

2 || Philosophical Shortcomings of Methodological Naturalism and the Path Forward

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Abstract

Methodological naturalism, when used to enforce an exclusive view of scientific investigation, is based on three problematic streams of philosophy: mechanical philosophy, positivistic epistemology, and divine incomprehensibility. Each of these philosophies has inherent flaws that prevent them from being usable across the entirety of causal relationships that science attempts to investigate. However, even in the face of such criticisms, methodological naturalism as a methodology does have some positive features that should be retained even if methodological naturalism itself is not.

1 Defining Methodological Naturalism

Methodological naturalism has had many different proponents and definitions over the years. Trying to sort these out can be rather difficult, as they each have their own idea of what methodological naturalism is, why it is important, and what it means for the scientific enterprise. Proponents of methodological naturalism have included those who think that non-naturalistic explanations are within the bounds of science but are not very fruitful as well as those who think that such explanations should be *a priori* removed from scientific inquiry.

Most claims about methodological naturalism fall into the *a priori* exclusionism camp. Likewise, the *a priori* exclusionism view is the most important because it can

be used, and has been used, as a rule for one party to exclude the investigations of another party from a field of science.

This paper will focus on the exclusionist view for two reasons. First of all, since we are looking at the issue from a philosophical standpoint, the question of whether or not some individuals find naturalism personally helpful or not is not very interesting. What people today find helpful says little about ontology or epistemology in the broader sense. Second, strict exclusionism is used as a rule to exclude the findings of others. That is, the whole point of strict exclusionism is not for someone to say what they themselves are doing or why they themselves have chosen a particular methodology, but to exclude from conversation others who have chosen differently. In order to rationally justify such an exclusion, one needs to establish a firm basis for doing so. If I prefer to study tree frogs over velociraptors, this is a choice that I may have reasons for, but that I do not need to justify to anyone other than myself. If I want to prevent other people from studying or publishing findings about velociraptors, then I need to have strong philosophical grounds for doing so, and such grounds must be open to scrutiny by others. Likewise, if someone wishes to focus on naturalistic causes and methods in their own study, there is no reason why anyone else should care. However, if someone wishes to prevent someone else from focusing on non-naturalistic causes and methods, they need to have strong grounds for such an action.

The most authoritative statement on the question of methodological naturalism comes from the National Science Teachers Association (NSTA), which has been used by other authoritative groups such as the National Academy of Sciences (NAS). The most commonly-referenced version of this statement appears in the 1998 book *Teaching about Evolution and the Nature of Science* published by the NAS. In this book, the NAS republished the NSTA's statement as follows:

Science is a method of explaining the natural world. It assumes the universe operates according to regularities and that through systematic investigation we can understand these regularities. The methodology of science emphasizes the logical testing of alternate explanations of natural phenomena against empirical data. Because science is limited to explaining the natural world by means of natural processes, it cannot use supernatural causation in its explanations. Similarly, science is precluded from making statements about supernatural forces because these are outside its provenance. Science has increased our knowledge because of this insistence on the search for natural causes.

(Working Group on Teaching Evolution, National Academy of Sciences, 1998, pg. 124)

The NSTA has updated their statement over the years, though it is the same in spirit. Their new statement says,

Science is a method of testing natural explanations for natural objects and events. Phenomena that can be observed or measured are amenable

to scientific investigation. Science also is based on the observation that the universe operates according to regularities that can be discovered and understood through scientific investigations. Explanations that are not consistent with empirical evidence or that cannot be tested empirically are not a part of science. As a result, explanations of natural phenomena that are not derived from evidence but from myths, personal beliefs, religious values, philosophical axioms, and superstitions are not scientific. Furthermore, because science is limited to explaining natural phenomena through testing based on the use of empirical evidence, it cannot provide religious or ultimate explanations.

(National Science Teachers Association, 2013)

Both of these statements are intended to be normative for scientific practice, have been used as the basis for the development of science standards, and have been used to justify the exclusion of other forms of inquiry from science (NGSS Lead States, 2013; SC Education Oversight Committee, 2014; Scharmann, 2005; Lerner, 2000; Katskee, 2006). These statements, because they were issued by normative agencies (the NAS and the NSTA) and because of their history of use for the exclusion of inquiry, will be used as the focus for this paper. The paper will focus especially on the 1998 statement because of its widespread distribution through the National Academy of Sciences. Quotes of the statement will refer to the 1998 statement.

2 Locating the Intellectual Sources of the Statement

In recent years, many scientists have disregarded philosophy as a valid source of knowledge. In fact, in the NSTA's updated statement above, the NSTA explicitly rejects philosophical axioms as a source of scientific knowledge. The problem with rejecting philosophy as a source of knowledge is that it also undercuts the foundations of science itself. Most scientific investigations operate based on the *principle of sufficient reason* and the *identity of indiscernibles* (Bartlett, 2014a). These principles come to science from philosophy, and, as such, indicate that nearly all scientific knowledge actually originates from philosophical axioms. If a person tests a substance to determine that its properties match that of hydrogen and concludes that it *is* hydrogen, then that person is going beyond the empirical data and using the identity of indiscernibles as a philosophical axiom to reason from the empirical data to the conclusion that the substance is hydrogen.

In fact, as has been pointed out by many philosophers of science, even so-called empirical facts are model-based and therefore based on philosophical axioms (Polanyi, 1946; Hanson, 1958; Quine, 1968; Feyerabend, 1993; Polkinghorne, 1998). As the

present paper will show, many of these models themselves are based on personal beliefs and what the NSTA would certainly classify as “myths.”

However, the present point is that scientists as a group, especially scientific organizations representing scientists, seem to be wholly ignorant of the role that philosophy plays in their reasoning. As such, it is very difficult to derive *from scientists* an explicit explanation of the underlying philosophy for what they do and how they describe what they do. This does not mean that they do not employ philosophy, but merely that they are unaware of what that philosophy is, where it comes from, and what the known limitations are with a given philosophy.

