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Returns to the Greeks: Conceptual Crisis, Interpretive Strategies, and the Role of the Ancient Greeks in Modern Physics

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Abstract

This paper explores how modern physicists—Schrödinger, Heisenberg, and Rovelli—draw on Greek philosophy in different ways. For Schrödinger and Heisenberg, Greek ideas offer conceptual tools to address quantum theory's challenges, with Schrödinger favoring pre-Socratic realism and continuity, while Heisenberg emphasizes Platonic and Aristotelian notions of potentiality and epistemic limits. Rovelli uses Aristotle to support scientific cumulativity, arguing older theories remain relevant within new frameworks. However, this conflates the recoverability of previous theories with historical continuity. The shift from Aristotelian to Newtonian physics represents a fundamental change in what counts as explanation, so references to the Greeks do not inherently guarantee cumulative knowledge; their impact depends on how Greek concepts are interpreted.

Keywords: Science cumulativity; Ancient Greek philosophy; Quantum Physics; Erwin Schrödinger; Werner Heisenberg; Carlo Rovelli.†

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1. Introduction

In moments when the conceptual resources of physics appear strained—when established categories no longer yield an intelligible picture of what the formalism is about—physicists have repeatedly staged a return to Greek philosophy. These returns are rarely antiquarian. They function as attempts to recover, reconfigure, or legitimize the most basic commitments of physical inquiry: what counts as an explanation, what sort of reality a theory can be said to describe, and what the aims of scientific knowledge ought to be (Palacios 2024). The appeal to "the Greeks," in other words, often signals that the crisis is not merely technical but foundational.

This paper examines three such returns across the twentieth and twenty-first centuries—those of Erwin Schrödinger, Werner Heisenberg, and Carlo Rovelli—and argues that their invocations of Greek thought exemplify distinct epistemic uses of antiquity. Schrödinger and Heisenberg turn to Greek philosophy as a living conceptual resource under the pressure of quantum theory, a theory whose empirical success outpaced the interpretive capacities of classical concepts. By contrast, Rovelli's recent appeal to Aristotle is mobilized primarily to support a broad historiographical thesis: that physics is "largely cumulative," and that scientific development is best understood as continuity across centuries rather than rupture (Rovelli 2024). The central claim advanced here is that these uses of "the Greeks" must be sharply distinguished. Schrödinger and Heisenberg appeal to Greek philosophy to reopen framework questions—questions about continuity and discreteness, realism and representation, being and becoming—when modern physics renders inherited answers unstable. Rovelli, on the other hand, appeals to Greek physics to underwrite a continuity narrative about scientific progress, one that relies on a methodological slide from regime-based recoverability (the fact that later theories can reproduce certain older descriptions under certain conditions) to historical continuity of explanation (the claim that physics develops cumulatively in its conceptual and explanatory aims). I argue that this slide is not justified. It conflates extensional overlap in descriptive output with intentional continuity in explanatory norms, ontological commitments, and the very sense of what physics is trying to do.

A recent and particularly relevant contribution is Fernández Mouján (2024), who reconstructs the "return to the Greeks" in Heisenberg, Pauli, and Schrödinger as a response to the conceptual crisis induced by quantum mechanics, emphasizing themes such as the revision of atomism, the reconfiguration of "understanding," and critiques of disciplinary and metaphysical "separations." While valuable as a synthetic account of shared motivations, Fernández Mouján's treatment is not organized around a systematic contrast between Schrödinger's and Heisenberg's different Greek genealogies and the distinct philosophical functions those genealogies serve in their competing interpretations of quantum theory. The present article builds on this literature by foregrounding that contrast (Ionian/continuity-oriented realism versus Platonic–Aristotelian form and potentiality), and by extending the analysis to a contemporary "return" in Rovelli, where Greek genealogy is mobilized not primarily to navigate a foundational crisis but to stabilize a continuity narrative about scientific development—precisely where the distinction between recoverability and framework continuity becomes methodologically decisive.

Verelst and Coecke (2006) offer a philosophically ambitious attempt to recover early Greek paradoxes (Being/non-Being, motion, One/Many) as resources for an explicitly ontological approach to interpretive problems in quantum mechanics, arguing that modern scientific categories—especially the assumption of a separable, stable "system"—inherit deep metaphysical commitments shaped by Platonic–Aristotelian strategies for securing stability and non-contradiction. Their paper is valuable for our purposes as a contemporary exemplar of "Greek return" literature that treats antiquity as a repertoire for diagnosing conceptual constraints internal to modern physics rather than as mere historical background. However, their project is largely programmatic and reconstructive, not a historically fine-grained analysis of how particular twentieth-century physicists selectively constructed different Greek genealogies for distinct interpretive ends. The present article therefore uses Verelst and Coecke as a conceptual foil: we keep the insight that Greek resources re-enter physics at moments of foundational strain, while shifting the focus to Schrödinger's and Heisenberg's contrasting, historically situated appropriations of "the Greeks," and to Rovelli's contemporary deployment of Aristotle in support of a continuity narrative about scientific development.

The phrase "return to the Greeks" can mislead if taken as a single gesture. Greek philosophy does not speak with one voice; its canonical tensions—Parmenides and Heraclitus, atomists and continuum theorists, Platonists and Aristotelians—offer not a unitary legacy but a repertoire. That plurality is precisely what makes Greek thought attractive to modern physicists seeking conceptual orientation. A return to the Greeks is typically a selective construction: a retrieval of a particular lineage that can serve as an intellectual anchor when contemporary categories become contested.

Schrödinger's case is paradigmatic. In *Nature and the Greeks*, he presents early Greek natural philosophy as inaugurating a distinctive ambition: a rational, unified, intelligible order of nature, articulated not as myth but as coherent world-understanding (Schrödinger 1954). His admiration is closely linked to his dissatisfaction with features of the Copenhagen settlement—especially discontinuity, abrupt "jumps," and the prominence of measurement in the articulation of quantum phenomena. Schrödinger's preferred "Greek" lineage is pre-Platonic and monistic: a model of intelligibility and continuity that supplies a normative image of what physics ought to aspire to say about reality.

Heisenberg's return differs in both its sources and its philosophical function. In *Physics and Philosophy*, he frames quantum mechanics as a transformation in the conditions of description and knowledge, emphasizing the limits of classical concepts and the irreducibility of the measurement context (Heisenberg 1958). Greek philosophy matters to Heisenberg because it provides a language for articulating a mode of being that is neither the straightforward actuality of classical realism nor mere subjective appearance. His appeal to Aristotelian potentiality—*dynamis*—is not decorative: it supplies a conceptual schema for treating the quantum state as real yet not classically actual prior to measurement. Greek philosophy thus functions as a legitimizing precedent for epistemic modesty and conceptual mediation, not as a warrant for continuity with classical pictures of nature.

Both Schrödinger and Heisenberg therefore use "the Greeks" to renegotiate what physics can claim about reality under quantum pressure. In doing so, they implicitly acknowledge a key point: foundational crises in physics are simultaneously crises of conceptual authority—crises about which philosophical commitments can still be responsibly carried by physical theory.

Rovelli's continuity thesis begins from a plausible observation: older theories are not simply discarded, but remain effective within restricted domains; in ordinary circumstances, Newtonian mechanics remains reliable even if later frameworks offer deeper or more general accounts (Rovelli 2024). From this starting point, Rovelli proposes a general historiographical moral: physics should be understood—"contrary to what is often stated"—as a cumulative body of knowledge (Rovelli 2024). A pivotal move in the paper is his rehabilitation of Aristotelian physics via everyday falling in a resisting medium: once drag is included, motion rapidly approaches constant velocity, and this is presented as aligning with an Aristotelian description of natural motion as approximately constant-speed under "everyday conditions" (Rovelli 2024). On this basis, Rovelli suggests that Aristotelian claims are not simply superseded but are, in an important sense, "right" in their domain—and that the historical narrative of physics as a sequence of ruptures is misleading (Rovelli 2024).

