Theism, Naturalism, and Scientific Realism

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Abstract: Scientific knowledge is not merely a matter of reconciling theories and laws with data and observations. Science presupposes a number of *metatheoretic shaping principles* in order to judge good methods and theories from bad. Some of these principles are metaphysical (e.g., the uniformity of nature) and some are methodological (e.g., the need for repeatable experiments). While many shaping principles have endured since the scientific revolution, others have changed in response to conceptual pressures both from within science and without. Many of them have theistic roots. For example, the notion that nature conforms to mathematical laws flows directly from the early modern presupposition that there is a divine Lawgiver. This interplay between theism and shaping principles is often unappreciated in discussions about the relation between science and religion. Today, of course, naturalists reject the influence of theism and prefer to do science on their terms. But as Robert Koons and Alvin Plantinga have argued, this is more difficult than is typically assumed. In particular, they argue, metaphysical naturalism is in conflict with several metatheoretic shaping principles, especially explanatory virtues such as simplicity and with scientific realism more broadly. I will discuss these arguments as well as possible responses. In the end, theism is able to provide justification for the philosophical foundations of science that naturalism cannot.

Keywords: laws of nature, naturalism, scientific realism, simplicity, theism

Science and religion, we often told, have had a poor and sometimes hostile relation for several centuries. Between rigorous empirical methods and the discovery of the laws of nature, theism is left with no real intellectual work to do. This and more is the received wisdom of naturalism.[1] But is it true?

To answer that question, let us begin with a simple pyramid model for the overall structure of science. The base constitutes “the data”: observations, experiments, and simulations. The second layer organizes and explains what is in the first by way of laws, theories, and models. For present purposes, the top level is the most important and also the least recognized, what I call *metatheoretic shaping principles*.[2] This is where the philosophy of science and science proper blend into one another. Among other things, such principles help determine what good theories look like, as well as how one should proceed in their development. Some shaping principles are metaphysical. Foremost among these is the primacy of laws: The universe is governed by a set of regularities, the laws of nature. Philosophers actively debate different ways of understanding laws, sometimes reducing them to something more basic, sometimes deflating them to be less metaphysical. Whatever one’s views, the utility of laws in science must be accounted for one way or another.

A related shaping principle is the uniformity of nature. This is uniformity across space and time. This principle says that the laws of nature are the same now as they always have been, and the laws are the same here as they are everywhere else in the universe. In other words, nature does not make dramatic changes, at least at the level of laws. This provides the stability required for induction and successful predictions.

Shaping principles regarding causation have changed over time. The early modern period starts with the rejection of Aristotelian causes other than efficient causation. Under the new mechanical philosophy, nature was thought to work only by way of contact forces. (This is the principle that Newtonian gravitation seemed to violate, much to the dismay of Newton’s contemporaries.) There was also Leibniz’s Law of Continuity, which says that “nature makes no leaps.” Change from one system state to the next is always continuous. While that principle was important for the development of differential equations, it was overthrown by quantum mechanics.

Epistemic shaping principles include the demand for repeatable observations and procedures for conducting experiments. This is also where the so-called “explanatory virtues” are found. Good explanations embody simplicity, testability, fit with background knowledge, empirical adequacy, and in some sciences mathematical elegance. Richard Swinburne has argued that among these simplicity is the most important, especially for resolving cases of underdetermination of theory by data (Swinburne 1979, 55). For my part, I do not see that any particular virtue trumps any of the others.

That there are such principles that govern the development of science is not news to philosophers. What we often pass by, however, is that many have theistic origins. The laws

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[1] Throughout this paper, ‘naturalism’ refers to the metaphysical thesis that there are no supernatural entities. I am not referring to the weaker idea of *methodological naturalism* that says science should proceed without reference to supernatural entities, regardless of whether they exist.

[2] That term and this model has its roots in the work of Del Ratzsch. See (Ratzsch 2001, chap. 7) and (Koperski 2015, chap. 1).

of nature themselves are the clearest examples. For the early moderns, the existence of laws was straightforward: kings proclaimed the laws for a country; God decreed the laws for nature. This was a radical change from Greek thought. Of course, Aristotle believed in the orderliness of reality, but he attributed it to the internal essences of things. Rocks fall straight down because that is what their essence dictates. Fire goes up because that is what it does by nature. But laws are not part of that picture. Laws in Greek thought were matters of politics. Nature is one realm; government is completely different. The idea of a "natural law" was something of an oxymoron.

