Where the Conflict Really Lies

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Chapter 9

Deep Concord: Christian Theism and the Deep Roots of Science

Recall my overall thesis: there is superficial conflict but deep concord between theistic religion and science, but superficial concord and deep conflict between naturalism and science. In the first few chapters, we saw many allegations of conflict between science and religion. Much of this alleged conflict is merely illusory—between evolution and theistic belief, between science and special divine action (for example, miracles), and between religious faith and the scientific way of forming belief. We also saw that some conflicts—that between theistic religion and various claims and theories of evolutionary psychology—are genuine; though genuine, however, they are merely superficial, in that these conflicts, rightly understood, do not tend to offer defeaters to those who accept theistic religion. We then turned from the question whether science conflicts with theistic belief to the question whether it *supports* theistic belief, gives us some reason to *accept* theistic belief. Here we addressed considerations from contemporary science, in particular fine-tuning arguments and biological arguments of the sort offered by Michael Behe. These, we saw, can be taken either as arguments or as design discourse; either way they perhaps offer a certain limited but still non-negligible support for theism. While these arguments and discourses are interesting and relevant, there is a much deeper concord between theistic religion and science. It is time to turn to this concord.

I SCIENCE AND THE DIVINE IMAGE

Modern Western empirical science originated and flourished in the bosom of Christian theism and originated nowhere else. Some have

found this anomalous. Bertrand Russell, for example, thought of the Christian church as repressing and inhibiting the growth of science. He was therefore disappointed to note that science did not emerge in China, even though, as he said, the spread of scientific knowledge there encountered no such obstacles as he thought the Church put in its way in Europe.[1] But the fact is, it was Christian Europe that fostered, promoted, and nourished modern science. It arose nowhere else. All of the great names of early Western science, furthermore— Nicholas Copernicus, Galileo Galilei, Isaac Newton, Robert Boyle, John Wilkins, Roger Cotes, and many others—all were serious believers in God. Indeed, the important twentieth-century physicist C. F. von Weizsäcker goes so far as to say, "In this sense, I call modern science a legacy of Christianity." [2]

This is no accident: there is deep concord between science and theistic belief.[3] So I say: but why should we think so? We may begin by asking the following question: what sorts of conditions would be required for the success of science? What would contribute to its growth? What would things have to be like for science to flourish? What are the necessary (and sufficient) conditions for such flourishing?

But first, how shall we think of science? There are many opinions here. Realists think science is an effort to learn something of the sober truth about our world; instrumentalists think its value lies in its ability to help us get on in the world; constructive empiricists claim that its point is to produce empirically adequate theories, the question of the truth of these theories being secondary. Initially (and perhaps naïvely) the realists are right: science is a search for truth about ourselves and our world. From science we learn a little about the great regularities displayed by the planets and their motions, and about how these same regularities are to be found at a more terrestrial level. We learn about the nature of electricity, about the structure of matter and the variety of the elements. We learn about the early history of our planet and about the history of our species. We learn about the incredible and enormously detailed structure of the human body, and have learned how to cope with many diseases and pathologies. By virtue of science, we have learned how to build airplanes that obliterate distance; in the nineteenth century the trip from Chicago to Beijing was an arduous months-long affair; now it takes twelve hours.

The basic idea, therefore, is simple enough: science is at bottom an attempt to learn important truths about ourselves and our world. According to Albert Einstein, a proper scientist is a "real seeker after truth."[4] Of course we don't expect science to give us the answer to just any question. Science can't tell us whether slavery is wrong, for example, though it might be able to tell us about some of the social or economic consequences of slavery. We don't expect science to tell us whether, say, Christian Trintarianism is true: that's not its business. (Nor does it make much sense to suggest that since we now have science, we no longer need any other sources of knowledge— religion, for example. That is like claiming that now that we have refrigerators and chain saws and roller skates, we no longer have need for Mozart.) Furthermore, while science is an attempt to find important truths about our world and ourselves, it isn't just any such attempt—there are other ways in which people have tried to discover truths about ourselves and our world. Still, the fundamental class to which science belongs is that of efforts to discover truths—at any rate it is science so thought of that I mean to deal with here. More specifically, science is a disciplined and systematic effort to discover such truths, an effort with a substantial empirical involvement. While it is difficult to give a precise account of this empirical component, it is absolutely crucial to science, and is what distinguishes science from philosophy.

Now how is Christian belief relevant here? What is this deep concord I claim? The first thing to see here is simplicity itself. It is an important part of Christian, Jewish and some Islamic thought to see human beings as *created in God's image*. This doctrine of the *imago dei*, the thought that we human beings have been created in the image of God has several sides and facets; but there is one aspect of it that is crucially relevant in the present context. This is the thought that God is a knower, and indeed the supreme knower. God is omniscient, that is, such that he knows everything, omniscient, that is, such that he knows everything, knows for any proposition p, whether p is true. We human beings, therefore, in being created in his image, can also know much about our world, ourselves, and God himself. No doubt what we know pales into insignificance beside what God knows; still we know much that is worthwhile and important. Crucial to the thought that we have been created in his image, then, is the idea that he has created both us and our

world in such a way that (like him) we are able to know important things about our world and ourselves.

