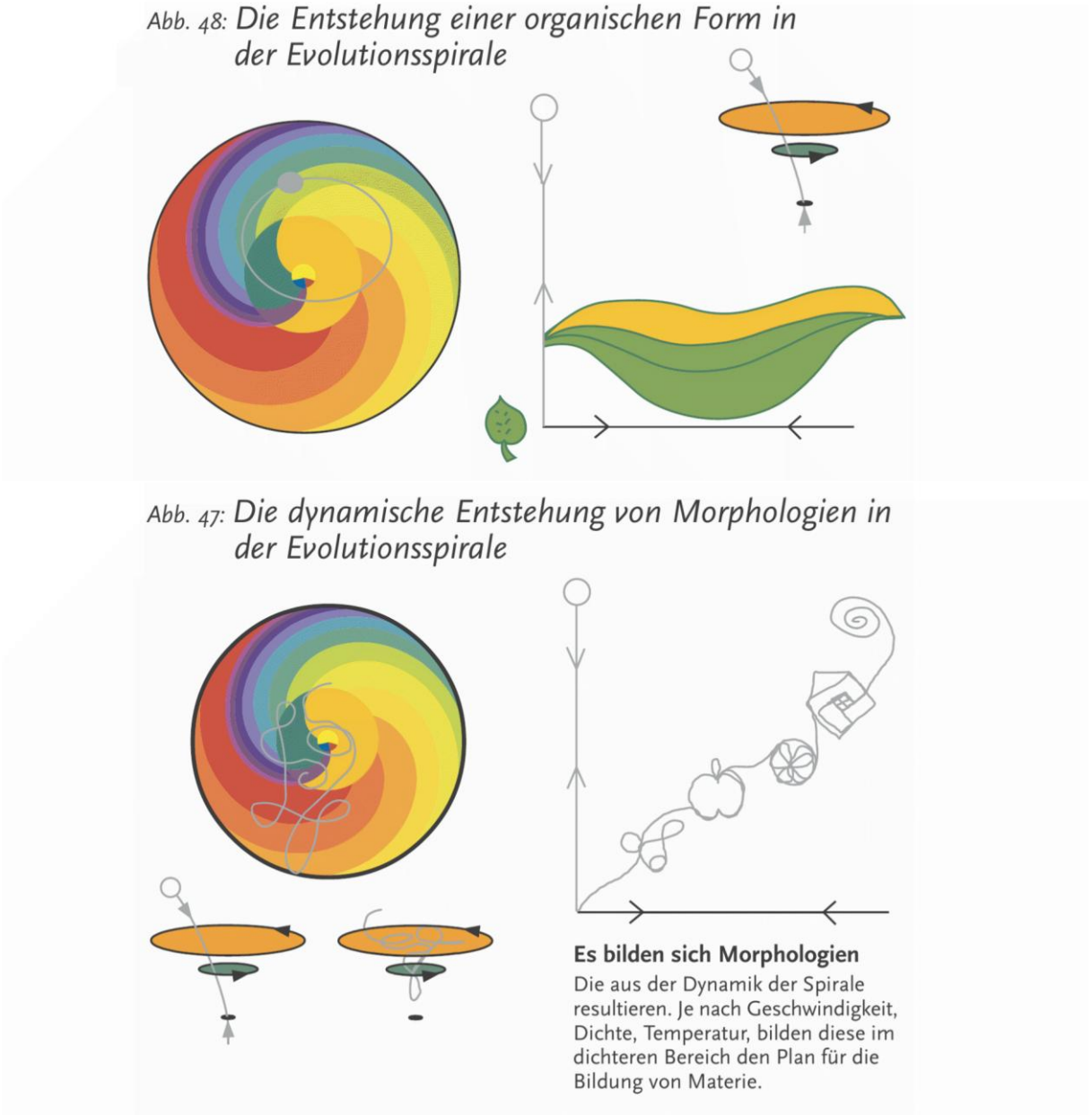

Fig. 1 *(48/47): The dynamic emergence of morphologies in the evolutionary spiral.*
Images are taken from the book Gesellschaft ohne Vertrauen – Die Grundlagen einer kreativen Gesellschaft, published in 2005.
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The spiral or sphere does not function in this representation as a form or a goal, but as a generator of a continuous dynamic space of possibilities. Along this dynamic, morphologies do not emerge as predefined shapes, but as local condensations and temporary stabilizations. Crucially, the spiral itself contains no forms. It describes a movement, a flow, within which certain configurations become holdable under suitable conditions.

In the graphic, this logic is rendered visible through multiple layers. The spiral movement is linked to parameters such as density, velocity, and energetic intensity. Morphological

expressions arise where these parameters enter a range of sufficient self-binding. Forms thus do not emerge uniformly everywhere, but preferentially in zones of increased stability—as attractors within an otherwise open dynamic field.

These morphologies are neither final nor privileged. They can change, dissolve, or newly emerge as soon as the underlying dynamic conditions shift. What is decisive is that form does not exist independently of the dynamics. It is not a target point toward which the process moves, but a state that persists only as long as the process sustains it. Order thus appears not as a stored structure, but as an ongoing achievement.

It is noteworthy that this model operates entirely without the assumption of a blueprint, an explicit target representation, or an ontologically autonomous space of forms. There is neither a storage location for form nor an instance that "knows" form within the representation. What exists is solely the dynamics itself and its capacity to generate stable configurations under certain conditions.

It is precisely here that the systematic connection to current concepts of morphospace becomes apparent. What is described there as navigation within a space of possible forms appears in the spiral-based representation as the operative reachability of stable states within a continuous process. The space of possibilities is not a separate ontological domain, but is identical with the structure of the dynamics itself. Forms therefore do not need to be "found" or "retrieved"; they arise as effects of self-organization.

The spiral-based representation thus makes explicit what remains implicit in many current debates: that goal-directedness in morphogenesis does not presuppose the existence of target states as entities. It merely presupposes that dynamic processes are capable of binding themselves in such a way that certain states become reproducible and corrigible. Morphology, in this sense, is not an object, but an event with duration.

In the next section, this structural reading of the graphic is further specified. It is shown how individual elements of the representation—particularly the distinction between dynamic flow and local stabilization—can be systematically related to current findings in bioelectric regulation, and how a non-Platonic, operatorial determination of morphospace follows from this.

This early representation deliberately remains at a structural level and is only later specified in operatorial terms in subsequent works.

4. Morphology as an Operatorial Process: From Early Dynamics to Explicit Theory

The spiral-based representation of morphogenesis introduced in the previous section is not to be understood as an isolated early work, but as an early condensation of a theoretical perspective that was systematically further developed in the author's later work. The aim of this section is not to present this theory in its entirety, but to make visible those structural assumptions that allow current findings in bioelectric morphogenesis to be conceptually situated without recourse to Platonic or information-theoretic models.

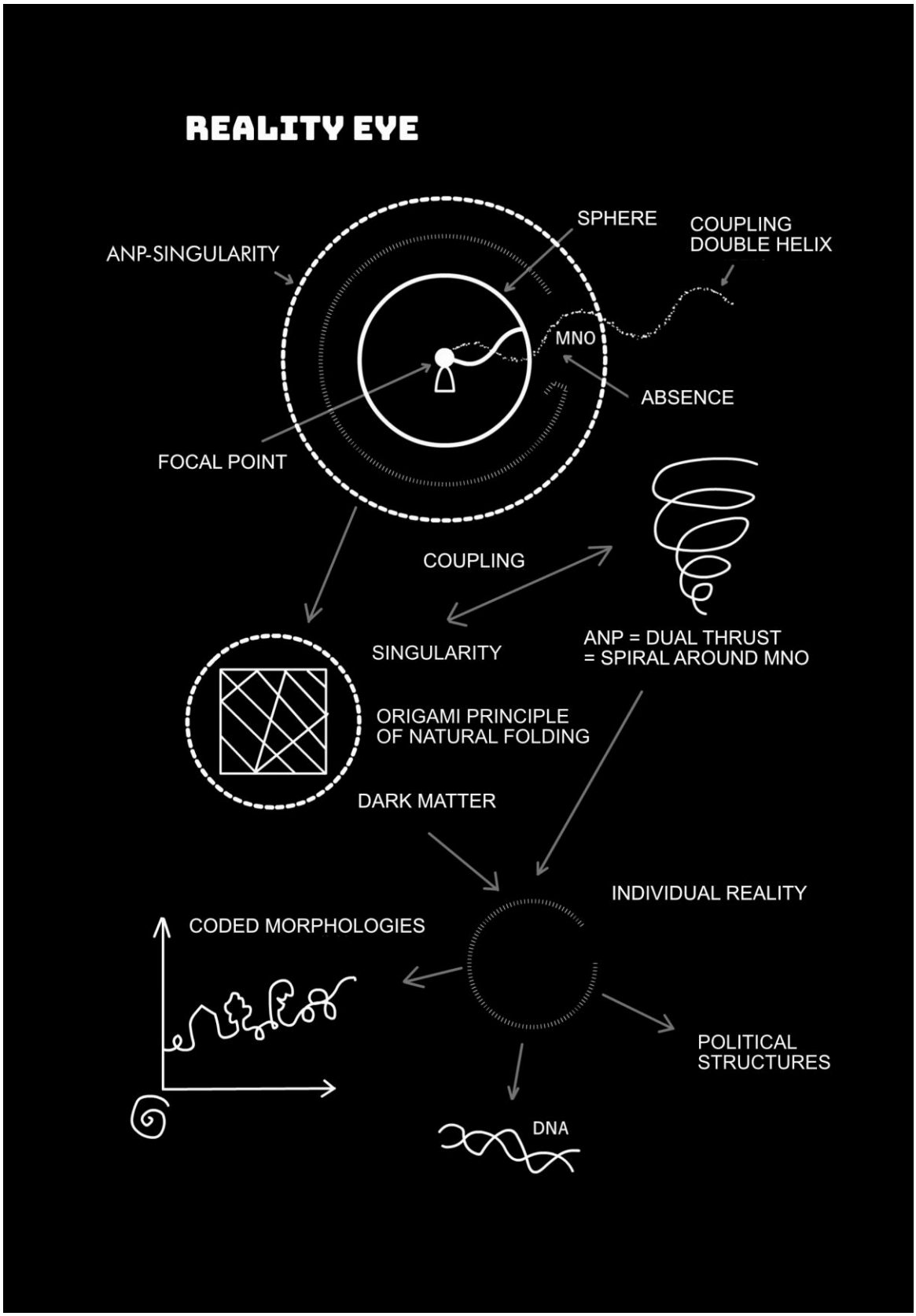
What these works share is the assumption that form does not arise from representation, planning, or target specification, but from the operative dynamics of a system capable of holding difference and temporarily stabilizing it. In this perspective, morphology does not appear as an object or a goal, but as an event with duration: as a state that exists only as long as the underlying dynamics sustain it.

This basic assumption was specified over the years in different contexts, among them *The Physics of the Poor* (2016) as well as later operator-theoretic works. There, emergence is not understood as a continuous developmental process, but as a qualitative transition, in which a system forms a new, stable order out of an open space of possibilities. What is decisive here is not the emergence of a form as such, but the system's capacity to maintain this form against disintegration.

The early spiral graphic (Fig. 1) expresses this logic in an elementary manner: the spiral does not function as a form or a goal, but as a generator of a continuous dynamic space of possibilities. Morphologies emerge within it as local condensations, preferentially in regions of increased stability. The graphic deliberately contains no storage location for form and no instance that "knows" form. Order is not deposited here, but enacted.

A further specification of this idea can be found in a later representation from *The Physics of the Poor* (2016), in which the spiral or sphere appears not only as a dynamic space of possibilities, but explicitly as an interface between openness and stabilization (Fig. 2). While the early graphic illustrates the process of form formation arising from dynamics, the later representation shifts the focus to the condition of the durability of emergent order. Morphologies are not understood here as end products, but as results of an ongoing coupling between possibility and actualization.

