Biocomplexity

Again, in an attempt to avoid confusion, an explanation of scientific terminology as it is understood by this writer is fitting.

Order is a measure of the uniformity among elements within an ensemble. It entails simplicity, while disorder entails diversity and complexity. Entropy may be thought of as the incapacity for spontaneous change and as a measure of the number of macroscopically equivalent microstates. It is a measure of the information needed to describe or define or specify a system's complexity. In the *Los Angeles Times*, 6/28/08, Sean M. Carroll is quoted as saying, "One way of explaining entropy is to say it's the number of ways you can rearrange the constituents of a system so that you don't notice the change macroscopically." Thermodynamic decay from negentropy to entropy entails the transformation of order to disorder; nonrandomness to randomness; constraint to freedom; redundancy to variety; reliability to uncertainty. (As an example of spontaneous transformation of redundancy into variety, when pencils are packed parallel in a box, the number of different directions in which they are oriented is one, and minimally entropic. When spilled, the number of different directions in which they are oriented increases.)

Disorder arises in accordance with the second law of thermodynamics, which applies to closed systems. Life is not closed energetically, but it obeys the second law to the extent that it is closed in other respects. This law is mute on the issue of organization, which is measure of the specificity of interactions among elements. Organization entails specific, regular, differential, predictable discrimination. Disorganization entails random, erratic, unpredictable, indiscriminate interaction. Organization often arises at the expense of order. The organization of a subset can be fueled by the decay of the remainder of the system in which it is embedded, the net result being downhill thermodynamically. It is in accordance with the second law of thermodynamics that atoms nonmiraculously self-assemble into molecules so as to assume minimum energy states.

Let it also be reported at the outset that this writer has found the following sources to be useful.

In *The Origins of Order: Self-Organization and Selection in Evolution* (Oxford Uni. Press, 1993. ISBN 0-19-507951-5), Stuart A. Kauffman hypothesizes that life crystallized as an integrated, collectively self-reproducing metabolism after a certain critical complexity threshold was crossed. Less complex precursors are nonfunctional, hence the term *prebiotic*. In this model, normal entropic complexification provides the context out of which collective properties can arise in the absence of systematic integration. Once function arises in a subset, the system can organize via feedback-driven collapse toward a minimum energy configuration at the expense of the parts of the system that are nonfunctional and are thus free to atrophy with impunity. Like the coalescence of planets from a solar nebula of planetesimals, life could have been distilled from a biochemical nebula.

In *Complexity: The Emerging Science at the Edge of Order and Chaos* (Simon & Schuster, 1992. ISBN 0-671-87234-6), M. Mitchell Waldrop portrays complexity as the science of emergence. Order and chaos are given as the two fundamental classes of dynamical behavior. The former consists of simple, solid, stable, frozen, closed, equilibrium systems like crystals, in which nothing happens and from which nothing novel emerges. The latter is complicated, fluid,

unstable and turbulent. Systems that are complex and not merely complicated operate at an abstract phase boundary between order and chaos. This is the realm of dynamic, spontaneous pattern formation, whereas chaos consists of unstable, unpredictable incoherence. This boundary is the realm where dwells the possibility of life, adaptation, learning and intelligence. Such cooperative phenomena are neither static nor random. They entail nondirected, generic, collective properties, with no central control. These are properties not of matter but of organization, governed by abstract laws of dynamical form. They transcend matter, but the transcendent principle is not spirit, as in vitalism, but organization. They are defined by behavior, not composition. Thus, even if a machine is not alive, its dynamics may be. Life is regarded as the natural expression of complex matter wherein cell types, organisms, species, ecosystems and cultures all constitute self-consistent patterns.

Science mathematizes nature to distill its abstract essence, and analyzes nature to discover those few simple rules by which phenomena can be explained. However, neoclassical theory, which is ahistorical, is not competent to explain complex behavior. Biology thus paints itself into a corner by adhering strictly to equilibrium models, such as the Hardy-Weinberg equilibrium. Alternative, nonequilibrium models also explain the fixation of suboptimally designed systems.

In *Entropy, Information, and Evolution: New Perspectives on Physical and Biological Evolution* (edited by Bruce H. Weber, David J. Depew, and James D. Smith. 1988. The MIT Press), Steven Frautschi, in a paper titled "Entropy in an Expanding Universe," asserts that both order and disorder can grow simultaneously in an expanding possibility space when the rate of expansion of that space outpaces the rate of exploration. He writes that in such situations, equilibrium is a moving target, receding even as entropy "increases (as in any nonequilibrium reaction), but the entropy that would be achieved by attaining equilibrium . . . increases more (the system lags further behind the evolving conditions for equilibrium)."

In *A New Kind of Science* (Wolfram Media, Inc., 2002. ISBN 1579550088), Stephen Wolfram, explains that complex phenomena do not necessarily require complex explanations. Much complex behavior is reducible to and described by simple mathematical models, particularly fractals and cellular automata. Natural complexity is analyzable into simple rules whether or not nature actually employs these simple rules to generate complexity. (Recall that Ockham's Razor is a principle of logic, not an assertion about nature.)

In their 1983 paper *On the Role of Chance in Biology: the Stochastic-Deterministic Continuum* (J. Theor. Biol. 102:463), J.W. Glasser and R.G. Wiegert discuss how stochasticity diminishes as a system moves away from equilibrium. Dynamic systems theory, a.k.a. chaos theory, deals with nonequilibrium, nonlinear, hierarchical, complex system dynamics and the resulting emergent, collective properties of whole systems. It recognizes that laws continue to emerge at progressively higher integrative levels. Etiquette, for example, does not apply to atoms. Speciation, discussed further in a subsequent essay, is an example of bifurcation, which is typical within complex adaptive systems (CAS).