Matters had changed dramatically by the 17th century. Between theism and mechanistic philosophy, the idea that God designed the universe by way of mathematical laws became the norm. Those were the principles in Newton's *Principia*. The uniformity of those laws, Newton argued, is due to God's omnipresence (*Opticks* 1730 Query 31). That they do not change over time, said Descartes, is because of God's immutability (*Principles of Philosophy* 1644 II 36).

Simplicity and parsimony were also defended on theological grounds throughout the modern era (Sober 2015, 22–51). This is somewhat ironic, given how Ockham's Razor is used against theism these days. Earlier thinkers tended to start with God and then infer parsimony as something we should expect from a rational creator. By the 19th century, the inference was flipped. Now the simplicity of the laws was used as an argument for God's existence. As for mathematical elegance, Kepler believed that "God has established nothing without geometrical beauty" (1952, 1025).

More surprising is how theism motivated empirical observations and experimentation. It begins with the idea that God had many options available in creation, including which laws to ordain and which specific mechanisms to employ. Since these choices were rooted in God's will rather than his intellect, the only way to discover them was through observation. Natural philosophers could not merely reason out the implications of this or that substantial form, as mathematician Roger Cotes put it in the preface of the 2nd edition of Newton's *Principia*:

> [This] world, so diversified with that variety of forms and motions . . ., could arise from nothing but the perfectly free will of God directing and presiding over all.
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> From this fountain it is that those laws, which we call the laws of Nature, have flowed, in which there appear many traces indeed of the most wise contrivance, but not the least shadow of necessity. These therefore we must not seek from uncertain conjectures, but learn them from observations and experiments. ([1687] 1962, xxxii)

In other words, empiricism itself originally had a theological basis.[3]

For this to work, God had to design our reason and senses so that we could make discoveries, something like what the medievals called the "adequation of the intellect to

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[3] This generalization fits Newton and his followers better than Leibniz or Descartes. For Leibniz, God's choices were constrained by the Principle of Sufficient Reason. And while Descartes was an arch voluntarist, he thought we could make valid inferences about the laws of motion based on God's immutability. See (Harrison 2013).

reality" (Plantinga 2011, 269). Kepler put it this way: "Those laws are within the grasp of the human mind. God wanted us to recognize them by creating us after his own image so that we could share in his own thoughts…" (Plantinga 2011, 277). Between the rational design of the universe and our God-given ability to discern it, early modern thinkers got very close to what is now called scientific realism.

There are other examples, but these are sufficient to make the point: several of the foundational metaphysical and epistemological principles that scientists still accept as "the way things are" and the best means of proceeding had their roots in theism.

So then, what happens if that foundation is removed? What is the naturalistic philosopher to do with the laws of nature, for example? Nancy Cartwright gives one clear answer:

> I think in the concept of law there is a little too much of God. We try to finesse the issue . . . [but] in the end the concept of a law does not make sense without the supposition of a law-giver. (Cartwright 1993, 299)

Some, like Cartwright, try to find a surrogate for laws. They might appeal to causal powers or dispositions as metaphysically fundamental. Laws would supervene on such things. Many philosophers of science hope to deflate laws into mere law-statements, the Mill-Ramsey-Lewis view being the most prominent example. M-R-L laws function as something like axioms in our overall best system of scientific knowledge, but have no metaphysical significance. They are not part of reality itself, which eliminates the need to explain their origin.

Robert Koons argues that while many shaping principles are explained by theism, the naturalist must merely accept them as brute facts (2003, 81–84). That the cosmos has an intelligible, stable structure must be taken as a given. Simplicity, elegance, and other explanatory virtues can be reliable indicators of truth if they track the choices made by an intelligent agent. But what if there is no such agent?

