

## **Intelligence or Accident? The Evolutionary Origin of a Controversy**

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Journalism loves simplicity. “Scientists as dogmatists” vs. “theocratic ideologues” appears to be the popular theme for the current dispute over the teaching of Intelligent Design in standard school curricula. While polarized diatribes are indeed the accepted means of political discourse in today’s society, I’d like to undertake a radical step: examining what a proponent of Intelligent Design actually says. Let’s take a (very brief) look at a real publication: “Dynamic genomes, morphological stasis, and the origin of irreducible complexity”, by Wolf-Ekkehard Lönnig of the Max Planck Institute, published in *Dynamical Genetics* 2004. Bear with me: we will decode or avoid the gibberish that scientists use to communicate amongst themselves. This isn’t that deep: the objects of dispute can be understood by ordinary folks (I’m not a biologist – just an interested amateur).

Let’s dispense with frivolous character destruction to begin with: this is a well-written paper by an author obviously familiar with the literature of his field. The paper makes three basic arguments that random chance is inadequate to explain the biological world we see:

- 1] Even though chromosomes (the little ribbons of DNA that carry the hereditary information of every large cell) are constantly subject to damage of all sorts, leading to relatively frequent mutation for all the genes they contain, certain genetic sequences have been preserved almost unchanged for more than three billion years and are present in essentially all living beings.
- 2] Individual species persist for very long periods almost unchanged, and it is rare to find clearly transitional forms in the fossil record between two such stable species, as required by Darwin’s version of the theory of evolution.
- 3] Some biological functions seem to be ‘irreducibly complex’: they consist of several different parts that serve no apparent function individually and must be assembled in their current form to work.

The basic assertion is that these mysteries are not explainable by ordinary means and therefore that something intelligent – okay, let’s be honest, God – rather than getting things started some 15 billion years ago and kicking back, has been intervening in the affairs of His children. Let’s examine each statement and see how plausible the assertion is.

- 1] Genetic stasis: it is certainly amazing that genetic information has been preserved for billions of years by the flimsy blobs of protoplasm that compose living matter. So is a walk through Muir Woods, whether or not you are a biologist (or a priest). Life is

amazing. To show that a given remarkable fact contradicts the basic tenets of evolutionary theory, we must show that these conserved genes are in fact **not** necessary for the survival of the cells that contain them, for if they are, they must be conserved by the simple fact that changes in these critical genes doom the affected cells before they can reproduce, and thus disappear. (Naturally that's a simplified statement: even a modest disadvantage of some such genetic change in each generation that possessed it would result in extinction over the long ages of geologic time.) No such demonstration is provided or cited in this paper. That doesn't mean there can't be one, but until such an example is provided, the alternative (and standard) explanation – some sequences are conserved because living cells can't live without them – is the preferred one because it is the simplest one.

2] Morphological stasis: The fact that species are conserved over long periods of time, and transitional forms between species are rarely found, was raised by Darwin in **The Origin of Species**, and has been an important topic of investigation ever since. Stephen Jay Gould and Niles Eldredge famously championed the idea of punctuated equilibrium: simply put, that species are pretty stable except under very special circumstances, and that speciation when it takes place is rapid, so that it's extremely hard to find transitional forms. It has always puzzled me that anyone who is the least familiar with the evolutionary system known as the market economy would be surprised at such an assertion: it is particularly easy to see here in Silicon Valley how a new discovery or opportunity gives rise to a burst of diverse new companies, of which only a few survive to grow to maturity, and that those companies thereafter persist with modest change for long periods of time before they become extinct as their niche disappears. Darwin advanced a very specific, gradualist idea of species development in his book, which is probably wrong.

However, to jump to the conclusion that everything about evolutionary theory is wrong as a consequence is absurd. For, if transitional forms between one species and another are rather rare, transitional forms between different genera (groups of species) and more importantly between different types of animals and plants are widely known and uncontroversial. A wonderful article in a recent *Scientific American* magazine ["Getting a Leg Up on Land", by Jennifer Clack, *Sci Am* December 2005 p. 100] provides a perfect example. Recently discovered fossil evidence shows how lobe-finned fish gained leg-like appendages, probably not to walk on land but to help breathe in shallow bodies of oxygen-poor water. In the process, the bone structures that would eventually become legs and shoulders developed. That is, the structures that enabled four-legged creatures to get around on land developed gradually, over the course of about 30-40 million years, for a quite different purpose, and were opportunistically appropriated to allow a simple sort of dry-land locomotion. This is exactly the sort of gradual adaptation that Darwin envisioned. Note that the author makes no claim to have discovered intermediates between any of the species she studies, and yet the pattern of change is clear enough. It is true that the individual steps can't be seen in detail (after all, all this was happening 380 million years ago), and could conceivably hide surprises, but the overall path from fish to lizard is apparent, and the need for divine intervention is not. The pattern is repeated all through the history of life on earth; recent finds show that the heretofore-mysterious