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Creationists typically allege that scientists believe exclusively in random processes. Science is committed to no such claim (*vix ea nostra voco*) and stands falsely accused of asserting that nature functions "by chance alone." The supposed contest between total randomness and divine creation is a false dichotomy. Science endorses neither assertion and thus

stands unscathed by such naive caricatures. Nevertheless, chance remains a popular straw man, as when one commentator wrote, "When I consider the complexities of life and the intricacies of the human mind and body, the Bible sounds much more rational to me." This demonstrates faulty consideration by an insufficiently intricate mind. Quantum mechanics may seem counterintuitive and even irrational, and yet it outperforms its competition in spite of the misgivings of those who do not understand it. And even quantum indeterminacy is still probabilistic, not totally random. Ironically, the very people who attack the straw man of randomness are those most likely to be still naively believing in Newtonian mechanics, which is devoid of randomness.

A spokesman for creationism says, "There are only two options here: We are all a great, big accident. Or we are not an accident." The emergence of life at random is not a current scientific postulate. To say that life is an accident is at least an accent fallacy. Science recognizes that life is certainly not *just* an accident. For example, instead of assuming that biological isomorphism occurs by chance, science properly takes homology to be the null hypothesis. Consequently, science does not dispute the claim that life is "too complex to have developed by chance," for chance does not exhaust the mechanisms of nature. ("Doc, it hurts when I do this.") Failure to recognize this merely exemplifies the Philosophers' Syndrome. According to this stance of universalizing one's disabilities via slothful induction, one's inability to complete a newspaper crossword puzzle is proof of the puzzle's insolubility, in spite of the publication of the solution in the following day's edition.

Another creationist has written, "I highly doubt that [life] is the product of chance." The supernatural is *a fortiori* to be doubted even more highly. Life is regarded by science to be the product of chance alone no more than planets are thought to continue in predictable orbits by chance alone. Life is no more accidental than is the falling of objects down rather than up. Creationists may believe in the equiprobability of falling up or down, or that a north magnetic pole is equally likely to repel a south magnetic pole as it is to attract it, but such miraculous scenarios are attributed to science falsely. Magnetic poles would constitute a misnomer were they not polarized. In such cases, a miraculous *un*loading of the dice would be required in order to achieve randomness. John Gray speculates on the consequences if "species are only assemblies of genes, interacting at random with each other and their shifting environments," which is an impossibility that need not be entertained.

The assertion that evolution is random is as much an accent fallacy as the assertion that humans consist of Hungarians. Even assuming random variation, equally integral to Darwinian evolution is selection. (Campbell's soup has been advertised using the slogan "Why settle when you can select?") As discussed below, selection entails differentiation, discrimination and preference, and is tautologically nonrandom, making the concept of random selection oxymoronic. And even chance has its laws. Gambling is probabilistic, yet the house wins because chance is not always blind. Selection may only be statistically deterministic, but it is a form of determination nevertheless.

Even in classical Darwinism, randomness only applies to variation, not selection. Modern evolutionary theory indeed recognizes many nonrandom modes of variation such that variation is no longer assumed to be uniformly distributed. Certain portions of a genome function as molecular clocks and are perfectly well explained by random drift, but some are not. Still, most creationists exhibit a monomaniacal and pervasively neglectful obsession with simple point mutations. Perhaps they simply got no further than this in their studies, unaware that the workings of nature are more diverse than is allowed for in such a slight and carelessly retrograde portrayal.

Restriction endonucleases recognize specific DNA sequences. Gene duplication and diploidy afford a safety net during genetic experimentation. Exon shuffling produces novel combinations of existing protein functionalities while avoiding frame shift problems. (Even now, human immunoglobulins result from genetic recombination that occurs within a single lifetime.) Some transposases insert transposons into the genome nonrandomly. Sex scrambles genes more than cloning does. Multi-organism populations supply survivors when lethal mutations arise and provide heterogeneity out of which selection can be made, in accordance with the Mark C. Bloom Principle: "You can't choose the right tire if you don't have a choice." (The value of polymorphism is reflected in the phenomena of hybrid vigor and inbreeding depression. As cheetah in the wild are discovering for themselves, "racial purity" is a recipe for extinction.)

In a letter to the *Los Angeles Times*, 8/19/05, Foster H. Shannon calls Intelligent Design (to be discussed presently) "a challenge to the absurdity asserted or implied by the majority of Darwinists that everything that exists is a colossal accident coupled with an exclusivist strategy to suppress all references to God or the Bible in the public square." As accident alone is indeed an absurdity, proper science does not assert it, as is known by anyone willing to crack a sufficiently scholarly book. Would that people like Shannon would so dare. Such assertions of accidentalism are made only by straw men or fools. One may as well mount a crusade against all the scientists who assert that the moon is made of green cheese. Other fools would like to pretended that no scientific alternatives to such absurdity exist, which they do, or that accidents do not happen, which they do. To be fair, scientific theories of undirected evolution, such as Kimuran drift, do indeed exist, but they lie outside of Darwinism and do not explain all biological phenomena. Also, as noted elsewhere, it is God who absents Himself from explanatory utility and is undeserving of social promotion.

In a letter to the *Los Angeles Times*, 10/1/05, Jean Brousseau refers to the "unsubstantiated assumption that the evolutionary principles evident within the natural world, including humanity, could not be part of the wisdom-filled creation we call our universe." An "unsubstantiated assumption" is tautological because when something is substantiated, it ceases to be an assumption. Science does not assume that nature *could* not have been divinely created, but only that it *was* not. Brousseau concludes, "Is it being 'really very intelligent' to imagine that this awesomely complex and beautiful, intricately measured and timed world just happened accidentally?" No, which is why science does not, though many are more than stupid enough to think that it does.

Michael Balter writes in the *Los Angeles Times*, 10/2/05, "Most scientists don't want any debate." They at least should not trouble themselves with old, resolved ones. Balter says that "intelligent-design theorists contend that natural selection fails to fully explain life's complexity, thus alternate explanations to evolution should be considered." Natural selection is not meant to explain complexity, but rather the lack of it. If this single isolated mechanism fails ("Doc, it hurts when I do this."), then, as per the example of Stuart Kauffman, other mechanisms should be sought (and are found) within nature first. The mistake (not counting Balter's split infinitive) is to look beyond nature before nature is exhausted. It is equally wrong to fail to recognize when nature has not yet been exhausted. Balter reports that hundreds of scientists have aligned themselves with statements such as: "We are skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life." Modern science makes no such claims. Random point mutations are known not to be the only source of biological variation, and, as Kauffman asserts, natural selection may not be able to impede the actions of

other natural mechanisms. Balter goes on to attribute to scientists the claim that "natural selection alone can account for life's complexity." Whether or not it can, it need not.

