Hossein Jorjani

https://hosseinjorjani.com/

hosseinjorjani2@gmail.com

On dialectic (3): Alternatives to dialectic

[This is part one of a three-part article series.]
[On dialectic (1): What is dialectic]
[On dialectic (2): Re-visiting dialectic]

For the latest version and a PDF copy, please see the following link:
https://hosseinjorjani.com/dialectic/

Revision history

2025-07-13
2025-08-25

Contents

1 - Abstract

Many transformations that seem dialectical are in fact quasi-dialectical—better explained by mechanisms such as scale-dependent thresholds. To the untrained eye, such transformations bear a superficial resemblance to the Hegelian–Marxist–Engelsian dialectic, yet they do not meet its conditions. Drawing on domains as varied as urban design, biological stability, artificial intelligence, and enzymatic systems, the article presents six cases of quasi-dialectical transformation. These transitions involve sharp discontinuities and systemic reorganization, yet can be understood without invoking dialectical metaphysics. Alongside these cases, the article takes a philosophical detour through critical theory, examining how suspicion of science in Adorno and Horkheimer shaped debates on dialectic, and contrasting their stance with a more pluralist, explanatory framework. The article concludes by examining the role of Inference to the Best Explanation (IBE) as a model for evaluating competing frameworks, and argues for treating dialectic not as a universal method but as one explanatory strategy among others within a pluralist framework.

2 - Introduction

Before introducing alternatives to dialectic, it is useful to briefly summarize the two preceding parts of this series.

2.1 - Summary of Part 1

On dialectic (1): What is dialectic. In the first part of this series, we traced the development of dialectic from Socratic dialogue to Žižekian paradox. What began as a modest epistemological technique in Socrates — dialogical testing — gradually accumulated further building blocks. Kant introduced formal constraints and transcendental tensions, turning dialectic into a regulative boundary for reason. With Hegel, and later Marx and Engels, the concept reached its architectural peak: dialectic became a metaphysical program [1], complete with internal contradiction, historical necessity, and the triadic movement of thesis–antithesis–synthesis. At this stage, dialectic claimed not only to organize knowledge, but also to explain nature and reality itself.

---

[1] Here, "metaphysics" and "metaphysical" are used in the sense of philosophy dealing with the structure of reality.

In more recent developments — from Adorno's negative dialectics to Žižek's ontological detours [2] — this grand structure has undergone partial dismantling. The most significant shift has been the abandonment of synthesis, especially among Frankfurt School thinkers, who often rejected closure as politically and morally suspect (partly because of suspicion of totalizing solutions) [3]. For them, contradiction was not something to resolve but something to sustain. As a result, dialectic has been stripped of structural rigidity and now floats more freely as a metaphorical stance, invoked for rhetorical force rather than methodological precision. Whether this counts as development or erosion remains an open (and uncomfortable) question.

2.2 - Summary of Part 2

On dialectic (2): Re-visiting dialectic. In the second part of this series, we examined two of Hegel's core building blocks and assessed their scientific validity. The first is the claim that contradictions are strictly internal. The second is the claim that quantitative accumulation leads to qualitative transformation.

By analyzing examples from physics, chemistry, and biology — such as phase transitions, incandescence, magnetic polarity reversal, allotropy, hydrocarbon series, the periodic table, and punctuated equilibrium — we argued that these phenomena are better explained through continuous, externally mediated processes rather than through internal contradiction or ontological leaps [4]. Our analysis showed that the so-called "quantity-to-quality" transition, often invoked as a universal law, lacks empirical support and methodological coherence. While dialectic may retain heuristic or rhetorical value, its extension into natural science — and likely into the social sciences as well — is unwarranted and should be reconsidered.

The first two parts traced the historical rise of dialectic and showed that its scientific claims, when tested, often collapse into more ordinary explanatory models.

---

[2] Žižek occupies a unique position in contemporary thought: he has revived Hegelian and Lacanian perspectives, but his philosophical rigor is contested, with divided reception among Marxists and critical theorists.

[3] "Totalizing systems" refers to frameworks that aim to construct all-encompassing explanations of reality, often minimizing or suppressing contradictions, contingencies, or irreducible particularities.

[4] By "ontological leaps" we mean claims of sudden, irreducible transformation not reducible to continuous processes.

3 - Aim of this part

We must clarify what is meant by a "dialectical leap [5]." In dialectical terms, a leap is not merely a threshold-crossing or a nonlinear response to cumulative input. Rather, it implies three interrelated criteria:

1. **Ontological discontinuity** — a transformation that cannot be reduced to a continuous gradient.
2. **Qualitative novelty** — the emergence of a new kind of entity or state, not just a quantitative modification.
3. **Internal causation** — the transformation must arise from contradictions or tensions within the system itself, rather than from external inputs or environmental triggers.

Together, these criteria — discontinuity, novelty, and immanence — distinguish the dialectical leap from the kinds of quasi-dialectical transitions we will examine: transitions that may appear dialectical but operate through different mechanisms.

A true dialectical leap requires internal contradiction, whereas quasi-dialectical transitions are better explained by external thresholds and mechanistic processes.

