

entailments involving necessary connections." Could Dr. Dembski possibly be such a babe in the woods when it comes to lawyering? In adversarial proceedings (and if there were none such, who would need lawyers?), the lawyers "weigh evidence subject to uncertainties" in the sense that they attempt to manipulate the perceptions of others so as to minimize the appearance of uncertainty when favorable evidence for their cause is at issue, and to maximize the appearance of uncertainty when contrary evidence is at issue. That is, they attempt to create illusions of entailment or near-entailment in the minds of those "others." What "others?" Why, those who "weigh evidence subject to uncertainties" *in order to reach a judgment*, that is, judges and juries.

As a lawyer and a good one, Phillip Johnson's job—and he knows it very well—is to use rhetoric to disguise the weakness and/or unoperationality of his own claims. That's why it's important to demonstrate that the *illusion* of entailment cannot be taken for *true* entailment—because there isn't any.

After all this obscurantistic Dembskian scrapple, the last paragraph of his critique is refreshingly interesting. In it, he inverts the sense of the quote that brought us together. Remember? It says "Darwinism and neo-Darwinism . . . carry with them an *a priori* commitment to metaphysical naturalism, which is essential to make a convincing case in their behalf." But Dembski says "naturalism needs something like Darwinism to keep it viable," and therefore I have missed the boat. No, Phillip Johnson missed the boat. Dembski might be able to write an interesting paper based on this novel thesis, and I hope he does—but he had better justify his logic, because logical propositions are not automatically symmetrical, like redox reactions.

Oh yes, Al and Bob. Only once, in the second paragraph of the Al and Bob excursus, does Dembski actually say that Bob *killed* Al. As it happens, he didn't. (Lying in a pool of blood on the floor doesn't entail being dead.) The actual *dénouement* is much more interesting. Al survived, and told the police the whole story, including who shot him.

God did it. But not to worry: Phillip Johnson for the defense got him off. Charles Darwin, who wasn't even there, got forty-six years for attempted murder, aggravated assault, and naturalism in the third degree.

12

Doubts About Darwinism

Peter van Inwagen

AT THIS SYMPOSIUM we have been asked to speak on the following thesis:

Darwinism and neo-Darwinism as generally held and taught in our society carry with them an *a priori* commitment to metaphysical naturalism, which is essential to make a convincing case on their behalf.

In order to have a label for them, I will call these words "the Quotation." I have thought about the Quotation, and I have decided that I cannot assent to it—although I by no means reject it. I have two reasons. First, I don't fully understand it, and, second, however it is to be interpreted, it is clear to me that I am not in a position to make judgments about it, owing to sheer factual ignorance.

I will take up the second point first. My ignorance pertains to the words "as generally held and taught in our society." I am not a sociologist of science, or of education, and I don't claim to know how any particular doctrine or theory is generally held and taught in our society. I admit that I've seen lot of individual bits of evidence, such as a cell biologist's quotation of a letter he was sent by a publisher telling him that a proposed textbook chapter on the origin of life should make it clear that "God is an unnecessary hypothesis," but I think I'll leave this aspect of the question alone.

As to my failure fully to understand the Quotation, this has mainly to do with the fact that different people use words in different ways, and I am not sure how the terms *Darwinism* (much less *neo-Darwinism*), *metaphysical naturalism*, and *a priori* are understood by the author of the Quotation. Each of those terms could mean more than one thing, and I know from experience that precision of meaning is important in questions about what carries commitment to what.

Although I cannot assent to the Quotation, it does not arouse in me any intellectual revulsion, but rather a sense of intellectual sympathy, a feeling that if I were to explain what I believed about the matters it touches on, someone who unreservedly agreed with it might well

conclude that he and I were on essentially the same side, even if I were regrettably obtuse about several important issues. Those whose visceral reaction to the Quotation is revulsion would probably feel that I was essentially on the other side, one of the enemy. Let me explain what I believe about these matters and why I think that what I believe is true, and we shall see.

What I am going to say is perilously close to autobiography. I am not an expert on anything having to do with Darwinism. I am not even a well-informed amateur. I am just an intelligent guy who has read a few books—a very dangerous type in the world of science and scholarship, as we all know. (On the other hand, I have to point out that we are not talking about superstring theory here. The issues involved don't seem to me to be all that difficult to grasp—which is what intelligent guys who have read a few books always think.)

