

# **Evolution's Logic of Credulity: An Unfettered Response to Allen Orr**

**By William A. Dembski**

## **1. Orr's Premature Declaration of Victory**

Allen Orr wrote an extended critical review (ca. 6000 words) of my book *No Free Lunch* for the *Boston Review* summer 2002 (<http://bostonreview.mit.edu/BR27.3/orr.html>). The *Boston Review* subsequently contacted me and asked for a 1000 word response. I wrote a response of that length focusing on what I took to be the fundamental flaw in Orr's review (and indeed in Darwinian thinking generally, namely, conflating the realistically possible with the merely conceivable). Of course Orr had the last word, with the *Boston Review* giving him 1000 words to reply to my response (for the exchange see <http://bostonreview.mit.edu/BR27.5/exchange.html>).

In his reply Orr takes me to task for not responding to the many particular objections he raised against my work in his original review, suggesting that this was the result of bewilderment on my part and intelligent design running out of steam and not, as was the case, for lack of space. This sort of rule-rigging by Orr and the *Boston Review* -- give the respondent a little space, and then let the original author crow about winning -- is to be expected. I actually find it encouraging, taking it as an indication of intelligent design's progress. Orr's review and follow-up hardly spell the death-knell for intelligent design or for my work in this area. Sooner or later (and probably sooner) Orr will find himself in a forum on intelligent design where the rules of engagement are not rigged in his favor. I look forward to his performance then.

## **2. The Significance of Michael Behe**

I want in this essay to deal in detail with Orr's review and his follow-up response. Let me begin with Orr's denunciation of Michael Behe's work on irreducible complexity. Orr contends that Behe's project has collapsed and requires an unqualified retraction. And since I tie my work to Behe's, Orr contends that my project is thereby overthrown as well. I want therefore to begin by reviewing Behe's project.

The controversy over Behe centers on a book he published in 1996 -- *Darwin's Black Box*. This widely influential book opened a great many ideas, central among them the concept of *irreducible complexity*. As Behe defines it, an integrated multipart functional system is irreducibly complex if removing any of its parts destroys the system's function. Orr interprets Behe's use of this concept in either of two ways, neither of which does justice to Behe's project. Thus Orr sees Behe as making either a purely logical or a purely empirical point. The logical point: Certain structures are provably inaccessible to a Darwinian mechanism. They have property P (i.e., irreducible complexity). But certain biological structures also have property P, so they, too, must be inaccessible to a

Darwinian mechanism. The empirical point: Certain biological structures are awfully complicated. There is not even a suggestion in the literature concerning the Darwinian mechanism for their construction. So chances are something beyond natural selection was responsible for their creation.

So stated, these are fundamentally different points and involve very different questions. If Behe seeks to make a purely logical point, then his model needs to be rigorous and mathematical after the fashion of Chomsky's demonstration that, for example, finite state automata are incapable of generating certain languages. If he wishes to make a purely empirical point, then he wastes his time to bring in the notion of irreducible complexity when what he really means is simply that the evolutionary pathways of certain biological objects have yet to be adequately explained. According to Orr, the conflation of these two different theses, the logical and the empirical, works rhetorically, but for a bad reason: it suggests in virtue of the sonority of the words "irreducible complexity," that something rigorous or well-defined is at issue when what is really at issue, provided Behe has abjured the logical point, is what has always been at issue between Darwinists and their critics -- the idea that life is "too damn complicated" to result from a blind, undirected, hit-or-miss, trial-and-error Darwinian process.

According to Orr, neither the logical point nor the empirical point nor a conflation of the two poses a challenge to evolutionary theory. Let's consider these options in turn. As for the logical point, irreducible complexity clearly cannot close off all possible avenues of Darwinian evolution. What irreducible complexity says is that all parts of a system are indispensable in the sense that if you remove a part and don't alter the other parts, you cannot recover the original function of the system. But that leaves the possibility of removing parts and modifying others to recover the original function. Also it leaves the possibility of removing parts and isolating subsystems that serve some other function (a function that could conceivably be subject to selection pressure). Irreducible complexity, treated as a logical restriction, therefore leaves loopholes for the Darwinian mechanism. (Orr portrays Behe as denying this point, but in fact Behe never denied such logically possible loopholes.)

As for the empirical point, it seems merely to commit the standard fallacy of arguing from ignorance. So what if certain biological systems are incredibly complicated and we haven't figured out how they originated? That doesn't mean the Darwinian mechanism or some other material mechanism didn't do it. It may just mean that we haven't yet figured out how those mechanisms did it. And as for conflating the logical and empirical points, that's the most disreputable option of all, for it makes Behe and fellow design theorists guilty of equivocation, using irreducible complexity to score a logical or empirical point as expedience dictates.

But this is too easy. In fact, Behe's project is more subtle than any of these criticisms suggests. Behe's project is properly conceived as making three key points: a logical, an empirical, and an explanatory point. What's more, he conflates none of them. The logical point is this: Certain structures are provably inaccessible to a *direct* Darwinian pathway. They have property P (i.e., irreducible complexity). But certain biological structures also

have property P, so they, too, must be inaccessible to a direct Darwinian pathway. This formulation looks similar to the previous logical point, but it differs in one crucial respect. In the previous formulation, inaccessibility was with respect to the Darwinian mechanism in toto and therefore with respect to all Darwinian pathways whatsoever, both direct and indirect. Here, the restriction is only on direct Darwinian pathways.

A direct Darwinian pathway is one in which a system evolves by natural selection incrementally enhancing a given function. As the system evolves, the function does not. Thus we might imagine that in the evolution of the heart, its function from the start was to pump blood. In that case a direct Darwinian pathway might account for it. On the other hand, we might imagine that in the evolution of the heart its function was initially to make loud thumping sounds to ward off predators, and only later did it take on the function of pumping blood. In that case an indirect Darwinian pathway would be needed to account for it. Here the pathway is indirect because not only does the system evolve but also the system's function. Now, as a logical point, Behe was only concerned with direct Darwinian pathways. This becomes immediately evident from reading Behe since in his definition of irreducible complexity, the function of the system in question always stays put.