4 - Quasi-dialectical processes

4.1 - False Dialectical Attributions:

Not all processes that appear dialectical are in fact governed by dialectical logic. In many fields of inquiry, one encounters transformations or oppositional dynamics that resemble dialectical movement — shifts in form, breaks in continuity, or apparent contradictions. Yet these arise from fundamentally different mechanisms. Such phenomena may display the external resemblance of dialectical reasoning without involving internal contradiction, determinate negation, or sublation [6]. I refer to such phenomena as **quasi-dialectical**.

[5] Some repetitions of the terms, such as "dialectical leap", are deliberate, used to reinforce key distinctions across contexts. Here, redundancy has been minimized while retaining emphasis where pedagogically useful.

[6] Sublation (Aufhebung) in Hegelian dialectic refers to contradiction being both negated and preserved within a higher synthesis.

Many processes may look dialectical, but without contradiction, negation, or sublation they are only quasi-dialectical.

4.2 - Quasi-Dialectical Phenomena: Definition and Scope

Quasi-dialectical phenomena must be distinguished from other relational systems that are often mislabeled as dialectical. In contemporary discourse, it is common to hear systems described as “dialectical” merely because they involve change, feedback, or interaction. Yet such features, while essential to many systems, do not by themselves constitute dialectic in any rigorous sense.

Examples include:

- A thermostat, which has a feedback loop but no contradiction.
- Predator–prey cycles, which oscillate but do nothave sublation [7].
- A conversation, which may be interactive but lacks immanent necessity.

Such systems are best understood as cybernetic (feedback-driven), reciprocal (mutually dependent), or adaptive (responsive to environment), not dialectical in any meaningful philosophical sense. They lack the structural tensions, determinate negations, or conceptual mediation required by dialectical reasoning. To call any dynamic or interactive process “dialectical” is to make the term so broad that it loses philosophical specificity. Recognizing this distinction helps maintain clarity between genuine dialectical models, quasi-dialectical models, and merely interactive systems.

Dynamism, feedback, or interaction alone does not make a system dialectical.

4.3 - Examples Across Domains

Quasi-dialectical models span a wide conceptual range. Examples include:

- Debate and adversarial reasoning, which replicate dialectic’s confrontational format but aim at persuasion or victory, not synthesis.
- Trial-and-error methods, which evolve through successive approximations rather than contradiction.

---

[7] For example, in fox–rabbit population cycles, each species’ numbers rise and fall with a temporal lag relative to the other. This interaction shows fluctuation but no internal contradiction or synthesis.

- Systems thinking, which in organizational sociology highlights feedback, emergence, and interdependence rather than contradiction and negation.
- Thermodynamic phase transitions and evolutionary models, which show discontinuities and tension but lack the logical mediation central to dialectic [8].
- Inference to the Best Explanation (IBE), which reconciles competing hypotheses without contradiction.
- Dialogical logic, which formalizes reasoning as structured dialogue, and polyphonic theory, which hosts conflicting voices without requiring resolution.
- Policy-making through critical systems heuristics or boundary critique, often applied to organizations and institutions, which interrogates assumptions without requiring dialectical development.

This distinction is crucial for identifying the real sources of systemic change in science, society, and technology — and for avoiding the mystification of transformation through dialectical mislabeling.

The concept of quasi-dialectical processes is offered here as one explanatory model among many. By situating it alongside other approaches — such as classical mechanism, Aristotelian teleology, rationalist idealism, empiricist inductivism, probabilistic modeling, systems theory, and pragmatist analysis — we highlight the diversity of explanatory strategies available for understanding complex phenomena. Quasi-dialectical reasoning shares with systems theory, evolutionary naturalism, and process philosophy a focus on transformation, interaction, and emergent structure, but without positing internal contradiction as the universal engine of change.

Quasi-dialectical models show that systemic change often follows diverse mechanisms — not the contradictions required by dialectic.

[8] Logical mediation means that transitions between stages follow necessarily from inner contradiction, not from external imposition.

5 - Scale-dependent transformation [9]

A particularly instructive quasi-dialectical model is scale-dependent transformation. In such cases, systems undergo qualitative shifts in structure, behavior, or strategy once certain quantitative thresholds are crossed. These transformations may appear to be dialectical leaps, but they are better explained by structural saturation, nonlinear dynamics, or resource constraints. Their prevalence cautions against interpreting discontinuity or transformation too quickly as evidence of dialectic. Instead, they invite a more precise analysis of what actually drives systemic change, and whether contradiction is genuinely at its core.

Scale-dependent transformation is notable because of its ubiquity across scientific domains. In the physical and biological sciences, systems exhibit abrupt changes of state once parameters exceed critical values. Physics provides examples such as phase transitions or symmetry breaking. In biology and ecology, population growth or increased ecosystem density can trigger new organizational regimes, including trophic cascades or shifts in metabolic demands described by allometric scaling laws [10].

Comparable dynamics occur in engineering, urban systems, and computational fields. Scaling up infrastructure or population leads to qualitative redesigns, such as the move from local provisioning to industrial supply chains or from informal traffic flow to structured multi-modal transit systems. In computational statistics, high-dimensional matrix operations or the breakdown of MCMC methods illustrate how problem spaces can demand fundamentally new algorithms once they surpass hardware or numerical thresholds. In general systems theory, metasystem transitions demonstrate how increasing complexity requires the emergence of higher-order control mechanisms. Across these examples, transformation is real and qualitative, but it stems from external structural constraints, scaling limits, or resource saturation—not from internal contradictions or dialectical tension.

