The measurement problem and Agrippa's Trilemma – Return of an Ancient problem

The aim of this essay is to approach the measurement problem in quantum mechanics from an alternative perspective. I will outline structural parallels with an ancient philosophical problem, namely Agrippa's Trilemma. Following a brief introduction to this trilemma, I will provide a concise overview of selected positions in the history of philosophy, highlighting the various strategies that have been employed in attempts to resolve it. This will be followed by an analysis of the analogy and structural correspondences between interpretations of the measurement problem and Agrippa's Trilemma. I will argue in conclusion that both historical developments in physics and ongoing contemporary efforts within the field tend to displace the structural problem rather than ultimately resolve it.

1. Introduction

As Wallace (2021) observes, the philosophy of physics seeks to bridge the perspectives of the metaphysician and the physicist in order to deepen our understanding of the fundamental nature of reality. However, it is neither possible nor desirable to draw sharp boundaries between the philosophy of physics, physics itself, the philosophy of science, and the history of physics.[1] Accordingly, the aim of this essay is not to resolve the measurement problem or adjudicate among competing interpretations of quantum mechanics. Rather, it is to offer a novel perspective on these longstanding issues.

To be sure, some physicists maintain that the interpretational questions surrounding quantum mechanics are of secondary importance: David Mermin famously characterized this attitude as the "shut up and calculate" interpretation.[2] Yet such a stance is itself not free from philosophical commitments. Refusing to engage with interpretational questions constitutes, at least implicitly, an agnostic philosophical position regarding the ontology and meaning of quantum theory.

By contrast, Tim Maudlin (2019) argues that quantum mechanics, strictly speaking, is not a theory but rather a collection of quantum recipes: a mathematical predictive apparatus that physical theories must supplement in order to account for empirical phenomena adequately[3]. The central task of quantum foundations is therefore to replace the standard quantum recipe with a fully articulated physical theory. On this view, the difficulties surrounding quantum mechanics arise because its foundational questions have not been properly addressed.[3]

While this diagnosis is compelling, Wallace (2021) emphasizes that the paradoxes of quantum theory indicate that something in the conceptual framework has gone awry. Broadly speaking, two responses suggest themselves: either one revises the physics or one revises the philosophy.[4]

The present essay pursues neither of these approaches, nor does it engage with the various solutions that have been proposed. Instead, it seeks to identify and examine a point of intersection between them. My central claim is that the interpretational landscape of quantum mechanics can be understood as reproducing, in a physical and scientific context, a structural problem that has accompanied philosophy since antiquity: the problem articulated by Agrippa's Trilemma.

2. The Trilemma

Throughout the history of philosophy, a central concern has been the attempt to grasp the nature of knowledge and to distinguish cognition and knowledge from mere opinion or subjective perception. In pursuing this objective, one soon encounters one of philosophy's fundamental problems: the problem of justification[5]. Logical inference plays an essential role in the justification of beliefs and propositions and constitutes the central subject matter of formal logic[6].

If this principle of formal-logical justification is taken seriously, a further difficulty emerges: the propositions to which a statement has been reduced in order to justify it themselves require justification. This gives rise to a situation involving three alternatives, all of which appear equally unsatisfactory. This predicament is articulated by Agrippa's Trilemma, also known as the Münchhausen Trilemma[7].

Since the notion of novelty plays a central role in the acquisition of knowledge, the present essay will also relate the concept of novelty to the context of Agrippa's Trilemma. At this stage, however, any treatment beyond an intuitive understanding would require the formulation and defence of a rigorous definition of novelty, together with an account of how such novelty might be connected to quantum physics—for example, as the emergence of determinate measurement outcomes or as the establishment of genuinely new justificatory grounds.

Yet any attempt to define novelty in a philosophically satisfactory manner would itself immediately raise the very epistemic difficulties encapsulated by Agrippa's Trilemma. Rather than becoming entangled in this preliminary problem, the discussion will therefore proceed directly to an exposition of the trilemma itself.