Does Behe's definition of irreducible complexity render certain structures provably inaccessible to direct Darwinian pathways? As laid out in *Darwin's Black Box*, Behe's definition actually needed a little fine tuning. The problem is that Behe didn't address systems that could retain their function by removing parts and then modifying the other parts that remained (Behe only considered removal, not modification). But there's a quick fix here, which I describe in chapter 5 of *No Free Lunch*: strengthen the concept of irreducible complexity to include a minimal complexity condition. Essentially this condition says that the system cannot be simplified and retain the level of function needed for selective advantage. With this proviso, irreducible complexity logically rules out direct Darwinian pathways. Note that many of the irreducibly complex systems Behe considers (notably the bacterial flagellum) satisfy this proviso.

In ruling out direct Darwinian pathways to irreducibly complex systems, Behe isn't saying it's logically impossible for the Darwinian mechanism to attain such systems. It's logically possible for just about anything to attain any other thing via a vastly improbable or fortuitous event. For instance, it's logically possible that with my very limited chess ability I might defeat the reigning world champion, Vladimir Kramnik, in ten straight games. But if I do so, it will be despite my limited chess ability and not because of it. Likewise, if the Darwinian mechanism is the conduit by which a direct Darwinian pathway leads to an irreducibly complex biochemical system, then it is despite the intrinsic properties or capacities of that mechanism. Thus, in saying that irreducibly complex biochemical systems are provably inaccessible to direct Darwinian pathways, design proponents are saying that the Darwinian mechanism has no intrinsic capacity for generating such systems except as vastly improbable or fortuitous events. Accordingly, to attribute irreducible complexity to a direct Darwinian pathway is like attributing Mount Rushmore to wind and erosion. There's a sheer possibility that wind and erosion could sculpt Mount Rushmore but not a realistic one.

It's not clear whether Orr is willing to concede that direct Darwinian pathways are inherently incapable of generating irreducible complexity. At any rate, Orr looks to save Darwinism not by challenging this point but by putting his eggs in another basket, namely, by looking to indirect Darwinian pathways. How does Behe handle indirect Darwinian pathways? Here Behe's point is no longer logical but empirical. The fact is that for irreducibly complex biochemical systems, no indirect Darwinian pathways are known. At best biologists have been able to isolate subsystems of such systems that perform other functions. But any reasonably complicated machine always includes subsystems that perform functions distinct from the original machine. So the mere occurrence or identification of subsystems that could perform some function on their own is no evidence for an indirect Darwinian pathway leading to the system. What's needed is a seamless Darwinian account that's both detailed and testable of how subsystems undergoing coevolution could gradually transform into an irreducibly complex system. No such accounts are available or forthcoming. Indeed, if such accounts were available, Orr would merely need to cite them and intelligent design would be finished.

Critics of Behe are at this point quick to throw the argument-from-ignorance objection his way, but this criticism can't be justified. A common way to formulate this criticism is to say, "Absence of evidence is not evidence of absence." But as with so many overused expressions, this one requires some nuancing. Certainly this dictum appropriately characterizes many everyday circumstances. Imagine, for instance, someone feverishly hunting about the house for a missing set of car keys, searching under every object, casing the house, bringing in reinforcements, and then the next morning, when all hope is gone, finding them on top of the car outside. In this case the absence of evidence prior to finding the car keys was not evidence of absence. Yet with the car keys there was independent evidence of their existence in the first place.

But what if we weren't sure that there even were any car keys? The situation in evolutionary biology is even more extreme than that. One might not be sure our hypothetical set of car keys exist, but at least one has the reassurance that car keys exist generally. Indirect Darwinian pathways are more like the supposed leprechauns a child is certain are hiding in his room. Imagine the child were so ardent and convincing that he set all of Scotland Yard, indeed some of the best minds of the age, onto the task of searching meticulously, tirelessly, decade after decade, for these supposed leprechauns, for any solid evidence at all of their prior habitation of the bedroom. And then imagine that in all those decades, the detectives, driven by gold fever for the leprechaun's treasure let's say, never flagged in searching out and postulating new ways of catching a glimpse of a leprechaun, a leprechaun hair, a leprechaun fingerprint, any solid clue at all. After these many decades, with not a single solid clue to show for all that work, what should one say to the aging parents of the now aging boy if these parents decided there were no leprechauns in the boy's room? Would it be logical to shake your finger at the parents and tell them, "Absence of evidence is not evidence of absence. Step aside and let the experts get back to work." That would be absurd. And yet that, essentially, is what Orr and his fellow evolutionary biologists are telling us concerning that utterly fruitless search for credible indirect Darwinian pathways to account for irreducible complexity.

If after repeated attempts looking in all the right places you don't find what you expect to find and if you never had any evidence that the thing you were looking for existed in the first place, then you have reason to think that the thing you are looking for doesn't exist at all. That's precisely Behe's point about indirect Darwinian pathways (see his chapter in *Darwin's Black Box* titled "Publish or Perish"). It's not just that we don't know of such a pathway for, say, the bacterial flagellum (the irreducibly complex biochemical machine that has become the mascot of the intelligent design movement). It's that we don't know of such pathways for any such systems. The absence here is pervasive and systemic. That's why critics of Darwinism like Franklin Harold and James Shapiro (neither of which are ID supporters) argue that positing as-yet undiscovered indirect Darwinian pathways for such systems constitute "wishful speculations."

Behe's logical point is that irreducible complexity renders biological structures provably inaccessible to direct Darwinian pathways. Behe's empirical point is that the failure of evolutionary biology to discover indirect Darwinian pathways leading to irreducibly complex biological structures is pervasive and systemic, and that such a failure is reason to doubt that indirect Darwinian pathways are the answer to irreducible complexity. The logical and empirical points together constitute a devastating indictment of the Darwinian mechanism, which has routinely been touted as capable of solving all problems of biological complexity once an initial life form is on the scene. Even so, the logical and empirical points together don't answer how one gets from the failure of Darwinism to account for irreducibly complex systems to the legitimacy of employing design to account for them.

This is where the third main point of Behe's project comes in, namely, Behe's explanatory point. Scientific explanations come in many forms and guises, but the one thing they cannot afford to be without is *causal adequacy*. A scientific explanation needs to call upon causal powers sufficient to explain the effect in question. Otherwise, the effect is unexplained. The effect in question for Behe is the irreducible complexity of certain biochemical machines. How did such systems come about? Not by a direct Darwinian pathway -- irreducible complexity rules that out on logical grounds. And apparently not by indirect Darwinian pathways either -- the absence of scientific evidence here is complete (critics who claim otherwise are bluffing). What's more, appealing to unknown material mechanisms is even more tenuous.