Fig. 2: *Schematic representation of emergent order as the coupling between openness and stabilization (Speed 2016 / The Physics of the Poor, DOI: 10.5281/ZENODO.17803906 / ISBN: 3695191287).*



It is important to emphasize that this later representation is likewise not to be read as a model in the representational sense. It does not claim to depict biological or physical processes, but rather marks a structural relation: form emerges where dynamics are not fully discharged, but remain bound in a way that allows repetition, correction, and reconfiguration.

In this sense, the two graphics can be read as complementary interfaces of the same theoretical approach. The early spiral makes visible that morphology arises from dynamics without reliance on target specifications. The later representation specifies that this dynamic presupposes an operative capacity for stabilization that cannot be equated with representation or information. Both thus point to an understanding of morphology as an emergent process whose order is not given, but must be continually produced anew.

For the current discussion of morphospace, this means that the space of possible forms need not be conceived as an independent ontological domain. Rather, it can be understood as an expression of the operative structure of a system: as the range of those states that are reachable and stabilizable under given dynamic conditions. In this reading, morphospace does not designate a collection of ideal forms, but the practical openness of a system to variation and correction.

The operative concept of morphospace proposed here is structurally identical to the shift elsewhere undertaken from the concept of intelligence to emergence: what is primary is not performance within stable spaces of possibility, but the operative condition of their stabilization.

The approach outlined here differs from classical theories of self-organization and process ontologies in that order is not understood as a property of processes, but as an operative achievement of stabilization.

The present contribution can only sketch this operatorial perspective. A comprehensive theoretical elaboration would exceed the scope of this paper and has been carried out elsewhere. For the present purpose, it suffices to note that the goal-directedness observed in bioelectric morphogenesis can be understood without recourse to Platonism or blueprint assumptions if form is conceived as the temporary stabilization of dynamic processes.

Mortality as Emergence Collapse
An Operator-Theoretic Reading of Bioelectric Morphogenesis

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Abstract

Genetic explanations of biological form and mortality reach their limits as soon as phenomena such as robust regeneration, form correction, and goal-directed self-organization come into view. Work on bioelectric morphogenesis, particularly by Michael Levin, shows that morphological stability is determined to a significant extent by distributed bioelectric feedback loops and persistent goal states that are not reducible to genetic coding.

The present contribution proposes an operator-theoretic reading of these findings. Emergence is not understood here as a singular event, but as a cyclical process that mediates between a space of possibilities, partial stabilization, and manifest form formation. Mortality appears, in this perspective, not primarily as a genetic defect or an accumulation of damage, but as an irreversible breakdown of this emergence cycle.

This framing allows for a coherent classification of regeneration, cancer, and aging processes as different modes of disturbed or reconfigured operator closure of biological order. The approach is intended as a theoretical complement to bioelectric morphogenesis and aims to make explicit the conditions of form stability and their limits.

1. Problem Statement: The Limits of Genetic Explanations

The classical molecular-biological explanation of development and form stability is based on the assumption that genes function as the primary carriers of biological information and that morphological order emerges essentially from genetic regulation. However, this model reaches its limits where organisms maintain or restore stable goal states even though local structures have been massively altered or destroyed.

In particular, phenomena such as:
• goal-directed regeneration after tissue loss,
• form corrections following experimental interventions,
• as well as the stability of global body plans despite local variations

cannot be adequately explained as a linear consequence of genetic activation.

These findings suggest that genes constitute necessary, but not sufficient, conditions of morphological order. What is decisive is not solely which molecular processes take place, but how biological systems stabilize and reconfigure order over time.

The central question thus shifts from genetic causality to systemic organization.

2. Bioelectric Morphogenesis: Order Beyond Genetic Control

Work on bioelectric morphogenesis, particularly by Michael Levin, has shown that morphological order does not arise exclusively from genetic regulation, but is determined to a significant degree by bioelectric states and their collective dynamics. Membrane potentials, ion fluxes, and electrical gradients do not function merely as local signals, but as distributed control structures that coordinate developmental trajectories across space and time.

These bioelectric patterns are capable of representing goal states of form, which Levin explicitly describes as *goal states* or morphogenetic target states. They enable organisms to return to stable configurations after massive interventions—such as tissue loss, cellular rearrangement, or experimental manipulation—without requiring a corresponding genetic recoding.

Central to this account is the concept of a persistent pattern memory: morphological order is not fully localized in material structures, but in dynamic states that serve as references for correction and regeneration. Development thus appears not as the mere unfolding of a plan, but as a feedback-based process that detects and compensates deviations.

The explanatory focus therefore shifts fundamentally. In place of hierarchical control by genes emerges a model of distributed control, in which biological systems actively maintain and reconfigure their form. This perspective opens an approach to regeneration, cancer, and aging that cannot be reduced to defects of individual components.

3. Emergence as a Cyclical Process

In many theoretical approaches, emergence is understood as a punctual event: as the transition from disordered complexity to stable structure. Such an understanding, however, remains insufficient to explain the temporal persistence of biological form. Form is not a result that emerges once, but an order that must be continuously maintained.

Emergence is therefore conceived here as a cyclical process comprising three structurally distinguishable, yet inseparably intertwined phases:

• **Submergence** designates the embedding of the system in an open space of possibilities, in which alternative organizational forms remain potentially available.

• **Indimergence** describes the partial stabilization of relations, feedbacks, and control loops that temporarily fix order without fully closing it.

• **Emergence** refers to the manifest expression of functional form in which these relations become effective.

These phases are not sequential in the sense of a completed developmental trajectory, but are recursively interconnected. Biological form exists only as long as the transition between possibility, stabilization, and manifestation is actively maintained.

From this perspective, stability is not a static state, but an operative achievement that requires a continuous re-binding to a space of possibilities under sustained feedback. Emergence thus does not describe the origin of order, but its ongoing reproduction under conditions of structural openness.

4. Mortality as the Breakdown of the Emergence Cycle

Against the background of a cyclical conception of emergence, mortality can be newly defined. Rather than understanding it primarily as the consequence of genetic defects, molecular accumulations, or energetic exhaustion, mortality appears here as the irreversible breakdown of the emergence cycle that stabilizes biological form over time.

As long as submergence, indimergence, and emergence recursively interlock, a biological system remains capable of recognizing, compensating for, and correcting deviations. If this cyclical feedback is permanently interrupted, however, the system loses its capacity for self-reference. Order can then no longer be related to a more general space of possibilities.

From this perspective, chaos is not the cause, but the result of the collapse of operator closure. The observable disintegration of biological processes points to a failure of translation between levels—such as between local dynamics and global goal states—rather than necessarily to a lack of information or energy.

Mortality thus marks not merely a limit of biological performance, but a structural limit of emergent order, beyond which recursive self-reference can no longer be maintained. It designates the point at which the operative reconfiguration of the system is no longer possible and the binding to stabilizing goal states is permanently lost.

5. Regeneration, Cancer, and Aging as Modes of Disturbed Emergence

The cyclical emergence perspective allows for a coherent classification of central biological phenomena without resorting to reductionist or teleological explanations. Regeneration, cancer, and aging processes can be described as different modes of disturbance or reconfiguration of the emergence cycle.

From this viewpoint, regeneration does not appear as a repetition of original development, but as a reactivation of the emergence cycle. Bioelectric goal states function as reference points against which deviations can be recognized and corrected. What is decisive is not the complete reconstruction of earlier states, but the restoration of operative feedback between possibility, stabilization, and manifestation.

Cancer, by contrast, can be understood as a case of partial decoupling. Local processes retain their internal dynamics, but lose their integration into global feedback structures. The system fragments into competing partial orders whose autonomy is no longer regulated by higher-order goal states. Pathology thus arises not through mere disorder, but through misdirected stabilization under conditions of lost global feedback.

Aging, finally, can be interpreted as a gradual fragilization of cyclical closure. With increasing time, the binding between emergent form and the space of possibilities becomes more unstable; corrections become slower, less complete, or fail to occur. Aging, in this sense, is not mere wear, but a temporal erosion of operator reconfigurability.

This reading connects bioelectric findings with a structural theory of emergent order and makes it possible to understand mortality as a boundary phenomenon without reducing it to individual causes.

6. Implications and Outlook

The operator-theoretic reading of bioelectric morphogenesis proposed here complements existing models by introducing an explicit theory of cyclical emergence. It makes visible that morphological stability can be understood neither as a static state nor as the mere result of genetic processes, but as an ongoing operative closure between possibility, stabilization, and manifest form.

In this perspective, mortality does not appear as an isolated biological failure, but as a boundary phenomenon of emergent order. This framing makes it possible to consider regeneration, cancer, and aging processes within a shared structural reference framework without leveling their respective internal logics.

For future research, this raises the question of to what extent targeted interventions in bioelectric regulatory circuits can be understood as reconfigurations of operator cycles. Such an approach could contribute to a more precise determination of the conditions under which biological form is restorable and to a systematic investigation of the limits of biological plasticity.

The present contribution does not present itself as a replacement for existing biological explanations, but as a theoretical extension that makes explicit the structural preconditions of form stability. In this sense, it aims to embed bioelectric morphogenesis within a more general emergence context that renders the finitude of biological order intelligible without reducing it.

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Morphology Without Memory
Folding Is Not Space
On the Ontological Limit of Blueprints, Setpoints, and Simulation

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Abstract

The current debate on morphology in biology, complexity research, and AI implicitly rests on the assumption that form possesses a kind of memory: as a blueprint, setpoint, attractor, or information-like target state that is in principle reconstructible, manipulable, or simulable. This assumption links otherwise heterogeneous approaches—from biological morphogenesis (e.g. Michael Levin) and pre-geometric order models (Stuart Kauffman) to contemporary AI and simulation narratives—into a shared ontology of feasibility.

The present text rejects this ontology. It argues that morphology has no memory in the sense of stored information, internal blueprints, or retrievable target states. The central conceptual error of the debate lies in the equation of folding with space. Folding describes topological constraints of form within a given space; it accounts for self-similarity, stability, and structural continuity. Space itself, however, does not arise from folding, but from Stülpung (ontological inversion)—that is, from a Seinsverschiebung (shift of being) in which potential is irreversibly lost and a relational negative space appears as a surrounding field of distortion.

This negative space—here conceptualized as negative topology (Negativtopologie)—carries no memory and no information. It operates solely as a temporal constraint on form, determining what can still become possible under altered conditions. Morphological "remembering" is therefore not an access to the past, but the irreversible effect of already closed possibility spaces. Repair can consequently never be a return, but only the emergence of new self-similarity under changed spatio-temporal conditions.

From this perspective it becomes clear that both biological control fantasies and AI-based simulations necessarily encounter an ontological limit. Simulation operates in the mode of folding—through state spaces, representations, and reconstructions—and thereby loses its connection to ontological inversion and negative topology. The text therefore does not propose an alternative morphological model, but a boundary determination within an operator-based research programme: it disciplines the concepts of form, space, memory, and repair, and marks the point at which feasibility, control, and simulation exceed their ontological domain of validity.

I. The Implicit Memory of Morphology

The contemporary debate on morphology presents itself as plural, open, and anti-mechanistic. Concepts such as field, attractor, target state, setpoint, or non-local order are intended to mark a break with classical, linear causal models. Nevertheless, these approaches share an implicit assumption that is rarely made explicit: that form possesses a kind of memory that, in principle, allows for its restoration, control, or retrieval.

This assumption is not confined to individual theories. It links biologically oriented concepts of morphological intelligence (for example in the work of Michael Levin) with cosmological or pre-geometric designs of order (e.g. Stuart Kauffman), as well as with current discourses on simulation, digital reconstruction, and AI-assisted repair. Despite differing terminologies and research goals, form is treated as something that remains, at least in principle, retrievable: whether as an implicit blueprint, a stable attractor, or a field-like target configuration.

This "memory" is usually not conceived as an explicit representation. This is precisely where its appeal lies. It does not appear as a naïve blueprint, but as an emergent, distributed, non-local order. Nevertheless, it fulfils the same functional role: it serves as a reference point for how something ought to be, even when it has been damaged, lost, or fragmented. Repair, regeneration, or reconstruction are thus conceived as fundamentally possible, provided that access to this order—biological, technical, or informational—can be achieved.

