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WHAT IS WRONG WITH INTELLIGENT DESIGN?

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ABSTRACT

This article reviews two standard criticisms of creationism/intelligent design (ID): it is unfalsifiable, and it is refuted by the many imperfect adaptations found in nature. Problems with both criticisms are discussed. A conception of testability is described that avoids the defects in Karl Popper's falsifiability criterion. Although ID comes in multiple forms, which call for different criticisms, it emerges that ID fails to constitute a serious alternative to evolutionary theory.

ONE striking difference between the intelligent design (ID) position and earlier forms of creationism is that ID is often formulated as a comparatively modest claim. For example, Young Earth Creationism denied that human beings share common ancestors with other species while affirming that God was the designer of organisms and that life on earth is at most 10,000 years old. ID, at least when stated in a minimalistic form, is officially neutral on these three claims (Behe 1996, 2005). The single thesis of what I will call mini-ID is that the complex adaptations that organisms display (e.g., the vertebrate eye) were crafted by an intelligent designer. Scientists have challenged Young Earth Creationism by pointing to compelling evidence for common ancestry and ancient life forms. These challenges do not touch mini-ID. Does that mean that mini-ID is well supported by evidence?

This question about the evidential status of mini-ID differs from the psychological question of why it was developed. Although the rest of this paper will address the first query, a few comments are in order with respect to the second. ID proponents often make assertions that go beyond mini-ID's single claim.

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For example, they often affirm that the intelligent designer they have in mind is supernatural (Johnson 1991; Dembski 2002),and most deny common ancestry (Davis and Kenyon 1993; Dembski 1999). Why, then, do proponents of ID think that mini-ID is so important? After all, it leaves out so much. One reason is that versions of creationism that mention a supernatural being have a Constitutional problem—U.S. courts have deemed them religious, and so they are not permitted in public school science curricula. ID proponents hope that mini-ID can avoid this objection. In addition, mini-ID has the advantage of expressing an idea to which all creationists subscribe; it thus presents a united front, allowing the factions to stop squabbling and to face their common enemy.

Although mini-ID is modest in what it asserts, ID proponents have high hopes for what it will achieve. According to the Discovery Institute's "Wedge Strategy" (available at http://www.antievolution.org/features/wedge.html), which was leaked on the internet in 2001, "[d]esign theory promises to reverse the stifling dominance of the materialist worldview, and to replace it with a science consonant with Christian and theistic convictions." The Discovery Institute is the flagship ID think tank, and the "Wedge Strategy" is its political manifesto. So much for questions about religious motivation and political context (Forrest and Gross 2004). What about the evidence?

The "No Designer Worth His Salt" Objection

Many biologists take the fact that adaptations are often imperfect to provide a decisive objection to creationism and to mini-ID. Charles Darwin presents this type of argument (Burkhardt et al. 1993:224). More recently, Stephen Jay Gould(1980) made the objection famous in his discussion of the panda's thumb. The "thumb" is a crude spur of bone that enables pandas to laboriously strip the bamboo they eat. Gould contends that if a truly intelligent designer had built the panda, the panda would possess a far more efficient device for preparing its meals. Biologists have cited other examples, but the conclusion drawn is the same—since no designer worth his salt (Raddick 2005) would produce the many imperfect adaptations we observe in nature, creationism is false.

This criticism concedes that creationism is testable. In addition, it assumes that the designer, if he existed, would have wanted pandas to have a more efficient device for stripping bamboo. Creationists have a reply to this criticism. How does Gould (or anyone else) know what God (or some unspecified designer) would have wanted to achieve in building the panda (Nelson 1996; Sober 2005)? This is a good reply by creationists, but it is one that invites an entirely different, but equally serious, criticism of ID.

Popper's Falsifiability Criterion

If imperfect adaptations do not demonstrate that the mini-ID claim is false, perhaps the right criticism is that this statement cannot be tested. But, what does testability mean? Scientists often answer by using Karl Popper's concept of falsifiability (Popper 1959). According to Popper, a hypothesis is falsifiable precisely when it rules out a possible observational outcome. Popper understood "ruling out" in terms of deductive logic; a falsifiable statement is logically inconsistent with at least one observation statement. Popper further suggested that falsifiability provides a demarcation criterion, separating science from nonscience.

Popper's account entails that some versions of creationism are falsifiable, and hence scientific. Consider, for example, the hypothesis that an omnipotent supernatural being wanted everything to be purple, and had this as his top priority. Of course, no creationist has advocated purple-ID. However, it is inconsistent with what we observe, so purple-ID is falsifiable (the fact that it postulates a supernatural being notwithstanding). The same can be said of other, more modest, versions of ID that do not say whether the designer is supernatural. For example, if mini-ID says that an intelligent designer created the vertebrate eye, then it is falsifiable; after all, it entails that vertebrates have eyes. An even more minimalistic formulation of ID is also falsifiable; the statement that organisms were created by an intelligent designer entails that there are organisms, which is something we observe to be true.