Thus, when it comes to irreducibly complex biochemical systems, there's no evidence that material mechanisms are causally adequate to bring them about. But what about intelligence? Intelligence is well known to produce irreducibly complex systems (e.g., humans regularly produce machines that exhibit irreducible complexity). Intelligence is thus known to be causally adequate to bring about irreducible complexity. Behe's explanatory point, therefore, is that on the basis of causal adequacy, intelligent design is a better scientific explanation than Darwinism for the irreducible complexity of biochemical systems.

Behe's logical and empirical points are mainly negative -- they identify limitations of the Darwinian mechanism. Behe's explanatory point, by contrast, is positive -- it provides positive grounds for thinking that irreducibly complex biochemical systems are in fact designed. One question about these points is now likely to remain. Behe uses the logical point to rule out direct Darwinian pathways and the empirical point to rule out indirect Darwinian pathways to irreducible complexity. But the absence of empirical evidence for direct Darwinian pathways leading to irreducible complexity is as complete as it is for indirect Darwinian pathways. It might seem, then, that the logical point is superfluous inasmuch as the empirical point dispenses with both types of Darwinian pathways. But in fact the logical point helps tighten the noose around Darwinism in a way that the empirical point can't.

If you look at the best confirmed examples of Darwinian evolution in the literature (from Darwin to the present), what you find is natural selection steadily improving a given feature performing a given function in a given way. Indeed, the very notion of "improvement" (which played such a central role in Darwin's *Origin of Species*) typically connotes that a given thing is getting better in a given respect. Improvement in this sense corresponds to a direct Darwinian pathway. By contrast, an indirect Darwinian pathway (where one function gives way to another function and thus can no longer improve because it no longer exists), though often inferred by evolutionary biologists from fossil or molecular data, tends to be much more difficult to establish rigorously.

The reason is not hard to see: By definition natural selection selects for preexisting function. It cannot select for future function. Once a novel function is realized, the Darwinian mechanism can select for it as well. But making this transition is the hard part. How does one evolve from a system exhibiting a preexisting selectable function to a new system exhibiting a novel selectable function. Natural selection is no help here and all the weight is on random variation to come up with the right and needed modifications during the crucial transition time when functions are changing (or, as Darwin put it, "unless profitable variations do occur, natural selection can do nothing"). The actual evidence that random variation can produce the successive modifications needed to evolve irreducible complexity is nil.

Behe's logical point about irreducible complexity ruling out direct Darwinian pathways therefore rules out the form of Darwinian evolution that is best confirmed. What's more, it rules out the only form of Darwinian evolution that is open to logical analysis. Indirect Darwinian pathways, by contrast, are so open ended that no logical analysis is capable of constraining them (almost invariably they are left unspecified, thus rendering them neither falsifiable nor testable). Behe's logical point therefore takes logic as far as it can in constraining the Darwinian mechanism and leaves empirical considerations to rule out what remains. And since logical inferences are inherently stronger than empirical inferences, Behe's has made his critique of the Darwinian mechanism as strong and tight as possible. It's not just that certain biological systems are so complex that we can't imagine how they evolved by Darwinian pathways. Rather, we can show conclusively that direct Darwinian pathways are causally inadequate to bring them about that indirect

Darwinian pathways, which have always been on much less stable ground to begin with, are utterly without empirical support in bringing them about.

To sum up, Michael Behe is significant in the debate between intelligent design and Darwinian evolution because he has taught us how to evaluate their relative merits. Behe has done this by giving us the concept of irreducible complexity and by showing us how to employ it. By carefully analyzing and disentangling the logical, the empirical, and the explanatory implications of irreducible complexity for the Darwinian mechanism, Behe has demonstrated that intelligent design is at the very least a viable contender in any attempt to explain the irreducible complexity of biochemical systems. What's more, he has shown how to bridge the scientific theory of design with our common-sense intuitions about design. In media reports on intelligent design, one often hears the following sound bite: "Life is too complicated to have arisen by natural forces so it must have been designed." This sound bite captures many people's intuitions about intelligent design, but for scientific purposes is too simplistic. Behe has shown us how to interpret this claim, substituting the rigorously defined phrase "irreducibly complex" for the vague and undefined phrase "too complicated," and showing how to reason our way properly from the inadequacy of undirected natural forces to design.

### **3. Evolutionary Logic**

Orr titled his reply to my response "Fantastically Flawed Proofs." Orr is convinced that intelligent design must be after logical certainty and mathematical proof in eliminating natural mechanisms for the emergence of certain types of biological complexity and that if ID proponents cannot attain that level of certainty, then our efforts are wasted. What's more, Orr rightly maintains that no logical impossibility prevents the Darwinian mechanism from bringing about Behe's irreducibly complex biochemical systems. Thus, if strict logical certainty were our aim, our case against Darwinian evolution would indeed constitute a "flawed proof," much as any putative theorem in mathematics would have a flawed proof if the justification offered did not follow as a strict logical deduction from accepted axioms or premises.

But logical certainty or mathematical proof were never the issue. We are, after all, in the realm of science and empirics and not in the realm of pure mathematics and logic when it comes to understanding the emergence of biological complexity (despite mathematics' relevance to the discussion). In consequence, logical possibility and impossibility had better not be our only criteria for assessing the emergence of biological complexity. If they were, we wouldn't need Darwin. Indeed, there's no logical impossibility for some vastly improbable thermodynamic accident to bring about all the nifty life forms we see in nature. Chance unaided by natural selection is fully capable of accounting for biology if logical possibility and impossibility are our only constraints on theory construction.

Yet for Orr, intelligent design purports to show that it is logically impossible for the Darwinian mechanism to generate irreducibly complex biochemical systems. And since there is in fact no logical impossibility for the Darwinian mechanism to accomplish this

feat, intelligent design has no traction against Darwinism and can safely be ignored (at least on scientific, though perhaps not on political, grounds). Orr lays out this logic less graciously in his reply to my response: "The discussion has, in other words, taken the following form: BEHE: Darwinism can't possibly produce IC [i.e., irreducibly complex] systems. ORR: Darwinism *can* produce IC systems. Here's how.... DEMBSKI: Orr has merely shown that a Darwinian explanation is *possible*. What a risibly low standard!"

