Why methodological naturalism?*

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September 2, 2014

Abstract

I discuss motivations for methodological naturalism in science. I argue that methodological naturalism neither needs nor supports metaphysical naturalism.

We are the beneficiaries of many generations' efforts to unlock the mysteries of nature. The best scientific theories of today have achieved unparalleled predictive success, and this success provides some evidence that these theories have latched onto the structure of reality.

Why has science been so successful? What are some defining characteristics of the scientific approach, and of its products, scientific theories? One striking feature of these theories is that they are *naturalistic*: they don't mention gods, demons, or any other supernatural beings. Does the absence of supernatural beings from our best scientific theories provide evidence for the absence of such beings from reality? Contrapositively, should a person who believes in supernatural entities, most notably a theist, find scientific theories to be inadequate if they don't include these entities?

I will argue that the answer to this question is No. In particular, I will argue that there are good reasons — most especially for theists — to restrict scientific investigations to the natural world. Consequently, the success of methodologically naturalistic science does not in any way detract from the plausibility of supernaturalist theism.

*An abbreviated version will appear in *The Blackwell Handbook of Naturalism*, ed. Kelly James Clark.

The structure of this paper is as follows. In section one, I undertake a preliminary discussion of the aims of science. In section two, I consider how to define methodological naturalism. In section three, I discuss two motivations for methodological naturalism. In section four, I defend methodological naturalism against the criticism that it would impede the progress of science. Section five presents my conclusions.

1 The aims of science

Many discussions about naturalism in science are guided by implicit assumptions about the aims of science. In particular, some of these discussions seem to assume that science aspires to discover all truths. But it's immediately apparent that this cannot possibly be the aim of any individual scientist, nor of the scientific enterprise as a whole. For example, no scientist is aiming to discover truths about my ice cream preferences, or about what I ate for breakfast this morning, or about what is morally right and wrong.

So if science isn't trying to discover all truths, then what is it trying to do? My hypothesis is that science aims to discover *certain sorts* of truths — in particular, those truths that can be systematized according to general schemata.

> (AIM) Science aims to explain a wide range of phenomena by unifying them under general schemata.

Let me make a few clarifications. First, I am thinking of AIM as a necessary, but not sufficient, criterion of scientific inquiry. Second, I have no opinion about the extension of the word "science." In fact, I would be happy enough to restrict my discussion to the scientific field that I know best: mathematical physics. If there is some science that doesn't satisfy AIM, then I will happily grant that my argument doesn't apply to that science. Finally, I'm using the term "general schemata" so as to be ecumenical between more specific views about scientific theories. The two paradigm cases of general schemata, however, are (1) natural law statements, and (2) mathematical models.

In Section 3.2, I will argue that if AIM is true, then a theist should be a methodological naturalist. In Section 4, I will argue that if AIM is true, then methodological naturalism wouldn't impede the progress of science

— it merely prescribes a good strategy for achieving the aims of science. In the remainder of this section, I'll provide some support for AIM.

Why should we believe that AIM is true? That is, why should we believe that science aims to explain diverse phenomena by unifying them under general schemata? First, I can speak from personal experience: when doing mathematical physics, we don't try to discover every truth about the systems we're studying. Rather, we try to construct mathematical models that capture some of the most salient structural features of these systems.

Second, and more importantly, AIM is a natural consequence of the views of some of the most acute philosophers of science. First, Immanuel Kant's view of science certainly validates AIM: "The single most distinctive criterion of demarcation for science, according to Kant, is *systematicity*" (Watkins 2012, p. xiv). Second, Hempel and Oppenheim (1948) argue that science aims to discover natural laws and then to use these natural laws to explain individual events. Again, what is characteristic of scientific knowledge is its bringing individual facts together under general schemata. Third, Van Fraassen (1991) contends that science aims at constructing empirically adequate models — in other words, to fit the phenomena into a mathematical scheme that facilitates prediction and understanding. Finally, in a recent book, Hoyningen-Huene (2013) argues that systematicity is in fact the feature that distinguishes scientific knowledge from other forms of knowledge. This list of philosophers of science could go on at length. But these examples suffice to show that some of the most insightful interpreters of scientific practice have claimed that science is interested in a particular sort of knowledge, namely knowledge of principles, laws, structure, or something of that nature.

