

Intelligent Design

The phrase “intelligent design” refers first to a purportedly scientific theory about the origin and evolution of life on earth and second to a well-established movement that seeks to discredit Darwin’s theory of evolution and have this so-called theory accepted as normative science. The conflict seems on the surface to be just about evolution, but the goals of the intelligent design movement are much larger than this. The movement is really an attack on science as such, and as such it is very dangerous. I will start by explaining the ideas behind intelligent design first and get back to the politics later.

Before I go any further I need to say a word about the word “theory.” Theory unfortunately has two meanings that are almost exact opposites of each other. Offhand I can’t think of another word so cursed. The primary meaning, according to my dictionary, is an organized body of knowledge; organized in the sense that it fits within an intellectual framework, often, though not necessarily, organized with the help of mathematics. A good example would be the special theory of relativity in physics. It consists of two postulates, some simple mathematics, and a vast body of experimental observations that confirm the predictions based on the postulates. It comes as a package. It’s just simply true. Critics of evolution will often say that “it’s only a theory.” If we take them at their word, they seem to be saying that, yes evolution is an organized body of knowledge like relativity, but that somehow isn’t good enough.

Let me review Darwinian evolution considered as an organized body of knowledge. The earth is 4.5 billion years old. The earliest fossil evidence of life in the form of blue-green algae is about 3.5 billion years old. As geological time passed more and more complex and highly organized life forms appeared of which we are one of the more recent. According to Darwin these life forms came about in a gradual way through the accumulation of small genetic changes. As chromosomes divide, they seldom make exact copies of themselves. There are simple copying errors and a host of more exotic errors. For example, some sections of the chromosome can be copied twice. Unrelated genes can get hooked together. Extra genes can be inserted by viruses, etc. Most of these changes result in organisms that are not functional, but occasionally a change takes place that

enables the organism to cope more successfully with its environment. These individuals have an advantage in the struggle for survival, and so these new genetic modifications are spread through the population. Darwin saw many examples of this mechanism when he visited the Galapagos Islands. For example, there were several closely related species of turtles which differed in the configuration of their shells and necks. It was easy to see that these body parts had evolved to enable the turtles to browse the different forms of vegetation on the different islands. On some islands the good eating was to be found high off the ground on bushes. Turtles on these islands evolved high arching shells and long necks to enable them to reach higher. On other islands the predominant vegetation was in the form of grass and weeds. Turtles on these islands came equipped with the appropriate hardware for browsing. These changes occurred in a relatively brief period of geological time. Darwin's great hypothesis is that all life evolved in this way over a period of 3.5 billion years from the original cells of blue-green algae. Most biologists regard this as a fact. As David Attenborough put it, without evolution, nothing makes sense.

The proponents of ID claim that this is just wrong. According to them, these complex life forms could not have evolved in this way because, well, they are too complex. Therefore they must have been "designed" by some supernatural agency. The ID people prefer not to say who or what the designer is. In fact most of their statements are phrased in such a way that the question doesn't come up. They will say that some biochemical pathway or some biological adaption "shows evidence of design." As I hope to convince you later, this is a code word, and it means created by God. Calling it intelligent design was a brilliant public relations ploy, because it makes a frankly religious agenda look like a scientific theory. Let's look at the logic behind this so-called theory.

Let's start by admitting that life is incredibly complex. The human genome, for example, has roughly 6 billion base pairs. The biochemical pathways of a single cell are staggeringly complicated. Can we explain in detail how all this evolved? Of course not. Now Darwin's adversaries used to say that everything we don't understand must therefore be created by God. This argument might have worked back in the 18th century, but by now it is thoroughly discredited. It's called the god-of-the-gaps argument, and everyone knows that science keeps filling in the gaps.

To be taken seriously, the ID people must claim to prove *scientifically* that the observed complexity could not possibly have come about in a way that is consistent with the laws of chemistry and physics. This borders on logical contradiction, to prove scientifically that something cannot be proved scientifically. If the ID proponent's arguments were correct, they would have done exactly this. It would be, as they modestly claim, the discovery of the century. Unfortunately the arguments are wrong.