If you are an expert, there is only one reason you might want to pay attention to what I have to say. I am your public. If you are an expert who doesn't care what the public thinks about evolution and related matters, then you can stop reading right now. But, some experts do care what the public thinks about these things. If you are one of them, and if you think I'm wrong, I can at least tell you what it would take to convince me that you're right and I'm wrong. Then you can write me off as unteachable, or try to show me that *other* things than those I have mentioned should convince me that you're right and I'm wrong. Or you can try to do the things that I have said would convince me, or whatever takes your fancy.

I'll start by explaining how I understand "Darwinism," which seems to be the key term in these discussions. Darwinism is a theory about evolution, so I'll explain how I understand the term *evolution*. Rather than try to mark out a certain process or phenomenon that I propose to designate by this name, I'll present a series of propositions I shall describe as together constituting the thesis that evolution occurs or has occurred or is real or whatever predicate believers in evolution should use. I won't be too particular about which processes referred to in these propositions are the ones that make up the phenomenon called evolution. Since I confine the scope of my remarks to our planet, some may prefer to call my discussion "the thesis of *terrestrial* evolution." Here are the first two propositions:

- Any two living organisms, past or present, have a common ancestor.

- There have been living organisms for a very long time, not just for a few thousand years but for *millions* of thousands of years—perhaps since a few hundreds of millions of years after the earth's surface was cool enough to support life.

These two propositions taken together make up a rather weak thesis. For one thing, it is weak because it says nothing about biological diversity. This thesis could be true even if the only organisms there had ever been were a particular sort of bacterium that had persisted unchanged for billions of years. This thesis is weak also because it says almost nothing about causation—although "ancestor" is a causal concept. It is compatible, for example, with the statement that God has been responsible for a vast array of miraculous innovations in the history of life. It is also compatible with the statement that intelligent extraterrestrials have been dropping in on the earth every ten million years or so to perform prodigies of genetic engineering in aid of some mysterious agenda involving terrestrial life. To get a more interesting thesis to associate with the word *evolution*, let us add some propositions about diversity and causation.

- Life exhibits (and has exhibited for a very long time) enormous taxonomic diversity.
- Only natural causes have been at work in the production of all this diversity.

What does *natural* mean? Well, the word can be opposed both to *miraculous* or *supernatural* on the one hand, and to *artificial* on the other. Let us understand *natural* in this context as carrying both implications. The thesis of evolution implies that only the laws of physics (operating of course under an enormously complex set of boundary conditions) have been at work in the terrestrial biosphere during the course of the diversification of life. It also implies that the only extraterrestrial influences on terrestrial life have been things that are in no way the instruments of intelligence or purpose: light from the sun, cosmic rays, falls of meteor dust, asteroid strikes, and the like.

I think it is useful to regard these four propositions as together constituting the thesis of evolution. (Should there be something here suggestive of the notion of "progress," or, at any rate, of increasing complexity? Anyone who thinks so may add a clause to the effect that, in the very long run, the complexity of both the biosphere and of the most complex organisms in the biosphere tends to increase. I would not object to the addition. This seems to be a part of what a lot of people

mean by evolution, and it seems to be true.)

I take Darwinism to be an identification of the “natural causes” referred to in the last of the four propositions. I take Darwinism to be a specification of a mechanism, a single mechanism, that explains taxonomic diversification. This mechanism is the operation of natural selection on random small heritable variations that come about in the course of reproduction.

I am not, in a paper of this scope, going to try to give an exposition of what lies behind the slogan “the operation of natural selection on random small heritable variations.” I know that there is considerable diversity of opinion among those who describe themselves as Darwinians as to how the reality behind the slogan should be spelled out in detail, but I don’t think that these disagreements have much to do with what I want to say. At any rate, I take it that we all have some idea of what these words mean. Even the slogan is too cumbersome for frequent repetition, so I’ll call the mechanism simply “natural selection.”

Darwinism, then, is the thesis of evolution plus the further thesis that the sole mechanism behind the enormous taxonomic diversity displayed by terrestrial life—behind the existence of all of those vastly different phyla and orders and classes—is natural selection. (I am aware that Darwin was probably not a Darwinian in this sense, and I am aware that he sometimes opposed natural selection to sexual selection. As to the former point, I am trying to capture at least something close to the most usual sense the word *Darwinism* has in current debates. As to the latter point, unless I am mistaken, most people today use the term *natural selection* in such a way that what Darwin called sexual selection is a special case of natural selection.)

