Philosophical Objections to Intelligent Design: Response to Critics

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I. Is Intelligent Design Falsifiable?

Some reviewers of *Darwin's Black Box* (Behe 1996) have raised philosophical objections to intelligent design. I will discuss several of these over the next few sections, beginning with the question of falsifiability. To decide whether, or by what evidence, it is falsifiable, one first has to be sure what is meant by "intelligent design." By that phrase someone might mean that the laws of nature themselves are designed to produce life and the complex systems that undergird it. In fact, something like that position has been taken by the physicist Paul Davies and the geneticist Michael Denton in their recent books, respectively, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (Davies 1999) and *Nature's Destiny: How the Laws of Biology Reveal Purpose in the Universe*. (Denton 1998) That stance also seems to pass muster with the National Academy of Sciences:

Many religious persons, including many scientists, hold that God created the universe and the various processes driving physical and biological evolution and that these processes then resulted in the creation of galaxies, our solar system, and life on Earth. This belief, which sometimes is termed "theistic evolution," is not in disagreement with scientific explanations of evolution. Indeed, it reflects the remarkable and inspiring character of the physical universe revealed by [science]. (National Academy of Sciences 1999, 7)

In such a view even if we observe new complex systems being produced by selection pressure in the wild or in the laboratory, design would not be falsified because it is considered to be built into natural laws. Without commenting on the merits of the position, let me just say that that is not the meaning I assign to the phrase. By "intelligent design" I mean to imply design beyond the laws of nature. That is, taking the laws of nature as given, are their other reasons for concluding that life and its component systems have been intentionally arranged? In my book, and in this essay, whenever I refer to intelligent design (ID) I mean this stronger sense of design-beyond-laws. Virtually all academic critics of my book have taken the phrase in the strong sense I meant it.

In the strong sense ID is no longer approved by the National Academy, for a specific reason: "[I]ntelligent design . . . [is] not science because [it is] not testable by the methods of science." (National Academy of Sciences 1999, 25) In his review of *Darwin's Black Box for Nature*, Jerry Coyne, professor of evolutionary biology at the University of Chicago, explains why he also thinks intelligent design is unfalsifiable.

If one accepts Behe's idea that both evolution and creation can operate together, and that the Designer's goals are unfathomable, then one confronts an airtight theory that can't be

proved wrong. I can imagine evidence that would falsify evolution (a hominid fossil in the Precambrian would do nicely), but none that could falsify Behe's composite theory. Even if, after immense effort, we are able to understand the evolution of a complex biochemical pathway, Behe could simply claim that evidence for design resides in the other unexplained pathways. Because we will never explain everything, there will always be evidence for design. This regressive ad hoc creationism may seem clever, but it is certainly not science. (Coyne 1996)

Coyne's conclusion that design is unfalsifiable, however, seems to be at odds with the arguments of other reviewers of my book. Clearly, Russell Doolittle (Doolittle 1997), Kenneth Miller (Miller 1999), and others have advanced scientific arguments aimed at falsifying ID. (See my articles on blood clotting and the "acid test" on this web site.) If the results with knock-out mice (Bugge *et al.* 1996) had been as Doolittle first thought, or if Barry Hall's work (Hall 1999) had indeed shown what Miller implied, then they correctly believed my claims about irreducible complexity would have suffered quite a blow. And since my claim for intelligent design requires that no unintelligent process be sufficient to produce such irreducibly complex systems, then the plausibility of ID would suffer enormously. Other scientists, including those on the National Academy of Science's Steering Committee on Science and Creationism, in commenting on my book have also pointed to physical evidence (such as the similar structures of hemoglobin and myoglobin) which they think shows that irreducibly complex biochemical systems can be produced by natural selection: "However, structures and processes that are claimed to be 'irreducibly' complex typically are not on closer inspection." (National Academy of Sciences 1999, p. 22)

Now, one can't have it both ways. One can't say both that ID is unfalsifiable (or untestable) and that there is evidence against it. Either it is unfalsifiable and floats serenely beyond experimental reproach, or it can be criticized on the basis of our observations and is therefore testable. The fact that critical reviewers advance scientific arguments against ID (whether successfully or not) shows that intelligent design is indeed falsifiable.