Before I go into the detailed arguments, let's provisionally accept the ID claims and ask what they say about the designer. First, the geological record looks very much like the product of evolution. Take the often-quoted example of the horse. The earliest recognizable horses appeared nearly 55 million years ago and were relatively small animals that browsed on bushes and other vegetation. Over the next 30 million years new species emerged, and during the past 20 million years this diversification continued, leading to as many as ten species, which include the modern horse as well as zebras and donkeys. The irony of this lineage is that all modern species of the horse family fit with a single genus, *Equus*. In the past the equine family tree actually included some three dozen extinct genera and a few hundred extinct species. The designer must have been extraordinarily extravagant to create all these species and then let them go extinct. Being supernatural he could create anything he wished. Why did he tinker with all these now extinct forms? And why did he do so in a way that looked like they were the natural product of evolution? Talking about the "designer" is disingenuous; this is really intelligent creation. Notice that the creator could not get away with creating just one individual. He/she/it would have to create perhaps thousands to be sure that the line survived. And what did the act of creation look like? Was there a great puff of smoke and flash of light? This outdoes the wildest thing you ever saw in a fantasy movie.

Notice that an omnipotent creator could have created the universe yesterday with the appearance of a universe that was 13.7 billion years old and created us at the same time with memories of a life that never existed. There is no logical way to disprove this; but as physicists like to say, a theory that explains everything explains nothing. The ID proponents claim that their theory is not like that; rather it is based on solid scientific reasoning. Let us look at those arguments in more

detail. Most intelligent design propaganda is just that – screed; long harangues against evolution. There are two scientists in the movement, however, who need to be taken seriously. They are Michael Behe who is a biochemist and William Dempski, a philosopher and mathematician. Both are knowledgeable men who have written books that to a layman at least seem enormously erudite and formidable.

Let's consider Behe first. His specialty is cellular biochemistry, and in this field he is undoubtedly an expert. His first book was entitled *Darwin's Black Box*, the black box in this case being the cell, about which Darwin could have known very little. Behe's examples are mostly taken from cellular chemistry and genetics. He does a good job of showing the staggering complexity of this tiny structure, the eukaryotic cell. His claim is that the cell is so complex that it could not be the product of evolution. To prove this he introduces the notion of "irreducible complexity." His favorite toy model to illustrate what he means by this is the old-fashion mousetrap. It consists of five distinct parts, all of which must be present to catch a mouse in the usual way. There is the platform, the catch, the spring, the hammer and the hold-down bar. If one of the parts is missing, you don't catch 80% of the mice; you don't catch any mice at all. The mousetrap could not have been assembled one part at a time because the intermediate steps would be useless. They would confer no advantage in the struggle for existence; so all species with partly-constructed mousetraps would become extinct. This is what is meant by irreducible complexity. Remove one part and the system becomes inoperative. It is irreducibly complex. Behe goes on to say that the probability that all five parts could come together by some random chance event is so vanishingly small that it could not happen. The mousetrap of course was designed by human beings. The implication is that biological systems that are irreducibly complex must have been designed in an analogous way by some supernatural Designer.

We need to think about what there is inside a cell that is analogous to a mousetrap, but first I must address the remark about probabilities. The statement is that events with very small probability don't happen. This is simply wrong as the following example illustrates. Suppose you are playing poker. What is the probability that your next hand will be a royal flush, say ace, king, queen, jack and ten of hearts? It's easy to work out with a pocket calculator. The answer is one chance in about

2.6 million for a probability of 4×10^{-7} . Now what is the probability of being dealt the worthless hand, four of hearts, three of clubs, five and seven of spades, and the queen of diamonds? Exactly the same, one chance in 2.6 million. The point is that the probability of being dealt *some* worthless hand is large, but the chance of being dealt any *specific* hand is one chance in 2.6 million. So *every* time you are dealt a hand in poker, an event with very small probability has occurred.

A second point about probabilities is this: we can calculate the probability of a royal flush because we know exactly what's in the deck, and equally important, we know the rules of poker. Calculating the probabilities for biological events is like calculating the probability of a winning hand when we don't know what's in the deck and we have no idea how the game is played.

Now back to the question of what inside the cell is like a mousetrap? One of Behe's favorite examples is the clotting of blood. The cascade of reactions that occurs during blood clotting is truly mind-boggling: thrombin activates accelerin, which, with Stuart factor, cleaves prothrombin; the resulting thrombin cleaves fibrinogen, making fibrin, etc. Knock out any of these innumerable steps and the animal either bleeds or clots to death. This sequence is clearly irreducible. The question is can we explain how this sequence evolved without resorting to miracles? The answer is yes.