So, experts recognize that science aims to systematize facts. But we didn't even need to ask experts, because we all know that science is in the business of constructing theories. And constructing a scientific theory is clearly distinct from describing reality. Of course, these two activities sometimes run together, since one of the main reasons for constructing scientific theories is to use them to describe reality. But the two activities are not identical, since it's possible to describe reality without constructing a scientific theory. For example, if I say that, "there is a lamp sitting on my desk," then I am describing reality, but I am not constructing a scientific theory. Even if a scientific theory were a collection of sentences, it wouldn't be just any collection of sentences. Rather, it would have to be a collection of sentences that has a certain tight order and structure.

But if our goal is to describe reality, then why take this detour through constructing scientific theories? Why not just describe reality directly? Well, it seems that the point of theory construction is that it gives us a *systematic* way of arriving at truths about reality. Consider an analogy: if you were a prehistoric human, and your goal was to get some food, then why would you take the detour through planting crops? Why not just go out and forage for food? Of course, the reason for planting crops is so that you'll have a systematic method for producing food. Similarly, the goal of science isn't just to discover truth; rather, the goal of science, insofar as its goal relates to discovering the truth, is to construct a system of truths.

Consider an example. Despite what you might hear in popular presentations, Einstein's general theory of relativity isn't simply a list of claims, such as "energy and mass are inter-convertible." Rather, general relativity provides a collection of models that can be used to describe situations in which gravity is the predominant force. So, for example, general relativity provides a model of the overall expansion of the universe after the big bang; it provides models for collapsing stars; and it provides the models that we use to describe the orbits of GPS satellites around the earth. General relativity shows that these situations have common structural elements; it systematizes these diverse phenomena, providing us with an efficient means of generating predictions.

2 Defining methodological naturalism

A number of philosophers and scientists argue that science presupposes methodological naturalism — but that adopting methodological naturalism doesn't require commitment to metaphysical naturalism (see DeVries 1986; Haught 2004; Miller 2009; Pennock 1999, 2011; Ruse 2005; Scott 1993, 2004; Sober 2010, 2011). In this section, I will consider how to define methodological naturalism. In the following section, I will consider motivations for adopting methodological naturalism.

A typical strategy for defining methodological naturalism might proceed as follows: (i) define "x is natural"; (ii) define *metaphysical naturalism* as the belief that, "everything is natural"; (iii) define *methodological naturalism* as the strategy of acting *as if* metaphysical naturalism were true. But this way of thinking about methodological naturalism has at least two major flaws. First, there are problems with defining the predicate "is natural."

Second, there are problems with thinking of methodological naturalism along the lines of acting *as if* metaphysical naturalism were true.

2.1 Natural things

Methodological naturalism requires scientific theories to mention only natural things. One problem with this suggestion is that scientists are constantly postulating new entities — e.g. quantum wavefunctions, quarks, genes. And who is to say whether or not these entities are natural? What are the defining characteristics of natural entities? The problem before us, then, is to complete the following definition:

(NAT) x is *natural* just in case ....

But it will be extremely difficult to complete this definition in a way that would be useful for guiding scientific practice.

First, it won't do to define natural entities as those mentioned by our *current* best scientific theories. The reason this definition won't work is because methodological naturalism would then lead to extreme conservatism about ontology: no new entities should be introduced in science.

Second, it won't do define "x is natural," in a way that involves the words "natural," "supernatural," or any synonym thereof, since the resulting definition would be circular. For example, it wouldn't be helpful to define natural entities as those that are governed by natural laws, or as those that are studied by the natural sciences. It also wouldn't be helpful to define natural entities as those that are not supernatural, or as those entities that do not transcend nature.