The present paper does not dispute the mathematical point that Newtonian dynamics with drag predicts terminal velocity, nor the pedagogical value of showing how different regimes yield different effective descriptions. The critique is methodological and philosophical: Rovelli's argument moves too quickly from a formal or phenomenological observation (later theory can reproduce some older descriptive regularities) to a historiographical and epistemological moral (physics is broadly cumulative; conceptual continuity predominates). That inference—recoverability ⇒ continuity—is precisely what must be defended rather than assumed.

To put the point sharply: regime-based recoverability is a relation between descriptions; historical continuity is a relation between explanatory frameworks. A modern theory can often generate behavior that an earlier vocabulary can capture approximately, but this does not entail that the earlier theory's explanatory aims, ontological structure, or norms of adequacy are preserved. Treating such recoverability as evidence of continuity risks a kind of presentist harmonization: the past is redescribed in the idiom of the present, and the ease of translation is then mistaken for a fact about historical development.

This methodological worry becomes vivid in the Aristotelian–Galilean transition. Even if one grants that some everyday appearances can be cast in Aristotelian-sounding terms, the passage from Aristotle to Galileo is not well captured by a continuity narrative, because it is not primarily a matter of correcting quantitative predictions. It is a reconstitution of what counts as a physical explanation.

On the Aristotelian framework, motion in the sublunary realm is embedded in a teleological explanatory economy: "nature" is not merely a set of regularities but a principle of directedness, and the intelligibility of motion is tied to a cosmos whose structure is not uniform. Whatever one's preferred formulation of Aristotle's mature position, it is inseparable from a differentiated world-picture and from explanatory forms in which final causes are not optional ornaments but integral resources. In the Galilean program, by contrast, the aspiration of physics becomes inseparable from mathematization and idealization; crucially, physical explanation of motion proceeds by excluding final causes from the explanatory machinery of mechanics (Dear 1995). The cosmos is treated as unified in relevant respects for the study of motion, and the explanandum shifts from "why this natural tendency?" to "what lawlike, mathematically expressible relations govern change of motion under specified conditions?" The very job description of physics changes.

This rupture matters not merely for historical classification but for understanding why Newtonian mechanics becomes possible. Newton's laws presuppose an explanatory stance in which motions are not fundamentally oriented toward natural ends and in which a unified dynamical framework is intelligible across terrestrial and celestial phenomena. The historical continuity that is philosophically salient here runs through a transformation in explanatory norms—precisely what is at risk of being obscured when Aristotelian descriptions are treated as domain-true in a way that blurs the conceptual break.

Methodologically, this paper distinguishes three levels at which appeals to Greek philosophy operate in modern physics: (1) Historical influence: which texts are read, cited, and taught; how a physicist's education and intellectual milieu shape their exposure to "Greek thought;" (2) Philosophical alignment: which conceptual motifs are extracted as congenial to a given interpretation (continuity vs. discreteness; realism vs. epistemic constraint; being vs. becoming); (3) Rhetorical authority: how "the Greeks" are used to confer legitimacy—presenting an interpretive stance as a return to deep rational origins rather than a local, contingent response to crisis.

This distinction allows a middle path between two unsatisfactory extremes: treating physicists as reliable historians of antiquity on the one hand, or dismissing their classical references as mere ornament on the other. Schrödinger and Heisenberg are best read as offering philosophical self-interpretations, selective but serious, in which Greek thought provides a vocabulary for framing what quantum mechanics permits one to say about reality (Schrödinger 1954; Heisenberg 1958). Rovelli, by contrast, uses Greek physics chiefly to authorize a claim about the overall structure of scientific development, and it is here that the difference between recoverability and conceptual continuity becomes decisive (Rovelli 2024).

The paper proceeds as follows. Section 2 clarifies the distinction between recoverability, conceptual continuity, and historiographical narrative, and identifies the inferential step at stake in contemporary continuity claims. Section 3 analyzes Schrödinger's "Greeks," focusing on how the ideal of unity and continuity functions as a normative constraint on interpretation of quantum theory (Schrödinger 1954). Section 4 turns to Heisenberg, reconstructing his appeal to Plato and Aristotle, especially potentiality, as a conceptual strategy for articulating contextual actuality and epistemic limitation in quantum mechanics (Heisenberg 1958). Section 5 then examines Rovelli's appeal to Aristotle in service of a cumulativity thesis, showing how the argument depends on conflating regime-based descriptive adequacy with continuity of explanatory aims (Rovelli 2024). Section 6 offers the Aristotelian–Galilean rupture as a decisive counterexample to the continuity inference: the break is not captured by limit-style reconstructions because it concerns the transformation of explanation itself. The conclusion draws a general moral: "returns to the Greeks" can illuminate how physics rethinks its foundations, but they cannot be used indiscriminately to support a continuity narrative about scientific progress.

In short, the recurring invocation of Greek philosophy in modern physics is not evidence for a single story about continuity, cumulativity, or "the origins" of scientific reason. It is evidence that, when physics confronts foundational instability, it reaches back to a repertoire of ancient possibilities in order to renegotiate what science is allowed to claim. Understanding how these negotiations differ in Schrödinger, Heisenberg, and Rovelli clarifies not only the philosophical stakes of quantum interpretation, but also the methodological limits of continuity narratives that mistake present-day reconstructions for historical development.

2. Recoverability Is Not Continuity: A Methodological Clarification

Continuity narratives in the history and philosophy of physics often trade on an ambiguity in what "continuity" is supposed to mean. On one reading, continuity is a claim about performance: later theories preserve the predictive and practical successes of earlier ones within certain ranges of conditions. On another reading, continuity is a claim about framework: later theories preserve the explanatory aims, ontological commitments, and conceptual roles that structured earlier approaches. The two senses can come apart, and conflating them can distort how scientific change should be described (Palacios 2024).

Rovelli's recent defense of cumulativity is a useful contemporary site at which this ambiguity becomes visible. His argument moves from the unobjectionable point that earlier frameworks can remain effective in restricted regimes to the stronger moral that the history of physics is "largely cumulative," and that major transitions—Aristotle to Newton, Newton to Einstein—exhibit deep continuity once interpreted properly (Rovelli 2024). This section isolates the methodological step that makes that move tempting and explains why, especially for the Aristotelian–Galilean case, it does not by itself deliver what a continuity narrative requires.

2.1 Three theses that are often run together

It helps to distinguish three theses that are frequently treated as interchangeable (Palacios 2024).

(T1) Regime validity (domain-limited adequacy). A theory can be reliable within a restricted domain even if it is not fundamental. Newtonian mechanics remains indispensable for many terrestrial and engineering purposes despite its limitations relative to relativity and quantum theory. Rovelli explicitly endorses this idea and uses it as a premise in his historiographical argument (Rovelli 2024).

(T2) Recoverability (limit, correspondence, approximation). A later framework can often recover aspects of an earlier one as a limiting case, approximation, or special regime. Rovelli leans on this reasoning, for instance, when he suggests that adding drag to Newtonian dynamics yields behavior that approaches constant-speed motion, which he associates with an Aristotelian description of ordinary falling (Rovelli 2024).

(T3) Historical continuity (continuity of explanatory framework). A transition is historically continuous when the conceptual roles, explanatory aims, and ontological architecture of the earlier framework are substantially retained, so that later work can plausibly be read as extension or systematic improvement rather than reconstitution of the enterprise.

The central point is that (T1) and (T2) do not entail (T3). Regime validity and recoverability are relations between successful descriptions; historical continuity is a relation between frameworks of explanation (Crowther 2020; Palacios 2024). Even if an Aristotelian-sounding sentence can be made approximately true inside a Newtonian-with-drag reconstruction, it does not follow that Aristotelian physics stands in a cumulative relation to Galilean dynamics in the sense relevant to historiography or philosophy of science (Norton 2012).