[9] This section is longer than others because scale-dependent transformations are most often mistaken for dialectical leaps. The extended treatment aims to clarify this frequent misidentification.

[10] Allometric scaling is a branch of biology concerned with how growth and function vary with body size. Its origins date to the late nineteenth century, but interpretations have shifted from deterministic to probabilistic frameworks. It can be captured with formulas of the type $y = k \cdot x^a$, which reveal regularities across diverse domains of life. See Peters, R. H. (1983). *The ecological implications of body size*. Cambridge University Press; Schmidt-Nielsen, K. (1984). *Scaling: Why is animal size so important?* Cambridge University Press.

To ground this argument in concrete terms, we turn to six representative examples drawn from different domains. First, the shift in bridge design from stone arches to suspension structures as span length increases. Second, the transformation of urban food provisioning from local farms to industrial supply chains in response to population growth. Third, the evolution of traffic and governance mechanisms in large cities, requiring layered infrastructure and institutional adaptation. Fourth, the redesign of genetic structures based on increased enzyme activity. Fifth, the emergence of metasystem transitions in organizational growth, where informal coordination gives way to hierarchical management. Sixth, the shift in artificial intelligence problem-solving strategies from brute-force search to heuristic and learned approaches as the search space grows. Together, these six cases illustrate how scale alone can compel qualitative redesign without invoking dialectical contradiction.

Scale-dependent transformations look dialectical in form, but they are driven by thresholds, saturation, and structural constraints rather than contradiction.

5.1 - From Arch to Suspension

How scale redefines bridge design can be seen in the contrast between small and large spans. Short-span bridges, such as Roman aqueducts or medieval stone bridges, relied on the arch design, which distributed weight through compression. This depended on a stable triad: the length of the span, the material properties of stone, and the principle of the arch.

As spans increased, this triad grew unstable. Wider arches generated greater lateral thrust, and the structure risked collapsing under its own weight. Engineers had to introduce new solutions: a change in material (from stone to wood, iron, or steel), a change in design (from arch to truss or suspension), or both. What results is not a simple enlargement of the earlier design but a qualitative shift in structural logic. Compression is replaced by tension, and rigid mass by flexible distribution.

This is a clear case of scale-dependent transformation. Growth in span length forces a redefinition of both material and design, producing a new kind of structure. Crucially, the change does not emerge from internal contradiction but from external constraints of scale.

As bridges grow larger, scale itself forces a change in material and design, showing how structural transformation can occur without dialectic.

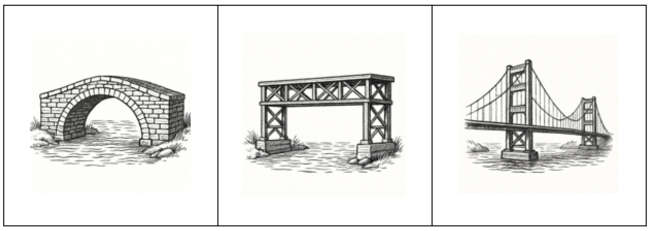

Figure 1. Illustrative progression in bridge design: from stone arch (compression-based), to truss (rigid distribution), to suspension (tension-based). Each transition reflects a scale-dependent transformation, where increasing span length compels qualitative redesign through external constraints rather than dialectical contradiction.

5.2 - From Local Farms to Agro-Industry

In a small town, food provisioning can be sustained through direct links with nearby villages. Fresh produce, dairy, and meat are transported over short distances with minimal infrastructure. In this setting, the system rests on a stable triad: limited population, perishable goods, and localized logistics. Size, material, and design are naturally aligned.

Once the urban population surpasses a certain threshold, this arrangement becomes untenable. Larger daily food volumes shorten the viable time window for perishables, overburden local transport routes, and render informal supply chains increasingly unreliable. At this point, the system requires a fundamental redesign. Industrial agriculture, long-distance logistics, and centralized distribution begin to replace village delivery. Refrigeration and cold-chain transport allow goods to travel greater distances, while processed and preserved products extend shelf life and buffer seasonal variability. Wholesale markets, refrigerated storage, and coordinated scheduling become essential to maintaining supply.

This transformation is not a linear scaling-up of the original system. It is a qualitative change in how city planners and institutions organize provisioning, one compelled by thresholds of spoilage, transport, and coordination. The redesign emerges not from internal contradictions but from external constraints imposed by scale.

Urban growth forces food provisioning to shift from local immediacy to cold-chain logistics and industrial coordination, a structural transformation driven by scale rather than dialectic.

5.3 - From Street Grids to Institutional Overhaul

In a small town or village, traffic can be managed with minimal infrastructure. Shared roads, a few signs, and informal social coordination are enough to maintain order. In this setting, the triad of scale, material, and design is aligned: a small population, simple routes, and cooperative norms sustain mobility.

As the city grows, however, this arrangement quickly reaches its limits. Increased traffic volume and route complexity overwhelm informal regulation. One-way streets, traffic lights, and simple bridges are added to preserve flow, but these measures soon prove insufficient once density passes a critical threshold. At that point, the system must undergo a deeper redesign. Elevated highways and subways appear, accompanied by new technological layers such as digital traffic management, surveillance, and road pricing.

