

# Teaching the debate

Eric Blair

12 December 2005

I had a wonderfully educational day on Amazon.com today. Before getting to the main subject, let me suggest a fun Amazon chestnut: if you click on “show all customer reviews”, you can sort the reviews to show the lowest rating first. Then, you can read one-star reviews explaining why works like *The Great Gatsby* or *All the King’s Men* were terrible books.

We had somehow gotten on to the topic of evolution, and I pulled up an evolution textbook, where all of the one-star reviews were about how misguided it is for a book to call evolution “science”. For balance, I pulled up *Of Pandas and People: The Central Question of Biological Origins*, which got many more flames than the Evolution textbook. After a few of the more entertaining reviews, one wonders whether any of the people on either side have actually read the books they are reviewing with such revulsion.

So, I started reading *Pandas*. The book opened, as do many biology books, with a discussion of chemistry: how genetic information is stored in DNA, which is a sequence of amino acids, and how scientists have been able to take a mixture of basic elements and zap them with electricity and wind up with amino acids. Also, how scientists have *not* been able to take the next step to turn those amino acids into self-replicating strands of DNA.

I skipped to the section on genetic mutation. It pointed out that the intelligent designers of old misinterpreted Plato to say that there are a set of ideal, immutable archetypes for each animal. This is absurd, because we observe evolution and change and even extinction. No, the correct interpretation is that there are a set of species, but those species change with time. That is, within a species there is genetic drift and variation. One presumes these species match Linnaeus’s use of the term, but I didn’t see this supported or refuted in what I’d skimmed.

However, to say that there can be unlimited variation, wherein one species transforms into another, is just absurd. Modern scientists readily induce limited variation in test animals, causing offspring to vary either by Mendeleev-style selective breeding or more direct manipulation of the gene, but modern scientists have never in the 62-year history of genetics been able to cause sustained, unlimited genetic variation. Yet they continue to pretend that such a thing is possible.

The textbook is not at all what I’d expected. It makes every effort to not deny lab-based scientific evidence. No, it takes the pragmatic approach: what is

the absolute minimum one needs to support the claim that there was a Divine intervention to create life and that people are not descended from monkeys? The text supports everything in modern science, except those few steps required for those premises. Sure, amino acids from random variation are OK, but that last step where they become an informational code is not. Genetic variation is OK, but only within species.

On the one hand, I found this romp through creationism to be refreshing, because it was not nearly as crackpot as I'd feared. The authors know a whole lot more about genetics than I do. On the other hand, it's that much more frustrating. They understand all of genetics, they understand genetic drift, but they just draw an arbitrary line that says that genetic drift has to stop at some point. No matter how cool they may be about the biology literature, that statement that there exists an arbitrary limit to genetic variation is the purest of dogma. The constructive means of handling the dispute would be to inquire as to the mechanisms that limit genetic variation to within-species changes, but I could not find anywhere in my short jaunt through the creationist literature the slightest suggestion of what the mechanism is that limits genetic drift to within species boundaries. We're just supposed to take seriously the assertion that genetic variation is limited to what we've been able to observe in the last few decades, in nature or the lab, and no more.

I want to shake these guys and make them learn statistics. If a million draws from a distribution all fall within five standard deviations of the mean, that doesn't prove that there is a mechanism in place that forces the data to fall inside five standard deviations, it just means that you'll need to make billions of draws to observe events seven or eight standard deviations off. Doing that could take millions of years, but one in a billion is substantively different from mechanically impossible.

Finally, if I were to put a review on Amazon, I'd say that the book is defensive instead of constructive: it points out those parts of the standard evolutionary model that don't work, but merely asserts the alternative model rather than providing a positive mechanism explaining why the alternative model is correct.

## Teaching the debate

Following the ultraliberal principle that all views—especially those that are contrary to the beliefs of the authorities—deserve to be aired, the intelligent-design team push for the debate to be taught in schools. I wholeheartedly agree with them. I think it is a salient debate that should be taught.

The key lesson that teaching the debate would cover is the difference between faith and science. It is not the night-and-day difference that some would describe it as. Richard Feynmann has gone on record stating that faith is based on absolute certainty while science is based on never knowing, and therefore the two can never merge. To leave it at that misses some important details, so let me explain exactly how this is so.