Now where do I stand on all of this?

First, I accept the thesis of evolution. More exactly, I accept evolution with the exception of our own species, and even in that one very special case, I don’t rule it out but merely suspend judgment. But I don’t want to talk about humanity, which *is* a very special case. As a *general* thesis about taxonomic diversity, I accept the evolutionary thesis.

For example, I accept the thesis that my cat and the spider she is playing with have a common ancestor. For that matter, I believe that my cat and the spider and I have a common ancestor. To make a long story short, this seems to be the best explanation of apparently arbitrary features we have in common: the pentadactyl limb structure that the cat

and I share and the genetic code that all three of us share with the algae and yeasts. I don’t mean to imply that the “shared arbitrary features” argument is the only good argument for the common ancestry thesis. And I don’t doubt that the lines of descent from their common ancestor to my cat and the spider involved only natural causes. To make a long story short, I believe this because I make it a rule to believe that an event or process has natural causes unless there is some reason to think otherwise, and, in the case of my cat and the spider, there seems to be no reason to think otherwise.

I accept the thesis that natural selection is *one* of the mechanisms connected with the existence of biological diversity. It has certainly been demonstrated that natural selection is a real phenomenon, a mechanism that actually operates in nature, and I see no reason to doubt that it is at least *among* the causal “inputs” that have produced the diversity of terrestrial life.

I accept the thesis that Darwinism is a genuine empirical hypothesis, and not a tautology. It is certainly true that there have been attempts to formulate Darwinism that look a lot like “in the long run, organisms that have the capacity for having the most descendants will probably have the most descendants,” but I take these attempts to be simply failed attempts at formulating Darwinism. Whatever else Darwinism may imply, it implies that natural selection has—“all by itself,” so to speak, without help from other mechanisms or miracles or intelligent extraterrestrials—produced enormous taxonomic diversity, and has done so within a certain measurable span of time. Darwinism therefore implies that natural selection is *capable* of doing that sort of thing, and of doing it “all by itself.”

This fact suggests a thought-experiment. Suppose that we seed the oceans of millions of planets that are lifeless but suitable for life with artificial prokaryotic organisms. Suppose that these organisms have no features that would make for taxonomic diversity among their descendants other than the fact that they reproduce themselves with random small heritable variations. (We know this because we have made them to have just that feature.) I believe that Darwinism predicts that on at least a significant proportion of these planets, we shall eventually observe biological diversity comparable with that of the present-day terrestrial biosphere: cells with nuclei, photosynthesis, multicellular organisms, sexual dimorphism, many phyla, and so on. Or perhaps we shall observe other kinds of diversity, equally striking, but

without terrestrial analogue. ("Eventually"? Well, if the experiment proceeded without result for half the main-sequence lifetime of a type G star, it would then be reasonable for the granting agency to refuse further funding.)

This thought-experiment cannot be performed, but its conceivability shows that Darwinism is not in any sense a tautology, since the predicted result does not follow from the meaning of "natural selection" or the meanings of any other words: it is perfectly possible to imagine the experiment failing. I note in passing that its failure would not *refute* Darwinism—I agree with the common view that no experiment can conclusively refute a theory—but it would certainly imply that the Darwinians had some explaining to do, and that is just the kind of leverage that experimental results are supposed to have in relation to theories with genuine empirical content.

Darwinism clearly makes this prediction, and there is certainly no evidence that this prediction is not right. But it *seems* to make others, and there is evidence that some of those are not right. Darwinism seems to predict that the history of life will look a certain way: there will be few if any sharp "breaks" in that history (perhaps a few sudden extinctions of geographically confined species or genres).

To give some intuitive sense to this prediction, suppose that we could see, laid out on a long strip of paper, a detailed picture of the father of a certain elephant, and the father of that elephant, and the father of *that* elephant, and so on. The "absence of sharp breaks" means that over millions of generations, we should see only very gradual change. A million generations ago, the animal depicted on the strip would not look very much like an elephant, but any hundred-generation section of the strip would contain only animals that looked very, very similar. And, of course, this point is intended to apply not only to elephants but to the members of any species or genus. The point applies also not to species and genres but to any taxon: A long enough strip that starts its backward journey with a picture of a snake will somewhere contain a picture of a fish, although any hundred-generation section of the strip will contain pictures of only very similar animals.