Probability Statements Are Not Falsifiable

In addition to entailing that many formulations of ID are falsifiable, Popper's criterion also has the consequence that probability statements are unfalsifiable. Consider the statement that a coin has a 50% probability of landing heads each time it is tossed. This statement is logically consistent with all possible sequences of heads and tails in any finite run of tosses. Popper attempted to solve this problem by expanding the concept of falsification. Rather than saying that *H* is falsified only when an observation occurs that is logically inconsistent with *H,* Popper suggested that we regard *H* as false when an observation occurs that *H* says is very improbable. But how improbable is improbable enough for us to be warranted in rejecting *H*? Popper thought that there was no objectively correct answer to this question; the choice of cut-off is a matter of convention (Popper 1959:191).

Popper's idea has much in common with Ronald Fisher's test of significance (Fisher 1959). According to Fisher, if *H* says that an observation *O* is very improbable, and *O* occurs, then a disjunction is true—either *H* is false or something very improbable has occurred. The disjunction does follow, but it does not follow that *H* is false, nor does it follow that we should reject *H*. As many statisticians and philosophers of science have recognized (Hacking 1965; Edwards 1972; Royall 1997), perfectly plausible hypotheses often say that the observations have low probability. This is especially common when a probabilistic hypothesis addresses a large body of data. If we make a large number of observations, it may turn out that *H* confers on *each* observation a high probability, although *H* confers on the *conjunction* of observations a tiny probability. If Fisher's test of significance fails to provide a criterion for when hypotheses should be rejected, it also fails to describe when a hypothesis is falsifiable. Perhaps Popper's *f*-word should be dropped.

The fact that Popperian falsifiability fails to capture what testability is does not mean that we should abandon the latter concept. Rather, a better theory of testability is needed.

Testing Is Comparative

To develop an account of testability, we must begin by recognizing that testing is typically a comparative enterprise. If ID is to be tested, it must be tested against one or more competing hypotheses. Creationists now single out evolutionary theory as their stalking horse. Before 1859, the competing theory was the vaguer idea of "chance"—that a mindless random process is responsible for the complex adaptations we observe. The details of these alternative hypotheses do not matter to the problem at hand, but they contribute an insight into the kinds of observational consequences that a formulation of ID needs to have if it is to be tested against its competitors. For example, if mini-ID says that an intelligent designer made the vertebrate eye, and this claim is to be tested against the claim that chance produced the vertebrate eye, we must discover how these two hypotheses disagree about what we should observe. Since both entail that vertebrates have eyes, the observation that this is true does not help. We need to find other predictions that mini-ID makes.

Duhem's Thesis

An additional point needs to be taken into account. As the philosopher Pierre Duhem (1954) emphasized, physical theories, on their own, do not make testable predictions. One needs to add "auxiliary propositions" to the theories one wishes to test. For example, the laws of optics do not predict when eclipses will occur. However, if propositions about the positions of the earth, moon, and sun are added to these laws, they do make predictions. Duhem's thesis holds for most theories in most sciences, and it has wide applicability when prediction is understood probabilistically, not just deductively.

Duhem's point applies to mini-ID. Taken alone, the statement that an intelligent designer made the vertebrate eye does not have observational consequences beyond the entailment that vertebrates have eyes. However, mini-ID can be supplemented with further assumptions that allow it to have additional observational entailments. For example, suppose we assume that if an intelligent designer made the vertebrate eye, that he would want

it to have the set of features *F*. Mini-ID, when supplemented with this auxiliary assumption, has implications about the detailed features that the eye will have. Just like the laws of optics, mini-ID does not predict much until auxiliary assumptions are added. Does this mean that mini-ID is no worse than the laws of optics?

Auxiliary Propositions Must Be Independently Supported

It is crucial to the scientific enterprise that auxiliary propositions not simply be invented. By inventing assumptions, we can equip a theory with favorable auxiliary propositions that allow it to fit the data. Conversely, a theory also can be equipped with unfavorable auxiliaries that lead it to conflict with the data. An important strategy that scientists use to avoid this nihilistic outcome is to insist that there be independent evidence for the auxiliary propositions that are used. When testing the laws of optics by observing eclipses, we do not arbitrarily invent assumptions about the positions of the earth, moon, and sun. Rather, we use propositions about their positions for which we have independent evidence.