Similarly, some argue that the Cambrian explosion could not have resulted from natural selection alone. First of all, selection is not meant to explain diversity, as it functions only to reduce it. Additionally, natural selection does not exhaust the processes of evolution. It is a spurious synecdoche to equate evolution with natural selection alone and to dismiss the former because of some inadequacy with the latter. Kauffman asserts that selection is not necessary for generating biological order and is incapable of debugging genomes. To him, order is due not to selection, but to membership in an ensemble in which such properties are generic and typical. Such collective properties can be explained without natural selection, which may not be strong enough to alter or preclude them. Once the properties of the ensemble are explained, individual species are recognized as their deductive consequences.

Intelligent Design

The Intelligent Design Network website states: "The theory of intelligent design (ID) holds that certain features of the universe and of living things are best explained by an intelligent cause rather than an undirected process like natural selection. ID is thus a scientific disagreement with the core claim of evolutionary theory that the apparent design of living systems is an illusion."

If the word "certain" is meant to refer to a minority of features, then the majority rules and nature still enjoys net superiority. As to being "best explained," it is unclear how any phenomenon can be explained by the supernatural *at all*, let alone explained better than by natural alternatives.

As to a cause that is "intelligent," such a cause need not be conscious. In *Darwin's Dangerous Idea*, Daniel Dennett writes, "So Paley was right in saying not just that Design was a wonderful thing to explain, but also that Design took intelligence. All he missed – and Darwin provided – was the idea that this intelligence could be broken into bits so tiny and stupid that they didn't count as intelligence at all, and then distributed through space and time in a gigantic, connected network of algorithmic process."

Darwin thus disposed of the mistaken assumption that God exhausts the category of intelligent designers. As a result, the contest between Darwinism and intelligent design is revealed to be a falsely dichotomous accent fallacy because Darwinism is itself a theory of intelligent design, with nature identified as the designer. The *Mallard Fillmore* cartoon of 1/16/06 is consistent with this, though presumably by accident, when it implies that it is wrong to attribute the concept of intelligent design exclusively to "religious freaks." Also, those who fail to realize how the concept is consistent with Darwinism may simply be ignorant and not necessarily religious.

According to Waldrop, intelligence entails adaptation on short time scales. Adaptation by stochastic learning is possible even if only the reward and not the problem is defined for the agent. Accordingly, John Holland demonstrated the design of pipeline control protocols by means of artificial intelligence. Directional adaptation arises spontaneously in the presence of directional feedback. Thus, contrary to some assertions, the design that can be discerned in nature does not necessarily imply mind. Even if design requires a designer, feedback suffices in that role.

Conservatives abhor the centralized planning and control of communism or even big, bureaucratic capitalist governments, but they demand it in creationism and soul-based cognitive theories, where they reject Leslie Orgel's Second Rule ("Evolution is cleverer than you.") in favor of slothful induction and the Philosophers' Syndrome. Whether or not nature is actually cleverer than you, the point is that it is not obliged to be as stupid as you. In practice, trial-and-error systems can be as successful as centralized intelligent planning. This observation will be revisited in the essay on consciousness.

Conservatives oppose top-down politics, but creationists ironically offer a top-down creation story, when the current trend in science is bottom-up. Peter Mitchell's chemiosmotic theory, that active transport results from the vector sum of organized but dumb agents, proved such a fruitful guide to experimentation in bioenergetics that it earned Mitchell a Nobel Prize. By contrast, hypothesized conscious but mysterious designers tend to leave general explanatory vacuity in their wake. Consequently, in December 2005, U.S. District Judge John E. Jones III ruled against ID in a Dover, Pennsylvania, case, referring to its "breathtaking inanity."

As noted above, the phrase "undirected selection" is oxymoronic. No process is selective that is not directional or biased or discriminatory. If a mixture of corks and nails is dumped into water, the two groups of objects will spontaneously and nonmiraculously sort themselves according to their relative density, with the corks floating and the nails sinking, the "designer" of this separation being gravity. The genetically coding nucleotides happen to be the most stable. Just as with differential buoyancy, nucleotides can be selected on the basis of differential stability. Similarly (and noncontroversially), electric charges interact selectively, exhibiting mutual attraction or repulsion accordingly.

Again, the notion of "random" or "undirected" chemistry is very peculiar, given the various natural causes and forces and laws by which chemical processes are directed. If all amino acids possessed identical chemical and physical properties, then there would be no basis on which chemists could chemically resolve them, distinguish them as particular entities and assign them different names. They would constitute a single, monolithic, indivisible category.

Creationist speak of the improbability of polymers forming with "the right order." Such a thing does not exist even now, given the degeneracy of the genetic code. Degeneracy denial constitutes the fallacy called denying the antecedent: "If x, then y. Not x, therefore not y." The conclusion results from failure to notice the absence of the phrase "and only if" in the proposition. The genetic code is lexically arbitrary in that any codon *could* code for any amino acid, given the proper tRNAs and sythetases. In this sense, there can be no *wrong* order. Analogously, among the meanings of *pan* are a cooking utensil, a prefix meaning "all," a yawing camera motion, a goat-legged Greek god and the Spanish word for "bread." Just as the status of mitochondrial Eve as such could have remained indeterminate for many generations after her death (and as demonstrated in Woody Allen's *Match Point*), an event cannot always be judged in real time as being beneficial, fortunate, favorable, just, right or proper. Thus the "rightness" of a sequence may remain to be seen.

