

Oh, Inverted World!: The Issue of Correspondence between Scientific Law and Ultimate Reality from Plato to Quantum Mechanics

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Overview: The Issue of Correspondence

It may help to think of the following paper as being loosely divided into two main parts. First, I introduce the problem of a scientific knowledge of ultimate reality¹ in a philosophical context. Having framed the issue of correspondence between objects of scientific law and objects of ultimate reality using the philosophies of Plato, Kant, and Hegel, I proceed to look at how classical and quantum physics deal with this issue of correspondence.

I begin by discussing Plato's *Theaetetus*, in which Socrates and Theaetetus fail to explain how the knowing self can give certainty to particular knowledge claims. Certainty requires that the object of knowledge have both *truth* and *being*; a certain knowledge claim is one whose object correctly corresponds to an object that exists in ultimate reality. I illuminate the *Theaetetus*' issue of correspondence with the critical philosophy of Immanuel Kant in his *Critique of Pure Reason*, and show that Socrates and Theaetetus' inability to account for *certain* knowledge is due to the inherent impossibility of reaching a level of noumenal knowledge—knowledge of ultimate reality. Unable to access ultimate reality, the understanding—the faculty that produces knowledge in Kant's system—can say nothing about knowledge's certainty, i.e. its truth *and* being. Specifically, the understanding cannot claim that its objects of knowledge correspond to noumenal objects, objects of ultimate reality.

Therefore the objects of scientific law, even if they are given a priori necessity² (I explain how this is possible in the discussion of Kant's *Metaphysical Foundations*), cannot be given certainty, since they cannot be said to exist in ultimate reality. If scientific laws operate in a universe of objects possibly apart from reality, what faith can we put in science as a description

¹ By “ultimate reality”, I mean reality insofar as it is essential and in itself. Ultimate reality does not depend on interpretation and exists apart from one's interpretation. The term is basically equivalent to Kant's noumenal world. I take Plato's abstract world of forms and Hegel's world qua “absolute notion” to both be expressions of ultimate reality.

² I.e., the necessity of the truth of scientific laws is known without having to appeal to experience.

of reality? Just like Kant's knowing self (the understanding), the Hegelian knowing self, Consciousness—the subject of the *Phenomenology of Spirit*³—fully realizes the gap between the world of Kantian scientific law and the noumenal world in the section of the *Phenomenology* entitled “Force and the Understanding”. But whereas Kant's knowing self was content with the mere acknowledgement of this gap, Hegel's Consciousness is seriously troubled by the gap. When Consciousness realizes that noumenal reality can be different from the world its laws explain, it posits the existence of an “inverted world”, where everything is opposite: black is white and north is south. I explain this admittedly absurd conception as the necessary outcome of Consciousness' refusal to recognize its own role in the process of scientific law formation in its quest to gain knowledge of noumenal reality.

The *Phenomenology*'s Consciousness is able to overcome the inverted world, and eventually reach the level of *absolute knowing*, in which its knowledge is completely united with the noumenal world. But I argue that this leap occurs only within Hegel's philosophical imagination, and therefore we cannot extrapolate his conception of absolute knowing to help illuminate the issue of correspondence between scientific law and ultimate reality. The conception of absolute knowing was not seen in or derived from the scientific laws in “Force and the Understanding”, but instead comes about only through the development of such structures as morality, culture, and Christianity. For Hegel, scientific laws do not correspond to ultimate reality—the Notion, the completely developed absolute concept that grasps noumenal reality, comes about only through religion.

³ The *Phenomenology of Spirit* is sometimes understood as a Bildungsroman, a German coming of age novel, whose protagonist, Consciousness, undergoes significant psychological, moral, and intellectual growth. In this vein, I generally present “Consciousness” as a capitalized proper noun, to stress the fact that it should be conceptually understood as a subject (though “subject” is not a term that Hegel uses) that is actively engaging in its quest for absolute truth.

Having framed but not solved the problem of scientific knowledge of reality using Plato, Kant, and Hegel, I outline the development of modern physics. Using Heisenberg's *Physics and Philosophy*, I compare classical and quantum mechanics' respective claims to scientific realism. Kant offers an account of the scientific realism of classical mechanics in his *Metaphysical Foundations of Natural Science*, in which he gives a priori certainty to scientific laws. I compare this project to parallel efforts by Heisenberg and others to establish the degree of realism present in the scientific laws of quantum mechanics. Looking at the Copenhagen interpretation of quantum mechanics (the standard interpretation), it seems that quantum mechanical laws do not contain universal a priori necessity, the criterion for scientific realism. I then explore the possibility of addressing this failure through **modal interpretations** of quantum mechanics (defined and explained in the section on scientific realism).

While classical mechanical laws are objective and a priori, quantum mechanics notes that the observer actually affects the outcome of events on a quantum level. Quantum mechanics describes fundamental reality as probabilistic in itself, wherein particular descriptions of quantum states are dependent on the observational circumstances. The role of the observer, a non-issue in classical mechanics, in quantum mechanics can be said to lead to a sort of epistemological relativism, in which scientific laws and equations, even given enough information about the initial conditions of a quantum system, cannot predict the outcome of events.

While the certainty of classical mechanics was proved not to apply to very small scales, quantum mechanics more accurately explains quantum phenomena but loses the a priori certainty that classical mechanical laws contained. To try to understand better understand the apparent epistemological relativism of quantum mechanics and the implications of such a relativism, I

introduce Nietzsche's "perspectival" epistemology. By combining Nietzsche's idea of "gay science" with David Bohm's modal interpretation of quantum mechanics, I offer Bohm's idea of "wholeness" to explain ultimate reality, and outline possible criteria for the positive future development of quantum mechanics.

Given the enormity of the topic and scope of this paper, I do not claim that it is in anyway way a comprehensive analysis of scientific realism, the development of quantum mechanics, or the idea that I call correspondence. Instead, this paper is an arena of interplay between major thinkers that I have studied and researched in regard to an issue that I see as fundamental to the philosophy, history, and future of physics. While its scope is very much limited as a result of this, I do not think this necessarily detracts from my aim, which is comparative and exploratory, and not comprehensive.

Furthermore, given the range and complexity of the texts in my paper, and the finite (though considerable) time and sanity that it has take me to complete this paper, certain terms and organizational strategies that I use may at first glance seem arbitrary or abstruse. If this is the case, I urge the reader at these times of uncertainty to continue to push forward. I fear that through my reading of philosophy I have adopted the German approach to writing, where the complexity of the subject matter is fully disclosed and not resolved until the end of a sentence, or a section, or a book. Page 51 contains two comparative tables to serve as a reference and visual aid to the reader. One table outlines the areas of tension between phenomenal knowledge and ultimate reality in the epistemologies of Plato, Kant, Hegel, and Nietzsche. The second table compares the tension between scientific knowledge and ultimate reality within the scientific laws of classical and quantum mechanics.

***Theaetetus*' aporia as gap between phenomenal knowledge and higher knowing**

In the *Theaetetus*, Socrates and his bright young interlocutor seek to understand what constitutes knowledge. In trying to get at the essence of knowledge, they formulate various definitions, introducing multiple metaphors to paint a picture of the process of knowing—but all of the definitions and metaphors encounter their own particular problems. The dialogue ends in aporia, when Socrates and Theaetetus realize that each definition of knowledge has led them no closer to its essence. Still, Socrates reflects, Theaetetus is better off than he was, because he is now relieved of his false ideas, his “wind eggs” (210C).⁴ But what can we as readers take away from the dialogue, apart from knowing what knowledge is *not*? The answer to this question can be grasped by looking at the shortcomings of each definition. Just as the *Critique of Pure Reason* can be seen as Kant's vindication of reason by means of outlining reason's limits, let us view the *Theaetetus* as an effort to uncover what we *do* know about knowledge by outlining the shortcomings in our existing conceptions.

In so doing, we find that the uncertainty and contradictions come not from the content of knowledge, but from the inability to attain a sort of knowledge that can differentiate true knowledge and false opinion. Socrates is relatively certain that we can know some things are true, and takes statements like $5+7=12$ to be pieces of certain true opinion. This appears to be one instance of alignment between a particular knowledge claim and a piece of fundamental reality, via access to the world of mathematical forms. But he is curious as to how some people, when computing $5+7$, can claim the answer to be 11. We can claim this answer is wrong, by comparing it to the universally accepted answer of 12, but how, Socrates wonders, can we

⁴ My citations for Plato, Kant, and Hegel refer to the section or paragraph number, not to the page number, so as to allow for easier cross-reference on the part of the reader.

possibly differentiate true and false opinion within ourselves, if we are prone to committing errors such as this?

Socrates and Theaetetus conclude the dialogue without a definition of knowledge that feasibly allows for the proper sorting through of the pieces of opinion, knowing which pieces we can claim as knowledge and which pieces are false opinion. The problem is not with knowledge qua actual *pieces* of knowledge—Socrates has no doubt that such pieces of knowledge exist and are attainable—but with an substantial, reliable overlying knowledge of one's own true and false opinion, a knowledge capable of differentiating true knowledge from false opinion within the mind.

I think this conclusion is incredibly interesting, and exceedingly relevant in light of the development of philosophy following Plato. Since Descartes especially, the study of one's knowledge of knowledge has been a major concern within epistemology. How can the self step outside itself as it were to endow its knowledge claims with certainty? For Descartes, the most immediate certainty is the self's own existence—and for Kant, one could argue that the intuitions and categories, the most fundamental components of the knowing self (more on this later), are more certain and immediate to the self than its perceptual knowledge. Why does the self not hold the same attitude of immediate certainty toward its perceptual/scientific knowledge? In the *Theaetetus*, Socrates and Theaetetus fail to reach that desired level of certainty for perceptual knowledge—yet the discussion does not end in frustration. Instead, Socrates verbally accepts the formal conclusion of the dialogue, namely the inability to account for an overlying knowledge of knowledge, while praising the art of dialectic that led to that conclusion. Socrates the Midwife

has purged Theaetetus of his “wind-eggs”⁵, leaving him in a cleansed and humble state for his future endeavors (210C).

