

SCIENCE: AUGUSTINIAN OR DUHEMIAN?

Alvin Plantinga

This paper is a continuation of a discussion with Ernan McMullin; its topic is the question how theists (in particular, Christian theists) should think about modern science—the whole range of modern science, including economics, psychology, sociobiology and so on. Should they follow Augustine in thinking that many large scale scientific projects as well as intellectual projects generally are in the service of one or the other of the *civitates*? Or should they follow Duhem, who (at least in the case of physics) held that proper science is independent of metaphysical, theological or (broadly) religious concerns? The focus of the discussion is biology; I support the Augustinian line of thought, while McMullin is more inclined to the Duhemian. I conclude by defending the idea that the epistemic probability of the Grand Evolutionary Scenario on Christian theism together with the empirical evidence is somewhat less than 1/2.

One of the most spectacular intellectual developments of the last 400 years has been the rise of modern science. Science has of course transformed our lives (both for good and ill). It is also, however, an intellectual process and structure boasting magnificent depth, power and beauty—due, in large part, to its cooperative nature, the way in which hundreds of people can work together and take advantage of each other's results. Modern science took root and flourished in the soil of Christian theism, nourished by the Christian belief that both we and the world were created by the same personal, conscious, and intelligent God—a God, furthermore, who created us in his image, thus enabling us to resemble him in the capacity to form true beliefs and acquire knowledge of the world.¹ Nevertheless relations between science and Christian belief have often been a bit strained, most particularly since the development of evolutionary biology beginning in the nineteenth century. And a fundamental question for a Christian theist—in particular, one who takes the Bible as authoritative—is this: how should we think about science generally? If there appears to be a conflict between a Christian belief and some bit of contemporary science, what should we do? Which (if either) should we jettison or modify? More specifically, how should we think about evolutionary biology? Suppose you are a Christian: should that make a difference to how you think about or prac-



tice science in general? That's the broad underlying question; there is also a more specific and perhaps more poignant question, namely, how should a Christian theist think about evolutionary biology?

I addressed this latter question in "When Faith and Reason Clash: Evolution and the Bible" (1991a). Ernan McMullin found himself in considerable disagreement and responded with "Plantinga's Defense of Special Creation" (1991), to which I replied with "Evolution, Neutrality, and Antecedent Probability: A Reply to van Till and McMullin" (1991b);² McMullin's riposte was "Evolution and Special Creation" (1993)³. I note with pleasure the deep underlying agreement between McMullin and myself; nevertheless there remain some points of equally deep difference. These issues are of great importance, both intrinsically and for the intellectual health of the Christian community; I therefore propose to continue the discussion. However I shall forgo line by line self-exculpation in order to look at some of the issues from a perspective untrammelled by the need to prove that wherever McMullin and I disagree, he must of course be wrong. In part I, I shall address some issues revolving around the notion of *Augustinian science*; in part II, I shall briefly address the question of the antecedent and consequent probability of the Grand Evolutionary Scenario, given Christian theism as background belief.

I Augustinian Science

According to St. Augustine, human history is the arena of a great contest, a struggle or conflict between two profoundly opposed forces. Augustine spoke of the City of God and the Earthly City or City of the World: the *Civitas Dei* and the *Civitas Mundi*. In 1991a and elsewhere⁴ I argued that there is indeed such a struggle or competition: as a matter of fact it is a three-way contest between theism, perennial naturalism, and creative anti-realism. I argued that the sciences are by no means wholly neutral with respect to this contest; much of what goes on in them—particularly in the so-called human sciences including economics, psychology, sociology, political science, parts of sociobiology, etc., but also in biology—proceeds from the assumption of a sort of *metaphysical* or religious *naturalism*. (Put simply but vaguely, metaphysical naturalism is the view that nature is all there is: there is no such person as God or anyone at all like him.⁵) But this means that the Christian community can't automatically take the word of the scientific experts; sometimes what the experts say presupposes a philosophical or religious stance quite opposed to that of Christian theism. I therefore suggested the Christian community needs two things here. First, it needs cultural criticism, or perhaps consciousness raising, which is a matter of coming to a clear vision of the ways in which metaphysical naturalism ingresses into science—or at any rate into what is ordinarily *called* science. And second, the Christian community ought to think about the subject matter of the various sciences—again, in particular the human sciences, but also to some degree the so-called natural sciences—from an explicitly theistic or Christian point of view. It should do so, of course, only where that is relevant: only where it looks as if thinking about the matter at hand

from that point of view might lead to conclusions or emphases different from those ordinarily to be found. I suggested calling the result 'Unnatural Science', or 'Creation Science', or 'Theistic Science'. A better name, I think, is "Augustinian Science", which recalls Augustine's suggestion that serious intellectual activity in general is ordinarily in the service of a broadly religious vision of the world.

A. Why do we Need Augustinian Science?

Fundamentally, because much of what goes on in the sciences is quite unsatisfactory, seriously flawed from the perspective of Christian theism. There are many examples, especially from psychology, sociology, sociobiology, political science, and other areas of the human sciences. Here I give one from sociobiology and a couple from evolutionary biology, the area where the disagreement between McMullin and me has been focused.

1. *Simon and Rationality*

According to Herbert Simon,⁶ there is a problem with *altruistic* behavior, the sort characteristic of Mother Teresa, or The Little Sisters of the Poor, or the Jesuit missionaries of the 17th century, or the Methodist missionaries of the 19th. The *rational* way to behave, says Simon, is to act or try to act in such a way as to increase one's personal fitness, i. e., to act so as to increase the probability that one's genes will be widely disseminated in the next and subsequent generations, thus doing well in the evolutionary derby.⁷ Mother Teresa and The Little Sisters, however, show very little interest in the propagation of their genes; this behavior clearly requires explanation; so what is its explanation? Simon proposes two mechanisms: "bounded rationality", and "docility":

Docile persons tend to learn and believe what they perceive others in the society want them to learn and believe. Thus the content of what is learned will not be fully screened for its contribution to personal fitness (p. 1666).

Because of bounded rationality, the docile individual will often be unable to distinguish socially prescribed behavior that contributes to fitness from altruistic behavior. In fact, docility will reduce the inclination to evaluate independently the contributions of behavior to fitness. . . . By virtue of bounded rationality, the docile person cannot acquire the personally advantageous learning that provides the increment, *d*, of fitness without acquiring also the altruistic behaviors that cost the decrement, *c* (p. 1667).

The idea is that a Mother Teresa displays "bounded rationality"; she adopts those culturally transmitted altruistic behaviors without making an independent evaluation of their contribution to her personal fitness. If she *did* make such an independent evaluation (and were clever

enough to do it properly) she would see that this sort of behavior does not contribute to her personal fitness, drop it like a hot potato, and get to work on increasing her fitness (perhaps by sponsoring a contest, among her younger relatives, to see who can have the most children).

But isn't this in clear conflict with Christian teachings about what it is rational for human beings to do? Behaving like Mother Teresa is not at all a manifestation of "bounded rationality"—as if, if she thought about the matter with greater clarity and penetration, she would instead act so as to increase her personal fitness. Behaving as she does is instead a manifestation of a Christ-like spirit; she is reflecting in her limited human way the splendid glory of Christ's sacrificial action in the Atonement. Indeed, is there any sense of 'rational' in which, from a Christian perspective, there is anything at all a human being can do that is *more* rational than what she does?