2.2 Why recoverability is attractive—and why it is insufficient

Recoverability arguments are attractive because they resonate with a powerful internal virtue of physics: unification by subsumption. Later theories can explain why earlier ones worked as well as they did in certain regimes, revealing structure in both the world and our theorizing. This is a genuine epistemic achievement.

But this virtue also encourages a familiar historiographical temptation: reading the past through the lens of present theory, treating the ease of translation into modern equations as evidence that the past was already “on the way” to the present (Norton 2012). The danger is not that the mathematics is wrong; it is that the historical inference is too quick. Rovelli’s strategy makes the issue vivid because it uses a modern reconstruction (Newtonian dynamics with drag) to generate a qualitative behavior (approach to terminal velocity) and then reads that as vindicating Aristotle “in everyday conditions” (Rovelli 2024). Even if the modeling is defensible as pedagogy, the historical conclusion requires an additional premise about what counts as continuity across frameworks.

2.3 Extensional overlap and intensional continuity

A helpful way to state the gap is to distinguish extensional overlap from intensional continuity (Palacios 2024). Extensional overlap concerns whether two theories agree (approximately) on observable regularities in a shared domain. Intensional continuity concerns whether the meaning and explanatory function of key terms and distinctions are preserved—whether the theories explain in the same way, with the same resources, for the same kind of explanatory purpose.

Continuity narratives based on recoverability often rely on extensional overlap to suggest intensional continuity. The drag example is emblematic: it shows how a modern model yields a regime in which motion is approximately constant-speed and then treats this as significant continuity with an Aristotelian characterization of ordinary falling (Rovelli 2024). But in Aristotle the meaning of "natural motion" belongs to a broader explanatory economy in which why a body moves is inseparable from its nature, its place in a structured cosmos, and forms of explanation not reducible to a differential equation plus a resistance term. Extensional agreement on a kinematic pattern does not suffice to establish continuity of explanatory framework (Norton 2012).

2.4 Continuity as a claim about explanatory aims

A more reliable way to avoid flattening is to treat continuity, in the historiographically relevant sense, as a claim about explanatory aims and norms, not only about approximate descriptive success (Crowther 2020). A mature scientific framework is a structured practice that implicitly answers questions such as: What counts as an acceptable explanation? What kinds of causes are admissible? What role should mathematics play in representation and explanation? What counts as the proper object of theory? What standards of adequacy govern appraisal?

When these norms shift, continuity cannot be read directly off shared outcomes. Often the explanandum itself is redescribed: the "same" phenomenon becomes intelligible under different explanatory questions. This is exactly what is at stake in the transition from a teleological physics of natural tendencies to a mechanics of mathematically expressible relations (Dear 1995). Continuity narratives that rest primarily on recoverability risk missing this deeper transformation.

2.5 The inferential step at stake in Rovelli's cumulativity thesis

With these distinctions in place, we can state the inferential step that underwrites Rovelli's cumulativity claim. Rovelli begins from (T1) and (T2): theories are domain-limited, and later theories can recover earlier descriptive successes in the appropriate regime (Rovelli 2024). From this he draws a broader moral: science is "largely cumulative," older theories are not "discarded," and the standard story of discontinuous revolutions is misleading (Rovelli 2024).

The move looks plausible because (T1) and (T2) are forms of retention. But what is retained need not be what matters for the historical identity of a framework. Recoverability shows that later theory can explain why earlier description worked in a restricted range; it does not show that the earlier framework's explanatory aim was continuous with the later one, nor that its central concepts retain their roles across the transition.

To defend a continuity narrative, one needs an additional premise—call it the continuity premise: if a later theory can recover an earlier theory's successful descriptions in an appropriate regime, then the earlier theory's framework is retained in a cumulative lineage. This premise is controversial in precisely the Aristotelian–Galilean case (Crowther 2020).

2.6 A diagnostic: when recoverability misleads

A practical diagnostic helps clarify when recoverability is likely to mislead as evidence for continuity. Recoverability is a good guide to continuity when the earlier framework's core explanatory ideals remain in place and the later framework extends the same representational strategy into new domains. Recoverability is a poor guide when there is a change in what counts as explanation, what counts as basic ontology, or what role mathematics plays in representation. In such cases, later theories may reproduce earlier empirical successes while redescribing the phenomenon within a different explanatory enterprise.

The Aristotelian–Galilean transition belongs to this second category. It is not merely a matter of improved numbers. The Aristotelian explanatory economy—teleology and a stratified cosmos, among other commitments—ceases to be an admissible basis for mechanics, and the aim of physics is reconstructed. If this is right, then "Aristotle was right in everyday conditions" may function as a pedagogically useful gloss, but it cannot carry the historiographical weight placed upon it by a cumulativity thesis.

This methodological clarification also explains why the comparison with Schrödinger and Heisenberg is not ornamental. Their returns to Greek philosophy respond to conceptual instability in quantum foundations: Greek plurality is used as a repertoire of options for renegotiating realism, representation, and intelligibility. Rovelli's return, by contrast, aims to stabilize a historiographical narrative by redescribing historical transitions in regime terms (Rovelli 2024). That is why recoverability versus continuity matters here. If extensional overlap is misread as intensional continuity, "returning to the Greeks" becomes a way of smoothing over discontinuities that are historically and philosophically central—especially the discontinuity that conditions the emergence of Newtonian mechanics.

3. Schrödinger's Greeks: Unity, Continuity, and the Normative Image of Science

Schrödinger's "return to the Greeks" is best read neither as cultural ornament nor as a neutral historical survey, but as a philosophical intervention into what quantum mechanics had made newly uncertain: what a physical theory ought to be *about*, and what counts as an intelligible account of nature. In *Science and Humanism* and *Nature and the Greeks*, Schrödinger constructs an origin-story of scientific thought that is explicitly normative. Greek natural philosophy, especially the earliest Ionian and pre-Platonic strands, is presented as the first decisive break with myth and anthropomorphic explanation and as the inauguration of a unified, impersonal, intelligible order of nature (Schrödinger 1951, 1954). This origin-story does not merely locate a beginning; it provides a standard by which Schrödinger judges modern physics—above all, the Copenhagen settlement that he regarded as epistemically successful but conceptually unsatisfying (Fernández Mouján 2024).

3.1 The Greeks as an origin of "world-understanding," not technique

Schrödinger insists that Greek science matters because it is the earliest sustained attempt to articulate what one might call world-understanding: a commitment to the intelligibility of nature, to explanation that does not depend on local narrative or divine caprice, and to a unity that makes the world describable as a coherent whole (Fernández Mouján 2024). What he admires is not primarily a specific doctrine (e. g., atomism or a particular cosmology), but a stance: the conviction that nature is governed by general principles accessible to rational inquiry. (Schrödinger 1954).

This emphasis matters because it already signals the kind of continuity Schrödinger is after. For him, continuity is not chiefly a claim about the historical succession of theories. It is a metaphysical and methodological expectation: if physics is genuine understanding, it should deliver a picture of nature that is unified, stable, and in some sense objective. Greek thought becomes exemplary precisely because it appears to him as an early crystallization of this expectation before later philosophical developments introduced what he regarded as distortions—especially forms of subjectivism that make the observer constitutive of the physical account.

Two features of his invocation of the Greeks are especially important for the present argument. First, Schrödinger treats Greek philosophy as a moment in which physics, metaphysics, and epistemology are not yet separated into distinct professional discourses (Palacios 2024). That unity is not, for him, a deficiency. It allows foundational questions to be asked without being prematurely constrained by technical formalisms or disciplinary boundaries (Schrödinger 1954). Second, he treats those "framework questions"—what reality is, what objectivity means, what kinds of explanation are admissible—as the proper concern of a reflective physics. In other words, his appeal to the Greeks is intended to legitimate precisely the kind of philosophical reflection on physics that the postwar "shut up and calculate" mood could sometimes marginalize.