In fact, *my argument for intelligent design is open to direct experimental rebuttal*. Here is a thought experiment that makes the point clear. In *Darwin's Black Box* (Behe 1996) I claimed that the bacterial flagellum was irreducibly complex and so required deliberate intelligent design. The flip side of this claim is that the flagellum can't be produced by natural selection acting on random mutation, or any other unintelligent process. To falsify such a claim, a scientist could go into the laboratory, place a bacterial species lacking a flagellum under some selective pressure (for mobility, say), grow it for ten thousand generations, and see if a flagellum--or any equally complex system--was produced. If that happened, my claims would be neatly disproven.(1)

How about Professor Coyne's concern that, if one system were shown to be the result of natural selection, proponents of ID could just claim that some other system was designed? I think the objection has little force. If natural selection were shown to be capable of producing a system of a certain degree of complexity, then the assumption

would be that it could produce any other system of an equal or lesser degree of complexity. If Coyne demonstrated that the flagellum (which requires approximately forty gene products) could be produced by selection, I would be rather foolish to then assert that the blood clotting system (which consists of about twenty proteins) required intelligent design.

Let's turn the tables and ask, how could one falsify the claim that, say, the bacterial flagellum was produced by Darwinian processes? (Professor Coyne's remarks about a Precambrian fossil hominid are irrelevant since I dispute the mechanism of natural selection, not common descent. I would no more expect to find a fossil hominid out of sequence than he would.) If a scientist went into the laboratory and grew a flagellum-less bacterial species under selective pressure for many generations and nothing much happened, would Darwinists be convinced that natural selection is incapable of producing a flagellum? I doubt it. It could always be claimed that the selective pressure wasn't the right one, or that we started with the wrong bacterial species, and so on. Even if the experiment were repeated many times under different conditions and always gave a negative result, I suspect many Darwinists would not conclude that the claim of its Darwinian evolution was falsified. Of complex biochemical systems Coyne himself writes "we may forever be unable to envisage the first proto-pathways. It is not valid, however, to assume that, because one man cannot imagine such pathways, they could not have existed." (Coyne 1996) If a person accepts Darwinian paths which are not only unseen, but which we may be forever unable to envisage, then it is effectively impossible to make him think he is wrong.

Kenneth Miller announced an "acid test" for the ability of natural selection to produce irreducible complexity. He then decided that the test was passed, and unhesitatingly proclaimed intelligent design falsified ("Behe is wrong"; Miller 1999, 147). But if, as it certainly seems to me, *E. coli* actually fails the lactose-system "acid test," would Miller consider Darwinism to be falsified? Almost certainly not. He would surely say that the experiment started with the wrong bacterial species, used the wrong selective pressure, and so on. So it turns out that his "acid test" was not a test of Darwinism; it tested only intelligent design. The same one-way testing was employed by Russell Doolittle. He pointed to the results of Bugge *et al.* (1996) to argue against intelligent design. But when the results turned out to be the opposite of what he had originally thought, Professor Doolittle did not abandon Darwinism.

It seems then, perhaps counterintuitively to some, that intelligent design is quite susceptible to falsification, at least on the points under discussion. Darwinism, on the other hand, seems quite impervious to falsification. The reason for that can be seen when we examine the basic claims of the two ideas with regard to a particular biochemical system like, say, the bacterial flagellum. The claim of intelligent design is that "*No* unintelligent process could produce this system." The claim of Darwinism is that "*Some* unintelligent process (involving natural selection and random mutation) could produce this system." To falsify the first claim, one need only show that at least one unintelligent process could produce the system. To falsify the second claim, one would have to show

the system could not have been formed by any of a potentially infinite number of possible unintelligent processes, which is effectively impossible to do.

I think Professor Coyne and the National Academy of Sciences have it exactly backwards. A strong point of intelligent design is its vulnerability to falsification. (Indeed, some of my religious critics dislike intelligent design theory precisely because they worry that it will be falsified, and thus theology will appear to suffer another blow from science. See, for example, (Flietstra 1998).) A weak point of Darwinian theory is its resistance to falsification. What experimental evidence could possibly be found that would falsify the contention that complex molecular machines evolved by a Darwinian mechanism?