Of course we might be tempted to claim that Simon's project really isn't science; but can we sensibly make that claim in these post-Kuhnian days? If the scientists call it science and get grants from the National Science Foundation for doing it, if it is published in scientific journals and written in that stiff, impersonal style characteristic of them, can we sensibly claim that it really isn't science? So here we have an example of a scientific project that, from a Christian perspective, is wholly misguided. It is, perhaps, a particularly flagrant example, but there are many others in the same neighborhood.⁸

2. *Randomness and design*

The next examples are taken from evolutionary biology, the specific area under dispute between McMullin and me. One of the most conspicuous examples of serious confusion on the part of some of the experts is the claim that current evolutionary theory demonstrates, or at any rates supports, the claim that human beings are not the product of intelligent design; they have not been designed by God or anyone else. A number of the most prominent writers on evolution unite in declaring that evolutionary biology reveals a substantial element of *randomness* or *chance* in the origin and development of the human species; therefore, human beings (so they claim) have not been designed. Stephen Gould writes: "Before Darwin, we thought that a benevolent God had created us."⁹ Gould's sentiments are expressed less tersely by Douglas Futuyma:

By coupling undirected, purposeless variation to the blind, uncaring process of natural selection Darwin made theological or spiritual explanations of the life processes superfluous. Together with Marx's materialistic theory of history and society and Freud's attribution of human behavior to processes over which we have little control, Darwin's theory of evolution was a crucial plank in the platform of mechanism and materialism—of much of science, in short—that has since been the stage of most Western thought.¹⁰

Clearer yet, perhaps, is George Gaylord Simpson:

Although many details remain to be worked out, it is already evident that all the objective phenomena of the history of life can be explained by purely naturalistic or, in a proper sense of the sometimes abused word, materialistic factors. They are readily explicable on the basis of differential reproduction in populations (the main factor in the modern conception of natural selection) and of the mainly random interplay of the known processes of heredity. . . . Man is the result of a purposeless and natural process that did not have him in mind.¹¹

The same claim is made by Richard Dawkins:

All appearances to the contrary, the only watchmaker in nature is the blind forces of physics, albeit deployed in a very special way. A true watchmaker has foresight: he designs his cogs and springs, and plans their interconnections, with a future purpose in his mind's eye. Natural selection, the blind, unconscious automatic process which Darwin discovered, and which we now know is the explanation for the existence and apparently purposeful form of all life, has no purpose in mind. It has no mind and no mind's eye. It does not plan for the future. It has no vision, no foresight, no sight at all. If it can be said to play the role of watchmaker in nature, it is the blind watchmaker.¹²

These writers, therefore, unite in declaring that modern evolutionary science has given us powerful reason to believe that human beings are, in an important way, merely *accidental*; that there are such creatures as human beings (creatures with the properties human beings display) is fortuitous, a matter of chance. There wasn't any plan, any foresight, any mind, any mind's eye involved in their coming into being or displaying the properties they have.

Now this is initially surprising: how would an empirical science show something like that? Could there be empirical evidence for it? But in fact there is confusion here. Evolutionary science speaks of 'randomness': random genetic mutation, for example. Now these events are 'random' in something like the sense of not arising from the proper function of the organism; more specifically, they are not a result of the organism's functioning in accord with any part of its design plan aimed at promoting or preserving its welfare. Thus Ernst Mayr: "The term, when applied to variation, means that it is not in a response to the needs of the organism". But the conclusion the above writers draw depends upon taking 'random' in a much stronger sense, a sense entailing *not supervised, orchestrated, caused, or planned by God*. As far as I can see, they simply confuse these two senses, leaping lightly from one to the other. This simple confusion, obviously, has enormous capacity for mischief; it can lead the unwary to think science has somehow shown that human beings were not designed by God and that their most crucial and characteristic capacities have arisen, not by way of divine design, but by way of chance or accident.

Someone might reply that the evidence for a theory is in its success, and evolutionary theory, taken with the stronger sense of 'random', is a highly successful theory with much empirical confirmation. By way of response, note that there are two versions of the relevant scientific theory here. The first and stronger version includes the claim that random events in the strong sense (the sense that entails being unplanned by God) play a crucial role in evolution; the second and weaker makes the same claim with respect to random events in the weaker sense of 'random'. Now consider the conjunction of the weak theory with the denial of the strong; and note that this conjunction is supported by the evidence at least as firmly as is the strong theory itself. Hence the evidence supports the strong theory no more firmly than its denial; hence it doesn't give us a reason to believe that theory as opposed to its denial. You might as well argue for theism by conjoining it with, say, relativity theory or quantum mechanics, pointing out that the resulting conjunction is empirically adequate; few, I take it, would regard that as much of a reason for starting to go to church. But the above confusion is no better reason for staying home.

3. *TCA and the genetic code*

One of the elements of the Grand Evolutionary Scenario is TCA, the Theory of Common Ancestry, the thesis that life originated at just one place on earth, all subsequent living creatures being related by descent to that aboriginal form. This is the claim, as Stephen Gould puts it, that there is a "tree of evolutionary descent linking all organisms by ties of genealogy".¹³ According to TCA, you and I are literally cousins of all living things—horses, bats, poison ivy and bacteria—distant cousins, no doubt, but still cousins. It is now rather widely conceded that the fossil record is not at all what one would expect on the conjunction of TCA and any presently known candidate-mechanism for evolution. The record typically displays sudden appearance and subsequent stasis, and few if any intermediate forms between the major taxa. There are no intermediary forms in the fossil record leading up to the first representatives of the phyla; and indeed much the same goes at the level of class. There are few even remotely plausible candidates, in the fossil record, for intermediates between fish and amphibia, amphibia and reptiles, reptiles and birds, reptiles and mammals, and the like.¹⁴

Lately, however, it has become popular to pooh-pooh this kind of consideration, claiming that the really important evidence is to be found at the molecular level. This evidence has come to light only recently, in the enormous explosion of information produced by the biochemistry and molecular biology of the last 30 years or so. In particular, so the claim goes, the conclusive evidence for TCA is the fact that all forms of life from the prokaryotes (bacteria, blue-green algae) on up employ the very same genetic code (the code by which nucleic acid specifies the structures of proteins). Thus Ernst Mayr:

Everything we have learned about the physiology and chemistry of organisms supports Darwin's daring speculation that "all the

organic beings who have ever lived on this earth have descended from some one primordial form, into which life was first breathed" (*Origin of Species*, London, Murray (1964 facsimile edition) p. 484). The discovery that the prokaryotes have the same genetic code as the higher organisms was the most decisive confirmation of Darwin's hypothesis. A historical unity in the entire living world cannot help but have a deep meaning for any thinking person and for his feeling toward fellow organisms.¹⁵

But here there is confusion. Given *naturalism*, this is possibly a just estimate of the probabilities; that is, if we take naturalism as part of our background information, then perhaps it is plausible to take a common genetic code¹⁶ as conclusive evidence for TCA. This is plausible in part just because (a) it is so hard to see how life could have come into existence *at all* just by virtue of the regularities studied in physics and chemistry, and (b) if by some wild chance it did arise more than once, it isn't likely that it would stumble on the same genetic code a second time. Given theism, however, things are very different. For given theism as background information, one possibility is TCA, but another is God's having created some forms of life specially—the original forms, perhaps, or the first representatives of the phyla, or the first representatives of some of the classes, or human beings. Christians can't rule this out merely because some of the experts seem to find the very idea of special divine creation somehow obscene and worthy only of contempt.

The fact—if indeed it is a fact—that all of life displays the same genetic code is very much to be expected on TCA and hence confirms it—confirms it in the sense that it raises its antecedent probability. But of course a common code is perfectly compatible with God's having created some forms of organic life specially; surely nothing would oblige him to use different genetic codes for different kinds of life. If special divine creation is one of the possibilities, therefore, the discovery that all forms of life use the same genetic code couldn't possibly be a "decisive confirmation" of TCA. It raises the antecedent probability of that hypothesis; but it doesn't by itself raise it high enough for decisive confirmation unless it lowers the probability of each of the rival hypotheses (and indeed of their disjunction) to much less than a half. But it doesn't—not, at least, given theism and the possibility that God would create some forms of life specially.¹⁷ We can say, I think, that the common code confirms TCA more than it confirms special creation: that is, it raises the antecedent probability of TCA more than that of special creation (so far as I can see, it doesn't raise the latter at all). But of course that doesn't so much as slyly suggest either that special creation is improbable, given the common code, or that TCA is more probable *all told* (e.g., given the common code and the rest of the empirical evidence) than special creation. Mayr seems to be confusing the probability of TCA on the empirical evidence *plus naturalism* with its probability on the empirical evidence alone.

4. Is TCA "Certain"?

Many of the experts tell us that evolution—TCA, at the least—is *certain*¹⁸

with respect to the empirical evidence, as certain as that the earth revolves around the sun rather than vice versa. But (as I argued in 1991a) this seems to be at best wild exaggeration. There are the problems with the fossil record: the great gaps and the fact that there aren't any documented or uncontroversial examples of macro evolution. There is also Mivart's old objection:¹⁹ as Mivart saw, the mammalian eye (for example) is an extraordinarily complex and functionally integrated structure, its various parts intimately dependent upon each other for their function. He pointed out how difficult it is to envision a series of organic forms leading up to the eye from creatures without eyes, where each step on the path through that space must be both close enough to the preceding step to be plausibly reachable in a single step, and also adaptive or at any rate not unduly maladaptive. (Although this objection was one of the first, it has never really been answered; people have just grown accustomed to living with it.) Indeed, it isn't really known that such a series is so much as biologically possible. There is also Michael Behe's new and vastly more powerful version of Mivart's objection (see below, p. 389).