In light of the *Theaetetus*’s negative formal conclusion, namely the inability to account for an overlying knowledge, Socrates highlights a positive result by pointing out the benefits of his dialectical midwifery. Although this dialogue did not lead to the desired conclusion, we find in this appraisal a hint as to why. No matter how many angles the two took, how many redefinitions of knowledge or metaphors for knowing they put forth, they were unable from their analysis of knowledge to get to a proper knowledge of knowledge—an overlying self-conscious knowledge, able to differentiate false opinion from true. I contend that their failure to get to an overlying knowledge is not because of a logical shortcoming on the part of the dialogue’s participants, but because of the inherent impossibility of achieving certainty in knowledge claims rooted in perception—the absolute certainty that Socrates is aiming for, of alignment between the knowledge claim and his hypothesized ultimate reality, the abstract a priori ideal world of forms.

From Plato to Kant

The goal of the *Theaetetus* is to give a rational account of perceptual knowledge that endows it with truth and certainty. The subsequent development of modern philosophy saw the divergence of the two modes of thought at play here: rationalism, the appeal to logic as the source of knowledge, and empiricism, the appeal to sensory experience. The conflict between the two theories of knowledge is precipitated by Plato, who wished to provide objects of empirical knowledge with actual being and empirical knowledge claims with the certainty of a sound logical proof. Empiricists such as Hume and Berkeley acknowledge the difficulty in moving

⁵ The Greek word “oúríon ὄν” —also an idiom for flatulence—refers to an egg that does not hatch, because it was believed to be conceived by the wind. Socrates uses the term to refer to ideas that contain no life.

beyond appearance to make rational claims about an object's inner essence. The problem of extracting truth from perceptually-rooted knowledge claims, laid out in the 115 pages of the *Theaetetus* and realized in the divide between rationalism and empiricism, was taken on in the grandest manner possible 2,000 years after Plato, in Kant's critical philosophy. Kant wished to account for and systematize all knowledge, the total pure set of which he divided into the three branches of philosophy: pure reason, practical reason, and pure judgment, corresponding to epistemology, ethics, and aesthetics.

In the *Critique of Pure Reason*, Kant synthesizes the ideas of the empiricists and the rationalists to provide a complete account of how we can come to know something. In the *Theaetetus*, Socrates and Theaetetus try to give a rational account of knowledge, and in so doing they expose the difficulty in reaching an overstanding of knowledge⁶ through analysis of perceptual knowledge. Kant's project in the *CPR* was to reconcile the dichotomy between perception and a priori reasoning.

All knowledge, Kant argues, begins with experience. But without the mind's ability to organize and conceptualize experience, perception is impossible. These two claims establish the necessity of both doctrines, empiricism and rationalism, since both experience and thought are prerequisite to knowledge. In order to experience the world and make sense of experience, the mind needs the faculties of sensibility and understanding. Sensibility provides the pure forms of intuition, namely space and time, which are necessary for all experience or cognition, Kant contends, since nothing can be perceived or thought without them.

The understanding is an active mental faculty that forms concepts and applies the concepts to objects. The process of the understanding can be divided into the three following

⁶ I use the word "overstanding" here to mean "overlying understanding"—an understanding that stands above the particular knowledge claims of the rational self.

stages. It is important to note that the process of the understanding, like the process of sensibility, occurs instantaneously, and so the following stages are dependent on each other not temporally but logically. Sensibility first provides the understanding with the *matter* and *forms*⁷ of given phenomena of experience. The understanding then synthesizes the manifold of sense-perceptions into coherent representations. Next, the imagination compares, differentiates, and brings together various representations to synthesize concepts. This active formation of concepts is framed by the twelve derived categories, which act as the rules through which synthesis is possible. With concepts, the mind is then able to represent objects of experience in the process of recognition.

These three stages of understanding describe the formation of all knowledge claims, from a simplistic statement like, “That is a tree” to a multi-faceted scientific law. In both cases, the concept produced by the understanding was initiated by phenomenal experience. Despite the fact that all knowledge claims are thus rooted in experience, this is not to say that all knowledge claims are *derived* from experience. It is possible for the understanding to produce knowledge claims that are *a priori*, meaning they can be understood without *reference* to experience. Whether a concept is apprehended directly from experience or derived without recourse to experience, the concept applies to phenomena, *not* to objects in themselves.

Kant likened this epistemological reformation to the Copernican Revolution in science, and in his second preface to the *Critique* summarized previous epistemological efforts thus: “Hitherto it has been assumed that all our knowledge must conform to objects. But all attempts to extend our knowledge of objects by establishing something in regard to them *a priori*, by means of concepts, have, on this assumption, ended in failure” (Bxvi). This provides an explanation of Socrates and Theaetetus’ failure to extend their perceptual knowledge objects to

⁷ Matter is the raw sensation of an experience, while form is the way in which we grasp the experience. For example, shape and color are the matter of a visual observation while space is the observation’s form.

an a priori overstanding of that knowledge. The two fail to gain such an overstanding of knowledge because, according to Kant, it is impossible to gain transcendental knowledge about the *Ding an sich*—thing in itself—since we can only come to understand things through the faculties of our own mind.

So it appears that, although Kant provides a systematized account of the process of knowing, pure knowledge of things in themselves can never be attained, since knowledge deals only with phenomena. In Kant's transcendental idealism, all objects external to the self are regarded as presentations, not things in themselves. (A368). Transcendental realism (which I will later explain to be "metaphysical realism"), on the other hand, "regards both time and space as something given in itself," and "conceives outer appearances as things in themselves that exist independently of us and of our sensibility" (A369). The transcendental realist asserts that the external objects must have existence in themselves, despite the fact that they cannot directly sense nor logically prove that existence.

We can understand the *Theaetetus*, then, as an inability to accept the doctrine of transcendental idealism. Socrates and Theaetetus are striving for a grounding of knowledge in something beyond experience—they point out the epistemological relativism that would result from accepting Protagoras' idea that man is the measure of all things (160A)—and are not content with accepting the objects as representations of unknown things in themselves. Theaetetus and Socrates take numerous creative measures to try to get to certain knowledge of things in themselves from the mind's representations, so I think it would benefit us to look at several of attempts to do so with our freshly donned Kantian lens.

Socrates' wax metaphor offers an account of the process of perception, wherein particular observed phenomena are imprinted in the mind's memory, its block of wax, in particular

locations. Once fully imprinted, the perceptions become objects of knowledge, which can be recalled when the mind wishes; false opinion arises when the mind mismatches a perception to its impression. But this model of perception is flawed, Socrates claims, because the simple one-to-one correspondence of perception to thought does not adequately describe the errors that arise between thoughts themselves (196C). This is not a central problem for Kant; the mind has recourse to internal faculties through which it can sort through concepts and provide clarity in thought. But clearly Socrates' metaphor is insufficient, since it has no faculty that allows the mind to sort through its own knowledge. So Socrates posits the birdcage metaphor.

Thoughts are no longer static localized imprints, but are instead dynamic living beings, birds, flying amongst one another. Knowledge is recalled by recapturing the specific pieces of knowledge—the particular birds in the cage that represent pieces of perceptual knowledge. Although this metaphor is more vivid and dynamic, there still seems to be no way for the mind to tell whether a bird represents a piece of true knowledge or a false opinion (199D). One way to eliminate false opinion is to say that there are only birds of true knowledge—but this does not explain the undeniable prevalence of false opinion among people. So the cage must contain birds of both true and false opinion, Theaetetus reasons (199E). But with birds of both true and false opinion present in the mind's cage, the mind must have a third birdcage, Socrates claims, which has knowledge over the other (200B). But this third set of birds in turn requires a fourth birdcage that has knowledge over it, and a fifth, and so on, *ad infinitum*.

With a Kantian understanding, we can see that this idea of a third cage is not as ludicrous as Socrates makes it out to be—though we cannot deny that the metaphor's oversimplification of the process of knowing dooms it to failure (in its inability to reconcile true and false opinion). While Socrates' birdcage metaphor merely points to some one who possesses the birdcage and

retrieves knowledge, it does not describe who or what exists outside of the cage—nor does it discuss the process of retrieval in much detail. But if we transpose Kant's process of the understanding onto Socrates' birdcage metaphor, we see that it is necessary to explain what exists outside of the birdcage.

The possessor of the birdcage is the mind, which is neither empty nor simple. The mind has the faculties of sensibility and the understanding. If we take the birdcage metaphor literally, we note that sensibility is necessary to provide the bird-catcher with intuitions that allow him to perceive and make sense of the birds that he wishes to capture. The bird-catcher uses his equipment, his faculties, to capture a bird, to translate the phenomenon of experience into a coherent representation. Following this capture, the representation is reconciled with other representations by the imagination, which synthesizes the manifold representations to create concepts. So perhaps, still going with the metaphor, it is only these concepts generated by the imagination that make it into the cage.

We see in this process no reason for any bird to represent a piece of false opinion, if the representation produced is accurate and placed in a proper relation to other representations. But since, as we note, false opinion does exist, we admit the possibility of an inaccurate representation, a clumsy capture. But even after recognizing this possibility, we do not have to abandon the metaphor at the point Socrates does. The problem with the metaphor is that there is no mechanism outside the birdcage to tell which birds represent true opinion and which represent false. But Kant's understanding does have tools with which it can perform such an analysis. It has transcendently-deduced categories, which it can use as points of reference for comparing representations.

We can see how Kant's self, composed of the faculties of sensibility and understanding—and all the tools that each faculty contains, the former containing intuitions and the latter containing categories and concepts—is able to systematize its knowledge and act as arbiter with recourse to these internal faculties. With Kant's self, the problem with the birdcage metaphor is not the inability to tell true from false opinion, since his knowing self has internal faculties to use for this purpose. We can conceive of these faculties in the metaphor as the proposed second birdcage, which contains a priori concepts created by the understanding. These birds are not representations, but conceptualizations, with which the birds of the first birdcage can be compared. And beyond this, the possessor of the cages has his own faculties, namely intuitions and categories given by the transcendental deduction, which provide the needed check on the second birdcage without the issue of infinite regress. Socrates' bird-catcher, on the other hand, has no such faculties, being himself barren.