Eventually, the pressure of scale extends beyond infrastructure into institutional arrangements. Large cities often require the decentralization of administrative services, the introduction of remote access to government functions, and in some cases, national-level coordination to manage congestion and service delivery.

What begins as a local problem of traffic engineering therefore becomes a challenge of metropolitan governance and national infrastructure planning. The prior framework no longer holds at larger scales, leading to new material and institutional arrangements.

As cities grow, mobility shifts from informal coordination to infrastructure and finally to institutional governance, a transformation driven by scale rather than dialectical contradiction.

5.4 - From Distributed Control to Constraint

Metabolic Control Theory (MCT) provides a clear mechanistic example of how systemic transformation emerges through scale, not through dialectical contradiction, but through resource saturation and redistribution. In a saturated linear enzymatic pathway at steady state, the overall system flux—the rate of production of the final product—remains constant [11]. The summation theorem of

[11] The overall flux of a system can be considered equivalent to the rate of production of the final product in a linear enzymatic chain. As in the earlier metaphor of a car factory, the flux corresponds to the number of cars leaving the assembly line per unit of time.

MCT states that the sum of control coefficients of all enzymes in the pathway equals one [12]. This creates a zero-sum structure: if one enzyme's influence increases, the influence of others must decrease proportionally. As long as external conditions remain stable, no internal contradiction arises.

When the activity of a single enzyme is perturbed, however, this balance is disrupted. The result is statistical interaction among enzymes, known in genetics as epistasis [13], where the effect of one "gene" product depends on the presence or activity of another [14]. If the perturbation is large, compensatory structures collapse and the system fails to maintain flux, marking a threshold at which reorganization is required [15].

Branching enzymatic pathways add further constraints. Downstream enzymes often compete for a common substrate. At first glance, this might resemble a contradiction, since one branch limits the other. But closer inspection shows that the limiting factor is external: resource scarcity. What looks like dialectical opposition is better described as allocation under constraint.

These biochemical dynamics extend naturally to quantitative genetics. The effects of enzymatic branching appear in patterns of genetic correlation among traits, often summarized in the genetic variance–covariance matrix (the G-matrix). When enzymes influence different traits, changes that are beneficial for one trait may be neutral or harmful for others, depending on conditions and resource availability. Such patterns, often described as trade-offs, are negative genetic correlations [16]. They reflect allocation constraints within the organism, not logical contradictions.

---

[12] The summation theorem in Metabolic Control Theory (MCT) states that the sum of all flux control coefficients equals one, creating a principle of distributed or "democratic" control. See Kacser, H., & Burns, J. A. (1979). "Molecular Democracy: Who Shares the Controls?" *Biochemical Society Transactions*, 7(5), 1149–1160.

[13] "Epistasis" refers to interactions in which the effect of one genetic locus depends on another. Originally phenotype-masking in classical genetics, it now covers non-additive interactions in systems biology, reflecting structural interdependence.

[14] The term "gene" is placed in quotation marks to signal its conceptual instability. While still widely used, it no longer refers to a single coherent unit in modern genetics.

[15] By analogy, just as a biological system destabilizes when one component is perturbed too strongly, so too social or political systems may collapse when change is pursued unilaterally in one dimension without systemic coherence.

[16] A negative genetic correlation indicates that an increase in one trait is associated with a decrease in another. In ecological and evolutionary contexts these are often called trade-offs. They arise from structural or resource limits, not from logical contradiction.

As the dimensionality of the G-matrix increases—whether from more traits, finer measurement, or data integration—new issues emerge: instability, loss of positive-definiteness [17], and misalignment between genetic and selective gradients. At small scale, assumptions of independence or additivity are tenable. At larger scale, they collapse, and the system becomes constrained by higher-order structures that redefine what is stable, what can evolve, and what must be redesigned.

This same pattern appears in computation. High-dimensional genetic matrices often cannot be inverted because of ill-conditioning or non-positive definiteness. Techniques such as weighted bending modify the eigenstructure to restore function [18]. This is not a trivial algorithmic patch: it marks an epistemological adjustment in how statistical systems accommodate uncertainty at scale. What was once a straightforward calculation becomes a site of reengineering, compelled by the material limits of complexity [19].

Metabolic and genetic systems show that scale-dependent transformation arises through allocation and constraint, not through dialectical contradiction—nature does not work dialectically.

5.5 - From Informal Coordination to Hierarchical Control

In a small organization—a startup, a local cooperative, or a project team of a dozen or fewer—coordination can be managed informally. Verbal agreements, mutual awareness, and flexible task assignment are sufficient, because the triad of scale, material, and design is aligned: few people, social trust and memory as the material of coordination, and a flat, non-hierarchical design.

As headcount grows into the dozens, then hundreds and beyond, this arrangement becomes less effective. Message volume rises faster than headcount, since each

[17] A matrix is positive-definite when all its eigenvalues are positive. Zero or near-zero eigenvalues cause ill-conditioning, while negative eigenvalues produce non-positive-definite matrices.