The three horns of the trilemma are as follows[8]:

1. Infinite Regress: The search for justifying grounds continues indefinitely, leading to no ultimate or secure foundation.
2. Circular Reasoning (Tautology): One appeals to propositions that have already appeared as requiring justification, thereby generating a logical circle.
3. Dogmatic Termination: The process of justification is arbitrarily terminated at a particular point, necessitating a suspension of the Principle of Sufficient Reason. Justification is then achieved through recourse to a dogmatic assumption or stipulation.

In a subsequent step, a brief examination of selected philosophical positions will illustrate how the ancient problem known as Agrippa's Trilemma has re-emerged over the course of several decades. This will be followed by a transition toward interpretations of the quantum measurement problem.

3. A Brief Philosophical-Historical Retrospective

In this section, I aim to highlight how various philosophical positions throughout history have sought to address the problem of novelty and the acquisition of knowledge (with reference to the Agrippa Trilemma). This overview is by no means exhaustive, neither in terms of the number of thinkers discussed nor in the depth of engagement with their respective positions. Rather, its purpose is to delineate the significance of this philosophical problem. I will refrain from drawing explicit parallels to the corresponding state of the natural sciences, particularly physics. It is nevertheless important to note that, in antiquity, philosophy and science were far more closely intertwined than they are today. Moreover, philosophical reflection until the advent of quantum mechanics was almost exclusively grounded in the macroscopic world of ordinary experience. The emergence of quantum theory in the twentieth century fundamentally disrupted this framework, introducing profound conceptual challenges that continue to shape contemporary philosophy, physics, and the philosophy of physics.

In Plato's philosophy, knowledge ultimately depends upon a recourse to eternal entities, namely the forms (ideas). Within this framework, nothing genuinely novel can emerge, since true knowledge—understood as unconditional truth—can only be attained through cognition of the forms themselves. To account for such knowledge, Plato requires a locus of pure cognition, which he identifies with the soul. Whereas the body remains bound to sensory experience and can attain only probabilistic insight, genuine rational knowledge becomes fully accessible only after death. Through his doctrine of forms, Plato establishes an authoritative metaphysical hierarchy at whose summit stand the forms as embodiments of unconditional truth.[9] This appeal to eternal realities ultimately culminates in a dogmatic termination (Agrippa, Point 3).

In Aristotle, one already encounters a step that bears a striking resemblance to certain conceptual features of modern quantum mechanics. This becomes evident in his notion of *potentia*, which expresses a tendency toward a particular actualization. Aristotle's philosophy thus introduces a mode of physical reality situated between mere possibility and full actuality. As Werner Heisenberg observes, Aristotle's conception occupies an intermediate position between possibility and reality.[10]

In order to formulate a logically coherent theory of causation—according to which everything in motion must have been moved by something else—Aristotle introduces the logical postulate of the "Unmoved Mover." His statement that "one would have to proceed to infinity; therefore, there must necessarily be a stopping point" illustrates the underlying difficulty.[11] Although Aristotle explains novelty through the actualization of potentiality (*potentia*), his account ultimately relies upon an appeal to an infinite causal chain and by avoiding this in the end remains vulnerable to the problem of dogmatic termination (Agrippa, Point 3).

For Augustine, the apprehension of truth—and consequently the emergence of novelty—is possible only through divine assistance. The new originates from God and through God. According to Augustine's doctrine of illumination, God enables human beings to recognize truth.[12] Here, justification terminates dogmatically through the postulation of God, as is evident in the following passage from the

Confessiones (X.27.38): "You called and cried aloud and shattered my deafness; You flashed and shone and scattered my blindness." (Agrippa, Point 3).