Inverted world: Kantian scientific law in “Force and the Understanding”

Kant's critical philosophy succeeded in nearly every respect he could have hoped for. His epistemological model synthesized the competing empirical and rationalist frameworks, and his transcendental idealism became the new standard in continental epistemology. Kant had vindicated the knowing self by outlining its limits and illustrating its dependence on perception, while endowing it with the intuitions and categories necessary to make meaningful knowledge claims. In stating that we cannot know the thing in itself, Kant steered knowledge acquisition toward a new kind of rational empiricism, one that uses synthetic a priori reasoning to formulate laws of logical necessity, which are in turn verified by observation. The Socratic question of self-knowledge became less relevant, since the self was dealing with universal a priori knowledge.

The traditional dialectical process was not necessary in Kant's system. And indeed, his epistemological model of synthetic a priori knowledge, formulated in universal scientific laws and in turn verified by experience, revolutionized epistemology, ethics, and aesthetics—and Kant's dominance in these fields went nearly unchecked in Germany until several notable Kantians sought to vindicate Kant's system, as it were, by exposing its weaknesses and outlining its limits.

One such German was G.W.F. Hegel, whose *Phenomenology of Spirit*, written 26 years after *CPR*'s first release, sought to describe the entire process of knowing by examining how consciousness' system of knowledge is constructed, starting from the most basic forms of knowledge and culminating in absolute knowing. The first stage of knowing is sense-certainty, wherein consciousness takes knowledge to be simple immediate sensory inputs. This type of knowledge falls apart, however, when consciousness realizes that it cannot *say* anything about an object while allowing the object to retain its simplicity. It cannot even say that it exists, since to say that requires the contexts of time and space (forms of intuition for Kant).

Consciousness then moves to the stage of perception, where it recognizes the object's relation to other objects and tries to systematize its mess of sense-data into meaningful concepts. Throughout the processes of sense-certainty and perception, the reader of the *Phenomenology*—the philosophical observer of the text's protagonist, Consciousness—could plainly see that Consciousness was inexorably involved in its apprehension of an object in the outside world (132). But Consciousness at the stage of understanding is still naïve enough to think otherwise, or is in denial of its own involvement. It believes that there is *objective truth* in the object, independent of consciousness (133).

Hegel's analysis of the understanding process is largely a commentary on Kant's categorization of phenomena, and its conclusion signifies a dramatic departure from Kant and a significant step toward a new sort of idealism—one of pure *unity* between subject and object. After the movement of understanding, Consciousness realizes that *it* is the one positing the laws that explain natural phenomena, shifting its gaze inward, searching for absolute truth within itself, becoming *Self-Consciousness*.

Aside from its being considered one of the densest and bewildering passages of the book, and its being a major turning point in the text, the section, as mentioned earlier, signifies a clear advancement past Kant's idealism. Hegel's rejection of Kant's limitations on human knowledge is a major argument of the book, and a notable move in the history of German idealism.

Naturally, the result of the previous movement, perception, serves as the starting point for the movement of understanding. Perception saw the object as dual-natured: on the one hand, a pure unity; the other, a medium of its properties (136). No longer the simple individuality from sense-certainty, the object in perception is a pure universal: while sense-certainty would have “this dog, here at this place and time,” Perception has the pure unity “doghood” (113). But this pure unity is complicated by the *de facto* relation to other objects that results when Consciousness speaks of its, e.g. dog's, properties (114).

For instance, dogs can be understood as *domesticated*, alongside cats and opposed to wolves, and as *land mammals*, like hedgehogs and in contrast to crocodiles. More generally, as animals, dogs are opposed to inanimate objects, like houses and books. Still, the object as apprehended by perception must be a pure standalone unity, able to exist without being related to other things. Consciousness recognizes this tension, and responds by positing the object's true essence in its unity, while claiming its qualities to be incidental, nonessential (119).

But if the object's true essence is in its unity and not its qualities, Perception is left with an abstract, empty object. This truth is inadequate for Consciousness. Consciousness therefore explains the discrepancy between the object's inner essence and its visible qualities by positing a necessary distance between it and the object. Here we have a move from an empiricism that maintains truth in the physical object to an empiricism that instead puts truth in consciousness' *idea* of the object, with the object's inner essence being unknowable.

There is one important distinction, however, between either of these empiricist consciousnesses and the *Phenomenology's* Consciousness as it begins the process of understanding. The first empiricism, which is basically Hume's empiricism, embraced the perceptual object while remaining skeptical toward the object's true nature. Consciousness on the other hand desperately desires to know the object's true nature. Kant also maintained the impossibility of understanding an object in itself, but his knowing self departed from Hume in its acceptance of synthetic a priori science that formulates laws of cause and effect. The most basic law of cause and effect, which the *Phenomenology's* Consciousness takes as its object, is force, as understood by the likes of Kant and Newton. Let us now try to understand force as an object of scientific law.

Kant details his conception of force in his *Metaphysical Foundations of Natural Science*. He separates force into attractive and repulsive forces (35) which together shed light on physical processes, and the understanding's concepts regarding the processes, through relation, negation, and limitation in what Kant calls "metaphysical dynamics" (62).

Force for Kant explains both *kinematics*, or motion itself, and *dynamics*, the root cause of motion (60). These manifestations of force as dynamics and kinematics can be seen, respectively, as affirmations against two relevant negative philosophical conceptions of science at the time:

Hume's refutation of explainable cause and effect, and Leibniz's denial of interactive substances. Kantian force can also be seen as a synthesis of Leibniz, who reduced force to dynamics, and Descartes, who took only to kinematics. Kant's force will thus be understood by Consciousness in this dual-nature.

Force, as conceived by Kant, is the new object of Consciousness, which now operates as the understanding. This object is no longer an idle entity as in sense-certainty or perception; it is now an object qua motion, alternating back and forth from a simple unity, an isolated standalone object, to an object that is moving relative to other objects (136). Force therefore appears to have two aspects to it: one, dynamic, or the innate cause of motion; two, kinematic, or the actual expression of force, visible in interactions between two objects (137).

Let us look at Newton's formulation of force in his second law of motion, $F=ma$, force equals mass times acceleration. This conception of force, in the back of both Hegel and Kant's mind in their discussions on the matter, is the perfect illustration of its dual nature. Force consists of the product of mass, which is an innate property—seen by some as the fundamental essence of a matter—and acceleration, which describes the rate of change of an object's motion with respect to either another object or the world at large.

So we have a conception of force as a self-sustaining movement between an object's inner essence, its mass, and its expression of its essence in the form of a relation to the rest of the world (137). But this cannot be a self-sustaining movement existing in the object alone; there had to have been some outside force that set the object in motion to begin with, solicited it, in Hegel's words. This interaction between the outside object and the solicited object is force (138). But this interaction is seen to be in fact a mutual solicitation. Even though it appears one object is acting on another through force, that solicited object is also (re)acting in the same way on the

apparent acting object (139). Here we have a formulation of Newton's third law of motion, that is, for any force exerted by a first object onto a second object, the second object will exert an equal and opposite force on the first.

Each force thus has an equal and opposite force counterpart (141). One force can only be understood through its opposite, leaving no distinction between the active force and the passive responsive force. So since neither force can subsist on its own, the two forces collapse and we are left with the *idea* of force that is greater than these unstable parts. Force is in motion only in Consciousness' own understanding. Consciousness thus moves past looking at force in the world to looking at its own world of ideas within understanding.

The idea is now taken to be truth. The understanding has access to the inner truth of the object, force, through physical phenomena (143). Kant argued that our only access to objects is through their appearance; that is, it is impossible to understand the object from the object's point of view; in other words, there is no absolute truth in nature except that which stems from the ideas of Consciousness. The true world therefore is the world of ideas, as opposed to the physical world (144).

Here we have the idea of force a priori, abstracted from the physical world, but confirmed by experience of phenomena. This is an exciting point in the text, at least for Hegel, because it is the first appearance of reason (144). It is the birth of a world of true ideas, bringing consciousness and inner truth of the world together through the world of appearance (143). Of course, this particular world of ideas is very much imperfect in this first appearance—chiefly due to its ignorance of consciousness' role in the process of understanding (145). Again, it is only through appearance that consciousness has access to inner truth.

Here Kant rears his ever-persistent head. The world of ideas exists for us as truth, but is not simply the same as the world of appearance which sense-certainty and perception provides us (147). The latter is immediate for the *Phenomenology's* Consciousness, but while it does not provide certain truth in itself, it does confirm understanding's conception of ideas, which Consciousness synthesizes in the form of laws (149). These laws are posited as the truth lying beyond the world that shows itself to us, and are taken to explain the unity of the plethora of natural phenomena.

But in application of this universal law, Consciousness runs into some problems. First, although the physical world often appears unstable and chaotic, it is said to be explained by a scientific law that is stable, unchanging (149). Second, we have the old Humean problem of induction: how many times is sufficient to observe a given effect before confirming a law that states the effect to follow from a given cause? Regardless of these preliminary concerns, laws ground experience and provide stability to nature, and for this they are to be admired (150).

Consciousness conceives of two different types of scientific law, specific law and universal law (150). But Consciousness struggles to come up with satisfactory examples of either one. Universal laws, in order to have universal a priori necessity, come forth as too general to shed light on any particular phenomena (150); and specific laws merely reflect given particular phenomena and provided no systematic understanding (151). So Consciousness tries to coalesce universal and specific laws in one all-inclusive law. But, Hegel will assert, and Consciousness will realize, a law that encompasses everything can actually say nothing about particular phenomena, rendering it useless (152). Hegel's token example is Newton's law of universal gravitation (151). In a general sense, all the law says is that every object is related to every object. And it appears to Consciousness that for a statement to be universally true it must have

that same sort of tautological or trivial status. Also, it is unclear whether the universal law of gravitation is even all-encompassing. Fundamental substances like time and space—taken by Newtonian mechanics to have absolute, actual, and distinct existence—are not affected by gravitation (under classical mechanics). So it seems a truly universal a priori statement would have to be on the level of sense-certainty, that these things merely *are* (152).