[18] Jorjani, H., Klei, L., & Emanuelson, U. (2003). A Simple Method for Weighted Bending of Genetic (Co)variance Matrices. *Journal of Dairy Science*, 86(2), 677–679. https://doi.org/10.3168/jds.S0022-0302(03)73646-7

[19] These constraints are not confined to biology but illustrate a broader principle: systemic interdependence imposes boundaries on transformation. See Turchin, V. (1977). *The Phenomenon of Science*. Columbia University Press.

additional member increases the number of potential interactions with all others. Tasks begin to overlap; responsibility becomes diffuse; spans of control widen; and handoffs multiply. Informal regulation proves unsustainable, not because of contradiction but because coordination costs increase quadratically with size.

At this threshold, organizations often undergo a metasystem transition, in which a higher-level layer emerges to coordinate lower-level units and their interactions (Turchin, 1977) [20]. Middle management, formal reporting lines, and specialized departments tend to appear; enterprise software, shared databases, workflow systems, and dashboards often provide the necessary material supports. The design commonly shifts toward division of labor, bounded authority, standardized interfaces, and schedule discipline.

With further growth, demands spill beyond infrastructure into institutional arrangements. Functions are decentralized; shared-service or platform teams consolidate expertise; remote and automated channels provide access; and city-, sector-, or national-level coordination may be required for compliance, risk, and service continuity. What begins as a local problem of team coordination becomes a problem of organizational governance.

The driver throughout is external constraint: communication complexity, interdependence, and reliability requirements rise with scale, forcing a redesign of both material infrastructure and organizational architecture. The transformation is qualitative, but it is induced by scale and coordination burdens, not by dialectical contradiction.

5.6 - From Brute Force to Learned Heuristics

In small or well-bounded problems, trying every option can work. With three guests, seating them around a dinner table is simple — there are only a handful of possible arrangements. But with ten guests, the number of seating plans explodes into the millions. At that point, brute-force trial and error quickly becomes impossible: most of the effort goes into testing arrangements that are awkward or unsuitable — like placing two feuding relatives side by side — rather than focusing on promising ones. This kind of combinatorial explosion is not unique to social settings: nature faces the same challenge in laying out the branching blood vessels of the mesentery,

[20] "Metasystem transition" denotes the formation of a higher-level control system that integrates and regulates interacting subsystems. For the original formulation, see Turchin, V. (1977). *The Phenomenon of Science*. Columbia University Press.

which must reach every part of the small intestine without wasting material or energy.

When problems reach this threshold, design has to change. In artificial intelligence, search shifts from exhaustively checking every possibility to using **heuristics** — rules of thumb or guides that help focus attention on the most promising paths. A scheduling program, for example, might prioritize aligning the availability of the busiest people first. More sophisticated systems go beyond fixed rules: they learn from experience which options are worth exploring, much like a host who remembers not to seat quarreling relatives together, or a vascular system that, through evolution, refines branching patterns generation by generation, building on past efficiencies rather than starting from scratch. In each case, the strategy is no longer blind enumeration but guided approximation.

The scaling problem becomes clear in classic AI domains. For simple puzzles with few possible moves, brute force can succeed. But in complex games like chess or Go, the number of possible sequences of moves is astronomical, far beyond what even the fastest computers can evaluate exhaustively. Here, heuristics, lookahead guided by learned estimates, and trial-and-error reinforcement learning become indispensable. These methods allow algorithms to approximate good solutions without exploring every dead end. The underlying shift is structural: from rigid, exhaustive rules to adaptive, learned guidance.

Seen in this light, AI's turn from brute force to heuristics is not an isolated phenomenon but an instance of a broader pattern. Whether in social coordination, biological organization, or computational search, scale forces a redesign of strategy. As the space of possibilities grows faster than resources to evaluate them, systems must move from exhaustive enumeration to selective guidance, from fixed rules to adaptive learning. The change is real and structural, but it arises from resource limits and threshold effects, not from any inherent contradiction.

As problems scale, brute-force search becomes impossible and systems must rely on heuristics and learned guidance.

Across the six cases, increasing scale compels redesign of both components and coordination mechanisms — not through automatic unfolding, but through the recognition and intentional adaptations by agents — in many cases human beings — responding to new constraints. Materials and load logic shift (stone arches to steel suspension; compression to tension). Provisioning moves from local supply to cold-chain industry, and mobility evolves from informal street norms to layered infrastructure and governance. Biochemical control shifts through evolutionary adaptation, giving way to allocation-constrained trade-offs. Organizations develop hierarchical management over flat coordination, and AI transitions from exhaustive enumeration to heuristic and learned guidance. These transformations are best explained by saturation points, design thresholds, and systemic constraints that call forth intentional reconfiguration, rather than by any immanent dialectical opposition. This sets up the philosophical question taken up next: by the standards of Inference to the Best Explanation, which framework most economically accounts for such changes?

The evidence across domains points to scale-driven constraints—not contradiction—as the engine of qualitative redesign.

6 - Philosophical Consequences

The six cases above show that many striking transformations are better explained by scale, thresholds, and constraints than by contradiction. This matters because calling any phenomenon with tension, feedback, discontinuity, or complexity "dialectical" risks conceptual inflation: the term loses specificity, and explanatory credit is misassigned. For example, phase transitions or policy oscillations are sometimes read as contradictions unfolding dialectically, when they are more parsimoniously treated as threshold or control phenomena. The aim is not polemic but diagnostic: to separate formal resemblance from causal structure.