Here McMullin reminds me that the evidence for TCA is *necessarily* incomplete: ". . . evolutionary explanation is of its nature *historical* and historical explanation is not like explanation in physics or chemistry. It deals with the singular and the unrepeatable; it is thus *necessarily* incomplete" (322). This is true, and important; but of course an hypothesis for which the evidence is *necessarily* weak is still one for which the evidence is weak. It is also part of my point; it is (partly) for this reason that it is absurd to claim that TCA is certain; those strident declarations of certainty must come from some source other than a cool, reasoned, dispassionate look at the evidence. Perhaps these writers have a philosophical or religious ax to grind, or perhaps they confuse TCA's being the best available hypothesis (or the best available hypothesis that conforms to the demands of methodological naturalism) with its being certain; more likely, perhaps they confuse the epistemic probability of TCA on the empirical evidence with its probability on that evidence together with naturalism. Whatever the problem, this assessment of the evidence is again wholly unsatisfactory from the standpoint of Christian theism; it is another reason why Christians must make their own estimates here, rather than blindly following the experts.

There are plenty of other examples from this area. For example, the famous zoologist G. G. Simpson poses the question "What is man?"; he answers, "The point I want to make now is that all attempts to answer that question before 1859 are worthless and that we will be better off if we ignore them completely".²⁰ And of course there are many examples from the social sciences. The great psychologist Jean Piaget asserts that a seven-year-old child whose cognitive faculties are functioning properly will believe that everything in the universe has a purpose in some grand overarching plan or design; a mature person whose faculties are functioning properly, however, will learn to "think scientifically" and realize that everything has either a natural cause or happens by chance.²¹ There is also the assumption, widely current in scientific (sociological, psychological) study of religion, that serious religious belief must be a manifestation of pathology, stu-

pidity, backwardness, or invincible ignorance. And my point is that in these areas the Christian intellectual community has a stake in noting that these claims—that human beings are not designed, that the common genetic code decisively confirms TCA, that TCA is certain, and so on—are not at all established by the empirical evidence. It has a stake in noting the role that naturalism or other broadly religious views play in the acceptance and dissemination of these claims. And it should work at some of these areas—particularly in the human sciences but in evolutionary biology as well—from the perspective of Christian theism. That is, it should pursue these sciences by *starting from* the basic tenets of Christianity, taking them as part of the constant contextual background with respect to which the plausibility and probability of scientific hypotheses and claims are to be evaluated.

B. Objections to Augustinian Science

Now as far as I can see, McMullin agrees that the Christian community should pursue *something* like Augustinian science. He recognizes that there could indeed be conflict between scientific theories and the deliverances of the Christian faith, what Christians learn from the Bible; he thinks that “the context where differences of this kind might properly occur seems restricted to issues concerning human nature”; and he mentions psychological or psychoanalytical theories that deny “human free choice and the consequent moral responsibility for actions performed”. So perhaps McMullin would agree that the Christian community needs Augustinian science in these areas. He is deeply suspicious of this approach, however, in evolutionary biology and allied areas:

It is this casting of special creation and evolution as rivals in the domain of cosmological explanation that I find so troubling. If one assumes that there is a presumption in favor of some sort of special creation at the critical moments in the historical development of life (a presumption whose plausibility wanes in regard to specific transitions as the strength of the evolutionary explanation of those transitions increases) one inevitably transforms the field of prehistory into a battleground where the religious believer is engaged in constant skirmishes with the protagonists of evolutionary-type theories, skirmishes that most often end in forced retreat for the religious believer (313).

Augustinian science, he says,

certainly ensures conflict; it is likely to maximize the strain between faith and reason, as the believer searches for the expected gaps in the scientific account (p. 313).

Here, I think, there is both misapprehension and error.

1. *Faith and Reason.*

First, the failure of communication. McMullin believes that pursuing Augustinian science here “is likely to maximize the strain between faith and reason”. But why so? A strain between faith and reason is a possi-

bility, of course, only for someone (or some community) that accepts the Christian faith, and then only if some deliverance of faith is in tension with some deliverance of reason. So far as I can see, however, the Christian faith doesn't teach us that TCA is false, and reason doesn't teach us that it is true. (Maybe reason plus *naturalism* does, but that is another matter entirely.) The believer needn't be anxious about TCA, or desperately eager to refute it. What is clear, from the point of view of Christian theism, is that the Lord has created the heavens and the earth and all that is in them; there is no particular way of doing so, however, such that it is clear that he did it in that way. It is also not clear that he didn't do so by way of TCA. (Perhaps he did something different and special in creating our first parents; that is quite compatible with their having descended from nonhuman forms of life.) As far as I can see, the proper attitude for Christians to take, towards TCA, is a sort of genial skepticism; *maybe* things happened that way, but then again maybe not. Indeed, as I argued above, it is the *naturalist* who has a real stake here. Evolution is the only answer anyone can think of to what would otherwise be a very embarrassing question; it is this that calls forth all those declarations of certainty.

And hence it is not the case that the believer need spend a lot of time "searching for the expected gaps in the scientific account", frantically looking for holes in the latest evolutionary theories. First, of course, there is no need to go *searching* for those gaps; the absence of transitional forms in the fossil record is one of its salient features. But more important, the believer, so far as I can see, has no particular stake in the outcome here. The Augustinian or theistic scientist has a certain freedom denied her naturalistic compeer: she can follow the evidence where it leads. If it leads towards TCA, no problem; God could surely have done things that way if he wished. If it leads away from it, again, no problem; God could also have done things by way of episodes of special creation, or in still other ways.²² It is the naturalist who has a real stake in evolution, not the theist. My point is only that in deciding on the right epistemic attitude to take to TCA, Darwinism, and the rest, the Christian scientific community should use *all* that it knows, including what it knows by faith. In particular, it should use the idea that it is God who in one way or another has created life, and he certainly could have done so by way of episodes of special creation.

So far as I can see, therefore, Augustinian science doesn't at all "maximize the strain between faith and reason". Indeed, it should do just the reverse. In doing Augustinian science, you start by assuming the deliverances of the faith, employing them along with anything else you know in dealing with a given scientific problem or project. Conflict between faith and reason can certainly occur; but it is less likely to occur, I think, than if the scientific investigation is insulated from the deliverances of the faith and left to develop of its own accord.

2. *Academic Trespass?*

McMullin points out that Augustinian science crosses contemporary academic boundaries; the theologian and scientist may find themselves

at loggerheads, bandying about charges of academic trespass. Given the present organization of the disciplines, this seems correct: Augustinian science, at least at first, will certainly involve people's making pronouncements or claims outside their areas of special competence. This is a real point, and has to be taken with real seriousness; in writing on these areas, I do myself certainly feel acute discomfort at venturing beyond the areas where I might be thought to know something about what I am talking about.

But as things presently stand, this kind of trespass is inevitable, at least if we propose to think about the broader involvements and significance of a theory like the Grand Evolutionary Scenario, or Darwinism, or TCA. We will inevitably stray outside our areas of competence, as Futuyama, Gould and others do in claiming that contemporary evolutionary theory shows that human beings are not designed, or as G. G. Simpson does in declaring that nothing on the nature of man written before 1859 is worth reading. There is no way to address the important questions here without getting outside our areas of competence. The alternative would be not to think about these matters—or if we think about them, not to speak or write about them. That seems to me a counsel that is dangerous as well as unduly diffident. The Christian community needs to know how to think about these matters. We must address them with all the care, insight and depth we can muster. Failing to do so will leave us likely to be misled, likely to think, e.g., that there really is something like a scientific quasi-demonstration that we are not designed by God, but are rather a product of chance or accident. It will leave us easily misled into thinking we really must understand what is most essential about us—love, morality, religion, altruism, art, literature, music, love of adventure, play, humor, intellectual curiosity, capacity for physics, philosophy and evolutionary biology—in broadly Darwinian terms. That way lies intellectual disaster for the Christian community.

And in any event, how can I rationally refrain from using all that I know in assessing the probability of a theory like TCA, in trying to come to the proper doxastic attitude towards it? Is it worthy of belief? of disbelief? Or should we instead be agnostic about it? If the later, how probable is it? Is it much more or much less probable than its denial? Or is it instead approximately in the same neighborhood? In answering these questions, how can I sensibly refrain from using all that I know, including what I know by faith?