I've already indicated why Behe is not properly interpreted as employing irreducible complexity as a criterion for establishing the strict logical impossibility of Darwinism. The more interesting point, however, is what happens when the demand for strict logical impossibility is relaxed and irreducible complexity is used as Behe intended it and as I described it in the last section, namely, to block direct Darwinian pathways on logical grounds (the logic here being the one intrinsic to the Darwinian mechanism and not the logic of impossibility) and to block indirect Darwinian pathways on empirical grounds. In that case, with less than logical impossibility working for it, can irreducible complexity nonetheless pose a challenge to Darwinism? Behe and I argue the answer to this question is yes. More interesting for this discussion, however, is why Orr thinks the answer is no.

A moment ago I remarked that unless intelligent design can rule out Darwinism as a strict logical impossibility, Orr regards intelligent design as waste of time and as having no scientific traction against Darwinism. The question we should be asking is why Orr, as a scientist, raises the standard so high against intelligent design. Certainly he realizes that as a criterion for judging claims, strict logical possibility/impossibility applies only in mathematics. Orr might answer that intelligent design proponents have themselves set so high a standard and that he is merely reporting that fact. But Orr was reviewing my book *No Free Lunch*, and I carefully avoid tying intelligent design's critique of Darwinism to the unreasonably high standard of logical impossibility or mathematical certainty (though, granted, I employ mathematics). Nor does a charitable reading of Behe yield such an interpretation. So let me pose the question again: Why is intelligent design held to such a high standard when that standard is absent from the rest of the empirical sciences (nowhere else in the natural sciences is strict logical possibility/impossibility enforced, not even with the best established physical laws like the first and second laws of thermodynamics)?

What's behind this double-standard is a curious logic that propels evolutionary reasoning. I call it *evolutionary logic* or the *logic of credulity*. Evolutionary logic takes the form of a reductio ad absurdum. The absurdity is intelligent design or more generally any substantive teleology. For evolutionary biologists, to treat design or teleology as fundamental modes of explanation capable of accounting for the emergence of biological structures is totally unacceptable. Any valid argument (deductive, inductive, abductive, or whatever) that concludes design in such cases must therefore derive from faulty premises. Thus, in particular, any claim that entails, makes probable, or otherwise implicates design in the emergence of biological structures must be rejected. But evolutionary logic doesn't stop there. Not only must any claim that supports design be rejected, but any claim that rules out design thereby demands assent and commands belief. Hence evolution's logic of

credulity -- belief in an evolutionary claim is enjoined simply because it acts as a defeater to design and not because any actual evidence supports it.

Orr employs this logic time and again in his review and follow-up reply. For instance, Behe has decisively ruled out direct Darwinian pathways as unable to account for irreducibly complex biochemical systems. If indirect Darwinian pathways could also be ruled out as unable to account for such systems, that would sink Darwinism and support intelligent design. But intelligent design in biology is unthinkable -- *you can't go there!* So anything that that leads you there must be rejected and anything that protects you from going there receives support. The Darwinian conclusion: indirect Darwinian pathways are not ruled out and in fact account for the way such systems evolved. This is a counsel of credulity: Believe despite the lack of evidence because the alternative is unthinkable.

Behe decisively closes off avenues by which the Darwinian mechanism could have given rise to irreducibly complex systems. Yet instead of casting doubt on the Darwinian mechanism, Behe's closing off of avenues merely confirms for the Darwinist that the Darwinian mechanism operated through other avenues, which have the advantage of being completely unspecified and unsupported by empirical evidence, to wit, indirect Darwinian pathways. Behe rules out ways the Darwinian hypothesis might be true. Is this hypothesis therefore disconfirmed or brought into question? No. Instead, ways (however implausible) that the Darwinian hypothesis might remain true are thereby confirmed. Theodosius Dobzhansky, in critiquing the work of Pierre Grassé, remarked: "To appeal to some wonderful future discovery which may explain it all is contrary to sound scientific method." This criticism applies as well to Darwinists like Orr who invoke indirect Darwinian pathways (e.g., scaffolding and incremental indispensability) to explain irreducible complexity. For now the elucidation of such pathways await "wonderful future discoveries."

Orr is oblivious to the problem. No wonderful future discoveries are necessary to overcome the challenge of irreducibly complexity; according to Orr we know enough even now. Consider again Orr's "knock-down refutation" of intelligent design: "BEHE: Darwinism can't possibly produce IC [i.e., irreducibly complex] systems. ORR: Darwinism *can* produce IC systems. Here's how.... DEMBSKI: Orr has merely shown that a Darwinian explanation is *possible*. What a risibly low standard!" Let's focus on Orr's part in this imaginary dialogue, and specifically on the "Here's how...." Note the ellipsis. How, if at all, has Orr filled in the ellipsis? The Darwinian mechanism describes a certain process of evolution. For that process to explain IC systems, Darwinists need to show how such a process might actually produce such systems. To be sure, an exact historical re-enactment of how a particular IC system arose is not necessary (or even feasible in any of the cases I know, like the bacterial flagellum). But a detailed, testable reconstruction, as by some form of reverse evolutionary engineering, of how a particular IC system might have arisen is surely a small request of a theory that is supposed to be overwhelmingly confirmed and whose mechanism is supposed to have the creative power to engender the whole of biological complexity and diversity.

So how does Orr fill in the ellipsis in "Here's how...."? In fact he doesn't, at least not with sufficient specificity to assess the efficacy of the Darwinian mechanism in producing IC systems. Here's one example of Orr fleshing out how Darwinism is supposed to account for IC systems, taken from his review of *Darwin's Black Box* for the *Boston Review* six years ago:

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.... I'm afraid there's no room for compromise here: Behe's key claim that all the components of an irreducibly complex system "have to be there from the beginning" is dead wrong.

For convinced Darwinists, this argument may be all that's needed to refute intelligent design and shore up Darwin's theory. But for skeptics of Darwinism, why should such an argument be persuasive? Orr never offers anything more than such hand-waving, highly abstract scenarios for how irreducible complexity might arise. But something more is clearly required. Minimally what more is required is some detailed testable reconstructions or models that demonstrate how indirect Darwinian pathways might reasonably have produced actual irreducibly complex biochemical machines like the bacterial flagellum (not unspecified abstract systems designated by letters like "A" and "B"). Evolutionary biologists have nothing like this.