In this way, scientific explanation is little more than mere description (154). If Consciousness observes a phenomenon, e.g. lightning, which is the result of a force, it creates a law of electricity that generalizes the observation. The law that consciousness posits as cause actually explains nothing that the force, taken to be the cause, did not already explain. The law, based on observation of a force, once formulated comes forth as a truth that is in turn verified by observation. But this is clearly a tautological movement (155).

To escape this tautology which effectively collapses into nothingness, Consciousness recreates a new (156). Since there is no necessary correlation between Consciousness' explanation of nature, formulated as scientific law, and the noumenal world (157) North pole is south pole (158); punishment is reward (159); all laws can be inverted or at least altered. This seems like an illogical and counterintuitive move for Consciousness to make, but it actually does make sense in the greater movement of the *Phenomenology*. With the benefit of hindsight and foresight, we as philosophical observer of consciousness can see that this absurd conclusion, the last of the first section of the book, is a reflection of the absurdity of the assumption that has guided the entire section, namely that there exists truth in objects independent of observation. Therefore it is not only a convenient move that bridges the gap between “Consciousness” and “Self-Consciousness,” but is the necessary and determinate final blow to that underlying

assumption that Consciousness has carried through all its movements, despite all evidence to the contrary.

The realization of the “inverted world” marks a significant point of inquiry into the process of scientific law formation. We saw that the purely descriptive scientific explanation of force was effectively useless for Consciousness—it says nothing about the interaction that was not already given by perception of the interaction. For a law to be more than mere description, the object of scientific law must be somehow different from the object of perception. Generally a scientific law translates a physical object in space and time into a idealized geometric object expressed mathematically. Whereas a direct description of an apple falling to the ground would merely recap the process of perception, a scientific explanation ought to provide an explanation that sheds more light on the event. In an effort to provide a basic scientific explanation, Newtonian mechanics conceives of the object as a nondescript point located at the apple’s center of mass. Subject to the downward force of gravity (and the upward force of drag), the point-mass experiences a net acceleration toward the earth.

The object of perception in this case was a fruit, colored red or green or yellow, with a brown stem, of a particular roundish shape. Scientific explanation simplifies the object, ignoring unessential features such as shape, taste, and texture (perhaps in a quite sophisticated calculation the latter would be accounted for in the calculation of the drag force) and isolating certain essential features, namely the object’s center of mass (for the purpose of determining its free fall velocity) and its surface area (for the purpose of determining the force of drag). In scientifically explaining the apple’s fall, the given simple perceptual presentation is translated into the language of mathematics. In the *Phenomenology*, this constructive act—the production of a conceptual object and process beyond those given directly by perception—appears to

Consciousness to be contingent, because it sees no necessity in the correspondence between its newly constructed world of law and the supersensible world, the noumenal world. This contingency is what tips Consciousness off to the fact that knowledge formation is mediated by Consciousness itself.

We do not want to get carried away in our Hegelianism here, reveling in the complexity of relations and layers of mediation that other philosophers simply ignore. Let us point out rather that Kant is well aware of the fact that the knowing self actively creates knowledge in a process of mediation with nature. In the *Phenomenology*, Understanding-Consciousness turns the concrete objects of perception into concepts, and then creates laws to explain the relation between the concepts. Scientific laws, processed through the language and a priori necessity of mathematics, are then verified by experience—this is Kant’s epistemological system. Since the self’s only access to the outside world is through the flawed process of perception, it can attach a priori necessity only to the laws themselves, qua objects of the understanding. It cannot attach any necessity to the correspondence between those objects of scientific law and the objects in themselves which the perceptions represent.

It is for this reason that I say the objects of Kantian scientific laws have no certain ontological status. The laws refer to objects of perception, not objects of reality. The laws are rooted in perception and verified by experience, but the scientific laws produce no certain knowledge of reality, of nature in itself—only certain knowledge of nature as appearance. This realization inevitably corrupts the purity of science as we generally conceive it, as a reliable account of reality.

For Kant, *concepts* are what we have access to, *not* objective reality. We must retain this modesty in our scientific endeavors, and not claim to understand the essence of nature when we

formulate scientific laws. But Hegel's "Consciousness" of the *Phenomenology* is not content with this limitation. Operating on the assumption that there *is* objective truth in the world (as Kant believes—though this ontological assumption is unnecessary for his epistemological project), Consciousness eventually comes to a conception of knowledge as a world of laws. This world of laws is generated from perception, and once established is verified by experience in the world, but, while the world of laws may have been constructed through logical necessity, Consciousness sees no necessity in the relation between its world of laws and the objective world of reality. The world of laws becomes the inverted world when Consciousness realizes that, since it does not have access to reality in itself, the objective world of reality could easily be different from the world of laws that it has constructed. Consciousness cannot accept this gap which Kant recognizes as the inherent limitation of science. In its quest for certainty, it looks at this very gap as its new object, and dubs the menacing gap "**infinity**" (160).

Consciousness thus realizes that this infinity, this ambiguity, inheres in Consciousness' own mind—objective reality certainly contains no ambiguity⁸ (160). It can push the movement of understanding no further; this contradiction is irreconcilable without a considerable step back or a huge step forward. Consciousness realizes that it is as of yet unable to suture the gap between its own conceptions and the certainty of objective reality that it hopes to attain (164). Since Consciousness failed to attain certain knowledge through perception, its kneejerk reaction is to remove itself from perception and turn inward, taking itself as object and becoming self-consciousness.

Kant perhaps did not share Hegel's intense desire to unite perceptually-rooted knowledge with ontological certainty concerning reality, so Kant's *Critique of Pure Reason* contains little of

⁸ This is an assumption, on which the entire *Phenomenology* is based.

the stuff that follows “Force and the Understanding” in the *Phenomenology*. Kant’s system details the faculties of Reason that construct knowledge, but is not concerned with analyzing all the layers that compose the self and the collective self. Kant accepts that its knowledge claims have no claim to certainty of objective reality, and is satisfied with producing knowledge claims that have the logical certainty that reason’s faculties provide. Socrates, we can recall, was not content with the fact that our perceptually-rooted knowledge must be correct—it is this very possibility that prevents Socrates from reaching a definition of knowledge he can accept. He, like Hegel, desires certainty in his knowledge, and knows deep down that he has access to the ontological truth of the world.⁹

Socrates exposes the problem of alignment between perceptually-rooted knowledge claims and objective reality (which Kant recognizes), but is unable at the time to come up with a proper solution, a way to achieve certainty in his knowledge of knowledge. In the *Phenomenology*, Consciousness is spurred by its own failure to attain certainty from phenomenal knowledge, but instead of stopping here (here being: Consciousness’ “infinity”; Kant’s ontological limitation; *Theaetetus*’ aporia), Hegel endeavors to detail the development of all types of knowledge. In so doing, Consciousness eventually attains to the level of Spirit.

In discussing the limitations of certainty regarding our own knowledge, Socrates finds no mechanism in the self that can differentiate true knowledge from false knowledge. But at the end of the dialogue, he hints at a solution when he responds to the failure by praising the dialectical process’s ability to bring false knowledge to light.

As to whether or not there is such a mechanism to differentiate true from false, Kant would say that Reason’s faculties provide knowledge of certainty vis-à-vis its a priori relations of

⁹ See Plato’s theory of recollection.

logical necessity—but this certainty cannot be extended to differentiate “true” from “false” beyond the logical relations. That is, Reason cannot state that a piece of knowledge is certain in the sense that it corresponds to noumenal reality.

A key epistemological concern that arises in Plato’s work is whether or not it is possible to account for pure knowledge without resorting to innate God-given forms à la. Kant’s rational account of pure reason does not lead to pure knowledge, because pure knowledge as such is not attainable for Kant. Hegel maintains that such a pure knowledge is attainable, and while Socrates remains unsatisfied with his own attempts to account for pure knowledge, Hegel believes he has truly done it.

Hegel is able to do this because he capitalizes on the idea of dialectic that Socrates so extols at the end of the *Theaetetus*. Plato’s writings are presented in the form of a dialogue between two or three participants, wherein they applying their respective logical capacities on the matter and see what they can agree on; in the *Theaetetus* the participants try to provide a rational account for knowledge that can hold up through the dialogues’ increasing layers of reflection and analysis. Hegel on the other hand observes the dialectical process that takes place within the knowing self itself, within Consciousness’ thought. In this dialectical process, Consciousness realizes its own active role in the acquisition of knowledge. In addition to this revealed dialectical process between self and world, Consciousness realizes that in order to get to a knowledge of knowledge, in order to even hope to attain the level of ontological certainty, the self must engage in the dialectical process of recognition whereby it confronts another self. Only through confrontation with an other can Consciousness advance toward a self-contained apprehension of the essence of knowledge.

This move marks the formal departure of Hegel from Kant, who would not agree that mediation from an other could possibly lead to destroying the gap between the understanding's laws and objective truth. For Kant, the subject/object gap was inherently insurmountable,¹⁰ but Hegel showed that this gap can be overcome through a reinterpretation of Socrates' art of dialectic. Hegel's idealism is thus not halted by the ontological limitation that Kant's is; instead, Hegel overcomes the gap (in his view), by accounting for the many levels of mediation between selves and between self and world. In so doing, Hegel pushes toward a science based on unity between self and world.

Digression

While it is impressive that Hegel can account for the union between the self and the object in itself (in light of Plato's and Kant's inability to do so), it is only through thorough analyses of many aspects of life that he does so. After working through epistemologies like perception and understanding, Consciousness encounters morality and broader systems of thought in culture and religion.

It is only through religion that Consciousness is able to raise itself to the level of Spirit and find the notion, or absolute being—the essence of reality—within itself (779). Through Christianity, Consciousness sees itself in God and God in itself. Jesus Christ is the manifestation of this realization, as a unity of spirit and substance, of God and man. This means that in order to accept the unity between self and world in Hegel's absolute knowing, we as readers must first accept the necessity of the doctrine of Christianity.