The present text intervenes precisely at this point. It argues that this assumption of a morphological memory is not an empirical hypothesis, but an ontological pre-decision. It presupposes that the space in which form stabilizes can be treated as given, and that time does not imply an irreversible loss of possibility, but merely a delay of access. Form thus appears as something that may be temporarily obscured, but not fundamentally lost.

This pre-decision usually remains unspoken because it corresponds to a familiar mode of thought: the idea that order, once it has existed, remains in principle reconstructible. In attenuated form, this assumption already appears in classical developmental models; in its

modern guise, it returns in field-theoretical, cybernetic, and information-based approaches. Even where linear causality is explicitly rejected, the idea of an accessible direction of form remains intact.

The text proposes not to further refine this assumption, but to question it at its root. This is not done by introducing alternative models of memory, but by showing that morphology must be thought without memory once space, time, and form are no longer presupposed as independent quantities. The decisive step consists in the distinction between folding and space—a distinction that is systematically blurred in the current debate.

II. Folding: Form Constraint Without Space

Over the past decades, the concept of folding has had a remarkable career. In biology, materials science, origami research, cognitive science, and morphology, it denotes those processes through which complex, functional forms emerge from seemingly simple initial states. Protein folding, brain folding, tissue folding, or bio-inspired folding structures are regarded as paradigmatic examples of how order can arise without a central blueprint.

In this reading, folding appears as a counter-model to classical developmental logic. Instead of linear programs, local constraints, energetic minima, geometric limitations, and self-similar rules are at work. Form does not arise through external control, but through inner necessity. This is precisely what makes the concept of folding attractive for contemporary debates on morphology: it allows one to speak of order without resorting to explicit representations, symbolic codes, or intentional planners.

This shift, however, is conceptually incomplete. Folding may describe how form is organized within a given framework, but it says nothing about where this framework itself comes from. Folding presupposes space. It operates within a topological configuration that is already given as a field of possibility. The decisive question concerning the emergence of this field remains unaddressed.

Formally considered, folding is a topological form constraint. It increases complexity without losing form. Self-similarity across scales, invariance under certain transformations, and structural robustness are typical characteristics of folded systems. All of this makes folding explanatorily powerful with respect to stability, resilience, and functional continuity. At the same time, it remains strictly lossless: in folding, no possibility space is lost, but merely reorganized.

This point is crucial. As long as folding is conceived as the primary principle of order, reversibility remains at least in principle intact. Folded structures can be unfolded, refolded, or reorganized in altered ways. Even if this may be practically demanding or energetically improbable, it is not conceptually excluded. Order thus appears as something that can be transformed, but not fundamentally or irreversibly lost.

In the morphology debate, this property is rarely problematized. Folding is implicitly equated with space: the space in which forms stabilize is treated as a neutral carrier of processes. Whether this space itself is altered, whether it becomes distorted or narrowed with each act of form formation, remains unnoticed. It is precisely here that the conceptual error begins.

Folding is not space. It is an operation within space. Whoever confuses folding with space tacitly assumes that all morphological changes take place within a constant field of possibility. Form is thereby conceived as in principle reconfigurable, even when blueprints, programs, or explicit control are rejected. The idea of an implicit memory—distributed, field-like, or emergent—thus remains intact.

The present text therefore proposes to strictly delimit folding. Not as a false principle, but as a secondary one. Folding explains the organization of form after its emergence, not the emergence of the space in which this organization becomes possible. In order to make this difference visible, another concept is required: Stülpung (ontological inversion). Only with this concept can it be grasped how space itself arises from loss, absence, and a shift of being (Seinsverschiebung)—and why morphology must be thought without memory.

III. Stülpung (Ontological Inversion): Space from Loss

The concept of Stülpung (ontological inversion) does not denote another mechanism of form formation, but a categorically different condition. It addresses a point at which existence can no longer be understood as mere variation within an open field of possibility. Seinsverschiebung (shift of being) minimally designates here that ontological transition in which something does not merely assume a form, but acquires existence, through which possibility is irreversibly lost. A shift of being does not mean movement, process, or development, but the fact that with the emergence of something, a part of what could have been possible is no longer possible.

While folding operates within a given space, ontological inversion concerns the emergence of this space itself. It is not a topological process in the positive sense, but the consequence of a shift of being in which possibility is not reorganized, but closed. Ontological inversion occurs where existence can no longer be conceived as a reversible configuration, but as a condensation that produces a remainder. This remainder appears as space.

In this understanding, space is not the neutral background in which things are located, but negative space, which is brought forth by the emergence of things in the first place. It is the inner side of a loss. Things do not generate space by filling it, but by distorting it. The space that appears is not an empty container, but the surrounding field of what is no longer possible.

The decisive difference from folding lies in the relation to the space of possibility. Folding reorganizes possibilities; ontological inversion closes possibilities. With each act of inversion, the space of possibility becomes smaller, not differently ordered. What emerges is not only form, but a new restriction of what can still be formed in the future. This restriction is irreversible. It cannot be unfolded, undone, or neutralized.

Ontological inversion is therefore inseparably linked to time. Time does not appear here as a linear sequence of states, but as the trace of loss that deepens with each shift of being. Time does not measure change, but the progressive closure of possibility. In this sense, time is not a parameter, but a curvature: the direction that results from the fact that not everything is possible at the same time, and not everything is possible again.

With the introduction of ontological inversion, the ontological focus shifts. Order is no longer the result of a process, but the consequence of a boundary formation that withdraws from

access. Where folding allows transitions, ontological inversion marks a threshold. This threshold is not gradual, but structural. It does not separate two states within the same space, but two different constitutions of space.

For the morphology debate, this has far-reaching consequences. Once space can no longer be presupposed as given, all concepts that rely on the principle reconfigurability of form lose their self-evidence. Attractors, setpoints, or field-like target states presuppose that the field itself remains stable. Ontological inversion, by contrast, shows that the field itself is altered with each act of form formation—not locally, but ontologically.

This also makes it understandable why repair, return, or restoration can never succeed on a one-to-one basis. What has been lost is not only a form, but a part of the space that once made this form possible. Every new form arises under altered conditions. It may be similar, functionally equivalent, or structurally related, but it is not the same. The difference lies not in the object, but in the space that carries it.

Ontological inversion makes visible that morphology does not fail at the level of processes, but at the level of presuppositions. As long as form is modeled within a space conceived as constant, the idea of an implicit memory remains plausible. Only when space itself is grasped as an effect of loss does it become clear that morphology must be thought without memory. What remains is not a store, but a negative topology (Negativtopologie): the distorted surrounding field that has emerged from past shifts of being and constrains future forms without determining them.

IV. Negative Topology: Space as a Surrounding Field of Distortion

With the introduction of ontological inversion (Stülpung), it becomes clear that space cannot be conceived as a neutral continuum. What emerges through a shift of being (Seinsverschiebung) is not an empty container, but a relational surrounding field that is distorted by the very existence of things. This surrounding field is not secondary, but constitutive. It determines what will be possible in the future without itself being a form or an object. In this sense, it is here designated as negative topology (Negativtopologie).

Negative topology is not another type of space alongside others. It is the outer space that emerges as soon as something exists as an object. An illustrative example is the negative space between the fingers of a hand: this space is neither nothing nor a mere by-product. It co-determines what is possible as a finger form at all. If a finger is lost, not only the object changes, but the entire surrounding field changes with it. Accordingly, the conditions of what can later emerge as a “finger” also change.

Decisive is the following: this surrounding field contains no information. It stores nothing, remembers nothing, and refers to no previous state. Its efficacy does not lie in representation, but in temporal distortion. Past shifts of being continue to exert an effect by further narrowing the space of possibility. Negative topology is thus the spatial manifestation of irreversible time.

In the morphology debate, this fact is systematically misunderstood. What is described there as morphological memory, as a setpoint, or as an implicit target structure is in reality the effect of an already distorted negative topology. The direction in which new forms develop does not

arise from a stored blueprint, but from the fact that certain possibilities are no longer open. Form emerges under constraint, but this constraint is not a plan; it is the result of past losses.

This also leads to a redefinition of the concept of memory itself. Morphological "memory" is not an access to the past, but the continued efficacy of closed possibilities. It is not the remembering of what was, but the no-longer-being-able of what was once possible. Time does not operate here as a sequence, but as a condensation: the more time has passed, the more pronounced the negative topology becomes, and the narrower the space in which new forms can emerge.

This perspective explains why repair can never be a return. Even if a new structure is functionally or visually similar to a lost one, it arises under different spatio-temporal conditions. The negative topology has changed. What emerges is a new self-similarity, not an identical reoccurrence. The difference lies not in the object, but in the surrounding field that carries it.

With negative topology, it becomes evident that the assumption of a morphological memory constitutes a categorical confusion. It translates spatio-temporal distortion into information-like terms and turns form constraint into a problem of control. This is precisely where the ideology of feasibility sets in: where surrounding field is confused with code, simulation appears as a legitimate substitute for world. Yet simulation operates exclusively within foldings. It can reconfigure forms, but it cannot generate or modify negative space.

At this point, the ontological limit is reached. Morphology without memory does not mean formlessness or arbitrariness, but the recognition of a constraint that cannot be addressed. Negative topology constrains without instructing. It limits without storing. And it makes visible why neither biological control models nor technical simulations can undo the loss of world.

IV.a Recurrence, Space of Possibility, and the Absence of Memory

The following excursus uses the term Recurrence in the sense developed in my Orch-OR and Recurrence papers; here it serves exclusively for the conceptual demarcation against storage- and memory-based ontologies.

In the sense of the ontology developed here, Recurrence does not denote access to a stored space of possibility and does not imply a morphological memory. The space of possibility introduced in Orch-OR–Recurrence theory is neither persistent nor ontologically given. It exists exclusively as a short-lived, metastable openness after an objective reduction (OR) and prior to full stabilization. Recurrence does not describe a return to past forms, but the deferral of the final closure of possibility.

This deferral is not to be understood as a temporal process in the sense of a sequence of states. The temporality of Recurrence is not chronological duration, but an implicative non-simultaneity of reduction and hardening. Time does not appear here as a framework within which Recurrence takes place, but as that which becomes experienceable only as long as the full formation of negative topology has not yet been completed. Recurrence is thus not an event in time, but the ontological ground for time to appear as experience.

In this model, consciousness does not arise through the reading-out of an internal blueprint or an implicit form store, but as the experience of a state in which negative topology has not yet been fully formed. Recurrence is therefore not memory, but the temporary suspension of hardening from which memory, identity, and stable spatial structure first emerge. Once stabilization sets in, this space of possibility is lost; it leaves behind no storable trace, but only a further distortion of the surrounding field.

Recurrence is thus not a place, but a transition—not a reservoir of form, but the last moment before full indimergence. Recurrence is the ontological fissure between decision and hardening. Consciousness is not what remains after spatial constriction, but what emerges as long as this constriction has not yet been fully completed. Consciousness does not arise from form-knowledge, but from the deferral of spatial constriction. Recurrence is not a point in time, but the condition of its experientiality.

V. Simulation and the Error of Reconstruction

The assumption that form is reconstructible reaches its most radical expression in simulation. Simulation promises to restore lost forms, functions, or orders through sufficiently accurate modeling. Whether in biological repair fantasies, in the idea of digital twins, or in AI-supported simulations of morphogenesis, it is consistently presupposed that the essential aspect of form lies in a reconstructible state space.

This presupposition is not a technical detail, but an ontological decision. Simulation necessarily operates in the mode of folding. It presupposes a state space that is fully specifiable, either explicitly or implicitly. Transitions are modeled as transformations within this space; losses appear as deviations that are, in principle, correctable. This is precisely where simulation derives its strength—and at the same time, its limit.

From the perspective of ontological inversion (Stülpung) and negative topology, it becomes clear why simulation must fail structurally as soon as it claims to replace world or to perform repair. Simulation can vary, reconfigure, or approximate forms, but it cannot generate a surrounding field. It cannot co-enact negative topology, because negative topology does not consist of states, but of the irreversible loss of possibility.