When we test the laws of optics by observing eclipses, the auxiliary propositions we use are "independently justified" in the sense that our reasons for accepting them do not depend on (i) assuming that the theory being tested is true or (ii) using the data on eclipses. The reason to avoid (i) is obvious, since a test of optical theory should not be question-begging. But why avoid (ii)? The reason is that violating this requirement would allow us to show that any theory, no matter how irrelevant it is to the occurrence of eclipses, makes accurate predictions about them. For if *O* describes an observation about the occurrence of an eclipse, and *O* is used to justify the auxiliary propositions we use to test theory *N,* then we can simply construct the auxiliary proposition "not-*N* or *O*;" this disjunction must be true if *O* is, and this auxiliary proposition, when conjoined to *N,* allows *N* to entail *O*.

The important scientific strategy of rendering theories testable by finding independently justified auxiliary propositions does not work for mini-ID. We have no independent evidence concerning which auxiliary propositions about the putative designer's goals and abilities are true (Kitcher 1984). Surprisingly, this is a point that several ID proponents concede. For example, the influential ID textbook, *Of Pandas and People: The Central Question of Biological Origins,* states that "the message encoded in DNA must have originated from an intelligent cause. What kind of intelligent designer was it? On its own, science cannot answer this question; it must leave it to religion and philosophy" (Davis and Kenyon 1993:7). In the same vein, Philip Johnson (1991) says that the designer's motives are "mysterious" (p 67) and "inscrutable" (p 71).

What ID Proponents Say about Testability

Proponents of ID have had a variety of reactions to the charge that their position is not testable. Sometimes they embrace the criterion of falsifiability and claim that ID fills the bill:

> The concept of intelligent design entails a strong prediction that is readily falsifiable. In particular, the concept of intelligent design predicts that complex information, such as that encoded in a functioning genome, never arises from purely chemical or physical antecedents. . . . All that is necessary to falsify the hypothesis of intelligent design is to show confirmed instances of purely physical or chemical antecedents producing such information (Hartwig and Meyer 1993:160).

We have already seen why Popper's notion of falsifiability fails to capture what testability is. The point of relevance here is that these ID proponents have misapplied Popper's criterion. ID asserts that somewhere on the causal chains leading up to "complex information" there is an intelligent designer at work. If a newspaper contains complex information, ID proponents are not obliged to say that the press used to print the newspaper is intelligent; presumably, the press is just as mindless as the paper it produces. Rather, their claim is that if you look back further along the causal chain, you'll find an intelligent being. And they are right—there is a person setting the type.

If scientists observe that "purely physical antecedents" at time t_9 give rise to complex information at t_{10}, this does not refute the ID claim any more than a mindless printing press does. ID proponents will simply maintain that an intelligent designer was present at an earlier stage. If scientists press their inquiry into the more remote past and discover that mindless physical conditions at t_8 produced the conditions at t_9, ID proponents will have the same reply: an intelligent designer was involved at a still earlier time. If scientists somehow manage to push their understanding of the complex information that exists at t_{10} all the way back to the start of the universe without ever having to invoke an intelligent designer, would that refute the ID position? Undoubtedly, ID proponents will then postulate a supernatural intelligence that exists outside of space and time. Defenders of ID always have a way out. This is not the mark of a falsifiable theory.

In addition, the proponents of ID who make this argument have lost sight of the role of observation in Popper's concept of falsifiability. For a proposition to be falsifiable, it is not enough that it be inconsistent with a possible state of affairs; it must also be inconsistent with a possible observation. Granted, the ID position is inconsistent with the existence of complex information that never had an intelligent designer in its causal history. It is equally true that "all lightning bolts issue from the hand of Zeus" is inconsistent with there existing even one Zeus-less lightning bolt (Pennock 1999). These points fail to address how observations could refute either claim.

Defenders of ID often claim to test their position by another route, by criticizing the theory of evolution. Behe (1996) contends that evolutionary processes cannot produce "irreducibly complex" adaptations; since we observe such traits, evolutionary theory is refuted, leaving ID as the only position standing. Behe (1996) says that a system is irreducibly complex when it is "composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning" (p 39). Before considering whether evolutionary theory really does rule out irreducible complexity, I want to note that this argument does nothing to test ID. For ID to be testable, *it* must make predictions. The fact that a different theory makes a prediction says nothing about whether ID is testable. Behe has merely changed the subject.

One flaw in Behe's argument is his assumption that evolutionary processes must always involve a lockstep increase in fitness. This ignores the fact that contemporary evolutionary theory describes evolution as a probabilistic process. Drift can lead to evolutionary changes that involve no increase in fitness and even to changes that lead fitness to decline. Evolution does not require that each later stage be fitter than its predecessors. At least since the 1930s, biologists have understood that evolution can cross valleys in a fitness landscape.

The most that can be claimed about irreducibly complex adaptations (though this would have to be scrutinized carefully) is that evolutionary theory says that they have low probability. However, that does not justify rejecting evolutionary theory or accepting ID. As noted earlier, many probabilistic theories have the property of saying that a body of observations has low probability. If we reject theories because they say that observations have low probability, all probabilistic theories will be banished from science once they are repeatedly tested.