II. What Is "Irreducible Complexity" and What Does It Signify?

Some reviewers have criticized the concept of irreducible complexity. In *Boston Review* University of Rochester evolutionary biologist H. Allen Orr agrees that many biological systems are "irreducibly complex," but argues that Darwinian evolution can, at least in theory, directly account for them. However, as I will show, his argument depends on changing the definition of irreducible complexity, which obscures the difficulty.

In his review Orr initially seems to clearly understand what I meant by "irreducible complexity" (quoted earlier). Of the example I used in *Darwin's Black Box* he writes: "A mousetrap has a clear function (crushing mice) and is made of several parts (a platform, a spring, a bar that does the crushing). If any of these parts is removed, the trap doesn't work. Hence it's irreducibly complex." (Orr 1996) So far, so good. Nonetheless, later in the review he seems to lose hold of the concept:

An irreducibly complex system can be built gradually by adding parts that, while initially just advantageous, become--because of later changes--essential. The logic is very simple. Some part (A) initially does some job (and not very well, perhaps). Another part (B) later gets added because it helps A. This new part isn't essential, it merely improves things. But later on, A (or something else) may change in such a way that B now becomes indispensable. This process continues as further parts get folded into the system. And at the end of the day, many parts may all be required. (Orr 1996)

Now, how can we square this paragraph with his initial agreement that if any part of a mousetrap is removed, it doesn't work? Thinking of the mousetrap example, what would correspond to "Some part (A)" that "initially does some job"? In fact, the whole point of the mousetrap example was to show that there is no "part (A)" that will initially do the job. There is no "part (B)" that helps gradually improve "part (A)." A gradual addition of parts is not possible for the mousetrap example (or at least it is very far from obvious that it is possible). Orr later gives a biological example of what he has in mind.

The transformation of air bladders into lungs that allowed animals to breathe atmospheric oxygen was initially just advantageous: such beasts could explore open niches--like dry land--that were unavailable to their lung-less peers. But as evolution built on this adaptation (modifying limbs for walking, for instance), we grew thoroughly terrestrial

and lungs, consequently, are no longer luxuries--they are essential. The punch-line is, I think, obvious: although this process is thoroughly Darwinian, we are often left with a system that is irreducibly complex. (Orr 1996)

In Orr's example, however, what is the irreducibly complex system? Is it the swim bladder? The lung? The whole organism? What is the function of the system? Is it "swimming," "breathing," "living," or something else? If we assume he meant that the irreducibly system is, say, the lung, can the lung be considered "a single system," as my definition requires (Behe 1996, p. 39)? What are the parts of the lung without which it will stop working, like a mousetrap without a spring? What is "part (A)" and what is "part (B)"? None of these things is clear at all--certainly not as clear as the parts and function of a mousetrap.

Let me preface my remaining remarks on this subject by acknowledging that it is often notoriously difficult to rigorously define a concept, as exemplified by the problems encountered in trying to define "science," "life," or "species." Furthermore, I am no philosopher; my end purpose is not to come up with a string of words that completely defines the phrase "irreducible complexity." Rather, my purpose is to focus attention on a class of biochemical systems that pose a particular challenge to Darwinian evolution. The examples I gave in my book--a mousetrap, cilium, clotting cascade, and so on--clearly show the necessity for some systems of having a number of discrete parts working together on a single function. The examples, I think, better get across the concept of irreducible complexity than does the definition I offered (Behe 1996, 39), although I think the definition I gave does an adequate job.