parent of whales and dolphins was a relative of the water-dwelling but leg-retaining hippopotamus. An animated film may require 1000 images to convey what a comic strip says in four frames – but the reader can still get the joke.

3] Irreducible complexity: Darwin said in **The Origin of Species** that if a living being could be found that could not have arisen from previous forms by small intermediate steps, his theory would have to be abandoned. However, there is a huge difference between the statement “I can’t imagine how this could have arisen” and a demonstration that it did not. It is difficult to imagine a seagoing tuna or marlin developing a sudden desire Ariel-like for legs to replace its fins, yet we have seen that a gradual path did exist for such an innovation to take place. It is revealing that all the examples given in Lönnig’s paper (cilia and bacterial flagella – these are movable organs stuck onto animal and bacterial cells-- blood clotting, carnivorous plants, and echolocation) don’t fossilize: when there’s no experimental data it’s easy to make whatever assertion you want. I haven’t looked into the flagellum question, but I don’t understand what the mystery about echolocation is: you can do it if you try, and blind folks use their hearing to get around every day. We humans don’t do it very well, but if it was critical to our survival we might get better quick.

This is another objection to evolution that has been raised since Darwin’s time. “I can’t imagine how this could arise in small steps” is all too often an expression of the limits of our imagination, not the limits of nature’s ingenuity. Life exists everywhere on Earth where there is water and energy, and has done so for most of the history of the Earth. That’s a lot of room for play, and the remarkable properties of heredity mean that a solution to a difficult problem need only evolve once and it can then be preserved and expanded upon indefinitely.

It is important to debunk another common rather frivolous calculational trick used in this paper and often encountered in discussions of evolution: “the probability of this or that gene or creature arising by chance is less than” followed by some astronomically small probability. The probability of hydrogen and oxygen molecules spontaneously rearranging themselves to form water is astronomically small, but that didn’t help the passengers on the Hindenburg. Rather than being limited by the imagination of amateur chemists, real molecules of hydrogen and oxygen gas explode through a catalytic process: a very small number of individual atoms, known as free radicals (without the political connotations) trigger the otherwise-improbable decomposition as a sequential process, one molecule at a time. The same result can be obtained less violently using a platinum catalyst. The chance of an event happening in the real world is the sum of all the ways it can happen, not just the ways we can think of.

Thus it is difficult to prove that something is ‘irreducibly complex’ but easy to prove it isn’t, by finding a transitional form -- and indeed essentially all the features of living beings that fossilize have been shown to arise by gradual changes, even highly specialized features like wing feathers that were at first believed inexplicable without flight. Should we teach our children the possible exception or the almost-inevitable rule?

Evolution is as complex as life itself, and many questions about it are unanswered – but the vast majority are not. The history of life on Earth, elucidated over three centuries by the hard and sometimes dangerous labor of paleontologists and biologists in the field, and the duller analysis of fossils in the laboratory, is perfectly clear: single-celled organisms gave rise to complex plants and animals, life began in the sea and adapted to the land, flying animals developed from flightless predecessors, and we arose from primates that stood up and later got smarter. Nowhere is there an order of life that arises without precursors: no one has ever found a human skeleton next to that of a stegosaurus, or a dinosaur skeleton in the same stratum as a trilobite.

There's an old joke showing a bearded professor standing in front of a blackboard covered with complex mathematical symbols, leading to the last statement of his proof: "and then a miracle occurs". This joke is funny because it's true: scientists are always battling to resolve little mysteries even in ideas that seem generally correct, and sometimes the resolution of an apparently-minor mystery provides insight into a whole new world. Intelligent Design is the search for a miracle where the rest of the scientific community merely sees a mystery. In order to justify its aspirations to be accorded the same status as the heritage of Darwin (and Wallace, who the ever-honest Darwin was at pains to acknowledge), its proponents need to prove that within one of the many mysteries of life's history on earth is hidden a miracle that only faith can illuminate.

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