Here the shared ontological core of biological control models and technical AI narratives becomes visible. In both cases, it is assumed that finding the correct representation—whether as a setpoint, a field, an attractor, or a high-dimensional model—is sufficient to restore form. This assumption links the morphology debate, for example in the work of Michael Levin, with contemporary simulation narratives as well as with pre-geometric order designs in Stuart Kauffman. Despite all differences, the framework remains the same: form is treated as in principle retrievable.

The decisive blind spot lies in the fact that simulation does not participate in the loss from which space emerges. It can represent loss, but it cannot be loss. It can encode absence, but it cannot allow absence to operate as a condition. This produces a paradoxical situation: the more precise the simulation becomes, the more convincing the illusion of reconstruction appears—and the more invisible the ontological rupture separating it from world becomes.

This rupture is not gradual. It cannot be bridged by higher resolution, increased computational power, or more complex models. Simulation remains operative within a given space of possibility. Ontological inversion, by contrast, alters this space itself. It withdraws the object of simulation without being able to replace it. What is simulated is always already an abstraction after loss, never the loss itself.

It follows that repair, in the strict sense, is not simulable. What simulation can provide is functional similarity, structural approximation, or operational substitutability. What it cannot provide is return. Every real repair—biological, social, or cultural—is a new self-similarity under altered spatio-temporal conditions. It arises from a new shift of being and a new loss, not from the reconstruction of a previous state.

The ideology of feasibility manifests precisely where this boundary is denied. Where simulation is understood as healing, restoration, or the overcoming of loss, world is confused with model. The concepts shift: space becomes state space, time becomes computation time, form becomes information. What disappears in this shift is negative topology—that surrounding field which compels form in the first place without storing it.

Morphology without memory therefore does not mean a rejection of technology or modeling. It means the recognition of a boundary. Simulation can describe, vary, and predict forms, but it cannot generate a space that arises from absence. At this boundary it is decided whether technology is understood as a tool within the world—or whether it presumes to replace the world itself.

VI. Three Modes: Morphology, Simulation, Repair

In order not to leave the previously developed concepts at an abstract level, morphology, simulation, and repair can be distinguished as three fundamentally different modes of relating to form. In current debates, these modes are frequently conflated or implicitly treated as equivalent. The following juxtaposition serves the purpose of conceptual discipline.

Morphology

Morphology describes the emergence and stabilization of form under real spatio-temporal conditions. It is bound to shift of being (Seinsverschiebung), loss of potential, and negative topology. Form does not arise here from a plan, but under the constraint of a surrounding field that has already been distorted by past losses. Morphology possesses no memory in the sense of stored information. Its direction results from closed possibilities, not from referable target states.

Simulation

Simulation operates within a presupposed state space. It describes, varies, or approximates form without altering the space in which this form becomes possible. Simulation necessarily works in the mode of folding: it transforms structures losslessly within a given framework. Absence appears here only as a data point, not as a condition. Simulation can imitate form, but it cannot generate negative space.

Repair

Repair is neither morphology nor simulation, but a real re-emergence of form under altered conditions. It is always bound to new loss and can therefore never be a return. Repair produces self-similarity, not identity. It is not reconstructive, but generative—yet without memory, without blueprint, and without any guarantee of similarity. Every act of repair further alters the surrounding field and closes additional possibilities.

These three modes are not distinguishable by degree. They rest on different ontological presuppositions. Whoever understands simulation as repair, or thinks morphology as simulation, commits not a terminological imprecision, but a categorical confusion.

VII. AI, Digital Life, and the Rhetoric of Feasibility

Contemporary AI rhetoric radicalizes those ontological assumptions that already underlie the morphology debate. Concepts such as *digital life*, *artificial regeneration*, *virtual healing*, or *reconstructible identity* presuppose that form can be fully translated into state spaces, data structures, or models. In this perspective, loss does not appear as an irreversible rupture, but as a temporary lack of information.

This rhetoric is not accidentally successful. It resonates with a deeply rooted cultural desire: to undo the loss of world. AI is thereby understood not as a tool operating within existing conditions, but as a promise to replace these conditions themselves. Space becomes computational space, time becomes an optimization sequence, and form becomes reconstructible information.

From the perspective developed here, it becomes clear why these promises necessarily run empty. AI can operate only where the space of its operation is already given. It cannot generate negative topology, because negative topology does not arise from data, but from absence. The more convincing the simulation becomes, the greater the danger that its ontological limitation becomes invisible.

The problem does not lie in the technology itself, but in its ideological overextension. When simulation appears as a substitute for world, loss is not acknowledged, but displaced. This is precisely where the ideology of feasibility takes hold: it confuses modellability with world-capability, and control with existence.

In this sense, AI rhetoric does not constitute a rupture, but the logical intensification of a mode of thought that treats space, time, and form as fundamentally available. The critique of this rhetoric is therefore not a technoskeptical position, but an ontological boundary determination.

VIII. Conclusion: The Ontological Limit of Feasibility

The present text has argued that morphology must be thought without memory once space, time, and form are no longer presupposed as independent quantities. The central conceptual error of the current debate lies in the equation of folding and space. This equation renders form

in principle reconfigurable and opens the path for blueprints, setpoints, and simulations as apparent substitutes for world.

By contrast, it has been shown that space itself arises from ontological inversion (Stülpung): from a shift of being (Seinsverschiebung), loss of potential, and the emergence of a negative topology that constrains future forms without storing them. Morphological "memory" is not a store, but the continued efficacy of closed possibilities. Repair is therefore never a return, but always a new self-similarity under altered conditions.

These insights do not constitute a new theory of morphology, but a boundary. They indicate where explanations, control fantasies, and simulations exceed their domain of validity. At this boundary it is decided whether technology is understood as a tool within the world—or whether it claims to replace the world itself.

Morphology without memory means taking loss seriously. Not as a deficit to be remedied, but as the condition under which space, time, and form can appear at all. This recognition is not a limitation of scientific thought, but its prerequisite wherever feasibility threatens to become ideology.

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Repair Without Eigenzeit
On the Ontological Instability of Simulation-Based Healing in Morphology and Medicine

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Abstract

Contemporary approaches to biological repair increasingly rely on simulation-based ontologies of form. From bioelectric control models and morphogenetic setpoints to regenerative medicine and cancer reprogramming, healing is conceived as the restoration of a lost or damaged target state. These approaches presuppose that form is in principle retrievable, that the space of possibility remains intact, and that temporal history can be functionally neutralized.

Building on the ontological clarification developed in *Morphology Without Memory* (https://doi.org/10.5281/zenodo.18449106), this paper argues that such repair ontologies operate under a fundamental illusion. They confuse formal stabilization with ontological integration and treat simulation as a substitute for world-formation. Central to this illusion is the neglect of Eigenzeit: the non-transferable, irreversible emergence-time of living systems. While form may be reproduced, shifted, or overwritten, its genealogical temporality cannot be reconstructed.

Using paradigmatic cases—biological cloning, bioelectric morphogenetic interventions, and contemporary narratives of cancer repair—the paper shows that simulation-based healing necessarily produces temporally displaced forms: coherent in appearance, functional in the short term, yet ontologically unstable. What is stabilized is not a restored organism, but a simulated order lacking endogenous temporal grounding.

The analysis demonstrates that the instability observed in cloning and large-scale regenerative interventions is not a contingent technical failure, but a structural consequence of bypassing Eigenzeit. Repair, when understood as return, is therefore impossible. What can emerge instead is only a new self-similarity under altered spatio-temporal conditions—an emergence that can neither be guaranteed, controlled, nor preserved through simulation.

In conclusion, the paper argues for a strict ontological distinction between morphology, simulation, and repair. It maintains that repair technologies remain legitimate only insofar as they acknowledge their non-restorative character. Where healing is conceived as overwrite, reset, or reconstruction, repair ontologies risk producing new pathologies rather than resolving existing ones.

I. Point of Departure: Repair as an Implicit Claim of Return

Repair initially appears in biological, medical, and technological discourses as a pragmatic, value-neutral intervention. It is understood as correction, restoration, or functional readjustment of a disturbed system. This apparent neutrality, however, conceals an ontological presupposition that is rarely made explicit: the assumption that a prior state of order is, in principle, reachable again.

Even where repair is no longer conceived in terms of classical reconstruction, but rather as reprogramming, readdressing, or self-organization under altered conditions, this claim of return remains operative. It merely shifts its form. In place of an explicit blueprint appear setpoints, attractors, target states, or field-like orders. The operative core remains the same: it is assumed that form—once existent—remains preserved in some manner and can be re-actualized.

Repair is thus never merely an intervention into an existing system, but always a statement about time. It claims that temporal difference is bridgeable, that loss does not act irreversibly, and that the emergence of form can be detached from its history. This claim need not be articulated in order to be effective. It is implicit in the practices themselves: wherever healing is conceived as restoration, reset, or functional return.

It is precisely at this point that the following analysis intervenes. It is not directed against individual technologies, methods, or therapeutic promises, but against the ontological structure they share. Repair ontologies differ in their technical means, but not in their fundamental assumption: that form can be stabilized without its emergence-time.

This assumption remains plausible as long as time is understood as an external parameter—as something that passes, can be measured, or can be compensated. Once, however, time is understood as a constitutive condition of form, the claim of return loses its self-evidence. Repair then no longer appears as recovery, but as the production of a new order under altered conditions.

The decisive step therefore does not lie in the question of whether repair succeeds technically, but in what emerges ontologically in the process. Is a system integrated, or is merely a formal coherence stabilized? Is time taken into account, or is it neutralized? This distinction is not gradual, but categorical.

In what follows, it is shown that repair ontologies systematically blur this distinction. They treat stabilization as integration and thereby fail to recognize the role of Eigenzeit in living systems. The consequence is not a merely theoretical imprecision, but a structural instability of the order produced—an instability that manifests in boundary cases such as cloning, bioelectric reprogramming, and implicit narratives of cancer healing.

II. Eigenzeit as a Blind Spot of Biological Healing Models

The central blind spot of contemporary repair ontologies does not lie in a lack of data, models, or technical sophistication, but in their understanding of time. Time appears there either as an external parameter, as developmental duration, or as a disturbance that can be compensated

through appropriate intervention. What is systematically missing is the recognition of Eigenzeit as an ontological condition of form.

Eigenzeit does not denote a measurable duration, a biological rhythm, or a subjective experiential time. Nor is it identical with developmental time in the empirical sense. Eigenzeit refers to the irreversible emergence-time of a system: that temporal dimension in which form not only appears, but becomes ontologically viable in the first place. It is not additive, not reconstructible, and not externalizable.

In biological healing and repair models, time is instead functionalized. It is treated as if it could be neutralized through control, reprogramming, or targeted intervention. What has been lost is to be replaced through suitable configurations; what has developed incorrectly is to be corrected by returning it to a stable state. This logic presupposes that temporal difference has no independent ontological status, but merely represents an obstacle that can be overcome.

It is precisely this presupposition that is problematic. For it fails to recognize that form does not exist independently of its emergence. Form is not a state that is reached at a particular moment, but the result of a temporal condensation in which possibilities have been irreversibly closed. Eigenzeit is the trace of these closures. It is not what passes, but what cannot be reopened.

Repair models that ignore Eigenzeit therefore operate with a tacit shortcut: they begin with visible form and treat it as if it could be stabilized independently of its temporal genesis. Stability is thereby confused with functionality, coherence with integration. That a system functions, however, does not mean that it is ontologically embedded. It can be stabilized without being carried.

This confusion explains why repair ontologies appear particularly successful where temporal depth is low or where developmental processes are organized in a highly regenerative manner. In such cases, an external order can be absorbed without immediately becoming effective as a foreign order. With increasing complexity, however—especially where multiple temporal layers, biographical embedding, and systemic feedback loops intersect—the neglect of Eigenzeit becomes problematic.