Thomas Aquinas put it as follows:

> Since human beings are said to be in the image of God in virtue of their having a nature that includes an intellect, such a nature is most in the image of God in virtue of being most able to imitate God;

and

> Only in rational creatures is there found a likeness of God which counts as an image…. As far as a likeness of the divine nature is concerned, rational creatures seem somehow to attain a representation of [that] type in virtue of imitating God not only in this, that he is and lives, but especially in this, that he understands.[5]

Here Aquinas says that a nature including an intellect is *most* in the image of God, in virtue of being most able to imitate God. Perhaps he exaggerates a bit in thinking that understanding, the ability to know, is the *chief* part of the image of God. What about being able to act, what about having a grasp of right and wrong, what about being able to love one another, what about being able, in some way, to experience God? In any event, however, this ability to know something about our world, ourselves and God is a crucially important part of the divine image.

But how, more exactly, is this supposed to go? God created both us and our world in such a way that there is a certain fit or match between the world and our cognitive faculties. The medievals had a phrase for it: *adequatio intellectus ad rem* (the adequation of the intellect to reality). The basic idea, here, is simply that there is a match between our cognitive or intellectual faculties and reality, thought of as including whatever exists, a match that enables us to know something, indeed a great deal, about the world—and also about ourselves and God himself. According to Noam Chomsky,

> This partial congruence between the truth about the world and what the human science-forming capacity produces at a given moment yields science. Notice that it is just blind luck if the human science-forming capacity, a particular component of the human biological

> endowment, happens to yield a result that conforms more or less to the truth about the world.[6]

From the point of view of theistic religion, this is not blind luck. It is only to be expected.

Science, clearly, is an extension of our ordinary ways of learning about the world. As such, it obviously involves the faculties and processes by which we ordinarily do achieve knowledge. Thus perception (whereby we know something of our environment), memory (whereby we know something of our past), *a priori* insight (by which we grasp logic and mathematics), broadly inductive procedures (whereby we can learn from experience), perhaps Thomas Reid's "sympathy" (by which we know about the thoughts and feelings of other people), and perhaps still others—all of these take their place in the prosecution of science. What is involved in science is these basic ways of knowing; of course it is also true that by use of these basic ways we can construct devices and instruments (telescopes, electron microscopes, and accelerators, not to mention opera glasses) that vastly extend the reach of our ordinary cognitive faculties.

For science to be successful, therefore, there must be a match between our cognitive faculties and the world. How shall we understand this fit? First, it is important to see that it is by no means just automatic or inevitable that there is such a match (as I'll argue in more detail in the next chapter). Our faculties are designed to enable us to know something about *this* world; if the world were very different, our faculties might not serve us this way at all. Visual perception of our kind, obviously enough, requires light, electromagnetic radiation of the right wavelength; in a world where everything is always obscured by thick darkness, our eyes would be of no use. Something similar, of course, goes for hearing and our other perceptual faculties. We might think that our evolutionary origin guarantees or strongly supports the thought that our basic cognitive faculties are reliable: if they weren't, how could we have survived and reproduced? But this is clearly an error, as I'll argue in the next chapter. Natural selection is interested in adaptive behavior, behavior that conduces to survival and reproduction; it has no interest in our having true beliefs.

So what more can we say about this required fit or match between our cognitive faculties and the world we seek to learn about? I've just mentioned perception; clearly this is a most important source of belief about the world; and one condition of the success of science is that perception for the most part, and under ordinary and favorable conditions, produces in us beliefs that are in fact true. This isn't inevitable. It is possible that perception should produce in us beliefs that are adaptive, or meet some other useful condition, whether or not they are true.

II RELIABILITYAND REGULARITY

For science to be successful, the world must display a high degree of regularity and predictability. As we saw in chapter 4, intentional action requires the same thing: we couldn't build a house if hammers unpredictably turned into eels, or nails into caterpillars; we couldn't drive downtown if automobiles unexpectedly turned into tea pots or rosebushes. Intentional action requires a high degree of stability, predictability, and regularity. And of course the predictability in question has to be predictability *by us*. For intentional action to be possible, it must be the case that we, given *our* cognitive faculties, can often or usually predict what will happen next. No doubt there could be creatures with wholly different cognitive powers, creatures who could predict the course of events in ways we can't; that might be nice for them, but science as practiced by us humans requires predictability given our cognitive faculties. Furthermore, science requires more than regularity: it also requires our implicitly *believing or assuming* that the world is regular in this way. As the philosopher Alfred North Whitehead put it, "There can be no living science unless there is a widespread instinctive conviction in the existence of an *Order of Things*. And, in particular, of an *Order of Nature*."[7]

It's an essential part of theistic religion—at any rate Christian theistic religion—to think of God as providentially governing the world in such a way as to provide that kind of stability and regularity. Let me quote again the Heidelberg Catechism:

> Providence is the almighty and ever present power of God by which he upholds, as with his hand, heaven and earth and all creatures, and so rules them that leaf and blade, rain and drought, fruitful and lean years, food and drink, health and sickness, prosperity and poverty—all things, in fact, come to us not by chance but from his fatherly hand.[8]