While some events occur by chance, others are bound by necessity. They are a matter of neither chance nor design but default. Molecular structure is a manifestation of atomic structure. A spherical lipid bilayer membrane spontaneously self-organizes in a process that depends on neither a genome nor natural selection but on unavoidable, ahistorical universal physical principles. At higher levels, certain forms may arise with the assistance of such nongenetic factors acting as attractors. Embryo cleavage patterns represent natural harmonic modes on a

sphere, and indeed much of biology is characterized by similarly constrained, stable, persistent, homeostatic patterns, such as cell types and organismal species.

The Intelligent Design Network website further states:

> Positive evidence of design in living systems consists of the semantic, meaningful or functional nature of biological information, the lack of any known law that can explain the sequence of symbols that carry the 'messages,' and statistical experimental evidence that tends to rule out chance as a plausible explanation. Other evidence challenges the adequacy of natural or material causes to explain both the origin and diversity of life.

"Positive evidence" exists for and against every theory ever proposed, the net result being all that counts. IDers embarrass themselves when they contend that science's baby is disqualified by its bathwater, when creationism is composed exclusively of the latter. With respect to "the lack of any known law that can explain the sequence of symbols that carry the 'messages,'" codons are not randomly assigned with respect to chemical affinity, and the genetic code correlates with physical properties as if determinatively self-selected by way of information coupling. For example:

Nelsestuen, Gary L. (1978). *Amino Acid-Directed Nucleic Acid Synthesis: A Possible Mechanism in the Origin of Life*. J. Mol. Evol. 11:109.

Weber, A.L. and J.C. Lacey, Jr. (1978). *Genetic Code Correlations: Amino Acids and Their Anticodon Nucleotides*. J. Mol. Evol. 11:199.

Reuben, Jacques and Freddie E. Polk (1980). *Nucleotide-Amino Acid Interactions and Their Relation to the Genetic Code*. J. Mol. Evol. 15:103.

Even if there were no "known law" *yet*, it remains a pity that some people cannot bring themselves to behave properly in the meantime. Whatever "evidence" that may "rule out chance as a plausible explanation," given the above references, it is not ruled in, such that ID is not a "disagreement," at least not a "scientific" one. Indeed, "the adequacy of natural or material causes" can be "challenged," but not by anything as good, as supernatural causes are less parsimonious, if even possible. As a "natural or material cause" of the "diversity of life," the second law of thermodynamics is not merely "adequate" but is accepted even by creationists. Even if design is required to explain biology, IDers have failed to explain *why* it is required or why nature is an inadequate designer.

Recall from the initial essay in this series Sean Hannity's special, narrow admonition against rushing to judgment, and let it be replaced by a superior and more abstract general admonition regarding one's behavior in anticipation of explanation. It is wrong to jump to the conclusion that any unexpected sound *must* be caused by a ghost or that any UFO *must* be an extraterrestrial spacecraft. When one cannot explain a magician's illusion, the assumption that it must therefore not be an illusion and must be the result of genuine magic is logical misconduct. Scientific challenges are not to be met with such misbehavior, dereliction and underperformance. Superior, not inferior, alternative theories are sought, and stupidity is not a viable alternative to anything.

Some people deal with uncertainty irresponsibly by the hand-waving employment of the catch-all God of the Gaps (hand waving being a particularly obscene gesture in the realm of logic). Similar misbehavior is demonstrated when employing Magic of the Gaps when dealing

with illusionists. In contradistinction to the Napoleonic Code (or at least to its caricature, since it includes no *de jure* presumption of guilt), the American criminal justice system lacks the requisite stupidity to use Guilt of the Gaps. Logic shows that the value of a filler is proportional to its parsimony. Therefore, gaps are to be filled with minimal extravagance because extravagance weakens explanations. This makes Nature, Illusion and Innocence of the Gaps, respectively, the best and therefore proper placeholders in science, stage magic and criminal justice. If a cause is *known* to be God, then it is God. When a cause is unknown, God is the least parsimonious (and therefore worst) filler for gaps in knowledge while waiting for them to be filled *by knowledge*. God is forced to retreat when natural phenomena such as x-rays and naturalistic explanations such as relativity come on the scene, when He was not rightfully occupying gaps in the first place, and can do so merely as a temporary substitute for truth that is awaiting discovery by science. To the extent that an intelligent designer is investigable, ID advocates are welcome to celebrate its investigability and to investigate it, bearing in mind that they would be wrong to assume it to be supernatural. Again, as per Popperian conjecture and refutation, although, the Bible is as good a source for theories as any, talk is nonetheless cheap, with merit being earned through testing.

Those lacking patience often prefer merely to forge ahead irresponsibly rather than wait for gaps to be filled with relevant and valid data. Psychologically, the wholesale dismissal of mechanisms not yet proven to be properties of nature in favor of those stipulated as not being a part of nature is negligent malfeasance born more often of cowardice than of impatience or defective reasoning. Any number of problems have yielded to science *over time*, in spite of IDers' hopes to the contrary. Conservatives who disapprove of deadlines in war are no more justified in applying them to science.

Intelligent design is said by some of its proponents to have nothing to do with religion, though religion is far less conspicuously absent than is logic. These proponents claim that it does not constitute religion if the designer is not identified. Yet their whole thesis rests on the assertion that nature *in toto* is incapable of this design function. Eliminating the natural leaves only the supernatural, with which religion exclusively deals. Therefore, their proposed designer, whether identified or not, is specified as being supernatural. However, placing the responsibility for design beyond nature also places it beyond research, there being no "there" there. Wrongly claiming that research can extend beyond nature to the supernatural is the very essence of religion. In Wiley Miller's *Non Sequitur* cartoon of 9/27/05, a man says, "And since it's too complex to be explained by modern accounting, there can only be one logical conclusion." The cartoon's caption reads, "Dave's theory that the tax code is a product of divine intervention."