Every philosophy brings with it knee-jerk prejudices. The goal of philosophy is not to eliminate these, but to bring them under examination. When a person thinks that they don’t use philosophy, what it usually means is that they are engaging in the knee-jerk prejudices of a philosophy that they are unaware of, and therefore are unable to critically examine. Therefore, the goal of assessing the philosophical underpinnings of these statements of methodological naturalism is to bring them fully to the surface so they can be examined in the light of day and not just held as mere prejudices.

The goal of this paper is to show the original streams of philosophy that undergird methodological naturalism (as exemplified by the NSTA statements), and then offer a critique of their ability to serve as a philosophical foundation for science.

The philosophy behind a particular scientific methodology would not matter so much if that methodology operated within an isolated scientific pursuit. Then it could be argued quite reasonably that the methodological restrictions emanate not from some particular universal philosophy, but by the nature of the subject matter itself. However, methodological naturalism is not just a claim about a specific science, but about all sciences. While science originated in physics, it now encompasses a diverse set of fields including biology, anthropology, psychology, cosmology, and evolution, each with their own individual subject matters. Methodological naturalism claims that each of these, because they are sciences, must entail the same methodological restrictions as physics. Additionally, two of the subjects mentioned—cosmology and evolution—are *totalizing* subjects. That is, the truth of their findings depends on taking into account *all* available causes; one cannot simply pick out an individual, restricted subject matter and focus on a subset of causes and have the results be valid. Cosmology, for instance, covers the entire history of the universe. If there are causes in play anywhere in the universe that are not covered by methodological naturalism, then those working in cosmology may be missing important causes simply by the methodological restrictions imposed from the outside. Likewise, this is true for evolution. If there are causes in play anywhere in the history of life that are not covered by methodological naturalism, then those working in evolution may be missing important causes necessary to discovering the truth about the evolution of life on Earth. Again, since these are totalizing subjects, such restrictions cannot be seen as emanating from the subject matters themselves since the subjects include every available cause in the subject’s history and not just those derived within a specific

context (i.e., the context of a lab or experiment).

Therefore, we can also say that because methodological naturalism is used in science no matter what the subject matter is and because it is used in totalizing sciences as well, methodological naturalism must be based not on the subject matter but on a governing philosophy of nature and epistemology. As such, it is imperative to uncover and analyze the philosophies behind methodological naturalism.

3 The Three Streams of Philosophy

This paper argues that methodological naturalism has its source in three streams of thought: mechanical philosophy, positivist epistemology, and theological incomprehensibility. These streams provide synergy to each other with each justifying the underlying presuppositions of the other. The result of these streams working together is methodological naturalism in science as exemplified by the NSTA statements.

The first stream is mechanical philosophy. Mechanical philosophy is a philosophy of nature originating in the 1600s. It has taken several forms (which will be explored), but in essence, the goal is to view nature as machine-like. It can be understood as a reaction to the scholastic philosophy of nature popular in the Middle Ages. The philosophers of the 1600s viewed the explanations given by the scholastic philosophers as essentially non-explanations (Slowik, 2014). The scholastics viewed the world in terms of substantial forms and qualities. To the mechanical philosophers, these forms and qualities seemed to require explanations themselves. To say that something is “dry” because it has more of the quality “dryness” seems to not actually explain dryness. Likewise, saying that something is circular because its form has a circular nature is not actually saying anything about why it possesses that shape.

Therefore, mechanical philosophy says that fuller explanations of the world can be made by treating the world as a machine and asking what sorts of mechanisms create the forms and qualities we see in nature.

In the nineteenth century, mechanical philosophy gave birth to positivism and its cousin, pragmatism, as epistemologies. Positivism is the idea that any statement that cannot be understood in terms of matter and motion (i.e., the fundamental terms of mechanical philosophy) is not only wrong, but entirely non-sensical. For instance, the word “love” is only meaningful if someone can give an operational definition of love—for example, “Love means that someone will hug me often.” In positivism, all terms must eventually be definable in operational (i.e., mechanical) terms to have any valid meaning. Positivism denied the reality of most spiritual beings, forces, and ideas by stating that since their ultimate meaning cannot be given in efficient terms, they cannot be knowable entities.

Pragmatism is similar to positivism but takes a slightly different tack. Positivism aims at real knowledge and limits real knowledge to things that can be known

in efficient terms. Pragmatism, on the other hand, does not seek real knowledge, but instead it seeks ideas with a “cash value.” Pragmatism does not care if *any* of its terms or relationships have any basis in reality to them at all. Pragmatism only cares whether or not certain considerations of reality prove useful. There are many ways that pragmatism can be made amenable to spiritual qualities. Even its founder thought that pragmatism could encompass spiritual ideas, saying, “If theological ideas prove to have a value for concrete life, they will be true, for pragmatism, in the sense of being good for so much” (James, 1907). For the interested reader, an extensive and thoughtful treatment of the pragmatism of such ideas in society can be found in Niebuhr (1952).

Despite its roots as a neutral player in religious and non-religious thought, American pragmatism over the years has largely coalesced with positivism. The “cash value” of positivism is usually construed as operational results—i.e., an idea is good if it provides predictive value of the future. Therefore, pragmatism is commonly used to exclude theological propositions on similar grounds as positivism does, but without making any metaphysical statement about the reality or unreality of such.

In short, positivism and pragmatism are very similar in practice with positivism viewing non-operational statements as “meaningless” and pragmatism viewing them as “worthless.”

Given that most people are religiously inclined (Hackett and Grim, 2012), and, in fact, that religious inclination may be a biological feature of humans (Boyer, 2008; Barrett, 2011), it would be surprising for these philosophies by themselves to have a large-scale impact on human thinking. However, a theological movement originating in the nineteenth century paved the way for positivistic ideas to establish themselves among the theologically-inclined.