Christian theism involves the idea that *God* governs the world; that what happens does not come about by chance, but by virtue of God's providential governance. The idea is that the basic structure of the world is due to a creative intelligence: a person, who aimed and intended that the world manifest a certain character. The world was created in such a way that it displays order and regularity; it isn't unpredictable, chancy or random. And of course this conviction is what enables and undergirds science. Whitehead, as we saw, points out that science requires an instinctive conviction that nature is ordered; he goes on to attribute this widespread instinctive conviction to "the medieval insistence on the rationality of God."[9]

What does this "rationality" of God consist in? What might the medievals have meant in saying that God is rational? When they discussed this topic, the medievals put it in terms of the question whether, in God, it is *intellect* or *will* that is primary. They thought that if *intellect* is primary in God, then God's actions will be predictable, orderly, conforming to a plan—a plan we can partially fathom. On the other hand, if it is *will* that is primary in God, then his actions would involve much more by way of caprice and arbitrary choice and much less predictability. If it is intellect that is prior in God, then his actions will be rational—rational in something like the way that we are rational; if it is will that is prior, then one can't expect as much by way of rationality. Aquinas championed the primacy of intellect in God, while William of Ockham endorsed the priority of will. This, of course, is vastly oversimplified (as is nearly anything one can say about medieval philosophy) but it conveys an essential point. Ockham seemed to think that God's will was essentially unconstrained by God's intellect (or anything else); God is free to do whatever he wants, even something that is irrational in the sense of contrary to what his intellect perceives as good or right. Ockham insisted that while in fact God chose to redeem humanity by becoming a human being, he could just as properly have

chosen to do so by becoming a stone, a tree, or an ass.[10] He also claimed that God could have commanded hatred instead of love, adultery instead of faithfulness, cruelty instead of kindness; and if he had, then those things would have been morally obligatory. Aquinas, on the other hand, taught that God's commands stem from his very nature, so that it isn't so much as possible that God should have commanded hate rather than love.

The rationality of God, as Aquinas thought, extends far beyond the realm of morality. God sets forth moral laws, to be sure, but he also sets forth or promulgates laws of nature, and he creates the world in such a way that it conforms to these laws. The tendency of Ockham's thought, on the other hand, is to emphasize the freedom (willfulness?) of God to such a degree that he becomes completely unpredictable; and to the extent that God is completely unpredictable, the same goes for his world. There is no guarantee that the world at some deep level is law governed, or lawful; there is no guarantee that God's world is such that by rational, intellectual activity, we will be able to learn something about its deep structure. In fact there is no reason to think, on Ockham's view, that it *has* a deep structure. What Whitehead points out here is that modern science required a sort of instinctive conviction that God is more like the way Aquinas thinks of him than the way Ockham does.[11] And indeed, many of the early pioneers and heroes of modern western science, the scientists propelling the scientific revolution, clearly sided with Aquinas. Thus Samuel Clarke: "What men commonly call 'the course of nature'… is nothing else but the will of God producing certain effects in a continued, regular, constant, and uniform manner."[12]

III LAW

[I cut this section, apart from the following summary of it. RJ]

With respect to the laws of nature, therefore, there are at least three ways in which theism is hospitable to science and its success, three ways in which there is deep concord between theistic religion and science. First, science requires regularity, predictability, and constancy; it requires that our world conform to laws of nature. In the west (which includes the United States, Canada, Europe, and, for these purposes, Australia and

New Zealand) the main rival to theism is naturalism, the thought that there is no such person as God or anything like God. Naturalism is trumpeted by, for example, three of the four horsemen of atheism: Richard Dawkins, Daniel Dennett, and Christopher Hitchens.[30] (The fourth horseman, Sam Harris, is an atheist, all right, but doesn't seem to rise to the lofty heights—or descend to the murky depths—of naturalism: he displays a decided list towards Buddhism.[31]) From the point of view of naturalism, the fact that our world displays the sort of regularity and lawlike behavior necessary for science is a piece of enormous cosmic luck, a not-to-be-expected bit of serendipity. But regularity and lawlikeness obviously fit well with the thought that God is a rational person who has created our world, and instituted the laws of nature.

Second, not only must our world in fact manifest regularity and law-like behavior: for science to flourish, scientists and others must *believe* that it does. As Whitehead put it (earlier in this chapter): "There can be no living science unless there is a widespread instinctive conviction in the existence of an Order of Things;" such a conviction fits well with the theistic doctrine of the image of God.

Third, theism enables us to understand the necessity or inevitableness or inviolability of natural law: this necessity is to be explained and understood in terms of the difference between divine power and the power of finite creatures. Again, from the point of view of naturalism, the character of these laws is something of an enigma. What is this alleged necessity they display, weaker than logical necessity, but necessity nonetheless? What if anything explains the fact that these laws govern what happens? What reason if any is there for expecting them to continue to govern these phenomena? Theism provides a natural answer to these questions; naturalism stands mute before them.