Mike Gene writes that "coming up with imaginary accounts that tap into our ability to imagine cooptional origins, by itself, is rather meaningless." Instead of being meaningless ("rather" or otherwise), it is perfectly adequate when the hypothesis to be falsified merely states that no such natural mechanism *could* exist. Even when scientific explanations are imaginary, creationist explanations are far worse, being both imaginary *and* metaphysical. When two explanations are both imaginary but one is physical and the other metaphysical, the explanatory superiority of the former allows it to trump the latter. Gene continues, "If we can successfully come up with such explanations where they are known to be false . . . , how do we know our ability to do likewise with things like the flagellum are not also inherently flawed?" Primarily because we can successfully come up with such explanations where they are known to be true. In the end, this is simply not the problem of science, for the burden of proof (and of imagination) logically rests on the less parsimonious hypothesis. In this case, it rests on those who strive to

demonstrate that nature lacks the requisite intelligence. IDers may *hope* that nature is incapable of design, and perhaps they can be neither bothered nor expected to search for such capabilities, in spite of bearing the burden of proof. They instead satisfy themselves with slothful induction.

Invoking an intelligent designer terminates the causal regress arbitrarily, for if a mere flagellum is too complex to emerge in the absence of an intelligent designer, then so is the intelligent designer, the design of whom is at least as improbable as that of his creations, a situation to which the Curie principle may apply. (Ironically, there even exists the rationalization that the story of Christ's virgin birth is "too improbable not to be true.") So even if God can be said to be uncaused, He must also be claimed to be undesigned, for the design of God is explained neither by His mere existence nor by an *obscurum per obscurius* fallacy. Even given an uncaused and undesigned creator, ID theory must address the designer's motives and mechanisms in order to be explanatory. Ultimately, what is absent in ID theory is not just an intelligently designed explanation, but any at all.

What, and give up show business?
Behe's Blacker Box

In *Darwin's Black Box: The Biochemical Challenge to Evolution*, Michael J. Behe champions a thesis in which life is analogized to "irreducibly complex systems" (ICS), such as mouse traps. However, not even stick and stones can break science's bones when aimed not at science but at a straw man.

Many aspects of life are demonstrably not irreducibly complex. Biochemical pathways are typically semiredundant. The genetic code is degenerate. Pseudogenes are common. Diploidy and gene duplication allow for nonlethal experimentation with surplus gene copies. Molecular clocks reveal mutation tolerance. The chicken genome is one-third the size of the human but carries as many genes, as does the fugu genome though it contains one-eighth the amount of DNA as the human. Opponents of radical environmentalism deny the irreducible complexity of the ecosystem when they claim that it is not fragile and can robustly tolerate profuse extinction. Organismally, the loss of hair, tonsils and even the spleen is seldom lethal. Humans survive perfectly well without any organs whatsoever *as zygotes*, as they must in order to give rise to adults. The incredulous need only consult Mel Gibson, who is happy to remind us that "at one stage I was that little cluster of cells myself, as were you, as was the doctor, as is everybody." "[T]hat little cluster" lacked a heart, a brain and much more, and yet survived to become Mel Gibson. Thus, in a sense, is human complexity drastically reducible. Were one to argue that such reduced complexity deprives the zygote of humanity or that its survival results from being a part of its mother's body, fundamental arguments against abortion would be fatally undermined. Developmentally, then, even if humans eventually possess all the necessary elements of an irreducibly complex system, they begin with far fewer. And if developmentally, then why not evolutionarily?

In spite of the claims that life is highly perfected, much biological suboptimality and inefficiency exists. Charles Darwin himself was already acquainted with what he called "the clumsy, wasteful, blundering, low and horridly cruel works of Nature." In 1903, William James wrote that nature "forms a real jungle, where all things are provisional, half-fitted to each other and untidy." In the case of junk DNA, some, admittedly, may be regulatory. In any case, genomes have simply not been thoroughly debugged.

In the *Los Angeles Times Book Review*, 1/13/08, Jesse Cohen, reviewing *Your Inner Fish: A Journey Into the 3.5-Billion-Year History of the Human Body* by Neil Shubin, writes, "Nerves that extend from facial muscles to our brain take complicated paths – paths that reflect primitive skeletal placement. Nor is this problematic kind of configuration confined to the human head. The nerves that control the diaphragm exit the brain stem, near the neck; 'a rational design,' Shubin explains, 'would have the nerves traveling not from the neck but from nearer the diaphragm.' However, 'the brain stem originally controlled breathing in fish' – in which the placement was a great deal more efficient. 'We can dress up a fish only so much without paying a price,' Shubin writes. We choke, succumb to hiccups, develop hemorrhoids and hernias and fall prey to heart disease all because our bodies are spruced-up versions of primitive models, and the kludges and patches that have developed over millions of years of evolution, like all kludges and patches, inevitably break down." Gary Marcus (*Los Angeles Times*, 5/4/08), "No sensible engineer would have designed things this way." In other words, the intelligent designer is invited to be more intelligent.

However, as if biological design were not bad enough, IDers, in their ironic attempt to demonstrate the intelligence of its designer, pretend that it is even less admirable than it already is. Nonredundant, irreducibly complex systems are quite vulnerable due to their lack of any margin of error (as was financially the case for the project depicted in *Lost in La Mancha*), and are thus unworthy of an intelligent designer. For example, automobiles without spare tires and hospitals without backup generators would exemplify unintelligent design. In biology, an ICS, unlike a more intelligently designed system, would have no resilience or adaptability that would allow for the nonlethal absorption of error. Even though nature is apparently not stupid enough to produce such systems, creationists amusingly seem to think that God is. Creationists would have been expected to attribute to God a design at least as good as the actual one rather than one that would be worse. Whether the design envisioned by ID proponents requires intelligence, it would seem to reveal stupidity. Whether or not life is irreducibly complex, it should not be. Thus, the principal argument for ID is based not on design but on its execution, asserting the intelligent construction of an unintelligent design.

Regardless of the supposed constraints placed on life by irreducibility, there remains variability. The presence of cytochrome c may be mandatory, but not a particular primary structure, hence the various sequences of this molecules throughout the biome. Even if an intelligent designer established the prototype for this molecule, a great deal of divergence has been accommodated in the subsequent billion years without loss of function.