3. *Is Augustinian Science 'Science'?*

McMullin displays a certain sympathy with a project somewhere in the neighborhood of Augustinian science; however he doesn't think the result should be called 'science' (or perhaps what he thinks is that the result really *isn't* science, whatever we call it):

I do not think, however, that theistic science [Augustinian science] should be described *as* science. It lacks the universality of science, as that term has been understood in the later Western tradition. It also lacks the sort of warrant that has gradually come to characterize a properly "scientific" knowledge of nature, one that favors systematic observation, generalization,

and the testing of explanatory hypotheses. Theistic science appeals to a specifically Christian belief, one that lays no claim to assent from a Hindu or an agnostic. . . . To use the term *science* in this connection seems dangerously misleading; it encourages expectations that cannot be fulfilled (303).

Now in a way it doesn't matter what we *call* this enterprise that (as McMullin and I agree) ought to be undertaken by the Christian community. And no doubt we would agree further that it is the *scientists* of the Christian community, the practitioners of the disciplines in question, who ought to undertake it. But there is *something* (research grants, for example) in a name, and I thoroughly disagree with McMullin's reasons for denying the name 'science' to this enterprise. He makes two points. First, Augustinian science, he says, lacks the *universality* of what is nowadays called 'science'; it couldn't be practiced by an agnostic or a Hindu. And second, it lacks "the sort of warrant that points to systematic observation, generalization, and the testing of explanatory hypotheses" (303).

But is it really true that what is nowadays called 'science' is universal, in McMullin's sense? Certainly not. Remember Herbert Simon's account of rationality and his treatment of altruism;²³ no Christian theist could either accept that account of rationality or (initially) acquiesce in the conclusion that altruistic behavior is a result of unusual docility and 'limited' rationality.²⁴ Simon's project is surely not universal; it doesn't start from and admit as premises only propositions everyone—Jew, Christian, Hindu or agnostic—already accepts or is prepared to accept. Not by a long shot. Similarly for the claims that a common genetic code is decisive evidence for TCA, for the claim that current evolutionary science supports the conclusion that human beings are not designed by God, for the Piagetian claim that the mature person realizes that everything has either a natural cause or else happens by chance, for the assumption that serious religious belief is pathological or a result of stupidity, unusual backwardness, or social disorder, and the like. All of these claims are assumed or accepted in one scientific project or another—i.e., in one or another project to which the term 'science' is commonly applied; but none of them is universal in McMullin's sense. I conclude that McMullin is mistaken here: the term 'science' is *not* currently used in such a way that it applies only to projects universal in that sense; hence we don't have here an objection to applying the term 'science' to Augustinian science.

As for the second point (that Augustinian science wouldn't involve observation, generalization and the testing of hypotheses characteristic of science) here there is misunderstanding. The way to try to understand, from a theistic perspective, how God created plants and animals and human beings is to take account of all that you know: what you know by faith, what you know as a Christian, as well as what you know in other ways. In the case at hand, the relevant considerations would be what, if anything, Scripture teaches or suggests on the matter, together with the antecedent probability of, e.g., TCA from a theistic perspective, together with the 'empirical evidence': the fossil record, the molecular evidence, homologies, and the like. Clearly this involves precisely the

sort of systematic observation, generalization and testing of explanatory hypotheses that McMullin cites as the hallmark of science. It may involve *more*; but it certainly involves this much. To establish his point, McMullin would have to argue something else: that science (properly so-called) somehow *couldn't* involve those other matters, the looking to see what (if anything) Scripture says on the matter, the consideration of the antecedent probability of a theory on theism and so on. And I haven't the faintest idea how that could be argued. Where is it laid down that anything that does that is not science?

The answer, McMullin thinks, lies in the *methodological naturalism* he thinks essential to natural science: the idea, to put it crudely, that in science we ought not to appeal to what we know about God, or his activity, or to what we know by way of the testimony of Scripture.²⁵ Speaking of methodological naturalism, he writes, "Scientists *have* to proceed in this way; the methodology of natural science gives no purchase on the claim that a particular event or type of event is to be explained by invoking God's 'special' action or calling on the testimony of Scripture" (303). But where does this embargo come from? It is ordinarily supported only by bad arguments of the type "God is not part of the universe; in science we can only refer to parts of the universe; therefore . . . "; or even "To refer to God in science is to treat God as an object, which is idolatry; therefore" Why believe that scientists have to proceed the way McMullin says they have to?

Consider, for example, the question how life originated: theists know that God created it in one way or another, and now the question is: how did he do it? Did he do it by way of the ordinary regularities or laws of physics and chemistry (the ordinary behavior of matter, so far as we understand it) or did he do something special? If, after considerable study, we can't see how it could possibly have happened by way of those regularities—if, as is in fact the case, after many decades of study the enormous complexity and functional connectedness and integrity of even the simplest forms of life make it look increasingly unlikely that they could have originated in that way—the natural thing to think, from the perspective of Christian theism, is that probably God did something different and special here. (Such a conclusion, of course, would not be written in stone. All we can say is that it is likely with respect to our *present* evidence; perhaps things will change; the inquiry is never closed.) And why couldn't one draw this conclusion precisely as a scientist? Where is it written that such a conclusion can't be part of science? Why should we accept methodological naturalism?

4. *Duhemian Science*

Pierre Duhem has an interesting answer²⁶—the best answer I know. Duhem was both a serious Catholic and a serious scientist; he was accused (as he saw it) by Abel Rey²⁷ of allowing his religious and metaphysical views as a Christian to enter his physics in an improper way. Duhem rejected the accusation, claiming that his Christianity didn't enter his physics in an improper way, because it didn't enter his physics in any way at all.²⁸ Furthermore, he thought the *correct* or *proper* way to

pursue physical theory was the way in which he claimed to have done it; physical theory should be completely independent of religious or metaphysical views or commitments. Why so? Fundamentally, he says,²⁹ because otherwise the disagreements that run riot in metaphysics will ingress into physics, so that the latter cannot be an activity we can all work at *together*, regardless of our metaphysical views:

Now to make physical theories depend on metaphysics is surely not the way to let them enjoy the privilege of universal consent. . . . If theoretical physics is subordinated to metaphysics, the divisions separating the diverse metaphysical systems will extend into the domain of physics. A physical theory reputed to be satisfactory by the sectarians of one metaphysical school will be rejected by the partisans of another school.

The point he makes is that if a physical theorist employs metaphysical assumptions that are not accepted by other workers in the field, and employs them in such a way that those who don't accept them can't accept his physical theory, then to that extent his work cannot be accepted by those others; and to that extent the cooperation important to science will be compromised. He therefore proposes a conception of science (of physics in particular) according to which the latter is independent of metaphysics:

. . . I have denied metaphysical doctrines the right to testify for or against any physical theory. . . . Whatever I have said of the method by which physics proceeds, or the nature and scope that we must attribute to the theories it constructs, does not in any way prejudice either the metaphysical doctrines or religious beliefs of anyone who accepts my words. The believer and the nonbeliever may both work in common accord for the progress of physical science such as I have tried to define it (p. 274-75).

So here we have another argument against Augustinian science and for methodological naturalism, an argument with an appealing simplicity: it is important that we all—Christian, naturalist, agnostic, whoever—be able to work at physics and the other sciences together and cooperatively; therefore we shouldn't employ, in science, views, commitments and assumptions only some of us accept. But then we can't employ (in that way) such ideas as that the world and the things therein have been designed and created by God; that is a commitment only some of us accept. Proper science, insofar as it is to be common to all of us, will have to eschew any dependence upon metaphysical and religious views held by only some of us; therefore we should endorse methodological naturalism. We do not, of course, have to be *metaphysical* naturalists in order to pursue Duhemian science; but if science is to be properly universal, it can't employ assumptions or commitments that are not universally shared.

This argument is pragmatic, not principial: it is a good thing to do science together; we should therefore maximize the possibility of coopera-

tion and cooperative inquiry wherever possible; therefore we should not employ, in science, theories or assumptions essentially involving beliefs that are not common to us all. Duhemian science, you might say, would be *public* science; it would be maximally inclusive and wholly neutral with respect to the world-view differences that separate us. And of course there are vast stretches of our cognitive economy where these world-view considerations do indeed seem to be quite irrelevant. Anyone with decent eyesight will see that the pointer points to 7; metaphysics and theology have nothing to do with it. The same will hold for a measurement of the distance from Earth to Jupiter. Anybody (with the possible exception of a few paralogicians from Australia) will see that a contradiction can't be true; again, it doesn't matter whether you are theist, naturalist, anti-realist or whatever. The same will go for a deduction of Cantor's Theorem from the axioms of ordinary set theory. (Of course disagreement may break out about those axioms.)