Acknowledging quasi-dialectical phenomena clarifies a practical distinction. Some systems transform because external saturation and resource limits force redesign; others change because of internal conceptual or normative conflict. The difference is consequential. In the first case, interventions reorganize resources, architectures, and coordination mechanisms; in the second, they address values, meanings, and rules. Not all change demands sublation, and not all progress follows a dialectical arc.

This discipline of use also reframes dialectic itself. Rather than a ubiquitous pattern, the Hegel–Marx–Engels tradition functions as a metaphysical program: a framework that posits necessary development driven by contradiction across thought, nature, and society. That thesis is powerful, rhetorically and psychologically, yet it is often overextended as an ontological claim. A more precise application treats dialectic as one explanatory strategy among others.

Placed alongside alternatives, the landscape becomes clearer. Mechanistic and naturalist programs explain change through forces on parts and contingent regularities; teleological and idealist programs appeal to ends or rational orders; evolutionary, systems, and process views emphasize adaptation, emergence, and becoming; analytic modal/structural approaches model necessity, possibility, and dependence without historical inevitability. These families often account for discontinuity and novelty without invoking internal contradiction as the universal engine.

When frameworks compete, Inference to the Best Explanation (IBE) becomes the appropriate filter: which account explains the patterns with greatest power and economy, best fits independent evidence, and integrates with background knowledge [21]? On the evidence of our six cases, constraint- and scale-based accounts typically outperform dialectical necessity on these criteria. Yet IBE is not a cudgel. It coexists with deduction and induction, guiding model choice under theoretical plurality; and it should be applied with awareness of its limits—subjectivity in weighting criteria, incommensurable virtues, and underdetermination—mitigated by pluralism and case-by-case comparison [22].

On IBE grounds, scale- and constraint-based explanations often outmatch dialectical necessity; dialectic remains a selective tool, not a universal key.

7 - A Philosophical Detour

7.1 - Enlightenment as Myth — Or Political Allegory?

Horkheimer and Adorno's *Dialectic of Enlightenment* famously opens with the provocation that "Enlightenment is totalitarian," a thesis that casts reason's

[21] Foundational discussions include Harman (1965) and Lipton (2004); for critique, see van Fraassen (1980); for an accessible overview, see Walton (2016). Working IBE criteria commonly include explanatory power, consilience with independent evidence, parsimony, predictive/explanatory success, and coherence with background theory.

[22] Methodological note: adopting IBE here signals disciplined pluralism rather than allegiance to a single program; competing frameworks should be assessed comparatively, case by case, with criteria made explicit. References: Harman, G. (1965). The inference to the best explanation. *Philosophical Review*, 74(1), 88–95. Lipton, P. (2004). *Inference to the Best Explanation* (2nd ed.). Routledge. van Fraassen, B. (1980). *The Scientific Image*. Oxford University Press. Walton, D. (2016). *Argument Evaluation and Evidence*. Springer.

emancipatory promise as complicit in domination (Horkheimer & Adorno, 1947). Their argument is powerful and historically situated: written in exile and in the shadow of fascism, it bears the imprint of its moment. The book's sweeping claims about reason and history sometimes read less as neutral analysis than as a politically charged narrative of catastrophe, an allegorical retelling of modernity's descent into administered life.

7.2 - The Irony of Social Embeddedness:

The authors themselves supply the materials for reassessment. If, as they insist, knowledge is produced within concrete historical, economic, and ideological conditions, then their own critique must also be read as a product of such conditions. The deep ambivalence toward reason, progress, and science reflects moral and political disillusionment as much as philosophical judgment. Without careful qualification, the critique risks functioning as a mirror image of the totalities it opposes—rhetorically potent, yet prone to overgeneralization where more discriminating analysis is possible [23].

7.3 - From Caution to Closure: When Critique Becomes Myth:

A cautionary stance toward reason can harden into its own metaphysical narrative. Just as Bacon diagnosed pervasive cognitive "idols," Horkheimer and Adorno portray scientific reason as pervasively instrumental. In both cases, structural pessimism threatens to eclipse critical discrimination, yielding a generalized suspicion that can become paralyzing. The issue is not whether abuses of reason occur—they do—but whether a wholesale indictment clarifies more than it obscures, especially in contexts where stable measurement and effective inquiry are demonstrable.

7.4 - IBE as a Response: From Suspicion to Explanation:

As argued in Section 6, Inference to the Best Explanation (IBE) offers a comparative standard: competing narratives are judged by explanatory power, economy,

[23] This assessment does not deny the work's historical and political force. Composed in exile, forced abroad by Nazi atrocities and in the midst of World War II's catastrophes, Dialectic of Enlightenment offered a penetrating diagnosis of modernity's entanglement with domination and technocracy. The claim here is narrower: its epistemological pessimism is often overextended relative to the evidence.

consistency with independent evidence, and coherence with background knowledge. From this angle, *Dialectic of Enlightenment* retains enduring value in diagnosing technocratic and capitalist pathologies, but its claim that science is inherently mythic reads less as discovery than as a historically shaped suspicion. IBE does not dismiss the suspicion; it treats it as one explanation among others and asks whether alternative frameworks—resource constraints, feedback, evolutionary adaptation—organize the same evidence more effectively.