The trouble with accepting Christianity in order to obtain absolute knowing is not limited to the atheist reader of the *Phenomenology*—this difficulty is surely felt by any critical reader. It

¹⁰ With the object being the in-itself, the noumenon, the inner essence of a thing

is nearly impossible to read the revealed religion section without first actively noting the convenient role Christianity plays in the narrative of the *Phenomenology*, as the prerequisite stage of absolute knowing. The revealed religion section is one instance of Hegel's philosophical imagination shining all too brightly. For his part, Hegel contends that each dialectical movement of the *Phenomenology* is necessary, and that his role as author is to provide Consciousness' own account of its development (and also, as philosophical observer, to comment on what has taken place). But to take the text's conclusion to be true is to commit the fatal error that Consciousness becomes aware of in the "Consciousness" section of the text—that is, to ignore that the ideas taken to be truth are products of a multi-layered process of mediation between the author of the ideas and the world in which the ideas take form.

We can accept Hegel's conclusion if we accept the legitimacy of his method of determinate negation¹¹ and the purity and necessity of each of the many applications of this method—namely, each and every step that Consciousness takes in the text. But if not, we are left with merely an interesting conclusion that is reached through a creative process. In extracting meaning from the text, we are able to learn from Hegel's method of determinate negation, and from particular stages of the process in relation to other stages—and we can perhaps use the text as an allegory to understand the parts of knowing that the particular stages refer to. But to fully account for the text requires an in-depth analysis of all parties involved in the apprehension, which, apart from being close to impossible logistically, would be subject to the same doubts as to its method and moments that we ascribe to the *Phenomenology* itself.

¹¹ Determinate negation is Hegel's dialectal process, wherein the subject (here Consciousness) starts with knowledge that is immediately certain. By thinking through the knowledge claim, the subject realizes the internal contradictions and layers of mediation contained within that knowledge claim, which it brings to light. The process of negation, or the bringing of internal contradictions to light, has a snowball effect on the object—each negation adds another layer to the object, which becomes an increasingly more complex object and moves toward a complete encapsulation of ultimate reality, which it attains in absolute knowing.

The purpose of this digression is to say that while there is value in Hegel's achieved unity between self and world, it is difficult to apply his conclusion of absolute knowing to other avenues of thought, due to what I call the Hegelian Imagination Problem (HIP). Due to the HIP, I hesitate to use the absolute knowing that Hegel reaches in the *Phenomenology* in order to explain the alignment between the self's conceptions and the world's ultimate reality, the alignment that Plato sought to explain and that Kant saw as unsolvable within the realm of epistemology.

After now having laid out the respective approaches that Plato, Kant, and Hegel take on the issue of correspondence of concepts to reality, let us now look at how their ideas have been reflected or challenged by the development of modern science. Has modern physics solved the Kantian problem of correspondence to the noumenal world? In attempting to answer this question, we must not feel constrained by the failures or successes of the aforementioned thinkers, but instead keep their conceptions in mind as we view the problem of correspondence in the development of modern physics.

Scientific realism from classical physics to quantum mechanics

Werner Heisenberg's *Physics and Philosophy*, published in 1958, traces the development of science from Descartes through classical mechanics to modern physics.¹² Descartes' skepticism, rigorous methodology, and emphasis on math helped to establish the scientific method and create the spirit of scientific revolution that Heisenberg sees as characterizing the history of science (52). As for correspondence, Descartes saw no necessity in the alignment of his own thoughts and objects of ultimate reality—but his belief in God (the existence of Whom is “proved” in Part IV of Descartes' *Discourse on Method*) provides the possibility, the likelihood of such a correspondence.

¹² By “modern physics” I mean basically quantum mechanics and relativity.

For Descartes, only God's existence could explain correspondence of thought and reality, but classical mechanics, Heisenberg notes, did not need to mention God (or the self) in its theories or laws (55). Instead, the scientific laws themselves were taken to explain reality. Classical scientific laws were rooted in perception, formulated through relations of mathematical necessity, and in turn verified by observation. In the General Scholium of the *Principia*, Newton explains that God is the omnipresent being that governs all of nature. So the necessity of correspondence between scientific law and reality in classical mechanics does not have to mention God—the correspondence comes through the scientific method itself, through observation, logical relation, and verification. God is only posited only after this correspondence is reached, as an explanation for why reality is orderly and able to be explained through scientific law.

The idea that scientific laws explain the *real* world is called scientific realism. This belief, Heisenberg asserts, was crucial in the development of physics, and indeed “soon seemed almost a necessary condition for natural science in general” (55). He lays out the varying degrees of scientific realism. **Practical realism**, the weakest formulation, maintains that there are statements that can be “objectivated”—an objective statement “does not depend on the conditions under which it can be verified”—and practical realism maintains that “in fact the largest part of our experience in daily life consists of such statements” (56). **Dogmatic realism** goes a step farther to say “that there are no statements concerning the material world that cannot be objectivated.” This is the ground for classical mechanics' knowledge claims, and it is on the basis of dogmatic realism that Einstein attacked quantum theory. Scientific laws formulated on the basis of dogmatic realism do not depend on the conditions under which they can be verified.

Scientific laws are taken by the dogmatic realist to capture some specific genuine feature of the universe, since they are true everywhere.

While scientific laws are universal for the dogmatic realist, this does not mean that the objects of scientific laws have objective *existence*. **Metaphysical realism**, on the other hand, makes the claim that objects of scientific law have objective existence (57). While the dogmatic realist would assert that all phenomena can be explained by scientific law, the metaphysical realist would go farther to say that the scientific explanations encapsulate the actual world in itself, the noumenal world.

The term Heisenberg uses for this type of realism, “metaphysical realism”, is indicative of the metaphysical leap necessary to reach this level. Descartes thought he had good reason to believe that the objects of scientific law “really exist” because “God cannot have deceived us” (Heisenberg 57). I have difficulty, however, describing Hegel as a “metaphysical realist”. Despite the fact that he overcame the gap (in his view) between the phenomenal and noumenal worlds, Hegel is more an idealist than a realist, and would reject the one-sided empiricism in the idea of “objectivation”. Furthermore, Hegel does not believe that the thing in itself is knowable through scientific law (as shown in “Force and the Understanding”), so we cannot call him a “scientific” realist. Even if all phenomena are explainable, not all phenomena can be understood by a scientific explanation, according to Hegel. Like Descartes, who relied on a belief in God’s goodness to believe in correspondence between thought and reality, Hegel’s union of thought and ultimate reality comes similarly through religion, where ultimate reality is immediate in the self as “Spirit” or “absolute Being” (Hegel 786).

Since Kant was unwilling in *Critique of Pure Reason* to appeal to religious belief for the ontological certainty of objects of knowledge, he had to reject the doctrine of metaphysical

realism. In Kant's epistemology, as in empiricism, the knowing self's only access to the world is mediated through the senses, so scientific laws based on experience cannot meaningfully speak of a noumenal world. Alternatively, if we take the world of scientific laws generated by the knowing self as a "supersensible world", a world beyond experience, we cannot this world's correspondence to the noumenal world.

Classical mechanics, on the other hand, does not have any such caveat about its laws' correspondence or lack of correspondence to ultimate reality. "Classical physics," Heisenberg explains, "can be considered as that idealization¹³ in which we speak about the world as entirely separated from ourselves" (Heisenberg 80). Kant's goal in the *Metaphysical Foundations of Natural Science* is to establish the possibility of such a pure science—a pure science, where we can speak of the world as entirely separated from ourselves, must, Kant maintains, contain "a pure part on which the apodictic certainty that reason seeks can be based" (*Metaphysical Foundations* 4:469). That pure part is mathematics; Kant famously claims, "in any special doctrine of nature [that is endowed with a priori certainty] there can be only as much *proper* science as there is *mathematics* therein" (4:470).

Kant's effort to establish a priori scientific law can be seen as an effort to validate, with some of his own conceptual clarification, the universal a priori necessity of basic Newtonian mechanics. One major clarification, especially for the purposes of this discussion, comes in the General Remark of Kant's last chapter in the *Metaphysical Foundations*. Absolute space, assumed by Newton to be actual—i.e. to exist in the physical world—can *only* be an idea of reason, and cannot be assumed to exist, claims Kant. Absolute space for Kant is only an a priori intuition—it *cannot* be an object of experience: it cannot itself be perceived nor conceptualized.

¹³ In light of the realization of classical mechanics' limits in explaining nature, it can now be regarded only as an idealization, not an explanation, of nature.

Absolute space, a prerequisite to all phenomena and experience for classical mechanics, as an object of scientific law has different ontological status for Kant and Newton. Kant's absolute space has a priori universal necessity, but not physical existence. Newton's absolute space has a priori universal necessity and physical existence. The example of absolute space clearly shows Kant to be a dogmatic realist and Newton to be a metaphysical realist.

Still, while we see the differing ontological statuses of Kantian and Newtonian scientific objects, Kant's goal remains in the *Metaphysical Foundations* to show the a priori necessity of properly constructed scientific laws—a cause Newton would approve of. Kant's criteria for such a proper construction are: [1] the utilization of the a priori necessity of the language of mathematics; and [2] the conceptualization of scientific laws using the *Critique's* categories of quantity, quality, relation, and modality (*Metaphysical Foundations* 4:474-476). Kant sees the empirical sciences of chemistry and psychology, as they were then practiced, to fail in meeting these criteria. Chemistry fails to meet the latter criteria—its laws cannot be intuitively constructed and presented a priori (4:471). Psychology, on the other hand, cannot have a “pure part”, because mathematics, Kant argues, cannot be applied to phenomena of inner sense. Phenomena of inner sense can only be systematized and understood by “division in thought” (4:471).

But physics had the potential to be a “pure” science, and in the *Metaphysical Foundations* Kant provides the a priori construction of fundamental physical concepts such as the quantity of motion of matter (4:490), attractive and repulsive forces (4:497-4:518), conservation of matter (4:541), Newton's first law of inertia (4:543), and Newton's third law on equality of action and reaction. While Newton assumed the universal a priori necessity of his scientific laws, Kant logically constructed this necessity. In discussing Newton's third law, Kant

explains that Newton “by no means dared to prove this law *a priori*, and therefore appealed rather to *experience*” (4:449).