Duhemian science, obviously enough, would involve methodological naturalism: no hypotheses involving God, or sin, or what one knows by special revelation will enter essentially into the constitution of such science. But here is the crucially important point: from the Duhemian point of view, methodological naturalism will be just one small part of a much more inclusive constraint. Science, so conceived, will not employ hypotheses about *God*, but it also won't employ any hypotheses whose cogency involves or presupposes metaphysical naturalism. Nor will it employ assumptions like those that seem to underlie much cognitive science. It couldn't, for example, properly assume that mind-body dualism is false, or that human beings are material objects, these being metaphysical assumptions that divide us. Nor could it employ the deterministic assumptions that seem to underlie much social science; these beliefs also relevantly divide us. Further, many assumptions about what constitutes proper function on the part of human beings and their faculties would have to be proscribed: for example, Simonian assumptions about what is and isn't rational, Piagetian claims about what a mature (and properly functioning) adult will believe, as well as the assumption that serious religious belief must be explained as a manifestation of pathology, stupidity or invincible ignorance. Further, Duhemian science would proscribe the idea that the Theory of Common Ancestry is certain, as well as the idea that the randomness or chance involved in genetic variation is such as to preclude human beings' having been designed—by God or anyone else. It is important to see how *much* of what goes on under the title of science is not Duhemian.

Duhemian science has much to be said for it and should surely be encouraged. But what about those who, like Simon, for example, think it is important also to do a sort of human science which starts, not merely from *methodological* naturalism, but from *metaphysical* naturalism? And what about those who, like Duhem's atomists, Cartesians and Aristotelians, think it is important to pursue a sort of science in which the aim is successful explanation in terms of underlying unobservable realities? And what about Christians or theists, who propose to investigate human reality employing all that they know, including what they

know as Christians or theists? So far as Duhem's claims go, there is nothing in the least improper about any of this. Should we call this kind of activity 'science'; does it deserve that honorific term? There is no reason in Duhem for a negative answer. It is important, to be sure, to see that science of this sort isn't *Duhemian* science and doesn't have the claim to universal assent enjoyed by the latter; but of course that is nothing against it. According to the fuller Duhemian picture, then, we would all work together on Duhemian science; but each of the groups involved—naturalists and theists, for example, but perhaps others as well—could then go on to incorporate Duhemian science into a fuller context that includes the metaphysical or religious principles specific to that group. The motivation for doing so, naturally enough, will vary from area to area. Physics, and chemistry are overwhelmingly Duhemian (of course the same isn't true for *philosophy* of physics); here perhaps Augustinian science would be for the most part otiose. Something similar goes for biological sciences: surely much that goes on there could be thought of as Duhemian science, although that area also contains the non-Duhemian elements we have already noted. In the human sciences, however, vast stretches are clearly non-Duhemian; it is in these areas that Augustinian science would be most relevant and important.

So return to the current question: should the Christian scientific community observe the constraints of methodological naturalism? So far as this argument is concerned, the answer seems to be: yes, of course, in those areas where Duhemian science is possible and valuable. But nothing here suggests that the Christian scientific community should not *also* pursue non-Duhemian Augustinian science where *that* is relevant. There is nothing here to suggest that if it ain't Duhemian, it ain't science.

II Probabilities: Antecedent and Consequent

A. God: Classicist or Romantic?

The antecedent probability of a thesis or hypothesis, for you, is its epistemic probability³⁰ on your background information, prior to or independent of consideration of the particular evidence at hand. I argued that the antecedent probability of evolution with respect to naturalism is very different from its antecedent probability with respect to Christian theism; in fact, I said, the antecedent probability of TCA, for the Christian theist, is less than that of its denial. Here McMullin digs in his heels; here, he says, is where he and I "really part ways".

In order to address this issue properly, we need a couple of distinctions. First, suppose we use the phrase 'The Grand Evolutionary Scenario' (GES) to denote the conjunction of four theses: (a) the 'Naturalistic Origins Thesis' according to which life arose from non life just by way of the regularities of physics and chemistry, (b) the 'Progress Thesis', according to which life has progressed from relatively simple unicellular forms³¹ to relatively complex forms, culminating, as we human beings like to think, in us, (c) TCA, according to which life originated at one place on earth, all subsequent living creatures being related by descent to those aboriginal

creatures, and (d) Darwinism, the claim that these enormous changes occurred by way of the accretion of many small steps and that the mechanisms driving the enormous changes occurring since the origin of life are broadly Darwinian (for starters, natural selection working on some source of variation such as random genetic mutation).

Now the epistemic probability of a theory such as GES or TCA is of course relative to a body of background belief or knowledge. I argued that the antecedent probability of GES on naturalism is high. For the naturalist, evolution is the only game in town, the only answer anyone can think of to the questions, Where did this teeming variety of flora and fauna come from? How did it get here? And what accounts for that appearance of design it displays? The theist has an easy answer: in one way or another, the Lord created all these creatures (why else are they called 'creatures'?). But that answer is not available to the naturalist; it is GES that gives an answer to this otherwise embarrassing question. Hence Richard Dawkins' remark to A. J. Ayer at one of those elegantly candle-lit and splendidly bibulous Oxford college dinners: he said he couldn't imagine being an atheist before 1859 (the year Darwin's *Origin of Species* was published); "although atheism might have been logically tenable before Darwin", said he, "Darwin made it possible to be an intellectually fulfilled atheist".³² I doubt that it is possible to be an intellectually fulfilled atheist, but Dawkins' essential point is right: GES is a reasonably plausible answer to the above question, and the only reasonably plausible answer anyone can think of. For the serious naturalist, therefore, evolution is an absolutely essential plank in his platform; and hence the antecedent probability of evolution, given philosophical naturalism, is high. It is this, I take it, that is in part responsible for those triumphal cries of certainty (above, pp. 0000).

Then I went on to argue that (because of the improbability of the Naturalistic Origins Thesis) the probability of GES with respect to Christian theism and the empirical evidence is very low, and the probability of TCA with respect to that same body is perhaps somewhat less than that of its denial, i.e., less than 1/2. I argued this by claiming first that the antecedent probability (its probability independent of the empirical evidence) of TCA is perhaps (judgments of this kind are of course necessarily infirm) less than 1/2; I then went on to say that when we add the empirical evidence, things don't change; on theism and the empirical evidence, TCA is still somewhat less probable than its denial.

Now why should we think the antecedent probability of TCA on Christian theism is less than 1/2? First, according to Christian theism, God is constantly at work in his universe. He is in constant, close, intimate causal contact with his creation, supporting and upholding it in being: were it not for this constant upholding activity, the cosmos would disappear like a candle flame in a high wind. Second, most Christians hold that God has frequently treated the things he has made in unusual and special ways: water turns into wine, human beings emerge unharmed from a fiery furnace and are miraculously cured of disease; and above all, there is the wondrous splendor of the life, death and resurrection of Jesus Christ. Apparently, therefore, God is not averse to working in his creation

in special ways. But then, so I said, there is no particular antecedent probability in favor of the idea that he wouldn't do anything different or special in the creation of life, say, or in the creation of special kinds of life. So it is hard to see how there is any antecedent probability in favor of GES, and hard to see that there is any antecedent probability in favor of TCA. Indeed, if God acts specially over *one* large and important range of his interaction with his creatures, isn't it a bit more probable than not that he would act specially over *other* large and important ranges?

So I'm inclined to think the antecedent probability of TCA with respect to Christian theism is a bit less than 1/2. But we still have to factor in what we know about the origin of life; and with respect to Christian theism and the present evidence, the Naturalistic Origins Thesis seems extremely improbable. As modern biochemistry reveals, the simplest forms of life display an astonishing, stunning complexity, a complicated interrelatedness and functional integrity that boggles the mind. According to Francis Crick, life must be regarded as the next thing to a miracle; according to Harold P. Kein of Santa Clara University, chairman of a National Academy of Sciences committee that recently reviewed origin-of-life research, "The simplest bacterium is so damn complicated from the point of view of a chemist that it is almost impossible to imagine how it happened."³³ It therefore looks as if God did something different and special in the creation of life.³⁴ (Of course things may change; that is how things look *now*.) These things taken together suggest that the Lord might very well have done something different and special, not only in creating life in the first instance, but also in creating certain subsequent forms of life. If he did something special in creating life, what would prevent him from doing something special at other points in his great creation drama, perhaps creating specially the original representatives of some of the phyla, or human beings, or still other forms of life? It would seem entirely in character. I am therefore inclined to maintain my suggestion that the antecedent probability of TCA, from a theistic point of view, is perhaps a bit less than 1/2.