3.2 Continuity as a metaphysical constraint on quantum interpretation

Schrödinger's use of Greek thought cannot be disentangled from his dissatisfaction with the dominant interpretive posture associated with Bohr and Heisenberg. His complaints about quantum mechanics are well known: unease with discontinuous "jumps," with the apparent centrality of measurement, and with the retreat from picturable ontology. These were not merely aesthetic preferences. They expressed a deeper thesis: that physics should aim at an observer-independent account of nature and that discontinuity at the level of being is not easily reconciled with intelligibility.

In this context, the Greeks function as a historical and philosophical resource because they represent for Schrödinger a model of intelligibility grounded in unity. He reads early Greek natural philosophy as pursuing the thought that the many can be explained through the one: diverse phenomena are manifestations of an underlying order, and the task of inquiry is to articulate that order conceptually. This "Greek" ideal dovetails with Schrödinger's own preference for field-like continuity and his hope (never fully realized) that quantum theory might be redescribed in an ontologically continuous manner (Fernández Mouján 2024). That hope is visible not only in the development of wave mechanics but also in Schrödinger's later reflections on the foundations of quantum theory, where he consistently resists the idea that physical reality should depend on an act of observation in any strong sense (Schrödinger 1951; 1954).

For present purposes, the key point is methodological: Schrödinger's return to the Greeks is a way of constraining what counts as an acceptable interpretation of quantum mechanics (Palacios 2024). It is not an attempt to stabilize a narrative of continuity in the history of physics. Rather, it uses Greek philosophy to protect a particular epistemic ideal—coherent world-picture, observer-independent intelligibility—against what he perceived as the conceptual fragmentation implied by Copenhagen-style emphases on measurement and probability. Greek thought thus functions for Schrödinger as a normative image of science: science should not merely predict; it should render nature intelligible in a unified way (Verelst and Coecke 2006).

This is why Schrödinger's appeal to antiquity differs in kind from Rovelli's later use of Aristotle. Rovelli's argument relies on recoverability and domain-limited adequacy to support a thesis about cumulative continuity across centuries (Rovelli 2024). Schrödinger, by contrast, invokes the Greeks primarily to make a claim about the aim of physics in the present: physics should aspire to a unified representation of reality, and interpretive strategies that make reality dependent on observational context threaten that aspiration (Schrödinger 1954).

3.3 Selectivity: Schrödinger's "Greeks" are pre-Platonic and anti-teleological

A second crucial feature is Schrödinger's selectivity. "The Greeks" are not for him a homogeneous authority. His admiration is strongest where Greek thought appears to him most consonant with unity and continuity: pre-Socratic naturalism and the early ambition to explain the cosmos without appeal to anthropomorphic ends. Even when he expresses respect for Plato, his ideal "Greek" is not a Platonic metaphysics of two worlds, and it is certainly not Aristotelian teleology. Schrödinger's ideal is closer to a monistic picture in which nature is one coherent order that can be understood by principles that do not depend on final causes (Schrödinger 1954).

This selectivity matters because it reveals what a "return to the Greeks" accomplishes in practice: it is a construction of lineage (Fernández Mouján 2024). Schrödinger does not merely discover an origin; he fashions a genealogy that helps him make sense of what he takes to be at stake in modern physics. The value of Greek philosophy, for him, lies not in a detailed correspondence between ancient doctrines and quantum mechanics, but in the availability of a conceptual posture—unity, intelligibility, continuity—that can be mobilized against a perceived retreat into epistemic modesty or instrumentalism.

Schrödinger's anti-teleological emphasis is also relevant to the larger arc of this paper because it places him at an interesting angle relative to the Aristotelian–Galilean rupture discussed later. Schrödinger is not, in any straightforward sense, advocating a return to Aristotle's physics; rather, he is using Greek naturalism as a counterweight to interpretive moves that, in his view, would make physics too dependent on conditions of observation. This difference becomes important when we contrast him with Heisenberg, who does invoke Aristotle positively—especially the concept of potentiality—to articulate a different, more context-sensitive metaphysics of quantum states (Heisenberg 1958). Schrödinger's "Greeks" thus already foreshadow the paper's central comparative claim: Greek philosophy functions as a repertoire that can be recruited to legitimate incompatible philosophical stances within modern physics.

3.4 The epistemic function of Schrödinger's return

At this point we can state more precisely the epistemic function of Schrödinger's return to the Greeks. It performs at least three tasks.

First, it provides a model of scientific rationality that is not reducible to prediction (Fernández Mouján 2024). Schrödinger repeatedly treats "understanding" as a central scientific value—an intelligible world-picture, not merely an algorithm for generating experimental frequencies (Schrödinger 1951, 1954). Second, it authorizes foundational questioning by locating it at the origin of science: the Greeks are invoked to show that asking what reality is, and what science can say about it, is not an extraneous philosophical pastime but part of the scientific enterprise at its birth. Third, it supplies a normative criterion for judging modern interpretations: discontinuity and observer-dependence appear not merely as technical novelties, but as threats to the Greek aspiration to coherent unity (Verelst and Coecke 2006).

These points also indicate how Schrödinger's appeal to antiquity should be evaluated. One could object that Schrödinger's account of Greek science is historically stylized or philosophically tendentious. That objection may be correct in detail. But for the purposes of philosophy of science, the more important question is not whether Schrödinger is a reliable classicist; it is what he is doing with antiquity. He is using "the Greeks" to frame a debate about realism, representation, and intelligibility in quantum theory. Greek philosophy becomes a source of philosophical leverage at a moment when modern physics forces a renegotiation of what counts as a satisfactory physical account.

Schrödinger's appeal to the Greeks therefore functions primarily as a normative image of what physics should be: a unified, intelligible account of nature that does not make reality depend on acts of observation. In this sense, his "return" is not a claim about the historical continuity of physics across centuries, but a way of stabilizing standards of explanation and realism at a moment when quantum theory made those standards contestable. The upshot for the paper's comparative argument is straightforward: Greek philosophy enters twentieth-century physics here as a resource for conceptual orientation under foundational pressure, not as evidence for cumulativity or historical smoothing.

4. Heisenberg's Greeks: Form, Potentiality, and the Limits of Classical Description

A strikingly different construction of Greek lineage, Heisenberg's return to Greek philosophy is neither a nostalgic appeal to origins nor an attempt to restore a classical image of nature. It is, rather, a strategy for making sense of a situation in which the classical conceptual scheme—trajectories, determinate properties, separable objects evolving continuously in time—no longer seems adequate to the phenomena. If Schrödinger invokes early Greek naturalism to defend an ideal of unified, observer-independent intelligibility, Heisenberg invokes Plato and Aristotle to justify a different conclusion: the proper lesson of quantum mechanics is that the conditions of description are not transparent windows onto an observer-independent inventory of properties. Physical theory describes nature through conceptual and experimental arrangements that partly constitute what can meaningfully be said (Palacios 2024). Greek philosophy matters to Heisenberg because it provides him with a vocabulary for articulating this conceptual mediation without collapsing into a crude instrumentalism.

4.1 Greek philosophy as precedent for conceptual mediation

In *Physics and Philosophy*, Heisenberg portrays modern physics as confronting not merely new empirical facts but a transformation in the relation between concepts and reality. Quantum mechanics, as he understands it, exposes the dependence of physical description on the experimental context and on the conceptual apparatus used to state measurement results (Heisenberg 1958). Rather than treat this dependence as a temporary imperfection to be eliminated, Heisenberg takes it to reflect something deep about the epistemic situation of physics: what can be said about nature is constrained by the kinds of questions that experimental arrangements and theoretical concepts make possible (Verelst and Coecke 2006).