Third, it won't be helpful to define "x is natural," in terms of space, time, energy, or mass. Contemporary science already defies simple intuitions about what is natural, and we can expect future science to do so to an even greater extent. For example, quantum wavefunctions don't live in space and time, and yet realist interpretations of quantum theory treat wavefunctions as genuine natural entities. Similarly, photons are natural entities that have neither location nor mass. What's more, physicists are currently entertaining theories in which space and time themselves emerge from a more fundamental substratum of non-spatiotemporal, and yet fully natural, entities.

I'm not the first person to point out these problems for defining "natural entity." Rea (2002) and Van Fraassen (2002), among several others,

argue that metaphysical naturalism has no precise definition, and so cannot be thought of as a hypothesis for which we could gather empirical evidence. At best, metaphysical naturalism is an attitude, stance, or research program. I agree with the critiques of these philosophers. However, I'm not convinced that there is no useful heuristic distinction between natural and supernatural entities — a distinction that could be useful in helping delimit the domain of scientific inquiry. In fact, it seems that theism has a rough and ready answer: an entity x is natural just in case x was created by God.[1]

2.2 Provisional atheism

Suppose, contrary to the argument of the previous subsection, that we had a clear distinction between natural and non-natural entities. In this case, a metaphysical naturalist would be a person who believes that everything is natural. And one might suggest that methodological naturalism requires us to do science *as if* metaphysical naturalism were true.

But this proposal doesn't really capture the essence of methodological naturalism *qua* research strategy. First of all, this proposal confuses focusing attention on one sort of object, with pretending that other sorts of objects don't exist. To see that this is indeed a confusion, consider that theistic mathematicians don't mention God in their proofs, but presumably not because they are provisionally atheistic. Rather, these mathematicians are simply focusing on mathematical objects and the relationships between them.

Similarly, a typical methodological strategy in natural science is to delimit the domain of objects of study, or to delimit those aspects of things that will be studied. For example, in gravitational physics, attention is focused on those aspects of objects that can be represented in terms of geometric structures. But focusing on these aspects of objects hardly amounts to denying that they might have other non-geometric aspects, or that there might be other objects that don't admit of any useful geometric representation.

There is a yet more fundamental reason for thinking that methodolog-

[1] Theists might worry that this definition would classify angels as natural entities. My response: so what? As far as I can tell, theism doesn't need to classify angels as supernatural.

ically naturalistic science isn't tantamount to provisional atheism. The reason is this: a theistic viewpoint played a crucial historical role in the development of the characteristic strategies of modern science, including the strategy of restricting focus to the natural world. The connection between theism and the development of modern science has been elaborated by Reijer Hooykaas, Eugene Klaaren, John Hedley Brooke, among several others (see Clark 2014; Hooykaas 1972, 1987; Klaaren 1977). The connection between theism and methodological naturalism is more than just a historical accident. The idea that a rational being (viz. God) created the universe by means of a free act suggests both that the universe has intelligible structure, and that this structure can only be discovered by means of empirical investigation (rather than by *a priori* deduction from the concept of God). [An interesting presentation of the conceptual connection between theism and scientific method can be found in a series of three papers by Michael Foster (1934, 1935, 1936).]

Finally, there is some reason to worry that atheism actually runs contrary to the spirit that animates (methodologically naturalistic) natural science. Most poignantly, if the universe is ultimately purposeless, then why would one want to spend their short life working hard to understand it? Or following Plantinga's (2009) evolutionary argument against naturalism, if you assume that your cognitive faculties are the result of unguided evolutionary processes, then don't you have reason to be suspicious of the results of the scientific enterprise?

The previous paragraph should be taken with a grain of salt, because I don't intend to argue that if God doesn't exist, then there's no reason to do science. I only claim that provisional atheism, unlike methodological naturalism, isn't particularly well-suited to helping science achieve its aims. In Section 3.2, I will turn this point on its head by showing that theism provides a good motivation for methodological naturalism.