The spiritual realm has always been viewed as a mystery to humans. Perhaps it is touchable, but it is largely seen as incomprehensible. Likewise, the Christian understanding of God asserts that God’s ways are not always understandable to humans. For example, Isaiah 55:8 says that God tells man, “For my thoughts are not your thoughts, neither are your ways my ways, declares the LORD. For as the heavens are higher than the earth, so are my ways higher than your ways and my thoughts than your thoughts.”

In Christian thought, this has historically been taken to be a partial assertion. That is, to some extent God’s thoughts and ways can be knowable, but ultimately God’s thoughts and ways are above us. However, this idea that God’s ways are above ours has, throughout history, often been used as an “escape hatch” for those engaging in apologetics. That is, if someone says that “God would not have allowed X in the world,” an apologist may respond, “God’s ways are higher than our ways, so it is possible that God has a really good reason for allowing X in the world.” The problem is that if any positive statement about theology can avoid disputation by simply stating that God’s ways are beyond ours, then it is difficult to see how any theological dispute may be resolved.

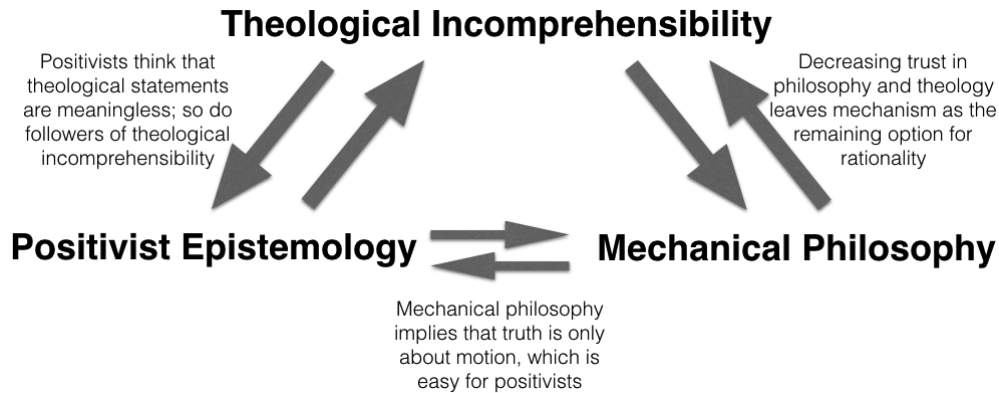
Starting in the nineteenth century, this led to the doctrine of divine mystery to be transmogrified into the doctrine of divine incomprehensibility. That is, not only is God mysterious, but there is no objective way to know or say anything about God. Therefore, nothing that we say about God can constitute knowledge. Originally, this began merely as a question of what humans can know about *God* but eventually was applied to all forms of spiritual knowledge. Today, while the doctrine of divine incomprehensibility is rarely stated as such, it can be seen in practice by the way that society treats theological knowledge as inherently personal and non-arguable. Theological propositions are personal because, though they might be true, there is no way to adjudicate differences of opinion. Therefore, they are treated as personal opinions and not the subject of public discourse. Because of divine incomprehensibility, they stand as both non-refutable and unknowable. Likewise, each individual's theological opinions are treated with equal weight because they are all equally non-refutable and unknowable.

These three philosophical streams—mechanical philosophy, positivism/pragmatism, and divine incomprehensibility—even though each does not necessarily entail the other, are mutually reinforcing. Mechanical philosophy provides an ontology of the world (or at least the natural world) that consists entirely of matter and motion. Positivism and pragmatism restrict epistemology to only quantities that are relevant to mechanical philosophy. From the other direction, divine incomprehensibility removes theological ideas from the realm of rational discourse, leaving only the terms that are used in mechanical philosophy.

Positivism views theological ideas as meaningless. Pragmatism views theological ideas as unhelpful. Mechanical philosophy views theological ideas as unreal. Divine incomprehensibility views theological ideas as real but unknowable. What is left over from this subtraction is, essentially, mechanical philosophy. While divine incomprehensibility usually presumes (contra mechanical philosophy) that there is a real spiritual aspect to the world, the fact that no definitive statements about God or the spiritual realm can be made makes it sufficiently innocuous for those operating within mechanical philosophy to countenance. Divine incomprehensibility also moves pragmatism closer to mechanical philosophy. As we noted earlier, it is possible for pragmatic theological statements to be developed. However, divine incomprehensibility discourages such claims by *a priori* determining them to have no cash value. While pragmatism makes no definitive claims about the nature of the world, it lines up very cleanly with mechanical philosophy.

So, while these philosophies are largely independent of each other, they exist together in a comfortable, mutually-reinforcing space. In other words, the knee-jerk prejudices of each of these philosophies line up and reinforce each other.

Figure 2.1: The Mutually-Reinforcing Nature of the Three Streams of Methodological Naturalism



4 Tracing These Views in the NSTA Statements

What we have established so far is the mutually-reinforcing nature of mechanical philosophy, positivist/pragmatist epistemology, and divine incomprehensibility. The question then is how does this trio add up to methodological naturalism? Each of these philosophies can quite easily be picked out from the NSTA statements themselves.

The starting assumption of the statement is that science “assumes the universe operates according to regularities and that through systematic investigation we can understand these regularities.” First of all, it assumes that the universe operates according to regularities. It could have said that *some parts* of the universe operate according to regularities. Instead, it made the blanket statement that the universe operates according to regularities. This is quite consistent with mechanical philosophy.

Next, note that it doesn’t say that we can understand *some* of these regularities or a *subset* of these regularities, but just that we can understand these regularities. Thus, epistemology is likewise limited to the contents of mechanical philosophy. Further, it states that science is based on testing against empirical data (i.e., matter and motion), which is from the positivist/pragmatist view of reality.