There is a second problem with Behe's position on irreducible complexity. The fact that a system can be segmented into n parts in such a way that it counts as irreducibly complex does not guarantee that the evolution of the system involved a stepwise accumulation of parts, moving from 0 to 1 to . . . to *n-1* to n parts coming on line. What we call "the parts" may or may not correspond to the historical sequence of accumulating details. Consider the horse and its four legs. A horse with zero, one, or two legs cannot walk or run; suppose the same is true for a horse with three. In contrast, a horse with four legs can walk and run, and it thereby gains a fitness advantage. So far so good—the tetrapod arrangement satisfies the definition of irreducible complexity. The mistake comes from thinking that horses (or their ancestors) had

to evolve their tetrapod morphology one leg at a time. In fact, the development of legs is not controlled by four sets of genes, one for each leg; rather, there is a single set that controls the development of appendages. A division of a system into parts that entails that the system is irreducibly complex may or may not correspond to the historical sequence of trait configurations through which the lineage passed. This point is obvious with respect to the horse's four legs, but needs to be borne in mind when other less familiar organic features are considered.

CONCLUSION

It is one thing for a version of ID to have observational consequences, something else for it to have observational consequences that differ from those of a theory with which it competes. The mini-ID claim that an intelligent designer made the vertebrate eye entails that vertebrates have eyes, but that does not permit it to be tested against alternative explanations of why vertebrates have eyes. When scientific theories compete with each other, the usual pattern is that independently attested auxiliary propositions allow the theories to make predictions that disagree with each other. No such auxiliary propositions allow mini-ID to do this.

It is easy enough to construct a version of ID that accommodates a set of observations already known, but it also is easy to construct a version of ID that conflicts with what we have already observed. Neither undertaking results in substantive science, nor is there any point in constructing a version of ID that is so minimalistic that it fails to say much of anything about what we observe. In all its forms, ID fails to constitute a serious alternative to evolutionary theory.

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REFERENCES

Behe M J. 1996. *Darwin's Black Box: The Biochemical Challenge to Evolution*. New York: Free Press.

Behe M J. 2005. Design for living. *New York Times* 7 February:A27.

Burkhardt F H, Browne J, Porter D M, Richmond M, editors. 1993. *The Correspondence of Charles Darwin: Volume 8, 1860*. Cambridge: Cambridge University Press.

Davis P, Kenyon D H. 1993. *Of Pandas and People: The Central Question of Biological Origins*. Second Edition. Dallas (TX): Haughton Publishing.

Dembski W A. 1999. Signs of intelligence: a primer on the discernment of intelligent design. *Touchstone* 12:76–84.

Dembski W A. 2002. *No Free Lunch: Why Specified Complexity Cannot Be Purchased without Intelligence*. Lanham (MD): Rowman and Littlefield.

Duhem P M M. 1954. *The Aim and Structure of Physical Theory*. Princeton (NJ): Princeton University Press.

Edwards A W F. 1972. *Likelihood: An Account of the Statistical Concept of Likelihood and Its Application to Scientific Inference*. Cambridge: Cambridge University Press.

Fisher R A. 1959. *Statistical Methods and Scientific Inference*. Second Edition. Edinburgh: Oliver and Boyd.

Forrest B, Gross P R. 2004. *Creationism's Trojan Horse: The Wedge of Intelligent Design*. Oxford and New York: Oxford University Press.

Gould S J. 1980. *The Panda's Thumb: More Reflections in Natural History*. New York: Norton.

Hacking I. 1965. *Logic of Statistical Inference*. Cambridge: Cambridge University Press.

Hartwig M D, Meyer S C. 1993. A note to teachers. Pages 153–163 in *Of Pandas and People: The Central Question of Biological Origins,* Second Edition, by P Davis and D H Kenyon. Dallas (TX): Haughton Publishing.

Johnson P E. 1991. *Darwin on Trial*. Washington (DC): Regnery Gateway.

Kitcher P. 1982. *Abusing Science: The Case Against Creationism*. Cambridge (MA): MIT Press.

Nelson P A. 1996. The role of theology in current evolutionary reasoning. *Biology and Philosophy* 11:493–517.

Pennock R T. 1999. *Tower of Babel: The Evidence Against the New Creationism*. Cambridge (MA): MIT Press.

Popper K R. 1959. *The Logic of Scientific Discovery*. New York: Basic Books.

Raddick G. 2005. Deviance, Darwinian-style. *Metascience* 14:453–457.

Royall R M. 1997. *Statistical Evidence: A Likelihood Paradigm*. London and New York: Chapman & Hall.

Sober E. 2005. The design argument. Pages 117–147 in *The Blackwell Guide to the Philosophy of Religion,* edited by W E Mann. Malden (MA): Blackwell Publishing.