3 Motivating methodological naturalism

The previous section ended in *aporia*: we didn't find an adequate definition of methodological naturalism. So let's take a different tack. Let's postpone trying to define methodological naturalism until we better understand its motivation. In this section, I will discuss two possible motives for methodological naturalism. First I will discuss a proposal by Boudry

et al. (2010) to the effect that methodological naturalism is motivated by the history of failed supernatural explanations. Second I will discuss the original theistic motivation for methodological naturalism.

3.1 Intrinsic versus provisional methodological naturalism

Boudry *et al.* (2010) distinguish two versions of methodological naturalism, which they call *intrinsic MN* and *provisional MN*. The distinction turns on whether MN is thought to be a presupposition of science (intrinsic), or simply a strategy that has proven to have good results (provisional). Boudry et al. object vehemently to intrinsic MN, claiming that it undermines the cause of naturalism: it lays defenders of MN open to the accusation of dogmatically excluding the supernatural from science. In contrast, provisional MN is supposed to be warranted in the same way that other scientific hypotheses are warranted — viz. by induction on past cases. Indeed, Boudry et al. claim that science provides strong evidence that there are no supernatural entities.

There are many problems with Boudry et al.'s argument for provisional MN. First and foremost of these problems is the fact (discussed above) that the concept "natural" has a shifting meaning — thereby trivializing inductive arguments for the claim that, "successful scientific theories will include only natural entities." Consider an analogy. Suppose that I have a hypothesis: all professors of philosophy are intelligent. But when I learn that Professor X took an IQ test and scored only 90, I conclude that IQ tests must not be the sole criterion of intelligence. That is, rather than abandon my original hypothesis, instead I rethink the meaning of "intelligent." In a similar fashion, at any time in history, it might be correct to say that our best scientific theories include only natural entities. But when the next scientific revolution comes along, we will rethink the meaning of "natural entities" to include whatever is described by the successful scientific theories. That is, we say that something is natural as soon as it appears in a successful scientific theory.

Conversely, consider the claim that supernatural explanations have typically not been successful. There are two ways to understand that claim — one grandiose way, which is implausible, and one more modest way, which doesn't support provisional MN. According to the grandiose

version of the "thesis of failed supernatural explanations," primitive peoples attempted to explain puzzling phenomena in terms of supernatural agents. But time and again, natural explanations (of the same phenomena) have proven superior, and have therefore replaced those failed supernatural explanations.

This sweeping claim — with its echoes of Comtean positivism — oversimplifies issues in many ways. First of all, it's not clear that there is all that much overlap between the events that science explains and the events that might be thought to call for a divine explanation. For example, science might explain why a certain liquid freezes at a certain temperature; but most religious creeds don't offer an account of phase transitions. Similarly, many religious creeds offer an explanation of why humans are valuable, whereas science seems only concerned with why humans might think that they are valuable.

Even in cases where science and religion purport to explain the same phenomena, people often have different intentions when offering a theological explanation than when offering a scientific explanation. For example, suppose we want to explain why Saul stopped persecuting Christians. Well, what are we trying to accomplish with our explanation? Are we trying to give a general account of how human dispositions are related to underlying physical conditions? Are we trying to describe Saul *qua* physical object? In that case, we might want some sort of neurological explanation. But perhaps we want to understand Saul's change in a way that we can relate to as persons, i.e. in a way that makes sense from a motivational point of view. In that case, we might want an explanation that involves agents — perhaps even agents who can (as some theists believe of God) stimulate transformations of a person's dispositions.

There is, however, a more modest version of the "thesis of failed supernatural explanation" that I will grant: theistic accounts of events usually lack those features that we value in our best scientific accounts of events. Our best scientific accounts manage to systematize huge swathes of data under a few general schemata. These accounts are precise; in the best case scenario, these accounts are couched in fully rigorous mathematical language. But must every good explanation have these features? "Sally went to the store because she wanted some bread." "John didn't accept the gift because it would have been wrong." Those explanations lack several of the hallmarks of our best scientific explanations; and yet, depending on the context, they might be perfectly acceptable explanations. Thus, the-

istic explanations may not be good *qua* scientific explanations; but they needn't be intended as *scientific* explanations.