This epistemic posture is one reason Greek philosophy becomes relevant. Heisenberg reads Plato and Aristotle as already grappling with the idea that knowledge is not a passive mirroring of things but is mediated by conceptual forms and by the structuring activity of thought. In this sense, his turn to Greek philosophy is meant to inoculate the quantum revolution against two temptations: on one side, a naïve realism that insists the world must be describable in the classical way; on the other, a positivist minimalism that treats theory as nothing more than a calculus of prediction (Crowther 2020). Greek philosophy becomes a historical and conceptual resource for a middle position: the world is real, but the form in which it can be described is not independent of the conditions of description.

4.2 Plato: mathematical form and the priority of structure

Heisenberg's Platonism is not a simple metaphysical doctrine; it is closely tied to the abstraction of modern theoretical physics. He emphasizes that advanced physics increasingly abandons picturable models and replaces them with mathematical structures that cannot be reduced to classical visualization. Quantum mechanics intensifies this trend. The formalism does not yield a straightforward picture of "what is happening" in the classical sense; instead, it yields a rule-governed structure that connects preparation and measurement outcomes. For Heisenberg, the fact that the formalism works with extraordinary precision suggests that physics has access to reality through structure rather than through classical images (Heisenberg 1958).

Plato provides Heisenberg with a way of treating mathematical form as more than a convenient language. It legitimizes the idea that the deepest access physics has to reality may be mediated by abstract form, not by sensory imagination or mechanical pictures. This is not to say that Heisenberg simply maps quantum theory onto Plato's theory of Forms. It is to say that Plato supplies a culturally authoritative precedent for taking mathematical structure seriously as an epistemic and perhaps ontological guide. Where Schrödinger wants to preserve a continuous, "picturable" underlying reality, Heisenberg is prepared to say that the price of fidelity to nature is to accept forms of description that cannot be assimilated to classical images.

4.3 Aristotle: potentiality as a category for quantum states

Heisenberg's most distinctive Greek appropriation, however, is Aristotelian rather than Platonic: the appeal to potentiality (*dynamis*) and actuality (*energeia*) as a way of interpreting the quantum state. Heisenberg introduces Aristotle's language to articulate a situation in which the quantum system cannot be said to possess determinate classical properties prior to measurement, yet it is not thereby unreal or merely subjective (Fernández Mouján 2024). The quantum state represents a structured set of possibilities—

possibilities that are not merely epistemic ignorance but objective constraints on what can become actual in a given measurement context (Heisenberg 1958).

The point of this move is conceptual: it supplies a vocabulary for a mode of being that lies between classical actuality and pure fiction. Classical physics presupposes that the basic properties of objects are actual at all times—positions, momenta, trajectories—even if unknown to us. Quantum mechanics, as Heisenberg reads it, forces a different account. Certain classical descriptions become meaningful only in relation to the measurement arrangement, and the formalism yields probabilities rather than deterministic predictions. Aristotle's potentiality, in Heisenberg's hands, becomes a way of saying: the system is real, but its properties are not actual in the classical sense prior to the measurement interaction; they exist as structured potentialities that can be actualized under determinate conditions.

This is not a minor rhetorical flourish. It performs philosophical work at exactly the point where quantum theory threatens to produce interpretive bifurcation. If one insists on classical actuality, one is driven toward hidden-variable pictures or toward treating the wavefunction as incomplete. If one gives up reality altogether, one risks collapsing into an instrumentalism that deprives physics of any claim to describe nature. Heisenberg's appeal to Aristotle is designed to resist both extremes by legitimizing a non-classical ontology of potential being that is nonetheless objective enough to underwrite the scientific enterprise.

4.4 Measurement, intervention, and the transition to actuality

Heisenberg's Aristotle is also connected to a distinctive conception of measurement. Measurement is not passive observation of preexisting values; it is an intervention that helps constitute the conditions under which certain quantities can be meaningfully ascribed. The transition from quantum potentiality to classical actuality is not merely a change in our knowledge; it is a physical process in which the system becomes entangled with the macroscopic measurement arrangement and yields a definite record. Heisenberg does not need to deny an external reality to insist that description is contextual. The point is rather that quantum theory forces a rethinking of the classical separation between observer and observed, and Aristotle's potentiality/actuality provides a conceptual idiom in which that rethinking can be made intelligible (Heisenberg 1958).

Here again Heisenberg's use of Greek philosophy differs from Rovelli's. Rovelli's continuity narrative treats Greek physics as a precursor whose descriptive statements can be reinterpreted as approximately true in certain regimes, thereby supporting a cumulative account of physics (Rovelli 2024). Heisenberg's appeal to Aristotle does not aim to rehabilitate Aristotle as "right" within a domain in a way that supports historical cumulativity. It aims to solve a modern interpretive problem: how to speak about quantum states without forcing them into classical categories of actuality. In this sense, Heisenberg's return is fundamentally conceptual rather than historiographical.

4.5 Plural "Greeks": Heisenberg's lineage as a deliberate construction

As with Schrödinger, the crucial point is selectivity. Heisenberg's "Greeks" are not the Ionians of naturalistic unity but the Plato and Aristotle of form, mediation, and modal being. He constructs a lineage that makes his philosophical stance in quantum mechanics appear not as an ad hoc invention but as a continuation of deep intellectual possibilities already articulated in classical philosophy. This construction is epistemically significant because it shows that appeals to antiquity can function as legitimizing devices: not merely arguments, but strategies for placing an interpretation within a broader history of reason.

This legitimizing function does not undermine the seriousness of Heisenberg's position. But it does clarify how the Greeks operate as a repertoire: their authority can be recruited to justify very different metaphysical and epistemological postures. Schrödinger's Greeks authorize an aspiration to unified, continuous, observer-independent reality; Heisenberg's Greeks authorize the acceptance of conceptual mediation, the non-actuality of properties prior to measurement, and the primacy of mathematical structure. The disagreement over quantum theory thus becomes, at least in part, a disagreement over which "Greek" legacy is to be treated as philosophically authoritative.

4.6 From quantum foundations to historiographical morals

The comparison between Schrödinger and Heisenberg already yields a general lesson: "the Greeks" operate as a plural repertoire that can legitimate incompatible philosophical stances within physics. Schrödinger's lineage secures an ideal of unified, observer-independent intelligibility; Heisenberg's lineage secures a framework of conceptual mediation, potentiality, and the primacy of mathematical structure. These are not historiographical claims about continuity of science so much as epistemic strategies for negotiating what quantum theory licenses us to say about reality.

5. Rovelli's Aristotle: Continuity by Reconstruction and the Problem of Presentist Genealogies

Rovelli's recent "return to the Greeks" differs in kind from those of Schrödinger and Heisenberg. In their cases, Greek philosophy functions primarily as a conceptual repertoire for navigating foundational uncertainty in contemporary physics (Fernández

Mouján 2024). Rovelli, by contrast, mobilizes Aristotle chiefly to support a historiographical moral about the structure of scientific development: physics, he argues, is "largely cumulative," and the standard image of progress as a sequence of ruptures misrepresents how scientific knowledge actually advances (Rovelli 2024). This section reconstructs the core of Rovelli's continuity argument and locates its methodological vulnerability: the argument moves from regime-based reconstruction to claims about historical and conceptual continuity, thereby risking a presentist genealogy that smooths over precisely the discontinuities that matter most for understanding the transformation of physics from Aristotle to Galileo and Newton (Norton 2012; Palacios 2024).

5.1 The structure of Rovelli's continuity argument

Rovelli's paper advances a thesis that is, in one sense, immediately plausible: older theories are not simply discarded. They remain reliable and fruitful within restricted domains; later theories often preserve their successes while extending, refining, or reframing them (Rovelli 2024). This point is uncontroversial. It captures the everyday fact that Newtonian mechanics remains indispensable in many practical contexts, and that scientific practice often proceeds by layered modeling rather than abrupt abandonment.