IV MATHEMATICS

A. Efficacy

The distinguished scientist Eugene Wigner spoke of the "unreasonable efficacy of mathematics in the natural sciences."[32] What might he have meant? Mathematics and natural science in the West have developed

hand in hand, from the Leibniz/Newton discovery of the differential calculus in the seventeenth century to the non-Abelian gauge theory of contemporary quantum chromodynamics. Much of this mathematics is abstruse, going immensely beyond the elementary arithmetic we learn in grade school. Why should the world be significantly describable by these mathematical structures? Why should these complex and deep structures be applicable in interesting and useful ways?

Perhaps you will claim that no matter how the world had been, it would have been describable by mathematics of some kind or other. Perhaps so; but what is unreasonable, in Wigner's terms, is that the sort of mathematics effective in science is extremely challenging mathematics, though still such that we human beings can grasp and use it (if only after considerable effort). No matter how things had been, perhaps there would have been mathematical formulas describing the world's behavior. For example, here is one way things could have been: nothing but atomless gunk with nothing happening. I guess there could be mathematical descriptions of such a reality, but they would be supremely uninteresting. Here is another way things could have been: lots of events happening in kaleidoscopic variety and succession, but with no rhyme or reason, no patterns, or at any rate no patterns discernible to creatures like us. Here too mathematical description might be possible: event A happened and lasted ten seconds; then event B happened and lasted twice as long as A; then C happened and had more components than A, and so on. But again, under that scenario the world would not be mathematically describable in ways of interest to creatures with our kinds of cognitive faculties. Still a third way things could have been: there could have been surface variety and chaos and unpredictability with deep regularity and law—so deep, in fact, as to be humanly inaccessible.

All of these are ways in which mathematical description would be possible; these ways would also be of no interest to us. What Wigner notes, on the other hand, is that our world is mathematically describable in terms of fascinating underlying mathematical structures of astounding complexity but also deep simplicity. To discover it has required strenuous and cooperative effort on the part of many scientists and mathematicians. That mathematics of this sort should be applicable to the world is indeed astounding. It is also properly thought of as unreasonable, in the sense that from a naturalistic perspective it would be wholly unreasonable to expect this sort of mathematics to be useful in describing our world. It makes eminently good sense from the perspective of theism, however. Science is a splendid achievement, and much of its splendor depends upon mathematics being applicable to the world in such a way that it is both accessible to us but also offers a challenge of a high order. According to theism, God creates human beings in his image, a crucial component of which is the ability to know worthwhile and important things about our world. Science with its mathematical emphasis is a prime example of this image in us: science requires our very best efforts—both as communities and individuals—and it delivers magnificent results. All of this seems wholly appropriate from a theistic point of view; as Paul Dirac, who came up with an influential formulation of quantum theory, put it, "God is a mathematician of a very high order and He used advanced mathematics in constructing the universe."[33] So here we have another manifestation of deep concord between science and theistic religion: the way in which mathematics is applicable to the universe.

B. Accessibility

Just as it is unreasonable, from a naturalistic perspective, to expect mathematics of this sort to be efficacious, so it is unreasonable, from that perspective, to expect human beings to be able to grasp and practice the kind of mathematics employed in contemporary science. From that point of view, the best guess about our origins is that we human beings and our cognitive faculties have come to be by way of natural selection winnowing some form of genetic variation. The purpose of our cognitive faculties, from that perspective, is to contribute to our reproductive fitness, to contribute to survival and reproduction. Current physics with its ubiquitous partial differential equations (not to mention relativity theory with its tensors, quantum mechanics with its non-Abelian group theory, and current set theory with its daunting complexities) involves mathematics of great depth, requiring cognitive powers going enormously beyond what is required for survival and reproduction. Indeed, it is only the occasional assistant professor of mathematics or

logic who needs to be able to prove Gödel's first incompleteness theorem in order to survive and reproduce.

These abilities far surpass what is required for reproductive fitness now, and even further beyond what would have been required for reproductive fitness back there on the plains of Serengeti. That sort of ability and interest would have been of scant adaptive use in the Pleistocene. As a matter of fact, it would have been a positive hindrance, due to the nerdiness factor. What prehistoric female would be interested in a male who wanted to think about whether a set could be equal in cardinality to its power set, instead of where to look for game?[34]

Of course it is always possible to maintain that these mathematical powers are a sort of spandrel, of no adaptive use in themselves, but an inevitable accompaniment of other powers that do promote reproductive fitness. The ability to see that 7 gazelles will provide much more meat than 2 gazelles is of indisputable adaptive utility; one could argue that these more advanced cognitive powers are inevitably connected with that elementary ability, in such a way that you can't have the one without having the other.