Consider an analogy. The reverse engineering of cars works because engineers from rival companies can rightly assume that new cars are designed with particular desiderata in mind. They know that the designers wanted a combination of speed, power, and reliability. Engineers from competing companies proceed by looking for how these ends are cashed out in a new vehicle. That is just what reverse engineering is.

But what if, going back to the science question now, there is no designer? The explanatory virtues work, but there would be no particular reason *why* they should work. If their usefulness is all just a happy coincidence, how could they be reliable? As Koons says, "[The] materialist has no adequate explanation of how the fundamental laws of nature are so constituted as to be learnable through experience" (2003, 85).

Matters are worse according to Alvin Plantinga's evolutionary argument against naturalism (2011, chap. 10). Say that our cognitive faculties are reliable only if they mostly produce true beliefs. Colorblind people do not have reliable perceptions about color; Alzheimer patients do not have reliable memory. But normal, healthy people have generally reliable faculties, leading to true beliefs most of the time.

Neo-Darwinian evolution, in contrast, is very good as producing one thing: beings that survive in a given environment. Survival can be improved along four axes: getting food, keeping oneself from becoming food, fighting when necessary, and reproducing. Natural selection selects traits that further one of those four. Plantinga's key point is that truth is not on that list.

For any advanced species that survives over a long period of time, its cognitive faculties will be adapted to its environment. The species' neurological traits will determine both (i) the content of its beliefs—if it has any,[4] and (ii) its behavior. But why think, asks Plantinga, that the content of a creature's beliefs will be true? *We* desire truth, but all that matters for fitness is whether the creature behaves the right way in a given set of circumstances. If a creature has beliefs at all, their content is irrelevant so long as they induce behavior that helps the creature survive. Clearly a deer has to behave in the right way when facing a predator: it needs to run. But that does not entail that the deer has to have true beliefs about the predator. Its cognitive faculties merely have to produce adaptive behavior.

The same is true for all of our pre-human ancestors. Natural selection favored primates that behaved in ways that promoted survival. The upshot is that, under naturalistic evolution, there is nothing special about our cognitive faculties. As far as natural selection is concerned, there is no particular reason why the contents of our beliefs should be true. Our cognitive faculties are adaptive, and so useful in promoting survival, but a high degree of fitness only entails something about behavior. It need have nothing to do with true beliefs. But if our cognitive faculties are not typically producing true beliefs, then the truth of scientific beliefs is also in doubt. Hence the naturalistic Darwinist has a defeater for his/her own beliefs.

Surprisingly, there are naturalists that sympathize with this this line of thinking. Darwin himself worried about it and Thomas Nagel caused something of an uproar when agreeing that

> unlike divine benevolence, the application of evolutionary theory to the understanding of our own cognitive capacities should undermine, though it need not completely destroy, our confidence in them. . . . Evolutionary naturalism implies that we shouldn't take any of our convictions seriously, including the scientific world picture on which evolutionary naturalism itself depends. (Nagel 2012, 27–28)

There are many replies to Plantinga's argument and I will not attempt to analyze them here. Instead, consider a narrower conclusion. Say that one believes two things: we live in an orderly, stable cosmos and our cognitive faculties are generally reliable. These are necessary conditions for scientific realism. As we have seen, the theist has reasons for believing them. Plantinga's argument, at the very least, raises some doubts for the naturalist. True scientific beliefs might be possible in a world where the Blind Watchmaker of natural selection rules, but they do not seem likely.

One might wonder if this is just a philosopher's problem. Perhaps science itself can help to resolve the matter. In fact, cognitive scientists at the University of California, Irvine and Rutgers University recently published a paper that is getting some attention across disciplines. They begin by showing that textbook evolutionary theory contradicts Plantinga. Our perceptions are "a detailed and accurate view of reality, exactly as we would expect if truth about the outside world helps us to navigate it more effectively" (Hoffman, Singh, and Prakash 2015, 1481). Perceptual mechanisms that were not veridical would be weeded out

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[4] This claim presupposes that naturalistic evolution would only produce material beings. There would therefore be no immaterial souls or minds that might be involved in the belief forming process.

by natural selection. (Note that when they use words like ‘truth’ and ‘veridical’, they are not talking about the content of beliefs. Their view is about accurate mental representations. The way these researchers use it, birds have veridical perceptions even though they have no beliefs in the propositional sense.)