With those comments in mind, it can be seen that Orr simply switched concepts in mid-review, as shown by his conflicting remarks quoted above. He jumped from my idea of irreducible complexity to a hazy concept that can perhaps be paraphrased as, "if you remove this part, the organism will eventually die." I'm happy to agree for purposes of discussion that a class of biological phenomena exists which are required for life and which can be changed gradually by natural selection, perhaps even including the swim bladder/lungs Orr mentions (although it is not nearly so obvious as he assumes it to be). It's just that they are not the same types of things as, nor do they somehow obviate the problem of, irreducibly complex systems like mousetraps and cilia. If they were, then Orr could have explained them away as easily as he does swim bladders and lungs. (After all, lung tissue contains cilia plus many, many other components; Orr should thus find it easier to explain cilia alone, rather than cilia-plus-other-components.) Implicitly changing the definition of irreducible complexity, as Orr did, does not tell us how the blood clotting cascade or the bacterial flagellum could have been produced. On the contrary, it distracts our attention from those features of the systems that make them recalcitrant to Darwinian explanation.

Other scientific reviewers have made arguments similar to Orr's which depend on implied definitions of irreducible complexity different from what I used. Writing in the *Wall Street Journal* Paul Gross compares biochemical systems to cities, where features can be added over time. (Gross 1996) But the analogy is poorly chosen because no city

completely stops working when a part is removed, as does a mousetrap or cilium. In *Boston Review* Douglas Futuyma writes:

In mammals, successive duplications of the beta gene gave rise to the gamma and epsilon chains, which characterize the hemoglobin of the fetus and early embryo respectively, and enhance uptake of oxygen from the mother. Thus a succession of gene duplications, widely spaced through evolutionary time, has led to the "irreducibly complex" system of respiratory proteins in mammals. (Futuyma 1997)

But the several hemoglobins that Futuyma calls the "'irreducibly complex' system of respiratory proteins" in fact do not constitute an irreducibly complex system in my sense of the term. They do not interact with each other, as do the parts of a mousetrap or clotting cascade. They go their separate ways, and for the most part aren't even present at the same time in the organism. Like Allen Orr, Futuyma implicitly switches the meaning of "irreducibly complex." Unfortunately, that does not solve the problem I pointed out, but only obscures it. (As an aside, it is difficult to understand what Futuyma intends by the quotation marks around the phrase irreducibly complex. He can't be quoting me; I never used the term in connection with hemoglobin--quite the opposite. He may intend them to be taken as "scare quotes," to warn the reader to take the phrase with a grain of salt. But since he is the one who decided to use the term in conjunction with hemoglobins and then to argue against it, the effect is that of setting up a straw man.)

A different question about irreducible complexity is asked by David Ussery on his web site. He notes that, whereas a bacterial flagellum in *E. coli* requires about 40 different proteins, in *H. pylori* only 33 are required. Since fewer proteins are required, how can the flagellum be irreducibly complex? Two responses can be made. First, some systems may have parts that are necessary for a function, plus other parts that, while useful, are not absolutely required. Although one can remove the radio from a car and the car will still work, one can't remove the battery or some other parts and have a working car. Ussery himself seems to recognize this when he writes "I would readily admit that there is STILL the problem of the evolution of the 'minimal flagellum,'" (Ussery 1999) but he hopes gene duplication will explain that. Second, one must be careful not to identify one protein with one "part" of a biochemical machine. For example, genes coding for two proteins in one organism may be joined into a single gene in another. A single protein in one organism may be doing the jobs of several polypeptides in another. Or two proteins may combine to do one job (an example is the a- and ß-subunits of tubulin, which together make microtubules, a "part" of the eukaryotic cilium).

In his review Ussery mistakenly attributes to me the belief that 240 separate proteins are required for the bacterial flagellum. The confusion apparently arose because at the end of a chapter on the eukaryotic cilium and bacterial flagellum, I stated that a typical cilium contains over two hundred different kinds of proteins. In the next paragraph I wrote, "The bacterial flagellum, in addition to the proteins already discussed, requires about forty other proteins for function." (Behe 1996, p. 72) Although I meant in addition to the flagellar proteins I had discussed a few pages earlier in the chapter, Ussery interpreted the statement to include the several hundred ciliary proteins as well. Ordinarily I would

simply overlook such a mistaken attribution, since it should be obvious to informed readers that I wouldn't be lumping the proteins of cilia and flagella together--after all, they are completely different structures that occur in separate kinds of organisms. In his review in *Biology and Philosophy*, however, Bruce Weber writes "Behe cannot imagine how anything short of the full 240 components of the flagellum could propel a bacterium. But only 33 proteins are needed to produce a functional flagellum for *Helicobacter pylori*." (Weber 1999) And Weber then cites Ussery's web site as his source. Since Ussery's misreading of my book seems to be spreading, and since naive readers might be more impressed by a drop from 240 to 33 than by a change from 40 to 33, I have to state for the record that I did not mean the bacterial flagellum requires the proteins of the eukaryotic cilium!