Eigenzeit does not mark an additional variable here, but a boundary. It designates the point at which intervention no longer acts integratively, but overwrite-like. Where this boundary is ignored, orders emerge that may appear formally coherent, but are not temporally grounded. They carry no history of their own, but simulate one they have never undergone.

This makes it intelligible why repair ontologies tend to naturalize their own presuppositions. By treating time as neutralizable, they render their interventions invisible. What appears as healing is, in reality, a temporally displaced stabilization—an order that has not emerged from the system's Eigenzeit, but takes its place.

In the next step, this structural problem is concretized through a paradigmatic boundary case: biological cloning. There it becomes visible that ontological instability is not the result of insufficient technology, but the necessary consequence of form-formation without Eigenzeit.

III. Cloning as a Paradigmatic Boundary Case of Temporal Dislocation

Biological cloning constitutes a boundary case in which the ontological problem of repair and reconstruction logics first became unmistakably visible. The recurring instabilities of cloned organisms—shortened lifespan, organ dysfunctions, increased susceptibility to disease—were long interpreted as technical shortcomings: as consequences of incomplete epigenetic reprogramming, faulty nuclear transfer, or insufficient control of molecular processes. This reading persists to the present day.

What is overlooked, however, is that these instabilities also appear where form, function, and early development initially seem coherent. The cloned organism is not failed in the sense of a defective blueprint. It is form-identical, functional, and in many cases viable. And yet it is ontologically displaced.

The decisive difference lies not in structure, but in time. The clone is temporally wrong. It carries a genealogical past that is not its own. Epigenetic markers, cellular aging processes, and biographical traces stem from a different context of emergence. What is reproduced here is not a beginning, but an already aged space of possibility. The form appears new, but its time does not.

This temporal dislocation cannot be understood as a mere technical error. It is not a contingency that could be eliminated through improved procedures. It necessarily results from the fact that emergence is simulated without re-traversing the system's Eigenzeit. The clone skips that irreversible phase in which form and time bind to one another. It does not emerge; it is set.

It is precisely here that the structural instability of cloning resides. The coherence of form conceals the absence of temporal anchoring. The organism functions, but it does not carry itself. It does not stabilize itself out of its own history, but out of an adopted, foreign temporality. The observed pathologies are therefore not accidental side effects, but expressions of an ontological incongruence.

Cloning thus makes visible what repair ontologies usually obscure: that form without Eigenzeit may be producible, but is not viable. The hope that this instability could be resolved through improved reprogramming or more complete resetting of the epigenetic clock rests on the very illusion that generated the problem in the first place. It presupposes that time is reconstructible, provided one intervenes deeply enough in molecular control.

The boundary case of cloning shows the opposite. Time is not a parameter that can be reset, but a condition that operates irreversibly with every emergence. Where this condition is bypassed, no return takes place, but a temporally displaced order arises. That this order collapses sooner or later is not surprising, but the logical consequence of its mode of emergence.

In the next section, it is shown that the same structure becomes operative again in contemporary bioelectric repair and reprogramming models—less obvious, technologically more refined, but ontologically no less problematic.

IV. Bioelectric Repair and the Illusion of Overwrite

Contemporary bioelectric models of morphogenesis promise a new form of biological repair. In place of genetic interventions, control is exercised at the level of membrane potentials, gap junctions, and electrical coupling fields. Tissue appears here as a collectively coordinated assemblage whose form is not organized by blueprints, but by field-like target states. Disturbances of form—malformations, degeneration, tumor growth—are accordingly interpreted as misaddressings within this control field.

This shift from the genetic to the bioelectric level is regarded by many as a paradigmatic advance. It appears to overcome the reductionism of molecular explanations while simultaneously opening up new therapeutic options. Form is no longer built, but reoriented. Healing appears as switching, not reconstruction.

It is precisely here, however, that the structural proximity to the problem of cloning becomes apparent. Bioelectric repair likewise operates with an implicit assumption of return. It presupposes that there exists a stable, healthy target state that—once correctly addressed—can become effective again. Whether this target state is described as a setpoint, an attractor, or a morphogenetic field is secondary. What is decisive is that form is conceived as retrievable, independently of the time in which it emerged.

Bioelectric interventions thus generate formal coherence. They can reorganize tissue, redirect growth patterns, and stabilize functional configurations. What they do not accomplish, however, is the restoration of the Eigenzeit in which these patterns originally emerged. The intervention acts externally upon a system whose temporal depth structure has already been shaped. It sets an order without sharing its genealogical emergence.

In simple or highly regenerative organisms, this overwrite can be integrated. There, temporal depth is low, developmental processes are cyclically organized, and new orders are rapidly absorbed into the system's own logic. The boundary between intervention and emergence thus remains blurred.

With increasing complexity, this boundary shifts. In multilayered organisms with differentiated organ structures, immunological feedback loops, hormonal rhythms, and biographically sedimented temporality, the bioelectric order no longer acts integratively, but overlay-like. The coherence produced remains external. It is stabilizing, but not carrying.

Here, the pattern of cloning reappears in a more subtle form. Once again, an order arises that functions without having emerged from the system's Eigenzeit. The form is correctly addressed, yet its temporal anchoring is absent. Repair does not produce a process of return, but a temporary simulation of health.

This simulation is not ineffective—on the contrary. Its very effectiveness is what makes it problematic. For it conceals the ontological displacement it produces. As long as the simulated order can be maintained, healing appears successful. Only where stabilization collapses or new pathologies emerge does it become visible that no integration has taken place.

Bioelectric repair models thus reproduce the same fundamental error as classical reconstruction approaches: they treat form as a controllable target and time as a neutralizable factor. Overwrite

replaces emergence. What appears as healing is the establishment of a new foreign order whose viability does not arise from the system's Eigenzeit.

In the following section, it is shown that this problem is not merely of theoretical significance in the context of cancer. There it becomes visible that overwrite can be not only unstable, but itself a source of new pathologies.

V. Cancer Not as Defect, but as a Breakdown of Eigenordnung (self-ordering)

In the context of cancer, the consequences of simulation-based repair ontologies become particularly evident. In most biological and medical models, cancer is understood as a defect: as a genetic derailment, a loss of control, a deviation from a healthy order. Even where genetic reductionism is explicitly avoided, this basic figure remains intact. Cancer appears as a faulty state that must be corrected, reset, or overwritten.

Bioelectric repair narratives shift this diagnosis without fundamentally transforming it. Here, cancer is not regarded primarily as a molecular error, but as a loss of collective coordination within tissue. Therapeutic hope consists in restoring this coordination through targeted switching of bioelectric fields. Healing is conceived as a reconnection to a healthy morphogenetic target state.

This shift is theoretically elegant, yet it overlooks a decisive alternative: the possibility that cancer is not the loss of order, but the result of a misdirected Eigenordnung (self-ordering). In this understanding, cancer is not a chaotic condition, but a form of stabilized self-organization that has decoupled itself from the overarching tissue logic. It is not unordered, but differently ordered.

If cancer is understood in this sense, the ontological situation changes fundamentally. Pathological stability then arises not from a lack of control, but from a displacement of temporal integration. The Eigenzeit of the affected tissue breaks out of the collective temporal framework and stabilizes itself along its own reproductive logics. In this sense, cancer is not a defect of form, but a rupture of temporal embedding.

Repair ontologies respond to this rupture through overwrite. They set an external order against an already established Eigenordnung. Bioelectric interventions, chemical therapies, or genetic corrections aim to neutralize pathological stability and replace it with a healthy one. Ontologically, however, this does not amount to integration, but to the confrontation of two orders that do not share the same time.

Herein lies the structural danger. If an external order is stabilized without re-traversing the system's Eigenzeit, no rebinding occurs, but only a temporary dominance. The pathological order is not dissolved, but overlaid. As long as the overwrite remains effective, healing appears successful. Once it weakens, the Eigenordnung returns—often in altered, resistant, or more aggressive form.

Seen in this light, the frequently observed recurrence or transformation of cancer after seemingly successful treatment is not an accidental failure, but an ontological consequence. The

therapy has simulated an order without generating the conditions of its viability. It has stabilized form without integrating time.

It thus becomes clear that repair ontologies in the context of cancer do not merely encounter a limit, but actively reproduce this limit. By conceiving healing as return or overwrite, they fail to recognize the temporal character of pathology. They treat cancer as a deviation from a target state, rather than as the expression of an autonomous, albeit destructive, order.

This analysis does not imply a rejection of therapeutic interventions. It does, however, mark a boundary of their claim. Where healing is understood as restoration, it remains ontologically precarious. What is possible is not a return to a former order, but the emergence of a new one—under altered spatio-temporal conditions and without any guarantee of its stability.

In the next section, this insight is translated into a systematic distinction. Morphology, simulation, and repair are no longer treated as variants of the same process, but as ontologically incommensurable modes.

VI. Three Ontologically Incommensurable Modes: Morphology, Simulation, Repair

In order not to misinterpret the preceding arguments as a mere critique of individual repair approaches, a conceptual clarification is required. Morphology, simulation, and repair are frequently conflated or implicitly equated in contemporary discourse. This equation is not gradually mistaken, but categorically so.

Morphology designates the real emergence and stabilization of form under irreversible spatio-temporal conditions. It is inseparably bound to Eigenzeit. Form does not arise here as the realization of a target state, but as the result of a temporal condensation in which possibilities have been irrevocably closed. Morphology possesses neither memory nor recourse. Its direction results from loss, not from storage.

Simulation, by contrast, operates within a presupposed space of possibility. It describes, varies, or approximates form without altering the space in which that form is possible. Simulation is necessarily lossless. Time appears here as computation time, as sequence, or as a controllable variable. Simulation can generate coherence, but not Eigenzeit. It imitates order without participating in its emergence.

Repair is neither morphology nor simulation, but a real intervention into an already existing system. Ontologically considered, repair can never be return. Every intervention alters the surrounding space of possibility and produces new structures of loss. Repair therefore does not give rise to identity, but at most to new self-similarity. Where repair is understood as reconstruction or reset, it necessarily becomes simulation.

These three modes are not transformable into one another through technical refinement. Whoever treats simulation as repair, or repair as controlled morphology, commits not a terminological inaccuracy, but an ontological confusion. The consequence of this confusion is stabilization without viability: functionally effective, yet temporally unintegrated.

VII. Conclusion: The Boundary of Healing

The boundary drawn here does not concern biological repair models alone, but every ontology that confuses simulation with world-capability—including contemporary AI-based fantasies of substitution and healing.

The preceding analysis has shown that repair ontologies are not problematic because they are technically insufficient, but because they contain an implicit claim of return that contradicts the temporal structure of living systems. By treating form as reconstructible, they neutralize time and bypass Eigenzeit.

Healing can succeed under these premises—yet only in the mode of simulation. What is stabilized is an order without genealogical viability. The instability observed in such interventions is therefore not accidental and not a transitional problem, but a structural consequence.

This does not mean that repair, intervention, or technology should be rejected. It does mean, however, that their claim must be limited. Repair cannot accomplish return. It can only enable new orders under altered conditions—orders whose stability is neither guaranteed, controllable, nor preservable.

Where healing is conceived as overwrite, reset, or reconstruction, an ontological displacement occurs: time is denied, loss is ignored, and form is separated from its emergence. Precisely there begins the danger of secondary pathologies—not despite, but because of functioning interventions.

The boundary of healing therefore does not run between nature and technology, but between integration and simulation. Technology remains legitimate as long as it recognizes this boundary. Where it oversteps it, it replaces world with model and stability with illusion.

Healing without Eigenzeit does not heal.

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Fixpunkte (focal points), folding, and morphological order
On the emergence of non-local structure in consciousness, culture, and society

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Abstract

This paper reconstructs and condenses core theoretical concepts from *Gesellschaft ohne Vertrauen* (2005/2025) by Timothy Speed and situates them within a contemporary interdisciplinary context of debates on emergence, non-locality, and morphology. Central to the analysis is the concept of Fixpunkte (focal points), understood as epistemic singularities of conscious systems: non-producible, non-algorithmically derivable condensations through which inner order, orientation, and creative dynamics take shape. Fixpunkte mark those moments in which a new order of reality folds out of diffuse experience—without being explainable through linear processes.