We do not have the strip. But we do have the inevitably much less satisfactory fossil record, and it is well known that this record does not show species gradually, almost imperceptibly, shading into others as our gaze extends backward in time. As regards the broader taxa, we do not observe any line of descent that starts with, say, certain fish, and

ends among the first amphibians, the members of this line becoming less and less fishy with the passage of time and acquiring more and more of the characteristics of amphibians, the intermediate members of the line being neither fish nor good red herring. Rather, we see sharp discontinuities—sharp at least as sharpness is measured on the geological time-scale, for what looks like a sudden discontinuity in the fossil record could well encompass many thousands of successive generations of organisms.

It is also well known that Darwin was troubled by the apparent discontinuities and lack of intermediate forms in the fossil record. Since Darwin's day these features have not disappeared in the light of new fossil discoveries but have become more and more evident.

On the surface, then, it looks as if Darwinism makes wrong predictions about the fossil record. But, as is usual in cases of an attractive scientific hypothesis that appears to be in conflict with some body of evidence, it is possible to devise "auxiliary hypotheses" that explain the apparent incompatibility. This has been done, if by no one else, by Gould and Eldredge, with their hypothesis that diversification takes place very rapidly among populations of peripheral isolates. As is usual in such cases, many scientists have insisted that this was just what everyone had believed all along.

When such an auxiliary hypothesis is proposed, some standard questions have to be asked: Is it coherent? Is it well motivated? Does it actually succeed in saving both the theory and the phenomena? Is the sole reason for accepting it that it saves the theory and the phenomena, or does it have something else going for it? Does the theory plus the hypothesis suggest experiments or observations that are not suggested by the theory itself?

Those are large questions. I am neither a biologist nor a philosopher of biology, and I am out of my depth here. But, speaking not as someone who claims to know anything but just as a member of the interested public, I have to say that I have not been convinced by the attempts I know of to answer them. I suppose that the main reason I am not convinced is that I am not convinced that the required intermediates are, in all cases anyway, anatomically and physiologically possible. I am not sure that a true amphibian, say, *could* be descended from a true fish across a few score thousands of generations by the small steps that Darwinism allows. I am not sure that you could take a particular fish and make a few changes in its genotype and then a few more changes

and then a few more changes, and, after a few score thousand of such small sets of changes, end up with the genotype of an amphibian—not if each intermediate genotype has to be the genotype of a viable organism, and not if “a few changes” means changes of the magnitude that typically separate an organism and one of its offspring.

Let’s call what I’m skeptical about the existence of “short paths”: short, baby-step genetic paths between organisms belonging to, say, different biological classes. I am also skeptical about how *many* short paths exist as abstract possibilities, given that any do at all—since even if there were short paths, there might be so few of them that it would be vastly improbable that any of them would actually get taken.

Presumably, since most biologists are Darwinians of some stripe, most biologists believe that short paths exist and are numerous enough as abstract possibilities that it is not at all surprising that quite a few would actually be taken. What I should like to know more about is this: Is this belief of theirs grounded in their nuts-and-bolts knowledge of anatomy, physiology, and molecular biology? Or is it grounded simply in the fact that its truth is required by Darwinism? Unless there is some reason to believe in the existence of short paths that is prior to and independent of Darwinism, I am going to continue to be skeptical about Darwinism.

Let me recall two well-known episodes from the history of science. Newton believed that interplanetary gravitational forces rendered the solar system unstable, that, owing to cumulative distortions of the orbits of the planets by the gravitational fields of the other planets, the solar system could not retain its dynamic stability for more than a few centuries. He dealt with this difficulty by postulating periodic divine corrections of the planetary orbits. To remove a red herring, let us pretend that he postulated not miraculous interference in the course of nature, but rather the action of some as yet unknown physical principle, in addition to the laws of motion and the law of universal gravitation. A generation or so after Newton, Laplace showed that the destabilizing effects of mutual planetary gravitational attraction that Newton worried about tended to cancel out, and that, although a solar system whose motions were governed solely by the laws of motion and gravitation was perhaps not *absolutely* stable, it would be capable of retaining its stability over vast stretches of time.