In so logically deducing classical mechanical laws, Kant endowed them with transcendental, universal a priori certainty. Classical mechanical laws then have the status of dogmatic realism—given sufficient information about a physical system, one can explain what that system will be like at a later point in time. The observer is irrelevant in the determination. But in quantum mechanics it is impossible to speak of the world as separate from the observer. On a quantum level, until the outcome of an event is observed, a physical system’s state is not determinate, but probabilistic. A given physical system instead exists as a superposition, or sum, of all its possible states. A quantum object’s natural location is not random, but probabilistic, depending on the particular wavefunction that describes its wave distribution, its superposition. It is the act of observation that causes the set of probabilities to “collapse” to a particular outcome, which becomes the observer’s measurement. This is the Copenhagen interpretation of quantum mechanics. Under this standard formulation of quantum mechanics, quantum laws offers only a probabilistic, and not deterministic, explanation of fundamental reality.

The Copenhagen interpretation was introduced by Niels Bohr, Heisenberg, and others in the mid 1920s, and developed by Von Neumann in 1932. To try to understand this standard formulation of quantum mechanics, I turn to Delft University of Technology senior researcher P. E. Vermaas, whose 1998 Ph.D. culminated in *A Philosopher’s Understanding of Quantum Mechanics: Possibilities and Impossibilities of a **Modal Interpretation***.¹⁴ I will explain the basics of the Copenhagen interpretation of quantum mechanics, which Vermaas outlines in four math-laden steps.

¹⁴ A modal interpretation of quantum mechanics is one that addresses the collapse of a probabilistic physical system into determinate values of measurement in observation.

For our purposes, a conceptual translation of the mathematical interpretation provided by quantum mechanics and explained by Vermaas will be sufficient. First, a quantum mechanical system is described as an N -dimensional complex linear space (9). Second, quantum mechanics defines “observables pertaining to a system”, or magnitudes representing certain physical properties, as being discrete with respect to each other, and as being correspondent with one of the possible determinations (“eigenvalues”) of the complex linear space (10-11). Third, quantum mechanics assigns a probability distribution explaining the possible states of the system (11-12). The fourth step explains the dynamics of a system’s states.

Steps one through three, especially when explained mathematically, clearly contrast the relative simplicity—and, as Kant shows, a priori necessity—of the classical explanation of a physical system. In the quantum explanation it is difficult to immediately see a priori necessity in the probability distribution which describes the system. So in this regard, because of the difficulty in seeing a priori necessity in its objects, quantum mechanics come on the scene as an unlikely candidate for Kant’s “pure” science. Moreover, the fourth step, yet to be explained, seems to violate the a priori universality—the irrelevance of the observer—required in pure scientific law.

There are two different “dynamics” of a physical system’s states. If no measurements are made, the state will evolve according to its particular wavefunction generated by the Schrodinger equation. If a measurement *is* made, however, the natural Schrodinger evolution of states is altered (13). In this case the state of the system changes according to what Vermaas calls the **projection postulate**. The act of measurement introduces many new interactions between the system and the measurement device, and instantaneously forces the system into a state fundamentally different from the Schrodinger evolution (15). This fundamental difference is

manifest in a fundamentally altered physical state and a dramatically different mathematical description of the physical state. So not only is the measurement then made of a fundamentally different system than that described by the Schrodinger wavefunction, but the observer also loses the ability to predict future outcomes of the new fundamentally different system (20).

Based on the projection postulate, it's difficult if not impossible to call quantum mechanics dogmatically realist. The same quantum event, if observed at a different time by a different observer or a different device, will yield different results. The old Kantian problem, the issue of correspondence between the phenomenal world and the noumenal world, rears its head higher than ever before in the development of science. Kant showed that classical physics need not maintain the empirical existence of its scientific objects (as in the example of absolute space)—it need only, for it to be a pure science, establish its laws' a priori necessity and universality. Quantum mechanical, on the other hand, by introducing the projection postulate and the role of the observer, seemingly destroys the notion of a priori universality.

Heisenberg explains quantum mechanics to be practically realist, and not dogmatically realist, for precisely this reason. Vermaas, however, through his modal interpretation seeks to give quantum mechanics the status of dogmatic realism. Analogous to Kant's metaphysical foundations of classical mechanics, Vermaas sets out the criteria for an interpretation of quantum mechanics that would properly describe reality universally and transcendentally (beyond the observer) (33). Vermaas' criteria for a pure science, as it were—one that establishes the universal necessity of scientific law—are “Instantaneous Autonomy”, “Dynamical Autonomy” (for composite systems, for whole systems, for atomic systems, and for measurements), “Empirical Adequacy”, “Consistency”, and “Internal Completeness”.

In order to get an idea of what would be required to give quantum mechanical laws the same universal status as classical mechanical laws via Kant, and the ontological status indicative of metaphysical realism, I will briefly discuss Vermaas' criteria for a pure science. But knowing that Kant's interpretation of classical mechanics meets his own criteria of pure science, and that it was yet proved wrong by empirical evidence, I am not eager to accept Vermaas' interpretation of quantum mechanics even while it may meet his criteria for a pure science. This is not to take away from his criteria of pure science or his modal interpretation of quantum mechanics, but, keeping in mind the Hegelian Imagination Principle, it is with difficulty that Vermaas' interpretation can be generalized without empirical verification and a degree of intellectual consensus.

The criterion of Instantaneous Autonomy is the requirement that "if two systems have equal states, then the instantaneous property ascriptions to those systems are also equal" (31). Dynamical Autonomy generalizes this with regard to time and scope—if two systems (composite, individual, or atomic) "evolve freely and have, during an interval, equal states...then the correlations between the properties ascribed to the systems at different times are also equal" (32). Dynamical Autonomy for measurements says that if two systems have equal states and are measured by the same measurement device, at a time when each system has the same properties, then the correlations between the systems, and the outcomes of the measurement device, are both also equal (32). Empirical Adequacy requires that there be correspondence between outcomes from measurement devices and predictions from the standard formulation of quantum mechanics (33). Consistency and Internal Completeness are the simple requirements that the description respectively be free of contradiction and be a complete description of the universe it sets out to describe (34).

If a modal interpretation were to meet the Autonomy requirements, it would succeed in overcoming the observer effect. By including the measurement device as an additional property of the system, the modal interpretation could achieve the status of dogmatic realism. But we must realize this as a sidestepping of the issue at hand. If we have correctly interpreted Vermaas' project as an effort to endow quantum mechanics with dogmatic realism, we see that he is fulfilling the requirement of dogmatic realism—that all statements can be objectivated, i.e. that they are not dependent on the conditions under which they can be verified—by subsuming the definition in the measurement process. That is, Vermaas is saying that quantum mechanics can reach the level of dogmatic realism, such that events do not depend on measurement conditions, if the events all have the same exact measurement conditions.

In addition to the HIP aspect of Vermaas' modal interpretation and its fulfillment of his criteria for a pure science, we now see an internal issue with Vermaas' criteria for such a pure science. The internal issue of observational relativism reestablishes the practical, as opposed to dogmatic, realism of quantum mechanics.¹⁵ Vermaas' effort to give quantum mechanical laws a priori necessity has in effect reintroduced Hegel's critique of Kantian scientific law that purports to contain universal a priori necessity. Hegel explained the contingency of scientific law through the realization that scientific concepts have no a priori necessity, but are instead part of a supersensible world, with no necessary correspondence to other supersensible worlds (the conceptual worlds of different observers or different ideologies), or to the world in itself, what we are calling ultimate reality. Vermaas even acknowledges the impossibility of the latter correspondence, that of his modal interpretation to reality in itself, when he says "precisely because modal interpretations describe states of affairs which are in principle unknowable,"

¹⁵ Quantum mechanics is practically realist, since it contains all the laws of classical mechanics, which are realist (plus more of its own laws which are not realist).

criteria for pure science should strive for “metaphysical tenability”—metaphysical tenability meaning possible, perhaps even likely, correspondence to ultimate reality (34). With the discrepancy between this supersensible world of law, in this case quantum mechanics, and ultimate reality, the knowing self, the observer, far from being certain about its knowledge claims, is left with an inverted world, with infinity.

Our new infinite

Was Hegel right all along? Does scientific law formation necessarily lead to ontological uncertainty? Kant endowed classical mechanics with a priori certainty in the *Metaphysical Foundations*, but sidestepped the ontological status of scientific objects by limiting his scope to the phenomenal world and not making claims about existence in the noumenal world. The limits of classical mechanics, which gave way to the birth of quantum physics, showed classical mechanics to not hold universally, throughout the phenomenal world. Classical mechanics was shown to break down on the most fundamental of levels. On these fundamental scales, nature was observed to be inherently probabilistic, and a description of nature was shown to be influenced by the very act of measurement. What conclusions can we draw from the revelations offered by our current most universal and accurate description of the phenomenal world? Not to mention the fact that quantum mechanics has seemingly brought us no closer to bridging the gap between the phenomenal world and the noumenal world. Perhaps the discovery of quantum mechanics can be seen as the ultimate realization of Hegel’s inverted world, of the contingency of scientific law, and of the infinity that must necessarily inhere in the gap between scientific law and ultimate reality. In this case perhaps a reevaluation of the goals of science is in order.

In *The Gay Science (TGS)*, Nietzsche brings to light the questionable origin and intention of science, arguing that its promotion and pursuit throughout history has been “because of three errors”: [1] to try to understand God’s goodness; [2] to harness science’s utility; [3] to flesh out the innocence and purity of science (55). In Book Five of *TGS*, Nietzsche takes his criticism a step farther, asking: “Is it not the *instinct of fear* that bids us to know? And isn’t the rejoicing of the person who attains knowledge just rejoicing from a regained sense of security?” (166). Interestingly, the metaphysical and ethical motivations—epistemological errors 1 and 3—are precisely the motivations of classical physics that are not present in quantum mechanics. Quantum mechanics, far from reflecting the purity and goodness of God, introduces into science the unholy ideas of indeterminacy and observational relativism.