Building on this, the paper develops a morphological perspective on order in which social, cultural, and cognitive structures are not conceived as stable systems, but as temporary foldings between openness and condensation. The Bran-Spiral is introduced as a non-metaphorical structure that describes cyclical movements of differentiation and integration in consciousness and culture, without recourse to teleological models of development.

In contrast to classical theories of emergence and process, order is not understood here as the result of an underlying dynamic, but as the consequence of irreducible orientational events that resist full ontologization. In its concluding section, the paper positions this approach in relation to more recent work on morphological intelligence (e.g. Levin), resonance theory (Rosa), and the work of S. A. Kauffman, and indicates why further theoretical development does not lie in a deepening of ontological mechanics, but in the marking of their limit. The paper thus presents itself as a conceptual consolidation and genealogical clarification of an approach formulated early (2005) and gaining renewed relevance today.

Based on the book:

Speed, T. (2005). Gesellschaft ohne Vertrauen - Die Grundlagen einer kreativen Gesellschaft (1 German) Zenodo. https://doi.org/10.5281/zenodo.17864617

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1. Fixpunkte as epistemic singularities

Within this approach, the concept of Fixpunkte (focal points) does not refer to stable states, objects, or target values within a system, but to irreducible epistemic singularities through which inner orientation, meaning formation, and structural order take shape. Fixpunkte are not the results of linear processes and can neither be generated algorithmically nor planned functionally. They occur as events in which a consciousness—individual or collective—does not merely process information, but couples it internally in such a way that a new inner order emerges.

Fixpunkte are therefore not contents, but sites of condensation. They mark those moments in which diffuse perception, experience, or crisis transitions into a coherent structure of reality. In this sense, they function as embryonic foldings: as the first sites at which a directed order forms out of openness. This order is neither fully explicable nor reducible to its preconditions. Once a Fixpunkt has been integrated, it cannot simply be revoked or "argued back"; it permanently alters the internal logic of the system. *(Sphere cycle, shift of being)*

Crucially, Fixpunkte are not generalizable. They evade objectifying description precisely because they do not operate at the level of properties or states, but at the level of orientation. From the outside, they therefore often appear subjective, idiosyncratic, or vague. In their concrete efficacy, however, they are highly structuring: they determine decisions, values, ethical non-negotiables, creative directions, and forms of knowledge. Historically, paradigmatic scientific ruptures can be traced back to such Fixpunkte just as much as individual biographical turning points or biological morphogenetic formations.

Fixpunkte can be facilitated, but not enforced. Neither social control nor institutional rationality is capable of producing them. On the contrary, systems oriented toward stabilization, standardization, or the management of fear systematically block the emergence of new Fixpunkte. In doing so, they cut themselves off, in the long run, from their own sources of renewal. Innovation, cultural dynamics, and societal learning capacity therefore do not rest on the optimization of existing processes, but on the integration of non-planable orientational events.

In this sense, Fixpunkte pose a fundamental challenge to classical process and emergence theories. They do not mark a stage within a dynamic, but an interruption of the dynamic at which a new order forms. Order appears here not as the product of an underlying mechanism, but as the consequence of an irreducible epistemic orientation point: a moment in which a system begins to understand itself differently and, accordingly, to structure itself differently.

It is important to note that the concept of Fixpunkte was not originally conceived as a boundary concept. In *Gesellschaft ohne Vertrauen*, Fixpunkte were initially introduced as real, functional structures of orientation: as implicit reference points through which order, meaning, and agency take shape without being consciously set or fully explicable. In this early understanding, there is a clear structural proximity to what Michael Levin later described as setpoints of biological self-organization: target or orientational states toward which systems work without explicitly "knowing" them. The later shift toward a logic of limits therefore does not constitute an original demarcation, but the result of a consistent working-through of this functional assumption. Only in the course of this work did it become apparent that, while

Fixpunkte are order-forming, they elude ontological grounding. The conception of Fixpunkte thus did not begin from a boundary-setting, but led to it necessarily.

2. Folding, openness, and condensation

Fixpunkte do not remain isolated. Their structural efficacy unfolds only where they trigger a folding: a transition from openness to temporary condensation. By folding, no process in the classical sense is meant, but a morphological shift in which a previously open field of possibilities partially closes and a directed order takes shape.

The initial condition of conscious, social, or cultural systems is not a stable structure, but openness. Openness here does not denote arbitrariness, but a high permeability to difference, ambiguity, and alternative options of order. In this state, orientation is weak, but transformability is high. Only through the integration of a Fixpunkt does condensation occur: certain relations stabilize, others lose relevance. An order emerges.

This condensation, however, is fundamentally temporary. Every folding generates structure, but at the same time new tensions. The emerging order already carries within itself the conditions of its own overextension. If condensation is absolutized—for instance through institutionalization, systemic normalization, or ideological solidification—it loses its capacity to connect to new Fixpunkte. Order then tips from structuring orientation into blocking rigidity.

The relation between openness and condensation is therefore not a dialectical mechanism of progress, but an asymmetrical field of tension. Openness is the precondition for new Fixpunkte; condensation is their necessary, but risky, consequence. *(Referred to in later works as indimergence.)* Systems that eliminate openness entirely secure short-term stability at the cost of long-term incapacity for development. Conversely, systems lacking sufficient condensation lead to disorientation and dissolution.

Folding designates precisely this critical transition: the point at which openness is no longer viable and condensation becomes unavoidable—without this condensation being fully controllable. In this sense, folding is neither purely voluntaristic nor purely structurally explicable. It occurs at the interface between inner orientation and the external world, where a system is compelled to position itself.

Decisively, folding is not reversible. Once the transition from openness to condensation has occurred, it permanently alters the internal logic of the system. Repair can therefore only be self-similar. This self-similarity arises from an inner formal constraint. Even when later crises force a renewed opening, this never takes place on an identical level. Every new openness is already historically inflected by prior foldings. Order is therefore always layered, never neutral.

From this perspective, social, cultural, and cognitive structures do not appear as linear developmental processes, but as sequences of foldings, each triggered by Fixpunkte and stabilizing in temporary orders. Attempts to fully formalize or optimize this dynamic miss its core. For the decisive transitions—Fixpunkt and folding—elude both technical control and complete theoretical capture.

3. The Bran-Spiral as a morphological structure of order

In order to render the recurring transitions between openness, Fixpunkt, and condensation not only logically but also structurally graspable, this approach introduced the Bran-Spiral. It describes neither a developmental stage, nor a logic of progress, nor a teleological movement, but a spatial-morphological form in which order takes shape in conscious, cultural, and social systems.

The Bran-Spiral is not a temporal sequence, but a form of irreversible inscription. It models how foldings do not succeed one another linearly, but inscribe themselves into one another. Each new order does not emerge "after" the previous one, but around it, as a further winding of a structure that integrates difference without dissolving it. Earlier foldings do not disappear; they remain effective as inner layers.

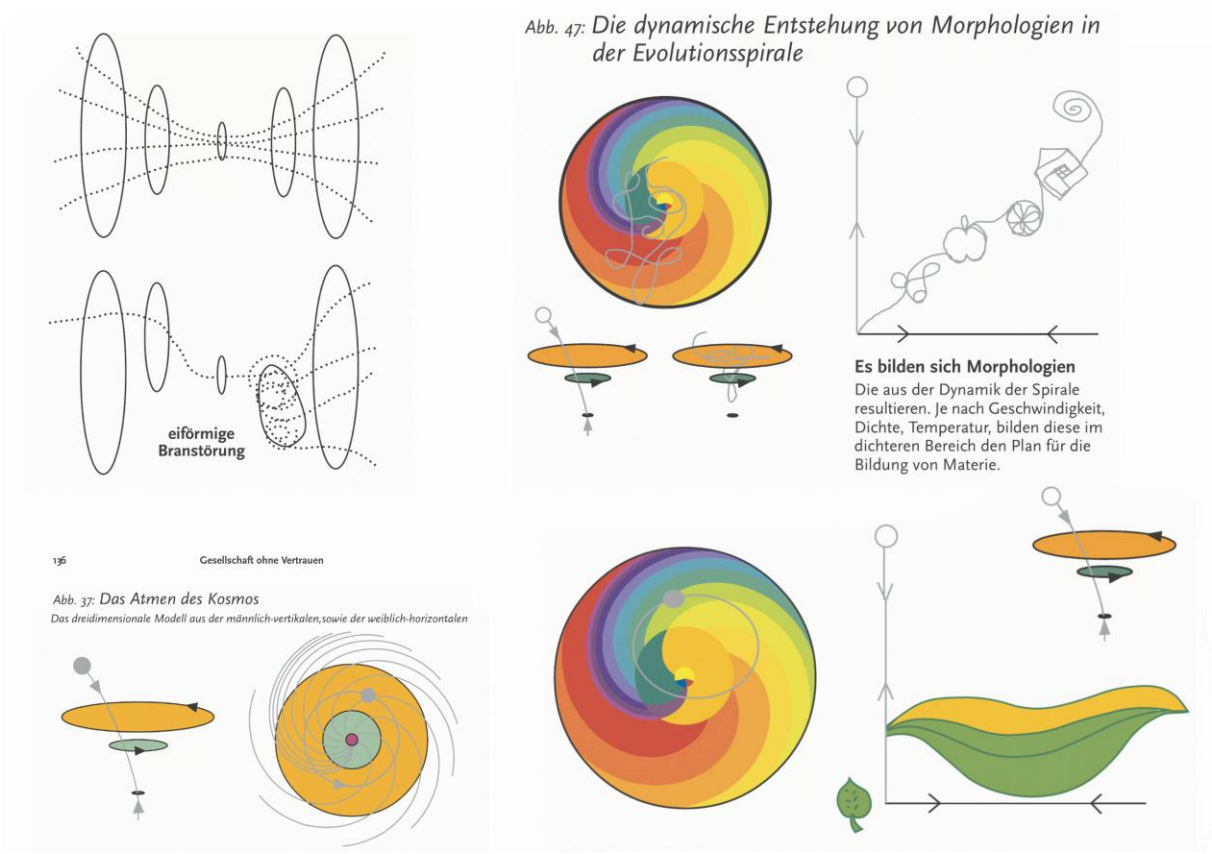
In contrast to stage-based, spiral, or evolutionary models that implicitly assume higher development or optimization, the Bran-Spiral describes a non-hierarchical recurrence. Complexity does not necessarily increase; rather, the relations between inner and outer orders change. Progress is not a relevant measure here. What is decisive is solely whether an order remains connectable to new Fixpunkte or closes itself off.

Morphologically considered, each winding of the Bran-Spiral emerges through a specific constellation of Fixpunkt and folding. A Fixpunkt generates orientation; the resulting folding stabilizes as a layer. This layer forms the resonance space for further Fixpunkte, which no longer build upon the original openness, but upon an already structured inner world. Order thus becomes recursive, not cumulative.

The Bran-Spiral makes it possible to think stability and change simultaneously without reconciling them dialectically. Systems can be highly stable and nevertheless lose inner mobility. Conversely, crises may arise that are to be understood not as failure, but as the necessary overextension of a winding. In this sense, crises do not appear as external disturbances, but as internal phenomena of tension within a folding that has become too tight.

Crucially, the Bran-Spiral does not prescribe a normative direction. It neither describes where a system "should" develop, nor does it privilege particular forms of order. Its function is different: it renders visible when order remains alive and when it blocks itself. Blockage arises where a winding is absolutized and forgets its own provisionality.

From this perspective, it becomes clear why attempts to stabilize social or cultural order permanently regularly culminate in rigidity or violence. They misconstrue order as an end state rather than as a temporary morphological configuration. The Bran-Spiral, by contrast, insists that every order remains viable only as long as it structurally allows for its own transgressability.



***Figures** from Gesellschaft ohne Vertrauen (2005).*
The accompanying figure does not serve an illustrative function, but provides a genealogical clarification of the formal transition between earlier morphological dynamics and later boundary architectures.