Lord Kelvin insisted that, despite what the paleontologists said, the sun could not have been shining at its present luminosity for more than a

score or so millions of years. This was because that is the longest period you could get on any reasonable initial conditions if solar radiation was, as he supposed, due entirely to the release of gravitational potential energy in the form of radiation as the material of the sun underwent gravitational contraction.

In my view, owing to the difficulties I have briefly mentioned, Darwinism is in the position either of classical celestial mechanics in the time of Newton, or else in the position of the standard late-nineteenth century theory of solar radiation that Kelvin appealed to. In each case the theory *appears* to make the wrong predictions about the observed phenomenon. Newton knew it. Kelvin denied it, dismissing the claims of paleontology as confidently as any twentieth century “creation scientist.” In the case of Newton and Laplace, the difficulty was surmountable, although surmounting it was by no means trivial. It required all the resources of one of the greatest applied mathematicians in history. In the latter case, the difficulty was insurmountable. Kelvin’s proposed mechanism (the transformation of gravitational potential energy to radiant energy) is *there* all right, but it is one of several mechanisms that contribute to solar radiation, and the others are responsible for the lion’s share of the effect. Lord Kelvin’s implicit theory, that only the one mechanism was at work, was wrong.

Which of these cases represents the situation of Darwinism? Well, I am inclined to think the second. Those who say that there is no problem are in roughly the position of Lord Kelvin vis-à-vis the data of paleontology. If the situation of Darwinism is analogous to the first case, we do not now know this. In that event, evolution has had in Darwin its Newton, but it has not yet had its Laplace. If the situation of Darwinism is analogous to the second case, then there are as yet undiscovered evolutionary mechanisms, ones that contribute the lion’s share of the effect. (I should mention that the analogies I have been appealing to have at least one serious defect. Classical gravitational mechanics is a quantitative theory, and it is pretty clear what its predictions are. It is not the fault of Darwinism that it is not a quantitative theory, but the fact that it is not does have the consequence that it is much less clear what its predictions are.)

I am not quite finished with the case of Lord Kelvin. Before leaving it, I want to use it as a stick with which to beat the following argument: “No one should say that evolution requires other mechanisms than natural selection unless he or she has some constructive proposal to

make about what those mechanisms might be." I have heard somewhere that, as a matter of fact, some paleontologists did rather timidly ask Kelvin whether there might be some unknown factor involved in the production of solar radiation. His reply was evidently contemptuous and dismissive. He might well have used an argument exactly parallel to the one we are considering: You shouldn't make that suggestion unless you have some constructive proposal to make about what that factor might be. If he had said this, he would have been wrong. He should have been willing to admit that paleontological evidence, in conjunction with his own calculations, established at least a very strong *prima facie* case for the conclusion that some factor other than gravitational contraction was partly responsible for the sun's energy output. He should have been willing to admit this despite the fact that no physicist, and certainly no paleontologist, had any constructive suggestion about what that factor might be. (We know now that any speculation about this question at the turn of the twentieth century would have been a waste of time.)

So that is where I stand. It looks to me as if natural selection is not a complete explanation of the diversity of life. I am inclined to think that its primary "function," if I may use that word, is to insure that species possess sufficient diachronic flexibility that they aren't just automatically wiped out by the first environmental change that comes along. And, of course, natural selection is a very efficient fine-tuning mechanism: once a species has found an ecological niche for itself, natural selection tends to optimize its "fit" into that niche.

And I am willing to allow a little more to natural selection than this. I am inclined to think that "unaided" natural selection *can* produce new species; I have a very hard time believing that it can produce, say, new classes. There are (or so it looks from where I stand—not much of a vantage-point, I admit) mechanisms involved in biological diversification that are as unknown, and probably as unguessable, today as the release of surplus binding energy in nuclear fusion was in the year 1900. (But I don't mean to suggest that these mechanisms involve new physical principles.) It looks to me as if Darwinians are like someone who, having observed that tugboats sometimes maneuver ocean liners in tight places by directing high-pressure streams of water at them, concludes that he has discovered the method by which the liners cross the Atlantic.

Now a concluding even more unscientific postscript, connecting what I have said so far with my religious views. Like St. Augustine, I

am not a literalist about the first three chapters of Genesis. Writing early in the fifth century, Augustine held that the six "days" of creation in Genesis were not meant to be taken as literal twenty-four hour days, but were a rhetorical figure used to describe six aspects of creation. He held that in the beginning the world contained much less actual order than it does today, and that the order we now observe in the world evolved—that is, "unfolded"—out of the potential order that God had placed in things at the moment of creation. This would be my view as well. I see it as the business of science to uncover the mechanisms of that unfolding.