Of course, not all animal perceptions are veridical. Frogs do not detect flies. They detect moving black spots of a particular size (Hoffman, Singh, and Prakash 2015, 1481). Some frogs can be surrounded by edible, recently deceased flies and not detect them. Moreover, male jewel beetles do not see females. They detect a particular glossy shade of brown that corresponds to the female’s wing casings. This explains why male beetles will swarm empty beer-bottles, ignoring the females in the process and causing at least one population to collapse. In these and many other cases the perceptions were not based on veridical information, “but rather on heuristics that worked in the niche where they evolved” (Hoffman, Singh, and Prakash 2015, 1481). Perceptions like these, based on fallible heuristics, are “good enough” in the sense that they usually promote survival.

Their research question is this: When does natural selection favor the veridical over the merely heuristic? Should we expect frogs to one day see flies and not merely moving spots? If so, under what circumstances and how prevalent will such an adaptation be? Using evolutionary game theory and genetic algorithms, one can calculate how different “perceptual strategies” compete with one another. These will show which traits can coexist, which will dominate a population, and which will go extinct.

The studies simulated a wide range of visual perceptions. At one end is what they called “omniscient realism,” which would include perfectly accurate perceptions from across the electromagnetic spectrum. That is an idealization, but one thought to be important for the study. Several, less-accurate perceptions were also simulated. The one most like human perception is “hybrid realism.” This allowed for the veridical detection of shape and motion—what are often thought of as primary qualities—but also color, which they take to be merely phenomenological. At the far extreme they included the “interface perceptual strategy” in which no perceptions are veridical. For such a creature, none of the properties that it perceives to be in its environment exist in reality. If there are any primary qualities in the mind-independent world, that creature does not perceive them.

One might think that this final option is doomed to the heavy hand of natural selection. The reason they chose to include it is this. Consider the “save” button in a word processor. The icon probably looks like a 3½ inch floppy disk. While colleges student know what floppy drives are, none of their computers have them. In a few years, they might not have any memory of such things. As Hoffman points out, however, that need not be a problem. Clicking on the icon will still work just fine even though there is no such thing as a floppy drive in the computer. The interface perceptual strategy takes all of a creature’s perceptions to function similarly. None of the properties that it perceives are literally out there in the world, although what it does perceive is correlated in such a way that it allows that creature to interact with its environment. That is sufficient, they argue, to include it in evolutionary simulations.

Their studies thus included a range of realist options of perception and one anti-realist one—the interface view. These were cast as competing traits in game-theoretic evolutionary simulations, as if they were different species each with a different range of perception. So then, when do the realist options out-compete the anti-realist one? Never. As Hoffman put it, “According to evolution by natural selection, an organism that sees reality as it is will never be more fit than an organism of equal complexity that sees none of reality but is just tuned to fitness. Never” (Gefter 2016). More precisely, various studies apart from their own show that when interface perceptual strategies compete with any realist strategy, the former will drive the latter into extinction (Hoffman, Singh, and Prakash 2015, 1487). Not co-existence, which is an option. Extinction. The lone exception is a specially constructed environment where evolutionary advantage is forced to change in lockstep with truth. In other words, the deck can be stacked so that anti-realist perceptions do not win, but that is not the generic case. They conclude, "The key insight from these evolutionary games is this: Natural selection tunes perception to payoffs, not to truth" (Hoffman, Singh, and Prakash 2015, 1487).

One might think of their work as "Kantian evolution." If Kantian categories, which operate on sense-data to produce our phenomenal experience, were subject to evolutionary pressures, then natural selection is far more likely to give us categories that produce an adequate, representational phenomenal realm, rather than one that accurately depicts noumenal reality. They even explicitly mention the idea that "our perception of physical objects in space-time no more reflects reality than does our perception of a flat and stationary earth" (Hoffman, Singh, and Prakash 2015, 1491).