Now McMullin is especially inclined to dispute my claims about the antecedent probability of TCA. He makes initial heavy weather over the very asking of the question what God is likely to do; if I understand him, however, he goes on to claim that in fact it is unlikely, indeed *very* unlikely, that God would do something special and different, or create something specially in bringing it about that there are human beings, or certain kinds of plants and animals, or even, presumably, life itself: To carry the argument a stage further: what would the eloquent texts of *Genesis*, *Job*, *Isaiah* and the *Psalms*, lead one to expect? What have theologians made of these texts? This is obviously a theme that far transcends the compass of an essay such as this one. I can make a couple of simple points. The Creator whose powers are gradually revealed in these texts is omnipotent and all-wise, far beyond the reach of human reckoning. His Providence extends to all His creatures; they are all part of His single plan, only a fragment of which we know, and that darkly. Would such a Being be likely to "intervene" in the cosmic process, that is, deal in two different manners with it? (Let me emphasize that I am uncomfortable

with this language of “likelihood” in regard to God’s actions, as though we were somehow capable of catching the Creator of the galactic universe in the nets of our calculations.) Why should an omnipotent God not create a universe in which God’s ends with regard to all creatures except humans would be achieved in a *natural* way? If one may use the language of antecedent probability at all here—and I am not at all certain that one may—it surely must point away from special creation.³⁵

A couple of comments on this passage: first, the issue is not, of course, whether there is some way to *calculate* the probability that God would do this or that; at best, on a topic like that, we have little more than crude guesses. And I applaud McMullin’s implicit suggestion that any ideas we might have about the antecedent likelihood of God’s doing this or that should be at best tentative. I think it a bit more probable that God would do something different and special in the creation of life, and human beings, and perhaps some other forms of life; but any such views, surely, should be tentative and held with appropriate diffidence. It certainly befits no one to be at all cocksure here.

This said, however, I fail to see any force in the considerations McMullin puts forward. God is indeed omnipotent and all-wise; his providence does indeed extend to all creatures; and indeed we know but a fragment of his total plan. These things are true; but how do they bear on the question whether God would or would not, for example, create in stages: first creating inanimate material, say, then later doing something special in creating life, perhaps, and then still later in creating human life? (It is part of the major theistic religions to think that God has created humankind *in his own image*; might he not have thought it appropriate to create human life in a special way, by way of an act of special creation?) We know, after all, that God is not averse to acting in special ways, as the many miracles recorded in the Bible attest.

McMullin seems to think of God as like a classical artist, devoted to ideals of simplicity, and elegance, economy and restraint. But why think of Him like *that*? Perhaps God is more like a romantic artist with limitless resources, extravagant, prolific, fecund, overflowing with uproarious creative activity, disdaining restraint and economy of action. (The millions of species that have become extinct would be examples of this exuberant fertility.) After all, what are the attractions of economy for Him? Creatures limited in energy, power and time have need for economy; God suffers from no such limitations. Is it instead the idea that God’s interest in economy of effort is a matter of aesthetic preference? But is there even the slightest reason to think so? The Lord constantly acts in his creation; apart from his upholding activity, it would disappear like a puff of smoke; why would he think it beneath his dignity, or aesthetically unpleasant, or otherwise disagreeable to take a hand in his creation in other ways? Perhaps he is very much a hands-on God. Perhaps he marks various important transitions and junctures in the history of his creation by special celebratory or ceremonial activity of some sort. Perhaps an example of this sort of activity is his creating certain kinds of life specially, thus symbolically marking the importance of the transition. “Are not sparrows two for a penny? Yet without your

Father's leave," says Jesus, "not one of them can fall to the ground." If the Lord's creation scheme is such that his leave is needed for a sparrow to fall, might he not have created various forms of life—perhaps even sparrows—specially? Why not?

So my claim is that the antecedent probability of episodes of special creation with respect to Christian theism but prior to the empirical evidence—i.e., the evidence bearing on TCA—is a bit greater than 1/2. McMullin, by contrast, insists that salvation history tells us nothing about natural history. What God does with respect to salvation gives us no probabilities with respect to special creation:

The story of salvation is a story about men and women, about the burden of being human. . . . The biblical account of God's dealing with humankind provides no warrant whatever for supposing that God would have brought the ancestors of the various kinds of plants and animals to be outside the ordinary order of nature (p. 324).

The reason seems to be that the story of salvation is "about free beings who sinned and who therefore *needed* God's intervention. Dealing with the human predicament 'naturally' so to speak would not have been sufficient" (p. 324). Here McMullin suggests that God would perhaps have *preferred* to deal with the human predicament without doing something unusual, but that wasn't possible; he therefore had to act specially. Since he wasn't thus constrained when it came to creation, however, his acting specially in salvation history doesn't make it any more probable that he would do so in creation.

But how do we know that God was somehow *obliged* to act specially in salvation history? This seems to be a new theological idea; like most original theological ideas, it warrants suspicion. What is our source of information as to God's constraints here? In any event, he certainly wasn't obliged to act specially so *often* in salvation history. According to Catholic doctrine, a miracle occurs whenever the mass is properly celebrated; on nearly all Christian views, God regularly guides and directs his people individually and his church collectively by virtue of the work of the Holy Spirit in the believer's heart;³⁶ each of these acts is special in the relevant sense. And so far as the "ordinary order of nature" is concerned, on the views both of John Calvin and Pope Pius XII (and in the face of fire power like that, who am I to demur?), God creates specially a new human soul or person whenever a human being comes into existence. If so, the order of nature regularly and ordinarily involves very many acts of special divine creation; at present the rate would be about 3 such acts per second. Some Christians might reject Pius' and Calvin's claim, but presumably not on the grounds that God has an aversion to acts of special creation.

Of course these are deep and difficult waters. I am inclined to think the antecedent probabilities slightly favor episodes of special creation; but I can certainly see the attractions of agnosticism here. Perhaps the most reasonable attitude is one of agnosticism: one just doesn't know what these antecedent probabilities are. What seems to me *unreason-*

able, however, is to be confident that antecedent probability favors TCA or GES. And if I am right, then we must rely most heavily, here, on the empirical evidence.³⁷

B. The Empirical Evidence

Turning briefly and finally to that empirical evidence, there are a couple of points that need to be made. (I must caution you that neither McMullin nor I can claim any expertise with respect to the empirical evidence; all we know is what we read in the papers. Think of each of the following sentences as prefaced by "I'm no expert, but . . .") McMullin writes as if the theistic skeptic with respect to evolution is fighting a sort of desperate rearguard action, with a succession of new and powerful pieces of evidence ever compelling further retreat, as one major gap after another is closed, one major transition after another definitively nailed down. And it isn't only McMullin who thinks this; there is a sort of widespread impression, a kind of widely shared but uncritical assumption, among academics who view the subject from a certain distance, that these major gaps and transitions are in fact steadily closing, or at least narrowing.

But where *are* all these gaps being closed by further discoveries? They are not easy to find. As McMullin points out, the fossil record contains many sequences of extinct forms (e.g., trilobites) "where the development of specific anatomical features can be traced in detail through the rock layers" (315). This is indeed so, but does not bear on the main problems for TCA with the fossil record, which have to do with the lack, in that record, of sequences of intermediary forms between the really major taxa—phyla and classes, for example.³⁸ "As new fossil evidence is uncovered," he says, (315) "paleontologists continue to uncover stage after stage in crucial linking: forms such as the therapsids, for example, the forms that related reptiles with the earliest mammals." This is misleading exaggeration. It suggests that paleontologists have discovered and continue to discover many forms that link, say, fish with amphibia, amphibia with reptiles, reptiles with birds, or reptiles with mammals. But so far as I know, this is not so. So far as I know, therapsids are the only candidates for a link between reptiles and mammals (and they have been known for a long time). Although there is some controversy about the therapsids, perhaps they really could be thought of as something like a linking forms between reptiles and mammals,³⁹ but if TCA were true, one would expect vastly many more such forms. Furthermore, Archaeopteryx, known since shortly after Darwin's death and formerly the only serious candidate for a similar post linking reptiles and birds, has according to some been demoted by the discovery of modern birds antedating it. And things stand no better with respect to those other major gaps.