Thomas Aquinas approaches the world through a logical analysis grounded in the assumption that a *regressus in infinitum* is impossible. Building upon Aristotle's conceptual pair of possibility and actuality, he seeks to explain phenomena within the world. In his proofs for the existence of God, Aquinas arrives at a first cause and an Unmoved Mover, concluding his argument with the famous statement: "And this everyone understands to be God." (Summa Theologiae I, q. 2, a. 3) Despite the considerable complexities of his philosophy of language and metaphysics, Aquinas ultimately brings the process of justification to a halt, directly or indirectly, through reference to God.[13] This constitutes a dogmatic termination of inquiry (Agrippa, Point 3).

Although John Locke's empiricism is rooted less in epistemology than in linguistic and conceptual criticism, he nevertheless appeals to experience whenever certain concepts resist further explanation. This is clearly expressed in his famous question concerning human knowledge: "Whence has it all the materials of reason and knowledge? To this I answer, in one word: from experience" (*Essay Concerning Human Understanding*, II.1.2).[14] Yet experience itself remains unjustified within Locke's framework and thus ultimately gives rise to an infinite regress (Agrippa, Point 1).

Leibniz explains novelty through combinatorial processes. In doing so, he seeks to extend the concept of probability beyond its Aristotelian framework by grounding it in both the analysis of empirical data and the Principle of Sufficient Reason. Truth, in the strict sense, would then appear as a limiting value among degrees of probability. At the same time, Leibniz's doctrine of monads reveals that he requires the postulation of God in order to preserve the coherence of his rationalist system.[15] Consequently, his account culminates in a dogmatic termination of justification (Agrippa, Point 3).

Kant relocates the source of novelty and knowledge to the constitutive activity of the subject. This occurs through a universal framework that secures the unity of all empirical cognition and theoretical construction while itself remaining non-empirical, that is *a priori*. The subject thereby generates a transcendental structure: an ordering function that first belongs to the understanding and subsequently to reason, producing the unity necessary for experience and knowledge.[16]

At this point, one might argue that Kant's position also involves a dogmatic termination, insofar as transcendental philosophy places the subject at the center of the epistemological enterprise (Agrippa, Point 3). However, Kant simultaneously appeals to the use of logical rules and regards logic as the guiding framework of philosophical investigation. From this perspective, the Agrippan challenge may reappear in the form of circularity: formal logic itself would seem to require justification. Kant, however, presupposes the principled limitation of logic to its purely formal function and therefore does not regard this as a vicious circle (Agrippa, Point 2).

The element of circularity (Agrippa, Point 2) becomes even more apparent in Hegel, for whom novelty emerges through contradiction and dialectical self-development. Hegel's dialectic does not rely upon the merely contradictory or contrary oppositions familiar from formal logic. Rather, negation is understood as a determinate negation endowed with content, generating a new concept that is richer and more comprehensive than its predecessor precisely because it incorporates that negation. In Hegel's account, each new form of consciousness arises from the experience of a consciousness that has become self-contradictory.[17]

I think, no further examples seem necessary to illustrate the historical and philosophical significance of the difficulties encapsulated by Agrippa's Trilemma. In the following section, I will briefly introduce the measurement problem as the object of further investigation. In the final section, I will argue that the principal interpretations of the measurement problem in quantum physics reconstruct, in a physical form, the very trilemma that has accompanied philosophical inquiry since antiquity.

4. The measurement problem

To be sure, the very existence, formulation, and significance of the measurement problem already depend upon a particular interpretative framework. Nevertheless, it is important to emphasize the historical role that the measurement problem has played within the development of modern physics. Since the emergence of quantum theory, perhaps the only point on which physicists have consistently agreed is their disagreement concerning its proper interpretation.

Faced with the conceptual paradoxes of quantum mechanics, physicists may be inclined to conclude that something is fundamentally amiss with the theory. Yet the extraordinary empirical success of quantum mechanics has rendered any attempt to modify or replace it exceedingly difficult. Preserving its unparalleled predictive power while simultaneously resolving its conceptual difficulties is far easier proposed than achieved.[18]

For the purposes of the present investigation, I will not engage in a detailed analysis of the various formulations of the measurement problem. Rather, in order to prepare the ground for the subsequent discussion of Agrippa's Trilemma, I will first provide a brief outline of the measurement problem and the challenges it presents.