As to biological order, if unaided natural selection really is capable of producing the ordered diversity we see in the terrestrial biosphere today, I see no reason why a God who wanted such ordered diversity should not have used this very elegant mechanism. If I doubt that God did this, it is only because I doubt that unaided natural selection could do the job. I think that other mechanisms would be required and that he therefore must have used them. But if unaided natural selection would work—well, why shouldn't God use something that would work?

It seems to be a widespread opinion that something about natural selection unfits it for use as a divine instrument. I have never been able to see this. When I was an agnostic, I was a Darwinian. When I became a Christian, a very old-fashioned, orthodox one, I was a Darwinian still. And although I have experienced many intellectual difficulties with my faith, my belief in Darwinism never caused me the least intellectual discomfort. My doubts about Darwinism began only when I discovered that the "smoothness" of the fossil record that I had always believed in was not there. I should add, in this connection, that I do not regard the difficulties that I believe Darwinism faces as constituting any sort of evidence of theism. I think that the truth or falsity of Darwinism has no more to do with theism than does, say, the hypothesis of continental drift.

But many people do not see things this way. I could quote both Darwinians and anti-Darwinians to this effect. Here is a famous quotation from Monod that will do as well as any. Speaking of the events that have been identified as the sources of mutations, he says:

We call these events accidental; we say that they are random occurrences. And since they constitute the *only* possible source of modifications in the genetic text, itself the *sole* repository of the organism's hereditary structure, it necessarily follows that chance alone is at the source of every innovation, of all creation

in the biosphere. Pure chance, absolutely free but blind, at the very root of the stupendous edifice of evolution: this central concept of modern biology . . . is today the *sole* conceivable hypothesis, the only one that squares with observed and tested fact.¹

Monod goes on to make clear that he understands chance in Aristotle's sense, as arising from the coincidence of independent lines of causation. (Thus, it is due to chance that Shakespeare and Cervantes died on the same day, as it would not be if they had killed each other in a duel. In this sense, chance can exist even in a fully deterministic world.) He identifies the source of this chance with imperfections in the fundamental mechanisms of molecular invariance in living organisms. He mentions only the causes of mutations, but he might have mentioned other sorts of events that are of evolutionary significance and can with equal plausibility be ascribed to chance: the flood that happened to destroy a certain herd of ruminants, the raising by geological forces of a land bridge that enabled representatives of certain species to move into a new environment, the intersection of the trajectories of the earth and a certain comet, and so on.

I don't quite see how it is that the hypothesis that all such events are due to chance is the only conceivable hypothesis. But let us suppose that this hypothesis is at any rate *true*. Does it follow that the general features of the biosphere are products of chance? It does not. To suppose that they are would be to commit the so-called fallacy of composition. It would be as if one reasoned that because a cow is entirely composed of quarks and electrons, and quarks and electrons are nonliving and invisible, a cow must therefore be nonliving and invisible.

There is a marvelous device for calculating the areas surrounded by irregular closed curves. It is an electronic realization of what is sometimes called the dartboard technique. To simplify somewhat: you draw the curve on a screen; then the device selects points on the screen at random, and looks to see whether or not each point falls inside the curve; as the number of points chosen increases, the ratio of the chosen points that fall inside the curve to the total number of chosen points tends to the ratio of the area enclosed by the curve to the area of the screen. For a large class of curves, including all that you could draw by hand, and probably all that would be of practical interest to scientists or engineers, the convergence of ratios is quite rapid. Because of this, such devices are useful and have been built. Now the properties of each point that is chosen, its coordinates, are products of chance in just Monod's

sense. But the whole assemblage of points chosen in the course of solving a given area problem has an important property that is not due to chance: its capacity to represent the area of a curve that had been drawn before any of the points was chosen.

Indeed, since the device was built by purposive beings, there can be no objection to saying that the whole assemblage of points has the *purpose* of representing the area of that curve—despite the fact that the coordinates of each individual point have no purpose whatever. It is also true that the fact that each point has coordinates that are due to chance is not due to chance and has a purpose: its purpose is the elimination of bias, to insure that the probability of a given point's falling inside the curve depends on the proportion of the screen enclosed by the curve and on nothing else.