Thus, Boudry et al.'s case for provisional methodological naturalism rests on a questionable understanding of the concept "natural," and on a questionable reading of the history of science. If there's something right about methodological naturalism, it will be more along the lines of intrinsic methodological naturalism — i.e. as a presupposition of science. Is there any independent motivation for the strategy of restricting focus to natural things?

3.2 The theistic rationale for methodological naturalism

If you look more closely at the history of science, you will find that methodological naturalism wasn't born out of a metaphysically naturalistic ideology. Quite to the contrary, methodological naturalism arose in an explicitly theistic context, as an outworking of the doctrine of creation.[2] According to the Judeo-Christian-Islamic doctrine of creation, our universe is an artifact — both designed and brought into being by God — and therefore it was built according to a blueprint that can be discerned by rational creatures like ourselves. Moreover, since God's choice of a universe was free and unconstrained by any natural law, the only way to discover the blueprint of creation is by means of empirical investigation. Therefore, the early modern scientists — all of whom were theists — believed that the following would be a worthy pursuit: to use one's intellect to put forward a possible blueprint of the natural (i.e. created) world; and then to use one's senses to test if the proposed blueprint matches our universe.

In this essay, when I speak of theism, I mean to include the claims: (i) the universe exists because God freely chose to create it; (ii) if there are laws of nature, then God decided what they would be, and he's not bound to obey them; and (iii) God interacts with creation, and is directly responsible for certain particular events in history.

If a person is a theist in this sense, then shouldn't that person think that God and God's activities are a perfectly legitimate subject for scientific inquiry? I don't think so. In this section I argue that theists should see natural science as aiming to reconstruct a blueprint of the universe. More-

[2]For more on the origin of methodological naturalism in the work of theistic scientists, see (Bishop 2013).

over, just as the blueprint for a building omits reference to the building's architect, the blueprint of the universe can be expected to omit reference to God.

The key idea behind my argument is the claim that I called "AIM" in Section 1: science aims to systematize phenomena by placing them under general schemata. If science's aim were to discover all truths, then a theist would certainly think that science ought to say something about God. But science doesn't aim to discover all truths; it aims to organize facts under general schemata (AIM). And a theist might reasonably think that facts about God aren't of this sort, and so properly fall outside the domain of scientific systematization.

I will argue for this claim by considering the two paradigm cases of general schemata: (1) statements of natural law, and (2) mathematical models.

3.2.1 God is not subject to natural laws

According to the classic view of Hempel (1948), science aims to discover natural laws, and then to explain phenomena in terms of these laws. Now, Hempel's view can be challenged on various grounds. But my goal in this essay is not to defend a specific philosophy of science; it is to argue that in many scientific contexts, a theist has good reasons to pursue a methodologically naturalistic strategy. And the claim now is: to the extent that science is trying to explain things in terms of natural laws, a theist should be a methodological naturalist.

According to theism, the laws of nature are not metaphysically necessary; indeed, God could have chosen different laws of nature if he had wished. But this means that God's actions — unlike the actions of any created thing — aren't necessarily governed by the laws of nature. I will argue that since God isn't subject to the laws of nature, "God" shouldn't be a theoretical term in a scientific theory.

In a scientific theory, theoretical terms — such as "mass" or "Higgs boson" — are connected to each other by means of law statements. If a term X is not connected to others by means of natural law statements, then X is not properly part of that theory. But theists believe that "God" is not connected to other terms by means of natural law statements. Therefore, theists have good reason to suppose that God won't be mentioned in a good scientific theory.

Incidentally, these considerations suggest a reason why theists might be uncomfortable with Intelligent Design (ID) theory. According to ID, there are certain natural phenomena — so-called irreducibly complex phenomena — that can only be explained by the action of intelligent agents. But it seems then that ID must be committed to a statement of the form:

> For any x, if x is irreducibly complex, then there must be an intelligent agent y that causes x.