Richard Dawkins characterizes the case Behe and I make against Darwinism as an argument from incredulity. The idea here is that ID proponents suffer a lack of imagination and for that reason can't believe the truth of Darwinism (though don't forget about our political and religious motivations, which also blind us to Darwinism's truth). *But for lack of imagination Darwinism would be blazingly clear!* But in fact it's not a lack of imagination that's the problem. Rather, the problem is an undisciplined imagination that spins out possibilities with no respect for the constraints of logic or reality. Incredulity in such cases is another word for healthy skepticism. Indeed, the problem is not incredulity on the part of ID proponents but credulity on the part of Darwinists like Orr, whose confidence in Darwinism is as boundless as it is unfounded. Evolutionary logic is a logic of credulity. It inspires belief in the power of the Darwinian mechanism in the absence of evidence because the alternative (intelligent design) is unthinkable.

#### **4. Displacement -- The No Free Lunch Principle**

Given my title, it's not surprising that critics see my book *No Free Lunch* as depending crucially on the No Free Lunch theorems of Wolpert and Macready. But in fact, my key point concerns displacement, and the NFL theorems merely exemplify one instance (not

the general case). The basic idea behind displacement is this: Suppose you need to search a space of possibilities. The space is so large and the possibilities individually so improbable that an exhaustive search is not feasible and a random search is highly unlikely to conclude the search successfully. As a consequence, you need some constraints on the search -- some information to help guide the search to a solution (think of an Easter egg hunt where you either have to go it cold or where someone guides you by saying "warm" and "warmer"). All such information that assists your search, however, resides in a search space of its own -- an informational space. So the search of the original space gets *displaced* to a search of an informational space in which the crucial information that constrains the search of the original space resides. I then argue that this higher-order informational space ("higher" with respect to the original search space) is always at least as big and hard to search as the original space.

Thus, in constraining the search of an original space by employing information, you do not provide a non-teleological, design-free explanation for the success of that search (if indeed it turns out to be successful). Instead, the solution you find in the original space merely reflects the solution you already had in hand in a higher-order informational space. And if the one solution exhibits specified complexity, then so does the other. In particular, when non-telic processes output specified complexity, it is because they are taking pre-existing specified complexity and merely re-expressing it. They are not generating it for free or from scratch. To claim otherwise is like filling one hole by digging another. If the problem was to be rid of holes period (i.e., design), then you've not done it.

It's against this backdrop of displacement that I treat the No Free Lunch theorems. These theorems say that when averaged across all fitness functions of a given class (each fitness function being an item of information that constrains an otherwise unconstrained search), no evolutionary algorithm is superior to blind or random search. The No Free Lunch theorems come in a variety of forms depending on the class of fitness functions being averaged over. The two theorems originally published by [Wolpert and Macready](#) considered all fitness functions on a given space (Theorem 1) as well as all fitness functions indexed by time on a given space (Theorem 2). Note that with both these theorems fitness functions of a given type were left wholly unconstrained -- i.e., all functions of a given type (nonindexed in Theorem 1, time-indexed in Theorem 2) were there. What's more, the evolutionary algorithms employing these fitness functions were "no prior knowledge" algorithms. "No prior knowledge" simply means that the algorithm has no additional information for finding a solution other than what it gets from the fitness function. In general, arbitrary, unconstrained, maximal classes of fitness functions each seem to have a No Free Lunch theorem for which evolutionary algorithms cannot, on average, outperform blind search.

Obviously, the way around NFL is to start constraining a given class of fitness functions. So you don't like time-dependent fitness functions that vary independently of the progress of the evolutionary algorithm in reaching a solution; therefore constrain this class of fitness functions so that they depend on progress to a solution. So you don't like fitness functions closed under permutation (see [Igel and Toussaint](#)); therefore focus on classes

that are not closed under permutation. All such focusing and constraining imparts information. Provided that information is both complex and specified, I show you never get more specified complexity out of such evolutionary processes than was programmed into them through such constraining.

But Orr remains oblivious to the problem. In his review he writes:

Consider fitness functions that are as unsmooth as you like, i.e., rugged ones, having lots of peaks and few long paths up high hills. (These are the best studied of all fitness landscapes.) Now drop many geographically separate populations on these landscapes and let them evolve independently. Each will quickly get stuck atop a nearby peak. You might think then that Dembski's right; we don't get much that's interesting. But now change the environment. This shifts the landscape's topography: a sequence's fitness isn't cast in stone but depends on the environment it finds itself in. Each population may now find it's no longer at the best sequence and so can evolve somewhat even if the new landscape is still rugged. Different populations will go to different sequences as they live in different environments. Now repeat this for 3.5 billion years. Will this process yield interesting products? Will we get different looking beasts, living different kinds of lives? My guess is yes.

To be sure, fitness in biology varies with time. As organisms evolve and the environment changes, what the environment deems fit changes as well. But what exactly constrains the transition from one fitness landscape or function to the next? If there is no constraint, then we are in the position of Wolpert and Macready's Theorem 2, with evolutionary algorithms proceeding independently of their progress to solution and thus unable to outperform blind search (which means that even with 3.5 billion years of evolution, it's going to be vastly improbable that the evolutionary algorithm approaches a solution). Conveniently, Orr doesn't tell us what constrains the transitions. Presumably nature, unprogrammed and unguided, spontaneously gives rise to the right and needed transitions between successive fitness landscapes, thereby ensuring a form of complexity-increasing evolution. But that is precisely what needs to be explained. Yet for Orr there is no problem, only boundless optimism.

Just try to program Orr's time-varying/coevolving fitness landscapes and see if they produce solutions to interesting problems (i.e., produce specified complexity). You'll find one of two things. Either you'll get sludge because you didn't adequately constrain how fitness landscapes vary with time in response to a changing environment, or you'll get something interesting (specified complexity) because you carefully introduced constraints and thereby did design work that cannot be reduced to material mechanisms. For Orr it is enough to get some replicators, place them in an environment, and let the Darwinian mechanism run its course. Presto, nifty things will happen. No need to ask for details how they happen because the alternative (intelligent design) is unthinkable. Such is evolution's logic of credulity. Orr's shifting fitness landscapes that magically generate specified complexity float in from nowhere. As soon as you specify them and the process that varies them, you'll find that you've introduced specified complexity.

Orr has two strategies for getting around the challenge of the No Free Lunch theorems and displacement generally. One is coevolution -- fitness functions that vary over time in response to past evolution and changing environments. For Orr, the advantage of invoking such coevolving fitness functions to account for specified complexity is the same as the advantage of invoking indirect Darwinian pathways to account for irreducible complexity. In each case Orr invokes an unspecified Darwinian process that accounts for the thing that needs to be explained. And since such a process is the only reasonable alternative to intelligent design, it has to be true. As Paul Ewald put it, "It's like arithmetic." Case closed. QED. (For more on evolutionary logic and the logic of credulity go [here](#).)