Despite the fact that Hegel and Nietzsche arrive at drastically different results, they both offer similar assessments of Kantian scientific law. For both, scientific law purports to explain ultimate reality while operating in a universe entirely removed from ultimate reality. The only difference between the two is their conclusions—for Hegel, ultimate reality is attainable through Christianity, while for Nietzsche ultimate reality is an illusion. In an aphorism entitled “*Science as prejudice*”, Nietzsche bitingly presents his criticism of scientific explanation in full:

The faith with which so many materialistic natural scientists rest content: the faith in a world that is supposed to have its equivalent and measure in human thought, in human valuations – a ‘world of truth’ that can be grasped entirely with the help of our four-cornered little human reason – What? Do we really want to demote existence in this way to an exercise in arithmetic and an indoor diversion for mathematicians? Above all, one shouldn’t want to strip it of its *ambiguous* character: that, gentlemen, is what *good* taste demands – above all, the taste of reverence for everything that lies beyond your horizon!...Thus, a ‘scientific’ interpretation of the world, as you understand it, might still be one of the *stupidest* of all possible interpretations of the world, i.e. one of those most lacking in significance...an essentially mechanistic world would be an essentially *meaningless* world! Suppose one judged the *value* of a piece of music according to how much of it could be counted, calculated, and expressed in formulas – how absurd such a ‘scientific’ evaluation of music would be! What would one have comprehended, understood, recognized? Nothing, really nothing of what is ‘music’ in it! (238-239).

A scientific explanation of the world is an oversimplification that strips the world of its ambiguity, its beautiful, musical qualities. Newtonian mechanics certainly falls under this lame reductionist umbrella for Nietzsche (this was the science that he was responding to), but it is hard to believe that Nietzsche would condemn quantum mechanics, which can be seen to preserve the “ambiguous character” of the universe through its explanation of the probabilistic nature of reality and the complex interplay between nature and observer. In this vein, it is worth noting that when Nietzsche warns against stripping the world of its ambiguity by means of science, he is decidedly *not* telling us to give up science altogether: “To stand in the midst of this *rerum concordia discors*¹⁶ and the whole marvelous uncertainty and ambiguity of existence *without questioning*, without trembling with the craving and rapture of questioning...that is what I feel to be *contemptible*” (30). We are therefore justified in pursuing a scientific explanation of the world, so long as that scientific interpretation preserves what Nietzsche sees as the ambiguous essence of the world.

Quantum mechanics preserves the ambiguous essence of the world and, as Nietzsche demands, reveres that which lies beyond its horizon. It recognizes reality in itself to be on a fundamental level impenetrable—bound by a probability distribution but decidedly indeterminate. Heisenberg echoes Nietzsche’s belief of appearance as essence when he says “we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning” (Heisenberg 32). Observation itself, the starting point and basis of verification for quantum mechanical law, is altered through the process of perception. This is indicative of the fact that any meaningful essence, one that we can apprehend and comprehend, must be in the world of appearance and not a supersensible physical world. As Nietzsche says, “there is only

¹⁶ A Latin phrase introduced by Horace, meaning “the concord of things through discord”.

the world of nature, life, history, becoming, and appearance...any other kind of reality is absolutely indemonstrable” (*Twilight of the Idols* “Reason” 6).

Nietzsche, ever the loner, embraced his isolation from the greater philosophical community by writing: “With the highest respect, I accept the name of *Heraclitus*.¹⁷ When the rest of the philosophic folk rejected the testimony of the senses because they showed multiplicity and change, he rejected their testimony because they showed things as if they had permanence and unity” (qtd. in Cox 188). Both Nietzsche and Heraclitus deny the difference between substance and accident, between essence and appearance and proclaim that ideas are secondary to, and derived from, the physical world (*Philosophy in the Tragic Age of the Greeks* 87).

This interplay between the observer and nature’s becoming leads necessarily to the projection postulate of quantum mechanics and the **chaos** of competing descriptions of reality. “The total character of the world...is for all eternity chaos,” Nietzsche proclaims (*TGS* 109). In light of Nietzsche’s perspectival nature of epistemology—“the world once again has become infinite to us: insofar as we cannot reject the possibility *that it includes infinite interpretations* (239)—he is fearful that a scientific interpretation, based on perceptions which refer to no necessary ultimate reality, may come to take the place of the empty ultimate reality. Indeed, Nietzsche saw that as a reality with classical mechanics: “the reputation, name, and appearance, the worth, the measure and weight of a thing—originally almost always something mistaken and arbitrary...has slowly grown onto and into the thing and has become its very body: what started as appearance in the end nearly always becomes essence and *effectively acts* as its essence!” (70).

Quantum mechanics, since it too constructs a world of scientific laws, runs this risk as well. The quantum mechanical description of nature puts forth a supersensible world just like

¹⁷ A pre-Socratic Greek philosopher who maintained that all was flux and that the only reality is appearance. Called the “obscure” or “weeping” philosopher for his radical ideas and professed contempt of humankind.

classical mechanics, in the language of mathematics. Nietzsche, like Hegel, would attack mathematics for being an idealization of dynamical nature that risks posing as reality in itself.¹⁸ But this does not mean that Nietzsche would disagree with the fact that quantum mechanics uses math to explain phenomena: “Let us introduce the subtlety and rigour of mathematics into all sciences to the extent to which that is at all possible; not in the belief that we will come to know things this way, but in order to *ascertain* our human relation to things. Mathematics is only the means to general and final knowledge of humanity.” Nietzsche here makes a bold proclamation, since the idea of utilizing math to illuminate “our human relation to things” must have been very abstract before the development of quantum mechanics. Classical physics makes no mention of “human relation to things”, but in quantum mechanics mathematical laws very much explain and illuminate the human relation to phenomena.

In the wake of God’s death and the burial of all objective truth, the human relation to reality for Nietzsche is one of competing interpretations, or opposing supersensible worlds. Hegel explained the tension between two competing supersensible worlds, and Consciousness’ resultant frustration at its inability to grasp ultimate reality, using the term “infinity”. Nietzsche, the perspectivist, dubs the competing interpretations, Because nature consists entirely of these various competing interpretations (it has no essence of itself), nature is necessarily chaotic. We are left with a cyclical relationship between human and world: nature is meaningless because it consists of competing valuations, which are themselves a product of (and inexorably bound to) the chaotic world. The whole of chaos consists then of “the errant and divergent movements of both world and world-interpretation” (Cox 207). Nietzsche’s philosophy can be described as an

¹⁸ In the preface to *The Phenomenology*, Hegel attacks mathematics for reducing the dynamical world to “rigid, dead propositions” (45).

anti-dualism and a sort of naturalism, akin to Spinoza's except that for Nietzsche nature is no longer a point of convergence we call God, but instead a point of divergence we call chaos.

The “whole marvelous uncertainty” (*TGS* 30) that characterizes nature for Nietzsche, is reflected in quantum mechanical laws, which are probabilistic rather than deterministic. Nietzsche's chaos, the seeming lack of order to nature that leads to competing interpretations, can be compared to the physical conception of chaos. Chaos theory, the study of dynamical systems extremely sensitive to initial conditions, has been found to describe many physical phenomena, from the structure of crystal lattices, to bound and scattering energy states of electrons, to concert halls and the weather (Gutzwiller). But while quantum mechanics reflects the indeterminism Nietzsche sees as nature's core, chaos theory's dynamical system, while complex, *is* deterministic. Physical systems can be described by mathematical laws, but their results are extremely sensitive to initial conditions, to a degree that is beyond even our absolute limit of measurement given by the Heisenberg Uncertainty Principle (Gutzwiller).

The concept of chaos has become even more relevant in recent years. In 2009, British Physicist Charlotte Werndl formulated a new implication of chaos, stating that in “predicting any event at any level of precision, all sufficiently past events are approximately probabilistically irrelevant” (Werndl). According to this conception, even if we have the complete information about a given system—the total description, containing all relevant information on its initial and past conditions, some systems remain unpredictable.

Whether due to inherent inaccessibility of certain physical systems or the informational gap between the objects of our scientific model and the physical systems themselves—that is, the physical systems are more complex than our theories are—it is clear that on some level, certain

physical systems are irreducible to cause and effect. Nietzsche explains the concept of cause and effect, taken by Kant to be a necessary category for science, as a false duality:

In truth a continuum faces us, from which we isolate a few pieces, just as we always perceive a moment only as isolated points... There is an infinite number of processes that elude us in this second of suddenness. An intellect that saw cause and effect as a continuum, not, as we do, as arbitrary division and dismemberment – that saw the stream of the event – would reject the concept of cause and effect and deny all determinedness (113).

With this in mind, chaos should not be understood, as its colloquial use implies, as a lack of order. It can maybe instead be understood as describing some realms of the material world that contain a set of information that is somehow indecipherable. If we define reality as the information set of all processes, we could theoretically understand all of reality if we could interpret all of the information.¹⁹ But since “there is an infinite number of processes that elude us in this second of suddenness,” especially in a sufficiently complex system, any such calculation (one of an effectively infinite degree) is by definition impossible. This is how we can say that a chaotic system is neither random nor deterministic.²⁰ We can describe the behavior of a chaotic system or a quantum mechanical system *after* observing it, but we are at a loss as to explain *why* this particular action occurred.²¹ Nietzsche notes, “Before the effect one believes in causes different from those one believes in after the effect” (114). We can explain the behavior with mathematical models, so it is not completely random; but we cannot ever predict the outcome beforehand, because nature is not deterministic—its parts are of infinite number.

¹⁹ I do not think Nietzsche would mind this sort of reductionism either way, but, as I am about to argue, reducing infinity into a complete and understandable human description is an impossibility.

²⁰ Computer scientist Christopher Langton coined the phrase “edge of chaos” in 1990 to describe this space occupied between determinism and randomness.

²¹ Nietzsche makes the important distinction between “explanation” and “description” in TGS, page 113. He argues that science has become better only at *describing* nature. This is an a posteriori *description* as opposed to any sort of teleological *explanation*.