In fact it looks as if the shoe is on the other foot. "When I think of the eye," Darwin said, "I shudder". He was thinking of the enormous complexity of the eye, and the strain involved in believing that an instrument of that delicate interrelatedness and functional integrity could have evolved by anything like the mechanisms he suggested. Perhaps

he was also thinking of Mivart's specific objections (above, pp. 375). But Darwin had no idea at all of the true complexity of the visual system;⁴⁰ if he shuddered at what he knew then, he would have quaked uncontrollably had he known what we know now.

Secondly, Mivart's worry returns in spades when we think of "irreducible complexity". According to Michael Behe,⁴¹ the cilium (used by many kinds of cells for swimming) is composed of some six molecules. All six are required for the cilium's function; if any is absent, no ciliary function is possible. Cilia, says Behe, are "irreducibly complex"; in that we can't envision any simpler forms that will carry out the cilium's function. In the case of Mivart's eye, we can certainly envision *some* intermediate forms; the problem is that it is hard to see how there could be the required complete series. (There is also the fact that it isn't really known that such a series is even biologically possible.) With the cilium, however, we can't envisage any members of a series of functional precursors at all. Still further, says Behe, this example of irreducible complexity is only one of several; there is also, for example, the system that targets proteins for delivery to subcellular compartments, as well as aspects of blood clotting, closed circular DNA, electron transport, the bacterial flagellum, telomeres, photosynthesis, and still other structures.

Thirdly, in Darwin's day it was possible to attribute the failure to find intermediate forms between the major taxa to the fact that the fossil record was largely unexplored. Since Darwin's day, however, the number of fossils discovered and catalogued has increased a hundredfold; it is no longer possible (or at any rate plausible) to make that excuse, and the gaps are at least as great as ever. Lots of series with some modification have been found, as with trilobites; the great gaps, however, remain.

Fourth, there is the gap between life and nonlife; as we have seen, this gap has greatly widened since Darwin's day.

Fifth, there is the Cambrian explosion. The fossil record displays unicellular life going all the way back, so they tell us, to 3 or 3.5 billion years ago—only a billion years or so after the formation of the earth itself and much less than a billion years after the earth cooled sufficiently to permit life. There is no fossil record of skeletal animals until about 530 million years ago, 2.5 or 3 billion years after the appearance of unicellular life. Then there is a veritable explosion of invertebrate life, a riot of shapes and anatomical designs, with ancestors of the major contemporary forms and all the marine invertebrate phyla represented, together with a lot of forms wholly alien in the contemporary context.⁴² None of this was known in Darwin's day, and would surely have given him pause. And now in a recent issue of *Science* we learn that the time during which this explosion took place was much shorter than previously thought; it all happened during a period of no more than 5 or 10 million years,⁴³ a period that seems much too short to accommodate such furious evolutionary creativity, at least with respect to any known mechanisms.⁴⁴ On balance, it is likely that if Darwin knew what we now know about the complexity of such organs as the mammalian eye and the human brain, the enormous intricacy revealed by biochemistry and molecular biology (including the astonishing complexity of the simplest

forms of life), the Cambrian explosion, the lack of closure in the fossil record, and so on, he would have been neither a Darwinian nor a devotee of TCA.

For a Christian, therefore, one who is not shackled by the demands of naturalism, the right attitude towards TCA is one of a certain cordial skepticism. TCA is a very pretty theory with many of the so-called theoretical virtues; it has been a fine source of research projects; incorporated into God's great drama of creation and Incarnation as in McMullin's concluding peroration, it is attractive. It doesn't follow, however, that it is true, nor even that it is more likely than not.⁴⁵

University of Notre Dame, Notre Dame, IN

NOTES

1. In my view, it can't sensibly flourish in any other sort of context: see chapter 12 of my book *Warrant and Proper Function* (New York: Oxford University Press, 1993).
2. All three of these, together with Pattle Pun's "Response to Professor Plantinga" and van Till's "When Faith and Reason Cooperate" are to be found in *Christian Scholar's Review*, vol. xxi, Sept. 1991.
3. *Zygon*, vol. 28, Num. 3 (Sept. 1993), pp. 299 ff. I proposed to publish a version of this paper in *Zygon*, but it was deemed unacceptable, perhaps because of ideological impurity.
4. E.g., in "Augustinian Christian Philosophy" *The Monist*, vol. 75, No. 3, 1992, and "On Christian Scholarship" in *The Challenge and Promise of a Catholic University*, ed. Theodore Hesburgh (Notre Dame: University of Notre Dame Press, 1994).
5. For difficulties in characterizing naturalism, see Bastiaan van Fraassen's "Science, Materialism and False Consciousness", in *Warrant in Contemporary Epistemology: Essays in Honor of Plantinga's Theory of Knowledge*, ed. Jonathan Kvanvig (New York: Rowman & Littlefield, 1996).
6. "A Mechanism for Social Selection and Successful Altruism", *Science* vol. 250 (December, 1990) pp. 1665 ff. Simon won a Nobel Prize in economics, but also works in computer studies and psychology; he is currently professor of computer studies and psychology in the Department of Psychology at Carnegie-Mellon.
7. More simply, says Simon, "Fitness simply means expected number of progeny" (p. 1665). *Why* he thinks this is the rational way to behave he doesn't explain; and could it really be part of science to make a normative claim of that sort? Simon apparently thinks it is simply given in our evolutionary origin that this way of behaving is the rational way. But couldn't I sensibly say that while my having lots of progeny might be best for my genes, I'm interested in *my* welfare, not theirs?
8. See below, pp. 375ff.
9. "So Cleverly Kind an Animal" in *Ever Since Darwin* (New York: Norton, 1977) p. 267.
10. *Evolutionary Biology*, 2nd edition (Sunderland, Mass: Sinauer Associates, 1986) p. 3.
11. George Gaylord Simpson, *The Meaning of Evolution* rev. ed. (New Haven: Yale University Press, 1967) pp. 344-45.

12. *The Blind Watchmaker* (London and New York: W. W. Norton & Co., 1986) p. 5. This claim is repeated by Daniel Dennett in *Darwin's Dangerous Idea* (New York: Simon & Schuster, 1995).

13. "Evolution as Fact and Theory" in *Hen's Teeth and Horse's Toes* (New York: Norton, 1983).

14. As George Gaylord Simpson puts it: "In spite of these examples [splitting and gradual divergence in a few genera, subfamilies and families] it remains true, as every paleontologist knows, that most new species, genera, and families, and that nearly all new categories above the level of families, appear in the record suddenly and are not led up to by known, gradual, completely continuous transitional sequences." *The Major Features of Evolution* (New York: Simon and Schuster, 1953), p. 360. More recently, Stephen Gould writes that "The extreme rarity of transitional forms in the fossil record," he says, "persists as the trade secret of paleontology. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of their branches; the rest is inference, however reasonable, not the evidence of fossils." *The Panda's Thumb* (New York: 1980), p.181.

15. *One Long Argument* (Cambridge, Mass: Harvard Univ. Press, 1991), p. 163.

16. If indeed all of life *does* use the same genetic code. Recent work has suggested not: see, e.g., "Recent evidence for evolution of the genetic code" by S. Osawa, T. H. Jukes, K. Watanabe, and A. Muto in *Microbiological Reviews*, 56: 229-264.

17. For discussion of the *probability* of this possibility, see part II. McMullin seems to me to mistake the logic of the situation here: I wrote "As for the similarity in the biochemistry of all life, this is reasonably probable on the hypothesis of special creation" (1991a, p. 23). McMullin replies: "But why *should* this be probable on the hypothesis of special creation? Would *this* hypothesis have been able to predict in advance that such biochemical similarities would be found?" (p. 318) But the point is that biochemical similarity is a powerful (Mayr's "decisive") confirmation of TCA only if it is extremely improbable on the rival hypotheses—which it isn't.