Several reviewers have questioned whether irreducible complexity is necessarily a hallmark of intelligent design. James Shapiro, who has worked on adaptive mutations, writes in the Boston Review (Shapiro 1997) of "some developments in contemporary life science that suggest shortcomings in orthodox evolutionary theory" while arguing for "a growing convergence between biology and information science which offers the potential for scientific investigation of possible intelligent cellular action in evolution." Thus Shapiro appears to think that irreducibly complex biochemical structures might be explained in a non-Darwinian fashion without invoking intelligence beyond the cells themselves. In *Biology and Philosophy* Bruce Weber (1999) writes that the work of Stuart Kauffman and others on self-organizing phenomena "disrupts the dichotomy Behe has set up of selection or design." Most explicitly, Shanks and Joplin argue in *Philosophy of Science* that self-organizing phenomena such as the Belousov-Zhabotinsky reaction demonstrate that irreducible complexity is not necessarily a pointer to intelligent design. (Shanks and Joplin 1999) I have responded to Shanks and Joplin's argument in a separate paper. (Behe 2000) Briefly, complexity is a quantitative feature; systems can be more or less complex. Although it produces some complexity, the self-organizing behavior so far observed in the physical world has not produced complexity and specificity comparable to irreducibly complex biochemical systems. There is currently little reason to think that self-organizing behavior can explain biochemical systems such as the bacterial flagellum or blood clotting cascade.

The underlying point of all these criticisms that needs to be addressed, I think, is that it is possible future work might show irreducible complexity to be explainable by some unintelligent process (although not necessarily a Darwinian one). And on that point I agree the critics are entirely correct. I acknowledge that I cannot rule out the possibility future work might explain irreducibly complex biochemical systems without the need to invoke intelligent design, as I stated in *Darwin's Black Box*. (Behe 1996, 203-204) I agree I cannot prove that studies of self-organization will not eventually show it to be capable of much more than we know now. Nor can I definitively say that Professor Shapiro's ideas about self-designing cells might not eventually prove true, or that currently unknown theories might prevail. But the inability to guarantee the future course of science is common to everyone, not just those who are supportive of intelligent design. For example, no one can warrant that the shortcomings of self-organization will not be

exacerbated by future research, rather than overcome, or that even more difficulties for natural selection will not become apparent.

I agree with the commonsense point that no one can predict the future of science. I strongly disagree with the contention that, because we can't guarantee the success of intelligent design theory, it can be dismissed, or should not be pursued. If science operated in such a manner, no theory would ever be investigated, because no theory is guaranteed success forever. Indeed, if one ignores a hypothesis because it may one day be demonstrated to be incorrect, then one paradoxically takes unfalsifiability to be a necessary trait of a scientific theory. Although philosophers of science have debated whether falsifiability is a requirement of a scientific theory, no one to my knowledge has argued that unfalsifiability is a necessary mark.

Because no one can see the future, science has to navigate by the data it has in hand. Currently there is only one phenomenon that has demonstrated the ability to produce irreducible complexity, and that is the action of an intelligent agent. It seems to me that that alone justifies pursuing a hypothesis of intelligent design in biochemistry. In his recent book *Tower of Babel: The Evidence against the New Creationism*, however, philosopher of science Robert Pennock argues that science should avoid a theory of intelligent design because it must of necessity embrace "methodological naturalism." (Pennock 1999) I have responded to Pennock elsewhere. (Behe 1999) Briefly, science should follow the data wherever it appears to lead, without preconditions. Further, the question of the identity of the designer remains open (see below) -- just as the cause of the Big Bang has been open for decades. Thus, science can pursue theories with extra-scientific implications (such as the Big Bang(2) or intelligent design) as far as it can, using its own proper methods.