Very generally spoken quantum mechanics makes correct predictions for averages, in spite of having nothing definite to say about individual cases.[19] At the same time the wavefunction may represent some aspect of the real physical situation of individual systems.[20]

Tim Maudlin (2019) formulates the measurement problem as arising from the joint acceptance of three claims that appear individually plausible but mutually incompatible when taken together. First, quantum mechanics is taken to provide a complete physical description of a system via its wavefunction. Second, the wavefunction evolves always and universally according to the linear Schrödinger equation, without exceptions. Third, however, measurements yield definite, determinate outcomes: when an observation is made, we experience a single, well-defined result rather than a superposition of outcomes. Maudlin shows that these three commitments cannot all be maintained simultaneously. If the wavefunction evolves linearly and is complete, then measurement interactions also lead to superpositions of macroscopic outcomes. Yet such superpositions are not observed. Conversely, if definite outcomes are taken as fundamental, then the universal validity of the Schrödinger dynamics must be modified or supplemented.[21]

At this juncture, it is worth clarifying why the present essay deliberately refrains from examining whether—and, if so, how—the rejection of each of Maudlin’s three assumptions might be mapped onto one of the three horns of Agrippa’s Trilemma (for example, the denial of universal linear evolution as a form of dogmatic termination, the denial of completeness as giving rise to circularity or infinite regress, or the denial of determinate outcomes as entailing regress). Such an analysis would shift the structural analogy from the various interpretative frameworks of quantum mechanics to Maudlin’s own formulation of the measurement problem itself.

The central claim advanced in this essay is more limited and more specific. It concerns the structural correspondence between the principal interpretative frameworks that have coexisted throughout the past century and the three epistemic strategies identified by Agrippa’s Trilemma. It is to this analogy that Section 5 now turns.

5. Interpretive Frameworks and Analogies to the Trilemma

5.1. Collapse Theories

For Maudlin (2019), collapse theories retain the wave function as a physically real entity while modifying the Schrödinger dynamics. The linear and deterministic evolution of the wave function is not universally valid; instead, it is interrupted by genuinely stochastic and physically real collapse events.

In Maudlin's presentation, the principal philosophical challenge is not the collapse mechanism itself but the problem of identifying local beables—entities localized in ordinary three-dimensional space-time that constitute the material world. There exist various interpretations and strategies to encounter the measurement problem.[22]

Following this strategy, the need for explanation has been translated to the identification of the local beables, while accepting a real collapse event by pure random. This pure randomness, viewing on the Agrippa Trilemma, corresponds to a dogmatic termination. (Agrippa, Point 3).

5.2. Pilot-Wave Theories (de Broglie–Bohm Theories)

Unlike collapse theories, pilot-wave theories retain the exact Schrödinger dynamics and supplement the quantum state with additional variables specifying the actual physical configuration of matter.[23] Within the de Broglie–Bohm framework, reality consists of two fundamental elements: a universal wave function and a determinate configuration of particles distributed in physical space. At every moment, particles possess definite positions, and measurement outcomes correspond directly to these configurations. Consequently, no physical collapse of the wave function occurs.[23]

From this perspective, the theory does not explain the emergence of novelty at the moment of measurement; rather, it rejects the very premise that such novelty emerges. What is commonly interpreted as a transition from possibility to actuality is redescribed as the epistemic disclosure of an already determinate ontological state.

Nevertheless, the introduction of a universal guiding wave function ultimately leads, albeit at a different stage than in collapse theories, to what may be characterized as a dogmatic termination (Agrippa, Point 3). When confronted with the question of how the guiding influence can depend instantaneously upon the global state of the universe, the theory offers no deeper explanatory mechanism. Its ontological response is simply that reality is constituted in precisely this manner: the universal wave function exerts a holistic guiding influence on particle motion, and this basic feature is accepted as an irreducible fact about the world's structure.