The distinctiveness of Rovelli's argument emerges when this domain-validity point is converted into a broader historiographical conclusion: since earlier frameworks remain "true" or "right" in their domain, science should be regarded as cumulative in a deep sense, and narratives that emphasize conceptual rupture are misleading (Rovelli 2024). The paper then seeks to give this conclusion force by using Aristotle as a test case. If even Aristotelian physics can be rehabilitated as "right" in ordinary conditions—where falling occurs in air rather than in vacuum—then the continuity thesis appears especially robust.

The argument therefore depends on a strong rhetorical and philosophical pivot: Aristotle is not merely "understandable" in context, nor merely "not stupid," but "simply right" in a certain everyday regime (Rovelli 2024). The subsequent continuity narrative is designed to follow: if Aristotle is right in his domain, then the Aristotle–Galileo–Newton sequence becomes less a rupture than a progressive refinement, and modern physics can be redescribed as a chain of conceptual inheritances rather than a break with teleological natural philosophy.

5.2 The key maneuver: rehabilitation by modern regime modeling

Rovelli's central maneuver is reconstructive. He models falling under Newtonian dynamics with resistance and emphasizes that, in such a model, velocity approaches a terminal value: after a transient, motion is approximately constant-speed, which he aligns with an Aristotelian description of natural motion as constant speed in everyday experience (Rovelli 2024). This supports two associated claims: (1) The standard textbook contrast—Aristotle says constant speed; Galileo/Newton say constant acceleration—is misleading for "everyday" conditions in which drag is present; (2) Aristotle's claims should therefore be treated as approximately correct within their proper domain, and the historical narrative of physics as a sequence of radical breaks is distorted (Rovelli 2024).

As physics pedagogy, this has real value: it reminds readers that constant acceleration is an idealization tied to neglect of drag and that actual falling frequently deviates from that idealization (Norton 2012). However, as a basis for a thesis about historical continuity, the move is fragile, because it depends on treating a modern regime reconstruction as a proxy for the conceptual content of an earlier framework. In effect, Aristotle's descriptive claims are mapped into the language of Newtonian dynamics plus drag, and the resulting overlap in behavior is treated as vindication of Aristotle "in his domain." The methodological worry is that this procedure establishes at most an extensional overlap, while the conclusion requires intensional continuity of explanatory framework (Palacios 2024).

5.3 Why the move does not license historical continuity

The crucial point is not that Rovelli's model is "wrong," but that its epistemic reach is limited. A modern model can generate patterns of motion that resemble what an older vocabulary reports, but that does not establish that the older framework and the later one share explanatory aims or conceptual structure.

To see the gap, consider what is being compared. Rovelli compares (i) a modern dynamical account (forces, equations of motion, and resistance terms) and (ii) an Aristotelian characterization, i.e natural motion as a kind of motion whose intelligibility is tied to nature, place, and the structure of the cosmos.

Even if the Aristotelian statement "falling tends toward a roughly constant speed in ordinary media" tracks certain appearances, the Aristotelian explanation is not a proto-version of Newton plus drag. Aristotle is not offering a dynamical law with a corrective term; he is offering a different kind of account, one in which final causes and a stratified cosmos are not optional ornaments but core resources (Koyré 1968). When Rovelli treats a behavior reproduced by a Newtonian-with-drag model as a vindication of Aristotle, he effectively treats the Aristotelian claim as if it were merely a coarse-grained statement about kinematics. But the historical question is not whether Aristotle had an approximately correct phenomenological generalization; it is whether the Aristotelian framework belongs to the same explanatory lineage as Galilean–Newtonian mechanics.

That lineage is precisely where discontinuity becomes salient. Galileo's transformation of mechanics does not consist in finding a better value for a parameter in an Aristotelian model. It consists in rejecting teleological explanation as a basis for mechanics, elevating mathematical idealization to a constitutive role, and moving toward a unified account of terrestrial and celestial motion (Dear 1995; Wallace 1992). Newtonian dynamics then consolidates this transformation into laws that presuppose a non-teleological account of motion. The point is not that Aristotle made no contact with experience. The point is that the aim and form of explanation that makes Newtonian mechanics possible are not continuous with Aristotelian natural philosophy in the way Rovelli's narrative suggests.

5.4 The continuity premise and its rhetorical force

Rovelli's argument relies on a continuity premise that is rarely made explicit but does substantial work: If a later theory can reproduce the successful descriptive claims of an earlier framework in a restricted regime, then the earlier framework is retained as part of a cumulative development.

The premise is plausible when the earlier framework's explanatory ideals remain in place and the later theory is an extension of the same representational strategy. It becomes questionable when the transition involves a change in (i) admissible forms of explanation, (ii) the ontology of what is basic, and (iii) the status of mathematics and idealization. The Aristotelian–Galilean transition is an instance of such a change; it is therefore a poor candidate for continuity by recoverability.

The rhetorical force of the premise is easy to understand: it allows one to convert a pedagogically useful point about regimes into a sweeping moral about scientific development. Yet precisely because of its rhetorical effectiveness, it demands methodological scrutiny. Without that scrutiny, a continuity narrative risks functioning as a kind of retrospective harmonization: the past becomes a set of partial descriptions waiting to be retranslated into present terms, and genuine differences in explanatory form are treated as superficial.

5.5 Presentist genealogy and the danger of Aristotle as limit case

We can now state the deeper problem: Rovelli's continuity narrative encourages a presentist genealogy in which Aristotle becomes a kind of "limit case" of modern mechanics—valid when drag dominates and acceleration is not salient (Palacios 2024). That genealogy is attractive because it compresses historical distance: Aristotle is no longer a fundamentally different kind of thinker; he becomes an early stage in a single unfolding project of describing motion. But this compression comes at a cost: it makes the decisive conceptual shifts that constitute early modern mechanics harder to see.

In other words, the problem is not that Aristotle cannot be redescribed using modern models; he can. The problem is that redescribing Aristotle in modern terms is not the same as understanding what changed when Aristotelian natural philosophy was displaced by Galilean–Newtonian mechanics (Bertoloni Meli 2006). A presentist genealogy reads the past as an anticipation of the present. An HPS-sensitive genealogy asks how the aims, norms, and explanatory resources of physics were transformed such that certain kinds of questions ceased to count as physical questions and certain kinds of explanations ceased to be admissible within mechanics (Dear 1995; Bertoloni Meli 2006).

Schrödinger and Heisenberg, notably, do not require such genealogical smoothing. Their "returns" exploit Greek plurality to clarify a conceptual crisis: they use Greek thought to articulate alternative stances toward realism, representation, and intelligibility. Rovelli's return, however, uses Aristotle to underwrite a narrative of cumulative continuity. That difference in function explains why Rovelli's use of the Greeks is particularly exposed to the objection developed in Section 2: recoverability is not continuity.

5.6 Setting up the decisive counterexample: Aristotle to Galileo

This is why the Aristotelian–Galilean transition must be brought back into the foreground. If there is a rupture in explanatory aims—teleological natural philosophy within a stratified cosmos giving way to non-teleological, mathematized dynamics within a unified order of nature—then the continuity moral cannot be read off from regime-based overlap alone (Koyré 1968; Dear 1995). The question is not whether Aristotle had a domain in which some of his generalizations track appearances. The question is whether treating those overlaps as evidence of cumulativity obscures the transformation that enabled the emergence of Newtonian law-governed mechanics.

6. Aristotle to Galileo: Rupture in Cosmology, Causation, and the Aims of Physics

If Rovelli's continuity narrative is vulnerable, it is because the case he uses to dramatize cumulativity—Aristotle—belongs to a framework whose core explanatory aims are not continuous with those of Galilean–Newtonian mechanics. The decisive point is not that Aristotle made empirical mistakes, nor that some Aristotelian-sounding claims cannot coincide with ordinary appearances. The decisive point is that the transition from

Aristotle to Galileo is a rupture in what counts as a physical explanation and in the ontological and methodological presuppositions that structure the explanandum (Dear 1995; Palacios 2024). In this section I articulate the rupture in three dimensions: (i) cosmology (stratified cosmos versus unified order), (ii) causation (teleology and natural tendencies versus non-teleological dynamics), and (iii) aims and norms of physics (explanation as natural-philosophical account of why versus explanation as mathematically expressible lawlike relation).