Let's put this in context. The question is the status of metatheoretic shaping principles, especially those related to scientific realism. For our purposes, we can ignore the larger issue of whether naturalistic evolution is ultimately self-defeating. Even so, there does still seem to be a tension between natural selection and scientific realism. According to Hoffman and his colleagues, when realist perceptual mechanisms have to compete with anti-realist, heuristic ones, the latter win. Perceptual anti-realism drives realism into extinction. Internal, mental representations need only be reliable:

> We've been shaped to have perceptions that keep us alive, so we have to take them seriously. If I see something that I think of as a snake, I don't pick it up. If I see a train, I don't step in front of it. I've evolved these symbols to keep me alive, so I have to take them seriously. But it's a logical flaw to think that if we have to take it seriously, we also have to take it literally. (Gefter 2016)

In short, naturalistic evolution produces *reliable* perceptions—correlated with reality. It does not produce *realistic* perceptions, showing us how things actually are.

Reliable with respect to what? The answer, in terms of natural selection, is our environment. Clearly our perceptions—and our cognitive faculties more generally—do help us navigate everyday situations. In terms of physics, that means medium-sized objects moving relatively slow. Our ancient ancestors were very good at finding berries, hunting animals without lethal claws, and avoiding animals that had them. But there is no particular reason, in terms of evolution, that we should be able to understand Planck-level physics or relativity. Quantum effects are generally hidden behind a very classical-looking world. And relativity only becomes apparent at cosmic scales or when objects are traveling over half the speed of light. Such phenomena cannot manifest themselves so as to influence our evolutionary development and so could do no work in shaping our cognitive faculties. A naturalist might rightly wonder, then, how reliable our cognitive faculties are when it comes to abstract physics.

To sum up, most theists believe that God wants us to have access to truth, rather than merely survive. Guided, theistic evolution provides a means to ensure that our senses, reason, and memory are up to the task. From a naturalistic point of view, however, scientific realism about fundamental physics has no such grounding. Without some sort of buttress or hidden variable—some principle alongside natural selection that has a preference for truth—evolution is not likely to produce realistic theoretical beliefs.

If one is a naturalist and rejects the theistic basis for the rational structure of nature or the reliability of our faculties for understanding that structure, what options are available?

One could appeal to chance. After all, nothing here shows that nature *cannot* have a rational structure or that reliable faculties are nomologically impossible. In terms of naturalistic evolution, such things are merely unlikely, but unlikely things happen. This seems to be philosopher Jerry Fodor's approach. In his view, reliable conscious intelligence was a "hopeful monster," a term made popular by paleontologist Stephen J. Gould (Fodor 2002, 31). A hopeful monster is an unlikely macro-evolutionary change that just happened to work in its environment. It is not something that a good Darwinian would have expected, but it is still possible given enough time.

These sorts of arguments are notoriously hard to evaluate. In principle, any nomologically possible event can be explained away by appeal to chance. If we live in the right kind of infinite multiverse, for example, then there must be some universe like this one that beat the evolutionary odds. There will also be one in which my book sells a million copies, and one where a massive diamond meteorite falls in our yard. Given sufficient probabilistic resources, even the most fanciful event might be nothing more than a matter of chance with no further explanation needed.

One might instead simply reject scientific realism. Perhaps science is not about discovering the deep truths of physical reality. Both the history and philosophy of science provide reasons to think this might be the case. After all, there are many examples of successful theories that were eventually overthrown. Scientists, it seems to me, are naively overconfident about this question, dismissively rejecting anti-realism out of hand. But as Kyle Stanford has argued (2006), textbook science depends on what options scientists could come up with at a given point in time. What counts as a scientific truth depends very much on historical happenstance. Niels Bohr preferred the Copenhagen approach to quantum mechanics that Einstein opposed. Decades later, Bohmian mechanics was developed: an empirically equivalent, deterministic quantum theory with no collapse of the wave-function. Many physicists see the Bohmian approach as an ad hoc way of fitting quantum phenomena into a more classical framework. But what if Bohmian mechanics had been developed in 1923? Would we now be thinking of *it* as the standard view and that the Copenhagen approach was the odd alternative? Would anyone now believe that nature contained an element of irreducible randomness? This illustrates Stanford's challenge: if some of the things we believe about quantum physics are only because Bohm failed to get there first, why should we take standard quantum mechanics realistically? In short, there are reasons for a scientific realist to tread lightly.