What is the force of the "must" in this statement? If this statement is a law of nature, then the variable "y" ranges over *natural* things. But then the observation of an irreducibly complex phenomenon would indicate the existence of a *created* intelligent agent, not a creator.

3.2.2 Misrepresenting God

Even if science isn't solely concerned with explanation in terms of laws of nature, there are still other reasons why it might be a good strategy to focus attention on natural things. I will now consider a view that has been prominent in philosophy of science since the 1970s — the so-called "model-theoretic" or "semantic" view of science.[3] According to this view, science aims at constructing mathematical models that represent its domain of study. I will argue now that, given the model-theoretic view of science, if God exists then a good scientific theory probably wouldn't mention him.

If science aims at constructing models, then a theist is faced with a question: should science aim at constructing models that include mathematical objects representing God, and that describe God's actions in the same manner that they describe physical processes? Should be God be represented by something like a tensor on a manifold, and should his actions be modelled by differential equations such as Einstein's field equations? Now, before you decide how a theist should answer this question, recall that the word "model" has several meanings, some quite general, and some quite technical. On the one hand, we can speak loosely of "a model of X" in any case where we construct some sort of representation of

[3] A version of this view has been advocated by Ron Giere, James Ladyman, Elizabeth Lloyd, Fred Suppe, Patrick Suppes, Paul Thompson, and Bas van Fraassen, among many others.

X. In this loose sense, of course many theists will think it a reasonable aim to construct models of God, and of God's relationship to the universe. On the other hand, the model-theoretic view of science uses the word "model" in a technical sense, as a certain sort of mathematical structure. For example, in Einstein's theory of relativity, a model of the universe is a four-dimensional Lorentzian manifold. But if we take "model" in this technical sense, then, theists shouldn't want to construct models of God, or of God's interactions with the universe.

Why shouldn't they? If God exists and interacts with the universe, then why shouldn't we be able to represent God and his activities via mathematical structures — just as we represent natural entities and processes? This is a good question. But a perhaps better question is: why do we represent natural entities and processes by means of mathematical structures? The simplest answer to this question is: it works. But for a theist, a more profound sort of answer suggests itself: we can represent the structure of physical reality using mathematics because the universe is an *artifact*, the creation of an intelligent mind. In particular, God created the universe according to a mental blueprint; and it is this mental blueprint that scientists aim to represent by means of mathematical models. So, for a theist, the applicability of a mathematical structure to physical reality depends on the fact that physical reality was created by a mind.

But now to return to the first question: why shouldn't the goal of science be to construct a mathematical model of everything that exists — including God, if God does exist? Why shouldn't we aim to model God and God's activities? Well, why should we? After all, God isn't like the physical universe: he wasn't created; he wasn't first conceived in a mind and then brought into being. So, for a theist, the metaphysical status of the physical universe — viz. that it's an artifact — suggests that it has a blueprint that can be represented by means of mathematical structures. But a theist believes that God is a free agent, governed by no higher laws, and not himself an artifact. God wasn't created according to a blueprint, and so there is no reason to think that God could be modeled by means of mathematical structures.

There are advantages and limitations to the method of representing things by means of mathematical structures. When we represent an entity X by means of mathematical structures, we provide ourselves with very detailed quantitative information about X. But the trade-off is that some concepts don't yield to mathematical representation. For example,

a geometrical description of my wife's hands provides me with detailed information about the size of her fingers. But a geometrical representation of her hands disregards their color and softness, not to speak of more high-level aesthetic qualities. In a similar fashion, if we attempted to represent God by means of a mathematical structure, then we would be committing ourselves to claims about God to which we are not entitled; and, what's worse, we would lose all of the information that theists think has been revealed about God (e.g. that he is just and loving). In other words, to represent God as a mathematical object would be to replace the revealed concept of God with a concept of our own making.