To see what's wrong with Behe's argument, let's go back to the mousetrap. If you remove the catch and the hold-down bar the device is useless for catching mice, but as pointed out by the noted biologist Kenneth Miller, it's a dandy device for launching spitballs! You can also use it as a tie clip. Add a couple of magnets and it can be used for clipping grocery lists on the refrigerator. The hold-down bar by itself can be used as a toothpick. The point is that a mousetrap minus a few pieces no longer functions as a mousetrap, but it still might function in some other capacity that would give the organism some selective advantage.

Perhaps a better analogy would be a big computer program. Such programs are always assembled from subroutines. They are irreducibly complex in the sense that removing one subroutine would make them useless. The subroutines themselves, however, typically are originally written for some other program that served some other function. A good programmer will write his program in such a way that as

many pre-existing subroutines as possible can be cobbled together to produce his final masterpiece. There is no question of writing the entire program “from scratch.” This will be a good analogy if we can find evidence of these “subroutines” in more primitive organisms. The long chains of amino acid building blocks from which proteins are formed are formed fold into distinct patterns called “domains.” A domain is something like one of these subroutines. It can be swapped back and forth to make new programs, but they are specialized to the extent that they can be instantly recognized even if the programmer has made minor changes. Research has shown that the genes that code for the various clotting factors are remarkably similar. They differ in that the various domains are swapped back and forth among the various genes. The gene swapping mechanism is well understood. When DNA molecules are duplicated just before the cell divides, the machinery often makes a mistake and copies the same small section twice. The duplicate gene then becomes “raw material” that can be inserted into preexisting molecules. Detailed studies have shown that just six gene swapping events could have produced most of the clotting factors that are common to most vertebrates. Incidentally, it is not true as ID proponents claim that the clotting mechanism is irreducible in the sense that removing one of the factors would be fatal. Whales and dolphins lack one of the factors, and the fugu fish lacks three! Not only that, the sea squirt, a primitive creature without any blood to clot has most of the domains necessary to make clotting factors.

So how in general could evolution put things like this together to make a finished product that is irreducibly complex? The logic is 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 just helps 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. At the end of the day, many parts may all be required. The point is that there is no guarantee that improvements will remain mere improvements. Indeed because later changes build on previous ones, there's every reason to think that earlier refinements might become necessary. To give a trivial example from macroevolution, fish first walked on land using modified flippers for legs and air bladders for oxygen. These

eventually evolved into legs and lungs which, for land dwellers, are absolutely necessary.

The ID people claim there is no evolutionary mechanism that can build structures with irreducible complexity. This is just wrong. There are many other things about Behe's book that seem wrong or weird but which are arguably peripheral. The central argument, however, just doesn't hold.

This brings us to the second major scientific figure in the ID movement, William A. Dembski. Dembski is a prolific writer whose literary production – while covering an extensive span of subjects, from history of philosophy to probability theory, theology to information theory – seems to be all devoted to one idea: to prove that the universe in general and life in particular are the results of a design by an unnamed intelligent mind. He has written three books specifically about intelligent design: *The Design Inference*, *Intelligent Design*, and *No Free Lunch*. The first thing you will notice about these books is overwhelming burden of abstract mathematical notation as well as reference to various arcane fields of science and mathematics including information theory, complexity theory, statistical thermodynamics and formal logic. It is quite impossible for a layperson or even a reasonably educated scientist like me to analyze everything in these three volumes. I have to rely on a specialist, and this case I am relying on Mark Perakh, a theoretical physicist and expert on information theory, and his excellent book, *Unintelligent Design*.

Perakh's first point is that most of the heavy-handed mathematical notation serves no useful function. It says in a convoluted mathematical way what could be better stated in a few simple sentences. A spectacular example is shown on the next slide. With that reassurance I will explain a few of his key ideas with simple English sentences!

How could one identify an event as being due to design? According to Dembski this can be done with what he calls the *explanatory filter*. It works like this. He assumes that an event can have only one of three possible causes. Either it is the product of law (or regularity), chance (or accident), or design. If we can eliminate the first two, we have unambiguously identified design. The explanatory filter is a three-step process for doing this. The first step is to eliminate law as a possible

cause. To see what Dembski means by law, think of a quartz crystal. With its smooth faces and perfect hexagonal geometry, surely someone made it that way. There must be a designer, although in this case a human designer. But no – it has that shape because the atoms that make quartz crystallize in a particular way. They are just obeying the laws of physics and chemistry. The crystal is a product of law rather than design. According to Dembski we make this decision solely on the basis of probability. If the event has high probability it must be due to law.