Finally, the statement deals with religious explanations. It says that “science is limited to explaining the natural world by means of natural processes, it cannot use supernatural causation in its explanations.” However, this statement is never justified. What is it about the nature of the world that prevents its regularities from having a supernatural cause? There are only two possible explanations: either this is merely a subject-matter distinction, or it is because the major proponents of this view believe mechanical philosophy to be a true statement about the world.

Let’s start by considering that this is merely a subject-matter distinction. That is, science doesn’t include supernatural causes because it is too busy focusing on natural causes. Non-natural causes may be interesting to some people but that is not

what these individuals have chosen to study. In such a view, the subject matter is the operating demarcation and methodologies flow naturally from the nature of the subject matter under investigation (Sich, 2014). However, the way that the NSTA statement is constructed, the NSTA is talking about the universe of inquiry into causation, not a subset of it.

Additionally, subject-matter restrictions never surface as absolute prohibitions. For instance, if I were to say that Renaissance studies were limited to the time period of the fourteenth century to the seventeenth century, there would be no opprobrium attached to a paper discussing thirteenth century precursors to the Renaissance, or its influence in the eighteenth century and beyond, or even about the overlap between the Renaissance and its precursors and after-effects. There would be no legal cases trying to use the courts to prohibit the introduction of such ideas into Renaissance studies.

Were the restriction merely one of subject matter, it is difficult to see how or why anyone would object to someone blurring the lines, finding overlaps, or identifying other kinds of integrational activities between science and non-science causes. Additionally, for the subject-matter restriction to make sense, it would need to provide some means of distinguishing between a cause that is within the realm of science and one that is not. Because such a distinction is not provided, it appears that the writers of the statement don't believe that any such cause exists.

Furthermore, the statement says, "science is precluded from making statements about supernatural forces because these are outside its provenance." Again, without a means of distinguishing between science and supernatural forces, it seems that the author thinks that all regularities and everything that can be rigorously investigated has nothing, and can have nothing, to do with the supernatural. This only makes sense on the grounds of divine incomprehensibility. If the universe contained supernatural causes, and a scientist rigorously investigated a cause that he did not yet know was supernatural, what would the NSTA statement have the scientist do? Destroy his data? Burn his books? Apologize for studying the wrong subject? No, it seems that the statement simply assumes that any rigorous investigation into the knowable world would only lead to naturalistic causes, indicating that those are either the only ones available or, assuming divine incomprehensibility, are the only ones that are intelligible.

Finally, the statement says, "Science has increased our knowledge because of this insistence on the search for natural causes." In this world of interdisciplinary cooperation, it seems strange that science alone benefits from a provincial view of knowledge. The only way to make sense of this provincial view is if its proponents believe it is the only game in town.

While the statement does not make explicit reference to mechanical philosophy, positivism/pragmatism, or divine incomprehensibility, the influence of these philosophies can be readily apprehended. Therefore, to see if the foundation of this reasoning is correct, we need to look at each of these philosophies in turn to see if they are both

correct in and of themselves and if they are helpful to the progress of science when strictly employed. I will make no attempt to answer the question as to whether these philosophies are helpful in individual cases (as I believe that they indeed have been), only to whether a *strict* adherence to them, and to the rules laid out in the NSTA statements, would have a negative impact on the progress of science.

5 Mechanical Philosophy

The ontology that sits behind all of this is mechanical philosophy—the idea that all of nature, including our minds, is the product of machine-like forces.

5.1 Mechanical Philosophy in the 1600s

Mechanical philosophy arose as a contender against scholastic Aristotelian views of nature that defined things in terms of substances and qualities. The proponents of mechanical philosophy felt that Aristotelian explanations did not really explain, and therefore sought to explain, nature in a way that gave deeper causal explanations. While Aristotelian philosophy was a philosophy of wholes, mechanical philosophy focused on breaking things down into parts and figuring out how the parts themselves worked. Aristotelian philosophy focused on beings and their natures and qualities, while mechanical philosophy focused on how the parts of beings worked together to make such natures and qualities work.

As such, this does not quite make an ontological distinction. What made mechanical philosophy so different was its relentless goal of re-envisioning everything in terms of material and efficient causes and the disregard of any form of non-material causation.

Whether true or not, this seems straightforward on the surface. The problem, however, comes in laying down what one really means by a “material cause.” The problem of defining material causes has plagued mechanical philosophy from the beginning. In fact, some of the things that today are viewed as the high achievements of mechanical philosophy were, in their day, in ardent opposition to mechanical philosophy.

Mechanical philosophy in the 1600s, for instance, while not completely uniform, generally held the following views:

Atomic Corpuscularism This is the view that, at its core, nature is based on the geometry of tiny, impermeable particles and their interactions. Some viewed these particles as rigid, though some thought they had some amount of flexibility at their core. Differently shaped atoms led to different types of substances and interactions.

Localism This is the view that change can only happen locally. That is, for one

particle to influence another, it must be touching that particle. Action at a distance is considered a spiritual mode of causation.

Gradualism This is the view that there are no instantaneous changes in nature. Everything must go through a smooth series of steps. In fact, this criteria is one of the reasons why some viewed atoms as being flexible—a fully rigid atom, when bounced against another, would have to instantaneously change direction. By allowing atoms to flex, it preserved both atomism and gradualism.

Passivism This is the idea that changes happen *to* atoms. That is, atoms just “are” and their geometry affects how they interact with each other. Atoms are basically passive and do not actively affect the world around them.

These views formed the basis of mechanical philosophy in the 1600s. Note that this does not just describe the physics of the 1600s, but is tied to the mechanical philosophy that was being developed at that time. Atoms were passive, not because of experiment, but because mechanical philosophy only allowed geometry to influence the actions of physics. The world was made of atoms because the higher-level beings described by the scholastics were too spiritual. Causation was local because in order to posit action at a distance, one had to suppose that there was some quality of matter beyond its geometry—again, harkening to the spiritualized scholastic view of the world.