6.1 Cosmology: from a stratified cosmos to a unified order of nature

A first and fundamental discontinuity concerns the structure of the world that physics is taken to describe. Aristotelian physics is not merely a set of claims about motion; it is embedded in a cosmological architecture in which the heavens and the sublunary realm are governed by different principles and exhibit different kinds of regularity (Koyré 1968; Machamer 1998). The sublunary world is the domain of change, generation and corruption, and heterogeneous motions; the celestial realm is ordered differently, displaying a distinct kind of regularity and a distinct ontological status. This stratification matters because it determines what counts as an explanatory question and what explanatory resources are admissible. The physics of a stratified cosmos is not, by default, a single unified theory of motion.

Galileo's intellectual project, by contrast, is inseparable from an aspiration to treat nature as unified in the respects relevant to mechanics. Even where Galileo's metaphysical and theological commitments remain complex, the methodological direction of his mechanics is toward uniformity of law: the same kinds of principles and mathematical relations should govern motions that earlier cosmologies treated as fundamentally different in kind. This is one sense in which early modern mechanics is oriented toward a "unified universe": not necessarily a fully modern cosmology in every respect, but a reorientation in which the explanatory division between sublunary and celestial loses its constitutive role for the study of motion (Koyré 1968; Machamer 1998).

This shift is not a minor background change. It reorganizes the very identity of physics. Under an Aristotelian framework, it is not obvious that one and the same mathematical-dynamical account should apply across the whole cosmos. Under a Galilean framework, it becomes a guiding ideal that such a unified account is precisely what physics should seek.

6.2 Causation: the exclusion of final causes from mechanics

The second discontinuity concerns causation and, more specifically, the status of final causation. In Aristotelian natural philosophy, teleological explanation is not an optional rhetorical layer; it belongs to the explanatory economy by which natural change is made intelligible (Dear 1995). Motions are connected to the natures of things, and explanation is not exhausted by a description of how motions proceed. It addresses why a body tends in a certain way—why it moves toward its natural place, why certain tendencies count as natural rather than forced, and how such tendencies express the internal principles of natural beings. Physics here is not merely kinematics; it is an account of nature as purposive order.

Galilean mechanics marks a decisive departure by reconstructing the explanatory task of physics so that final causes cease to be admissible within mechanical explanation (Dear 1995; Machamer 1998). The explanation of motion is sought not in the ends toward which bodies strive, but in lawlike relations that connect quantities under specified conditions, articulated through mathematization and idealization. This does not require Galileo to deny that nature is ordered, or to deny theological interpretations of that order. It requires a methodological restriction: whatever ultimate metaphysical or theological ground one might ascribe to the order of nature, mechanics does not appeal to purposes as explanatory resources. The very intelligibility of motion is relocated from teleological ends to mathematically expressible relations.

This methodological exclusion of teleology is not merely a philosophical preference. It is a condition of the later conceptual possibility of Newtonian mechanics. Newton's laws do not explain motion by reference to final causes; they express general dynamical constraints relating forces, masses, and accelerations (or, in more modern terms, changes of momentum) in a way that is indifferent to purposes. If one treats Aristotelian teleology as continuous with this later project, one risks confusing two different senses of "natural motion": Aristotle's natural motion as directed fulfillment of nature, and the Galilean–Newtonian notion of unforced or inertial motion as motion that requires no teleological grounding.

6.3 Aims and norms: from *why* in nature to lawlike mathematical explanation

The third discontinuity concerns not cosmology or causation in isolation, but the aims and norms of physics as an epistemic enterprise. Aristotle's physics is part of natural philosophy: it aims to articulate the principles of nature and to make intelligible the patterns of change characteristic of natural bodies. Explanation is therefore deeply connected to ontology—what kinds of things exist, what their natures are, and how those natures ground their characteristic motions. The explanatory ideal is not primarily the derivation of quantitative relations from universal mathematical laws; it is the articulation of natural principles and causes in a way appropriate to the domain of change.

Galileo's mechanics, by contrast, treats mathematization and idealization not merely as convenient instruments but as constitutive of explanation (Dear 1995; Norton 2012). To explain is increasingly to show how a phenomenon follows from a mathematically expressible relation under idealized conditions that isolate relevant factors. This is a transformation in what counts as a satisfactory answer (Wallace 1992). The shift can be described as a change in the explanatory question: from "Why does this body move as its nature dictates within a structured cosmos?" to "What general relation governs the change of motion under specified conditions, and how can it be expressed mathematically?" Once this shift occurs, the epistemic identity of mechanics changes. It becomes possible to treat explanation as lawlike structure rather than as disclosure of purpose-laden nature.

This is the sense in which the Aristotelian–Galilean transition is not well captured by regime-based recoverability. Recoverability shows that certain descriptive statements can overlap in some range of cases. It does not show that the epistemic norms governing what counts as explanation are preserved. And it is the transformation of those norms that constitutes rupture.

6.4 Why the rupture is invisible to continuity-by-reconstruction

We can now see why a continuity narrative based on modern reconstruction is likely to miss what matters. If one begins with contemporary dynamics and adds a term (drag), one can produce behavior that resembles an Aristotelian description: motion toward constant speed in a medium. But that resemblance is extensional. It concerns a kinematic pattern, abstracted from the explanatory economy in which it originally had meaning (Palacios 2024; Norton 2012).

From an Aristotelian standpoint, the interest of the pattern would be inseparable from questions about natural motion, the natures of bodies, the role of the medium, and the place of teleological explanation within physics. From a Galilean–Newtonian standpoint, the pattern is a consequence of forces, resistance, and dynamical relations expressible in mathematical form. The same observable regularity can thus be embedded in two different explanatory projects. To treat the regularity as evidence of continuity is therefore to mistake a shared output for a shared framework.

This helps diagnose the rhetorical force of claims like "Aristotle was right in everyday conditions." The claim is tempting because it points to a genuine fact about drag and ordinary experience. But it risks functioning as a category mistake: it collapses the difference between an empirically adequate generalization and an explanatory framework. One can concede the former while rejecting the latter.

6.5 Galileo's restriction of physics and the possibility of progress

The rupture described above can also be framed positively: it clarifies what made progress in mechanics possible. Galileo's refusal of the sublunary–celestial division as constitutive for mechanics, and his restriction of mechanical explanation to non-teleological, mathematizable relations, together amount to a redefinition of what physics is for (Machamer 1998; Wallace 1992). Physics is no longer tasked with preserving purposes in nature or with articulating a cosmos structured by different ontological regimes. It is tasked with articulating general relations of motion that hold across contexts under idealizable conditions.

This restriction is not a "loss" of meaning but a gain in methodological power (Bertoloni Meli 2006). It makes possible a research program in which questions about ultimate metaphysical grounds—creation, divine intention, the moral order—are not treated as conditions of mechanical explanation. Physics may coexist with theological or metaphysical interpretations, but it does not require them to do its explanatory work. In this sense, the emergence of early modern mechanics depends on a delimitation of scientific explanation: the explanation of motion is not expected to deliver proofs about God, creation *ex nihilo*, or moral purpose. It is expected to deliver mathematically articulate laws and models that unify diverse phenomena.

The point here is methodological rather than polemical. To say that mechanics does not aim at proving theological doctrines is not to claim that science and theology cannot interact historically, nor to claim that scientists did not hold theological views. It is to claim that the progress of mechanics depended on a separation between the norms of physical explanation and the demands of teleological or theological justification. This separation is part of the rupture: it marks a shift in what physics takes itself to be doing when it explains motion.