The interesting thing is that a coevolutionary process doesn't buy you anything that you didn't already have with a standard evolutionary process once the processes in question are specified. In the latter case you only have to specify a given fitness function. In the former you have to specify how the fitness functions vary with time. But in either case the displacement problem kicks in with full force. Orr takes me to task for not adequately dealing with coevolution (i.e., time-varying fitness functions):

But don't let him [Dembski] tell you that it [the failure of Darwinian evolution to account for specified complexity] follows ineluctably from some mathematical theorem because it doesn't. The troubling thing is that the above scenario [the one with shifting fitness landscape over a 3.5 billion year time frame described in the previous quote by Orr] isn't some contrived attempt to sidestep Dembski. It's the standard explanation of why organisms don't get permanently stuck on local peaks. For one brief moment Dembski seems to realize that changing environments might matter, pulling the rug out from under his it-won't-go-anywhere argument. But the worry is quickly dispatched with a footnote: "More precisely,  $f$  needs to be an evolving fitness function indexed by time. My argument, however, remains intact." Unfortunately it doesn't.

The footnote to which Orr refers occurred in section 4.8 of *No Free Lunch*. Perhaps Orr stopped reading after that section because if he had continued to section 4.10, he would have found an entire section (and thus considerably more than a "brief moment") devoted to fleshing out that footnote, a section titled "Coevolving Fitness Landscapes." In that section I show that coevolving fitness landscapes are mathematically equivalent to evolution with respect to a fixed fitness landscape. The argument requires reconceptualizing the configuration space so that coevolving fitness, as it were, gets built into it. The upshot is that coevolution introduces no new mathematics and therefore no way out of the displacement problem. If displacement is a problem for evolution with respect to a single fitness landscape, then it remains a problem for coevolving fitness landscapes. That's why in the footnote that Orr cites I state -- and continue to maintain -- that my argument remains intact. Orr should have read further.

Just as Orr gives no evidence of having read to section 4.10, he gives no evidence of having read the preceding chapters, and especially chapter 3. In that chapter I lay out the

law of conservation of information or what I also call the fourth law of thermodynamics (this latter terminology being consistent with recent work of Stuart Kauffman but also hearkening back to some reflections by Victor Weisskopf). That law establishes the inability of material mechanisms to generate specified complexity de novo. I contend that this result follows with the same force and rigor as the other laws of thermodynamics. An ambitious claim no doubt, but one Orr never engaged. Yet for failing to engage it Orr is in no position to deny that there are powerful mathematical reasons for claiming that specified complexity is beyond the reach of material mechanisms. In fact, there are such powerful reasons, and I lay them out in chapter 3. Those reasons undergird the entire discussion of displacement and No Free Lunch theorems in chapter 4 (the chapter to which Orr devotes the most attention in his review). Chapter 4 is about how the Darwinian mechanism re-expresses existing specified complexity. That the Darwinian mechanism cannot generate specified complexity is a consequence of chapter 3.

Orr's other strategy for getting around the challenge of displacement is to say that in biology there are no "prespecified targets," as though displacement depended on the explicit identification of patterns *prior to* their realization by physical processes. But the whole point of my conceptualization of specification was to generalize the patterns that are legitimate for eliminating chance and inferring design, rendering irrelevant the temporal ordering when the pattern was identified and when it was realized. Prespecifications occur in statistics, where they are known as rejection regions set up in advance of experiments. Dawkins's METHINKS IT IS LIKE A WEASEL is also an example of a prespecification.

But specifications, as I characterize them, occur more generally and are frequently discovered after the fact. What's more, they occur in biology. A bacterial flagellum is a bidirectional, motor-driven propeller. Humans invented such machines before they ever knew about bacterial flagella. Such systems are independently and objectively specified. Evolution had to perform a search to attain them. Perhaps not a conscious, goal-directed search, but a search nonetheless (certainly a sampling of possibilities). Such systems require explanation, and they require explanation precisely because they are specified (even Richard Dawkins admits as much -- see his *Blind Watchmaker* and *Climbing Mount Improbable*). What's more, for Darwinists like Orr, such systems have an explanation in Darwinian terms. Any dispute about Darwinism's ability to explain complex structures like the flagellum has nothing to do with their specification. Rather, it has everything to do with the probability of a Darwinian search being successful at finding a structure that matches the specification. That's the question that needs to be answered. So, when Orr writes "Nice Answer, Wrong Question," it's simply because he has redefined the question.

Let's stay with this point a moment because Orr's misdirection here is masterful. Darwinism, he asserts, isn't about finding prespecified targets but about differential survival and reproduction (or "sheer cold demographics" as he puts it). But this is doubly wrong. Darwinism is at least in part about finding specified targets (albeit not prespecified targets), the most obvious specification being the one that distinguishes life from nonlife (how else could Darwinism be cashed out in terms of survival and

reproduction?). What's more, Darwinism cannot simply be about demographics -- i.e., which organisms outreproduce which. That biological specifications (most of which are functional specifications) need to be accounted for in Darwinian terms is clear from the fact that Darwinists are constantly telling stories about how such specifications might have been realized. The formal theory for specifications that I develop maps onto the biology unproblematically and transcends the limitations of prespecifications (limitations that Dawkins correctly recognizes as applying to his METHINKS IT IS LIKE A WEASEL example).

As for Darwinism being simply about demographics, it's easy to see that this can't be the whole story. There are environments with replicators operating strictly under the control of a Darwinian mechanism that never do anything interesting (Orr takes me to task for using the word "interesting" in this way, so let me spell it out: *evolution does something interesting when it exhibits a net increase in specified complexity*). I detail several such scenarios in *No Free Lunch*, notably Sol Spiegelman's experiments on the evolution of polynucleotides in a replicase environment. Here you had a purely Darwinian form of evolution running along and actually simplifying the replicators to make them as efficient as possible in their replication. To be sure, none of this contradicts Darwinism. But that's just the point: Because "sheer cold demographics" is compatible with evolution leading to no net increase in specified complexity and quite possibly a net decrease, something else besides Darwinism must account for why we see a net increase of specified complexity over the course of biological evolution in the real world (or as I put it in *No Free Lunch*, for why "something interesting happens").