Surprisingly, the major advance in physics in the 1600s didn’t come out of mechanical philosophy, but out of Newtonian physics, which broke with nearly every aspect of mechanical philosophy. Much of Newton’s work was based on gravity, which was much more scholastic than mechanical.

First of all, gravity is an inner power, a quality of an object—not the result of any geometry of that object. As a quality, gravity harkens back to the scholastic ways of thinking, which considered nature in terms of substances, powers, natures, and qualities. Second, gravity exerts action across a distance. Prior to Newton, the ability to exert action across a distance was reserved for spiritual beings and forces. Finally, with gravity, objects are active instead of passive players in physics. Objects themselves, by their nature, exert forces on the things around them. They are not passive as required by mechanical philosophy.

Thus, Newtonian physics, while held up by many today as the triumph of mechanism over religious views of the world, was actually the opposite in its day. Newton was the one who violated methodological naturalism by imputing qualities to nature that were previously reserved for spiritual beings and forces. In fact, this was one of the most common criticisms of Newtonian physics at the time it was presented.

Gottfried Leibniz was one such critic:

It is also a *supernatural thing* that bodies should attract one another at a distance without any intermediate means and that a body should move

around without receding in the tangent, though nothing hinders it from so receding. For *these effects cannot be explained by the nature of things*.

(Leibniz, 1716, emphasis added)

As you can see, Leibniz, co-inventor of Calculus, criticized Newton for proposing a supernatural force and even re-emphasized that these forces were non-natural. Some, such as Einstein, have proposed more localized versions of Newtonian mechanics that didn't succumb to Leibniz's criticisms. However, the question is, what should Newton have done with his own investigations? Should he have abandoned them since they didn't conform to the naturalistic expectations of his day? Should he have waited for the time when he could make a naturalistic version of them? If not, then on what basis should someone today allow naturalistic expectations of nature to impede on an investigation? As we see with Newton, what was viewed as non-mechanistic in one era is viewed as the epitome of mechanism in another.

5.2 Mechanical Philosophy in the 1800s

As noted earlier, trying to pin down mechanical philosophy is somewhat difficult. After the success of Newtonian physics, a new mechanical philosophy had to be invented which included the Newtonian perspective. Therefore, in the 1800s, the new mechanical philosophy focused on these points:

Causal Closure of Nature This held that there is nothing besides nature itself that leads to the outcomes of nature. Nature is composed of fixed laws, and once the laws are known and the present state of the world is known, everything is known about the causes that will generate the next series of effects.

Determinism Because of the causal closure of nature, if all of the forces acting in nature are known, then the effects can be known as well (in theory, though no one believes this would be true in practice). Since the current effects are the causes of the next set of effects, then the cause/effect cycle can be theoretically followed as far into the future as one wishes. Thus, all future effects can be, in principle, determined from the current state of the world.

Matter-focused Because one of the purposes of mechanical philosophy is to remove spiritual modes of causation from nature, mechanical philosophy is fundamentally matter-focused.

This new mechanical philosophy is best summarized by the mathematician Pierre Laplace:

We may regard the present state of the universe as the effect of the past and the cause of the future. An intellect which at any given moment knew all of the forces that animate nature and the mutual positions of

the beings that compose it, if this intellect were vast enough to submit the data to analysis, could condense into a single formula the movement of the greatest bodies of the universe and that of the smallest atom; for such an intellect nothing could be uncertain and the future just like the past would be present before its eyes.

(Laplace, 1814)

This new mechanical philosophy seemed strong and formidable. However, at the beginning of the twentieth century, new breakthroughs in physics destroyed this view of mechanical philosophy as well. The rise of quantum mechanics showed that all physical descriptions are partial and incomplete. Not only is quantum mechanics itself incomplete, but experiments have shown that randomness (i.e., the inability to fully describe causation in terms of its present state) is fundamental to physics. This destroys both the causal closure of nature as well as determinism.

Likewise, quantum mechanics brought about a shift in thinking away from matter-focused physics. The wave/particle duality of quantum physics means that a matter-focused philosophy of nature was inherently deficient. In fact, in some branches of quantum mechanics (such as the Copenhagen school), mind is itself considered a fundamental entity.

Finally, the one aspect of mechanical philosophy of the 1600s that Newton did not contradict, gradualism, was in fact overturned by quantum mechanics, which says that causation can and does happen in leaps.

Therefore, for a second time, the advances in physics were not in line with the expectations of mechanical philosophy and naturalism. While naturalism has certainly successfully retrofitted itself to make room for each of these advances in physics, it is difficult to make the case that naturalism in any way helped push physics forward, except perhaps as a means of codifying the assumptions of the present age that needed to be challenged. It certainly does not seem that science should be limiting itself based on a particular era's view of what counts as a naturalistic explanation.

5.3 Modern Mechanical Philosophy

With every iteration, mechanical philosophy has grown quite a bit weaker as a statement about reality. The mechanical philosophy of the 1600s made fairly definite statements about what it thought "mechanism" did and did not include. While this philosophy turned out to be largely mistaken on its view of the world, we can at least appreciate it as an intelligible description of how they thought the world worked.

In the mechanical philosophy of the 1800s, the focus was not on a definitive description of the world, but on a general model of how causes and effects interacted in any suitable description of the world. In other words, they skipped over what the

specific laws of physics should be and just focused on the relationship between the laws and the things governed by those laws.