Even if life were irreducibly complex, ID merely attacks another straw man when criticizing supposed explanations of its origins. Behe's thesis is that "ICS cannot be produced by successive small modifications of a precursor system." Even if that were true when a precursor is less complex than the resulting ICS, such systems are not necessarily suspected of arising in that manner. ("Doc, it hurts when I do this.") Behe's assertion is the same kind of accent fallacy ridiculed in the *Mallard Fillmore* cartoon of 9/21/05, where Mallard says, "In other news, the Reverend Jesse Jackson today said that all American hurricanes are racist, citing the fact that you never see one hit Idaho or Montana." Even so, those states have their own problems. In the cartoon of 1/19/07, Mallard observes, "Every day, millions of people get e-mails claiming that they can collect money from African accounts belonging to Americans killed in plane crashes. But we know what the risk is here. Americans really oughtta quit flying around in Africa," which is a somewhat inverted acknowledgment of the same wisdom. In any case, until explicitly

proved, the assertion that no series of incremental changes can account for evolution is merely a sorites fallacy.

The existence of ICS is not dependent upon Behe's proposed mode of assembly, as both natural and artificial examples exist of reducibly complex penultimacy. Natural stone arches need not form via stalagmitic accretion through the air, but can occur due to the erosion of underlying material. Similarly, the immediate precursor of a finished, irreducibly complex architectural arch is not the arch minus one voussoir. It is the complete arch plus temporary scaffolding. The arch is completed not by adding the last stone, but by removing the scaffolding. The resultant system is the residue that derives from the simplification and organization of a precursor that is more complex, not less. The question is not how to build up to such a system but how to edit and delete down to it. In accord with Kauffman's model of the crystallization of life out of larger ensemble, even irreducibly complex systems may be assumed to be the result of a process of complexity reduction experienced by a more (and reducibly) complex antecedent system. Function emerges out of previously accumulated nonfunctional complexity. The analogous biochemical situation could be demonstrated by drawing on a backboard a Byzantine network of indiscriminate interactions. Inevitable inequalities of efficiency are then amplified by positive feedback, such that the weaker pathways atrophy and one erases one's way down to the final streamlined pathway. At the most abstract and general level, atrophy of the unnecessary is totally undeserving of any suspicion of being miraculous.

Michaelangelo regarded a statue as preexisting within the block of marble, such that he need only remove the excess, there already being *more* marble than was needed. Hoodoos are similarly thought to result from a reductive process. Consider the dance at the gym in *West Side Story*: The precursor to the Tony/Maria system is neither Tony nor Maria alone, but is Tony and Maria *and everyone else*. Tony and Maria become a functional unit when there are more people than the two of them at the dance, not fewer. The others then fade away. In the game Where's Waldo? an individual is similarly picked out of an existing crowd. In the game of Jenga, the antecedents of the structure that ultimately collapses are more robust, not less, the object being to weaken and destabilize the stack progressively, working down to a critical structure, not up to it. The human brain undergoes a diminution of neural connections during maturation. It is this pruning of connections that constitutes organization. (From this perspective, viruses may be considered to be degeneratively hypobiotic.) And let it not be forgotten that Darwinism, in accordance with the Mark C. Bloom principle, has always postulated selection from among alternatives, making Darwinian evolution multiple choice, not essay.

Again, an irreducibly complex system is most likely to be a degenerate, vestigial residue formed by a subtractive process of erosion acting on an entity of greater complexity. Only a straw man believes that functional, irreducibly complex systems, such as Behe's mouse trap, are built in isolation, rather than being distilled from within a larger array that has grown far beyond minimal necessary complexity prior to the emergence of function. An actual mouse trap is made of a piece of wood cut from a larger one, a wire cut from a longer one and metal parts stamped out of larger ones. Thus, irreducibly complex systems are built up to in the same sense that, in the old joke, one gets down off an elephant. That is, one does not get down off an elephant; one gets down off a duck. ("Doc, it hurts when I do this.") Similarly, the film *Spartan* answers the question of how one fakes a DNA test: One does not. Instead, one issues a mendacious press release.

Behe writes, "An irreducibly complex system cannot be produced directly by numerous, successive, slight modifications of a precursor system, because any precursor to an irreducibly

complex system that is missing a part is by definition nonfunctional." However, nonfunctionality is not tautologically true of a precursor system that is *not* missing a part. A precursor system may be functional if it incorporates all the necessary parts *and more*. Even if direct production of the form described by Behe is impossible, this in no way precludes *indirect* production. ("Doc, it hurts when I do this.") And again, why do you think they call it "*pre*biotic?"

Unlike a straw man, this writer does not suggest any such "build-up" scenario because that is simply not the way things happen, such that it would "hurt when I do this." Instead, he theorizes that particular ICSs would arise in the manner that such things *normally* occur.

In the *Los Angeles Times Book Review*, 4/8/07, Richard Eder writes, "A biography should create the appetite that its details feed." Similarly, theory should do explanatory work other than the mere toppling of straw men. However absurd a straw-man parody may be, such problems evaporate once reality is embraced. An excellent example of a straw man is to be found in a Michael Ramirez cartoon from December, 2005, where a Democrat offers "a plan to win the war on terror" that prohibits "wiretapping potential terrorists," when Democrats would be happy to accept all wiretapping for which judicial warrants were obtained. Also, who is not a *potential* terrorist? The applicable legal concept is *probable* cause, not *potential* cause.

Let it also be noted that even if "modifications of a precursor system" must necessarily be "small," which may not be the case, that in itself may not be an impediment. Small genetic changes, especially if regulatory, can have large, unexpected phenotypic consequences. For example, a single regulatory sequence appears to be responsible for all small dogs (those that weigh less than 20 pounds when adults). It is noted in *Scientific American*, 10/04, that "all . . . systems have an intrinsic complexity limit . . . until . . . the regulatory mechanism changes fundamentally." Thus, changes in regulation allow increased complexity. And even if "small modifications" are somehow inadequate, then let there be large saltational ones, such as exemplified by homeotic mutations, which can replicate complex body parts in their entirety and in novel locations. Again: "Doc, it hurts when I do this."