Nonetheless, it would be difficult for most naturalists to embrace global anti-realism given that the success of science, understood in realist terms, is often touted as the best argument for naturalism in the first place. Naturalism says that only natural entities exist. What are those? The sorts things that the natural sciences study. Questions about fundamental ontology are left to science itself. But if science is not in the business of discovering what really exists, as the anti-realist says, then it would be in no position to answer those questions.

The best option for the naturalist, it seems to me, lies elsewhere. Say that Koons and Plantinga are right: Naturalists tend to believe in both scientific realism and evolutionary biology, but the two seem to be in tension with one another. Beliefs at the level of evolutionary biology are in conflict with more abstract beliefs in epistemology and the philosophy of science.

While this can be uncomfortable from a cognitive point of view, it is also quite common. There are all sorts of conceptual tensions with no resolution in sight, some within physics itself. The one between quantum mechanics and general relativity is the best known, but there are many more. These tensions and mismatches are the main reason why full-blown reductionism has failed (Koperski 2015, chap. 6). Forget about reducing psychology to neuroscience. There may never be a completed reduction of thermodynamics to atomic physics or of classical chaos to quantum mechanics. The reductionist dream of a fully unified science is a promissory note that will not be paid off.

Matters only get worse when trying to square physics with metaphysics. Do you believe that the past and future are intrinsically different? If so, space-time physics will present some difficulties. How about free will? It may be that some sort of soft determinism is the best that science itself can accommodate. That is not to say that one should immediately give up libertarian freedom or the passage of time if science seems to be in conflict with such views. The point is merely that there are tensions between science and common philosophical beliefs that many of us hold. There are, of course, strategies for reconciling these matters. Or one might hope that there must be *some* way to reconcile fundamental science and more abstract beliefs, even if no solution is currently known.

The naturalist can make a similar move. Even if neo-Darwinism and scientific realism are in tension, there is still a great deal of conceptual distance between the two. Plantinga thinks we can clearly see how evolution impinges on philosophy. Perhaps the naturalist, or at least the naturalist who has rejected reductionism, should be skeptical. Medical science has failed to sort out the causal links between eggs, consumed cholesterol, blood cholesterol, heart disease, and longevity. Perhaps we just are not smart enough to understand how evolution could produce creatures with veridical cognitive abilities.

Call this response *skeptical naturalism*, based on a similar strategy in philosophy of religion known as *skeptical theism*. The latter is the view that while general truths about God are knowable, one cannot know in any individual case why God acts in any particular way. So the skeptical theist believes there are good answers to the problem of evil from a God's-eye point of view, but those reasons are not knowable in any specific case. The skeptical naturalist is a scientific realist who believes in evolutionary biology, but does not believe that we can clearly understand all of the connections between them, weaving through epistemology, psychology, neurophysiology, and the rest. The skeptical naturalist believes that somehow it all meshes together, but we are not in a position to grasp the causal relations. In my view, this is an expression of faith, in this case faith in naturalism. This is not a defect, since I do not think that finite creatures can get around in the world without faith, regardless of what naturalists typically say about such things.

Putting realism to the side, let's circle back and briefly consider some other shaping principles.

Koons says that the naturalist has to accept many principles that they have inherited from theism as brute. Is that a problem? Perhaps it does not matter how scientists stumbled on ideas like the uniformity of nature. The point is that they work. Shaping principles are not algorithms; they are rules-of-thumb. If these principles stop being useful with respect to future science, they will be replaced with new ones. That is what happened when quantum mechanics came along, despite Einstein's objections.

However, the naturalist will have a harder time with explanatory virtues like simplicity and elegance. Two things need to be explained: (i) why there are laws, symmetries, etc., that have such properties; and (ii) how we are able to reliably discern them.

One approach is to treat the aesthetic virtues the way a Humean treats causation. Hume was fine with events, like pushing a book and the book falling on the floor. What Hume famously denied was that there is something over and above those events: causation itself. For a good Humean, the sense that the pushing caused the book to fall is nothing more than a psychological projection. Causation is not out there in the world to be discovered.