Well, perhaps; but it sounds pretty flimsy, and the easy and universal availability of such explanations makes them wholly implausible. It's like giving an evolutionary explanation of the music of Mozart and Bach in terms of the adaptiveness, the usefulness, in the Pleistocene, of rhythmical movement in walking or running long distances.[35]

C. The Nature of Mathematics

There is a third way in which the "unreasonable efficacy" of mathematics in science points to and exemplifies deep concord between theistic religion and science. Mathematics, naturally enough, is centrally about numbers and sets. But numbers and sets themselves make a great deal more sense from the point of view of theism than from that of naturalism. Now there are two quite different but widely shared intuitions about the nature of numbers and sets. First, we think of numbers and sets as abstract objects, the same sort of thing as propositions, properties, states of affairs and the like. It natural to think of these things as existing necessarily, such that they would have been there no matter how things had turned out. (After all, we think of some propositions—true mathematical propositions, for example—as necessarily true; but a proposition can't be necessarily true without existing necessarily.) On the other hand, there is another equally widely shared intuition about these things: most people who have thought about the question, think it incredible that these abstract objects should just exist, just *be* there, whether or not they are ever thought of by anyone. Platonism with respect to these objects is the position that they do exist in that way, that is, in such a way as to be independent of mind; even if there were no minds at all, they would still exist. But there have been very few real Platonists, perhaps none besides Plato and Frege, if indeed Plato and Frege were real Platonists (and even Frege, that alleged arch-Platonist, referred to propositions as *gedanken*, thoughts). It is therefore extremely tempting to think of abstract objects as ontologically dependent upon mental or intellectual activity in such a way that either they just are thoughts, or else at any rate couldn't exist if not thought of. (According to the idealistic tradition beginning with Kant, propositions are essentially *judgments*.)

But if it is *human* thinkers that are at issue, then there are far too many abstract objects. There are far too many real numbers for each to have been thought of by some human being. The same goes for propositions; there are at least as many propositions as there are real numbers. (For every real number r, for example, there is the proposition that r is distinct from the Taj Mahal.) On the other hand, if abstract objects were divine thoughts, there would be no problem here. So perhaps the most natural way to think about abstract objects, including numbers, is as divine thoughts.[36]

Second, consider sets. Perhaps the most common way to think of sets is as displaying at least the following characteristics: (1) no set is a member of itself; (2) sets (unlike properties) have their extensions essentially; hence sets with contingently existing members are themselves contingent beings, and no set could have existed if one of its members had not; (3) sets form an iterated structure: at the first level, there are sets whose members are nonsets, at the second, sets whose members are nonsets or first level sets, and so on.[37] (Note that on this iterative conception, the

elements of a set are in an important sense prior to the set. That is why on this conception no set is a member of itself, thus disarming the Russell paradoxes in their set theoretical form.[38])

It is also natural to think of sets as *collections*—that is, things whose existence depends upon a certain sort of intellectual activity—a collecting or "thinking together." Thus Georg Cantor: "By a 'set' we understand any collection M into a whole of definite, well-distinguished objects of our intuition or our thought (which will be called the 'elements' of M)."[39] According to Hao Wang, "the set is a single object formed by collecting the members together."[40]

And

> It is a basic feature of reality that there are many things. When a multitude of given objects can be collected together, we arrive at a set. For example, there are two tables in this room. We are ready to view them as given both separately and as a unity, and justify this by pointing to them or looking at them or thinking about them either one after the other or simultaneously. Somehow the viewing of certain given objects together suggests a loose link which ties the objects together in our intuition.[41]

If sets *were* collections, that would explain their having the first three features. (First, if sets were collections, the result of a collecting activity, the elements collected would have to be present before the collecting; hence no set is a member of itself. Second, a collection could not have existed but been a collection of items different from the ones actually collected, and a collection can't exist unless the elements collected exist; hence collections have their members essentially, and can't exist unless those members do. And third, clearly there are non-collections, then first level collections whose only members are noncollections, then second level collections whose members are noncollections or first level collections, et cetera.) But of course there are far too many sets for them to be a product of *human* thinking together. Furthermore, many sets are such that no human being could possibly think all their members together—for example, the set of real numbers. Therefore there are many sets such that no human being has ever thought their members together, many such that their members have not been thought together by any human being. That requires an infinite mind—one like God's.

The basic objects of mathematics, that is, numbers and sets, fit very neatly into a theistic way of looking at the world —vastly better than into a naturalistic perspective. Perhaps this explains the strenuous efforts, on the part of Hartry Field and others, to "reinterpret" mathematics in such a way as to make it possible for naturalism to accommodate it.[42] Again, we see deep concord between theistic religion and science.

D. Mathematical Objects as Abstract

[In this section Plantinga argues that his theistic view of mathematical objects solves the problem of how we can gain knowledge of abstract (hence non-causal) entities.]

V INDUCTION AND LEARNING FROM EXPERIENCE

Another and perhaps less obvious condition for the success of science has to do with our ways of learning from experience. We human beings take it utterly for granted that the future will resemble the past. As David Hume pointed out with his usual keen insight, in the past we have found bread but not stones to be nourishing (this may have been known even before Hume); we expect the former to continue to have this salubrious property and the latter to lack it. Past ax heads dropped into water have sunk; we expect the next one to do the same. Night has always followed day: we assume in consequence that today will be followed by tonight. It is only by virtue of this assumption, furthermore, that we are able to learn from experience. Of course we don't expect the future to resemble the past in *every* respect; I have no doubt, for example, that my grandchildren will be larger ten years from now. Saying precisely how we expect the future to resemble the past is no mean task; we expect the future to resemble the past in relevant respects; but specifying the relevant respects is far from easy. Nevertheless, we do expect the future to resemble the past, and this expectation is crucial to our being able to learn from experience.