5.3 Many-Worlds Theories (Everettian Quantum Mechanics)

According to Maudlin's analysis the Everettian interpretation preserves the Schrödinger equation without modification and therefore dispenses entirely with collapse processes. The evolution of the universal quantum state remains strictly unitary and deterministic at all times. During a measurement interaction, the universal wave function develops into a superposition of macroscopically distinct branches, each corresponding to a different measurement outcome. Crucially, no branch is eliminated: every branch persists, and every physically possible outcome is realized within some branch of the universal state.[24]

The Everettian framework thus avoids both stochastic collapse and hidden variables by treating the universal wave function as the sole fundamental ontology. However, this solution comes at the cost of an ever-expanding multiplicity of branches, each requiring further specification and interpretation. The proliferation of branches is not an accidental by-product but a constitutive consequence of the theory itself. What from the Everettian standpoint represents a fundamental ontology, from an epistemological perspective appears as an infinite regress (Agrippa Point 1).

5.4. Observer-dependent approaches

Wheeler inherited Bohr’s rejection of naive realism and embraced Niels Bohr’s well-known dictum that “no phenomenon is a phenomenon unless it is an observed phenomenon,” while extending it into a more explicitly participatory conception of reality. He interpreted the quantum measurement problem as indicating that physical reality is not fully determined prior to observation. In this sense, the experimentalist’s choice of measurement is not merely a passive act of discovery but plays a constitutive role in the emergence of physical phenomena.[25]

As Zeilinger (2004) emphasizes in his discussion of Wheeler’s position, however, it is not the observer’s consciousness that influences the quantum system. Rather, by selecting the experimental arrangement, the observer determines which phenomenon can manifest itself. Zeilinger further argues that an infinite regress of ever smaller constituent systems is untenable. Instead, this regress terminates at the point where a system is defined as carrying only a single bit of information, encapsulated in Wheeler’s famous slogan “it from bit.” Within this informational framework, there is consequently no room for hidden variables that would determine physical properties independently of the measurement context.[25]

Measurement –within the observer-dependent approaches– is not a passive revelation of pre-existing properties but an act of observer-participation through which definite facts emerge from quantum possibilities. In his participatory-universe framework, observers are constitutive elements of reality itself, and the measurement problem points toward a fundamental connection between observation/measurement, information, and existence. The claim that the outcome of the measurement (reality) is constituted through observation faces a potential difficulty: observation is itself a physical process embedded in reality. Reality thus becomes both the explanans and the explanandum, giving rise to an apparent circularity in the account (Agrippa, Point 2).

6. conclusion

By identifying a fundamental structural feature of the measurement problem, the present essay has sought to demonstrate that a central question—namely the origin of “novelty,” interpreted through the lens of Agrippa’s Trilemma—pervades both the historical development of physics and contemporary interpretative debates in a particularly salient manner. The main thesis advanced here suggests a recurring pattern in the evolution of interpretations of the measurement problem, characterised not by its resolution but rather by its systematic displacement.

In this sense, the Agrippan framework is proposed as a heuristic device for historians and philosophers of physics, enabling a more structured classification of interpretative strategies and a clearer understanding of why a definitive resolution continues to remain elusive.

A likely objection to the present essay is that it fails to provide a rigorous definition of novelty (Instead, I advocate a dogmatic termination based on an intuitive cognition of novelty, regarding Agrippa's Trilemma to be inherently insurmountable), does not offer an unequivocal assignment of individual cases to the branches of the Trilemma and that its argument ultimately culminates in either infinite regress or circularity. I concur with this assessment. However, this objection does not undermine the argument; it rather confirms its core claim.

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[1] Wallace, David. *Philosophy of Physics: A Very Short Introduction*. Oxford: Oxford University Press, 2021, p.3.

[2] Wallace, David. *Philosophy of Physics: A Very Short Introduction*. 2021, p.130.