III. Can We--May We--Detect Design in the Cell?

Several reviewers have argued against the legitimacy of reasoning to a conclusion of intelligent design based on biochemical evidence. In the same review discussed above Allen Orr raises an intriguing question of how we apprehend design. He writes:

We know that there are people who make things like mousetraps. (I'm not being facetious here--I'm utterly serious.) When choosing between the design and Darwinian hypotheses, we find design plausible for mousetraps only because we have independent knowledge that there are creatures called humans who construct all variety of mechanical contraptions; if we didn't, the existence of mousetraps would pose a legitimate scientific problem. (Orr 1997)

So, Orr says, we know mousetraps are designed because we have seen them being designed by humans, but we have not seen irreducibly complex biochemical systems being designed, so we can't conclude they were.

Although he makes an interesting point, I think his reasoning is incorrect. Consider the SETI project (Search for Extraterrestrial Intelligence), in which scientists scan space for radio waves that might have been sent by aliens. Those scientists believe that they can

distinguish a *designed* radio wave (one carrying a message) from the background radio noise of space. However, we have never observed space aliens sending radio messages; we have never observed aliens at all. Nonetheless, SETI workers, funded for years by the federal government, are confident that they can detect intelligently-designed phenomena, even if they don't know who produced them.

The relevance to intelligent design in biochemistry is plain. Design is evident in the designed system itself, rather than in pre-knowledge of who the designer is. Even if the designer is an entity quite unlike ourselves, we can still reach a conclusion of design if the designed system has distinguishing traits (such as irreducible complexity) that we know require intelligent arrangement. (One formal analysis of how we come to a conclusion of design is presented by William Dembski in his recent monograph, *The Design Inference* (Dembski 1998).)

We can probe Orr's reasoning further by asking how we know that something was intelligently designed even if it indeed resulted from human activity. After all, humans engage in all sorts of activities which we would not ascribe to intelligence. For example, in walking through the woods a person might crush plants by his footsteps, accidentally break tree branches and so on. Why do we not ascribe those marks to purposeful activity? On the other hand, when we see a small snare (made of sticks and vines) in the woods, obviously designed to catch a rabbit, why do we unhesitatingly conclude the parts of the snare were purposely arranged by an intelligent agent? Why do we apprehend purpose in the snare but not in the tracks? As Thomas Reid argued in response to the skepticism of David Hume, intelligence is apprehended only by its effects; we cannot directly observe intelligence. (Dembski 1999) We know humans are intelligent by their outward actions. And we discriminate intelligent from non-intelligent human actions by external evidence. Intelligence, human or not, is evident only in its effects.

Michael Ruse in *Boston Review* raises another objection, saying that scientists *qua* scientists simply can't appeal to design.

> Design is not something you add to science as an equal--miracles or molecules, take your pick. Design is an interpretation which makes some kind of overall metaphysical or theological sense of experience. (Ruse 1997)

Contrary to Ruse's argument, however, many scientists already appeal to design. I mentioned the SETI program above; clearly those scientists think they can detect design (and nonhuman design at that.) Forensic scientists routinely make decisions of whether a death was designed (murder) or an accident. Archaeologists decide whether a stone is a designed artifact or just a chance shape. Cryptologists try to distinguish a coded message from random noise. It seems unlikely that any of those scientists view their work as trying to make "metaphysical or theological sense of experience." They are doing ordinary science.