According to the Judeo-Christian-Islamic tradition, God revealed himself through the words of ordinary people — not through abstract, mathematized languages such as those developed for scientific purposes. Thus, these traditions' claims about God and God's relation to the universe are wrapped up in natural language, with all its ambiguities and emotive involvements. In contrast, the language of science has been tailored to maximize empirical informativeness, to eliminate ambiguity, and to minimize emotive involvement with the subject matter. As such, the language of science isn't particularly well suited for talking about other persons, including divine persons, if they exist.

4 Defending methodological naturalism

Methodological naturalism has detractors on both ends of the ideological spectrum: theists who argue that God shouldn't be kept out of our scientific theories, and non-theists who argue that the non-appearance of God in our best scientific theories is good evidence that he doesn't exist. In both cases, critics claim that methodological naturalism would disempower science (in particular, by disallowing it from addressing ultimate questions such as, "does God exist?" or "did God create the universe?"). In this section, I will explain what's wrong with these criticisms of methodological naturalism.[4]

According to William Dembski,

[4]For some more nuanced criticisms of methodological naturalism, see (Koperski 2008; Plantinga 1997; Ratzsch 2004). I think these more nuanced criticisms are effective against certain versions of methodological naturalism, but not the one for which I've argued.

> Although methodological naturalism is a regulative principle that purports to keep science on the straight and narrow by limiting science to natural causes, in fact it is a straightjacket that actively impedes the progress of science. (Dembski 2004, p. 170)

Similarly, Brad Monton claims that,

> If science really is permanently committed to methodological naturalism, it follows that the aim of science is not generating true theories. Instead, the aim of science would be something like: generating the best theories that can be formulated subject to the restriction that the theories are naturalistic. . . . I maintain that science is better off without being shackled by methodological naturalism. (Monton 2009, p. 58)

Similarly, Evan Fales opines that science shouldn't be limited to natural causes:

> A fundamental mission of science is to discover the causes (more generally, the explanations) of things. If there are supernatural causes, then science should seek them. (Fales 2009).

Finally, Fishman and Boudry claim that methodological naturalism imposes artificial constraints on science:

> Science, at least ideally, is committed to the pursuit of truth about the nature of reality, whatever it may be, and hence cannot exclude the existence of the supernatural *a priori* . . . without artificially limiting its scope and power. (Fishman and Boudry 2013, p. 921)
>
> . . . MN imposes artificial constraints on science which are antithetical to its fundamental goal: to pursue the truth about the nature of reality on the basis of the evidence, wherever it may lead. (Fishman and Boudry 2013, p. 923)

These are some formidable opponents for methodological naturalism. What are we to make of their criticisms?

These criticisms have a common structure, which we can represent as follows:

1. Science aims at *X*-ing.

2. Requiring methodological naturalism might hinder science from *X*-ing.

3. Therefore, methodological naturalism should not be required.

The *X* varies slightly from critic to critic. For example, Monton indicates that science aims at generating true theories; and Fales suggests that science aims at discovering the causes of things. I will argue, however, that there is no *X* such that science plausibly aims at *X*-ing, whereas methodological naturalism might hinder science from *X*-ing. In other words, I will argue that premises 1 and 2 cannot be simultaneously true.

Let's begin with Monton. In this case, I'll grant the first premise, i.e. that science aims at generating true theories. But what is a scientific theory? As Monton well knows, a true theory is not just a collection of facts — and so saying that science aims at generating true theories is not the same as saying that science aims at generating facts. For example, if the semantic view of theories is true, then a theory is a collection of (mathematical) models, and a theory is true just in case one of its models is isomorphic to its intended domain. In this case, science aims at constructing models that are isomorphic to the intended domain.

Could the intended domain of science be *everything*? That depends on one's metaphysical presuppositions. I have suggested that theists have reasons for thinking that God cannot be represented with mathematical models in the same way that the natural world can be represented with mathematical models. But in this case, restricting science to the natural world wouldn't be an impediment to science; in fact, this restriction would *help* science stay focused on a domain that can be mathematically modeled.