18. Evolution, says Francisco J. Ayala, is as certain as "the roundness of the earth, the motions of the planets, and the molecular constitution of matter." "The Theory of Evolution: Recent Successes and Challenges", in *Evolution and Creation*, ed. Ernan McMullin (Notre Dame: University of Notre Dame Press, 1985), p. 60. According to Stephen J. Gould, evolution is an established fact, not a mere theory; and no sensible person who was acquainted with the evidence could demur. "Evolution as Fact and Theory" in *Hen's Teeth and Horse's Toes*, pp. 254-55. According to Richard Dawkins, the theory of evolution is as certainly true as that the earth goes around the sun. (In a recent review in the *New York Times* he adds that "It is absolutely safe to say that if you meet someone who claims not to believe in evolution, that person is ignorant, stupid or insane (or wicked, but I'd rather not consider that".) Daniel Dennett cheerfully volunteers that failure to believe in evolution is a manifestation of inexcusable ignorance" (*Darwin's Dangerous Idea*, p. chapter 2)). This astronomical comparison apparently suggests itself to many; in "Evolutionary Biology and the Study of Human Nature" (presented at a consultation on Cosmology and Theology sponsored by the Presbyterian (USA) Church in Dec., 1987) Philip Spieth claims that "A century and a quarter after the publication of *The Origin of Species*, biologists can say with confidence that universal genealogical relatedness is a conclusion of science that is as firmly established as the revolution of the earth about the sun"; and according to Ernst Mayr "It (evolution) is as much of a fact as

the observation that the earth revolves around the sun rather than the reverse". Michael Ruse adds (with characteristically restrained enthusiasm, that "Evolution is Fact, Fact, **Fact!**").

19. In *On the Genesis of Species*, (New York: D. Appleton and Co., 1871).

20. Quoted in Richard Dawkins, *The Selfish Gene* (Oxford: Oxford University Press, 1976) p. 1. Speaking of Dawkins, he provides another example, this one perhaps resulting less from philosophical confusion than from eagerness to establish a point. In *The Blind Watchmaker* (pp. 81 ff.) he states Mivart's objection as "what good is 5% of an eye?" His answer, in essence, is to confuse 5% of an eye with 5% vision. But of course Mivart's point is that not just any 5% of an eye will lead to 5% vision, or indeed any vision at all.

21. *The Child's Conception of Physical Causality* (London: Kegan Paul, 1930).

22. For example, he could have done it by way of something like Augustine's 'seeds'; see McMullin p. 311).

23. Above, pp. 370ff.

24. 'Initially': that conclusion is antecedently unlikely from the standpoint of Christian theism. But of course it is conceivable that it is nonetheless true. To test it, we would presumably have to administer altruism, docility, and intelligence tests to a properly chosen sample of the population, to see whether altruism really is accompanied by increased docility and lessened intelligence—carefully avoiding, of course, the tendency on the part of many social scientists to take serious religious belief and accompanying altruism as a *criterion* of low intelligence.

25. See my "Methodological Naturalism?" in *Facets of Faith and Science*, ed. J. van der Meer (Lanham, MA: University Press of America) 1995.

26. In *The Aim and Structure of Physical Theory*. Trans. Philip P. Wiener, foreword by Prince Louis de Broglie (Princeton: Princeton University Press, 1954). The book was first published in 1906.

27. "La Philosophie scientifique de M. Duhem" *Revue de Métaphysique et de Morale*, XII (July, 1904), 699 ff.

28. See the appendix to *The Aim and Structure of Physical Theory*, which is entitled "Physics of a Believer" and is a reprint of Duhem's reply to Rey; it was originally published in the *Annales de Philosophie chrétienne* Vol. I (Oct. and Nov.) 1905, pp. 44 ff. and 133 ff.

29. My reading of Duhem here is not wholly uncontroversial, and not the only sensible reading; my aim, however, is not so much to determine just what Duhem had in mind as to consider the argument his text suggests.

30. For an account of epistemic probability (more specifically, conditional epistemic probability) see my *Warrant and Proper Function* (Oxford: Oxford University Press, 1993) chap. 9.

31. *Relatively* simple: in fact even prokaryotes (bacteria, e.g.) are immensely complex.

32. Richard Dawkins, *The Blind Watchmaker* (London and New York: W W. Norton & Co., 1986), pp. 6-7.

33. *Scientific American*, Feb., 1991, p. 120. See also *The Mystery of Life's Origin*, by Charles Thaxton, Walter Bradley and Roger Olsen; *Origins*, by Robert Shapiro; *Evolution, Thermodynamics, and Information: Extending the Darwinian Program*, by Jeffrey S. Wicken; *Seven Clues to the Origin of Life and Genetic Takeover and the Mineral Origins of Life*, by A. G. Cairns-Smith; and *Origins of Life*, by Freeman Dyson; and see also the relevant chapters of Michael Denton, *Evolution: A Theory in Crisis*. The authors of the first book believe that God created life specially; the authors of the others do not.

34. McMullin comments: "Crick, who is notably unsympathetic to theistic belief, would surely not agree with the inference being drawn from this!" (314). But of course we are here inquiring into the likelihood of God's creating life specially *given theistic belief*, not into its likelihood given Crick's naturalism. With respect to the latter, its probability is presumably zero; but nothing at all follows about its probability with respect to the former.

35. pp. 324-25. McMullin's word 'intervene' isn't a good one in the theistic context; God constantly supports every created thing in existence by way of activity without which the creature would disappear like your breath on a frosty morning; furthermore, according to the bulk of the theistic community, no creaturely action is so much as possible without his further concurrent activity. So he necessarily and constantly takes a hand in the operation of his creation; he necessarily and constantly "intervenes" in his creation; were he to leave it to its own devices, even for an instant, it would vanish like a dream upon awakening. Creating something new—life, for example, or human life—isn't really in any sensible sense an 'intervention' for him.

36. In fact, of course, the Holy Spirit does much more than guide and direct; for a genuinely powerful account, see Jonathan Edwards' *Religious Affections* (Boston, 1746).

37. I said that the antecedent probability of TCA just on Christian theism is a bit less than 1/2, and that when we factor in the evidence having to do with the origin of life, the antecedent probability of TCA remains less than 1/2; I added that we should rely more heavily, here, on the empirical evidence than on estimates of antecedent probability, which are bound to be a bit shaky. McMullin makes heavy weather over this; suggesting that "Plantinga appears to have changed ground somewhat . . . now the warrant for claiming the antecedent likelihood of special creation appears to shift from the salvation story to the 'empirical evidence'" (313). He adds that the antecedent probability is "no longer strictly antecedent" (314), notes that I say "that actual empirical evidence must be allowed to speak more loudly than speculative theological assumptions" and comments "So much for his original claim that the story of God's dealings with Israel spoke loudly in favor of special creation over TCA!"

But here McMullin has uncharacteristically erred. First, the antecedent probability of a hypothesis is its probability with respect to some body of belief antecedent to the evidence under current consideration, whatever that is. My claim in 1991a was that, given Christian theism and what most Christians believe, but antecedent to *any* of the empirical evidence bearing on GES, the probability of TCA is perhaps a bit less than 1/2. My claim in 1991b is that the probability of TCA on Christian theism *together with the empirical evidence bearing on the origin of life* is also a bit less than 1/2—and maybe also a bit less than the first probability. There is of course no inconsistency or tension here, or any shifting of ground. Furthermore it is inaccurate to say, as McMullin does, that I originally claimed that the story of God's dealings with Israel "spoke loudly in favor of special creation over TCA!" (314) What I said was that "it is a bit more probable, before we look at the scientific evidence, that the Lord created life and some of its forms—in particular, human life—specially" (22). "A bit more probable," I said; nothing here about the story of God's dealings with Israel speaking *loudly* in favor of TCA. And in fact I think they speak *softly* here; the empirical evidence has much more weight and should be allowed to speak more loudly than the antecedent probabilities. It should also be allowed to speak more loudly, a great deal more loudly, than semi-deistic theological assumptions according to which God would find it beneath his dignity or be

somehow reluctant to act specially in the world he has created and lovingly sustains from moment to moment.

38. See footnote 14 above.

39. Of course they could also be thought of as outrigger forms on a typological classification. In general, the gaps in the fossil record are better accommodated by the successive but independent appearance of the major *bauplans* with substantial evolution radiating out from these *Ur* forms.

40. See Michael Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: The Free Press, 1996), ch. 2.

41. *Darwin's Black Box* (0000: Free Press, forthcoming).

42. "The real shocker for me is the worm that looks like it has kneecaps," said Dr. Ellis L. Yochelson, a paleontologist at the Smithsonian Institution. He was referring to an animal known as *Microdictyon*. ("Spectacular Fossils Record Early Riot of Creation," *New York Times*, 4/23/91.)

43. Vol. 261, Sept. 3, 1993, pp. 1274, 1293.

44. The initial response of Darwinists has been something like, "Wow! Evolution can move much faster than we thought!"

45. My thanks to Del Ratzsch, Gordon van Harn, and Ralph Stearley.