We generalize what we learn to the future; but this is not the extent of our generalization of experience. Aristotle held that heavy objects fall faster than light objects; according to scientific folklore, Galileo dropped a couple of balls of unequal weights from the leaning Tower of Pisa, noted that they fell at the same rate, and concluded that Aristotle was wrong. We run a few experiments, and conclude that Newton's law of gravity is at least approximately true. In cases like these we don't conclude merely that Aristotle's theory is false for that pair of balls Galileo allegedly dropped, or for the area around the leaning tower, or on Thursdays. We don't conclude that maybe Aristotle was right in his day—two thousand years ago, maybe heavy things did fall faster than light. No; we conclude that Aristotle's theory is false generally, and that Galileo's results hold for any pair of balls that might be dropped. In experiments verifying Newton's laws, we don't infer merely that Newton's laws held in the time and place where those experiments were conducted; we think they hold much more generally. We don't necessarily conclude that they hold for all of time and space (we are open to the idea that things may have been different shortly after the big bang, or in one of those other universes of which cosmologists speak); but we do conclude that they hold far beyond the temporal and spatial limits of the situation of the experiments. The great eighteenth century philosopher Thomas Reid claimed that among the "principles of contingent truth" is that "*in the phaenomena of nature, what is to be, will probably be like to what has been in similar circumstances*" (Reid's emphasis). What he meant is that we simply find ourselves, by virtue of our nature, making that assumption. This principle, furthermore, "is necessary for us before we are able to discover it by reasoning, and therefore is made a part of our constitution, and produces its effects before the use of reason."[44] Reid goes on to claim that having this conviction—that "in the phaenomena of nature, what is to be, will probably be like to what has been in similar circumstances"—is essential to learning from experience. This isn't exactly right, at any rate if what Reid means is that one must explicitly have this belief in order to learn from experience. A child learns from experience; "the burnt child dreads the fire." The burnt child may never have raised the question whether the future resembles the past, and she may have no explicit views at all on that topic. What learning from experience requires is more like a certain habit, a certain practice—the habit of making inductive inferences. But that too isn't exactly right: in any event there need be nothing like explicitly thinking of premise and conclusion. It is more as if we have the experience and in direct response to it form a belief that goes far beyond the confines of the experience.

We are able to learn that unsupported rocks near the surface of the earth will fall down rather than up, that water is good to drink, that rockfall is dangerous—we learn these things only by virtue of exercising this habit. Indeed, it is only by virtue of this habit that a child is able to learn a language. (My parents teach me "red"; I get the idea and see what property they express by that word; unless I proceed in accord with this habit, I shall have to start over the next time they use "red.") Our ordinary cognitive life deeply depends on our making this assumption, or following this practice.

Of course this holds for the practice of science as well as for everyday cognitive life. According to the story noted above, Galileo dropped two balls, one heavy and one light, off the leaning Tower of Pisa, to see if Aristotle was right in thinking heavy objects fall faster than light. Aristotle was wrong; they fell at the same rate. Presumably no one suggested that Galileo should perhaps perform this experiment every day, on the grounds that all he had shown was that on that particular day heavy and light objects fall at the same rate. No one suggested that the experiment should be repeated in Asia, or that we should look for other evidence on the question whether in Aristotle's time he may have been right. A crucial experiment may be repeated, but not because we wonder whether the same circumstances will yield the same result.

David Hume, that great patron of skeptics, thought he detected a philosophical problem here:

> As to past Experience, it can be allowed to give *direct* and certain information of those precise objects only, and that precise period of time, which fell under its cognizance: but why this experience should be extended to future times, and to other objects, which for aught we know, may be only in appearance similar; this is the main question on which I would insist. The bread, which I formerly ate, nourished me; that is, a body of such sensible qualities was, at that time, endued with such secret powers: but does it follow, that other bread must also

> nourish me at another time, and that like sensible qualities must always be attended with like secret powers? [45]

Right; it doesn't follow. There are plenty of possible worlds that match the actual world up to the present time, but then diverge wildly, so that inductive inferences would mostly fail in those other worlds. There are as many of those counterinductive worlds as there are worlds in which induction will continue to be reliable. It is by no means inevitable that inductive reasoning should be successful; its success is one more example of the fit between our cognitive faculties and the world.

Hume goes on to claim that there is no rational foundation for this sort of reasoning, and that inductive reasoning is not in fact rational. Is this correct? Say that a kind of reasoning is rational, for us, just if a human being with properly functioning cognitive faculties (properly functioning *ratio* or reason) would engage this kind of reasoning; if so Hume is wrong. We human beings, including those among us with properly functioning cognitive faculties, are inveterately addicted to inductive reasoning. And this is another example of fit between our cognitive faculties and the world in which we find ourselves. Like the others, this fit is to be expected given theism. God has created us in his image; this involves our being able to have significant knowledge about our world. That requires the *adequatio intellectus ad rem* (the fit of intellect with reality) of which the medievals spoke, and the success of inductive reasoning is one more example of this *adequatio*. According to theism, God has created us in such a way that we reason in inductive fashion; he has created our world in such a way that inductive reasoning is successful. This is one more manifestation of the deep concord between theism and science.