Let's turn now to Fales. According to Fales, science aims at discovering the causes of things. But there are many reasons to doubt this claim, casting suspicion on the first premise of his anti-methodological-naturalism argument. First of all, as Bertrand Russell pointed out long ago (Russell 1912), the notion of "cause" no longer plays a role in fundamental physics. And Russell's claim still holds true: if you open any textbook of quantum field theory, you won't find the word "cause." But if fundamental physics doesn't aim at discovering causes, then science doesn't generally aim at discovering causes. [For a recent argument against the world's having fundamental causal structure, see (Norton 2003).] What's more, causation

is still one of the most problematic notions in metaphysics. Should we really define the aims of science in terms of an opaque notion that only appears in the less fundamental sciences?

But setting aside the fact that causation isn't a central notion in fundamental science, there are many causes in which no science displays an interest. For example, my desire to complete this article caused me to set my alarm for 6:00 a.m. But science isn't aiming to discover this cause (nor do I think it would, even if the NSF had unlimited funding). What science might try to discover are the causes that are *typically* or *generally* associated with early morning rising. In other words, science doesn't seem to be interesting in discovering all causes; rather, science seems to be interested in discovering reliable causal links.

But now, if science aims to discover reliable causal links, then methodological naturalism wouldn't impede science. In particular, a theist might well think that there are no reliable causal links between God and the natural world — in which case restricting science to the natural world would only help science achieve its aims by keeping it focused on a tractable domain.

Thus, both Monton and Fales make an unwarranted jump from the fact that science is trying to discover truths, to the claim that science is trying to discover *all sorts* of truths. But some people, in particular theists, might think that some truths aren't amenable to scientific investigation.

I will illustrate this point by returning to an earlier analogy. Imagine yourself a pre-historic human, whose primary goal is to acquire food. Now suppose that you propose to adopt the agricultural method — to till the soil, plant crops, and tend them. And suppose that I reply:

> This agricultural method would impede me from getting food. While you are out tilling the soil and planting crops, I could be foraging for whatever kind of food I want. While you'll be limited to eating things like corn and wheat, I'll be able to eat anything that I can find. The agricultural method would place arbitrary restrictions on my diet.

It's completely obvious what's wrong with my way of thinking in this scenario. Tilling the soil and planting crops might entail the loss of some opportunities to collect food; but the upside of the agricultural method is the fact that it is systematic and reliable.

The "shackling science" argument against methodological naturalism makes the same sort of mistake. The scientific method stands to acquiring truth as the agricultural method stands to acquiring food. Just as there are unsystematic ways of acquiring food, so there are unsystematic ways of acquiring truth. And just as the agricultural method systematically generates food, so the scientific method — when it's working well — systematically generates truths about the natural world.

Nonetheless, the agricultural method has limitations: it can't produce every kind of food. Similarly, the scientific method has limitations: it might not be well-tuned for the discovery of every kind of truth. And of all people, a theist is most likely to think that some truths aren't of the right sort to be fit into a scientific account of the world; some truths simply don't fall under general laws, nor can they be accurately represented by means of mathematical models. That's why a theist shouldn't expect to find God in science — because science works by restricting itself to a more manageable kind of fact.

5 Conclusion

Discussions of naturalism often generate a lot of heat, but rarely much light. One of the main problems with these discussions is the fact that the word "naturalism" has no precise definition, and yet it carries so much emotive content: some people self-identify as naturalists, and others reject naturalism, even though these two groups of people might agree on almost everything else, including how to do science. In this essay, I have discussed two types of naturalism: on the one hand, naturalism can be a synonym for atheism; on the other hand, naturalism can be a strategy for scientific investigation. I have argued that the latter form of naturalism has little to do with the former form of naturalism. Indeed, methodological naturalism — a strategic narrowing of investigative focus — finds a highly plausible motivation in supernaturalist theism.

Acknowledgments: For helpful feedback, I thank James Anderson, Robert Bishop, Kelly Clark, Andy Crouch, Robbie Hirsch, Jeff Koperski, Alan Love, Rebecca McLaughlin, and especially Del Ratzsch.

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