Nietzsche's criticism of science as set of contrived causes and effects attempting to explain something that is fundamentally unexplainable is well received in light of our discussion on quantum mechanics. Nietzsche's criticism, and the development of quantum mechanics, reinforces the ideal of modesty in the scientific endeavor. No longer does science see itself as a fundamental explanation of reality in itself, since that ultimate reality is recognized to be unknowable in itself and describable only through an invasive act of observation. Nietzsche's chaos is now manifest in the very essence of nature as the indeterminacy of quantum states and the observer-dependence of quantum description.

Conclusion: a science of gaiety and wholeness

Nietzschean chaos permeates through nature and scientific description in quantum mechanics. Vermaas' modal interpretation of quantum mechanics attempts to overcome this chaos, but it still cannot overcome the chaos in the observer effect—it cannot attain the status of dogmatic realism without sidestepping the requirement of freedom from measuring conditions that dogmatic realism demands. Before giving up on the possibility of quantum mechanics attaining the level of dogmatic realism, let us look at one more interpretation of quantum mechanics.

Quantum physicist David Bohm, clearly influenced by Hegel's concept of the absolute, posit the idea of wholeness. The whole is reality in itself, basically equivalent to Kant's noumenal world. But while Kant denies the possibility of knowledge of the thing in itself, Bohm held that scientific theories strive to understand the whole of reality in itself (*The Undivided Universe* 323). In the discussion of Hegel's "Force and the Understanding", we saw how Kantian scientific law posits the expression of force and force in itself as phenomenal/noumenal

reflections of each other. Similarly, Bohm conceives of wholeness or the implicate order as reality in itself and the unfolding of events or the explicate order as noumenal/phenomenal reflections of each other (*Wholeness and the Implicate Order*).

Like Kant, Bohm warns: “We have thus to be alert to give careful attention and serious consideration to the fact that our theories are not ‘descriptions of reality as it is’ but, rather, ever-changing forms of insight, which can point to or indicate a reality that is implicit and not describable or specifiable in its totality” (17). But while it may be impossible to describe the implicate order, the whole, the noumenal world, in its totality, Bohm maintains that a major goal of science should be to reflect the wholeness of the implicate order in the process of thought which constructs scientific knowledge: “when we really grasp the truth of the one-ness of the thinking process that we are actually carrying out, and the content of thought that is the product of this process, then such insight will enable us to observe, to look, to learn about the whole movement of thought and thus to discover an action relevant to this whole” (19).

Bohm provides conditions and strategies to strive for a whole-oriented thought process and science. Regarding the effort to achieve wholeness in thought, Bohm discusses Eastern thought, wherein various forms of meditation can be utilized by the man to reach “a state of mind in which he ceases to sense a separation between himself and the whole of reality” (24). But after noting the contradiction in such a notion, “for the immeasurable is, if anything, just that which cannot be brought within limits determined by man’s knowledge and reason,” Bohm proposes a more modest approach (though not by far): he proposes and begins an “archaeology of our thought process” by means of a study of the origin of words such as “thing” and “reality”, since such words structure our thought process (54). Reaching a level of understanding beyond the

limits of these words could lead to a union that was previously impossible due to analytic limitations of the linguistic definitions of terms.

To push toward wholeness in scientific law, Bohm provides his own modal interpretation of quantum mechanics, in his **hidden variables theory**. A hidden variable explains the indeterminacy we see in quantum events as not a fundamental property of quantum systems. Rather, uncertainty arises from “a multitude of new kinds of factors, outside the context of what can enter into the quantum theory” (68). Discovering these hidden variables would reformulate the whole of quantum theory, and possibly serve as the desired determinate causes of the apparent probabilistic nature of quantum states.

But hidden variables theory only point to such hidden variables as mere possibilities, as hypothesized causes for observed effects. Bohm recognizes that under the standard interpretation of quantum physics as understood by Heisenberg, such hidden variables have only metaphysical status, being “empty of real experimental content” and in turn violating Ockham’s Razor (70). While these hypothesized hidden variables at this point have only tenable metaphysical status, this is not to say that they should be dismissed as being irrelevant in the development of quantum mechanics. Clearly, quantum mechanics is still very much in the stage of development. As of now it is fundamentally incompatible with relativity, while both theories are taken to be accurate descriptions of reality. For quantum mechanics to achieve the status of dogmatic realism, to subsume the measurement problem and establish the a priori necessity of its laws and outcomes, it must provide universal deterministic descriptions of phenomena.

The argument that there are levels of physical reality “outside the context of what can enter into the quantum theory” is not an absurd claim. Even our fundamental quantum mechanical laws and scientific understanding break down at the intersection of quantum

mechanics with relativity. The Large Hadron Collider, by colliding particles at 99.999999% the speed of light (“LHC Machine Outreach”), will shed some light on the status and future of quantum mechanical laws—and will perhaps lead us closer to uncovering more fundamental variables that help begin to decipher what we now see as uncertainty, as chaos.

But would the discovery of such new variables not destroy the ambiguous element of quantum reality that Nietzsche would find so congenial? There is a fine but definite line, Nietzsche would agree, between an abstract imaginative construction of reality and a tenable mathematically rigorous and empirically verifiable scientific law. As long as quantum mechanics does not get carried away by fancy and fall prey to the Hegelian Imagination Problem—e.g. by taking an unfalsifiable model like string theory to describe reality in itself—it has potential to continue to flesh out its details and push closer and closer to describing the whole of reality. I agree with Bohm that a full description of the whole of ultimate reality may be inherently impossible. And Nietzsche would certainly agree as well. But combining Nietzsche and Bohm’s conceptions of science would help provide the creativity to fuel quantum mechanics’ epistemological mission.

Nietzsche’s “gay science” is a self-conscious creative art of discovery which provides “a reawakened faith in tomorrow and a day after tomorrow, of a sudden sense and anticipation of a future, of impending adventures, of reopened seas, of goals that are permitted and believed in again” (3). Bohm’s ideal holistic science can come only through a spiritual union of the self and the dynamical world (11). Nietzsche’s gay science can provide the emotional, epistemological drive to push toward Bohm’s holistic science—a spiritual unity between self and world.

By acknowledging the significant relationship between self and world, quantum mechanics has introduced the possibility of a spiritual unity that is not merely given by God, but

is derived from scientific laws based on rigorous experimentation and theorizing. We have already discovered fundamental characteristics of our world using quantum physics, and are discovering more all the time. One can raise a Kuhnian objection and claim that there is no grounds for valuing the truth of quantum mechanics over the truth of Newtonian mechanics or Aristotelian mechanics, since each is merely representative of their respective ideological climates. But this objection can be dismissed with a simple functionalist analysis. New scientific concepts do not simply displace older ones on an abstract epistemological level—new scientific concepts offer a new understanding of phenomena, which is manifest in the ability to predict phenomena, manipulate outcomes of events, and develop new technology possible only through that increased scientific understanding.

We must be wary, however, not to let genuine scientific curiosity give way to dogmatism or madness. Instead of following Nietzsche who steadfastly pushes into the depths of chaos which he saw as the essence of nature—which ultimately led to madness—science must approach the unknown slowly and methodically, with caution but not cowardice. Future science ought to incorporate Nietzsche's gaiety as a mentality and Bohm's holism as an ideal. It can use the former as the backdrop for all its scientific endeavors and the latter as the upper bound of all its possible scientific knowledge—a bound which can be approached but never attained. Nietzsche's gaiety will help provide solace to our scientific mission, which is on some level utterly doomed to failure.

After recognizing that ultimate reality can never be encapsulated by scientific law, we can use Nietzsche's gaiety to as motivation to push ever closer toward ultimate reality. But we must bear in mind Nietzsche's chaos (and Hegel's infinity) when we conceive of the gap between our understanding and the desired account of ultimate reality, and realize that while the

continual development of science will necessarily minimize the gap, the gap will never be completely removed. To understand our mission in the context of the *Phenomenology*, future science will remain at the level of scientific law—that is, it will not use morality, culture, and religion to bring about the spiritual union between self and world. As such, scientific laws will always be subject to the same Kantian doubt of correspondence (which drives the *Phenomenology*'s Consciousness to posit the inverted world). We can mitigate this doubt (but not remove it entirely) by making our laws more sophisticated by unpacking the nuances, through mathematics and observation, of the interplay between observer and reality. Diving into this relationship will expose the complex nature and mutual interdependence of theory and observation, and it is this chaos that we will expose and explain. We still ought, however, to overcome this gap in *spirit* and take comfort in the fact that we cannot overcome it in scientific law. With the latter realization, accepting a reality whose essence is unattainable through scientific law allows for the creativity, the gaiety, that this chaos leaves us. Scientific law, though essentially separate from ultimate reality, allows for infinite progress in dismantling the chaos that characterizes our relation to that reality.

Figures

Tension between the conceptual world and ultimate reality

text	<u>Plato</u> <i>Theaetetus</i>	<u>Kant</u> <i>Critique of Pure Reason</i>	<u>Hegel</u> <i>Phenomenology of Spirit</i>	<u>Nietzsche</u> <i>The Gay Science</i>
degree of realism	metaphysical	dogmatic	none (idealist)	none (relativist)
result of tension between concept and object	aporia	ontological uncertainty	infinity, inverted world	epistemological/moral/ontological relativism
possibility of resolving tension	mathematics, myth	metaphysical leap	self-consciousness	perspectivism
ultimate resolution	theory of forms	none	absolute knowing	chaos

Tension between scientific law and ultimate reality

	<u>Classical Mechanics</u>	<u>Quantum Mechanics</u>
degree of realism	dogmatic ²²	practical
arena of tension between law and ultimate reality	none	observation
result of tension	n/a	quantum uncertainty, state collapse

²² Newton subscribes to metaphysical realism, insofar as he [1] believes scientific law to correspond to ultimate reality and [2] provides empirical rather than logical justifications for several scientific laws. But the objects of classical physics need not necessarily exist—they can be understood as ideals of mathematics or concepts of the understanding, as Kant holds. This is why classical mechanical laws are at least dogmatically realist but not necessarily metaphysically realist.

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