VI SIMPLICITY AND OTHER THEORETICAL VIRTUES

Scientific theories, so we are told, are underdetermined by the evidence. This just means that these theories go *beyond* the evidence; they are not merely compendious ways of stating the evidence. Very few experiments of the sort Galileo conducted with those balls of different weights have been conducted; we still think his results hold for all or nearly all objects.

The evidence for Newton's laws (as applied to middle-sized objects moving at moderate velocities with respect to each other) is extensive, but the laws go far beyond the evidence, applying to future cases of motion as well as past but unobserved cases. The same goes for any scientific theory. For example, the actual experimental evidence for general relativity is fairly slim, and is compatible with many theories inconsistent with general relativity. The evidence for Newton's law of gravitation is compatible with a "law" such as

> Any two physical objects attract each other with a force conforming to Gm_1m_2 over r^2 except on Thursdays, when G is replaced by G*, (where G* a value indistinguishable from G by current methods).

One way to think of this is in terms of the curve fitting problem. As Leibniz already pointed out in the seventeenth century, for any finite set of observations of the path of a comet, infinitely many different curves can be found to fit; he also points out that given any finite set of statistics, there will be infinitely many statistical hypotheses fitting the facts.[46]

So why do we choose certain hypotheses to endorse, when there are infinitely many compatible with our evidence? Because these hypothesis, as opposed to others, display the so-called *theoretical virtues*. Among these virtues the following have been proposed: simplicity, parsimony (which may be a form of simplicity), elegance or beauty, consilience (fit with other favored or established hypotheses), and fruitfulness. Nobel laureate Steven Weinberg suggests that the beauty of general relativity is what led him and others to embrace it, well before there was serious evidence for it:

> I remember that, when I learned general relativity in the 1950s, before modern radar and radio astronomy began to give impressive new evidence for the theory, I took it for granted that general relativity was more or less correct. Perhaps all of us were just gullible and lucky, but I do not think that is the real explanation. I believe that the general acceptance of general relativity was due in large part to the attractions of the theory itself—in short, to its beauty.[47]

Simplicity (which is involved in beauty) is often thought of as particularly important.[48] Thus Einstein:

> With every new important advance the researcher here sees his expectations surpassed, in that those basic laws are more and more simplified under the pressure of experience. With astonishment he sees apparent chaos resolved into a sublime order that is to be attributed not to the rule of the individual mind, but to the constitution of the world of experience; this is what Leibniz so happily characterized as "pre-established harmony." [49]

Complicated, gerrymandered theories are rejected. Complex Rube Goldberg contraptions are ridiculed. When confronted with a set of data plotted on a graph, we draw the simplest curve that will accommodate all the data. There are any number of other curves that will accommodate the data; but these will be rejected in favor of the simplest alternative. Physics gives us a law of conservation of energy: energy is conserved in all closed physical systems. This is compatible with our evidence; but of course so are indefinitely many other "laws"—for example, energy is conserved in all closed physical systems except in months whose names start with "J," in each of which there are exactly twelve undetectable exceptions.

Simplicity, therefore, is a crucially important part of our intellectual or cognitive architecture—or rather, *preference* for simplicity is. That the world be relevantly simple is also required, of course, for the success of science. It isn't a necessary truth, however, that simple theories are more likely to be true than complex theories. Naturalism gives us no reason at all to expect the world to conform to our preference for simplicity. From that perspective, surely, the world could just as well have been such that unlovely, miserably complex theories are more likely to be true.

Theism with its doctrine of the *imago dei*, on the other hand, is relevant in two quite distinct respects. First, insofar as we have been created in God's image, it is reasonable to think our intellectual preferences resemble his. We value simplicity, elegance, beauty; it is therefore reasonable to think that the same goes for God. But if he too values these qualities, it is reasonable to think this divine preference will be reflected in the world he has created. Second, what we have here is another example of God's having created us and our world in such a way that there is that *adequatio intellectus ad rem*. We are so constituted that our intellectual success requires that the world be relevantly simple; the world is in fact relevantly simple. This fit is only to be expected on theism, but is a piece of enormous cosmic serendipity on naturalism. It is therefore one more way in which there is deep concord between theistic religion and science. Surely the world could have been such that unlovely, miserably complex theories are more likely to be true. It could have been such that there is insufficient simplicity for science, at least our human brand of science, to be successful.

VII CONTINGENCYAND SCIENCE AS EMPIRICAL

[In this section, Plantinga says that the empiricism of early scientists like Newton was based on the idea that the God had some free choice in picking the laws the physics. (Within the general constraints of picking ones that made rational sense, allowed life to exist, etc.) Since free choices cannot be rationally predicted, we humans must do experiments to find out what God picked.]