Ruse probably meant that scientists can't specifically appeal to God or the supernatural. Evolutionary biologist Douglas Futuyma echoes Ruse's sentiment with rousing rhetoric:

When scientists invoke miracles, they cease to practice science . . . . Behe, claiming a miracle in every molecule, would urge us to admit the defeat of reason, to despair of understanding, to rest content in ignorance. Even as biology daily grows in knowledge and insight, Behe counsels us to just give up. (Futuyma 1997)

In speaking of "miracles"--relying for rhetorical effect on that word's pejorative connotations when used in a scientific context--Ruse and Futuyma are ascribing to me a position I was scrupulous in my book to avoid. Although I acknowledged that most people (including myself) will attribute the design to God--based in part on other, non-scientific judgments they have made--I did not claim that the biochemical evidence leads ineluctably to a conclusion about who the designer is. In fact, I directly said that, from a scientific point of view, the question remains open. (Behe 1996, 245-250) In doing so I was not being coy, but only limiting my claims to what I think the evidence will support. To illustrate, Francis Crick has famously suggested that life on earth may have been deliberately seeded by space aliens (Crick and Orgel 1973). If Crick said he thought that the clotting cascade was designed by aliens, I could not point to a biochemical feature of that system to show he was wrong. The biochemical evidence strongly indicates design, but does not show who the designer was.

I should add that, even if one does think the designer is God, subscribing to a theory of intelligent design does not necessarily commit one to "miracles." At least no more than thinking that the laws of nature were designed by God--a view, as we've seen, condoned by the National Academy of Sciences (National Academy of Sciences 1999). In either case one could hold that the information for the subsequent unfolding of life was present at the very start of the universe, with no subsequent "intervention" required from outside of nature. In one case, the information is present just in general laws. In the other case, in addition to general laws, information is present in other factors too. The difference might boil down simply to the question of whether there was more or less explicit design information present at the beginning--hardly a point of principle.

While we're on the subject of God, another point should be made: A number of prominent scientists, some of whom fault me for suggesting design, have themselves argued for atheistic conclusions based on biological data. For example, Professor Futuyma has written: "Some shrink from the conclusion that the human species was not designed, has no purpose, and is the product of mere mechanical mechanisms--but this seems to be the message of evolution." (Futuyma 1982) And Russell Doolittle remarks concerning the blood clotting cascade: ". . . no Creator would have designed such a circuitous and contrived system." (Doolittle 1997) It is rather disingenuous, however, for those who use biological data to argue that life shows no evidence of design, to complain when others use biological evidence to argue the opposing view.

IV. "Giving Up" in "Ignorance"

Some scientific reviewers have dismissed the conclusion of design as an "argument from ignorance," or a "God of the gaps" argument. This can take several forms. One form of the objection is presented by University of London evolutionary biologist Andrew Pomiankowski, who writes:

Most biochemists have only a meagre understanding of, or interest in, evolution. As Behe points out, for the thousand-plus scholarly articles on the biochemistry of cilia, he could find only a handful that seriously addressed evolution. This indifference is universal. (Pomiankowski 1996)

So, Pomiankowski argues, we do not have answers because nobody has looked, and biochemists haven't looked because they have little interest in the subject.

Although initially plausible, this interpretation suffers from the fact that there is demonstrable interest in evolution among molecular bioscientists. (One doesn't have to officially call oneself a "biochemist" to address such problems. Molecular biologists, geneticists, immunologists, embryologists-- investigators in all of these disciplines are in a position to work on them.) The authors of the large number of books and papers listed on John Catalano's and David Ussery's web sites are clearly interested in evolution (see my discussion of the evolutionary literature on this web site), as are the authors of numerous other studies that involve sequence comparisons. Since many papers are published in the general area of molecular evolution, we have to ask why there are so few in the particular area of the Darwinian evolution of irreducibly complex systems. Pomiankowski proposes it is because the problem is so difficult (Pomiankowski 1996); I suggest it is difficult because irreducibly complex systems fit poorly within a gradualistic theory such as Darwinism.

A less reasonable form, I think, of the "ignorance" accusation is presented by Neil Blackstone. An evolutionary biologist at Northern Illinois University, Blackstone levels a formal charge at me of an error in logic--the "argumentum ad ignorantium," as his review is titled (Blackstone 1997). He even cites a philosophy textbook by Irving Copi to give the charge authority. Those who chop logic to rule out a hypothesis, however, should make sure they are on very firm logical ground. Blackstone is not.