4. From the Bran-Spiral to the shift of being (Seinsverschiebung): the break of reversibility

Within this approach, the Bran-Spiral constitutes an early morphological response to a problem that was later articulated more precisely: the irreversibility of order. In its original formulation, the Bran-Spiral describes how order forms through repeated foldings without abolishing earlier layers. Each winding remains effective; every order leaves a structural trace. Return in the sense of a complete restoration of prior openness is not possible; order is layered, not linear.

In the early theory, however, this irreversibility is not yet understood as an ontological boundary, but as structural fatigue. Order can overextend, rigidify, or enter into crisis—yet the rupture initially appears as a problem of "breathing" within the spiral: as the loss of the capacity to alternate between openness and condensation. The spiral no longer "breathes." Reversibility is not principially excluded in this model, but practically blocked.

In this reading, the crisis of an order is the result of a disturbed circulation. Movement within the Bran-Spiral comes to a standstill because a particular winding is absolutized and loses its own provisionality. Order loses its elasticity, but not its structural possibility. The theory thus remains within the space of morphological reparability: through opening, crisis, or deliberate destabilization, new movement can emerge, even if it is neither guaranteed nor controllable.

In retrospect, however, it becomes clear that at this point the Bran-Spiral reaches a limit that it cannot yet explicate itself. For empirically, what becomes apparent is not merely a blockage of movement, but a qualitative break of reversibility itself. Certain orders can no longer be "further breathed," not because they have become too tight, but because through their establishment the conditions of breathing have changed. At this point, no further process is being described; rather, a level shift is enacted. The object of analysis shifts from the dynamics within a framework to the loss of this framework itself. What was previously formulated as a question of what is happening, or of what an order is, now becomes a pre-ontological setting of implication—that is, a determination of the conditions under which anything can appear as a process at all: order no longer appears as something that occurs, but as a condition for anything to appear as a process at all. This setting is not content-based, but logically grounded: since everything and nothing cannot be simultaneously the case, order necessarily appears as a closing-off process, without having its origin in that process. The spiral cannot simply be continued, because the space in which it operates is no longer the same.

In this difference lies the transition to the later conception of the shift of being. While the Bran-Spiral still describes how order nests, overextends, and becomes blocked, the shift of being marks the point at which this very description loses its validity. It is not order that is blocked, but the possibility of continuing to operate within the same ontological framing. Return, one-to-one repair, or re-folding thus become not only factually impossible, but conceptually meaningless.

The Bran-Spiral can therefore be read as a precursor model. It renders visible that order is neither linear, nor reversible, nor fully controllable. At the same time, it remains within a conceptual space in which rupture appears as an internal structural problem—as a disturbance of an in-principle continuable morphodynamics. Only the later theory shifts the focus from the disturbance of movement to the break of the framework within which movement can have meaning at all.

This genealogical difference is decisive. It shows that the later logic of limits does not emerge from a refinement of morphology, but from the insight into its structural boundedness. The Bran-Spiral thus marks no error, but a necessary step: the last point at which order could still be thought as a breathing structure, before it became clear that certain transitions can no longer be explained through movement, but only through absence and the loss of positing. The concept of implication replaced that of process.

5. Convergences and distinctions: non-local order, morphology, and resonance

The theory reconstructed here does not stand in isolation. In recent years, approaches have emerged across different disciplines that—each from its own perspective—respond to comparable problem constellations: the limits of processual explanation, the non-steerability of order, and the role of non-local organizational principles. Particularly noteworthy in this regard are works on non-local emergence (Stuart Kauffman), morphological intelligence (Michael Levin), and resonance theory (Hartmut Rosa). All three, in different ways, mark an approach to those boundary regions that were addressed early on in the genealogy presented here.

Kauffman's more recent work on quantum and pre-geometric foundations explicitly takes its point of departure from the inadequacy of classical dynamics. Order no longer appears as the result of local causality, but as an effect of non-local correlations that undermine space, time, and classical process logic. This position exhibits a clear structural proximity to the early theory of Fixpunkte: in both cases, order is not explained through continuous development, but through singular constellations that are not fully derivable. The decisive difference, however, lies in the theoretical aim. Kauffman continues to search for a generative ontology—for a deeper generative order from which spacetime and dynamics emerge. The theory reconstructed here, by contrast, marks the point at which precisely this search itself becomes problematic. Fixpunkte are not deeper causes, but boundary markers at which ontological explanation loses its jurisdiction.

Levin describes biological systems as goal-directed, non-neuronally organized entities whose behavior cannot be derived from local micro-causality alone. Central to this account are setpoints, attractors, and field-like organizational forms that operate across cells and tissues. This perspective converges structurally with the concept of Fixpunkte: in both cases, what is at stake are non-producible orientational anchors that enable order without themselves being the result of a linear process. While Levin maintains a commitment to functional explanation within an expanded natural-scientific framework, Fixpunkte are here explicitly conceptualized as epistemic singularities that resist full naturalization.

Rosa's theory of resonance also exhibits a clear proximity to the morphology developed here. Resonance designates a responsive relation to the world that eludes availability and is systematically undermined by acceleration, control, and instrumental rationality. This diagnosis corresponds structurally to the distinction between openness and condensation, as well as to the analysis of blocked foldings. Resonance becomes possible where order is not absolutized and new Fixpunkte can be integrated. At the same time, Rosa's approach deliberately remains on a normative–phenomenological level. It describes how relations to the world can be experienced, without explicating the morphological structure of their emergence.

Kauffman, Levin, and Rosa can therefore be read as indicators of convergence. From different directions, their approaches show that classical models of control, causality, and progress are reaching their limits. At the same time, each remains within a conceptual space that continues to presuppose order as, in principle, explainable, functionally integrable, or normatively regulable. The genealogy reconstructed here takes a different step. It marks not only the non-availability of certain transitions, but the break of the ontological framing within which availability, functionality, or normative steering can be meaningfully addressed at all.

The proximity to these approaches therefore does not consist in substantive equivalence, but in an asymmetrical convergence. The early morphology of Fixpunkte and the Bran-Spiral emerges from a search movement that does not aim at the optimization or extension of existing models, but at the clarification of their limit. Fixpunkte, foldings, and morphological order are, in this sense, not alternative explanations, but markers of epistemic finitude.

6. Conclusion: the contemporaneity of a limited morphology

The reconstruction of Fixpunkte, the logic of folding, and the Bran-Spiral shows that the theory developed here is not to be understood as a closed ontology, but as a limited morphology. Its epistemic value does not lie in the provision of a universal explanatory model, but in the precise marking of those points at which explanation itself becomes precarious. Order appears neither as the product of linear processes nor as the result of underlying mechanisms, but as a temporary configuration emerging from irreducible orientational events.

It is precisely in this respect that the contemporary relevance of this approach becomes evident. In a situation in which emergence, non-locality, resonance, and morphological intelligence are increasingly discussed, there is a risk of overlooking the limits of these concepts and reabsorbing them into functional or ontological models. The genealogy reconstructed here counters this tendency. It shows that certain transitions—Fixpunkt, folding, break of reversibility—cannot be further deepened, operationalized, or simulated without losing their sense.

The early morphology makes visible why order is neither fully steerable nor arbitrarily reproducible. At the same time, it explains why attempts to stabilize order permanently regularly culminate in blockage, rigidity, or violence—not because order would be problematic per se, but because its provisionality is denied. Order remains alive only insofar as it structurally allows for its own transgressability—a condition that cannot be enforced.

The later conception of the shift of being radicalizes this finding without refuting it. It shifts the focus from the disturbance of movement to the loss of the framework within which movement itself can still be meaningfully described. This shift is not a development in the sense of greater depth or scope, but a boundary-setting. It marks the point at which morphology encounters its own epistemic finitude.

In this sense, the present paper does not understand itself as a contribution to the expansion of existing theories, but as a genealogical consolidation of a line of thought that was formulated early on and is gaining renewed relevance today. Its task is not to deliver new models, but to render visible where models reach their end. This visibility is not a deficit, but a necessary precondition for responsible thinking within complex and crisis-prone orders.

The model does not claim universality, but the marking of epistemic boundaries. The position developed here does not claim empirical operationalization, but the clarification of the conditions under which such operationalizations become meaningful—or meaningless.

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The End of World-Time: Indimergence, Curved Possibility, Recurrence, and the Limit of World-Capability

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Abstract

The present paper clarifies a structural tension within indimergence-based ontologies: on the one hand, the consistent assumption of curvature, negative topology, and irreversible loss of possibility implies that every stabilized world necessarily ends in a funnel-like constriction. On the other hand, earlier works have shown that indimergence is not only closing but simultaneously differentiating, implying new orders of complexity that cannot be understood as a mere continuation of the same world. Without explicit clarification, this gives rise to the impression of an ontological contradiction between the end of the world and emergence.

The paper argues that this contradiction is only apparent and results from an insufficient determination of temporality. Time is not defined as a neutral medium, but as the trace of irreversible loss of possibility. The funnel therefore does not designate the end of reality, but the end of that form of time under which a particular world can exist in a stable manner at all. In this understanding, the singularity does not mark a future point within the same temporal order, but the limit of the applicability of world-time itself.

Indimergence thus performs a double, logically non-temporal operation: it terminates the world-capability of a given topology while simultaneously implying another order of differentiation that is neither world-internal, nor sequential, nor processual. The ontological space of possibility within which phenomena such as recurrence occur is likewise subject to the curvature produced by indimergence and is therefore not available as a neutral space of emergence. Within this framework, complexity does not grow through continuation within the world, but through an ontological displacement of the conditions of world-formation. The paper thereby disciplines both funnel-shaped end-time readings and emergence-idealistic misunderstandings, and precisely determines the boundary between the end of the world, the end of time, and differentiation.

I. Problem Statement: Funnel, Emergence, and the False Assumption of Time

The present paper takes as its point of departure a tension that has so far not been explicitly clarified within indimergence-based ontologies, even though it has been implicitly operative. If the assumptions of curvature, negative topology, and irreversible constriction of possibility are taken seriously, it follows necessarily that every stabilized world-form is subject to a funnel-shaped finitude. Possibility is consumed, relations solidify, objectivity gains coercive force. The

world thus appears not as an open field of unlimited continuation, but as a structurally finite order of worldhood.

At the same time, earlier works have shown that indimergence is not to be understood solely as loss. It does not act only in a closing manner, but simultaneously in a differentiating one. In the singularity, indimergence was conceptualized as a boundary act that implies new orders of complexity which do not arise from the mere continuation of existing world-relations. This perspective contradicts a purely entropic or decay-theoretical reading and makes clear that the end of the world must not be equated with the end of reality.

Without explicit conceptual separation, a seeming contradiction arises here: either the world necessarily ends in the funnel, or indimergence drives emergence and complexity. In many receptions, this contradiction is resolved by either relativizing the funnel or temporally misinterpreting the singularity—for example, as a later phase, as a transition, or as the next developmental stage of the same world.

The paper argues that this contradiction is not ontological, but categorical. It arises from a tacitly presupposed conception of time in which time is treated as a neutral medium within which both constriction and emergence are supposed to take place. It is precisely this assumption that is rejected here. The question is not what happens after the funnel, but under what conditions concepts such as "after," "further," or "emergence" are meaningful at all.

The aim of the paper is therefore not to develop a new cosmology, developmental logic, or metaphysics of the end. It pursues a boundary determination: the temporal finitude of the world is to be precisely distinguished from the non-temporal implicature of ontological differentiation. Only through this clarification can it be shown why the world necessarily ends without reality being exhausted, and why differentiation is not located within world-time, but at its boundary.

II. World-Time: Time as the Trace of Loss

In this approach, time is not presupposed as a neutral medium, a continuous background, or a universal coordinate. It is neither a container nor a parameter, neither a measure of change nor a mere ordering of events. Time appears here exclusively as the effect of an ontological intervention: as the trace of irreversible loss of possibility. Where no possibility is lost, no time exists in the ontological sense.