[3] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. New Jersey: Princeton University Press, 2019, p.224.

[4] Wallace, David. *Philosophy of Physics: A Very Short Introduction*. 2021, pp.120.

[5] Albert, Hans. *Traktat über kritische Vernunft*. Tübingen: Mohr Siebeck, 1991^{5} , p.9.

[6] Albert, Hans. *Traktat über kritische Vernunft*. 1991^{5} , p.13.

[7] Albert, Hans. *Traktat über kritische Vernunft*. 1991^{5} , pp.13-15.

[8] Albert, Hans. *Traktat über kritische Vernunft*. 1991^{5} , pp.15-16.

[9] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 1: Antike. Hamburg: Felix Meiner Verlag, 2003, pp. 221–223.

[10] Heisenberg, Werner. *Quantentheorie und Philosophie*. Stuttgart: Reclam, 1979, pp.17-18).

[11] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 1: Antike., 2003, pp.292–294.

[12] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 2: Christliche Antike-Mittelalter. Hamburg: Felix Meiner Verlag 2003, pp.67–70.

[13] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 2: Christliche Antike-Mittelalter. 2003, pp.395–398.

[14] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 3: Neuzeit. Hamburg: Felix Meiner Verlag 2003, pp.201-203.

[15] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 3: Neuzeit. pp.250-260.

[16] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 3: Neuzeit. pp.335-339.

[17] Schupp, Franz. *Geschichte der Philosophie im Überblick*. Band 3: Neuzeit. pp.389-392.

[18] Wallace, David. *Philosophy of Physics: A Very Short Introduction*. 2021, p.115.

[19] Smolin, Lee. *Einstein's Unfinished Revolution: The Search for What Lies Beyond Quantum Physics.* London: Penguin Books, 2019, p.63.

[20] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. 2019, p.80.

[21] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. 2019, pp.36-78.

[22] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. 2019, pp.94-136.

[23] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. 2019, pp.137-172.

[24] Maudlin, Tim. *Philosophy of Physics: Quantum Theory*. 2019, pp.173-204.

[25] Zeilinger, Anton. *Why the quantum? "It" from "bit"? A participatory universe? Three far-reaching challenges from John Archibald Wheeler and their relation to experiment.* Science and Ultimate Reality Quantum Theory, Cosmology, and Complexity, Cambridge: Cambridge University Press, 2004, pp. 201 – 220.

Addendum (Congratulations if you've made it this far!)

In the arts, the problem outlined above—the trilemma—becomes a mode of practice. Art is compelled to produce novelty continuously, even though the origin of that novelty remains fundamentally uncertain.

Many artistic traditions conceive of the new as variation. Analogous to the regress model, genuine novelty does not emerge here; rather, every work has a predecessor from which it derives. In artistic practice, development takes the form of remixing, quotation, stylistic variation, recourse to tradition, and the transformation of existing forms. The question of an ultimate beginning is effectively bracketed.

Other aesthetic movements, by contrast, understand the new as a radical rupture. They assert: "This has never existed before." Innovation and genius move to the foreground, while the creative act itself becomes the central focus. Yet the question remains: where does this act originate? At this point, a dogmatic termination of inquiry occurs, positing creativity within the human individual as its ultimate source.

A further axis conceives novelty as arising through context and perception. Here, the new does not emanate from the object itself but is constituted in the act of seeing. Meaning thus becomes dependent upon the observer: context an interpretation generate novelty. Something becomes new because it is interpreted in a new way. The difficulty with this position is that the observer is simultaneously part of the very world being explained, thereby introducing a form of circularity.

Nevertheless, art is under the constant imperative to generate novelty. As a consequence, genuine innovation in artistic production is elevated to the status of a fundamental principle, even though its origin remains unresolved. At this point, David Mermin's famous interpretation of quantum mechanics[2] re-enters the discussion: "Shut up and calculate." Transposed into the domain of artistic practice, the maxim becomes: "Shut up and create art."