7.5 - A Thermometer in a Room: The Limits of Social Embedding:

Consider a simple but telling case: a calibrated thermometer placed in a room registers 21 °C. Under ordinary conditions of calibration and measurement error, its reading does not change with the class position, ideological commitments, or personal histories of those who look at it. The instrument has a social history — like all technologies — and its readings can certainly be misused. Yet in cases such as this, the act of measurement itself is remarkably robust: it yields the same result across political regimes, cultures, and beliefs. To collapse such reliability into "domination" risks confusing the instrument's embeddedness with its invalidity, and in doing so undermines the very empirical inquiry that critical reflection ought to enrich [24].

Adorno and Horkheimer's reframing of Enlightenment reason also reshapes dialectic's status. In their hands, dialectic no longer functions primarily as an epistemological method aimed at reconciliation or understanding; it marks an impasse of reason. This is not a neutral redefinition but an intellectual declaration of war on science itself, collapsing empirical inquiry into domination and treating Enlightenment's very tools of progress as instruments of totalitarianism. In this respect, they radicalize a trajectory already present in Hegel, Marx, and Engels, where dialectic increasingly bears metaphysical weight rather than methodological

[24] Of course, a thermometer can be manipulated, miscalibrated, or placed in an unrepresentative spot. But such cases are failures of application, not proof that measurement itself is reducible to ideology or power. The very possibility of identifying a "bad reading" presupposes that better, more reliable readings are available. Physical instruments can be calibrated against external natural phenomena — for example, the freezing and boiling points of water at sea level — which shows that science is not wholly dependent on social factors but can anchor its practices in reproducible features of the natural world.

discipline—a shift that demands critical resistance as much as historical parsing [25].

In much of the humanities and social sciences, "positivism" has become less a descriptive category than a curse word, deployed to discredit quantitative or empirical approaches wholesale. This reflex owes much to the intellectual climate shaped by *Dialectic of Enlightenment*, which recast science not as a tool of discovery but as an accomplice of domination. Yet such blanket suspicion mistakes fallibility for futility. The earliest statistical and mathematical models were indeed simplistic — univariate regressions, linear assumptions, limited data — but this is how scientific inquiry always begins. The remedy for crude models is not abandonment, but refinement: moving from single variables to multivariate interactions, from static equations to dynamic feedback, from simplifications to richer approximations. Progress in the sciences has consistently followed this trajectory, and there is no reason to treat the social sciences differently. To collapse every form of measurement into domination is to throw out the child with the bathwater.

This overreaction has been fed, admittedly, by scientistic overreach of the opposite kind.

From Auguste Comte's vision of sociology (1830–42) as a 'social physics' to E. O. Wilson's call for consilience (1998), there has been a recurring impatience to subsume the humanities under a single scientific framework. Such sweeping universalism provoked defensiveness, but Adorno and Horkheimer's reply went further: rather than criticizing scientism's excesses, they demonized science itself, conflating the abuse of empirical tools with their very possibility. In doing so, they helped institutionalize a stance of suspicion that discourages methodological pluralism and undermines the careful, incremental work by which models improve. A more constructive path would be to recognize both dangers — the arrogance of impatient universalists, and the despair of wholesale rejection — while continuing to refine empirical methods as one vital strand in the broader tapestry of knowledge.

---

[25] For contrastive contemporary rearticulations of "dialectic" that foreground epistemic method rather than totalizing critique, compare Brandom's inferentialism (dialectical progression recast as the social articulation of commitments and entitlements) and Bhaskar's dialectical realism (retaining ontological contradiction while rejecting idealism). On the classical side, see Bacon's *Novum Organum* (1620), where "dialectica" functions as an instrument of inquiry rather than a metaphysical scheme (passim).

Read through IBE, the critical insights of *Dialectic of Enlightenment* can be preserved while resisting totalizing suspicion: not all inquiry is domination, just as not every thermometer is propaganda. Dialectic is best treated as a selective instrument of critique — a scalpel rather than a sledgehammer.

8 - Conclusion

Across physical, biological, and social domains, we explain change with models; the question is whether one model can account for all transformation. The argument of this series—especially in this third part—is that no such overarching model exists. A pluralistic approach is preferable: compare frameworks case by case and keep what works.

Here we developed one such lens—scale-dependent transformation—and examined six domains: bridge design, urban food provisioning, urban mobility and governance, metabolic and genetic systems, organizational structure, and artificial intelligence. In each, the decisive shifts were compelled by thresholds, saturation, and coordination limits that force redesign of components and control, not by contradiction and sublation. That is why these cases are best treated as quasi-dialectical (thresholds / constraints) rather than dialectical (contradiction / necessity).

To adjudicate among competing accounts, we relied on Inference to the Best Explanation (IBE): prefer the framework with greater explanatory power, parsimony, consistency with independent evidence, and coherence with background knowledge. Used this way, IBE supports a disciplined pluralism—room for empirical inquiry and theoretical critique without the temptations of a single key to all change.

This stance is revisable. It would be weakened by reproducible cases in which internal contradiction, independent of threshold or resource constraints, uniquely drives development and yields superior predictions to constraint-based models; or by formal results showing that contradiction-based dynamics outperform scaling explanations across multiple domains with clear empirical tests.