Orr won't acknowledge the problem. He writes:

Dembski's attempts to explain why Darwinism won't extrapolate don't wash. He offers two reasons. The first is that things get simpler not fancier under Darwinism. "Simplicity by definition always entails a lower cost in raw materials... than increases in complexity, and so there is an inherent tendency in evolving systems for selection pressures to force such systems toward simplicity." Darwinism thus chokes when confronting a biological world that's so baroque. This is an ancient argument and the replies to it are equally old. Even if selection favors simplicity, note that the history of life *must* show a trend of increasing complexity. The reason is this history starts at zero complexity. On average it can only go up (where we cannot see the descendants of lineages that crashed and burned back into zero complexity). There are also good reasons for thinking that organisms get stuck at higher levels of complexity. John Maynard Smith and Eörs Szathmáry argue at book length that the formation of complex assemblies is often irreversible. When free living mitochondria and early cells came together, for instance, to make the first eukaryotic (true) cells, they swapped genes, so that mitochondrial proteins are now encoded by nuclear genes and vice-versa. At this point, things are essentially irreversible and the two partners can't go their separate, simpler ways. Dembski seems unaware of this well known point. Dembski's it-just-gets-simpler argument also relies on an erroneous assumption that natural selection cares primarily about the cost of raw materials. But selection

cares *only* about how many kids you have. If I use more raw materials but have more kids than you, my type gets more common, period.

Actually, I'm quite aware of all the points Orr raises in this paragraph. What's more, I never argued that Darwinism requires or entails that evolution proceed toward simplicity. My point was simply that Darwinism, in itself, does not mandate increasing complexity and inherently favors simplicity. Thus, if we see increasing complexity, something besides Darwinism must be at work. Now Orr offers several rationales for why we should expect increasing complexity strictly on Darwinian grounds (e.g., the irreversibility of certain changes and the lower wall of complexity below which things are dead). But all of these rationales are post hoc -- in each case the opposite might well have happened and Darwinism would still be true. Thus we can imagine (and even program on computer) Darwinian evolutionary scenarios in which reversibility has a selective advantage, in which arms races are won by simplifying, and in which the lower wall of complexity is an absorbing barrier where maximal fitness is conferred by being maximally simple.

For Orr there is no problem with evolution producing increased complexity. Thus for me to challenge Darwinism for failing to account for a complexity-increasing form of evolution is merely to repeat an "ancient argument" for which "the replies to it are equally old." Orr's sniffing and yawning are evasions, serving merely to sweep important unresolved problems under the rug. His post-hoc rationalization for Darwinism underwriting a complexity-increasing form of evolution certainly doesn't establish his point -- *post hoc ergo propter hoc* is, after all, a fallacy. But more significantly, scholars who have thought more deeply about this problem than either Orr or I see a deep mystery here. Consider the following remark by Stuart Kauffman at a recent ISCID online discussion (see special feature in this issue of *PCID*):

One of the deep puzzles is why the universe has become complex. Why has the biosphere become complex? Why has the number of ways of earning a living increased so dramatically? We have no theory about this overwhelming feature of our universe. I propose in *Investigations* that biospheres, on average, increase the diversity of "what can happen next," their "adjacent possible," as fast as they can without destroying the order already achieved. At least it is a possible start in this direction.

What for Orr is a foregone conclusion is for Kauffman a deep mystery. Who's right? Is the fact that the biophysical universe is complexity-increasing a profound problem awaiting resolution or one that, at least in biology, has received a decisive answer from Darwinism? I've talked to Kauffman personally about this problem, and we've discussed the Darwinian rationales that Orr rehearses. I won't even gesture at resolving the problem here, but it should be clear that Orr's dismissal of the problem is far too easy.

I want to wrap up this section by drawing an analogy between displacement and Church's Thesis. Displacement, or what I'm now also calling the No Free Lunch Principle (not to be confused with the No Free Lunch theorems), functions within the theory of intelligent design in much the same way that Church's Thesis functions within the theory of

computation. Church's Thesis states that if you have some procedure that is intuitively computable (i.e., that can be characterized with well-defined rules), then it can be coded as an algorithm running on a Turing machine. The No Free Lunch Principle states that if you have some naturalistic process whose output exhibits specified complexity, then that process was front-loaded with specified complexity. The task of the design theorist in that case is to "follow the information trail" and show where the specified complexity that was outputted was first inputted (much as the task of the computer scientist is to show how some procedure that is intuitively computable can be explicitly formulated as an algorithm capable of being run on a Turing machine).

Note that there is no -- and indeed can be no -- mathematical proof in the strict sense of either Church's Thesis or the No Free Lunch Principle (for the latter, there's always the outside possibility that specified complexity could happen as a wildly improbable event). Even so, the two are subject to empirical verification. With Church's Thesis, the challenge is to show that the intuitively computable invariably submits to the formally computable. With the No Free Lunch Principle, the challenge is to show where the specified complexity outputted by a naturalistic process was in fact front-loaded. Evolutionary biologists regularly claim to obtain specified complexity for free or from scratch. In chapter 4 of *No Free Lunch* I run through case studies showing where the specified complexity supposedly gotten for free was in fact smuggled in (Thomas Schneider is one of the worst offenders in this regard). Think of the No Free Lunch Principle, therefore, as an auditor's tool for scrutinizing Darwinism's inflated claims and ultimately showing the theory to be bankrupt.

## **5. Conclusion: Orr's Tu Quoque**

According to Orr, neither specified complexity nor irreducible complexity is beyond the reach of Darwinism. Yet to justify this claim, all Orr has done is describe supposedly possible Darwinian pathways, in highly abstract and schematic terms, to which, in the case of Darwinism, no significant details have been added since the time of Darwin (and, I would urge, none has been added even since the time of Empedocles and Epicurus). In consequence, critics of Darwinism who say it is merely a theory don't go far enough -- it doesn't even deserve to be called a theory. No Darwinist, for instance, has offered a hypothetical Darwinian production of any tightly integrated multi-part "adaptation" with enough specificity to make the hypothesis testable even in principle. When it comes to the large-scale evolutionary changes needed to account for the complexity and diversity of life, Darwinism is a pile of promissory notes for future theories, none of which has been redeemed since the publication of Darwin's *Origin of Species* almost 150 years ago.