Copi defines the fallacy as follows: "The argumentum ad ignorantium is committed whenever it is argued that a proposition is true simply on the basis that it has not been proved false, or that it is false because it has not been proved true." (Copi 1953) But I certainly did not argue that the Darwinian evolution of biochemical complexity is false "simply on the basis" that it has not been proved true. Nor did I say that intelligent design is true "simply on the basis" that it has not been proved false. To lay the groundwork for a proposal of intelligent design I did argue extensively that the blood clotting cascade and other systems have not been explained by Darwinism. That, of course, was necessary because many people have the impression that Darwinian theory has already given a satisfactory account for virtually all aspects of life. My first task was to show the readership that that impression is not correct.

But my argument did not stop there. I spent many pages throughout the book showing that there is a *structural reason*--irreducible complexity--for thinking that Darwinian explanations are unlikely to succeed. Furthermore, I argued that irreducible complexity is a hallmark of intelligent design, took several chapters to explicate how we apprehend design, showed why some biochemical systems meet the criteria, and addressed

objections to the design argument. Truncating my case for intelligent design and then saying I commit the fallacy of argumentum ad ignorantium is not, in my opinion, fair play.

Let's explore the intricacies of formal logic a little further. Although Blackstone didn't mention it, Copi has more to say on the argument from ignorance.

A qualification should be made at this point. In some circumstances it can be safely assumed that if a certain event had occurred, evidence of it could be discovered by qualified investigators. In such circumstances it is perfectly reasonable to take the absence of proof of its occurrence as positive proof of its non-occurrence. (Copi 1953)

Although I did not limit my argument to the lack of evidence for the Darwinian evolution of irreducibly complex biochemical systems, when qualified investigators (such as, say, those investigating blood clotting) come up empty, it is "perfectly reasonable" to weigh that against Darwinism. (By itself, of course, it is not positive evidence for design.) Although lack of progress is not "proof" of the failure of Darwinism, it certainly is a significant factor to consider.

In a milder variation of the "argument from ignorance" complaint, other scientific reviewers have objected that an appeal to intelligent design is tantamount to "giving up." For example, in the *Forward* Emory University evolutionary biologist Marc Lipsitch remarks:

[Behe] correctly suggests that a complete theory of evolution would include an account of how the intricate chemical systems inside our bodies arose (or might have arisen) from inanimate molecules, one step at a time. Mr. Behe's question is a fair one, but instead of suggesting a series of experiments that could address the question, he throws up his hands. (Lipsitch 1996)

Unfortunately, the point is made with circular logic: it depends on the presupposition that life is not designed, which is the point at issue. If life is not designed then, yes, a theory of intelligent design is ultimately a blind alley (if not quite "giving up"). However, if aspects of life are indeed designed, then the search for the putative unintelligent mechanisms that built them is the blind alley. But how do we decide ahead of time which is correct?

We can't decide the correct answer ahead of time. Science can only follow the data where they lead, as they become available.

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EndNotes

(1) Kenneth Miller leads readers of *Finding Darwin's God* into thinking such a process would be very easy. He writes, "If microevolution can redesign one gene in fewer than two hundred generations (which in this case took only thirteen days!), what principles of biochemistry or molecular biology would prevent it from redesigning dozens or hundreds of genes over a few weeks or months to produce a distinctly new species? There are no such principles of course..." (Miller 1999, 108) Well, then, why doesn't he just take an appropriate bacterial species, knock out the genes for its flagellum, place the bacterium under selective pressure (for mobility, say), and experimentally produce a flagellum--or *any* equally complex system--in the laboratory? (A flagellum, after all, has only 30-40 genes, not the hundreds Miller claims would be easy for natural selection to rapidly redesign.) If he did that, my claims would be utterly falsified. But he won't even try it because he is grossly exaggerating the prospects of success.

(2) That the Big Bang theory has extra-scientific implications can be seen in the reaction of those who do not welcome the implications. For example, in a 1989 editorial in *Nature* with the intriguing title "Down with the Big Bang," John Maddox wrote "Creationists and those of similar persuasions seeking support for their theories have ample justification in the doctrine of the Big Bang. That, they might say, is when (and how) the Universe was created." (Maddox 1989)

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