I prefer to describe the process via the Bayesian model of inquiry: people begin with a prior belief, gather data, and then update that data to arrive

at a posterior belief. [Note to statisticians: this is a model of thought and human beliefs that mirrors but does not match the data-processing method named *Bayesian updating* that competes with classical hypothesis testing and is intended to mirror this process of human belief formation. All of this is named after the Reverend Thomas Bayes, by the way.]

There are other words one could use instead of *beliefs*. For example, one could use *biases*, in which case we'd say that the researcher begins with some biases, gathers data, and concludes with new biases which are closer to reality. But *bias* has a negative connotation that a belief doesn't necessarily merit: my bias toward the theory of gravity is very well-founded in data.

One could even use the word *faith*, but the important distinction between a faith and a belief or bias is that a faith, as per Mr. Feynmann's definition, can not change. The researcher begins with the faith that something is true, gathers data, and ends with exactly the same faith.

To teach the debate properly would require that we look to examples from history such as the repression of Copernican beliefs by the Church, and how, even though we have never made a star in the lab and the Copernican model of movement of the planets is still just a model, the preponderance of evidence was so great that the Church eventually had to concede, and that which it had taken as un-updateable dogma was updated. Has the Church's claims about wheels within wheels been disproven? No, but there is so much data against it that we have a very strong bias against it, and most are willing to just round off the statement "I am 99.999% certain this is false" to the technically incorrect but much simpler statement "this is false."

Teaching the debate would involve a digression into the idea of falsifiability, and how it fits into the bias-updating model. We would begin with a moderate belief in a theory, gather data, and depending on the data either end with a stronger or weaker belief in the theory. By repeating this process a thousand times, we might wind up with a very strong belief in the theory. But if there is no downside to the process, so that there is no data that could possibly give us a weaker belief in the theory, then there can be no upside: no data that could possibly give us a stronger belief. We'd start with a moderate bias toward the theory, gather data, and since the data is irrelevant we'd end with the same moderate bias toward the theory. The cliché applies: nothing ventured, nothing gained.

Applying this to the questions above, we see that the claim that there are set species and that they can not inter-evolve is not falsifiable. There is no set mechanism to define *species* besides "that which seems to inter-evolve", so as we find wider and wider evolutionary changes, we can rewrite the definitions so the system continues to work. If there were a claimed mechanism that puts a fixed (as opposed to a statistical) limit on evolution, then we could design tests to determine whether to place stronger or weaker belief in those mechanisms, but lacking such a mechanism, all we can do is seek the widest evolutionary change we can find and then rewrite the definition of species to fit. This is what our authors did above when they pointed out that former creationists who'd believed in a Platonic ideal for each species were wrong.

Notice that non-falsifiability does not mean that we can never reject the theory, because there is a sort of race among theories. Every year we get new data that the range of genetic drift is larger and no new evidence that the range of genetic drift has a fixed upper limit. As such, a formerly neutral belief in the falsifiable claims of mainstream evolutionary theory would get stronger every year, while a neutral belief in the non-falsifiable claims of intelligent design would remain lukewarm. Eventually we get to a point where there is so much more data supporting one over the other that we just throw out the weakly-supported theory.

Teaching the debate would indeed show that science is a human process, not the perfectly objective mechanism that it is sometimes characterized as in the media. It would show how each individual paper or study takes the steps above—author begins with some belief, gathers data, and revises those beliefs—and how the preponderance of hundreds of thousands of papers allows us to do the same belief-updating process on a larger scale. This would show the student that although science is a human process and is about the updating of biases, some biases have more support and more validity than others.

Teaching the debate would not reject the idea of faith. It would point out that there are limits to what scientific inquiry can gather data on, and these realms (such as ethics) are a fine place for faith to take over. The perspective and opinions that are put forth in literature and theology are all valid and deserve to be heard because there is no way to gather data to disprove a perspective, but beliefs in different theories are not equally valid, because there exists data that allows us to put more or less belief in some. One does not need to teach a debate in a science class the way that a debate would be taught in a literature or sociology class because there are some concepts so unsupported by data that we stop saying ‘we believe theory A has much, much more support than theory B’ and just round off to ‘we believe theory A’.