In the modern incarnation of mechanical philosophy, a mechanism is considered anything that is:

- A distinct phenomena
- Composed of parts
- Parts that have a structure
- Parts that are in some form of a causal relationship with each other

While there is probably nothing wrong *per se* with this form of mechanical philosophy, it is difficult to see what, if anything, it has to say for a scientist investigating a phenomenon. Even someone investigating the paranormal (ghosts, goblins, etc.) would be able to frame their investigations in terms of this definition of mechanism. In fact, it is difficult to imagine any description of events that would not be consistent with this form of “mechanism.” As such, if this is all that is meant by “natural phenomena,” it is difficult to envision what it is that the NSTA statements were trying to exclude.

Therefore, if the NSTA statement is attempting to make a description of something with the term “natural phenomena” it is difficult to see what it is that they mean. Mechanical philosophy is usually what that term is thought to include, but, as we have seen, mechanical philosophy has repeatedly been shown to be false, or, in the modern incarnation, it is fairly meaningless as a way of demarcating phenomena. In fact, as the history of mechanical philosophy has shown, “natural phenomena” seems to only signify the prejudices of the current age, which holds science back, rather than a template for moving science forward.

One other possible meaning of “natural phenomena” in the modern era, which has a more definitive structure, is computationalism, which is described in Stephen Wolfram’s Principle of Computational Equivalence (Wolfram, 2002) and other similar principles, such as the Tractable Cognition Thesis (van Rooij, 2008). The idea behind these principles is that the limits of nature are the same as the limits of computation. For this philosophy, a “natural phenomenon” is one that is computable with a Turing-like machine.

Like the previous versions of mechanical philosophy, this view likely serves to encapsulate the prejudices of the current era, which need to be overcome, rather than actually describing the real state of the world. While a full criticism of this view will not be presented in this paper, the reader can read more on this subject in Bartlett (2014b) and in Bartlett (2016).

6 Positivism and Pragmatism

Even though mechanical philosophy is untenable as an ontological basis for methodological naturalism, this does not necessarily invalidate the positivist/pragmatist epistemology. For instance, it is possible that even if specific theories of the world do not need to rely on mechanical philosophy, our knowledge of them may be limited to the operational ways in which these theories affect our experience.

As noted earlier, depending on what someone's goals are, it is possible to formulate pragmatism in a manner outside the realm of positivism. It is *often* aligned with the positivistic view of things, but this is not a necessary equivalence. Additionally, if one's goal in science is to discover reality, pragmatism is not a suitable epistemology. Pragmatism is often used as a "compromise" or "placeholder" epistemology, where if the ontological status of a statement is in question, one can appeal to the pragmatic value of the statement even if the ontological status is largely doubted.

As such, the only view of epistemology that would be foundational for a strict exclusionist view of methodological naturalism would be positivism. Therefore, the question becomes, can positivism form a *normative* basis of scientific epistemology for the entire world of inquiry into causation in the universe?

It is possible that in a limited frame of reference, positivism may be a worthwhile epistemology just like naturalism may be a worthwhile ontology for some aspects of the world. However, science, as practiced today, does not just include physics, but also biology, psychology, evolution, cosmology, and others. Cosmology and evolution, being total views of cosmic history, likewise require total views of causation in order to form an accurate picture of their subject. Therefore, for an epistemology to be normative for science generally, and not a specific science, it must be universally applicable. As such, we will show that positivism is an inadequate total epistemology.

The fundamental problem with positivism is that it is self-refuting. Positivism claims that all statements that are meaningful must only be defined operationally (i.e., in terms of empirically-verifiable results) or must be true *a priori* (i.e., mathematical statements). However, the claim of positivism itself cannot be defined in terms of empirically-verifiable results, and it is not true *a priori*. Therefore, if positivism were true, it would refute itself as meaningless. That alone should exclude it from being a total epistemology.

However, for reasons that are incomprehensible to the present author, some do not think that self-refutation (a common problem in skeptical epistemologies) invalidates a philosophical position. Therefore, we will present additional problems with positivistic views.

The first problem with positivism is Quine's ontological relativity. Quine points out that all statements, including empirical ones, are part of a larger web of belief structures. Therefore, in order to make empirical statements, we must have in place prior belief structures that are not empirical that allow us to make our measurements. As Hanson points out, all empirical measurements are model-based. Since our mea-

surements are founded upon these models and belief structures, the measurements can only be as true as the underlying models and belief structures upon which they are based. Therefore, for empirical results to be meaningful, the non-empirical models upon which empirical results are based must also be meaningful.

The second problem with positivism is Gödel's incompleteness, which states that there are true, knowable facts that are not verifiable from a fixed set of axioms. The only allowed exceptions to empirically verifiable truths allowed by positivism are *a priori* truths such as mathematics. However, Gödel's incompleteness introduces a new set of mathematical truths that are *based* on mathematics, but are not verifiable axiomatically from mathematics and are not verifiable empirically. At least some of these truths are knowable. Therefore, there are real, important truths that are not verifiable in the ways positivism lays out.

Third, there are similar problems with non-mathematical knowledge. As Plantinga points out, life is full of real but unverifiable truths. For instance, one cannot verify the consciousness of other minds. The existence of such is something that we all presume, but it cannot be verified in any external fashion. One may argue that we have a biological (and therefore *a priori*) foundation for such beliefs, but that would mean we also have a biological basis for believing in God and other spiritual beings. Therefore, if positivism includes biological foundations in the set of *a priori* knowledge that can be used in science, then one could not exclude supernatural explanations on that basis.

However, positivism and pragmatism are not completely empty as epistemologies. One quality that they emphasize, and is worth keeping, is the connectedness of truths to each other. Positivism, by connecting all knowledge to operational action, forces knowledge to at least be connected to *something*. This does in fact help eliminate meaningless truths that are completely unconnected to reality. The problem, though, is that assuming everything must be connected in a certain way to a particular set of truths overly restricts knowledge and meaning.