The charge here is the same charge I've been making throughout this paper. I've variously tagged it "causal specificity," "sheer versus real possibilities," "failure to provide detailed, testable models," and so on. The essential point behind this charge is a demand for details. The devil is in the details, and ID proponents want to see the details by which the Darwinian mechanism accomplishes the magnificent feats attributed to it. But since those details are neither available nor forthcoming, ID proponents suggest that it is time for

Darwinism's exclusion of design from biology to end. Orr, to be sure, will have none of this. In particular, he doesn't regard the absence of such details as reason to question Darwinism. Yet by neither filling in those details himself nor by pointing us to where they may be found, Orr does not help Darwinism's credibility. To be sure, convinced Darwinists need no such details, but skeptical outsiders do, and those outsiders constitute the bulk of the American population (hence Kansas, Ohio, Cobb County, etc.). Orr therefore turns the tables with a tu quoque:

The causal specificity argument is also an exercise in nerve. We are, recall, trying to choose between two theories [note the admission that intelligent design is a theory -- what progress!]. One says bacterial flagella were built by mutation and selection and the other says they were built by an intelligent designer. And Dembski concludes the *first* theory lacks historical concreteness? *Darwinism* suffers a shortage of specificity? When, after all, did Dembski's designer come up with plans for flagella? Just how did he reach out and shape that flagellum? Which protein did he move first or did he touch them all at once? It is the height of hypocrisy for Dembski to complain that Darwinism lacks causal specificity when his own theory lacks *any* specificity, including one atom of historical concreteness. Dembski may not have much of an argument, but you've got to admit he's got chutzpah

Orr's countercharge is not nearly as potent as he thinks. The reason is that causal specificity is a burden for Darwinism in a way that it is not for intelligent design. Darwinism is a theory about process. Darwinism says that a certain type of process took organisms of type A and transformed them into organisms of type B. The Darwinian process occurs in discrete steps (the finest level of resolution of those steps being the generation of one organism from another in reproduction). Darwinism is committed to a sequence of manageable steps that gradually transforms A into B. In consequence, there has to be some sequence such that  $A = A_1$  transforms into  $A_2$ , which in turn transforms into  $A_3$  ... which then transforms into  $A_n = B$ , where each transition from one step to the next can readily be accounted for in terms of natural selection and random variation. Thus, for instance, in a Darwinian explanation of the bacterial flagellum, we know that bacteria lacking a flagellum (and also lacking any genes coding for a flagellum) had to evolve into bacteria with a flagellum (and thus possessing a novel genetic complement for the flagellum). If Darwinism is correct, some step by step Darwinian process had to take us from the former type of bacteria to the latter. So how did it happen? How could it have happened? Nature somehow filled in the details, but Darwinists somehow never do. This is a fault in Darwin's theory, and intelligent design is rightly drawing attention to it.

But what about intelligent design? Orr suggests that the same fault applies to it, but it does not. Intelligent design, in contrast to Darwinism, is not a theory about process but about creative innovation. Now creative innovation is not a process. Creative innovation can occur in a process, but even then it is a process where each step constitutes an individual creative act (a micro-innovation, as it were). In our experience with intelligences, creative innovation is a unifying conceptual act that ties together disparate

elements into a purposeful whole. The act can occur over time in a process or it can occur in one fell swoop. But in either case, creative innovation is not reducible to a causal chain where one step "causes" the next. Causal specificity is about finding antecedent circumstances that account for and thus predict (whether deterministically or probabilistically) an event, object, or structure. But intelligences are free. In the act of creation they violate expectations. They create as they choose to create. There's nothing that required Mozart to compose his Jupiter Symphony or Bell to invent the telephone or Shakespeare to write *King Lear*. And there's no way to have predicted these creative innovations. Consequently, causal specificity applies secondarily, not primarily, to creative innovation and therefore to intelligent design.

In the theory of intelligent design, causal specificity comes up in the antecedent circumstances that condition (but do not determine, explain, or account for) creative innovation. Antecedent circumstances condition the possibilities of creative innovation. Technologies, for instance, evolve by building on previous technologies. But they evolve in the first instance by inventors having ideas. Where do those ideas come from? Causal specificity is not much help here. No set of antecedent circumstances can account for a creative innovation. Antecedent circumstances, however, need definitely to be considered for their effect on constraining the innovations that are produced. Beethoven, for instance, could not have written music for the piano until after the piano was invented. Hegel generalizes this point beautifully with regard to the unfolding of culture, showing how one cultural advance builds on the next. But note that for Hegel it is intelligence (*Geist*) that does the building and not brute material processes.

Causal specificity is certainly relevant to the antecedent circumstances that lead up to a creative innovation. It is also relevant in the aftermath of a creative innovation. Creative innovations, after all, have consequences. Causal chains flow out from them. Causal specificity therefore applies both to the lead-up and to the follow-up of a creative innovation. Indeed, that is where much of the intellectual labor on intelligent design will focus in coming years, namely, in tracing the antecedent circumstances that lead-up to and thereby condition the design of biological systems and then in tracing the impact of those systems throughout the biological world. Causal specificity therefore remains a live issue for intelligent design. But it is not the primary issue. The primary issue is to determine whether there is design (i.e., creative innovation by an intelligence) in the first place. Causal specificity is no help here. For that you need specified complexity. Once specified complexity is identified and design thereby detected, then causal specificity becomes an issue. I indicate how I see this interaction between specified complexity and causal specificity playing out in coming years in the "research themes" portion of my essay "Becoming a Disciplined Science: Prospects, Pitfalls, and Reality Check for ID" (see this issue of *PCID*).

Bottom line: Darwinism has a burden of proof that intelligent design does not have. Darwinism is a theory of process and therefore needs to provide convincing evidence that the processes it describes are able to bear the weight placed on them. That weight is considerable -- indeed, no less than the whole of biological complexity and diversity. Intelligent design by contrast has a different burden. As a theory of creative innovation,

its burden is to show where creative innovations first emerge and then trace their causal antecedents and consequents. Darwinism and intelligent design therefore face fundamentally different tasks, though there will be considerable overlap in their practical outworking (intelligent design, for instance, does not require that every aspect of biology be designed and is fully capable of assimilating the Darwinian mechanism). Ultimately what will decide the controversy between Darwinism and intelligent design is scientific fruitfulness. Darwinism, despite having many bright guys like Allen Orr to plough its fields and despite having all the research moneys you could want and despite having had almost 150 years to prove itself has come up empty in accounting for the emergence of biological complexity. Behe's book, which was the first major positive statement of intelligent design, was published a mere six years ago. Intelligent design researchers are presently few in number and cannot obtain government funding for their research. That will change. Interest is mounting. And George W. is after all my neighbor.

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