Suppose that every mutation that has ever occurred is, as Monod says, due to chance. Suppose, in fact, that every individual event of any kind that is a part of the causal history of the biosphere is due to chance. It does not follow that every aspect of the biosphere is due to chance. And if none of these individual events has a purpose, it does not follow that the biosphere has no purpose. To make either inference is to commit the fallacy of composition.

Now this reasoning shows at most that the thesis that some features of the biosphere are not due to chance (and likewise the stronger thesis that they have a purpose) is logically consistent with Darwinism. It could still be that the conditional probability of the thesis that there are features of the biosphere that are not due to chance is very low, even negligible, on the hypothesis of Darwinism. But the reasoning does show that if someone wants to construct an *argument* for the conclusion that Darwinism is in any sense incompatible with the thesis that some features of the biosphere are not products of chance, he or she will have to employ some premise in addition to "Darwinism implies that all events of evolutionary significance are due to chance." And, as I have implied, I do not find that premise itself indisputable.

One argument might be that the features of the biosphere are in a very important respect unlike the features of an assemblage of points produced by our area-measuring device. Each time we draw a curve on the screen of the area-measurer and turn the thing on, it is for all practical purposes determined, foreordained, that the assemblage of points it produces will have the property of representing the area enclosed by the curve.

But, it might be argued, the properties of the biosphere are not like that. There used to be a popular thesis called Biochemical Predestination, according to which they *were* like that. According to Biochemical Predestination, you just take a lifeless planet that satisfies certain conditions (conditions the earth satisfied before there was any life on it, and which are undemanding enough that it would be reasonable to suppose that a pretty fair number of planets in a given galaxy satisfied them) and in due course you will “automatically” have life, eukaryotic life, multicellular life, sexually dimorphic life, highly differentiated life, and, finally, intelligent life—the whole *Star Trek* scenario.

Biochemical Predestination does not seem to be very popular among the practitioners of the life sciences these days, although belief in it seems to be common among physicists and astronomers and nearly universal among university undergraduates, who believe that Vulcans and Klingons await us among the stars with the same unreflective assurance that attended the belief of their twenty-times-great grandparents that elves and trolls awaited them in the woods. But if Biochemical Predestination is not true, if the main features of the biosphere did not fall into place automatically, but rather are due to remote chances that just happened to come off, then how can it be that these features are due to the purposes of a divine being—or any intelligent being? In short, the failure of Biochemical Predestination shows that, since the evolutionary process has no determinate “output,” it is not the kind of thing that could be anyone’s instrument.

Curiously enough, Biochemical Predestination was said by those who believed in it to show that the evolutionary process was not anyone’s instrument, owing to the fact that, according to that hypothesis, the features of the biosphere are a consequence of the laws of physics operating on the matter near the surface of the earth, and have therefore been produced without any need for manipulation by outside forces. Moreover, since these same features would have emerged from almost any set of initial conditions, they have been produced without any need for any sort of initial adjustment or fine-tuning of the state of the matter near the surface of the earth.

I don’t myself see the force of either of these ideas. I don’t see why either Biochemical Predestination or its denial should be thought to have any theological (or atheological) implications. Perhaps what is needed in order for there to be a useful discussion of the question whether there

are such implications is some measure of agreement about what a biosphere that was a divine creation would look like: what it would look like at any given point in time, and what its history would look like. After all, if you propose to refute an hypothesis by an appeal to observation, you have to have some idea about what things would look like if that hypothesis were true.

I myself have almost no expectations about what a divinely created biosphere would look like. I mean I have no *a priori* expectations. Since I think that the biosphere is in fact a divine creation, I of course think I know *one* thing a divinely created biosphere might look like: what it does look like. How should I know what features to expect a biosphere to have if that biosphere were created by a being whose knowledge and wisdom were unlimited and whose power was limited only by considerations of what is intrinsically possible? Before I could make even a guess, I should have to know what that being wanted the biosphere *for*, and I should have to know a lot more than I do about what is intrinsically possible. I don’t see how anyone could know what a divine being wanted a biosphere for—not unless the divine being told him, anyway. And I doubt whether anyone knows much more than I do—much more than almost nothing at all—about what is intrinsically possible.

NOTE

¹Jacques Monod, *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*, tr. Austryn Wainhouse (New York: Vintage Books, 1971), pp. 112-113.