7 Divine Incomprehensibility

As mentioned previously, divine incomprehensibility is an approach to theological ideas that says theological knowledge is super-rational. This term is sometimes used for the notion that there are *aspects* of God that are not comprehensible to us (Sproul, 2014). However, here we are referring to the movement that gained headwinds in the nineteenth century and goes beyond this saying that everything about God (except possibly God's existence) is unknowable. Since God's ways are above our ways, and God's nature is above our nature, there is no way for us to have any real knowledge about God or any supernatural subject. Divine incomprehensibility is technically limited to knowledge about God, but it is usually, as will be shown, then applied to all theological and non-material knowledge.

There is a question as to what theology motivated the early development of empiricism in science. Voluntarism, the idea that God created the world freely, in the way that He chose, and without compulsion, is often viewed as the foundation of empiricism (Oakley, 1961; Henry, 2009). Since the choice to create was a free choice of God, *what* he created was also a free choice and therefore could not be deduced from *a priori* knowledge. Instead, we must go out into the world and study it to learn what it was God chose to create. Harrison (2002) has contended that a weaker form of divine incomprehensibility stood at the heart of the early empiricists. Since the scientists could not know God's thoughts, they must therefore discover what the world was like through empiricism. At that time in history, while their *a priori* knowledge of God's intentions were viewed skeptically, the *ability to learn* God's intentions through empirical study was not.

In the nineteenth century, however, the doctrine of divine incomprehensibility had started to take hold in academic circles, and its influence paved the way for modern ideas about methodological naturalism.

This can be seen, for instance, in the modifications to Darwin's *Origin of Species* throughout its various editions. Darwin continually revised *Origin* in response to criticisms of his work. These revisions can give insight to the way in which Darwin justified his methods and inferences. Dilley (2013) has catalogued the changes to *Origin* that deal with methodological naturalism (though not under that name) and its justifications.

As Dilley points out, in the first three editions, nothing like methodological naturalism appeared. It isn't that Darwin did not believe in methodological naturalism (Gillespie (1979) notes that he believed in it from early in his career), but rather that either Darwin didn't feel he needed to include it as a justification, or, as Dilley suggests, he believed that the intellectual climate at the time would not accept it as a justification.

In the sixth edition, he appealed implicitly to divine incomprehensibility as the justification for excluding supernatural explanations in biology. The following was added to the sixth edition (emphasis mine):

He who believes that some ancient form was transformed suddenly through an internal force or tendency into, for instance, one furnished with wings, will be almost compelled to assume, in opposition to all analogy, that many individuals varied simultaneously. It cannot be denied that such abrupt and great changes of structure are widely different from those which most species apparently have undergone. He will further be compelled to believe that many structures beautifully adapted to all the other parts of the same creature and to the surrounding conditions, have been suddenly produced; and of such complex and wonderful co-adaptations, *he will not be able to assign a shadow of an explanation*. He will be forced to admit that these great and sudden transformations have left no trace

of their action on the embryo. To admit all this is, as it seems to me, to *enter into the realms of miracle, and to leave those of Science.*

(Darwin, 1861, pg. 205)

In other words, if one asserts that a miracle occurs, then no shadow of explanation can be determined in principle. The implicit reason is that God's ways are incomprehensible to us.

Additionally, owing to the more expanded view of divine incomprehensibility, this is not just the case for God, but for *any* non-naturalistic explanation. Darwin has applied this doctrine to not only apply to miracles, but also to internal non-mechanical forces of organisms. Darwin classes those sorts of mechanisms in *the same category* as that of miracle. No justification is given, except for the suggestion that "no shadow of explanation" can be determined if this is the case.

This mode of justification has persisted into modern times, as can be seen in several writings about methodological naturalism. However, this idea of divine incomprehensibility is usually implicitly, rather than explicitly, made. The explicit argument is typically made regarding God's omnipotence rather than His incomprehensibility. The form this modern argument takes is that since God can do anything, anything that occurs is logically consistent with God having done it capriciously. As an example, Forrest (2000) says,

Introducing supernatural explanations into science would destroy its explanatory force since it would be required to incorporate as an operational principle the premise that literally anything which is logically possible can become an actuality, despite any and all scientific laws; the stability of science would consequently be destroyed.

Boudry, Blancke, and Braeckman (2010) point out that this and similar statements are not actually problematic, as it merely restates the definition of logical possibility. However, if one includes the doctrine of divine incomprehensibility as an unstated foundation, the statement becomes much more convincing. If God's actions were comprehensible, then God's omnipotence would not pose the problem described—finding the comprehensibility of God's actions would be just like finding the comprehensibility of anything else. It is only if we presume God to be incomprehensible that this poses a real problem for science.

Additionally, Forrest's claim is not just about God, but about *all* supernatural explanations. Only under the more expansive view of divine incomprehensibility does the ineffability of God extend to every other aspect of the supernatural. Otherwise, finding the comprehensibility of the supernatural would not be radically different than finding the comprehensibility of anything else. One needs only to establish a methodology for reducing the logically possible to the actually possible.

As Boudry et al. point out, this problem is not unique to Forrest, but extends to most modern defenses of methodological naturalism in science.

In summary, the empiricism of the seventeenth century was established by theological voluntarism, which only rejected our ability to know God's thoughts in an *a priori* manner. However, in the nineteenth century, this transformed into a total skepticism of our ability to comprehend or obtain knowledge of anything about God or even anything supernatural or non-natural. This is the implicit justification that makes sense of modern claims about theological knowledge in defenses of methodological naturalism.

It is interesting that the justification for methodological naturalism relies not on empirical facts, but rather on theological questions of what can and cannot be determined through empiricism. If the goal is to exclude theological thought in the development of science, the irony is that methodological naturalism does not exclude it but instead takes sides on theological questions.