The next step is to test if the event might be due to chance. This decision is also made purely on the basis of probability. In this case if the probability is intermediate, the event is rejected as being at least potentially due to chance.

To pass the third test of the filter the event must satisfy two criteria. It must have small probability, and it must have a property Dembski calls *detachability*. He explains this with the following example. Suppose you are walking along a path and you see a pattern of small pebbles in the dirt. They seem random to you, so you dismiss them as the product of pure chance. Then along comes an amateur astronomer who recognizes the pattern as one of the constellations, Orion the Hunter, for example. Since he recognizes the pattern he concludes that the pattern must be the result of intelligent design; someone who shares his interest in astronomy placed the pebbles in that particular way. Dembski tries to formalize this by introducing the terms *conditional independence*, *tractability*, and *delimitation*. So far as I can see this can be summarized easily as subjective recognizability. To conclude then, if the event has passed the previous two tests, if it has small probability, and if it has detachability it must be due to design.

There are a number of problems with this, which you probably have already spotted. Here are a few.

- He assumes that each event has a certain objective probability. It is as if every object or event comes with a number written on it, its probability. In fact probabilities must be calculated based on some knowledge. For example, what is the probability that water will freeze at 32 degrees? If you knew nothing about physics you would say that the probability is zero because there are an infinite number of temperatures at which it might freeze. If you knew a little about phase transitions you would say that the

probability is 100% because that's the freezing point of water. You see the point? We don't know there's a law because we have calculated the probability. We knew there was a law and that made it possible for us to calculate the probability. Another point about probabilities. At no point does Dembski specify what values of probability he would regard as "high," "intermediate," or "low."

- Dembski assumes that events are due either to law or to chance or to design and that these three factors are independent and disjoint. As you all know, most events in the real world are due to some complicated interrelations between law, chance, and sometimes, design.
- It is important that the explanatory filter allows no "false positives." If we can come up with an example that passes the filter but is obviously not due to design, then the procedure is worthless. Perakh has a cute example. Somewhere in the Caucasus Mountains is a mountain which from the right point of view, looks like a beautiful young woman lying on her side. Law? Of course not. Chance? Vanishingly small. Subjective recognizability? Absolutely!!

There is one other important idea that I need to discuss. Dembski claims to have proved a theorem called the Conservation of Information Theorem which he modestly calls one of the great discoveries in the history of science. "Natural causes are incapable of generating complex specified information (CSI)." There are several corollaries. "The CSI in a closed system of natural causes remains constant or decreases," and "CSI cannot be generated spontaneously, originate endogenously, or organize itself." This implication is obvious. If we find CSI in a biological system, then it must have been put there by a designer. Part of the problem here is that he never really defines CSI. It seems from several examples, however, that he is using CSI as a synonym for "meaningful content."

I must make a digression here. There is an important field in engineering and mathematics called information theory. The field originated in 1949 with the work of Claude Shannon who was thinking about how best to send digital signals over noisy channels. His work has found many practical uses. For example, you can watch a movie that is recorded on a scratched DVD. The information theory gurus

have figured out how to preserve the integrity of your movie even when some of the data on the disk are garbled. Information theory is also a branch of abstract mathematics, and some of the greatest mathematicians of the last century have contributed to it. Dembski is presumably an expert in this field (I am not), and has used some of the information theory formalism in proving and developing his theorems. One of the contributions of information theory is a precise quantitative definition of the amount of information contained in a text. A “text” might be a string of numbers or letters or a sequence of base pairs on a chromosome. The relevance to genetics and intelligent design is obvious. We can sequence a genome and calculate the amount of information it contains. If we discover a finite amount of information, as we surely must, then according to Dembski’s theorem, it could not have come about through any natural process. It must be the product of design. This would indeed be a remarkable result if it were true. Unfortunately it is not.