6.6 Consequences for Rovelli's cumulativity thesis

If the Aristotelian–Galilean transition is understood in this way, then the limitations of a continuity-by-reconstruction strategy become clear. Rovelli's argument invites us to see Aristotle as approximately correct in a certain regime and to treat this as evidence for cumulativity (Rovelli 2024). But the historical and philosophical significance of the transition does not lie chiefly in whether a kinematic description matches ordinary experience. It lies in the transformation of the explanatory aims and norms of physics: the exclusion of final causes from mechanics, the mathematization of explanation, and the move toward a unified account of motion.

This does not entail that the history of science is nothing but rupture, or that earlier frameworks contain no insight. It entails a more specific conclusion: the continuity that can be established by domain validity and recoverability is insufficient to ground a claim of deep historical cumulativity across frameworks whose explanatory aims are discontinuous (Crowther 2020; Palacios 2024). In the Aristotelian–Galilean case, the discontinuity is precisely what enabled the later cumulative development of classical mechanics (Dear 1995; Bertoloni Meli 2006). It is therefore misleading to treat the case as emblematic of continuity.

6.7 What the "returns" reveal

The argument of this section also illuminates the broader comparative claim of the paper. Schrödinger and Heisenberg return to Greek philosophy because modern physics forces a renegotiation of what science can say about reality. Their returns are symptomatic of conceptual openness and foundational tension. Rovelli returns to Aristotle to stabilize a narrative of cumulativity by smoothing over rupture. But the Aristotelian–Galilean rupture is not an incidental detail; it is constitutive of the emergence of modern mechanics. Recognizing that rupture does not deny that theories can be domain-valid or that later theories can recover earlier regularities. It denies that such recoverability suffices to establish continuity of physics as an explanatory project.

7. The Rhetorical and Epistemic Work of "the Greeks": Three Returns, Three Functions

Schrödinger, Heisenberg, and Rovelli all "return to the Greeks," yet their returns do not perform the same kind of epistemic work. The difference is not merely one of personal taste or educational background. It concerns the function antiquity is made to serve within an argument about physics—whether it is mobilized to (i) reopen foundational possibilities, (ii) legitimate a contested interpretation, or (iii) stabilize a historiographical narrative of continuity (Fernández Mouján 2024). This section articulates a typology of these functions and shows how it clarifies both the strengths and the limits of Greek genealogies in modern physics.

7.1 Greek philosophy as a repertoire, not an origin-story

A first guiding observation is that "the Greeks" are not a unitary intellectual source. Greek philosophy is a landscape of tensions—being and becoming, continuity and discreteness, appearance and reality, mathematization and empirical attention—and a "return" to it is never simple retrieval. It is a selective act that constructs a lineage by choosing which Greek voices count as authoritative for the problem at hand (Fernández Mouján 2024).

This has two consequences. First, Greek genealogies are productive rather than merely descriptive: they help to make certain philosophical stances in modern physics appear intelligible and historically grounded. Second, they are contestable: since Greek philosophy is plural, different invocations can support incompatible conclusions. The appeal to the Greeks therefore positions disputes; it does not by itself decide them.

7.2 Three functions of a "return": reopening, legitimation, stabilization

The cases examined here suggest three distinct functions.

1) Conceptual reopening under crisis. In a foundational crisis, "the Greeks" can function as a repertoire of conceptual possibilities that precede and exceed modern disciplinary constraints. This is the dominant function in Schrödinger and, in a different register, in Heisenberg. Quantum mechanics disrupted inherited assumptions about objectivity, determinism, and picturability; Greek debates offered a vocabulary for reframing what physics can claim about being, becoming, and the structure of knowledge (Schrödinger 1951, 1954; Heisenberg 1958; Verelst and Coecke 2006). In this function, the Greeks are invoked not to show that science steadily accumulates truths, but because the foundations are open.

2) Interpretive legitimation in contested foundations. A return can also function as a legitimizing strategy: by anchoring an interpretation in venerable lineages, a physicist can present it as continuous with deep rational traditions rather than as an ad hoc response. This is clear in the contrast between Schrödinger and Heisenberg. Schrödinger's pre-Socratic lineage authorizes an ideal of unified intelligibility; Heisenberg's Platonic–Aristotelian lineage authorizes a view centered on mathematical structure, potentiality, and epistemic limits. Here "the Greeks" provide not merely ideas but authority for competing conceptions of what physics is entitled to claim.

3) Historiographical stabilization of continuity narratives. A third function, prominent in Rovelli, uses Greek physics less to reopen conceptual options than to stabilize a narrative about scientific development: science is "largely cumulative," and even Aristotle can be rehabilitated as "right" in an appropriate domain once the relevant regime is modeled properly (Rovelli 2024). Here Aristotle serves as a crucial test case: if the most obvious counterexample can be neutralized, the continuity story gains rhetorical

force. But it is also where the argument is most vulnerable, since the Aristotelian–Galilean transition is precisely a case where rupture in explanatory aims matters most.

7.3 The performative dimension

Across these functions there is also a performative dimension: invoking Greek philosophy signals that one is addressing foundational questions rather than merely technical puzzles. Greek reference serves as a marker of philosophical seriousness and helps frame disputes as reappearances of long-standing tensions in rational inquiry. But performative depth is not historiographical evidence. The fact that modern physicists can recruit Greek concepts to support modern interpretations does not entail that the history of physics is best told as a steady accumulation of retained frameworks.

7.4 What the typology clarifies

The typology explains why Schrödinger and Heisenberg can be philosophically illuminating even when their readings of antiquity are selective: their aim is to renegotiate the conceptual possibilities of physics under pressure, not to supply a genealogy of cumulative development. Rovelli's case is different. Because it draws a historiographical moral, selective reconstruction becomes consequential: what matters is not selectivity as such, but the inference from regime-based reconstruction to continuity of explanatory aims.

The broader moral is therefore restrained. Greek genealogies can legitimately clarify options and legitimate interpretive stances. But they cannot, by themselves, establish continuity of explanatory frameworks across episodes where explanatory aims, norms of adequacy, and ontological commitments are reconstituted. In that sense, a "return to the Greeks" is best treated as a strategic epistemic act whose philosophical value depends on which function it serves and on whether the inferences drawn from it fit that function. This sets up the conclusion's central claim: domain-limited adequacy and recoverability are real virtues of physics, but they do not by themselves warrant a strong thesis of historical cumulativity across ruptures in explanatory framework.

8. Conclusion: Beyond Cumulativity—What "Returns to the Greeks" Can (and Cannot) Show

This paper has argued that "returns to the Greeks" in modern physics do not have a single epistemic meaning. In Schrödinger and Heisenberg, Greek philosophy functions primarily as a repertoire for negotiating the conceptual authority of physics under quantum-theoretical strain: Schrödinger's "Greeks" authorize an ideal of unified, observer-independent intelligibility, while Heisenberg's "Greeks" legitimate conceptual mediation through mathematical form and Aristotelian potentiality. In Rovelli, by contrast, Aristotle is mobilized to support a historiographical moral—cumulativity and continuity—by translating historical claims into modern regime behavior.

The central methodological result is that this inferential move is not licensed. Regime validity and recoverability can establish extensional agreement, but they do not by themselves establish continuity of explanatory aims, conceptual roles, or ontological architecture. Continuity, in the historiographically relevant sense, is a claim about the stability of explanatory norms—not merely about the approximate preservation of outcomes.

The Aristotelian–Galilean transformation is therefore not a marginal complication but a decisive counterexample. Even where descriptive overlaps can be reconstructed, the historical significance of the transition lies in the reconstitution of what counts as a physical explanation: teleology excluded from mechanics, mathematization and idealization made constitutive, and the aim of a unified account of motion brought into view. The broader moral is conditional rather than sloganistic: scientific change can be cumulative in predictive success while discontinuous in explanatory framework, and appeals to "the Greeks" illuminate this only when we specify the epistemic function—conceptual reopening, interpretive legitimation, or historiographical stabilization—they are made to serve.

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