Behe is said to accept that "all organisms are descended from a common ancestor," though his contention is that nature is incapable of generating all the attendant modifications. To repeat, rather than demonstrating that biocomplexity could not have arisen naturally, advocates of intelligent design claim only to show that it could not have arisen via one particular straw-man scenario. ("Doc, it hurts when I do this.") Their claim of the absence of a Darwinian explanation, even if true, is no more interesting than the lack of a Newtonian explanation for an astronomical phenomenon. Modern biologists are Darwinians in the same sense that modern astronomers are Copernicans. Since Copernicus, there have been major contributions by Kepler, Galileo, Newton, Einstein, Hubble and many others. If the astrophysics of Copernicus leaves too many phenomena unsatisfactorily explained, this alone does not make a fraud of science because Newton explains more, and Einstein explains more still. Perhaps Newtonian mechanics cannot explain time dilation or the precession of the orbit of Mercury, but relativity can. Copernicans are the heirs of a fundamental shift. But ignoring all the improvements that have occurred since is voluntary amnesia at best. The failure of Newtonian mechanics to explain all phenomena does not invalidate the whole of physics, a fact that remains true whether or not creationists have noticed it or can understand it. Physics successfully expanded beyond Newtonian mechanics and its outdated model of telekinetic universal gravitation.

It is similarly falsely synecdochous to pretend that Darwinism exhausts evolutionary theory and that the latter has not moved beyond the former, even if some are willfully late to the party due to cowardice. (In the *Los Angeles Times Book Review*, 7/8/07, Debby Applegate

commits an amusingly false synecdoche when she writes of whales as being "seemingly half-animal, half-fish.") In the *Mallard Fillmore* cartoon of 11/26/05, "Mainstream-Media Person" is amazed to discover that Nebraska is west of the Hudson. Would that more people were familiar with any of the biologists who have come along since Darwin. If a Darwinian natural mechanism is not available, then invoke a non-Darwinian natural mechanism. Phenomena not explained by Darwin may have been explained by Stuart Kauffman. If random mutation is insufficient to achieve evolution, then let mutation also occur nonrandomly. If evolution cannot occur *because* of natural selection, then, as per Stuart Kauffman, let it occur *in spite* of it. In short, if Darwinian evolution is insufficient, then let evolution occur via non-Darwinian mechanisms. Critiques of 19th-century science seem silly and sorely lacking in perspectival breadth when they fail to recognize that science has continued to occur since then.

ID proponents rightly assert that Darwinism is not the last word in how life evolved, and claim that their theory challenges what they say is the Darwinian proposal that life evolved by random variation and natural selection *exclusively*. For example, it has been reported, "Behe argued that organisms are too complex to have evolved through natural selection and random mutation." Even if true, they need not have. ("Doc, it hurts when I do this.") On his radio program 3/11/08, Hugh Hewitt spoke of "defining deviancy down." Evolutionary theory is defined decidedly downward when reductively abbreviated first to Darwin alone and then to chance alone.

Behe says that as of 1988, "I had never heard of a scientist who criticized Darwin." This writer is younger than Behe and had by that time already heard of and met many Darwin-critical evolutionary biologists. It is a great pity that Behe did not get around much in those days. He says, "I came to realize that a pillar of my thinking was supported not by evidence but by sociological factors, what other people think." It is slothful induction to extrapolate this situation beyond what he calls "my thinking." It certainly does not apply to this writer. It is Behe's responsibility to be better informed such that progress in his own field does not come at him from ambush.

Behe's feeble examination of the scientific literature is outlined in the following paper (accessible via http://nsmserver2.fullerton.edu/departments/chemistry/evolution_creation/web/): Weber, Bruce H. (1999). *Irreducible Complexity and The Problem of Biochemical Emergence*. Biology and Philosophy. 14:593.

Typically, Behe practices cherry picking while failing to find existing references, as he could not bring himself to search adequately. Behe's selective citation helps define his target audience. His message is aimed at those too lazy to check for themselves and willing to accept mere accusation by stipulation, perhaps demonstrating the realization of a *maître des basses œuvres* that in the land of the blind the one-eyed man is king (*tel brille au second rang qui s'éclipse au premier*)(*un sot trouve toujours un plus sot qui l'admire*). If you want to know about nature, then consult nature, not Aristotle. If you want to know what is in the scientific literature, then consult the scientific literature, not Behe. Or as Daniel Dennett would say, "Look harder."

In the cartoon of 4/12/06, reporting on excessive government spending, Mallard says that his "findings suggest that the mainstream media are about as likely to *report* this as the government is to quit *doing* it." Neither would the conservative media be expected to report the findings of modern science nor even to know of them in the first place.

In the cartoon of 4/13/06, Mallard asserts that the media selectively report waste by the pentagon. This is analogous to what Behe will not report, assuming he actually knows it. Lackadaisically placing activism before scholarship is no better than purposeful ignorance.

Michael Sorkin once said, "What Tom Wolfe doesn't know about modern architecture could fill a book. And so, indeed, it has, albeit a slim one." Such proves to be the case with authors such as Behe, Coulter and D'Souza. One has a duty to learn maximally (at least, with the exception of clowns, before shooting off one's mouth) and, as Alexander Pope recognized, "a little knowledge is a dangerous thing." According to G.K. Chesterton, "The traveler sees what he sees. The tourist sees what he has come to see." Behe is invited to do less touring and more traveling.

Behe says that his colleagues have "had a chance to show what a dope I am, and in my completely unbiased view, they've failed." The more parsimonious proposition does not bear the burden of proof. Defense attorneys need not prove the innocence of their clients. So the failure of which Behe speaks gains him absolutely nothing, as it is for him to show what a dope he is not. In an interview with Richard Dawkins, 7/6/07, Bill O'Reilly made this same error, saying he would adhere to religion until science proved its case. This "Napoleonic" attitude is worse than an *argumentum ad ignorantiam* and shows one to be unfit for jury duty. Further, the equally "completely unbiased view" of this writer may differ. It is for logic to decide.