The flaw in the argument turns on the definition of information. According to the usual definition, the amount of information in a text is defined as the length of the shortest computer program that could reproduce the text. For example, consider the infinite sequence 1010101010..... You could generate this with a program with just a few lines. It has almost no information. Now consider a sequence of completely random numbers. The computer program would have to be as long as the string itself, and would in fact just be a copy of the string. Such a string has the maximum possible amount of information. This is counterintuitive. A completely random string has the maximum amount of information in this sense, and any string that carried a meaningful message would carry some lesser amount of information. How much information? It’s impossible to tell. Information theory has no way to deal with the concept of meaningful. Dembski’s work is riddled with this ambiguity. He constantly shuffles between these two meanings of the word information. It is a consistent inconsistency. As a result his work has lots of information (whatever your definition) but it’s meaningless.

If the theorem of conservation of information is interpreted with the usual definition of information it is also demonstrably wrong. This can be seen in a qualitative way with living organisms, but it can also be studied in a quantitative way with computer models. One program in particular looks at the way proteins bond to bases on the chromosomes. It starts out with a random sequence of bases

and repeats a cycle of replication, mutation and selection. Over the course of many generations the proteins bond better and better as the genes evolve. One can see the amount of information associated with the bases increase before your very eyes. A natural Darwinian process has created information! Incidentally, the program, called ev, is available on line. You can run it on your home computer.

So much for the science. Now I would like to tell you a bit about the history and politics of the intelligent design movement. The movement began in Berkeley (where else) in 1987. Phillip Johnson, a tenured professor of criminal law, had found evolution a stumbling block on the way to faith. For him, Darwinism represented much more than just an erroneous scientific theory. It was the essential underpinning of a worldview that was profoundly hostile to religious thought, and therefore to the founding principles of Western society. Johnson found a willing and well-funded sponsor for his ideas in the Discovery Institute of Seattle. Inspired and guided by Johnson, Discovery established a Committee for the Renewal of Science and Culture to provide intellectual and financial support for the leading advocates of ID. In 1998 Johnson assembled his ideas in an outline known as the Wedge document. The document became public when it was leaked to the Internet in 1999, although several years would pass before the Discovery Institute grudgingly admitted its authenticity. In discussing the scientific world view the document reads, “This materialistic conception of reality eventually infected virtually every area of our culture, from politics and economics to literature and art.”

What was to be done about this? Read on.

“If we view the predominant materialistic science as a giant tree, our strategy is intended to function as a wedge that, while relatively small, can split the trunk when applied at its weakest points.” The very beginning of this strategy, the “thin edge of the wedge,” was Phillip Johnson’s critique of Darwinism begun in 1991 in *Darwinism on Trial*, and continued in *Reason in the Balance* and *Defeating Darwinism by Opening Minds*. Michael Behe’s highly successful *Darwin’s Black Box* followed Johnson’s work. “We are building on this momentum, broadening the wedge with a positive scientific alternative to materialistic scientific theories, which has come to be called the theory of intelligent design.”

The target, you see, is not just Darwinism, but the whole of science and the materialistic foundations of the scientific process. So how well have they done with this agenda? So far as public opinion is concerned, outrageously well. So far as science is concerned, not so well as even Johnson has admitted. To some extent this affair came to a head in a trial held in federal court in Harrisburg, Pennsylvania. On December 14, 2004, a group of eleven parents of students in the Dover School District filed a lawsuit in federal court alleging that the Dover Board of Education had violated their constitutional rights. *Kitzmiller v. Dover*, as the lawsuit is known, charged that by using government power to bring the idea of intelligent design into public school classroom, the board had, in effect, established a religion in violation of the First Amendment to the Constitution. The case attracted much attention, and it shaped up to be the grand confrontation between the intelligent design movement on one hand and Darwinian science on the other. Eight of the leading proponents of ID signed on as expert witnesses and an impressive array of scientists defended Darwin. The trial turned out to be something of a rout. To begin with, five of the eight ID witnesses including Dembski failed to show up. The plaintiffs were able to show that not a single ID article had ever been published in a refereed scientific journal. They proved that the school board had acted with clear religious motivation. Perhaps best of all, they got Michael Behe up on the witness stand and showed him overwhelming scientific evidence that many of the things he claimed could not possibly be the result of evolution, in fact were. All Behe could do was shake his head and say, "Well, it's not good enough for me." The judge made some ironic comment to the effect that the necessity of convincing Behe would be too much of a burden on modern science.

Many people have compared *Kitzmiller v. Dover* with the Scopes trial many years ago. Kenneth Miller, the lead witness for the plaintiffs, compared it with the battle of Gettysburg, the turning point, the farthest intrusion of the enemy.

Let's hope so.