Rather than seek universality, the better task is to sharpen our comparative tools and determine, case by case, which model best illuminates the phenomenon at hand.

The evidence favors scale and constraint—not contradiction—as the main engine of qualitative redesign, and IBE recommends choosing whichever framework explains that fact most economically.

9 - Postscript

As this article reframes dialectic as one explanatory strategy among others, two influential attempts to revise—rather than reject—dialectical thinking are instructive: Robert Brandom's inferentialism and Roy Bhaskar's dialectical realism. Each offers a rearticulation of transformation and conceptual structure that resists the metaphysical inflation criticized earlier.

Brandom's inferentialism relocates the engine of conceptual change from contradiction to norm-governed reasoning. Meanings arise from the inferential roles of concepts within a discursive practice—their entitlements, commitments, and consequences—so change proceeds through revision of what follows from, or is licensed by, our claims. In this sense, the "shape" of dialectical progression is retained (iterative revision under normative pressure) without invoking metaphysical necessity or sublation. A familiar illustration is conceptual repair after counterexamples: for example, community-wide adjustments to the inferential use of a term in light of new cases, where commitments are reallocated rather than contradictions "overcome" (Brandom, 1994; 2000) [26].

Bhaskar's dialectical realism, by contrast, foregrounds ontological commitments. Reality, on this view, is stratified and structured by absences and real contradictions; dialectical change arises from tensions among causal powers and from transformative praxis. Here, novelty is not merely discursive but material: emergent properties and negated possibilities figure in the world's constitution, not only in our descriptions of it. A stock example is cross-level determination, where biological organization constrains and reconfigures chemical powers, generating tensions whose resolution drives change (Bhaskar, 1993; Collier, 1994) [27].

---

[26] Brandom, R. (1994). *Making It Explicit: Reasoning, Representing, and Discursive Commitment*. Harvard University Press (norm-governed inference; chs. 1–3). Brandom, R. (2000). *Articulating Reasons: An Introduction to Inferentialism*. Harvard University Press (overview of inferential roles; ch. 1).

[27] Bhaskar, R. (1993). *Dialectic: The Pulse of Freedom*. Verso (absences, stratification, real contradiction; pt. I). Collier, A. (1994). *Critical Realism: An Introduction to Roy Bhaskar's Philosophy*. Verso (accessible synthesis; chs. 3–4).

Under Inference to the Best Explanation (IBE), these positions function as alternatives to be assessed case by case: Brandom recodes dialectic as quasi-dialectical practice (norms and inference), Bhaskar retains a fully dialectical ontology (real contradiction and emergence). Neither is presumed universal; each must earn its keep where it best explains the pattern at hand.

These countercurrents show the persistence of dialectical motifs even among critics of totalizing systems, while also supporting the central thesis of this article: change is plural in form, and explanation should remain open—whether inferential, structural, or realist—subject to comparative evaluation rather than metaphysical fiat.

Brandom offers a quasi-dialectical, practice-based revision; Bhaskar preserves an ontological dialectic—both are candidates in a pluralist, IBE-guided comparison rather than universal keys.

10 – References

Bacon, F. ([1620] 2025) *Novum Organum*. https://hosseinjorjani.com/novum-organum/ .

Bhaskar, R. (1993). *Dialectic: The Pulse of Freedom*. Verso.

Brandom, R. (1994). *Making It Explicit: Reasoning, Representing, and Discursive Commitment*. Harvard University Press.

Brandom, R. (2000). *Articulating Reasons: An Introduction to Inferentialism*. Harvard University Press.

Collier, A. (1994). *Critical Realism: An Introduction to Roy Bhaskar's Philosophy*. Verso.

Comte, A. ([1830–42] 2000) Course of Positive Philosophy. Translated by H. Martineau. Batoche Books. Kitchener.

van Fraassen, B. (1980). *The Scientific Image*. Oxford University Press

Harman, G. (1965). The inference to the best explanation. *Philosophical Review*, 74(1), 88–95

Horkheimer, M. & T. Adorno ([1944/1947] 2002) – *Dialectic of Enlightenment*. Edited by G. Schmid Noerr, Translated by E. Jephcott. Standford University Press.

Jorjani, H., Klei, L., & Emanuelson, U. (2003). A Simple Method for Weighted Bending of Genetic (Co)variance Matrices. *Journal of Dairy Science*, *86*(2), 677–679. https://doi.org/10.3168/jds.S0022-0302(03)73646-7

Kacser, H., & Burns, J. A. (1979). “Molecular Democracy: Who Shares the Controls?” *Biochemical Society Transactions*, 7(5), 1149–1160.
Keightley, P. D., & Kacser, H. (1987). Dominance, Pleiotropy and Metabolic Structure. *Genetics*, *117* (10), 319–329.
Lipton, P. (2004). *Inference to the Best Explanation* (2nd ed.). Routledge.
Peters, R. H. (1983). *The ecological implications of body size*. Cambridge University Press;
Schmidt-Nielsen, K. (1984). *Scaling: Why is animal size so important?* Cambridge University Press.
Turchin, V. (1977). *The Phenomenon of Science*. Columbia University Press.
Walton, D. (2016). *Argument Evaluation and Evidence*. Springer.
Wilson, E. O. (1998) Consilience : the unity of knowledge. Alfred A. Knopf, Inc.