In the *Los Angeles Times*, 3/20/05, Edmund Fawcett, reviewing *History on Trial* by Deborah E. Lipstadt, writes the following concerning Holocaust denier David Irving:

> The defense first asked Cambridge historian Richard Evans to assess Irving's oeuvre. Evans' 700-page report, which was put into evidence and became the core of his own book on the trial, *Lying About History*, proved devastating. Evans found a pattern of transcription errors, twisted or elliptical quotations and slipperiness with dates. The errors tended to buttress the argument that Irving had prejudices. Rampton [attorney] skillfully exploited this gold mine. With dry patience he exposed Irving's distortions, keeping careful count of the plaintiff's ever lamer excuses – "I was tired," "I was stressed," "I forgot."

When it comes to being tired, stressed and forgetful, no one can hold a candle to creationists.

Behe's irreducible complexity model is an explanation in search of an explanadum (*brutum fulmen*). It is a disanalogous cartoon employing inappropriate metaphors. (In the *Los Angeles Times Book Review*, 3/16/08, Ben Ehrenreich writes of "the most lethal disease of travel writers – the urge to render the unfamiliar familiar, to masticate the strange and spit it back as pablum.") Its easy and false parallels are a study not so much in complexity as perplexity, betraying an infantile grasp of the subtleties to which it is not applicable (*scribimus indocti doctique*). If not a case of willful ignorance, it is at least another example of a failure of imagination mistaken for an insight into necessity, which, as previously noted, Daniel Dennett calls the Philosophers' Syndrome, and which Kenneth R. Miller calls the "argument from personal incredulity." Creationists thus flatter themselves if they claim to have contributed to the demonstration of any actual impossibility, for ignorance and uncertainty do not constitute disproof. IDers have not demonstrated the incapacity of nature to design, but only the incapacity of their minds to imagine (or to find existing, published explanations). In October, 2005, Behe testified in court on behalf of supporters of ID, submitting his own failure of imagination as evidence. Lacking Stuart Kauffman's ability to light candles, poor Behe can only curse the darkness.

When a natural explanation for some phenomenon is not obvious, the proper action is to think harder. Instead, creationists, as a result of slothful induction, exhibit the hubris of solipsistically claiming that there could not exist anything for which their imagination could not account. If Michael H. Dickinson can understand how bumble bees can fly, then so what if August Magnan could not? Many do not understand how an airplane could fly, and yet many people do, *and* airplanes actually fly. Protein folding remains difficult to understand comprehensively, and yet it is known to occur nevertheless.

Nor do naive notions of improbability always tell the whole story.In the *Los Angeles Times Book Review*, 11/7/04, reviewer Nicholas Thompson writes:

> In his new book, "The (Mis)Behavior of Markets," [Benoit] Mandelbrot describes the bucking stock market of August 1998: "The standard theories, as taught in business schools around the world, would estimate the odds of that final, August 31, collapse at one in 20 million – an event that, if you traded daily for nearly 100,000 years, you would not expect to see even once. The odds of three such declines in the same month were even more minute: about one in 500 billion."

Perhaps, according to proponents of "standard theories," we are supposed to believe, contrary to history, that the events in question did not happen. Given that they did, deal with it.

In summary, IDers can at best invoke an intelligent constructor because, given their obsession with the calendar, another thing that science has been unable to do after all this time is to corroborate the existence of the irreducibly complex design that IDers seek to explain. Also, such a design is a stupid one, and an intelligent designer is not necessary in order to explain a stupid design. Further, an intelligent constructor is only needed if an irreducibly complex system results from building up rather than down, just as the "magic bullet" needs to be magic only if JFK and John Connally were sitting in fictitious rather than historical positions.

Finally, consider *The Politically Incorrect Guide to Darwinism and Intelligent Design* by Jonathan Wells, the incorrectness of which extends far beyond politics. If this is *ID for Dummies*, then let it eat the dust of *ID for Geniuses*. Part of the book's description on Amazon.com reads, "Intelligent design is based on scientific evidence, not religious belief." The evidence is of exhausted imaginations (the Philosophers' Syndrome), not of divine intervention.

"Wells then turns to the theory of intelligent design (ID), the idea that some features of the natural world, such as the internal machinery of cells, are too 'irreducibly complex' to have resulted from unguided natural processes alone." Science places no such restriction on itself. In fact, it recognizes not only random and scalar phenomena but deterministic and vectorial ones as well.

"Darwinists' materialistic, atheistic assumptions rule out any theories but their own, and account for their willingness to explain away the evidence—or lack of it." Less parsimonious presumption are logically ruled out *as presumptions*, not of conclusions. The presumption of criminal innocence in no way rules out guilt, but merely places the burden of proof where it belongs.

"[Wells] also supplies a revealing list of 'Books You're Not Supposed to Read' (as far as the Darwinists are concerned) and puts at your fingertips all the evidence you need to challenge the most closed-minded Darwinist." This writer cites books from which creationists do not seem to have benefitted, whether or not they themselves want to read them. It is wrong to be either

close-minded or a mere Darwinist, though the phrase "closed-minded Darwinist" is a possible rationalization regarding people whose minds are open but not empty.

Discussion of the book on Amazon.com included objections to methodological naturalism, which is no more arbitrary than the presumption of innocence rather than of guilt in criminal law. Creationists are among those who prematurely imagine that man has come to understand all that there is to be understood about nature. As reported by Sara Lippincott in the *Los Angeles Times*, 3/2/08, A.A. Michelson, in 1894, said, "The more important fundamental laws and facts of physical science have all been discovered, and . . . the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote." Nature seemed to have been exhausted before it was shown to extend beyond the Newtonian realm. Creationists must not believe that x-rays existed prior to the 1890s.

Abandoning the appearance and even the possibility of relevance, the book invokes sociology and politics so as to impress those too stupid to recognize the *argumentum ad hominem*, *argumentum ad populum* and *ignorantio elenchi* as fallacious. Given that it is affirmed by both good and bad people that 2+2=4, is the equation itself good or bad? Even if the belief that 2+2=4 causes misbehavior, this does not invalidate the equation's arithmetic truth. The salient feature of truth is not its popularity but its truth.