Not only that, but Darwin's rejection of final causes made biological knowledge incomprehensible. If one follows Darwin, then *any* discussion of final causes in biology is non-scientific. This led to generations of biologists avoiding any kind of teleological language in biology. In the early twentieth century, biologists would avoid saying things like, "the animal made a nest *in order to* lay eggs in it," as that was too teleological. Instead, biologists would often phrase it as "the animal made a nest *and then* laid eggs in it," which reduced the actions to non-teleological, mechanical descriptions.

Pittendrigh (1958) and Mayr (1961) re-established teleological language in biology through the use of the concept of teleonomy. Even so, it is interesting that despite the fact that teleological behaviors are the primary ways in which organisms function, it took many decades to find a loophole around methodological naturalism in order to talk about teleology in a way that is compatible with methodological naturalism. Thus, rather than aiding in the investigation of the subject matter, such restrictions were a setback to biological investigation. One could also argue that Pittendrigh and Mayr did not successfully naturalize teleology in biology, and that, in fact, biology generally operates from teleological assumptions couched in naturalistic language and terminology (Bedau, 1991; Fodor and Piattelli-Palmarini, 2010).¹ In either case, it is evident that naturalism did not arise from the study of the subject matter, but instead was the result of a certain flow of theological reasoning.

In fact, theological reasoning has been foundational to many aspects of science. Experimental biology was developed by Francesco Redi to prove that organisms only originate by God after their kind and not by spontaneous generation.² Mendel (1865)

¹As a further example of this, systems biology shows the productivity of a biology that holds the purpose of the system as methodologically equal, or even prior to, the understanding of its components (Lander, 2004; Noble, 2006; Snoke, 2014). While many participants of systems biology would consider their approach naturalistic, the purpose-first methodology is actual counter to this understanding.

²Redi (1688) states, "I shall express my belief that the Earth, after having brought forth the first plants and animals at the beginning by order of the Supreme and Omnipotent Creator, has never since produced any kinds of plants or animals, either perfect or imperfect; and everything which we

developed genetics to show that variation has fixed limits (i.e., within created kinds).³ A Catholic priest developed the Big Bang Theory, which aligned Thomistic theology and Genesis with cosmology.⁴

As such, it is difficult to maintain, given that several of the overarching theories of modern science were developed in a theological context, that somehow theology cannot in principle add knowledge to inquiry. Instead, it seems that theology has actually been fairly successful at providing frameworks for inquiry.

8 Re-Establishing Non-Naturalistic Knowledge

In summary, nearly every part of the NSTA statement on methodological naturalism has been shown to rest on faulty philosophy or theology. While methodological naturalism may make sense in certain contexts, the use of it as a total stricture on every type of scientific inquiry, especially totalizing inquiries, is not philosophically sound.

However, one should not discount the benefits that methodological naturalism has had for science. We can use this to learn how to include non-naturalistic knowledge into science. First of all, methodological boundaries make inquiry easier by limiting the scope of inquiry. Every person who has written a dissertation knows the importance of limiting the scope of inquiry in order to make definitive statements. Such limits are required for successful extrapolation from the evidence. Second, methodological naturalism contained within it (via positivism) a system of warrant and justification.

Thus, methodological naturalism reduced the scope of inquiry enough to make many inquiries manageable, and it provided a system of justification that one could

know in past or present times that she has produced, came solely from the true seeds of the plants and animals themselves, which thus, through means of their own, preserve their species.” Thus, he began his experiments to prove the truth of Genesis and started the field of experimental biology.

³The last two paragraphs of Mendel’s paper indicate this. He says, “Gärtner, by the results of these transformation experiments, was led to oppose the opinion of those naturalists who dispute the stability of plant species and believe in a continuous evolution of vegetation. He perceives in the complete transformation of one species into another an indubitable proof that species are fixed with limits beyond which they cannot change. Although this opinion cannot be unconditionally accepted we find on the other hand in Gärtner’s experiments a noteworthy confirmation of that supposition regarding variability of cultivated plants which has already been expressed.” Carl Friedrich von Gärtner (1772–1850) was a prominent creationist at that time, and here Mendel is describing how his system of genetics aligns well with Gärtner’s results.

⁴Many people think that Lemaître entirely separated his science from his theology. However, the evidence is that Lemaître privately aimed at arriving at a cosmology that integrated his Thomistic theology with science. In public, Lemaître made statements such as “As far as I can see, such a theory remains entirely outside any metaphysical or religious question” (Holder, 2012, pg. 50). However, his unpublished work showed that he viewed the Big Bang as validating Genesis (Holder, 2012, pg. 49). Additionally, there are reports that in private conversations early in the development of his theory that he viewed the Big Bang as a reconciliation of Thomism with science (Peratt, 1988, pg. 196).

use to externally validate claims. This system does not work perfectly and is not always used. However, having a framework in place gives everyone who practices science a common reference point for thinking about and analyzing claims. I will define a *methodological framework* as a combination of limiting inquiry and a system of justification. As a methodological framework, methodological naturalism limits itself to objects exhibiting mechanical behavior and uses positivism as its system of justification.

In order to successfully do scientific work outside of methodological naturalism, two things are needed. First, new methodological frameworks are needed for different subject matters and types of inquiry. Second, a means of integration between methodological frameworks is needed for integrating knowledge between disciplines and studies. As an example, Rakover (2016) introduces a methodological framework aimed at psychology. It is a beginning step, but it includes limits to the subject matter, a system of justification, and some rudiments on how it can be integrated with other types of inquiry.

Science itself, as well as the modern conception of methodological naturalism, came out of philosophical and theological reasoning. As Sich (2014) points out, science cannot neither establish its own principles nor validate its own ability to guide the investigator to truth. Philosophy and theology are required for these things. Therefore, we should look toward philosophy and theology to further establish new methodological frameworks for investigation, to establish the principles by which they operate, and to validate their abilities to guide the investigator to truth.

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