The Humean might take a similar approach to the aesthetic shaping principles. On this view, beauty is in the eye of the beholder. Scientists are not detecting anything in mathematical physics that corresponds to elegance. They have instead mistaken their projections for discoveries.

Like all projectivist accounts, realists are not likely to accept this story. The dialectic is by now quite common. The projectivist explains away, say, ethical obligation or religious experience as being merely in us. We are told that we have mistakenly mapped our phenomenology onto the world itself, and that there is no God to experience or obligations apart from our feelings. Ethical realists and most theists reject this reduction. They complain that, upon reflection, they are not naively projecting their feelings onto the desert landscape of natural events, and that projectivist accounts do not take their experiences and arguments seriously.

I tend to think that Newton, Einstein, and Steven Weinberg would have much the same reaction to projectivist accounts of aesthetic shaping principles. They are not imposing elegance and simplicity onto mathematical descriptions of the universe; they are discovering those properties. Weinberg suggests that it was the beauty of general relativity that led him and others to embrace it before there was good evidence (Plantinga 2011, 47). If beauty were merely a matter of human psychology, how could it be useful in the hard sciences? Putting beauty and mathematical elegance to the side for the moment, there are plausible naturalistic accounts of simplicity available. As Elliot Sober has argued, in some cases simplicity can understood in terms of Bayesian likelihoods (2015, chap. 2). If e is some evidence, h_s a simple hypothesis, and h_c a more complex one, then e favors h_s when the probability of e given h_s is greater than the probability of e given h_c, $\Pr(e|\, h_s) > \Pr(e|\, h_c)$. In order to invoke simplicity, says Sober, one need only argue in favor of these relative likelihoods. In other cases, it can be justified purely as a matter of predictive success, the idea being that simpler models tend to be influenced less by noise in the data. Without going into the details, it does seem to me that simplicity can largely be defended in ways amenable to naturalism.

What about other aesthetic properties? While elegance cannot be reduced to probability, one might be able to naturalize it. This is Theo Kuipers's approach when defending appeals to beauty in science (Kuipers 2002). He allows that there is something real that scientists are calling 'elegance.' What it is, precisely, is less clear. Consider Weinberg's claim: "Through countless false starts, we have gotten it beaten into us that nature is a certain way, and we have grown to look at that way that nature is as beautiful" (1992, 158). The properties that Weinberg is talking about are not intrinsically beautiful, on this view, as if beauty were a Platonic form that might be instantiated here and there. Aesthetic properties in physics are things that scientists pick up by exposure. Physics students are given examples of the laws of nature and then come to see them as beautiful. The naturalist can allow that there is something in the mathematics to be detected, which through experience one comes to sense as beauty.

That, it seems to me, is the most plausible approach to these questions that the naturalist has to offer. What it does not explain is why there is anything out there to detect in the first place. What is this property that physicists come to recognize as elegance and why does it exist? That unanswered question makes many philosophers of science reluctant to allow aesthetic properties any place in a material world. In fact, when Kuipers presented his paper titled “Beauty: A Road to Truth” several years ago at the British Society for the Philosophy of Science, the audience was extremely hostile. They recognized that even a naturalized view of elegance did not fit well in a material world.

This paper started with the well-established idea that science depends on philosophical assumptions. That these assumptions had theistic roots, in contrast, is often overlooked. Early modern scientists believed that God both ordered the cosmos in a lawlike way and provided humanity with the ability to discover that order. It is no surprise, then, that their tacit philosophy of science most closely resembles realism. As Plantinga and Koons have argued and as cognitive science now seems to suggest, naturalism lacks the resources to likewise provide support for realism. A similar conclusion holds for explanatory virtues such as simplicity and elegance. They are imperfect guides, no doubt, but the fact that they work well at all seems to require an explanation. Once again, theism provides a rationale for their use while naturalism struggles to accommodate them.

Naturalists will complain that theism is a weak explanation. While that is debatable, one thing is clear: theism made tangible contributions to the rise of modern science, which cannot be written-off as artifacts of a more religious age. That should tell us something about the relation between science and theology, and whatever that is, it is not that the two have been at war for the past 400 years.

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