NOTES

1. Russell, *The Problem of China* (Charleston, S.C.: BiblioBazaar, 2006), p. 164.
2. Von Weizsäcker, *The Relevance of Science* (NewYork: Harper: 1964), p 163.
3. Peter van Inwagen, one of the finest philosophers of our age, cites it as one of his main reasons for believing in God; see his "Quam Dilecta" in *God and the Philosophers*, ed. Thomas Morris (New York: Oxford University Press, 1994), pp. 52ff.
4. Einstein in a letter to Robert Thornton, December 7, 1944. Einstein Archives 61–574.
5. *Summa Theologiae* Ia q. 93 a. 4; ST Ia q.93 a.6.
6. Chomsky, *Language and the Problems of Knowledge* (Cambridge: The MIT Press, 2001), pp. 157–58.
7. Whitehead, *Science and the Modern World* (New York: McMillan, 1925), pp. 3–4.

8. Lord's Day Ten, Question and Answer 27.
9. Whitehead, *Science and the Modern World*, p. 13.
10. Josef Pieper, Scholasticism: *Personalities and Problems of Medieval Philosophy* (Notre Dame, Ind.: St. Augustine's Press, 2001), p. 148.
11. There is also an important contrast here between the usual Christian and the usual Islamic way of thinking about God. This is not the place to go into detail into Islamic conceptions of God (even if I knew enough to do so), and of course there are several different Islamic conceptions of God, or Allah, just as there is more than one Christian conception of God. But on the whole it seems that the dominant Muslim conception of God is of a more intrusive, unpredictable, incomprehensible divinity. Rodney Stark points out that a common "orthodox" claim was that all attempts to formulate natural laws are blasphemous, because they would limit Allāh's freedom. See his *Discovering God* (New York: Harper, 2007), p. 367.
12. Clarke, *A Demonstration of the Being and Attributes of God*, ed. Ezio Vailati (Cambridge: Cambridge University Press, 1998), p. 149.
30. See Dawkins, *The God Delusion* (New York: Bantam, 2006); Dennett, *Breaking the Spell: Religion as a Natural Phenomenon* (New York: Penguin, 2006); and Hitchens, *God Is Not Great: How Religion Poisons Everything* (New York: Hachette Book Group, 2007).
31. Harris, *The End of Faith: Religion, Terror, and the Future of Reason* (New York: Norton, 2004) and *Letter to a Christian Nation* (New York: Knopf, 2006).
32. Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," in *Communications in Pure and Applied Mathematics*, vol. 13, no. 1 (February 1960).
33. Dirac, "The Evolution of the Physicists's Picture of Nature," *Scientific American* 2008, no. 5 (May 1963), p. 53.
34. Well, you never really know. Eleonore Stump, the mater familias of Christian philosophy, reminds me that female pheasants seem to be deeply impressed by apparently gratuitous decorative plumage; and some claim that perverse preference on the part of female Irish elk for males with gigantic horns led to the extinction of the species. Who knows what idiosyncratic romantic preferences prehistoric women might have had? Still, set theory…?
35. See chapter 5.

36. Consider Thomas Aquinas, *De Veritate*: "Even if there were no human intellects, there could be truths because of their relation to the divine intellect. But if, per impossibile, there were no intellects at all, but things continued to exist, then there would be no such reality as truth." And see my "How to be an Anti-Realist," *Proceedings and Addresses of the American Philosophical Association*, 1982.

37. See Charles Parsons, "What is the Iterative Conception of Set?" in *Mathematic in Philosophy* (Ithaca: Cornell university Press, 1983), pp. 268ff.

38. J. R. Shoenfield, *Mathematical Logic* (Boston: Addison-Wesley, 1965) writes: A closer examination of the (Russell) paradox shows that it does not really contradict the intuitive notion of a set. According to this notion, a set A is formed by gathering together certain objects to form a single object, which is the set A. Thus before the set A is formed, we must have available all of the objects which are to be members of A (p. 238).

39. Cantor, *Gesammelte Abhandlungen mathematischen und philosophischen Inhalts*, ed. Ernest Zermelo (Berlin: Springer, 1932), p. 282.

40. Wang, *Mathematics to Philosophy* (New York: Humanities Press, 1974), p. 238.

41. Wang, *Mathematics to Philosophy*, p. 182.

42. Field, *Realism, Mathematics and Modality* (Oxford: Blackwell, 1989).

43. See Paul Benacerraf, "What Numbers Could Not Be," *The Philosophical Review*, 74: 47–73 (1965).

44. Reid, *Essays on the Intellectual Powers of Man*, Essay VI, V, 12. A similar principle is stated by David Hume:

    If reason determined us, it wou'd proceed upon that principle, that past instances, of which we have had no experience, must resemble those, of which we have had experience, and that the course of nature continues always uniformly the same. *A Treatise of Human Nature*, ed. L.A. Selby-Bigge (Oxford: Clarendon Press, first edition 1888), Book I, Part III, 6, p. 89 (Hume's emphasis).

45. Hume, *An Enquiry Concerning Human Understanding* (LaSalle: The Open Court Publishing Co., 1956), Sect. IV, 2, p. 34.

46. See Ian Hacking's *The Emergence of Probability* (Cambridge: Cambridge University Press, 1975), p. 164.

47. Weinberg, *Dreams of a Final Theory* (New York: Pantheon, 1992), p. 98.

48. Here see Richard Swinburne, *Simplicity as Evidence of Truth* (Milwaukee: Marquette University Press, 1997).

49. Einstein, *Ideas and Opinions* (New York: Bonanza Books, 1954), p. 224–27.