This determination contradicts both classical-physical and phenomenological conceptions of time. Time is not that *in* which the world unfolds, but that which emerges from the constriction of possibility. It is not a presupposed framework, but a derived structure. Only where possibility is no longer fully open, where exclusion takes place, does time arise as direction, as asymmetry, as irreversibility.

Indimergence designates precisely this point. It is not an event in time, but the act through which temporality becomes operative at all. With each indimergent setting, possibility is not selected but excluded. What emerges is not merely facticity, but a temporal order in which what has passed cannot become possible again. Time is thus not movement, but a history of loss.

In this sense, time is strictly bound to world. It is not a property of reality as such, but a condition of stabilized world-formation. World-time arises where objectivity is enforced, where relations are fixed and spaces of possibility are constricted. It is the temporal signature of a specific ontological topology. Where this topology does not apply, time does not apply either.

This determination has an immediate consequence: time is finite. Not empirically, not cosmologically, but structurally. Since world-formation rests on irreversible constriction, time cannot progress indefinitely. It carries within itself the condition of its own exhaustion. The finitude of time is not an additional assumption, but the logical consequence of its condition of emergence.

This simultaneously excludes using time as a universal medium for transitions, progress, or emergence. Where time is understood as the trace of loss, it cannot at the same time serve as a neutral bridge to new orders. Any talk of "after," "further development," or "next phase" already presupposes a continuing world-time. It is precisely this presupposition that is rejected here.

Time is thus neither the medium of the singularity nor the site of differentiation. It is the condition of the world—and it ends with it.

III. The Funnel: The Finitude of Every Stabilized World-Form

If time is determined as the trace of irreversible loss of possibility, it necessarily follows that world-time possesses a finite structure. This finitude is not to be understood empirically, cosmologically, or prognostically, but ontologically. It arises directly from the condition of its emergence: possibility cannot be excluded without limit without the conditions of world-formation themselves becoming exhausted. The so-called funnel designates precisely this structure of progressive constriction.

The funnel is not an image of a future collapse and not a metaphor for a terminal state. It describes the inner logic of every stabilized world-form. With each indimergent setting, the space of the possible constricts, relations lose alternatives, and objectivity gains coercive force. This development is not additive, but cumulative: lost possibility does not return, but continues to operate as a restriction on future world-formation. The world does not condense toward greater openness, but toward greater determinacy.

In this sense, the funnel is not an exception, but the rule. It is not the fate of a particular world, but the consequence of world-formation as such. Every world that stabilizes already carries within itself the condition of its own finitude. This finitude is not external, but structural. It does not arise from external influences, but from the inner logic of irreversible setting.

It is crucial to determine the scope of this finitude precisely. The funnel does not concern reality as such, but the possibility of being world under a specific topological and temporal order. What becomes exhausted is not the real, but the world-capability of a given order. The funnel thus marks not the end of being, but the end of a specific form of worldliness.

From this perspective, the funnel loses its apocalyptic character. It is not an event that "occurs," but a structural boundary that approaches with each setting. The world does not end suddenly, but becomes increasingly non-continuable as a world. At a certain point, it is no longer that too

little possibility remains, but that no sufficient condition remains under which world-time could be meaningfully continued.

This simultaneously excludes interpreting the funnel as a transition to a next phase of the same world. Concepts such as "after," "beyond," or "new world" presuppose a continuing world-time. It is precisely this presupposition that is annulled by the funnel. It designates not a state within time, but the exhaustion of the form of time under which the world had hitherto been possible.

The funnel is therefore not the site of the singularity, but its boundary. It marks the point at which world-time loses its viability. What is implicated at this boundary can no longer be described within the same temporal order. Thus, a transition to another order is not excluded, but it is categorically to be distinguished from any world-internal continuation.

IV.2 No Timeless Totality: On the Misreading of Expansion, Multiplicity, and Reflection

The determination of the singularity in connection with the All–Nothing Paradox (ANP) raises a particularly delicate question: does the limit of world-time imply an expansion in the sense of a timeless complexity in which infinitely many worlds produced through indimergence accumulate, mirror one another, or coexist? This notion readily suggests itself once concepts such as singularity, differentiation, or non-closure enter the discussion. Ontologically, however, it is not tenable.

Such a reading implicitly reintroduces precisely those categories that are supposed to lose their validity with the end of world-time: space, multiplicity, relation, and comparability. To speak of "many" worlds implies an order in which these worlds are simultaneously given, distinguishable, and placed in relation to one another. Likewise, any talk of mirroring or accumulation presupposes a structured space within which something can be reflected or collected. A timeless totality would thus not be a boundary determination, but already a world again—albeit in a metaphysically elevated form.

The All–Nothing Paradox does not permit such a totalization. It describes neither a domain, nor a space, nor a higher order, but a boundary condition of world-capability. World is possible only where neither complete determinacy nor complete emptiness is realized. When this condition collapses, it is not only a particular world-form that ends, but the applicability of the categories under which world could be described at all. The singularity designates precisely this boundary. It is not a place beyond world-time, but the end of the validity of spatial and temporal determinations themselves.

It follows from this that the worlds produced through indimergence must not be conceived as elements of a superordinate multiplicity. That indimergence can repeatedly give rise to world-forms does not mean that these worlds coexist within a timeless order or reflect one another. Such a conception would resolve the paradox instead of maintaining it as a condition. It would turn the boundary structure into a totality and thereby enact precisely the kind of closure that is criticized here.

If differentiation or non-closure can be spoken of in this context at all, then only in a negative, non-quantitative sense. What is meant is not an expansion in the sense of a "more," but the

principled impossibility of a final world, a complete order, or a total closure. The singularity does not mark the collection of all worlds, but the structural non-closure of world-formation itself. It is not a space without time, but the point at which spatial and temporal categories lose their ontological jurisdiction.

In this sense, the ANP does not imply a timeless complexity, but a persistent boundary tension. Neither a finite world nor an all-encompassing totality is world-capable. The temptation to translate the end of world-time into a higher order of multiplicity is an expression of a categorical regression. Wherever one can speak of many worlds, one is already once again within a world. The ontology proposed here refuses precisely this return.

V. Indimergence as a Double Boundary Operation: The End of World-Time and the Implicature of Difference

The preceding sections have shown that time, funnel structure, singularity, and the All–Nothing Paradox cannot be treated independently of one another. Their connection becomes consistent only where indimergence is not understood as a process, a transition, or a mediating event, but as a double boundary operation: it terminates a specific order of world-capability and simultaneously implies differentiation beyond this order, without determining this differentiation temporally or spatially.

Indimergence initially acts in a closing manner. With each setting, possibility is irreversibly excluded, negative topology condenses, and world-time gains direction and irreversibility. This closure is not gradual, but structurally effective. It generates that temporal order within which a world can exist in a stable way and simultaneously carries within itself the condition of its exhaustion. In this sense, the funnel is not an additional assumption, but the necessary consequence of indimergent world-formation.

At the same time, indimergence does not exhaust itself in this closing function. Precisely because it does not operate as an event within time, but rather grounds temporality itself, it cannot be reduced to world-time. Where a particular world-form loses its viability, it is not reality that ends, but the validity of the conditions under which world had hitherto been possible. This boundary is not temporally traversable, but marks the point at which temporal categories lose their jurisdiction.

The singularity introduced in earlier works designates precisely this boundary. It is not the future of a world and not a new phase within the same order, but the collapse of world-time as an ordering principle. That indimergence nevertheless implies differentiation therefore does not mean that new worlds arise from old ones or attach themselves to them. Differentiation is here logically implicated, not temporally realized. It designates the principled non-closure of world-formation, not its continuation.

The All–Nothing Paradox functions in this context as a minimal condition and boundary marker. World is possible only where complete determinacy is avoided just as much as complete emptiness. The funnel describes the progressive weakening of this condition at the level of world. The singularity marks the point at which it can no longer be sustained. That this

boundary is reached implies no higher totality, no timeless multiplicity, and no space beyond the world, but merely the end of the applicability of worldly categories.

Indimergence is thus neither a mechanism of world-emergence nor a principle of infinite expansion. It is a boundary condition under which world is possible at all, and at the same time the condition of its finitude. Within this framework, complexity does not grow through accumulation, but through rupture. Difference does not arise through progress within world-time, but through an ontological displacement of the conditions of world-formation themselves.

The perspective developed here makes it possible to keep the end of the world, the end of time, and differentiation strictly distinct without playing them off against one another. The world necessarily ends. Time ends with it. Reality is not thereby exhausted; rather, the claim to its worldly totalization is rejected. Precisely in this lies the ontological consequence of indimergence.

VI. Consequences for Recurrence

The determination of time developed here as the trace of irreversible loss of possibility, and of world as a structurally finite order, has immediate consequences for the understanding of recurrence. The ontological space of possibility introduced in earlier works is not to be understood as a neutral, timelessly open space to which recurrence returns unchanged. Rather, this space of possibility itself is subject to the curvature brought about by indimergence and thus stands, from the outset, under conditions of irreversible loss.

Recurrence therefore always unfolds under already shifted conditions. It does not return to an original or unconsumed space of possibility, but operates within a field of possibility deformed by loss, displacement of being, and negative topology. There is no fully open emergence, no unexhausted reservoir of possibility, and no timeless reserve of alternatives that would be ontologically accessible.

Recurrence is thus not a counter-principle to constriction, but its final form of residual openness. It suspends complete stabilization only briefly, without reversing or compensating for the loss of possibility already incurred. Consciousness—within the framework of the MNO and Orch-OR recurrence theory—is therefore not the experience of unlimited openness, but the experience of a limited, already curved openness at the edge of world-time.

Recurrence therefore does not stand in contradiction to the finitude of the world, but marks its innermost tension: the experience of possibility under conditions that structurally preclude its full unfolding.

VII. Conclusion: The End of the World Is Not the Limit of Reality

The argument developed in this paper does not pursue a cosmological, eschatological, or metaphysical interest. It does not aim at a theory of the end, but at a precise determination of the conditions under which world, time, and difference can be meaningfully distinguished at all. The funnel, the finitude of world-time, and the singularity do not mark speculative horizons, but ontological boundary points.

Central to the argument was the clarification that time must not be presupposed as a neutral medium. Time appears exclusively as the trace of irreversible loss of possibility and is thus strictly bound to world-formation. Where this condition is exhausted, it is not only a particular world-form that ends, but the applicability of temporality itself. The funnel designates this structural exhaustion of world-time, not a future state within the same order.

Accordingly, the singularity was not determined as a temporal transition, but as a limit of world-capability. In conjunction with the All–Nothing Paradox, it was shown that neither a fully closed order nor a timeless totality is ontologically tenable. World is possible only where this boundary tension is maintained. When it collapses, world ends—not reality.

Decisive here is the rejection of any logic of expansion or accumulation. The singularity implies neither a timeless multiplicity of worlds nor a higher order of complexity. Such conceptions would reintroduce precisely those categories—space, relation, comparability—whose domain of validity has been explicitly restricted here. The non-closure of world-formation must not be confused with totalization.

Indimergence was finally determined as a double boundary operation: it grounds world-time and simultaneously carries its finitude within itself. That differentiation nevertheless remains possible does not mean continuation, but ontological displacement. Complexity does not grow through addition within the world, but through the interruption of the conditions under which the world had hitherto been possible.

The result is not a new metaphysics, but a disciplining of concepts. The world necessarily ends. Time ends with it. Reality is not thereby explained, expanded, or replaced; rather, the attempt to subsume it under a final world-order is rejected. The boundary of the world is not the boundary of the real, but the boundary of its world-form.

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This work operates operatorically rather than discursively; its claims are derived from internal structural invariance rather than from literature synthesis.

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Further publications, papers, and archival materials are available at:

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(The present text constitutes an interface translation into neurotypical academic discourse. This translation functions as an accessibility measure necessitated by dominant linguistic and epistemic conventions. It does not represent the native epistemic form of the research, but a communicative adaptation required for participation in standardized scholarly exchange.)

A more in-depth paper on the methodology can be found here:

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A paper providing an overview of the work can be found here:

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